

INFORMATIVE INVENTORY REPORT 2026

SUBMISSION UNDER THE CLRTAP AND NECD
SLOVAK REPUBLIC



MINISTERSTVO
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PREFACE

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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) 2016/2284 (1) on the reduction of national emissions of certain atmospheric pollutants (NECD) was adopted, this report also represents 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 the 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 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.

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
IPCC 2019 GL	2019 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	Požiarotechnický 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

ES.1 BACKGROUND INFORMATION ON INVENTORY OF AIR POLLUTANTS

The 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-range 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 (NO_x), non-methane volatile organic compounds (NMVOC), sulphur oxides (SO_x) and ammonia (NH₃);
- particulate matter (PM): fine particulate matter (PM_{2.5}), coarse particulate matter (PM₁₀) 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 2024, 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, and analysis of emission trends.

ES.2 MAJOR GENERAL CHANGES

All changes were made to improve the data quality, data completeness and transparency of the results, in line with the legal requirements and with the SK Review 2025 Recommendations.

In the Energy sector, emissions of HMs and POPs were recalculated to reflect improved methodology for calculating waste incineration with energy recovery, which is allocated to the categories **1A1b**, **1A2c**, and **1A2f**. Tier 2 methodology was used, and abatement technologies were added to the calculations.

In the category **1A4bi**, emissions for the year 2023 were recalculated because of an error in the calculation.

In the 2026 submission, an updated COPERT model was implemented. Furthermore, a new time series was introduced for category **1A3bvi**, following TERT recommendations. Activity data were also

included in the IIR 2026, while a Tier 2 methodology for NO_x emissions was introduced for category **1A4cii**.

In the IPPU sector, emissions of Pb, Cd, As, Cr, Ni and Se changed in category **2A3** due to the addition of the calculation (Tier 1 methodology) of these pollutants to the calculation of Water glass production.

In the categories **2B1** and **2B5**, BC emissions were calculated using the Tier 1 emission factor for **2B**. Recalculation in the category **2D3i** is related to the change in the use of the lubricants in the transport sector.

In the Agriculture sector, emissions of NO_x and NH₃ were recalculated due to activity data correction and their harmonisation with the GHG inventory. Also, new mitigation technologies were applied to the calculations of manure management.

In the Waste sector, in categories **5C1bi** and **5C1bii**, conversion factors for POPs were corrected, which resulted in an increase of PCDD/F emissions and a decrease of PAHs, HCB and PCBs emissions.

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 are provided 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 an 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 the 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 provision of data via FTP server erases the annual administration and paperwork related to the official necessary permissions between institutions. Besides, the determination of qualified and authorised persons with direct access improves the effectiveness of this cooperation.

ES.4 OVERVIEW OF THE EMISSION TRENDS

The following **Figures ES4.1 – ES4.4** show the overall emission trend of Main pollutants (NO_x, NMVOC, SO_x, NH₃), Particulate matter (PM_{2.5}, PM₁₀, BC), Priority heavy metals (Pb, Cd, Hg) and Persistent organic pollutants (PCDD/F, PAHs, HCB, PCBs).

Figure ES4.1: Overall emission trends of main pollutants

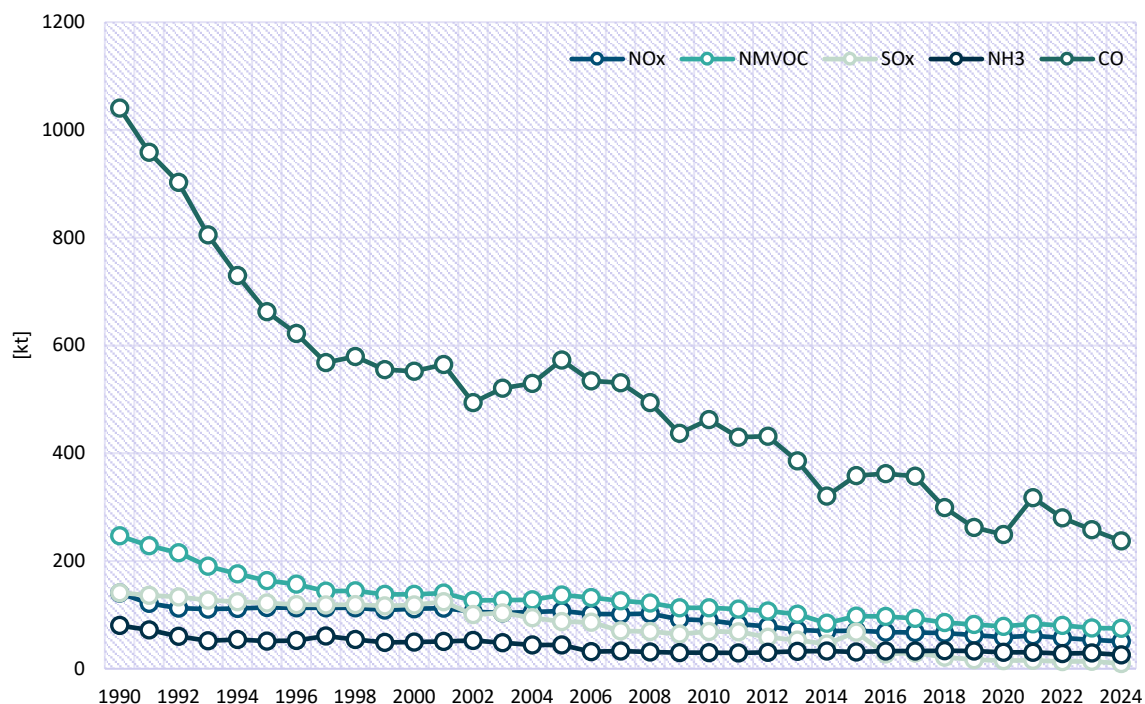


Figure ES4.2: Overall emission trends of the particulate matter

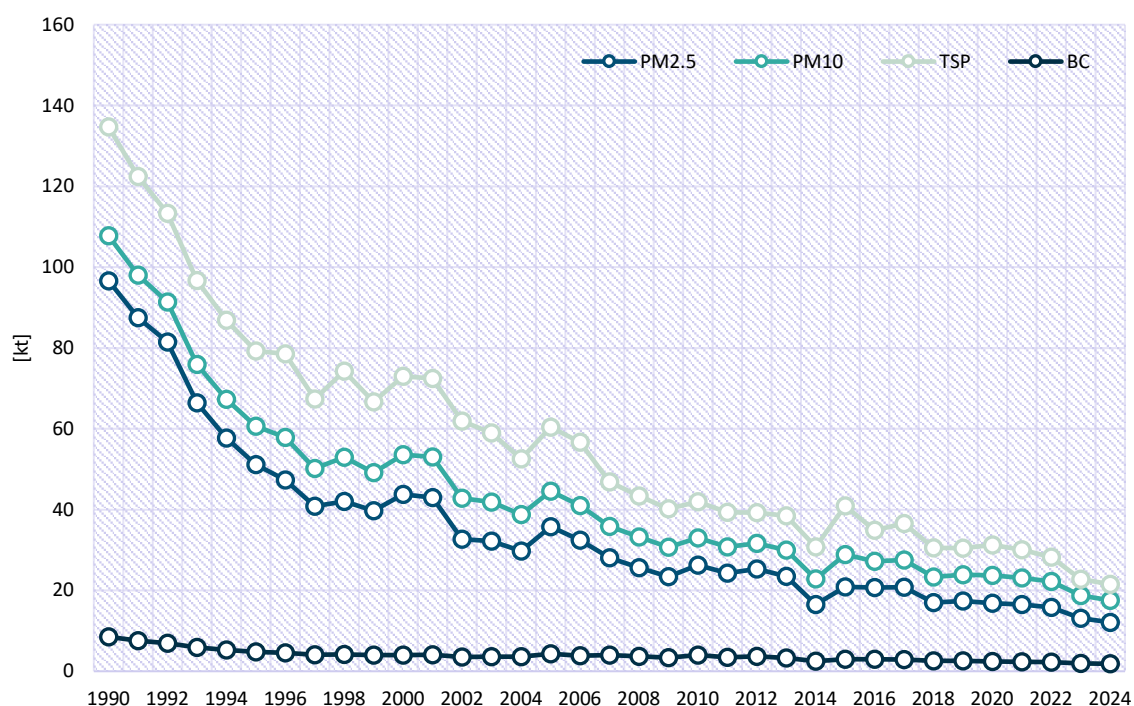


Figure ES4.3: Overall emission trends of the priority heavy metals

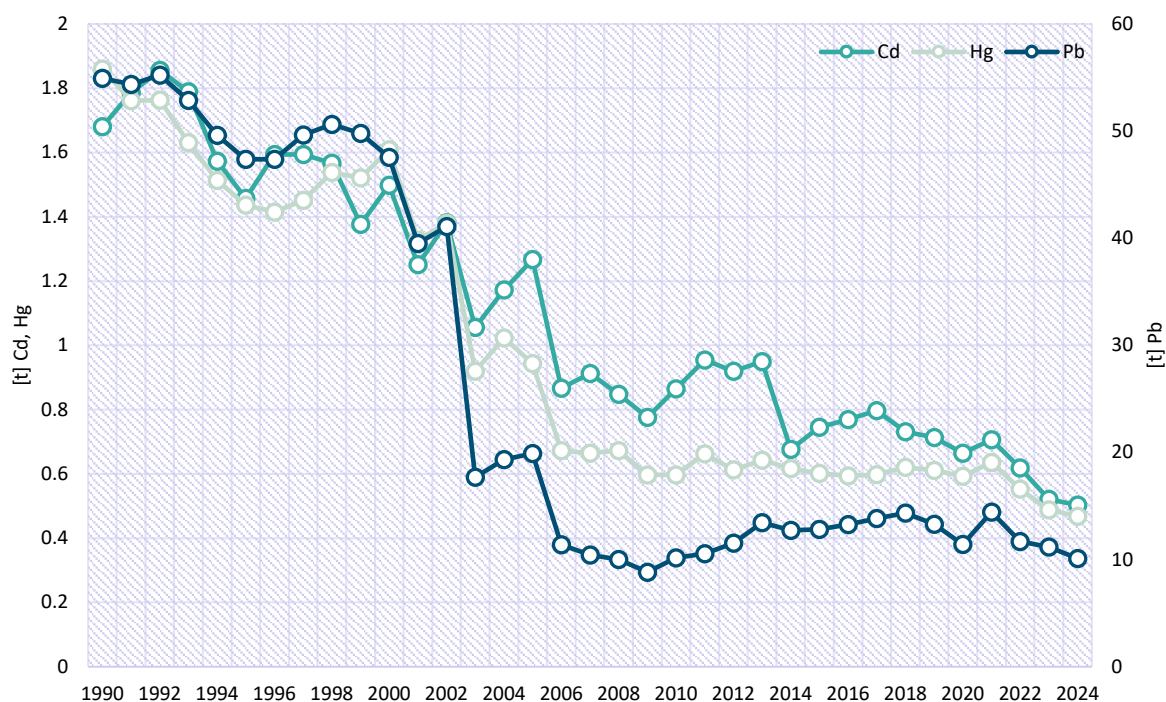
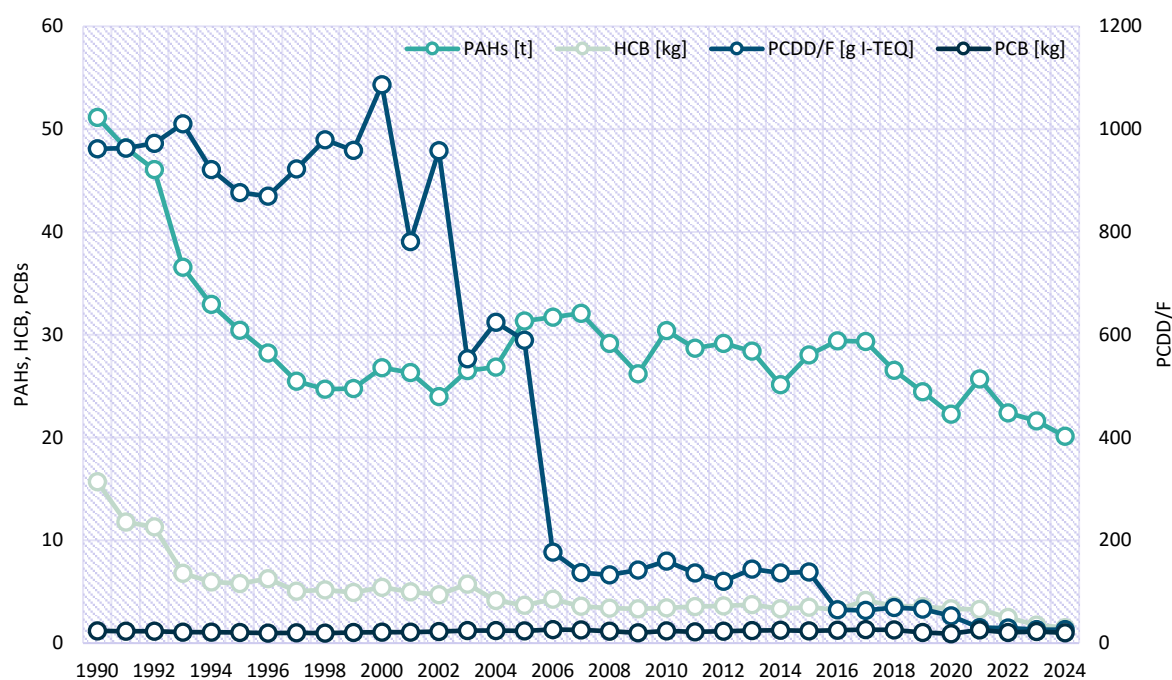


Figure ES4.4: Overall emission trend of the persistent organic pollutants



ES.5 OVERVIEW OF RECALCULATIONS

Most of the recalculations realised in the 2026 submission are related to the improvement of activity data, values of emission factors or error corrections. Also, recalculations related to the improvement of the methodologies focused on the combinations of the installation types/fuels used in our country. In the sector Agriculture, emissions were recalculated due to the harmonisation of the activity data with the GHG inventory and the addition of the emissions control measures into the calculation. [Table ES5.1](#) provides an overview of recalculations in the 2026 submission. More detailed data can be found in the chapters of this report.

Table ES5.1: Main recalculations and their explanation, % difference for the years 2023, 2020, 2015, 2010, 2005, 2000 and 1990 between the 2025 and 2026 Final Submission

POLLUTANT	CHANGE 1990	CHANGE 2000	CHANGE 2005	CHANGE 2010	CHANGE 2015	CHANGE 2020 S	CHANGE 2023	UNITS	COMMENT/EXPLANATION
NO _x (as NO ₂)	3%	1%	1%	2%	5%	4%	5%	kt	Emissions increased mainly due to recalculations in categories 1A3b , 3Da2a and 3Da3 .
NM VOC	0%	0%	0%	0%	0%	0%	0%	kt	The decrease in emissions in 2023 was caused by recalculations in category 1A4bi . The slight increase since 1990 was caused by recalculation in the category 3B3 , and since 2013 was caused by recalculations in the categories of 1A3b .
SO _x (as SO ₂)	0%	0%	0%	0%	0%	0%	0%	kt	Minimal increase of emissions since 2013 was caused by recalculations in the categories of 1A3b and 2D3i in the use of lubricants in transport.
NH ₃	51%	68%	53%	31%	21%	18%	15%	kt	Emissions increased mainly due to recalculations in categories 3Da1 and 3Da2a .
PM _{2.5}	0%	0%	0%	0%	0%	1%	0%	kt	A slight decrease in emissions in the period 1990-2011 was caused by recalculations in category 3B . Since 2013, the main source of the emission increase was recalculations in the categories of 1A3b ; the decrease in 2023 was caused by error correction in category 1A4bi .
PM ₁₀	0%	0%	0%	0%	1%	1%	0%	kt	A slight decrease in emissions in the period 1990-2011 was caused by recalculations in category 3B . Since 2013, the main source of the emission increase was recalculations in the categories of 1A3b ; the decrease in 2023 was caused by error correction in category 1A4bi .
TSP	0%	0%	0%	0%	0%	0%	0%	kt	A slight decrease in emissions in the period 1990-2011 was caused by recalculations in category 3B . Since 2013, the main source of the emission increase was recalculations in the categories of 1A3b ; the decrease in 2023 was caused by error correction in category 1A4bi .
BC	0%	0%	0%	0%	2%	2%	1%	kt	Increase of emissions was caused by adding the calculation of BC in the categories 2B1 and 2B5 .
CO	0%	0%	0%	0%	0%	0%	0%	kt	Since 2013, the main source of the emission increase was recalculations in the categories of 1A3b and a decrease in 2023 in category 1A4bi .

Table ES.1: Main recalculations and their explanation, % difference for the years 2019, 2015, 2010, 2005, 2000 and 1990 between the 2024 and 2025 Final Submission

POLLUTANT	CHANGE 1990	CHANGE 2000	CHANGE 2005	CHANGE 2010	CHANGE 2015 S	CHANGE 2020 VALUES	CHANGE FOR 2023 VALUES	UNITS	COMMENT/EXPLANATION
Pb	4%	5%	14%	26%	22%	43%	13%	t	Emissions increased due to recalculations of waste incineration with energy recovery in categories 1A1b , 1A2c and 1A2f , to recalculations in the category 1A3bvi and activity data correction in category 2A3 .
Cd	29%	30%	36%	21%	33%	38%	20%	t	Emissions increased due to recalculations of waste incineration with energy recovery in categories 1A1b , 1A2c and 1A2f , to recalculations in the category 1A3bvi and activity data correction in category 2A3 .
Hg	3%	3%	5%	3%	7%	13%	2%	t	Emissions increased due to recalculations of waste incineration with energy recovery in categories 1A1b , 1A2c and 1A2f .
As	6%	9%	11%	6%	11%	15%	7%	t	Emissions increased due to recalculations of waste incineration with energy recovery in categories 1A1b , 1A2c and 1A2f , to recalculations in the category 1A3bvi and activity data correction in category 2A3 .
Cr	6%	11%	9%	4%	10%	10%	12%	t	Emissions increased due to recalculations of waste incineration with energy recovery in categories 1A1b , 1A2c and 1A2f , to recalculations in the category 1A3bvi and activity data correction in category 2A3 .
Cu	7%	12%	9%	4%	23%	26%	26%	t	Emissions increased due to recalculations of waste incineration with energy recovery in categories 1A1b , 1A2c and 1A2f , and to recalculations in the category 1A3bvi .
Ni	3%	11%	16%	7%	13%	14%	11%	t	Emissions increased due to recalculations of waste incineration with energy recovery in categories 1A1b , 1A2c and 1A2f , to recalculations in the category 1A3bvi and activity data correction in category 2A3 .
Se	3%	5%	4%	3%	7%	8%	8%	t	Emissions increased due to recalculations of waste incineration with energy recovery in category 1A2c and activity data correction in category 2A3 .
Zn	4%	5%	4%	2%	7%	8%	8%	t	Emissions increased due to recalculations of waste incineration with energy recovery in category 1A2c and to recalculations in the category 1A3bvi .
PCDD/PCDF	17%	14%	41%	77%	119%	2%	13%	g I TEQ	Emission increased mainly due to the conversion factor correction in the categories 5C1bi and 5C1bii .
PAHs	-1%	-2%	-2%	-1%	-1%	0%	-1%	t	Emissions decreased mainly due to conversion factor correction in the categories 5C1bi and 5C1bii and recalculations of waste incineration with energy recovery in categories 1A1b , 1A2c and 1A2f .
HCB	-19%	-42%	-74%	-69%	-76%	-81%	-85%	kg	Emission decreased mainly due to the conversion factor correction in the category 5C1bii .
PCBs	-60%	-64%	-70%	-61%	-62%	-54%	-33%	kg	Emission decreased mainly due to the conversion factor correction in the categories 5C1bi and 5C1bii .

ES.6 IMPROVEMENT AND PRIORITIES

In 2023, 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. In 2024, 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, prioritising key categories, as the uncertainty analysis changed the key categories.

A categorisation of operators is not fully in compliance with the GHG inventory at this moment, although major improvements were achieved. Cooperation with the GHG inventory experts was initiated, but due to capacity constraints, a comprehensive solution has not yet been 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 PM₁₀

In the 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 in PM emission factors: Aviation ([1A3a](#)), Off-road vehicles and other machinery ([1A4cii](#)) and Other mobile sources ([1A5b](#)). Other categories are estimated using the model COPERT, and the inclusion of condensable compounds 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

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 succeeded 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 succeeded 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 ratified 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 ratified on 28 April 2005

NEC Directive (1) – Directive (EU) 2016/2284 of the European Parliament and the Council on the reduction of national emissions of certain atmospheric pollutants for certain pollutants.

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 the NEC Directive 2001/81/EC, the National Emission Ceilings Directive ([Table 1.1.1](#)). 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 (SO_x)
- Non-methane volatile organic compounds (NMVOC)
- Nitrogen oxides (NO_x)
- Ammonia (NH₃)
- 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 1.1.2*).

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 come into force in 2020.

Table 1.1.1: Emission Ceiling of the Slovak Republic for the year 2010

	NO _x	SO _x	VOC	NH ₃
Slovak Republic	130	110	140	39
EU-28	8 297	9 003	8 848	4 294

Table 1.1.2: Emission Reduction Commitments for the Slovak Republic set in the New NECD

	NO _x	SO _x	NMVOC	NH ₃	PM _{2.5}
2020-2029	36%	57%	18%	15%	36%
2030 and onwards	50%	82%	32%	30%	49%

UN context – The UN Framework Convention on Climate Change was adopted in 1992 as an instrument to tackle climate change. The objective of the Convention was to stabilise 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 a 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 23 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 arisen. In 1997, the Parties to 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 12 December 2015, because 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 22 April 2016, in New York. The proposal for the adoption of the Paris Agreement was negotiated by the Government of the Slovak Republic on 14 September 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 21 September 2016. The SR completed its ratification process on 28 September 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 28 November 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 both at the EU and Member State levels. The update of the national energy and climate plans was reported in March 2025.

1.1.1 Historical Background and Circumstances

Political changes in the 1990s, as well as the Slovak Republic's efforts to join the European Union, led to 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 the independent states of the Czech Republic and Slovakia 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 1 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 by the following legislation:

- Act No 309/1991 Coll. on the Protection of Air from Pollutants (Air Act) as amended (4).
- Act No 134/1992 Coll. on State Administration of Air Protection as amended (5)
- 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 (6)

- Decree of the Ministry of the Environment of the Slovak Republic No 103/1995 Coll. as amended (7).

Nowadays, these acts/decrees have been 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)
- Directive 84/360/EEC of the European Parliament and of the Council on combating 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, the 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 harmonisation was achieved:

- Act No 478/2002 Coll. on air protection (8),
- Decree of the Ministry of Environment of the Slovak Republic No 408/2003 Coll. on monitoring of emissions and air quality monitoring (9),
- Decree No 409/2003 Coll. on emission limits, technical requirements and general operating conditions of certain activities and installations, which use organic solvents (10),
- 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 categorisation of air pollution sources and on requirements of emission dispersion as amended (11),
- Decree No 705/2002 Coll. on air quality (12),
- 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 (13),
- Decree No 60/2003 Coll. on the Specification of a maximum volume of discharged pollutants (emission quotas) (14),

- Decree No 144/2000 Coll. on the Requirements for the quality of fuels (15).

Nowadays, are these acts/decrees repealed or it is covered by the Act on air protection No 137/2010 Coll. (16) as amended and related regulations.

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 gas 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: Vestník, Ministry of Environment, XV, 3, 2007. (17). 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 the 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 is in the following [Table 1.2.1](#).

Table 1.2.1: List of internal and external contributors to the Emission Inventory under CLRTAP

SECTOR/SUBSECTOR	CONTRIBUTOR	INSTITUTION	E-MAIL
CLRTAP coordinator	Zuzana Jonáček	SHMÚ	zuzana.jonacek@shmu.sk

SECTOR/SUBSECTOR	CONTRIBUTOR	INSTITUTION	E-MAIL
Energy	Monika Jalšovská	SHMÚ	monika.jalsovska@shmu.sk
	Michaela Câmpian	SHMÚ	michaela.campian@shmu.sk
	Ján Horváth	SHMÚ	jan.horvath@shmu.sk
	Marcel Zemko	SHMÚ	marcel.zemko@shmu.sk
Transport	Ján Horváth	SHMÚ	jan.horvath@shmu.sk
IPPU	Ivana Bellušová	SHMÚ	ivana.bellusova@shmu.sk
	Vladimír Danielik	STU BA	
Agriculture	Kristína Tonhauzer	SHMÚ	kristina.tonhauzer@shmu.sk
	Patricia Navrátilová	SHMÚ	Patricia.navratilova@shmu.sk
	Ondrej Pastierik	EEA	
	Vojtech Brestenský	NPPC	
Waste	Zuzana Jonáček	SHMÚ	zuzana.jonacek@shmu.sk
	Petra Kršáková	SHMÚ	petra.krsakova@shmu.sk
Projections	Marcel Zemko	SHMÚ	marcel.zemko@shmu.sk
	Kristína Tonhauzer	SHMÚ	kristina.tonhauzer@shmu.sk
	Ján Horváth	SHMÚ	jan.horvath@shmu.sk
	Jiří Balajka	Senior consultant	
Gridded emissions	Marcel Zemko	SHMÚ	marcel.zemko@shmu.sk
LPS	Monika Jalšovská	SHMÚ	monika.jalsovska@shmu.sk
QA/QC	Lenka Zetochová	SHMÚ	lenka.zetochova@shmu.sk
	Petra Kršáková	SHMÚ	petra.krsakova@shmu.sk

Based on the official Agreement between the MŽP SR¹ 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 authorised persons with direct access to the server.

In the emissions inventory of transport, the 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 the emission inventory was performed in cooperation with the Ministry of Agriculture and Rural Development (MPaRV). The responsibility for data and compilations of 3B Manure management was consequently shifted to the allowance organisation - the National Agriculture and Food Centre (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

¹ 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

- 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 (18) that are processed by the inventory first approach for air pollutants and the 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
- b) for verification of E-PRTR

The emission inventory under the 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 2023 (18) and implements the NFR (reporting nomenclature) and the category. Data are provided between 1990 and 2024. 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 1.4.1](#).

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 authorised persons with direct access.

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

Annual data are collected from large and medium-sized sources in the energy and industry sectors. 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 categorisation for solid, liquid, gaseous fuels, biomass and other fuels. The emissions balances of air pollutants in the range from 2000 to 2024 were processed in the NEIS CU module in 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.

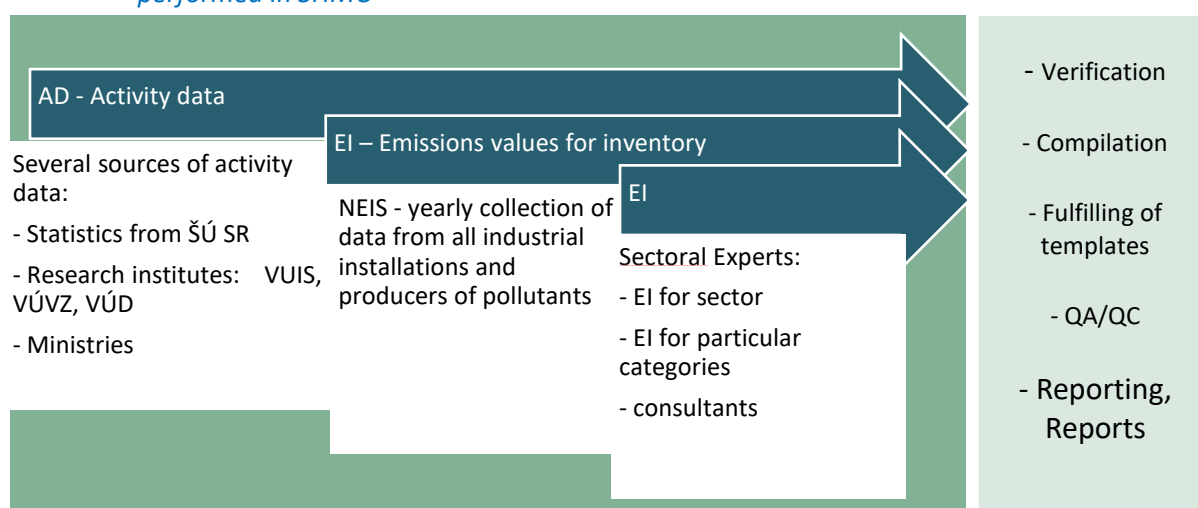
The MŽP SR has mandated the SHMÚ to ensure communication with the producers to collect the necessary data, which they are not obliged to provide to the NEIS.

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 PM₁₀ 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 (20).

The NEIS database contains a special program that automatically calculates emissions of PM₁₀ and PM_{2.5}. The outputs from the NEIS database are verified and presented in Excel sheets. [Figure 1.4.1](#) shows the general principle of how inventory compiling works.

Figure 1.4.1: Scheme of different sources for the 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 several 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 focused 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: SO_x, NO_x, NMVOC, NH₃, CO
- PMs: TSP, PM₁₀, PM_{2.5}
- HMs: Cd, Hg, Pb, As, Cr, Cu, Ni, Se, Zn
- POP: PAH, PCDD/F, HCB, PCBs

The methodology used for the 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 1.5.1](#).

[Equation 1.5.1: 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 1.5.2](#) if more than one year of inventory data are available.

Equation 1.5.2: Trend assessment

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

Where:

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

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

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

The presented key category analysis was performed with data for air emissions of the submission 2024 to the UNECE/LRTAP. For all gases, a level assessment for all years 1990 (base year) and 2024 (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 1.5.1](#)). For the first time, uncertainty was considered for the identification of key categories. The table below represents the key categories, but the detailed analysis is provided in [Chapter ANNEXES](#), as this table does not show the technology and fuels.

Table 1.5.1: Summary of Key Categories of key pollutants with uncertainty – Contributions per pollutant for Level Assessment (LA) and Trend Assessment (TA) in %

NFR	NOx		SOx		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				
1A1a		6		18				2		1							9		22		18	8	41					5	31		13				17			54	52	9	14	320		
1A1b			10	5														10	12							3							2									44		
1A1c																																	9	7								16		
1A2a			3					1											5	4	10	12							2		4												41	
1A2c																			21	3			4																	4		33		
1A2d				3															3	8	6	4															10	10				45		
1A2f	3	2	2																		23	14	4					4	3														54	
1A2gvii	3	4											2		3	2																											14	
1A2gviii					1	2																																					3	
1A3bi	12	12				6	3	2					4	8	16	9	19			6	4						6						3	5	4								119	
1A3bii	4	3													5	2																											13	
1A3biii	4	13														8											8						3										36	
1A3bv					5																																							5
1A3bvi							6	5	6	6	5	5				9	8	77	52	10	8			20	8	78	71	98	59	32	26	7	6	48	50								701	
1A3bvii							3	2	3	2	3	3																															17	
1A3c	3	3																																2						9	47	63		
1A3di(ii)	2																											25	10														37	
1A3dii																												8	6														14	
1A4ai																					2	2																3	3				11	
1A4bi		2		8	6	24	40	53	17	30	9	23	34	45	27	42			12	9				3		2								11	6		10		4			417		

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							
1A4bii															8	5																														13	
1A4cii	6	20							2							5	7																													39	
1A5a																									19																					19	
1B1a								2																																						2	
1B1b									3	2	3	3	5	4	4	2	3					4	2	2		5						5	3	6	4			12	9	28	21						131
1B2ai							6	2																																						8	
1B2aiv			46	35																																										81	
1B2av							8	28																																						35	
1B2b							14	2																																						16	
1B2d							8																																							8	
2A3																					2	2			10	2							62	48												127	
2A5b							8					3	3	8	7																															29	
2B10a			5	4																																										10	
2C1	3	3	12	7											9	5			6	3	2		2	11	2				9	5		9	6	14	11			49	41	8	7	67	14				305
2C7a																					4				2	6	5									39	32									89	
2D3a							1																																							89	
2D3d							3	1																																						5	
2D3i																																				25	11									37	
2G																	4	3				6	5																							18	
2H2							16	9																																							25

NFR	NOx		SOx		NH3		NMVOC		PM2.5		PM10		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								
3B1a							4	1	2				2																																10					
3B1b					7	6	5	3	3		2		3																																	28				
3B3					5	6					2		10																																		23			
3B4gi											3	1	11	5																																	20			
3B4gii							2				2		3																																	6				
3B4h									2	1				2																																		112		
3Da1	26	10			43	33																																										67		
3Da2a	8				21	37																																										7		
3Da2c	8																																																103	
3Da3		2			5																																												31	
3Dc									4	3	33	28	19	17																																				103
3Df																																																	7	
5C1bi														7																																			7	
5C1bii			3											3						5	4																											19		
5C1biii																							2																										4	
5C1bv																							12	9																									21	
5C2		2							12	10	6	6	4	4	20	12	10	8			3	2			14	4																							143	
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 the EN ISO 9001:2008 standard of conformity. In the frame of the introduction of the QMS for the SHMÚ as a global standard, the certification itself proceeds according to the partial processes within 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 has been 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 the GHG inventory. In the last meeting, the experts from Slovakia, the Czech Republic, Poland, Hungary and Austria attended.

1.6.1 QA/QC Plan

A QA/QC plan is an internal document to organise and implement all activities across all 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 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; they 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 the activities of inventory members and results are reported. 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 conforms to the general and specific procedures.

Documentation: Write down all verification results by filling out a checklist, including conclusions and irregularities that must 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 the 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 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 the 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 sectors. In this submission, several emission 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 not at a sufficient level.

1.7 UNCERTAINTY ASSESSMENT

Uncertainty analysis was provided for the main pollutants (SO₂, NO_x, NMVOC, NH₃ 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_x, NO_x, NMVOC, NH₃, CO, TSP, PM_{2.5}, PM₁₀, 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 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 factors 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 1.7.1](#)) following the EMEP/EEA GB 2023.

Table 1.7.1: 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	E	E	E	D	E	C	E
1A1b	A	A	A	A	A	A	A	A	A	E	E	C	C	E	E	E
1A1c	A	A	A	A	A	A	A	A	A	C	C		C	E		
1A2a	A	A	A	A	A	A	A	A	A	E	E	E	E	D	D	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	D	D	C	D	D	D	D
1A2d	A	A	A	A	A	A	A	A	A	E	E	E	E	E	D	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	D	C	D	E	E	C	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	C	D	D	E
1A3a	B	B	A	C	C	C	C	C	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		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							
1A4ai	A	A	A	A	A	A	A	A	A	E	E	E	E	D	D	E
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	B	C	B	C	C	C	C
1A4ci	A	A	A	A	A	A	A	A	A	D	D	D	D	C	C	E
1A5a	A	A	A	A	A	A	A	A	A	E	E	E	D	C	D	E
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	C	C		C	C	C	C	C			

NFR	NOx	NM VOC	SOx	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	Pb	Cd	Hg	PCDD/F	PAHs	HCB	PCB
1B2av		E														
1B2b		E														
1B2d		B		D								D				
2A1					A	A	A	A								
2A2					A	A	A	A								
2A3					A	A	A	A		E	C	E				
2A5a	A	A	A		A	A	A									
2A5b					C	C	C									
2A6	A	A	A	A	A	A	A		A							
2B1	A	A	A	A	A	A	A	A	A							
2B2	A			A												
2B5	A	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	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							
2C6		A		A	A	A			A	E	E	E	E			E
2D3a		B										C				
2D3b		A			A	A	A	A					E			
2D3c		A			A	A	A	A								
2D3d		A														

NFR	NOx	NMVOC	SOx	NH3	PM2.5	PM10	TSP	BC	CO	Pb	Cd	Hg	PCDD/F	PAHs	HCB	PCB
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			A	A	A									
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												
5C1bi	E	E	E		B	B	B	C	E	C	C	C	C	C	E	C
5C1bii	E	E	E		B	B	B	C	E	C	C	C	C	E	E	E
5C1biii	B	B	C		C	C	C	C	C	C	E	C	C	C	E	E
5C1bv	E	E	E		E	E	E		E	E	E	E	E	E	E	E
5C2	D	D	D		D	D	D	C	D	C	C		C	D		
5D1		C		C												
5D2		C														
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 2023 for the air pollutants NO_x, NMVOC, SO_x, NH₃, PM_s, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PAH, PCDD/F, HCB, PCBs and BC in the year 2024 and the respective level and trend uncertainties. The basis for this assessment is the qualitative rating as presented in [Table 1.7.1](#). The results of the uncertainty analysis are indicated in the following [Table 1.7.2](#).

Table 1.7.2: Results of quantitative uncertainty analysis of mandatory main pollutants, heavy metals and persistent organic pollutants

POLLUTANT	LEVEL ANALYSIS IN 2024 [%]	TREND ANALYSIS IN 2024 [%]
NO _x	21.33	4.71
NMVOC	32.25	7.43
SO _x	19.39	1.33
NH ₃	91.10	25.13
PM _{2.5}	21.26	3.09
PM ₁₀	43.10	6.28
TSP	39.35	5.34
BC	23.94	5.11
CO	12.39	3.95
Pb	303.20	56.82
Cd	72.86	23.58
Hg	105.70	24.79
As	63.36	70.98
Cr	260.98	164.50
Cu	716.80	1359.09
Ni	174.28	24.60
Se	118.85	18.96
Zn	293.15	203.62
PCDD/F	130.03	3.88
PAHs	229.10	49.88
HCB	156.87	14.02
PCBs	53.87	25.53

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 provided 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 daily on the backup servers of SHMÚ. This activity is performed for all data processed in SHMÚ (which 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, except the arranged FTP server, are archived electronically at SHMÚ and the Statistical Yearbook published annually by the ŠÚ SR is stored in paper form.

All documents and background materials of the internal experts of SHMÚ and the external experts 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 the 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 the recent inventory submission (2024). The list of categories reported by the notation keys NE and IE is provided in [Table 1.9.1](#).

Several NE key categories have been reported in the 2025 submission for 1990-2024.

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 1.9.1: List of NFR categories reported with notation key NE or IE

NFR	NOT ESTIMATED	YEARS	INCLUDED ELSEWHERE	YEARS
1A2b	HCb, PCBs	1990-2002, 2008-2024		
1A2gvii	Pb, Hg, As, PCDD/F, B(k)F, I()P, HCB, PCBs	1990-2024		
A3ai(i)	NH ₃ , Pb, Hg, Cd, AHMs, PCDD/F, PAHs	1990-2024, Pb 1990-2018		
A3ai(ii)	NH ₃ , Pb, Hg, Cd, AHMs, PCDD/F, PAHs	1990-2024, Pb 1990-2018		
1A3aii(i)	NH ₃ , Pb, Hg, Cd, AHMs, PCDD/F, PAHs	1990-2024, Pb 1990-2018		
1A3aii(ii)	NH ₃ , Pb, Hg, Cd, AHMs, PCDD/F, PAHs	1990-2024, Pb 1990-2018		
1A3bvi	Hg, PCDD/F, I()P	1990-2024		
1A3bvii	HMs, POPs	1990-2024		
1A3c	Pb, Hg, As	1990-2024		
1A4aii	Pb, Hg, As, PCDD/F, B(k)F, I()P, HCB, PCBs	1990-2012, 2014-2024		
1A4bii	Pb, Hg, As, PCDD/F, B(k)F, I()P, HCB, PCBs	1990-2024		
1A4cii	Pb, Hg, As, PCDD/F, B(k)F, I()P, HCB, PCBs	1990-2024		
1A5b	Cd, Hg, AHMs, POPs	1990-2024		
1B1a	BC, HMs	1990-2024		
1B1b	HCB, PCBs	1990-2024		

NFR	NOT ESTIMATED	YEARS	INCLUDED ELSEWHERE	YEARS
1B2ai	SOx, PCDD/F	1990-2024		
1B2aiv	BC, PAHs, HCB, PCBs	1990-2024	NH ₃	1990-2024
1B2b	SOx, PCDD/F	1990-2024		
1B2c	NH ₃ , POPs	1990-2024	NOx, NMVOC, SOx, PMs, CO, HMs	1990-2024
1B2d	NOx, SOx, NH ₃ , PMs, CO, HMs, POPs	1990-2024		
2A1			MPs, HMs, POPs	1990-2024
2A2	PHMs	1990-2024	MPs	1990-2024
2A3	PCDD/F, PAHs, HCB	1990-2024	MPs	1990-2024
2A5c			PMs	1990-2024
2A6	BC	1990-2024		
2B2	PM _{2.5}	1990-2024		
2B5	HMs, PCDD/F, PAHs, HCB	1992-2024		
2B10a	HMs, POPs	1990-2024		
2B10b	BC	1990-2024		
2C1	B(a)P, B(b)F, B(k)F, I()P	1990-2024		
2C2	HMs, PCDD/F, PAHs	1990-2024		
2C3	NH ₃ , HMs, PCDD/F, HCB	1990-2024		
2C5	NH ₃ , BC, Cr, Cu, Ni, Se, PAHs, HCB	2011-2024		
2C6	NOx, NMVOC, NH ₃ , BC, CO, Cr, Cu, Ni, Se, PAHs, HCB	2012-2014		
2C7a	NH ₃ , Se, Zn, PAHs, HCB	1990-2024		
2C7c	BC, HMs, POPs	1990-2024		
2C7d			PMs	1990-2024
2D3a	PM _{2.5}	1990-2024		
2D3b	NOx, SOx, CO, PAHs, HCB	1990-2024		
2D3c	NOx, CO, PHMs, PCDD/F, PAHs, HCB	1990-2024		
2D3e	PM _{2.5}	1990-2024		
2D3f	PM _{2.5}	1990-2024		
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	1990-2024		
2D3h	PM _{2.5} , BC	1990-2024		
2D3i	NOx, NH ₃ , PMs, CO, POPs	1990-2024		
2G	Se, HCB, PCBs	1990-2024		
2H1	NH ₃ , PAHs, HCB	1990-2024	NOx, NMVOC, SOx, CO	1990-2024
2H2	BC	1990-2024		
2H3	BC	1990-2024		
2I	BC, As, Cu	1990-2024		
2K	Pb, Cd, AHMs, HCB	1990-2024		
3Da2a			NMVOC	1990-2024
3Da3			NMVOC	1990-2024
5A	NH ₃	1990-2024		
5B1	NOx, NMVOC, SOx, PMs	1990-2024		
5B2	NOx, NMVOC, SOx, PMs, CO, PHMs, Cr, Zn, POPs	2001-2024		
5C1bi	NH ₃ , Se, I()P	1990-2016, 2018-2020, 2022-2023		
5C1bii	NH ₃	1990-2024		
5C1biii	NH ₃ , Se, Zn, B(a)P, B(b)F, B(k)F, I()P	1990-2024		

NFR	NOT ESTIMATED	YEARS	INCLUDED ELSEWHERE	YEARS
5C1bv	BC	1990-2024		
5C2	NH ₃ , Hg, Cr, Ni, I(P), HCB	1990-2024		
5D1	PMs, HMs	1990-2024		
5D2	NH ₃ , PMs, HMs	1990-2024		
5E	NO _x , NMVOC, SO _x , BC, CO, Ni, Se, Zn, PAHs, HCB, PCBs	1990-2024		
11B	HMs	1990-2024		
11C	NO _x , NMVOC, NH ₃	1990-2024		

MPs – Main Pollutants: NO_x, NMVOC, SO_x, NH₃, CO; **PMs – Particulate Matter:** PM_{2.5}, PM₁₀, TSP, BC; **HMs – Heavy metals:** **PHMs – Priority Heavy Metals:** Pb, Cd, Hg; **AHMs – Additional Heavy metals:** As, Cr, Cu, Ni, Se, Zn; **POPs – Persistent Organic Pollutants:** PCDD/F; **PAHs – Polycyclic Aromatic Hydrocarbons:** B(a)P, B(b)F, B(k)F, I(P); HCB, PCBs

Several categories are reported as not occurring (NO) due to the non-existence of the emission source or the source being out of the threshold and measurement range. If the methodology does not exist in the EMEP/EEA GB 2023, the notation key not applicable (NA) was used. The lists of notation keys NA and NO are available in [Table 1.9.2](#).

Table 1.9.2: List of NFR categories with notation key NA and NO

NFR	NOT APPLICABLE	YEARS	NOT OCCURRING	YEARS
1A1a			NH ₃	1990-2014, 2018, 2020-2024
1A1c	Hg, HCB, PCBs	1990-2024		
1A2a			NH ₃	1990-2015, 2017-2024
1A2b			NH ₃	1990-2024
1A2c			NH ₃	1990-2024
1A2d			NH ₃	1990-2006
1A2f			NH ₃	1990-1999, 2006-2011
1A3ai(i)	HCB, PCBs	1990-2024		
1A3ai(ii)	HCB, PCBs	1990-2024		
1A3aii(i)	HCB, PCBs	1990-2024		
1A3aii(ii)	HCB, PCBs	1990-2024		
1A3bv	NO _x , SO _x , NH ₃ , PMs, CO, HMs, POPs	1990-2024		
1A3bvi	MPs	1990-2024		
1A3bvii	MPs	1990-2024		
1A3di(i)			All pollutants	1990-2024
1A3di(ii)			All pollutants	2000
1A3ei	NH ₃ , HMs, POPs	1990-2024		
1A3eii			All pollutants	1990-2024
1A4ai			NH ₃	1990-2013, 2023-2024
1A4aii			All pollutants	2013
1A4ciii		1990-2023	All pollutants	1990-2024
1A5c			All pollutants	1990-2024
1B1a	NO _x , SO _x , NH ₃ , CO, POPs	1990-2024		
1B1c			All pollutants	1990-2024
1B2ai	NO _x , SO _x , NH ₃ , PMs, CO, HMs, POPs	1990-2024		
1B2av	NO _x , NH ₃ , SO _x , PMs, CO, HMs, POPs	1990-2024		

NFR	NOT APPLICABLE	YEARS	NOT OCCURRING	YEARS
1B2b	NOx, NH ₃ , PMs, CO, HMs, PAHs, HCB, PCBs	1990-2024		
2A2	AHMs, POPs	1990-2024		
2A3	PCBs	1990-2024		
2A5a	NH ₃ , BC, HMs, POPs	1990-2024		
2A5b	MPs, BC, HMs, POPs	1990-2024		
2A5c	MPs, BC, HMs, POPs	1990-2024		
2A6	HMs, POPs	1990-2024		
2B1	HMs, POPs	1990-2024		
2B2	NM VOC, SOx, PM ₁₀ , TSP, BC, CO, HMs, POPs	1990-2024		
2B3			All pollutants	1990-2024
2B5	NH ₃ , PCB	1992-2024	All pollutants	1990-1991
2B6			All pollutants	1990-2024
2B7			All pollutants	1990-2024
2B10b	HMs, POPs	1990-2024	NH ₃	2006-2024
2C2	HCB, PCBs	1990-2024	NH ₃	2004-2009
2C3	PCBs	1990-2024		
2C4			All pollutants	1990-2024
2C5			All Pollutants	1990-2010
2C6			All pollutants	1990-2011, 2015-2024
2C7a			As	2018-2024
2C7b			All Pollutants	1990-2024
2C7d	MPs, HMs, POPs	1990-2024		
2D3a	NOx, SOx, NH ₃ , PM ₁₀ , TSP, BC, CO, Pb, Cd, AHMs, POPs	1990-2024		
2D3b	NH ₃ , HMs, PCBs	1990-2024		
2D3c	SOx, NH ₃ , AHMs, PCBs	1990-2024		
2D3d	NOx, SOx, NH ₃ , PMs, CO, HMs, POPs	1990-2024		
2D3e	NOx, SOx, NH ₃ , PM ₁₀ , TSP, BC, CO, HMs, POPs	1990-2024		
2D3f	NOx, SOx, NH ₃ , PM ₁₀ , TSP, BC, CO, HMs, POPs	1990-2024		
2D3h	NOx, SOx, NH ₃ , PM ₁₀ , TSP, CO, HMs, POPs	1990-2024		
2H1	HMs, PCDD/F, PCBs	1990-2024		
2H2	NOx, SOx, NH ₃ , CO, HMs, POPs	1990-2024		
2H3	HMs, POPs	1990-2024	CO	2017-2024
2I	PHMs, Cr, Ni, Se, Zn, POPs	1990-2024	NH ₃	2011-2013
2J			All Pollutants	1990-2024
2K	MPs, PMs, PCDD/F, PAHs	1990-2024		
2L			All Pollutants	1990-2024
3B1a	SOx, BC, CO, HMs, POPs	1990-2024		
3B1b	SOx, BC, CO, HMs, POPs	1990-2024		
3B2	SOx, BC, CO, HMs, POPs	1990-2024		
3B3	SOx, BC, CO, HMs, POPs	1990-2024		
3B4a			All Pollutants	1990-2024
3B4d	SOx, BC, CO, HMs, POPs	1990-2024		
3B4e	SOx, BC, CO, HMs, POPs	1990-2024		

NFR	NOT APPLICABLE	YEARS	NOT OCCURRING	YEARS
3B4f			All Pollutants	1990-2024
3B4gi	SOx, BC, CO, HMs, POPs	1990-2024		
3B4gii	SOx, BC, CO, HMs, POPs	1990-2024		
3B4giii	SOx, BC, CO, HMs, POPs	1990-2024		
3B4giv	SOx, BC, CO, HMs, POPs	1990-2024		
3B4h	SOx, BC, CO, HMs, POPs	1990-2024		
3Da1	NMVOC, SOx, TSP, BC, CO, HMs, POPs	1990-2024	PM _{2.5} , PM ₁₀	1990-2024
3Da2a	SOx, PMs, HMs, POPs	1990-2024		
3Da2b	NMVOC, SOx, PMs, CO, HMs, POPs	1990-2024	NOx, NH ₃	2023-2024
3Da2c	NMVOC, SOx, PMs, CO, HMs, POPs	1990-2024		
3Da3	SOx, PMs, CO, HMs, POPs	1990-2024		
3Da4	NOx, NMVOC, SOx, PMs, HMs, POPs	1990-2024		
3Db	NOx, NMVOC, SOx, PMs, HMs, POPs	1990-2024	NH ₃	1990-2024
3Dc	MPs, BC, HMs, POPs	1990-2024		
3Dd	All Pollutants	1990-2024		
3De	NOx, SOx, PMs, HMs, POPs	1990-2024	NH ₃	1990-2024
3Df	MPs, PMs, HMs, PCDD/F, PAHs, PCBs	1990-2024		
3F			All Pollutants	1990-2024
3I	All Pollutants	1990-2024		
5A	NOx, SOx, BC, HMs, POPs	1990-2024		
5B1	HMs, POPs	1990-2024		
5B2	As, Cu, Ni, Se	2001-2024	All Pollutants	1990-2000
5C1a			All Pollutants	1990-2024
5C1bi			All Pollutants	2017, 2021, 2024
5C1biv			All Pollutants	1990-2024
5C1bv	NH ₃	1990-2024		
5C1bvi			All Pollutants	1990-2024
5C2	PCBs	1990-2024		
5D1	NOx, SOx, CO, POPs	1990-2024		
5D2	NOx, SOx, CO, POPs	1990-2024		
5D3			All Pollutants	1990-2024
5E	NH ₃	1990-2024		
6A			All Pollutants	1990-2024
6B			All Pollutants	1990-2024
11A			All Pollutants	1990-2024
11C	SOx, PMs, HMs, POPs	1990-2024		

MPs – Main Pollutants: NOx, NMVOC, SOx, NH₃, CO; **PMs – Particulate Matter:** PM_{2.5}, PM₁₀, TSP, BC; **HMs – Heavy metals:** **PHMs – Priority Heavy Metals:** Pb, Cd, Hg; **AHMs – Additional Heavy metals:** As, Cr, Cu, Ni, Se, Zn; **POPs – Persistent Organic Pollutants:** PCDD/F; **PAHs – Polycyclic Aromatic Hydrocarbons:** B(a)P, B(b)F, B(k)F, I(l)P; HCB, PCBs

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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 (SO_x as SO₂, NO_x as NO₂, NMVOC, NH₃ and PM_{2.5}), PM₁₀, 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

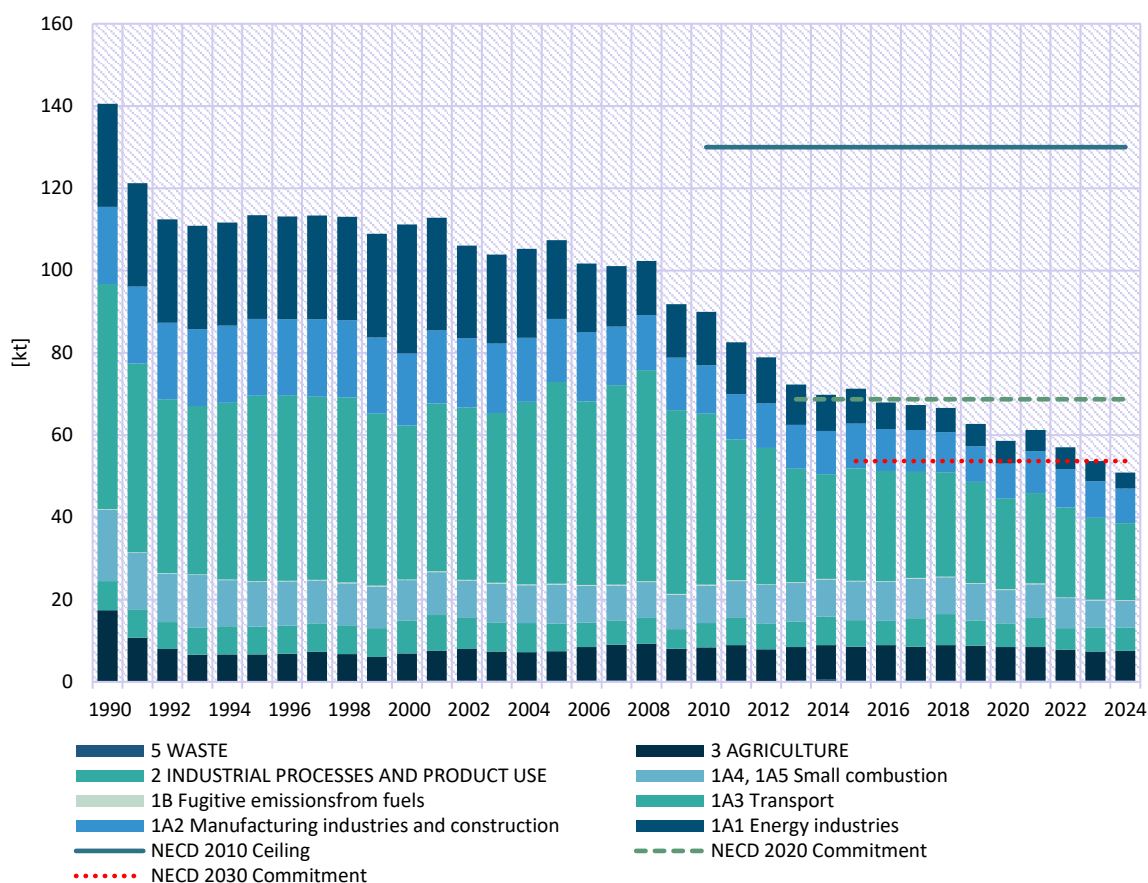
In Europe, regional air pollution is regulated by several protocols under the CLRTAP (Convention on Long Range Transboundary Air Pollution) under the UNECE (United Nations Economic Commission for Europe). Additionally, there is EU legislation that mostly mirrors the obligations under the CLRTAP. The Directive 2001/81/EC on National emissions ceilings (**NEC Directive**) (1) sets limit values of emissions of **sulphur dioxide** (SO₂), **nitrogen oxides** (NO_x), **volatile organic compounds** (VOCs) and **ammonia** (NH₃).

This Directive was replaced by the **New NEC Directive** 2284/2016 (2), which sets national emission reduction commitments for the Member States and the EU for five important air pollutants: NO_x, NMVOCs, SO₂, NH₃ and, for the first time, for fine **particulate matter** (PM_{2.5}).

2.1.1 Trends in Emissions of NOx

In **Figure 2.1.1** can be seen that emissions of NOx have a constantly decreasing trend and do not exceed the emission ceilings set up in the **NEC Directive 2001/81/EC** (1) for 2010. Since the year 2005, emissions decreased by 42, which means the Slovak Republic reached its National Commitment for this pollutant, set by the **NEC Directive 2016/2284/EU** (2) 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. The **Sofia protocol** of CLRTAP (3) concerning the control of emissions of nitrogen oxides or their transboundary fluxes was fulfilled.

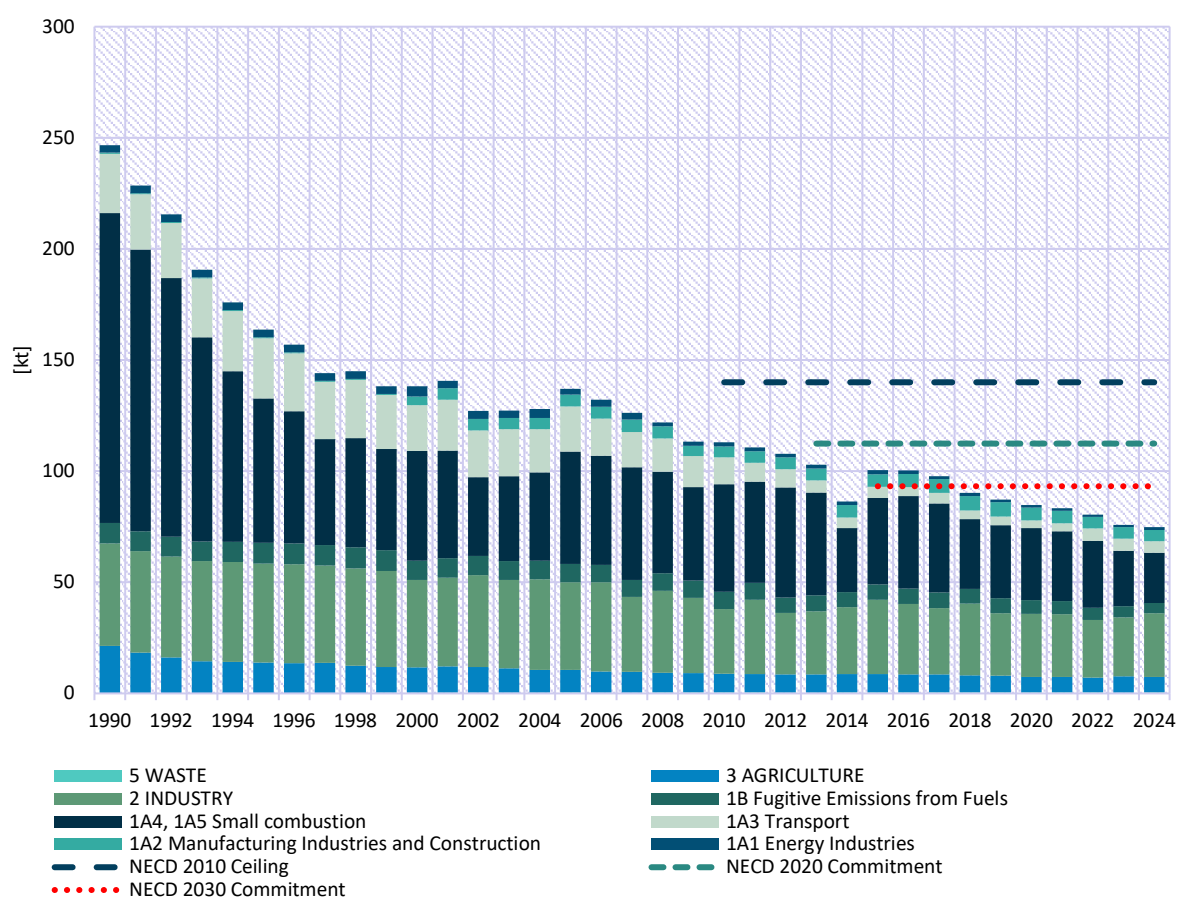
Figure 2.1.1: Total NOx emissions by sectors



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 26% of total NMVOC emissions in 2024. The decrease in the period 1990-2000 was caused primarily by a decrease in energy demand in households, which reconstructed their houses, and an increase in the energy efficiency of boilers. National Emission 2010 Ceiling set by **NEC Directive 2001/81/EC** (1), as well as Commitment set by new **NEC Directive 2016/2284/EU** (2) for the period 2020-2029, were not exceeded (**Figure 2.1.2**). **Geneva Protocol** of CLRTAP (4) 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 2.1.2: Total NMVOC emissions by sectors



2.1.3 Trends in Emissions of SO_x

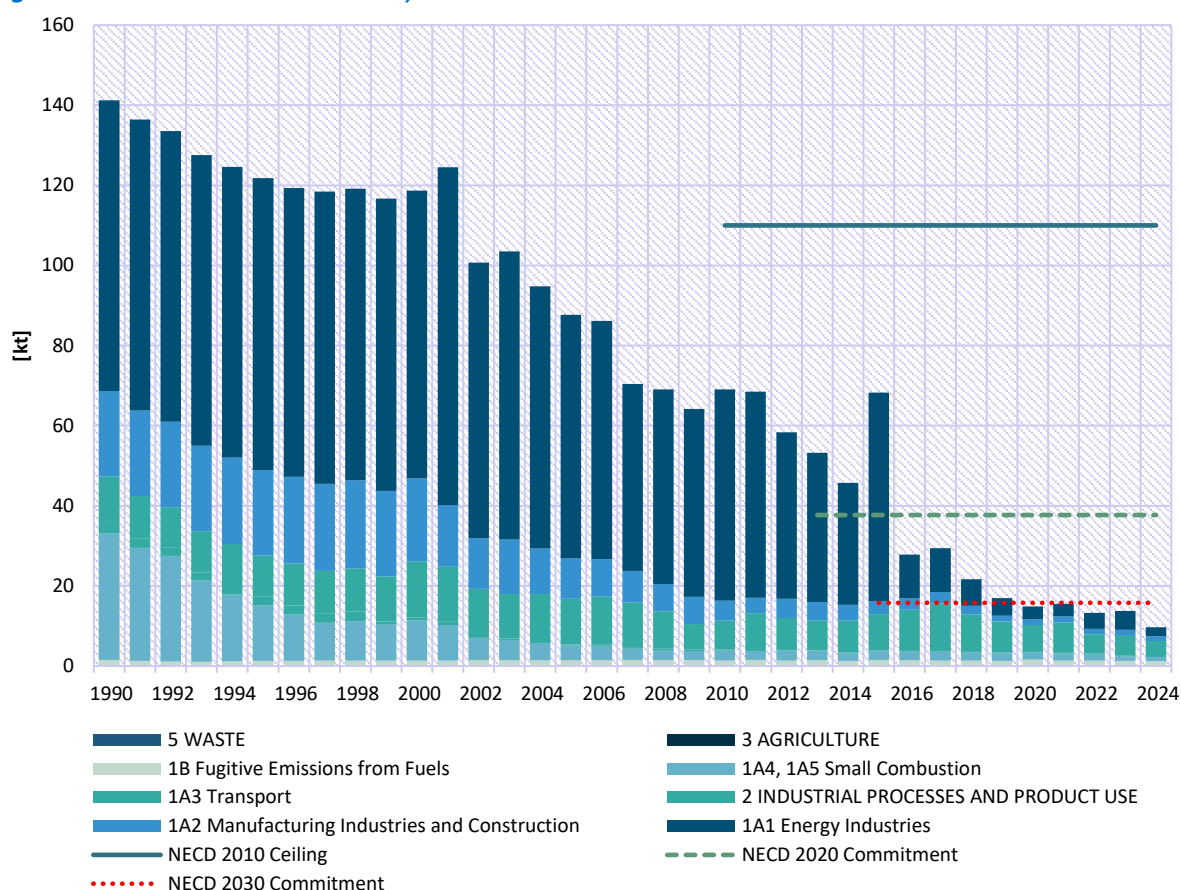
The trends of SO_x emissions decreased continuously until 2014. Since 1990, SO_x emissions have shown a significant decrease due to strict air protective legislation. The downward trend also relates to the composition of the fuel used in all sectors and related legislative limitations.

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 as 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 granule 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 SO_x comply with the **NEC Directive** (ceiling for the year 2010 (1), national commitment for the period 2020-2029 and 2030 onwards (2)), as with the **Oslo Protocol** (5) 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 (6) (*Figure 2.1.3*).

Figure 2.1.3: Total SO_x emissions by sectors



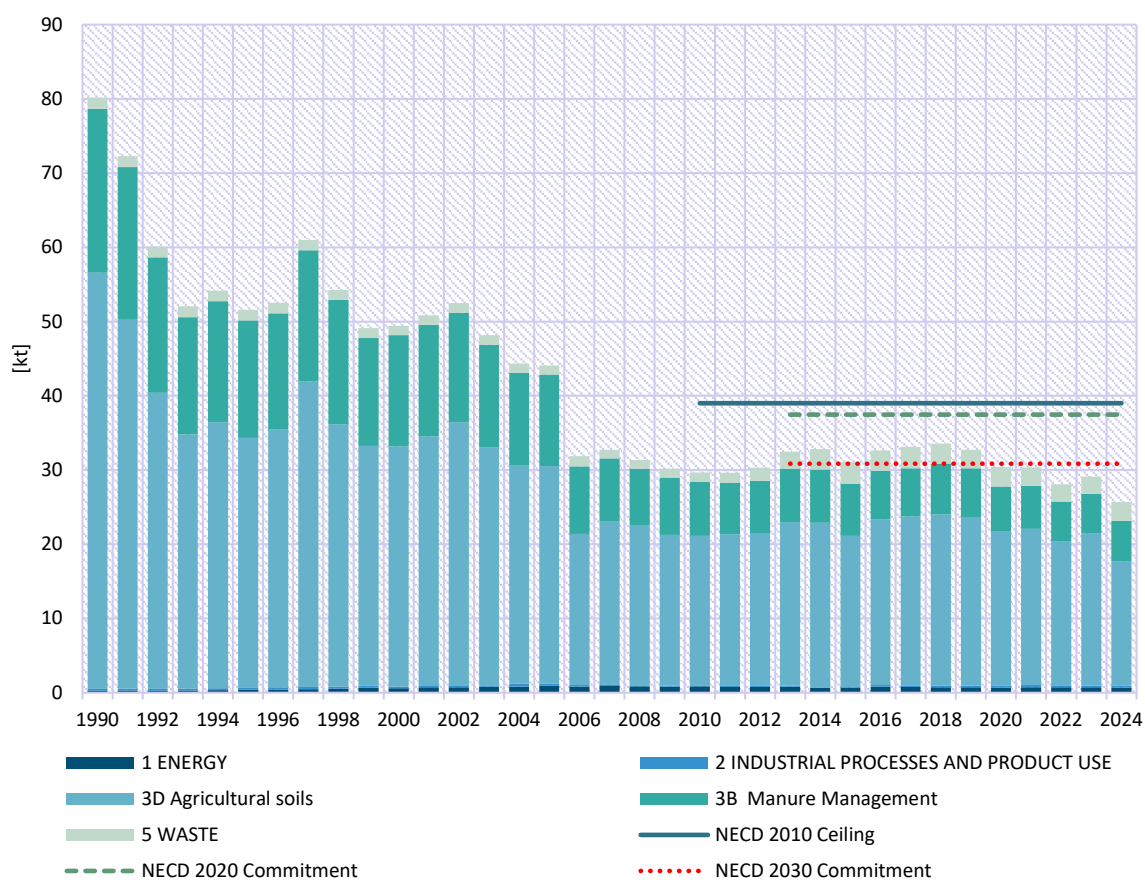
2.1.4 Trends in Emissions of NH₃

The overall trend of the emission inventory for ammonia (NH₃) 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-fertiliser into soils (*Figure 2.1.4*).

This category is the main polluter of NH₃ in the whole time series.

As shown in *Figure 2.1.4*, the Slovak Republic fulfils both the 2010 emission ceiling set by the **2001/81/EC Directive** (1) and national commitment for the periods 2020-2029 and 2030 onwards set by the new **NEC Directive 2016/2284/EU** (2).

Figure 2.1.4: Total NH₃ emissions by sectors



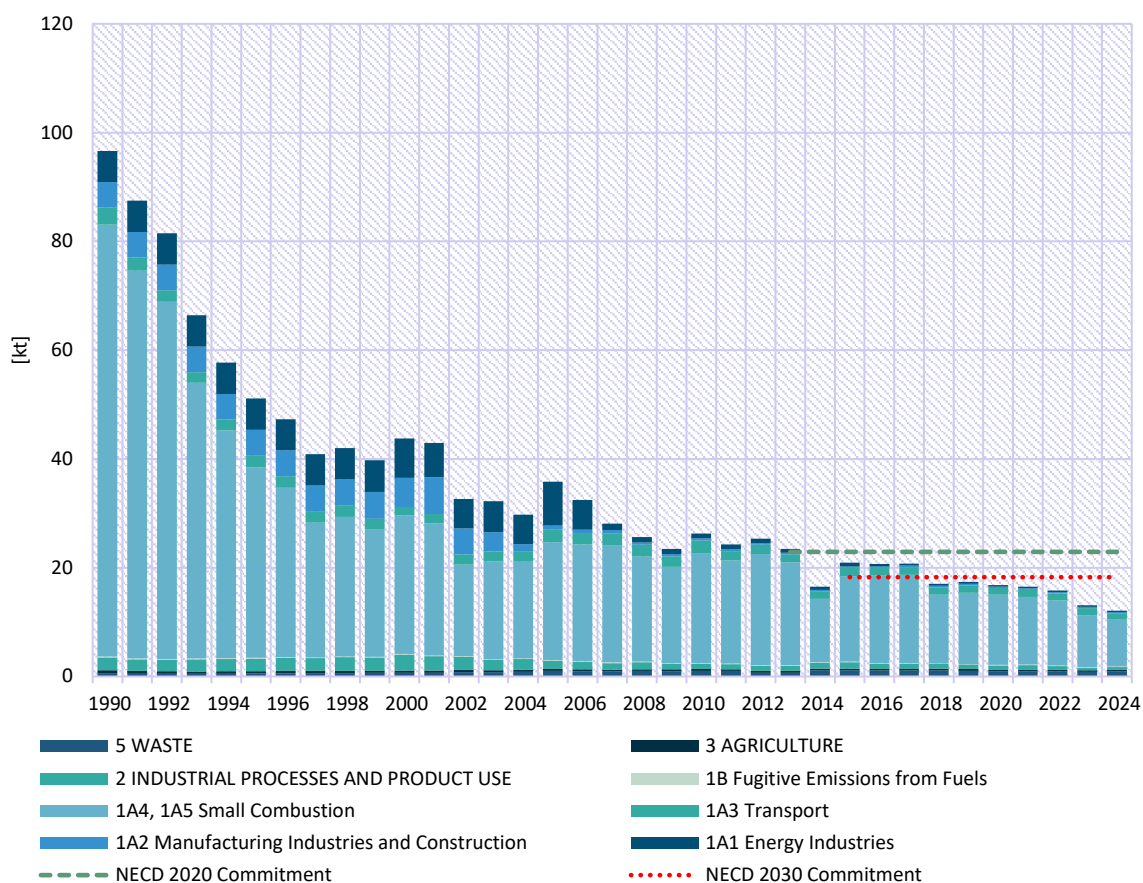
2.1.5 Trends in Emissions of PM_{2.5}

The emission trend of PM_{2.5} is significantly affected by the emission trend of the category of Residential heating. This category produced 67% of total PM_{2.5} emissions in the Slovak Republic in the year 2024. 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 have been moderately fluctuating according to conditions connected with the heating season and energy demand of households (*Figure 2.1.5*).

National emission commitments set by the **2016/2284/EU Directive** (2) for the period 2020-2029 and after 2030 have been fulfilled.

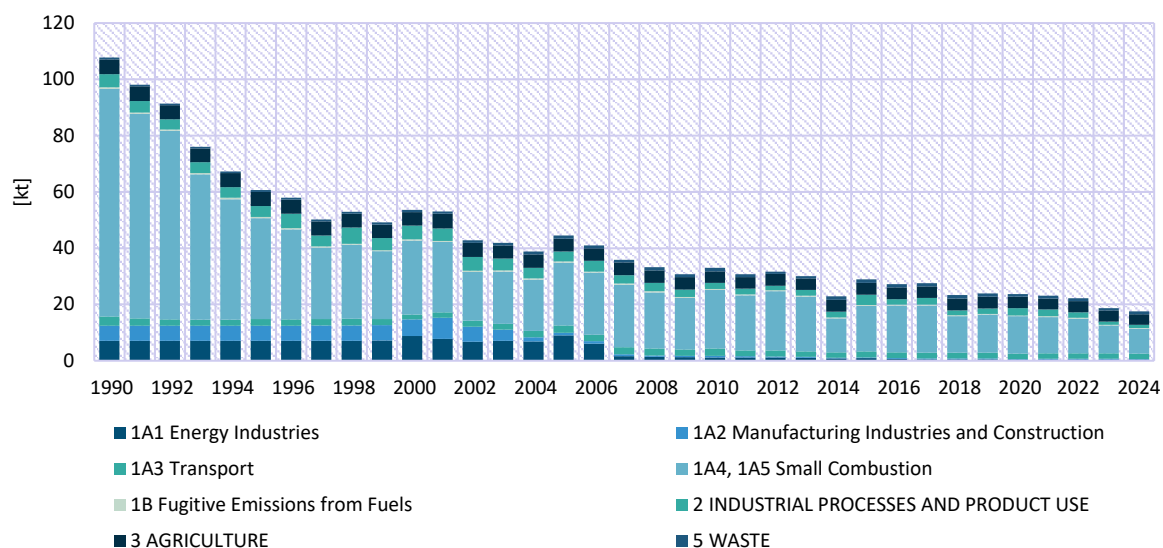
Figure 2.1.5: Total PM_{2.5} emissions by sectors



2.2 TRENDS IN EMISSIONS OF PM₁₀, BC AND CO

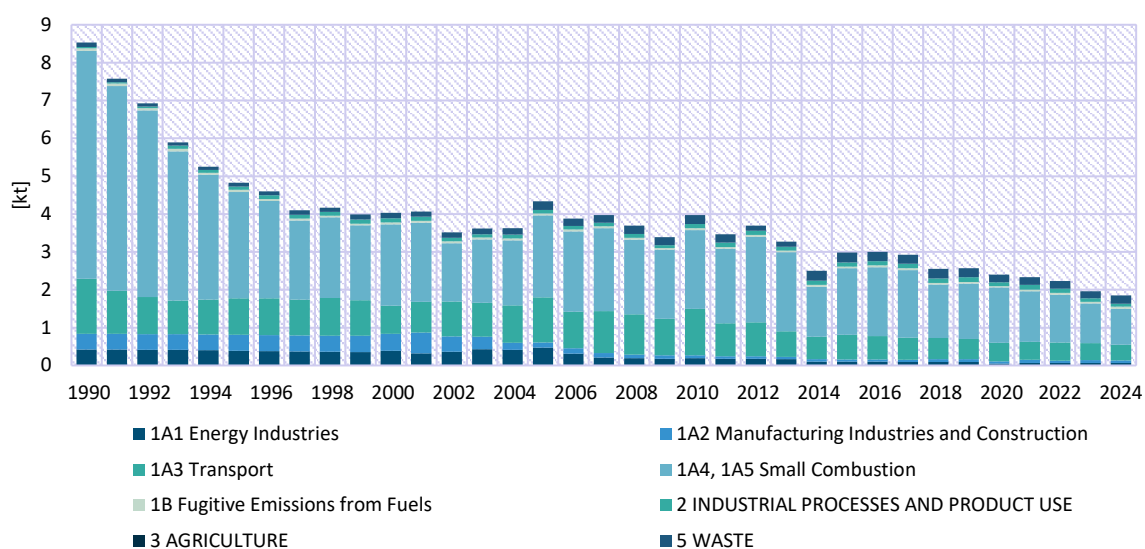
Similar to PM_{2.5}, emissions of PM₁₀ are strongly related to the category of Residential heating, which is the main contributor in the whole time series ([Figure 2.2.1](#)).

Figure 2.2.1: Total PM₁₀ emissions by sectors



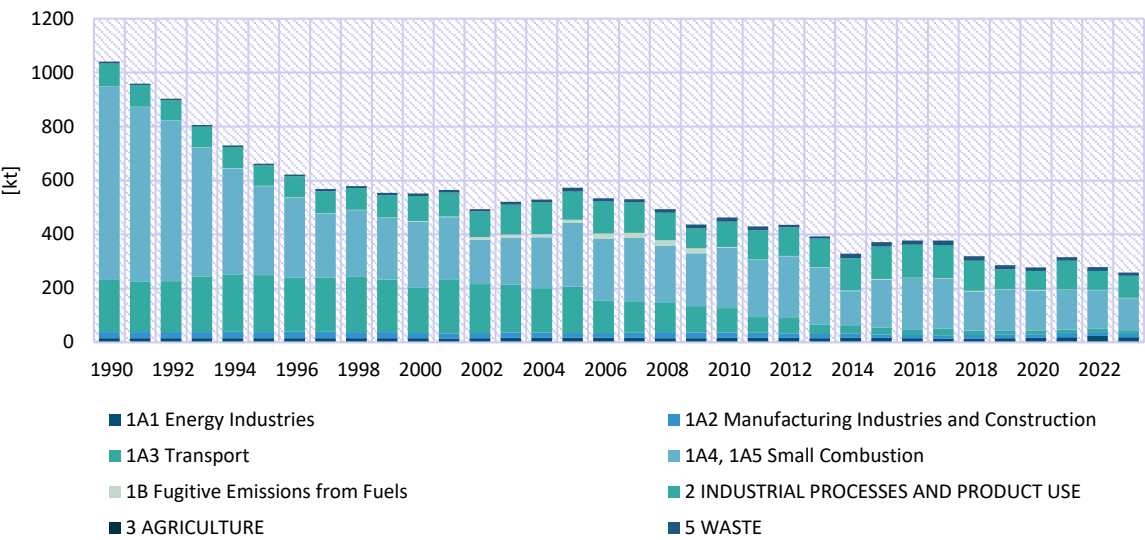
Emissions of BC decreased significantly in the period 1990-2000, and since then they have fluctuated slightly ([Figure 2.2.2](#)). These emissions originate mostly from Residential heating, but are emitted in Road transport, too.

Figure 2.2.2: Total BC emissions by sectors



CO emissions have had a stable decreasing trend with slight fluctuation in the last two decades (*Figure 2.2.3*). These emissions come especially from residential heating.

Figure 2.2.3: Total CO emissions by sectors



2.3 TRENDS IN EMISSIONS OF HEAVY METALS

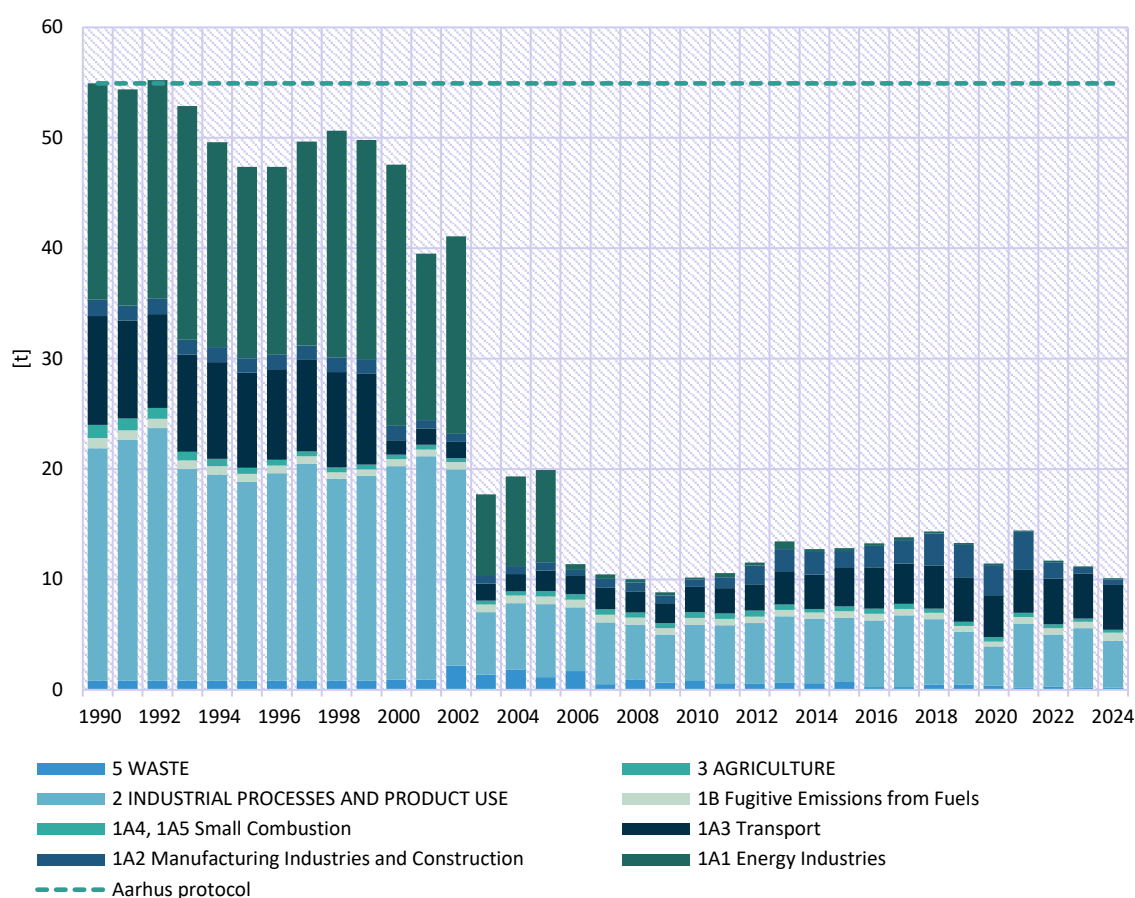
2.3.1 Trends in Emissions of Pb

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.

The Aarhus Protocol of CLRTAP on heavy metals (7) requires that parties not exceed their base year (1990) level of emitted heavy metals. The Slovak Republic's emissions did not exceed this level.

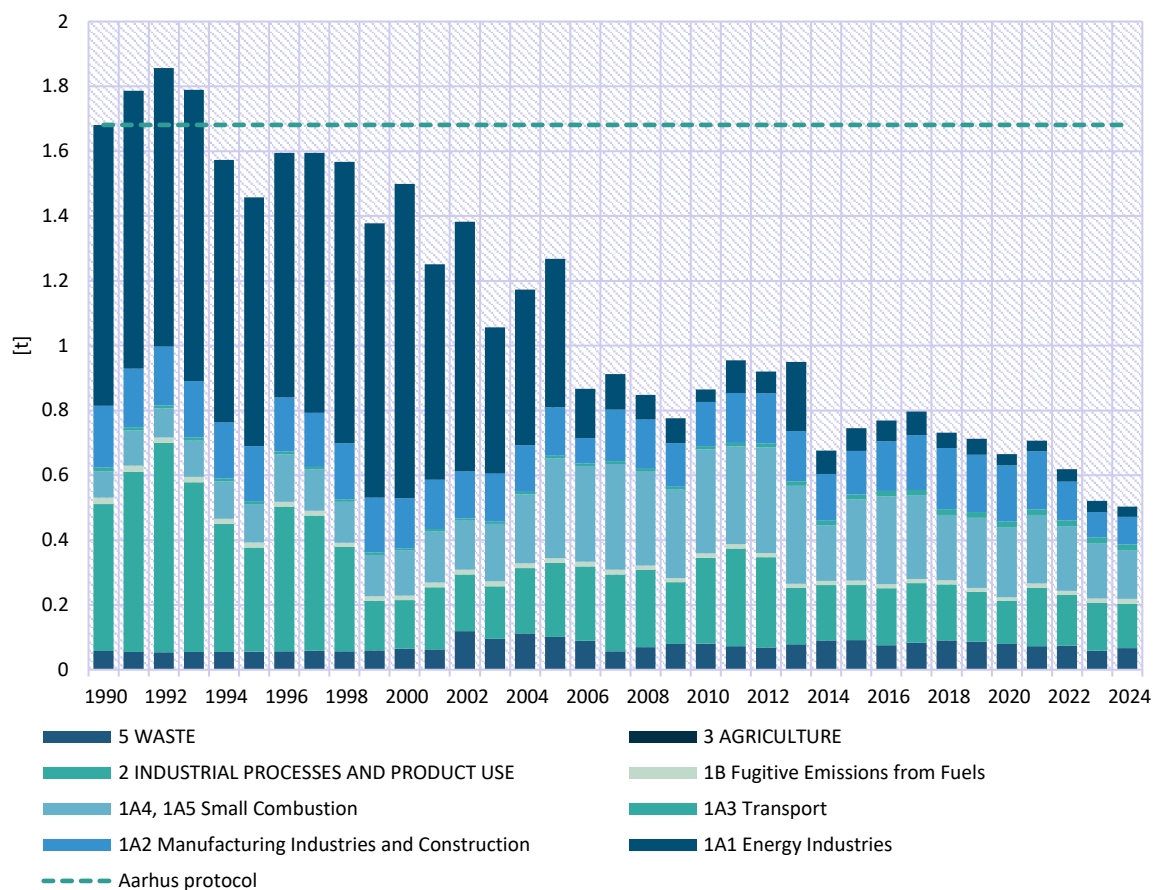
Figure 2.3.1: Total Pb emissions by sectors



2.3.2 Trends in Emissions of Cd

As shown in *Figure 2.3.2*, 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 have been household heating and the production of paper and pulp, which are both characteristic of the wide use of biomass as fuel.

Figure 2.3.2: Total Cd emissions by sectors



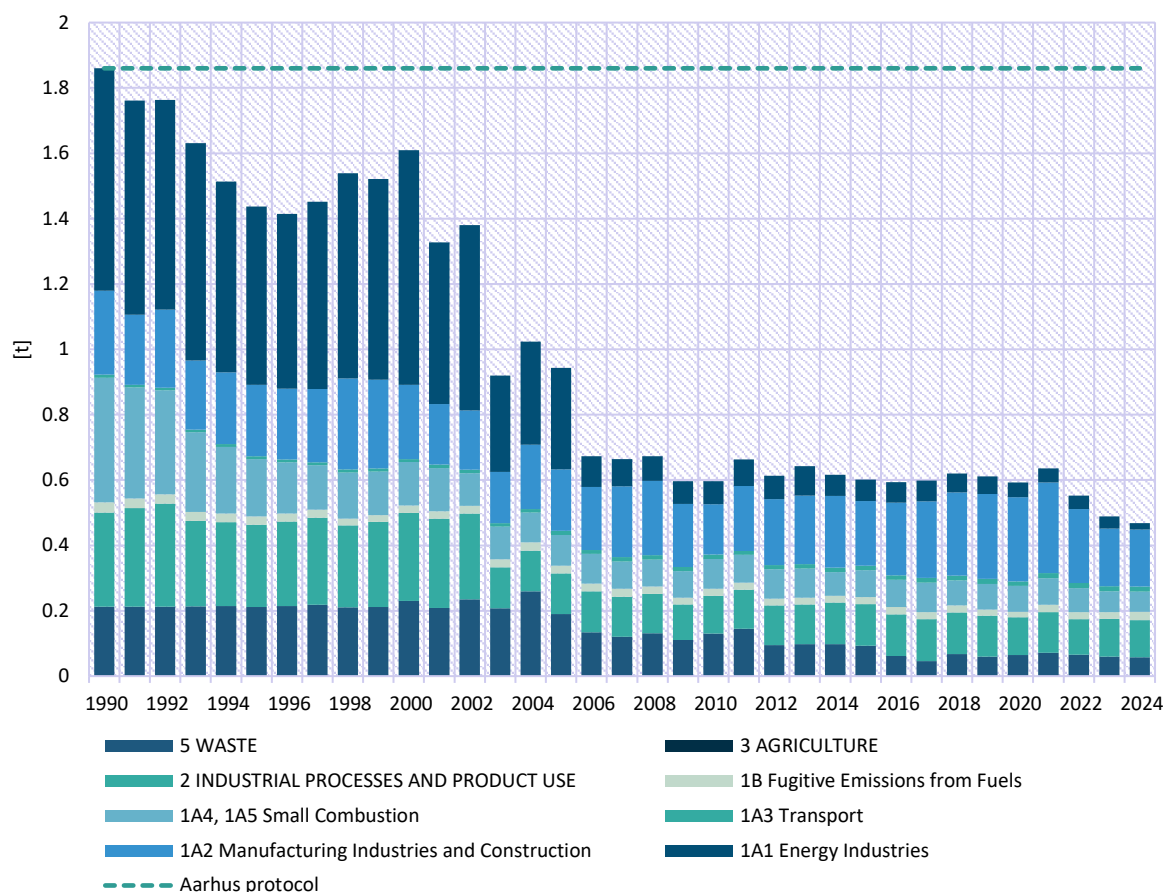
2.3.3 Trends in Emissions of Hg

The emissions trend of Hg is decreasing in general (*Figure 2.3.3*). 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 2.3.3: Total Hg emissions by sectors



2.4 TREND IN EMISSION OF POPS

The emission inventory of POPs (PCB, PCDD/F, PAHs – benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene and indeno(1,2,3-cd)pyrene) for the Slovak Republic is elaborated according to EMEP/EEA GB 2023 (8) and in compliance with requirements of the respect of the working group for emission inventory (UNECE Task Force on Emission Inventory).

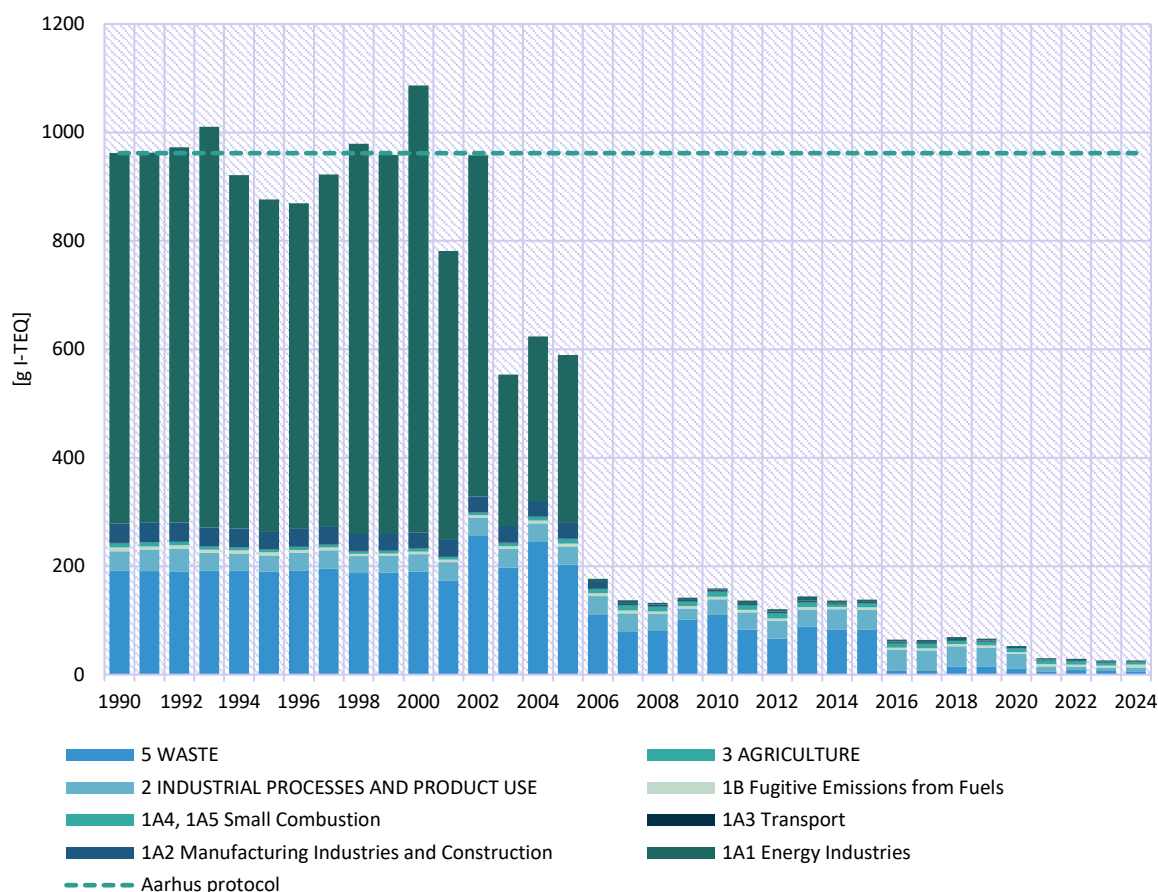
2.4.1 Trends in Emissions of PCDD/PCDF

Emissions of PCDD/F dropped in 2003 and 2006 due to technological improvements in facilities that combust municipal waste as a fuel to produce energy ([Figure 2.4.1](#)). Since 2006, emissions have shown a slightly increasing trend because of waste management policies in the Slovak Republic, which prefer combustion to landfilling waste.

In 2024, the main contributors were metal production (28%), Solid fuels transformation with their share of 21% and household heating with the share of 15%.

The Aarhus Protocol of CLRTAP on persistent organic pollutants (9) requires that parties not exceed their base year (1990) level of emitted heavy metals. The Slovak Republic's emissions have not exceeded this level since 2001.

Figure 2.4.1: Total PCDD/PCDF emissions by sectors

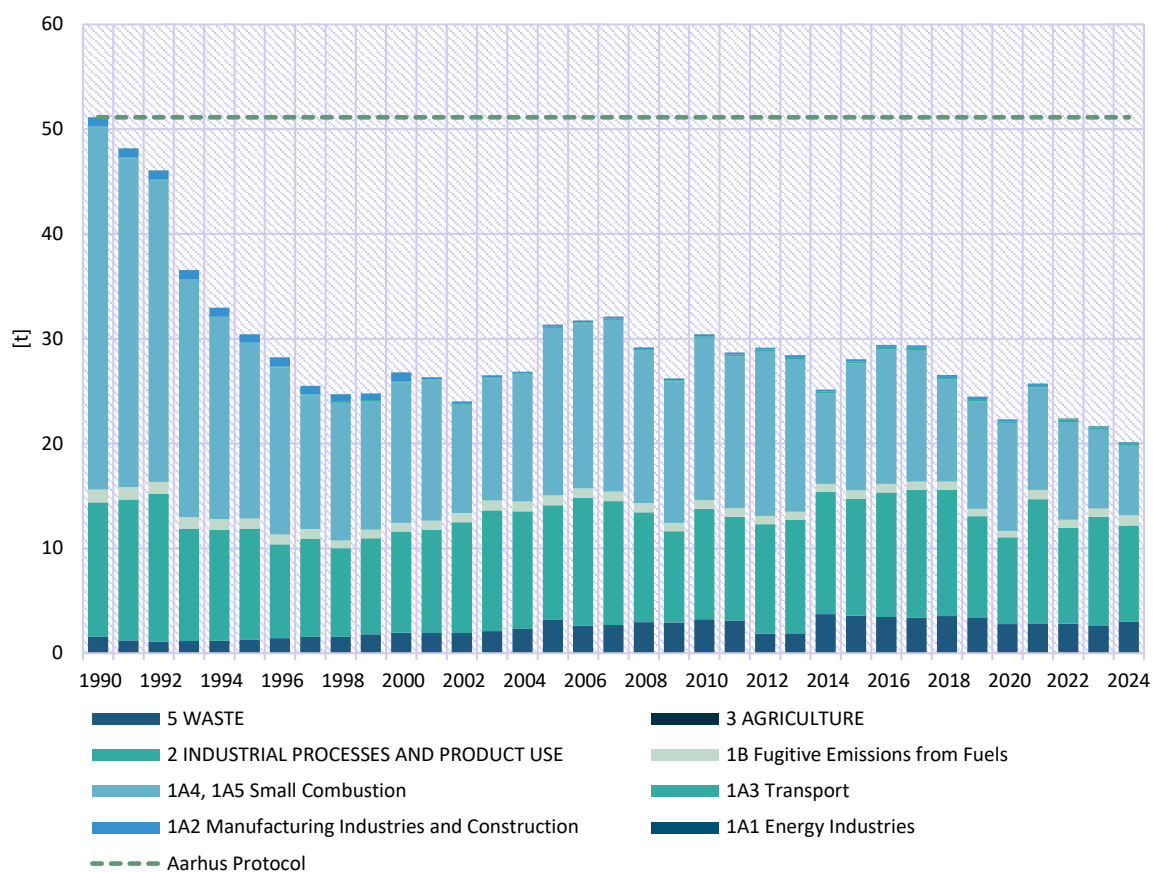


2.4.2 Trends in Emissions of PAHs

The decreasing trend of PAHs emissions is the most intensive in the period 1990-2000. Since then, these emissions have fluctuated slightly (Figure 2.4.2).

The emission of PAHs originated in the sector of metal production (45%) and households (33%) in 2024. No exceedances of the **Aarhus protocol** (9) were recorded.

Figure 2.4.2: Total PAHs emissions by sectors

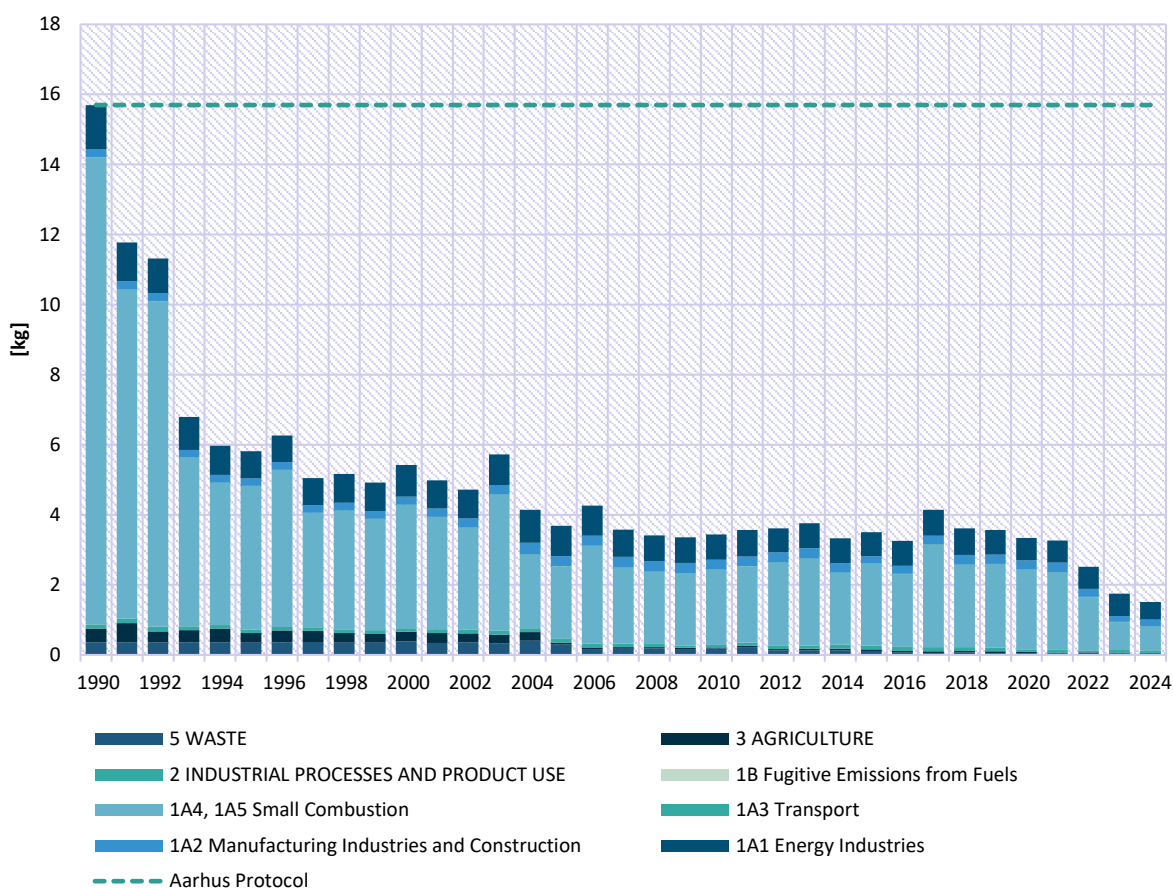


2.4.3 Trends in Emissions of HCB

Emissions of HCB are connected to household heating. *Figure 2.4.3* 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 household sector. 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** (9) were recorded.

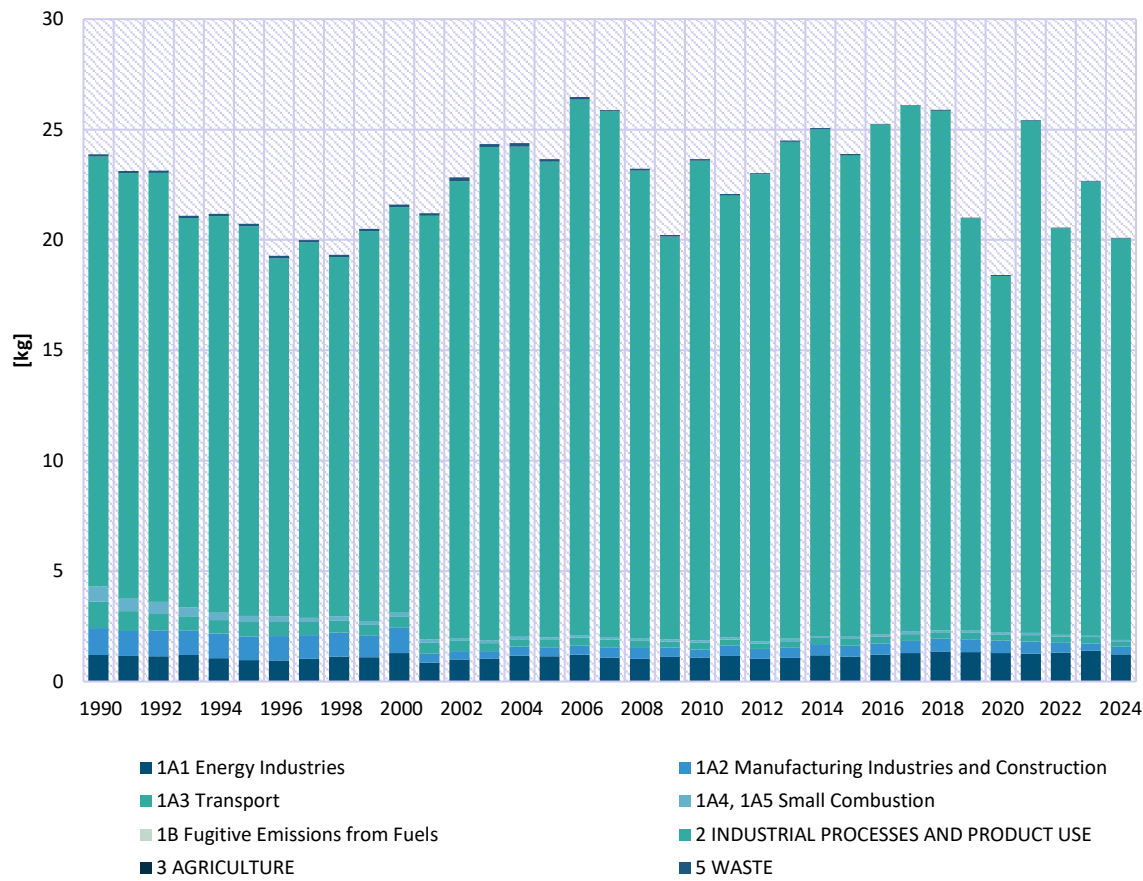
Figure 2.4.3: Total HCB emissions by sectors



2.4.4 Trends in Emissions of PCBs

Emissions of PCBs show a 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 2024 was 88% (Figure 2.4.4).

Figure 2.4.4: 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 (NH₃), total suspended particles (TSP, PM₁₀ and PM_{2.5} are consequently compiled) and carbon monoxide (CO). All data that comes from the database are considered as T3 methodology. In the year 2024, the system contained 13,552 large and medium sources.

b/ COPERT 5 model – this methodology is balancing fifteen different emissions, including greenhouse gases from road transport. All data that come from the model is considered as T3 methodology. A detailed description is provided in [Chapter 3.6.3 Road Transport](#).

c/ Estimations are 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 bound by 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](#) cover large and medium energy stationary sources of air pollution in the Slovak Republic.

Table 3.1.1: Overview of reported categories, Tier or notation key used in the energy sector

NFR	LONGNAME OF CATEGORY	METHODOLOGY/TIER					
		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	T2, NK	T2, 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, T2	T1, T2
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	T2	T2

NFR	LONGNAME OF CATEGORY	METHODOLOGY/TIER					
		NO _x , NMVOC, SO _x , CO	NH ₃	PM _{2.5} , PM ₁₀ , TSP	BC	HM	POPs
1A2gvii	Mobile combustion in manufacturing industries and construction (please specify in the IIR)	T1	T1	T1	T1	T1, NK	T1, NK
1A2gviii	Other (please specify in the IIR)	T3	T3	T3	T3	T2	T2
TRANSPORT							
1A3ai(i)	International aviation LTO (civil)	T3	T3	T3	T3	NK	NK
1A3aii(i)	Domestic aviation LTO (civil)	T3	T3	T3	T3	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	T1	T1	T1	T1	T1
1A3di(ii)	International inland waterways	T1, NK	T1, NK	T1, NK	T1, NK	T1, NK	T1, NK
1A3dii	National navigation (shipping)	T1	T1	T1	T1	T1	T1
1A3ei	Pipeline transport	T3	NK	T3	T3	NK	NK
1A3eii	Other (please specify in the IIR)	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 (mobile)	T1	T1	T1	T1	T1, NK	T1, NK
1A4ci	Agriculture/Forestry/Fishing: Stationary	T3	T1	T3	T3	T2	T2
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	T1, T2	T1	T1	T1	T1, NK	T1, NK
1A4ciii	Agriculture/Forestry/Fishing: 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 (including military, land based and recreational boats)	T1, NK	T1, NK	T1, NK	T1, NK	T1, NK	NK
FUGITIVE EMISSIONS							
1B1a	Fugitive emission from solid fuels: Coal mining and handling	T1, NK	NK	T1	NK	NK	NK
1B1b	Fugitive emission 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	Fugitive emissions oil: Exploration, production, transport	T1, NK	NK	NK	NK	NK	NK
1B2aiv	Fugitive emissions oil: Refining and storage	T1	NK	T1	NK	T1	T1, NK
1B2av	Distribution of oil products	T1, NK	NK	NK	NK	NK	NK
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	T1, NK	NK	NK	NK	NK	NK

NFR	LONGNAME OF CATEGORY	METHODOLOGY/TIER					
		NO _x , NMVOC, SO _x , CO	NH ₃	PM _{2.5} , PM ₁₀ , TSP	BC	HM	POPs
1B2c	Venting and flaring (oil, gas, combined oil and gas)	NK	NK	NK	NK	NK	NK
1B2d	Other fugitive emissions from energy production	T1, NK	NK	NK	NK	NK	NK

General methodological issues

In general, the methodology used to calculate emissions of HMs and POPs in the energy sector is followed with the newest EMEP/EEA GB, except for the categories **1A1a**, **1A2a**, **1A2d**, **1A2gviii**, **1A4ai**, **1A4ci** and **1A5a**, where the Czech country-specific methodology was used.

In the category **1A4bi**, 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 measurement at low and nominal heat ratings throughout the project *LIFE Integrated Project: Implementation of Air Quality Plan for Małopolska Region – Małopolska in a healthy atmosphere* (1). Emissions of the Main pollutants are taken from the NEIS database, where all the operators of large and medium sources report their annual emissions.

For the transport sector, the COPERT model was used to estimate road transport emissions.

3.2 TRENDS IN THE SECTOR ENERGY

Table 3.2.1 below shows an overall decreasing trend of emissions of the main pollutants since 1990 due to the strict air protection legislation. This, together with progress and advancements in pollutant removal systems, has led to a reduction in air pollutant emissions due to the transposition of European legislation, the continuous improvement of national legislation and the efforts of industry to implement BAT technologies (where investment is available). Categories of the energy sector are the key categories for most of the main pollutants, heavy metals and POPs. The most significant categories are **1A1a**, which is the key category for NO_x, SO_x, PM_{2.5}, PM₁₀, TSP, Pb, Cd, Hg, As, Ni, Se, PCDD/F, HCB and **1A4bi** is the key category for NO_x, SO_x, NMVOC, PM_{2.5}, PM₁₀, TSP, BC, CO, Cd, Hg, As, Cr, Ni, Zn, PCDD/F, PAHs, HCB and PCBs.

Table 3.2.1: Overview of emissions in the energy sector

YEAR	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	115.9995	179.1462	129.8438	0.2648	93.1573	97.1536	110.0795	8.3984	948.5171
1995	99.9972	105.2202	111.6195	0.3710	47.8288	51.1214	59.3662	4.6872	580.9085
2000	96.3175	87.1851	104.7169	0.6150	39.6983	43.0982	50.8061	3.8368	449.5526
2005	93.2256	87.0226	76.1362	0.9347	32.9173	35.2474	42.7842	4.1491	454.2587
2010	75.6564	75.0706	61.7126	0.8457	23.9287	25.5266	28.5005	3.7562	353.4863
2011	66.9527	68.5090	59.2765	0.7742	22.0000	23.5271	26.3414	3.2518	308.0055
2012	64.7098	71.7075	50.2692	0.7802	23.4019	24.9999	27.8876	3.4444	320.7742
2013	57.6063	66.0791	45.7950	0.8012	21.4954	23.1502	25.9868	3.0337	278.7414
2014	53.9533	47.4797	37.6786	0.6249	13.9866	15.3700	17.6387	2.1254	192.0720
2015	56.2388	58.3948	59.1509	0.7032	18.2611	19.8196	22.3795	2.6136	234.6220
2016	53.1267	60.0983	17.5267	0.8220	18.3831	19.9356	22.4169	2.6433	240.8365
2017	51.8320	59.3390	17.6599	0.7625	18.4108	19.8943	22.3608	2.5667	237.4976
2018	50.0940	49.9527	12.2353	0.7093	14.7272	16.1467	18.3965	2.1805	192.0035
2019	47.8007	51.1196	9.2064	0.7160	15.2223	16.6379	18.8770	2.2061	198.1864

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
2020	44.3167	48.9925	8.1983	0.6683	14.7583	16.0394	18.0219	2.0971	195.1770
2021	45.6898	47.6481	7.9184	0.7219	14.4285	15.7927	17.9317	2.0065	197.4929
2022	43.9502	47.3707	8.5424	0.7503	13.9018	15.2444	17.2950	1.9136	196.2330
2023	40.4451	41.6020	8.7935	0.7358	11.4772	12.7623	14.6258	1.6815	164.4850
2024	37.6427	38.7523	5.8507	0.6923	10.4054	11.6479	13.4657	1.5507	148.2433
1990/2024	-68%	-78%	-95%	161%	-89%	-88%	-88%	-82%	-84%
2023/2024	-7%	-7%	-33%	-6%	-9%	-9%	-8%	-8%	-10%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	33.0383	1.1695	1.3599	1.5865	4.7999	9.6567	8.0296	5.4944	19.6099
1995	28.5415	1.0802	0.9736	0.9728	2.7833	6.7360	3.2573	2.8418	12.5791
2000	27.3034	1.2838	1.1098	0.9374	2.3974	5.5157	1.5008	2.8746	11.5435
2005	12.1513	0.9383	0.6298	0.5091	2.5579	7.3825	1.3371	3.0077	14.1158
2010	4.2368	0.5195	0.3513	0.2784	2.2064	7.2211	1.3597	2.2678	12.8037
2011	4.7208	0.5812	0.3984	0.3163	2.2086	7.0340	1.3359	2.2336	12.9559
2012	5.4735	0.5731	0.3965	0.3060	2.1966	7.2348	1.1180	2.0911	13.0900
2013	6.7769	0.6977	0.4233	0.3832	3.0789	26.3902	1.2933	2.0134	18.1353
2014	6.3035	0.4153	0.3909	0.3202	2.5649	26.6187	1.1486	1.8150	15.2102
2015	6.3011	0.4840	0.3815	0.3236	2.9742	29.9293	1.3303	1.8480	17.6209
2016	7.0064	0.5178	0.4042	0.3381	3.0971	31.9837	1.3124	1.7183	18.5692
2017	7.0824	0.5295	0.4237	0.3551	3.0665	31.2767	1.2647	1.7358	18.6466
2018	7.9425	0.4680	0.4255	0.3484	2.9601	33.4593	1.1424	1.7012	18.1065
2019	8.0335	0.4727	0.4262	0.3461	2.9619	34.2549	1.1652	1.4840	18.2049
2020	7.4930	0.4519	0.4125	0.3297	2.7803	32.3112	1.0821	1.2340	16.9651
2021	8.4620	0.4546	0.4403	0.3515	2.8451	32.9310	1.1518	1.1428	17.5148
2022	6.6859	0.3888	0.3779	0.3094	2.8855	34.9839	1.1377	1.0742	17.6138
2023	5.5862	0.3144	0.3130	0.2570	2.6955	34.4440	1.0802	0.8978	16.4641
2024	5.6386	0.2996	0.2971	0.2507	2.6034	34.2547	1.0214	0.4443	16.0074
1990/2024	-83%	-74%	-78%	-84%	-46%	255%	-87%	-92%	-18%
2023/2024	1%	-5%	-5%	-2%	-3%	-1%	-5%	-51%	-3%

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	734.0293	13.6829	10.0305	5.8589	7.1814	36.7538	14.8239	4.2989
1995	656.2221	6.8669	5.1295	2.9702	3.5802	18.5469	5.0903	2.9663
2000	864.0987	5.5933	4.3049	2.3868	2.9048	15.1898	4.6580	3.1089
2005	353.0007	6.4057	4.8145	2.6400	3.3379	17.1982	3.2273	1.9957
2010	20.5430	6.1814	4.6774	2.5409	3.2339	16.6336	3.1496	1.8650
2011	21.6413	5.8031	4.4293	2.3879	3.0428	15.6631	3.2155	2.0046
2012	21.0048	6.2381	4.7520	2.5609	3.2812	16.8321	3.3523	1.8278
2013	23.7913	5.7823	4.4560	2.3802	3.0521	15.6705	3.4885	1.9468
2014	16.0867	3.5378	2.8482	1.4930	1.8726	9.7515	3.0324	2.0518
2015	18.5949	4.8593	3.8295	2.0279	2.5872	13.3039	3.2306	2.0315
2016	19.1385	5.1285	4.0304	2.1583	2.7438	14.0609	3.0269	2.1499
2017	19.3113	4.9720	4.0054	2.0837	2.7075	13.7686	3.9283	2.2637
2018	17.0382	3.9151	3.2224	1.6702	2.1512	10.9589	3.3846	2.3232
2019	16.2793	4.0670	3.3302	1.7276	2.2505	11.3752	3.3614	2.3046
2020	14.4828	4.0178	3.2674	1.6918	2.2388	11.2158	3.1751	2.2130
2021	15.5160	3.9053	3.2371	1.6779	2.1775	10.9977	3.1063	2.1980

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]
2022	14.6720	3.6959	3.0452	1.5993	2.0805	10.4209	2.3810	2.1220
2023	13.6087	3.0535	2.5175	1.3380	1.7072	8.6162	1.6066	2.0783
2024	12.8087	2.7906	2.3404	1.2448	1.5509	7.9267	1.3832	1.8884
1990/2024	-98%	-80%	-77%	-79%	-78%	-78%	-91%	-56%
2023/2024	-6%	-9%	-7%	-7%	-9%	-8%	-14%	-9%

Shares of categories in emissions of individual pollutants in the energy sector are shown in [Figure 3.1.1](#) below. Transport categories are the main contributor to NO_x emissions, especially category **1A3bi** (Passenger cars), with a share of 27% of emissions in the energy sector in 2024 ([Figure 3.1.1](#)). Emissions in these categories decrease slowly.

Emissions of NMVOC are emitted mostly by the category **1A4bi** (Residential: Stationary). In 2024, it was almost 51% of all NMVOC emissions in the energy sector ([Figure 3.1.1](#)) and 26% of the total emissions of this pollutant. Emission is relatively stable, with only slight fluctuation since 2005.

SO_x emissions are mainly emitted by category **1A1b** (32% in 2024) in the energy sector ([Figure 3.1.1](#)). Residential heating is the main contributor to emissions of PM_{2.5}, PM₁₀ and TSP. From [Table 3.2.1](#) is clear that emissions of PM_{2.5} (the trend for PM₁₀ and TSP is very similar) show a decreasing trend since 1990, although since 2005 emissions in this category are relatively stable. In 2024, this category contributed almost 79% of total emissions of PM_{2.5} in the energy sector ([Figure 3.1.1](#)). CO emissions are emitted mostly by residential heating and road transport ([Figure 3.1.1](#)).

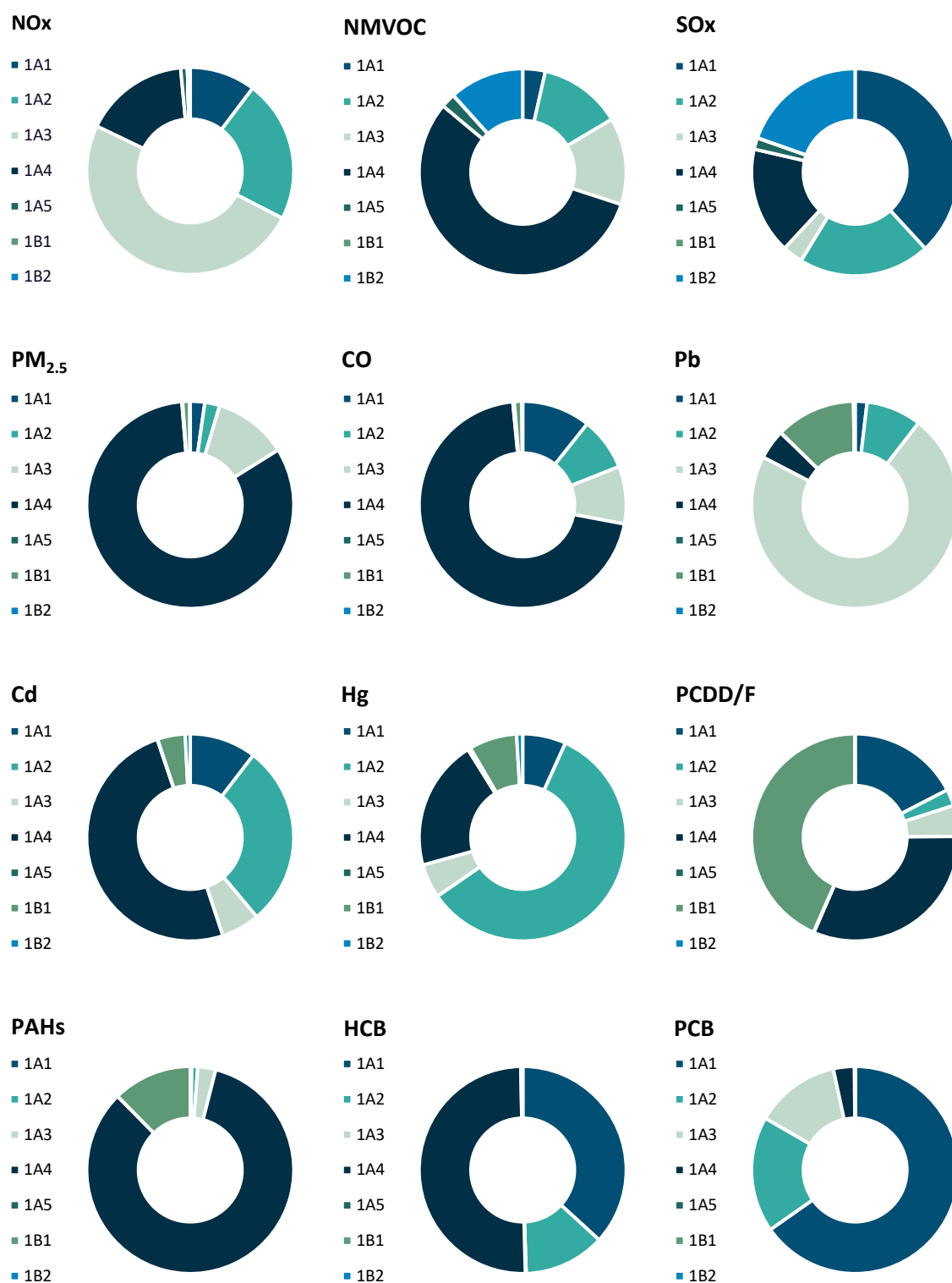
Until 2005, the main contributor to emissions of Pb was the incineration of municipal waste with energy recovery allocated in category **1A1a**. Reconstruction of both MSW incineration plants led to a significant decrease in emissions. The decrease in Pb emission from road transport in 2000 was caused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

Emissions of Cd decreased only slightly in this sector since 1990. Like Pb emissions, MSW incineration plants contributed significantly to their emissions until 2005 ([Table 3.2.1](#)). Since then, combustion activities in iron and steel production and household heating have become important.

The number 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 3.1.1](#)). In 2024, almost 65% 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 3.1.1](#)).

Figure 3.1.1: Shares of categories in emissions of individual pollutants in 2024 – energy sector



3.3 RECALCULATIONS, IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

The energy sector is undergoing continuous improvement. In the 2026 submission, an updated COPERT model was implemented. Furthermore, a new time series was introduced for category **1A3bvi**, following recommendations **SK-1A3bvi-2025-0001** and **SK-1A3bvi-2025-0002**. Activity data were also included in the IIR 2026 in accordance with recommendation **SK-1A3c-2025-0001**, while a Tier 2 methodology for NO_x emissions was introduced for category **1A4cii** (recommendation **SK-1A4cii-2025-0001**). A detailed analysis of the allocation of sources to NFR categories across the entire NEIS database is planned for the next period, as it has been identified that certain sources may currently be incorrectly allocated.

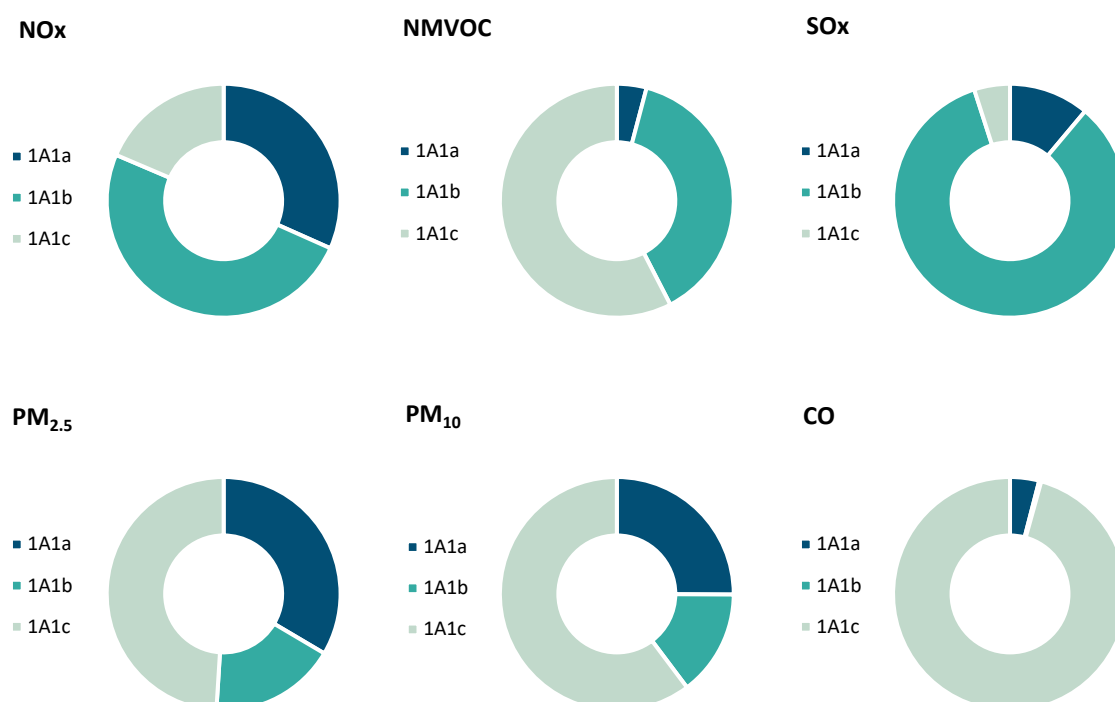
3.4 ENERGY INDUSTRIES (NFR 1A1)

3.4.1 Overview

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. Category **1A1a**, which also includes municipal waste incineration with energy utilisation, contributes to most of the main pollutants, heavy metals and POPs. Shares of emissions of main pollutants in individual subcategories are shown in **Figure 3.4.1**.

Figure 3.4.1: Shares of main pollutants emissions in categories of 1A1 in 2024



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 3.4.1](#).

This category includes the power installations for electricity and heat production 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 3.4.1: Activities according to national categorisation included in category 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 NO_x, SO_x, PM_{2.5}, PM₁₀, TSP, Pb, Cd, Hg, As, Ni, Se, PCDD/F and HCB. From the emission data are a visible increase in 2015 and a drop in 2016, the most significant in SO_x. 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 the 2016 emissions.

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 increase in PM_{2.5} emissions in 2005 was caused by a single source (Elektrárň Vojany). As mentioned in their annual report, in 2005, the trend of gradual reduction of emissions of basic pollutants into the air, which was the result of increased use of reconstructed fluid combustion boilers and reliable operation of flue gas cleaning technologies, stopped. In this period, it prevailed in SE, a. s., by trying to use the remaining life of equipment which, in accordance with the air protection legislation of the Slovak Republic, could continue to be operated in the mode of exceeding the established emission limits during that period. The increased deployment of units 3 and 4 at Elektrárne Vojany in 2005 led to an increase in the absolute amount of PM_{2.5} released into the air. Mitigation of these negative phenomena in SE conditions occurred only after 2006 and subsequently after 2010, when the Slovak air protection legislation no longer permitted the operation of the mentioned facilities due to non-compliance with the prescribed emission limits for the release of harmful substances into the air ([Recommendation No SK-1A1a-2024-0001](#)).

The emission data of air pollutants are presented in [Table 3.4.2](#). The emissions originating from MSW incineration with energy utilisation are described in [Chapter 6.6.2](#).

Table 3.4.2: Overview of emissions in category 1A1a

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [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	0.1747	2.6616
1995	20.9769	0.1708	60.9819	NO	5.1254	6.1524	8.1609	0.1449	2.6759
2000	26.3778	0.1559	58.8624	NO	6.3197	7.5860	10.0625	0.1322	2.6729
2005	15.2963	0.1529	51.9931	NO	7.2630	7.8104	11.7351	0.1485	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	1.5E-02	0.4611	0.5645	0.7051	0.0139	1.6742
2016	4.2010	0.1530	9.2366	2.0E-02	0.2072	0.2494	0.3018	0.0062	2.1715
2017	3.8701	0.1504	8.6485	1.9E-02	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
2019	3.3581	0.1324	2.3546	9.6E-06	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
2023	2.1764	0.0978	2.3200	NO	0.1244	0.1340	0.1496	0.0039	1.7094
2024	1.2273	0.0562	0.2481	NO	0.0789	0.0805	0.0819	0.0025	0.6390
1990/2024	-94%	-67%	-100%	-	-98%	-99%	-99%	-99%	-76%
2023/2024	-44%	-43%	-89%	-	-37%	-40%	-45%	-35%	-63%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	18.9513	0.6584	0.6509	0.5422	1.0013	0.6171	5.5355	4.6181	6.7499
1995	16.6790	0.5588	0.5157	0.3991	0.4713	0.2721	1.4589	2.1537	2.8348
2000	22.9953	0.7615	0.6881	0.5160	0.4903	0.2667	0.4823	2.2348	2.6416
2005	7.7642	0.2657	0.2837	0.2045	0.4864	0.2660	0.4435	2.3404	2.6423
2010	0.0904	0.0144	0.0678	0.0410	0.3752	0.1703	0.3383	1.8462	1.6851
2011	0.0907	0.0145	0.0684	0.0418	0.3676	0.1565	0.3226	1.8071	1.5465
2012	0.0841	0.0134	0.0633	0.0390	0.3353	0.1578	0.3288	1.6487	1.5684
2013	0.0812	0.0129	0.0613	0.0372	0.3180	0.1383	0.2721	1.5634	1.3682
2014	0.0755	0.0124	0.0567	0.0333	0.2871	0.1292	0.2226	1.4090	1.2752
2015	0.0775	0.0125	0.0581	0.0347	0.2909	0.1193	0.2266	1.4277	1.1770
2016	0.0735	0.0122	0.0550	0.0326	0.2775	0.1285	0.2385	1.3603	1.2718
2017	0.0722	0.0121	0.0548	0.0313	0.2792	0.1428	0.2013	1.3706	1.4089
2018	0.0695	0.0119	0.0531	0.0300	0.2655	0.1466	0.1905	1.3020	1.4461
2019	0.0630	0.0111	0.0485	0.0285	0.2263	0.0993	0.1650	1.1049	0.9771
2020	0.0536	0.0098	0.0418	0.0251	0.1802	0.0616	0.1259	0.8751	0.6074
2021	0.0491	0.0090	0.0395	0.0235	0.1591	0.0818	0.1133	0.7734	0.8162
2022	0.0478	0.0090	0.0367	0.0213	0.1491	0.0624	0.1172	0.7207	0.6260
2023	0.0435	0.0087	0.0335	0.0195	0.1265	0.0437	0.0997	0.6065	0.4308
2024	0.0198	0.0051	0.0164	0.0092	0.0303	0.0281	0.0264	0.1335	0.2894
1990/2024	-100%	-99%	-97%	-98%	-97%	-95%	-100%	-97%	-96%
2023/2024	-54%	-41%	-51%	-53%	-76%	-36%	-74%	-78%	-33%

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	628.9964	0.0014	0.0017	0.0012	0.0007	0.0050	1.1944	1.1419

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]
1995	557.8771	0.0010	0.0010	0.0008	0.0003	0.0031	0.7103	0.9188
2000	770.9188	0.0012	0.0012	0.0010	0.0003	0.0037	0.8488	1.2311
2005	258.4235	0.0011	0.0011	0.0009	0.0003	0.0035	0.8142	1.0903
2010	0.8329	0.0011	0.0013	0.0010	0.0003	0.0038	0.7171	1.0763
2011	0.8801	0.0012	0.0014	0.0011	0.0003	0.0040	0.7330	1.1414
2012	0.7982	0.0011	0.0015	0.0010	0.0003	0.0040	0.6690	1.0135
2013	0.7983	0.0011	0.0015	0.0011	0.0003	0.0041	0.6542	1.0173
2014	0.8932	0.0013	0.0016	0.0011	0.0003	0.0043	0.6907	1.1737
2015	0.8607	0.0012	0.0016	0.0011	0.0004	0.0044	0.6697	1.1170
2016	0.9042	0.0013	0.0016	0.0011	0.0003	0.0043	0.6914	1.1965
2017	0.9550	0.0013	0.0016	0.0012	0.0003	0.0043	0.7273	1.2760
2018	1.0025	0.0014	0.0016	0.0012	0.0003	0.0045	0.7476	1.3467
2019	0.9803	0.0013	0.0016	0.0012	0.0003	0.0044	0.6959	1.3289
2020	0.9331	0.0013	0.0015	0.0011	0.0003	0.0041	0.6308	1.2774
2021	0.9303	0.0013	0.0016	0.0012	0.0003	0.0044	0.6221	1.2550
2022	0.9443	0.0013	0.0016	0.0011	0.0003	0.0043	0.6222	1.2985
2023	0.9859	0.0013	0.0015	0.0012	0.0002	0.0043	0.6281	1.3772
2024	0.8595	0.0011	0.0013	0.0010	0.0001	0.0035	0.5012	1.2248
1990/2024	-100%	-16%	-26%	-20%	-79%	-29%	-58%	7%
2023/2024	-13%	-15%	-17%	-16%	-36%	-17%	-20%	-11%

The overview of activity data (energy consumption) for this source category is in [Table 3.4.3](#) below. Incineration of MSW is included in biomass (biomass fraction) or other fuels (non-biomass fraction).

Table 3.4.3: Overview of activity data in 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
2023	83.07	14,660.30	17,945.07	4,105.70	2,415.19
2024	1.42	3,951.31	21,483.01	3,280.98	2,179.07
1990/2024	-100%	-94%	-41%	-	-
2023/2024	-98%	-73%	20%	-20%	-10%

3.4.2.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024.

The historical data (1990-1999) are not covered by the NEIS; therefore, the emission factors used for the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.4.4](#)).

Emissions of NH₃ are recorded only for the last four years. Emission presence is linked with the usage of DENOX abatement technologies.

Table 3.4.4: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NOx	[g/tGJ]	201.00
NMVOC	[g/tGJ]	1.64
SOx	[g/tGJ]	584.32
TSP	[g/tGJ]	78.20
PM _{2.5}	[% of TSP]	62.80%
PM ₁₀	[% of TSP]	75.39%
CO	[g/tGJ]	25.64

The methodology for calculating BC, heavy metals, and POPs is described in [Annex X](#). [Table 3.4.5](#) shows the distribution of fuels to the subsequent categories used in the methodology.

Table 3.4.5: Fuel consumption in TJ in category 1A1a

TYPE OF FUEL	LIQUID FUELS					HARD COAL		
TYPE OF BOILER	ALL TYPE OF BOILERS				STATIONERY ENGINES	FLUIDIZED BED BOILERS		
THERMAL CAPACITY [MW]	<5	5-50	50-100	>100	-	5-50	50-100	>100
1990	-	-	8,590.93	10,944.81	0.80	748.27	4,281.75	41,490.44
1991	-	-	6,753.96	8,604.53	0.63	615.96	3,524.65	34,154.11
1992	-	-	5,205.87	6,632.26	0.48	513.35	2,937.51	28,464.67
1993	-	-	3,922.66	4,997.45	0.36	437.05	2,500.87	24,233.65
1994	-	-	2,879.88	3,668.96	0.27	383.78	2,196.06	21,279.96
1995	-	-	2,053.12	2,615.67	0.19	350.28	2,004.37	19,422.51
1996	-	-	1,417.94	1,806.44	0.13	345.70	1,978.14	19,168.32
1997	-	-	949.89	1,210.15	0.09	335.74	1,921.15	18,616.06
1998	-	-	624.54	795.67	0.06	335.75	1,921.22	18,616.78
1999	-	-	417.47	531.86	0.04	348.67	1,995.18	19,333.46
2000	-	-	338.70	431.50	0.03	364.74	2,087.09	20,224.08
2001	-	-	233.99	298.10	0.02	422.28	2,416.36	23,414.66
2002	-	-	207.54	264.40	0.02	393.99	2,254.47	21,845.94
2003	-	-	314.13	400.21	0.03	427.26	2,444.87	23,691.00
2004	-	-	349.39	445.12	0.03	433.33	2,479.62	24,027.72
2005	-	-	274.49	349.70	0.03	382.11	2,186.52	21,187.55
2006	-	-	210.12	267.69	0.02	352.53	2,017.25	19,547.26
2007	-	-	136.94	174.46	0.01	329.08	1,883.05	18,246.87

TYPE OF FUEL	LIQUID FUELS					HARD COAL		
TYPE OF BOILER	ALL TYPE OF BOILERS				STATIONERY ENGINES	FLUIDIZED BED BOILERS		
THERMAL CAPACITY [MW]	<5	5-50	50-100	>100	-	5-50	50-100	>100
2008	-	-	145.72	185.64	0.01	313.42	1,793.43	17,378.47
2009	-	-	155.78	198.46	0.01	275.12	1,574.30	15,255.11
2010	-	-	169.76	301.31	0.02	174.56	1,411.86	12,762.49
2011	-	-	164.45	265.71	0.59	209.40	1,580.63	11,019.91
2012	-	-	169.33	352.38	0.72	175.43	1,856.86	11,354.14
2013	-	-	123.37	218.65	1.38	96.56	2,900.82	8,412.35
2014	-	-	85.77	123.52	0.99	39.11	1,685.29	8,985.77
2015	-	-	61.91	161.91	1.70	42.37	2,917.63	6,567.10
2016	-	0.35	96.81	193.89	0.50	21.59	761.39	9,904.90
2017	-	0.07	22.84	108.53	0.99	53.28	2,380.31	9,958.62
2018	-	0.02	23.64	88.51	0.42	21.84	542.48	12,392.55
2019	-	0.03	12.70	101.53	0.33	-	523.97	7,394.06
2020	-	0.04	15.69	56.24	0.19	-	465.89	3,662.91
2021	-	1.28	1.58	52.45	1.51	-	151.31	6,634.19
2022	0.23	0.02	9.17	89.29	0.39	-	200.52	4,375.11
2023	-	0.00	-	82.69	0.37	-	2.66	2,622.82
2024	-	0.00	-	-	1.43	-	8.06	2,191.34

TYPE OF FUEL	BROWN COAL				GASEOUS FUELS			
TYPE OF BOILER	FLUIDIZED BED BOILERS				ALL TYPE OF BOILERS			
THERMAL CAPACITY [MW]	<5	5-50	50-100	>100	<5	5-50	50-100	>100
1990	-	2,246.52	7,009.80	68,643.23	324.32	1,861.08	1,998.83	3,239.67
1991	-	1,849.29	5,770.33	56,505.75	313.56	1,799.33	1,932.51	3,132.18
1992	-	1,541.24	4,809.10	47,092.94	343.40	1,970.55	2,116.40	3,430.23
1993	-	1,312.15	4,094.27	40,092.99	370.40	2,125.54	2,282.86	3,700.02
1994	-	1,152.22	3,595.24	35,206.30	359.83	2,064.83	2,217.66	3,594.34
1995	-	1,051.64	3,281.43	32,133.28	414.68	2,379.61	2,555.73	4,142.30
1996	-	1,037.88	3,238.48	31,712.74	431.32	2,475.09	2,658.28	4,308.51
1997	-	1,007.98	3,145.18	30,799.06	443.87	2,547.14	2,735.67	4,433.93
1998	-	1,008.02	3,145.30	30,800.26	452.03	2,593.95	2,785.94	4,515.41
1999	-	1,046.82	3,266.38	31,985.95	455.48	2,613.73	2,807.18	4,549.83
2000	-	1,095.05	3,416.86	33,459.43	497.83	2,856.77	3,068.22	4,972.92
2001	-	1,267.80	3,955.90	38,738.02	518.30	2,974.24	3,194.37	5,177.39
2002	-	1,182.86	3,690.87	36,142.68	476.98	2,737.14	2,939.72	4,764.66
2003	-	1,282.76	4,002.59	39,195.21	465.27	2,669.92	2,867.53	4,647.65
2004	-	1,301.00	4,059.48	39,752.30	445.76	2,557.98	2,747.30	4,452.79
2005	-	1,147.21	3,579.63	35,053.41	403.46	2,315.21	2,486.56	4,030.19
2006	-	1,058.40	3,302.51	32,339.66	364.31	2,090.57	2,245.30	3,639.15
2007	-	987.99	3,082.81	30,188.26	310.57	1,782.19	1,914.10	3,102.34
2008	-	940.97	2,936.09	28,751.54	363.14	2,083.86	2,238.09	3,627.47
2009	-	826.00	2,577.35	25,238.59	309.22	1,774.41	1,905.74	3,088.80
2010	-	594.83	1,052.04	31,958.70	315.74	1,943.72	2,261.41	3,507.28
2011	-	96.64	1,073.51	32,347.13	307.86	1,448.98	1,976.83	2,922.48
2012	-	40.12	262.55	29,398.79	319.10	1,156.11	2,047.65	3,339.04

TYPE OF FUEL	BROWN COAL				GASEOUS FUELS			
TYPE OF BOILER	FLUIDIZED BED BOILERS				ALL TYPE OF BOILERS			
THERMAL CAPACITY [MW]	<5	5-50	50-100	>100	<5	5-50	50-100	>100
2013	-	24.46	246.68	28,550.85	297.59	1,226.83	1,913.78	2,705.40
2014	-	2.97	404.35	25,340.77	1.26	797.94	3,908.07	2,141.55
2015	-	-	356.23	26,411.44	106.25	884.56	4,346.93	2,637.88
2016	-	-	-	24,673.84	94.10	878.49	4,004.44	2,034.84
2017	-	-	252.80	23,782.74	4.62	640.73	2,699.36	2,179.34
2018	-	-	271.86	21,947.08	1.09	691.72	2,890.84	1,860.69
2019	-	-	66.66	20,345.31	1.05	726.21	2,551.13	1,518.85
2020	-	22.62	133.67	17,080.82	0.87	657.20	3,071.32	1,277.38
2021	1.15	21.14	959.52	12,631.32	6.81	1,045.62	3,766.61	2,156.40
2022	-	-	1,005.76	12,560.45	11.69	1,073.80	3,192.96	2,064.89
2023	-	-	283.55	11,751.27	3.14	1,674.10	1,544.73	2,002.78
2024	-	-	-	1,751.91	1.71	1,593.05	1,224.64	2,389.15

TYPE OF BOILER	GASEOUS FUELS		BIOMASS			
TYPE OF FUEL	GAS TURBINES	STATIONERY ENGINES	FLUIDIZED BED BOILERS			
THERMAL CAPACITY [MW]	-	-	<5	5-50	50-100	>100
1990	12,136.24	-	12.23	68.93	62.87	157.34
1991	11,733.57	-	12.21	68.86	62.81	157.18
1992	12,850.10	-	12.55	70.76	64.54	161.50
1993	13,860.78	-	13.55	76.39	69.67	174.36
1994	13,464.90	-	11.57	65.23	59.50	148.89
1995	15,517.60	-	10.92	61.59	56.17	140.57
1996	16,140.25	-	10.57	59.60	54.36	136.03
1997	16,610.08	-	11.64	65.65	59.88	149.85
1998	16,915.34	-	13.06	73.60	67.13	168.00
1999	17,044.29	-	12.80	72.13	65.79	164.65
2000	18,629.22	-	15.46	87.15	79.49	198.93
2001	19,395.22	-	9.76	54.99	50.16	125.53
2002	17,849.06	-	11.81	66.56	60.71	151.92
2003	17,410.72	-	12.24	69.03	62.96	157.56
2004	16,680.76	-	14.55	82.03	74.82	187.23
2005	15,097.63	-	16.46	92.79	84.63	211.79
2006	13,632.74	-	18.95	106.85	97.46	243.90
2007	11,621.77	-	25.77	145.29	132.52	331.62
2008	13,588.98	-	26.66	150.30	137.09	343.07
2009	11,571.06	-	47.69	268.87	245.23	613.70
2010	12,307.23	-	55.01	361.28	761.37	1,193.91
2011	18,761.47	-	44.90	306.14	814.07	1,690.82
2012	16,053.92	-	44.38	257.08	985.90	2,545.32
2013	13,341.84	-	45.32	196.51	996.86	3,069.56
2014	5,573.70	19.54	37.89	80.62	1,641.49	2,756.71
2015	5,762.76	53.35	34.90	32.17	1,716.68	3,207.71
2016	6,152.88	64.52	27.57	-	1,720.51	2,519.83
2017	8,081.93	65.45	31.60	-	1,951.19	1,891.75

TYPE OF BOILER	GASEOUS FUELS		BIOMASS			
TYPE OF FUEL	GAS TURBINES	STATIONERY ENGINES	FLUIDIZED BED BOILERS			
THERMAL CAPACITY [MW]	-	-	<5	5-50	50-100	>100
2018	9,123.74	7.07	-	-	2,185.47	1,949.39
2019	16,731.48	422.69	-	-	2,061.46	1,934.10
2020	19,359.50	2,417.12	-	152.81	2,205.48	1,359.96
2021	22,660.54	3,066.72	-	340.84	4,123.34	328.33
2022	7,421.48	4,343.45	-	1,012.81	3,255.22	187.84
2023	11,213.20	1,507.13	-	450.03	3,246.08	405.48
2024	13,639.58	2,630.94	-	375.33	2,259.76	642.06

3.4.2.3 Completeness

Emissions are well covered. Ammonia emissions in this category do not occur until 2014, and then in 2018 and 2024.

3.4.2.4 Source-specific Recalculations

No recalculations were made in this submission.

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, 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 Slovakia'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 industrial waste incineration as well. Activities listed within this category are shown in **Table 3.4.6**.

Table 3.4.6: Activities according to national categorisation included in category 1A1b

CATEGORISATION 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 3.4.7**.

Table 3.4.7: Overview of emissions in category 1A1b

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [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

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
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
2023	2.0128	0.5182	2.2833	0.0124	0.0647	0.0708	0.0711	0.0119	0.0515
2024	1.9276	0.5238	1.8738	0.0028	0.0412	0.0471	0.0474	0.0076	0.0468
1990/2024	-49%	-74%	-83%	-88%	-82%	-81%	-81%	-82%	-91%
2023/2024	-4%	1%	-18%	-78%	-36%	-33%	-33%	-36%	-9%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.6502	0.2081	0.0299	0.0611	0.1820	0.5201	0.1040	0.0020	0.8582
1995	0.6512	0.2084	0.0300	0.0612	0.1823	0.5210	0.1042	0.0020	0.8596
2000	0.6506	0.2082	0.0299	0.0612	0.1822	0.5204	0.1041	0.0020	0.8587
2005	0.5992	0.1917	0.0276	0.0563	0.1678	0.4793	0.0959	0.0018	0.7909
2010	0.0737	0.0236	0.0034	0.0069	0.0206	0.0590	0.0118	0.0002	0.0973
2011	0.2696	0.0863	0.0124	0.0253	0.0755	0.2157	0.0431	0.0008	0.3559
2012	0.1666	0.0533	0.0077	0.0157	0.0466	0.1333	0.0267	0.0005	0.2199
2013	0.6256	0.2002	0.0288	0.0588	0.1752	0.5005	0.1001	0.0019	0.8258
2014	0.1867	0.0597	0.0086	0.0175	0.0523	0.1493	0.0299	0.0006	0.2464
2015	0.1774	0.0568	0.0082	0.0167	0.0497	0.1419	0.0284	0.0005	0.2341
2016	0.1625	0.0520	0.0075	0.0153	0.0455	0.1300	0.0260	0.0005	0.2145
2017	0.1918	0.0614	0.0088	0.0180	0.0537	0.1535	0.0307	0.0006	0.2532
2018	0.1082	0.0346	0.0050	0.0102	0.0303	0.0866	0.0173	0.0003	0.1429
2019	0.1196	0.0383	0.0055	0.0112	0.0335	0.0957	0.0191	0.0004	0.1579
2020	0.0754	0.0241	0.0035	0.0071	0.0211	0.0604	0.0121	0.0002	0.0996
2021	0.0740	0.0237	0.0034	0.0070	0.0207	0.0592	0.0118	0.0002	0.0977
2022	0.0924	0.0296	0.0043	0.0087	0.0259	0.0739	0.0148	0.0003	0.1220
2023	0.0802	0.0257	0.0037	0.0075	0.0225	0.0642	0.0128	0.0002	0.1059
2024	0.0811	0.0260	0.0037	0.0076	0.0227	0.0649	0.0130	0.0002	0.1071
1990/2024	-88%	-88%	-88%	-88%	-88%	-88%	-88%	-88%	-88%
2023/2024	1%	1%	1%	1%	1%	1%	1%	1%	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]	PCBs [kg]
1990	52.0136	6.6E-06	9.1E-07	7.9E-06	1.3E-06	1.7E-05	0.0611	0.0585
1995	52.0988	6.6E-06	9.1E-07	7.9E-06	1.3E-06	1.7E-05	0.0612	0.0586
2000	52.0440	6.6E-06	9.1E-07	7.9E-06	1.3E-06	1.7E-05	0.0612	0.0585
2005	47.9320	6.1E-06	8.4E-07	7.3E-06	1.2E-06	1.5E-05	0.0563	0.0539
2010	0.5900	7.5E-07	1.0E-07	9.0E-07	1.5E-07	1.9E-06	0.0069	0.0066
2011	2.1568	2.7E-06	3.8E-07	3.3E-06	5.4E-07	7.0E-06	0.0253	0.0243
2012	1.3326	1.7E-06	2.3E-07	2.0E-06	3.3E-07	4.3E-06	0.0157	0.0150

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]
2013	5.0048	6.4E-06	8.8E-07	7.6E-06	1.3E-06	1.6E-05	0.0588	0.0563
2014	1.4933	1.9E-06	2.6E-07	2.3E-06	3.7E-07	4.8E-06	0.0175	0.0168
2015	1.4189	1.8E-06	2.5E-07	2.2E-06	3.5E-07	4.6E-06	0.0167	0.0160
2016	1.2997	1.7E-06	2.3E-07	2.0E-06	3.2E-07	4.2E-06	0.0153	0.0146
2017	1.5347	2.0E-06	2.7E-07	2.3E-06	3.8E-07	4.9E-06	0.0180	0.0173
2018	0.8660	1.1E-06	1.5E-07	1.3E-06	2.2E-07	2.8E-06	0.0102	0.0097
2019	0.9568	1.2E-06	1.7E-07	1.5E-06	2.4E-07	3.1E-06	0.0112	0.0108
2020	0.0060	7.7E-07	1.1E-07	9.2E-07	1.5E-07	1.9E-06	0.0071	0.0068
2021	0.0059	7.5E-07	1.0E-07	9.0E-07	1.5E-07	1.9E-06	0.0070	0.0067
2022	0.0074	9.4E-07	1.3E-07	1.1E-06	1.8E-07	2.4E-06	0.0087	0.0083
2023	0.0064	8.2E-07	1.1E-07	9.8E-07	1.6E-07	2.1E-06	0.0075	0.0072
2024	0.0065	8.3E-07	1.1E-07	9.9E-07	1.6E-07	2.1E-06	0.0076	0.0073
1990/2024	-100%	-88%	-88%	-88%	-88%	-88%	-88%	-88%
2023/2024	1%	1%	1%	1%	1%	1%	1%	1%

The overview of activity data (energy consumption) for this source category is in [Table 3.4.8](#) below.

Table 3.4.8: Overview of activity data in 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	1.0E-06	0.00
2020	1.51	19,565.52	1,608.55	4,692.13	1.0E-06	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
2023	1.60	20,408.41	1,535.69	4,465.75	NO	7.48
2024	1.62	18,650.90	1,309.92	4,854.93	NO	7.62
1990/2024	-88%	-37%	23%	-54%	-	-
2023/2024	1%	-9%	-15%	9%	-	2%

3.4.3.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024.

The historical data (1990-1999) are not covered by the NEIS; therefore, the emission factors used for the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.4.9](#)).

Table 3.4.9: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NOx	[g/tGJ]	92.09
NMVOC	[g/tGJ]	48.33
SOx	[g/tGJ]	272.51
NH ₃	[g/tGJ]	0.56
TSP	[g/tGJ]	6.13
PM _{2.5}	[% of TSP]	91.17%
PM ₁₀	[% of TSP]	99.58%
BC*	[% of PM _{2.5}]	18.40%
CO	[g/tGJ]	12.04

*T1 EMEP/EEA GB 2023 EF

HMs and POPs emissions from category **1A1b** were allocated to category **1B2aiv** because when the Tier 1 approach is adopted for the process emissions, the combustion emissions are already covered and should not be reported again in category **1A1b**, since this would lead to double counting. Only industrial waste incineration emissions for HMs and POPs are allocated in this category. Calculations of heavy metal and POP emissions were performed using a more detailed T2 methodology for sewage sludge incineration. The emission factors used to calculate heavy metal and POP emissions are the default EFs from EMEP/EEA GB 2023 ([Table 3.4.10](#)).

Table 3.4.10: Emission factors for calculating emissions of heavy metals and POPs

T2	UNIT	EF
Pb	[g/t]	50
Cd	[g/t]	16
Hg	[g/t]	2.3
As	[g/t]	4.7
Cr	[g/t]	14
Cu	[g/t]	40
Ni	[g/t]	8
Se	[g/t]	0.15
Zn	[g/t]	66
PCDD/F	[mg I-TEQ/t]	40
B(a)P	[mg/t]	0.51
B(b)F	[mg/t]	0.07
B(k)F	[mg/t]	0.61
I()P	[mg/t]	0.1
PAHs	[mg/t]	1.29
HCb	[mg/t]	4.7
PCB	[mg/t]	4.5

3.4.3.3 Completeness

Emissions are well covered.

3.4.3.4 Source-specific Recalculations

Industrial waste incineration emissions for HMs and POPs were allocated in this category. Recalculations of heavy metal and POP emissions were made based on the use of a detailed methodology for sewage sludge incineration ([Table 3.4.11](#)).

Table 3.4.11: Differences in emissions (%) in category 1A1b between the previous and current submission caused by recalculations

YEAR	Pb	Cd	Hg	As	Ni	PCDD/F	PAHs	HCB
1990	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
1991	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
1992	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
1993	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
1994	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
1995	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
1996	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
1997	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
1998	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
1999	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
2000	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
2001	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
2002	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
2003	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
2004	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
2005	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	39,900.00	-99.99	135.00
2006	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	3,900.00	-99.99	135.00
2007	3,746.15	15,900.00	4,007.14	29,275.00	5,614.29	3,900.00	-99.99	135.00
2008	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2009	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2010	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2011	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2012	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2013	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2014	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2015	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2016	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2017	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2018	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2019	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	1,900.33	-99.99	135.00
2020	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	-80.00	-99.99	135.00
2021	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	-80.00	-99.99	135.00
2022	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	-80.00	-99.99	135.00
2023	107,808.27	94,403.19	4,007.14	39,686.19	17,913.62	-80.00	-99.99	135.00

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 3.4.12](#).

Table 3.4.12: Activities according to national categorisation included in category 1A1c**CATEGORISATION 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 3.4.13](#).

Table 3.4.13: Overview of emissions in category 1A1c

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [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
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
2023	0.7188	0.3267	0.1200	0.0263	0.1056	0.1778	0.2671	0.0507	17.2784
2024	0.7204	0.7868	0.1107	0.0247	0.1154	0.1933	0.2885	0.0554	15.2023
1990/2024	67%	-37%	-84%	-72%	-73%	-73%	-73%	-73%	24%
2023/2024	0%	141%	-8%	-6%	9%	9%	8%	9%	-12%

YEAR	Pb [t]	Cd [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0050	0.0002	0.0036	0.0081	0.0038	0.0020	0.0041	0.0172
1995	0.0050	0.0002	0.0036	0.0081	0.0038	0.0020	0.0041	0.0172
2000	0.0052	0.0002	0.0038	0.0085	0.0040	0.0021	0.0042	0.0179
2005	0.0054	0.0002	0.0040	0.0089	0.0042	0.0022	0.0044	0.0188
2010	0.0039	0.0002	0.0028	0.0064	0.0030	0.0016	0.0032	0.0135
2011	0.0046	0.0002	0.0033	0.0075	0.0035	0.0019	0.0037	0.0158
2012	0.0044	0.0002	0.0032	0.0073	0.0034	0.0018	0.0036	0.0153
2013	0.0044	0.0002	0.0032	0.0071	0.0034	0.0018	0.0036	0.0151
2014	0.0045	0.0002	0.0032	0.0073	0.0034	0.0018	0.0036	0.0154
2015	0.0047	0.0002	0.0034	0.0077	0.0036	0.0019	0.0038	0.0162
2016	0.0047	0.0002	0.0034	0.0077	0.0036	0.0019	0.0038	0.0162
2017	0.0045	0.0002	0.0033	0.0074	0.0035	0.0018	0.0037	0.0156
2018	0.0046	0.0002	0.0033	0.0075	0.0035	0.0019	0.0037	0.0158
2019	0.0040	0.0002	0.0029	0.0065	0.0031	0.0016	0.0033	0.0138
2020	0.0034	0.0002	0.0024	0.0055	0.0026	0.0014	0.0028	0.0116
2021	0.0047	0.0002	0.0034	0.0076	0.0036	0.0019	0.0038	0.0161
2022	0.0043	0.0002	0.0031	0.0070	0.0033	0.0017	0.0035	0.0147
2023	0.0044	0.0002	0.0032	0.0073	0.0034	0.0018	0.0036	0.0153

YEAR	Pb [t]	Cd [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2024	0.0041	0.0002	0.0030	0.0067	0.0031	0.0017	0.0033	0.0141
1990/2024	-18%	-18%	-18%	-18%	-18%	-18%	-18%	-18%
2023/2024	-8%	-8%	-8%	-8%	-8%	-8%	-8%	-8%

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
2023	1.4893	0.0165	0.0002	0.0001	4.04E-05	0.0169
2024	1.3660	0.0152	0.0002	0.0001	3.70E-05	0.0155
1990/2024	-18%	-18%	-18%	-18%	-18%	-18%
2023/2024	-8%	-8%	-8%	-8%	-8%	-8%

The overview of activity data (energy consumption) for this source category is in [Table 3.4.14](#) below.

Table 3.4.14: Overview of activity data in category 1A1c

YEAR	COAL TRANSFORMED [kt]	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]
1990	2,258.95	NO	7,109.30	NO
1995	2,261.97	NO	7,061.99	NO
2000	2,359.26	NO	7,431.88	0.93
2005	2,471.97	NO	7,231.65	1.85
2010	1,777.00	0.09	6,491.11	3.43
2011	2,082.00	0.08	6,187.55	1.76
2012	2,018.00	0.10	6,211.97	2.46
2013	1,984.00	0.07	6,130.61	2.48
2014	2,027.00	0.09	6,209.12	1.29
2015	2,131.00	0.10	6,456.99	1.23
2016	2,132.00	0.13	6,471.44	1.33
2017	2,052.00	0.05	5,934.80	6.83
2018	2,077.00	0.10	6,087.14	6.82
2019	1,816.00	0.08	5,585.03	7.02
2020	1,530.00	0.05	5,056.88	4.93
2021	2,117.00	0.12	6,038.13	6.37
2022	1,933.00	0.16	6,001.56	4.63
2023	2,018.00	0.14	6,540.67	29.85

YEAR	COAL TRANSFORMED [kt]	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]
2024	1,851.00	0.12	6,018.66	62.05
1990/2024	-18%	-	-15%	-
2023/2024	-8%	-13%	-8%	108%

3.4.4.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024.

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}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.4.15](#)).

Table 3.4.15: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NOx	[g/tGJ]	60.68
NMVOC	[g/tGJ]	176.23
SOx	[g/tGJ]	97.21
NH ₃	[g/tGJ]	12.50
TSP	[g/tGJ]	151.76
PM _{2.5}	[% of TSP]	39.58%
PM ₁₀	[% of TSP]	66.62%
BC*	[% of PM _{2.5}]	48.00%
CO	[g/tGJ]	1,730.01

*T1 EMEP/EEA GB 2023 EF

HMs and POPs emissions were calculated using Tier 2 emission factors with by-product recovery from EMEP/EEA GB 2023 ([Table 3.4.16](#)).

Table 3.4.16: Emission factors for calculating emissions of heavy metals and POPs

T2	UNIT	EF
Pb	[mg/t Coal]	2.2
Cd	[mg/t Coal]	0.1
As	[mg/t Coal]	1.6
Cr	[mg/t Coal]	3.6
Cu	[mg/t Coal]	1.7
Ni	[mg/t Coal]	0.9
Se	[mg/t Coal]	1.8
Zn	[mg/t Coal]	7.6
PCDD/F	[ng/t Coal]	738
B(a)P	[mg/t Coal]	8.2
B(b)F	[mg/t Coal]	0.1
B(k)F	[mg/t Coal]	0.03
I()P	[mg/t Coal]	0.02
PAHs	[mg/t Coal]	8.35

3.4.4.3 Completeness

Emissions are well covered. Notation keys for Hg, HCB and PCB are used according to EMEP/EEA GB 2023.

3.4.4.3 Source-specific Recalculations

No recalculations were made in this submission.

3.5 MANUFACTURING INDUSTRIES AND CONSTRUCTION (NFR 1A2)

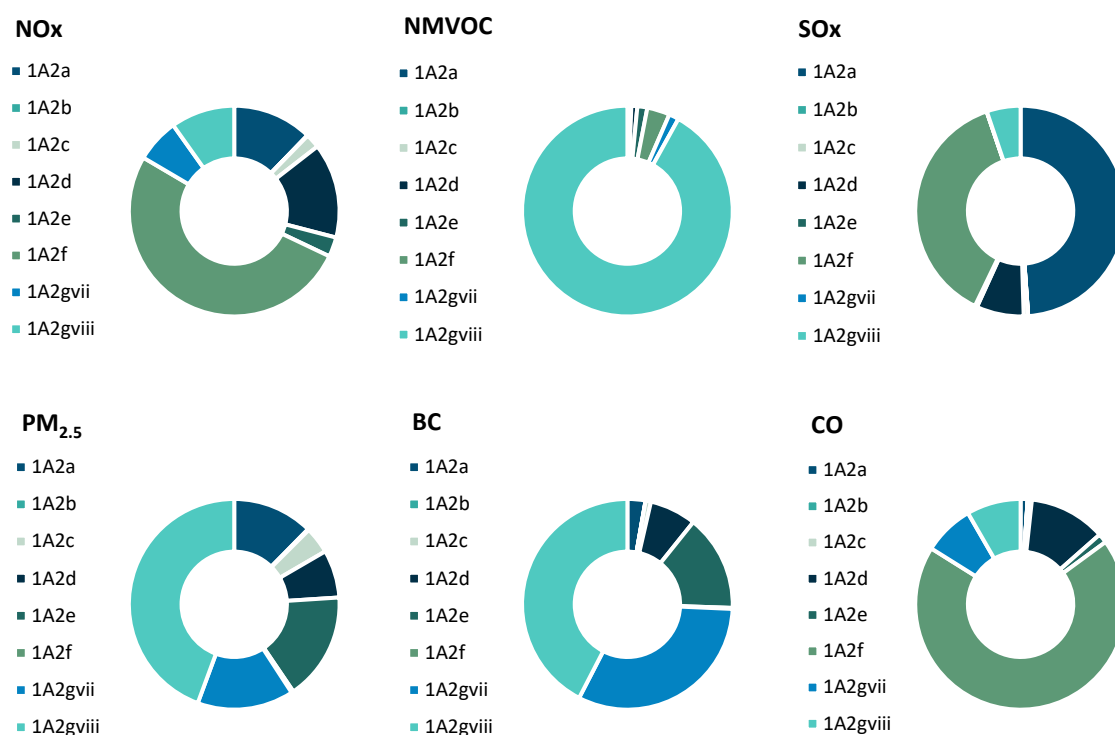
3.5.1 Overview

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_x, NO_x, CO, NMVOC, particulate matter (TSP, PM₁₀, 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).

Manufacturing industries and construction are substantial contributors to most air pollutants. Categories **1A2a**, **1A2d**, **1A2f** and **1A2gviii** are the key categories for various air pollutants (*Figure 3.5.1*).

Figure 3.5.1: Shares of main pollutants emissions in categories of 1A2 in 2024



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 of the 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 approximately 18,000 TJ in 2024. 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 deal with a higher share of sulphur. Activities listed within this category are shown in [Table 3.5.1](#).

Table 3.5.1: Activities according to national categorisation included in category 1A2a

CATEGORISATION 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 increase in NOx emissions in 2021 was caused by significantly higher combustion of blast furnace gas exhaust in one operator. One source producing energy for steel production used blast furnace gas as a secondary solid fuel, which is included in solid fuels. Reported emissions from this source increased more than 27 times, and the amount of gas burned was approximately 30 times. This, after aggregating all the data, caused the different increases in emissions and fuel amounts. The decrease in NOx

emissions between 2018 and 2019 was caused by a change, the operation of the heating plant source producing energy for steel production was terminated, and a new source was opened (*Recommendations No SK-1A2a-2023-0002*). The overview of emissions in this category is shown in *Table 3.5.2*.

Table 3.5.2: Overview of emissions in category 1A2a

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [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	5.1282
1995	5.2063	0.0368	4.4499	NO	3.7123	3.9811	4.6077	0.2372	5.2063
2000	6.0894	0.0367	9.7871	NO	4.5250	4.8526	5.6164	0.2890	6.0894
2005	5.7510	0.0287	4.8804	NO	0.2555	0.2589	0.2870	0.0163	5.7510
2010	3.8203	0.0509	3.9807	NO	0.1790	0.1836	0.2007	0.0114	3.8203
2011	2.8316	0.0487	2.8248	NO	0.1209	0.1235	0.1360	0.0077	2.8316
2012	3.3872	0.0570	3.8774	NO	0.0642	0.0784	0.0979	0.0041	3.3872
2013	3.2981	0.0560	3.6654	NO	0.0503	0.0595	0.0746	0.0032	3.2981
2014	3.0680	0.0612	2.7901	NO	0.0616	0.0725	0.0890	0.0039	3.0680
2015	3.0669	0.0424	2.3135	NO	0.0418	0.0517	0.0728	0.0027	3.0669
2016	2.5749	0.0381	1.9776	1.1E-05	0.0377	0.0448	0.0539	0.0024	2.5749
2017	2.1911	0.0339	1.5720	NO	0.0299	0.0360	0.0481	0.0019	2.1911
2018	2.5348	0.0474	1.3473	NO	0.0347	0.0401	0.0545	0.0022	2.5348
2019	0.9780	0.0373	0.5527	NO	0.0328	0.0362	0.0387	0.0021	0.9780
2020	0.9744	0.0375	0.6027	NO	0.0206	0.0234	0.0254	0.0013	0.9744
2021	2.0873	0.0538	0.7029	NO	0.0366	0.0402	0.0424	0.0024	2.0873
2022	1.7550	0.0386	0.7405	NO	0.0308	0.0339	0.0357	0.0020	1.7550
2023	1.7255	0.0325	0.7857	NO	0.0360	0.0390	0.0408	0.0023	1.7255
2024	1.0244	0.0251	0.5885	NO	0.0300	0.0327	0.0343	0.0019	1.0244
1990/2024	-80%	-31%	-87%	-	-99%	-99%	-99%	-99%	-80%
2023/2024	-41%	-23%	-25%	-	-17%	-16%	-16%	-17%	-41%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.4202	0.0325	0.0085	0.0190	0.0092	0.0494	0.0858	0.0571	0.2350
1995	0.4266	0.0334	0.0087	0.0195	0.0094	0.0507	0.0880	0.0585	0.2410
2000	0.7581	0.0344	0.0090	0.0202	0.0098	0.0523	0.0909	0.0603	0.2489
2005	0.4317	0.0425	0.0042	0.0118	0.0069	0.0702	0.1215	0.0709	0.3586
2010	0.6545	0.0283	0.0028	0.0085	0.0054	0.0468	0.0810	0.0472	0.2388
2011	0.5703	0.0285	0.0028	0.0086	0.0054	0.0470	0.0814	0.0477	0.2402
2012	0.7353	0.0314	0.0031	0.0092	0.0058	0.0519	0.0898	0.0563	0.2648
2013	0.8143	0.0310	0.0031	0.0091	0.0056	0.0512	0.0887	0.0517	0.2617
2014	0.5220	0.0280	0.0028	0.0084	0.0054	0.0462	0.0800	0.0466	0.2361
2015	0.5840	0.0276	0.0027	0.0083	0.0052	0.0456	0.0790	0.0460	0.2330
2016	0.3735	0.0194	0.0019	0.0063	0.0042	0.0320	0.0555	0.0323	0.1636
2017	0.3239	0.0197	0.0020	0.0063	0.0042	0.0326	0.0564	0.0335	0.1665
2018	0.3129	0.0252	0.0025	0.0078	0.0051	0.0416	0.0720	0.0421	0.2124
2019	0.1024	0.0225	0.0022	0.0066	0.0042	0.0370	0.0642	0.0404	0.1891
2020	0.0991	0.0214	0.0022	0.0063	0.0040	0.0352	0.0606	0.0370	0.1785
2021	0.1848	0.0216	0.0022	0.0067	0.0046	0.0353	0.0610	0.0421	0.1793
2022	0.1628	0.0199	0.0020	0.0061	0.0039	0.0327	0.0565	0.0329	0.1665
2023	0.1803	0.0152	0.0016	0.0051	0.0035	0.0249	0.0428	0.0249	0.1263
2024	0.1316	0.0176	0.0018	0.0054	0.0036	0.0288	0.0498	0.0289	0.1467

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990/2024	-69%	-46%	-79%	-71%	-61%	-42%	-42%	-49%	-38%
2023/2024	-27%	16%	15%	7%	1%	16%	16%	16%	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]	PCBs [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	3.8E-05	0.0001	0.0001	0.0001	0.0002	0.0696	0.0122
2011	0.0216	3.9E-05	0.0001	0.0001	0.0001	0.0002	0.0700	0.0123
2012	0.0226	4.1E-05	0.0001	0.0001	0.0001	0.0002	0.0771	0.0136
2013	0.0222	4.0E-05	0.0001	0.0001	0.0001	0.0002	0.0762	0.0134
2014	0.0212	3.8E-05	0.0001	0.0001	0.0001	0.0002	0.0688	0.0121
2015	0.0208	3.7E-05	0.0001	0.0001	5.0E-05	0.0002	0.0679	0.0119
2016	0.0168	2.9E-05	0.0001	3.9E-05	3.9E-05	0.0002	0.0477	0.0084
2017	0.0168	2.9E-05	0.0001	4.0E-05	3.9E-05	0.0002	0.0485	0.0085
2018	0.0203	3.5E-05	0.0001	4.9E-05	4.7E-05	0.0002	0.0619	0.0109
2019	0.0165	3.0E-05	0.0001	4.1E-05	4.0E-05	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
2023	0.0148	0.0001	0.0002	0.0001	0.0001	0.0004	0.0368	0.0065
2024	0.0149	0.0001	0.0002	0.0001	0.0001	0.0004	0.0428	0.0075
1990/2024	-48%	61%	51%	-20%	-7%	21%	-38%	65%
2023/2024	0.5%	-1%	-0.4%	1%	1%	-0.2%	16%	16%

The overview of the activity data (energy consumption) for this source category is in [Table 3.5.3](#) below.

Table 3.5.3: 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]
1990	5.93	18,622.60	1,451.96	NO
1995	5.97	18,979.64	1,400.55	NO
2000	5.50	20,111.83	1,465.23	NO
2005	NO	27,089.95	1,319.92	NO
2010	0.35	24,392.52	1,756.07	NO
2011	2.82	23,921.25	2,160.77	NO
2012	17.10	24,668.61	1,740.10	NO
2013	2.23	23,780.86	2,085.08	NO
2014	1.36	23,837.29	1,849.90	NO
2015	0.60	23,489.52	1,561.83	NO
2016	1.30	20,577.44	1,413.57	NO
2017	4.64	20,294.87	1,446.04	NO
2018	2.89	24,210.47	1,295.23	NO
2019	14.44	18,054.40	1,401.57	NO
2020	9.55	16,955.23	1,424.88	8.72
2021	28.80	21,631.33	1,301.52	8.91
2022	1.53	18,447.22	944.67	5.61
2023	0.23	18,326.22	939.93	7.24
2024	0.19	16,871.04	1,165.34	7.01

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]
1990/2024	-97%	-9%	-20%	-
2023/2024	-19%	-8%	24%	-3%

3.5.2.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024.

The historical data (1990-1999) are not covered by the NEIS; therefore, the emission factors used for the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.5.4](#)).

Table 3.5.4: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NOx	[g/tGJ]	255.38
NMVOC	[g/tGJ]	1.80
SOx	[g/tGJ]	218.28
TSP	[g/tGJ]	226.02
PM _{2.5}	[% of TSP]	80.57%
PM ₁₀	[% of TSP]	86.40%
CO	[g/tGJ]	20.93

The methodology for calculating BC, heavy metals, and POPs is described in [Annex X](#). [Table 3.5.5](#) shows the distribution of fuels to the subsequent categories used in the methodology.

Table 3.5.5: Fuel consumption in TJ in category 1A2a

TYPE OF FUEL	LIQUID FUELS				HARD COAL		
TYPE OF BOILER	ALL TYPE OF BOILERS			STATIONERY ENGINES	FLUIDIZED BED BOILERS		PULVERISED BED BOILERS
THERMAL CAPACITY [MW]	<5	5-50	>100	-	5-50	>100	>100
1990	-	5.93	-	-	3.63	10,192.04	-
1991	-	5.93	-	-	3.64	10,218.63	-
1992	-	5.93	-	-	3.65	10,250.18	-
1993	-	5.94	-	-	3.65	10,257.78	-
1994	-	5.91	-	-	3.65	10,254.53	-
1995	-	5.97	-	-	3.72	10,453.85	-
1996	-	5.87	-	-	3.71	10,427.47	-
1997	-	6.10	-	-	3.73	10,485.38	-
1998	-	5.72	-	-	3.85	10,809.86	-
1999	-	6.77	-	-	4.07	11,429.21	-
2000	-	5.50	-	-	3.84	10,793.77	-
2001	-	10.53	-	-	4.47	-	12,378.07
2002	-	7.98	-	-	4.82	-	13,755.63
2003	-	-	-	-	5.22	-	14,217.39
2004	-	-	-	-	4.98	-	13,724.69
2005	-	-	-	-	6.30	-	15,564.36
2006	-	-	-	0.00	5.18	-	15,932.62

TYPE OF FUEL	LIQUID FUELS				HARD COAL		
TYPE OF BOILER	ALL TYPE OF BOILERS			STATIONERY ENGINES	FLUIDIZED BED BOILERS		PULVERISED BED BOILERS
THERMAL CAPACITY [MW]	<5	5-50	>100	-	5-50	>100	>100
2007	-	-	-	0.02	2.40	-	13,406.10
2008	-	-	-	0.03	2.64	-	12,767.42
2009	-	11.47	-	0.06	2.94	-	9,879.12
2010	-	0.28	-	0.07	3.39	-	10,375.33
2011	-	1.37	-	0.18	3.01	-	10,436.53
2012	-	15.87	-	0.07	2.88	-	11,503.21
2013	-	0.16	-	0.07	2.55	-	11,370.36
2014	-	0.10	-	0.12	2.24	-	10,256.92
2015	-	0.04	-	0.05	1.61	-	10,121.95
2016	-	-	-	0.05	2.65	-	7,106.45
2017	-	2.60	-	0.07	2.52	-	7,229.56
2018	-	0.96	-	0.08	2.06	-	9,225.39
2019	-	12.02	-	0.09	1.98	-	8,215.19
2020	-	6.86	-	0.17	2.20	-	7,755.20
2021	0.04	26.18	0.01	0.15	1.49	-	7,787.51
2022	0.02	0.03	0.01	0.15	2.07	-	7,234.32
2023	0.04	0.08	0.02	0.10	0.74	-	5,484.91
2024	0.04	-	0.02	0.13	-	-	6,372.62

TYPE OF FUEL	BROWN COAL		GASEOUS FUELS				BIOMASS
TYPE OF BOILER	FLUIDIZED BED BOILERS		ALL TYPE OF BOILERS			GAS TURBINES	PULVERISED BED BOILERS
THERMAL CAPACITY [MW]	<5	5-50	<5	5-50	>100	-	<5
1990	90.27	-	52.13	553.73	9,182.76	-	-
1991	90.51	-	52.12	553.61	9,180.70	-	-
1992	90.79	-	52.17	554.16	9,189.91	-	-
1993	90.85	-	52.31	555.58	9,213.45	-	-
1994	90.82	-	52.42	556.73	9,232.49	-	-
1995	92.59	-	52.35	556.07	9,221.60	-	-
1996	92.36	-	52.95	562.34	9,325.60	-	-
1997	92.87	-	53.24	565.46	9,377.37	-	-
1998	95.74	-	53.36	566.77	9,399.02	-	-
1999	101.23	-	54.11	574.72	9,530.91	-	-
2000	95.60	-	56.90	604.37	10,022.56	-	-
2001	82.87	16.26	79.20	641.33	9,476.72	284.60	-
2002	9.26	10.93	84.03	383.63	10,119.93	492.83	-
2003	79.70	22.09	104.26	248.35	11,364.82	515.56	-
2004	1.44	19.97	97.28	496.66	12,201.26	501.70	-
2005	-	9.36	136.40	518.98	11,671.47	503.00	-
2006	-	-	128.09	452.40	13,556.76	517.69	-
2007	-	-	137.18	409.86	11,746.48	497.76	-
2008	-	-	147.41	296.73	12,468.52	439.73	-
2009	-	-	130.47	377.64	12,126.12	428.43	-
2010	-	-	302.09	269.11	14,729.20	469.47	-

TYPE OF FUEL	BROWN COAL		GASEOUS FUELS				BIOMASS
TYPE OF BOILER	FLUIDIZED BED BOILERS		ALL TYPE OF BOILERS			GAS TURBINES	PULVERISED BED BOILERS
THERMAL CAPACITY [MW]	<5	5-50	<5	5-50	>100	-	<5
2011	-	-	108.46	251.98	14,814.21	469.10	-
2012	-	-	142.22	277.00	14,029.85	454.70	-
2013	-	-	126.48	281.72	13,628.17	458.66	-
2014	-	-	91.83	276.68	14,608.58	452.07	-
2015	-	-	94.78	287.70	14,091.43	454.40	-
2016	-	-	107.74	286.94	14,034.06	454.41	-
2017	-	-	105.90	303.35	13,629.92	471.63	-
2018	-	-	107.02	309.51	15,393.63	469.94	-
2019	-	-	100.40	296.70	10,391.03	453.01	-
2020	-	-	96.57	289.65	9,794.80	444.21	8.72
2021	-	-	108.78	298.19	14,323.39	415.92	8.91
2022	-	-	103.84	365.28	11,640.70	47.00	5.61
2023	-	-	94.89	323.59	13,362.01	-	7.24
2024	-	-	92.49	273.33	11,124.74	173.19	7.01

3.5.2.3 Completeness

Emissions are well covered.

3.5.2.4 Source-specific Recalculations

No recalculations were made in this submission.

3.5.3 Stationary Combustion in Manufacturing Industries and Construction: Non-ferrous Metals (NFR 1A2b)

3.5.3.1 Overview

This category is focused on combustion processes in the production of non-ferrous metals. Activities listed within this category are shown in [Table 3.5.6](#).

Table 3.5.6: Activities according to national categorisation included in category 1A2b

CATEGORISATION 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 3.5.7](#).

Table 3.5.7: Overview of emissions in category 1A2b

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.0040	0.0001	0.0002	0.0002	0.0002	0.0003	8.8E-06	0.0014
1995	0.0044	0.0001	0.0002	0.0002	0.0003	0.0003	9.8E-06	0.0016
2000	0.0011	0.0001	6.9E-06	4.0E-05	4.3E-05	0.0001	1.6E-06	0.0004
2005	0.0036	0.0001	0.0004	0.0002	0.0002	0.0006	1.0E-05	0.0015
2010	0.0033	0.0002	2.0E-05	0.0002	0.0002	0.0002	6.3E-06	0.0013

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
2011	0.0035	0.0002	2.8E-05	0.0001	0.0002	0.0002	5.9E-06	0.0016
2012	0.0036	0.0002	2.2E-05	0.0002	0.0002	0.0002	6.7E-06	0.0014
2013	0.0035	0.0002	2.1E-05	0.0002	0.0002	0.0002	6.8E-06	0.0014
2014	0.0039	0.0002	2.4E-05	0.0002	0.0002	0.0002	7.4E-06	0.0016
2015	0.0041	0.0002	2.5E-05	0.0002	0.0002	0.0002	7.8E-06	0.0017
2016	0.0042	0.0003	2.6E-05	0.0002	0.0002	0.0002	7.9E-06	0.0017
2017	0.0050	0.0003	3.0E-05	0.0002	0.0002	0.0003	9.1E-06	0.0020
2018	0.0053	0.0003	3.2E-05	0.0002	0.0003	0.0003	9.6E-06	0.0021
2019	0.0050	0.0003	3.1E-05	0.0002	0.0002	0.0003	8.9E-06	0.0020
2020	0.0057	0.0004	3.5E-05	0.0002	0.0003	0.0003	1.0E-05	0.0023
2021	0.0062	0.0004	3.9E-05	0.0003	0.0003	0.0003	1.1E-05	0.0025
2022	0.0055	0.0003	3.4E-05	0.0003	0.0003	0.0003	1.1E-05	0.0022
2023	0.0055	0.0003	4.7E-05	0.0004	0.0004	0.0005	1.6E-05	0.0022
2024	0.0054	0.0003	3.6E-05	0.0004	0.0004	0.0005	1.6E-05	0.0022
1990/2024	36%	353%	-77%	72%	87%	71%	78%	56%
2023/2024	-2%	-1%	-24%	2%	3%	4%	-3%	-2%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	9.0E-07	7.4E-08	4.4E-05	8.2E-06	1.1E-06	2.1E-07	1.1E-06	4.8E-06	6.0E-05
1995	1.0E-06	8.3E-08	5.0E-05	9.2E-06	1.2E-06	2.4E-07	1.2E-06	5.3E-06	6.7E-05
2000	5.5E-07	4.5E-08	2.7E-05	5.0E-06	6.5E-07	1.3E-07	6.5E-07	2.9E-06	3.7E-05
2005	6.6E-05	9.4E-07	4.4E-05	9.4E-06	7.5E-06	8.7E-06	7.3E-06	5.2E-06	1.5E-04
2010	8.4E-07	6.9E-08	4.1E-05	7.6E-06	9.9E-07	2.0E-07	9.9E-07	4.4E-06	5.6E-05
2011	9.0E-07	7.3E-08	4.4E-05	8.2E-06	1.1E-06	2.1E-07	1.1E-06	4.7E-06	6.0E-05
2012	9.1E-07	7.5E-08	4.5E-05	8.3E-06	1.1E-06	2.2E-07	1.1E-06	4.8E-06	6.1E-05
2013	1.1E-06	9.2E-08	5.5E-05	1.0E-05	1.3E-06	2.7E-07	1.3E-06	5.9E-06	7.5E-05
2014	6.8E-07	5.5E-08	3.3E-05	6.1E-06	8.0E-07	1.6E-07	8.0E-07	3.6E-06	4.5E-05
2015	1.1E-06	8.8E-08	5.3E-05	9.7E-06	1.3E-06	2.6E-07	1.3E-06	5.6E-06	7.1E-05
2016	1.1E-06	9.0E-08	5.4E-05	1.0E-05	1.3E-06	2.6E-07	1.3E-06	5.8E-06	7.3E-05
2017	1.3E-06	1.0E-07	6.3E-05	1.2E-05	1.5E-06	3.0E-07	1.5E-06	6.7E-06	8.5E-05
2018	1.4E-06	1.1E-07	6.7E-05	1.2E-05	1.6E-06	3.2E-07	1.6E-06	7.2E-06	9.0E-05
2019	1.3E-06	1.1E-07	6.3E-05	1.2E-05	1.5E-06	3.1E-07	1.5E-06	6.8E-06	8.6E-05
2020	1.5E-06	1.2E-07	7.2E-05	1.3E-05	1.7E-06	3.5E-07	1.7E-06	7.8E-06	9.8E-05
2021	1.6E-06	1.3E-07	7.8E-05	1.4E-05	1.9E-06	3.8E-07	1.9E-06	8.4E-06	1.1E-04
2022	1.4E-06	1.2E-07	7.1E-05	1.3E-05	1.7E-06	3.4E-07	1.7E-06	7.6E-06	9.6E-05
2023	1.4E-06	1.2E-07	7.0E-05	1.3E-05	1.7E-06	3.5E-07	1.7E-06	7.6E-06	9.6E-05
2024	1.4E-06	1.2E-07	6.9E-05	1.3E-05	1.7E-06	3.4E-07	1.7E-06	7.4E-06	9.4E-05
1990/2024	55%	55%	55%	55%	56%	57%	55%	55%	56%
2023/2024	-2%	-2%	-2%	-2%	-2%	-3%	-2%	-2%	-3%

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	4.3E-05	5.9E-05	2.4E-04	9.0E-05	8.9E-05	4.8E-04	NE	NE
1995	4.8E-05	6.6E-05	2.7E-04	1.0E-04	1.0E-04	5.3E-04	NE	NE
2000	2.6E-05	3.6E-05	1.5E-04	5.5E-05	5.4E-05	2.9E-04	NE	NE
2005	1.4E-04	7.6E-05	2.5E-04	9.4E-05	9.0E-05	5.1E-04	3.0E-07	8.2E-05
2010	4.0E-05	5.5E-05	2.2E-04	8.4E-05	8.3E-05	4.4E-04	NE	NE
2011	4.2E-05	5.9E-05	2.4E-04	9.0E-05	8.8E-05	4.7E-04	NE	NE
2012	4.3E-05	6.0E-05	2.4E-04	9.1E-05	9.0E-05	4.8E-04	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]	PCBs [kg]
2013	5.3E-05	7.4E-05	3.0E-04	1.1E-04	1.1E-04	5.9E-04	NE	NE
2014	3.2E-05	4.4E-05	1.8E-04	6.8E-05	6.6E-05	3.6E-04	NE	NE
2015	5.1E-05	7.0E-05	2.8E-04	1.1E-04	1.1E-04	5.6E-04	NE	NE
2016	5.2E-05	7.2E-05	2.9E-04	1.1E-04	1.1E-04	5.8E-04	NE	NE
2017	6.1E-05	8.4E-05	3.4E-04	1.3E-04	1.3E-04	6.8E-04	NE	NE
2018	6.4E-05	8.9E-05	3.6E-04	1.4E-04	1.3E-04	7.2E-04	NE	NE
2019	6.1E-05	8.5E-05	3.4E-04	1.3E-04	1.3E-04	6.8E-04	NE	NE
2020	7.0E-05	9.7E-05	3.9E-04	1.5E-04	1.4E-04	7.8E-04	NE	NE
2021	7.5E-05	1.0E-04	4.2E-04	1.6E-04	1.6E-04	8.4E-04	NE	NE
2022	6.8E-05	9.4E-05	3.8E-04	1.4E-04	1.4E-04	7.6E-04	NE	NE
2023	6.8E-05	9.4E-05	3.8E-04	1.4E-04	1.4E-04	7.6E-04	NE	NE
2024	6.6E-05	9.2E-05	3.7E-04	1.4E-04	1.4E-04	7.4E-04	NE	NE
1990/2024	55%	55%	55%	55%	55%	55%	-	-
2023/2024	-2%	-2%	-2%	-2%	-2%	-2%	-	-

The overview of activity data (energy consumption) for this source category is in [Table 3.5.8](#) below.

Table 3.5.8: Overview of activity data in category 1A2b

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]
1990	NO	NO	82.27
1995	NO	NO	92.15
2000	NO	NO	50.36
2005	NO	0.48	74.88
2010	NO	NO	76.40
2011	NO	NO	81.65
2012	NO	NO	83.09
2013	0.01	NO	102.13
2014	0.01	NO	61.46
2015	0.01	NO	97.30
2016	0.01	NO	99.67
2017	0.01	NO	116.37
2018	0.01	NO	123.28
2019	0.01	NO	117.47
2020	0.01	NO	134.22
2021	0.02	NO	144.64
2022	0.01	NO	130.80
2023	0.04	NO	130.29
2024	0.01	NO	127.83
1990/2024	-	-	55%
2023/2024	-64%	-	-2%

3.5.3.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024.

The historical data (1990-1999) are not covered by the NEIS; therefore, the emission factors used for the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.5.9](#)).

Table 3.5.9: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NOx	[g/tGJ]	48.12
NMVOG	[g/tGJ]	0.90
SOx	[g/tGJ]	1.92
TSP	[g/tGJ]	3.41
PM _{2.5}	[% of TSP]	78.26%
PM ₁₀	[% of TSP]	84.83%
CO	[g/tGJ]	16.93

HMs and POPs emissions were calculated using Tier 1 emission factors from EMEP/EEA GB 2023 ([Table 3.5.10](#)).

Table 3.5.10: Emission factors for calculating emissions of heavy metals and POPs

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	0.0026	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

The methodology for calculating BC emissions is described in [Annex X](#).

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 were made 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 3.5.11**. The emissions from the combustion of industrial waste are included in this category because of the energy recovery from the combustion process.

Table 3.5.11: Activities according to national categorisation included in category 1A2c

CATEGORISATION 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
5.1. Industrial waste incineration	combustion

The overview of emissions in this category is shown in **Table 3.5.12**.

Table 3.5.12: Overview of emissions in category 1A2c

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.7208	0.0375	0.4394	0.0311	0.0462	0.0687	0.0023	0.1880
1995	0.6853	0.0357	0.4178	0.0296	0.0439	0.0653	0.0022	0.1787
2000	0.3992	0.0207	0.2715	0.0232	0.0345	0.0513	0.0018	0.1221
2005	0.2958	0.0057	0.0595	0.0165	0.0169	0.0206	0.0067	0.0472
2010	0.2064	0.0050	0.0092	0.0108	0.0120	0.0153	0.0008	0.0606
2011	0.2299	0.0056	0.0128	0.0119	0.0128	0.0162	0.0009	0.0649
2012	0.2375	0.0050	0.0119	0.0120	0.0130	0.0162	0.0009	0.0667
2013	0.2275	0.0059	0.0120	0.0116	0.0125	0.0151	0.0009	0.0655
2014	0.2301	0.0054	0.0125	0.0100	0.0104	0.0107	0.0007	0.0651
2015	0.2402	0.0060	0.0145	0.0107	0.0109	0.0112	0.0006	0.0807
2016	0.2368	0.0059	0.0150	0.0117	0.0122	0.0127	0.0011	0.0787
2017	0.2372	0.0058	0.0274	0.0121	0.0127	0.0133	0.0009	0.0741
2018	0.2534	0.0057	0.0197	0.0113	0.0117	0.0121	0.0008	0.0708
2019	0.2343	0.0057	0.0209	0.0106	0.0109	0.0116	0.0006	0.0685
2020	0.2105	0.0053	0.0068	0.0101	0.0104	0.0108	0.0014	0.0675
2021	0.2121	0.0052	0.0033	0.0124	0.0128	0.0132	0.0007	0.0614
2022	0.1994	0.0047	0.0060	0.0122	0.0127	0.0132	0.0009	0.0705
2023	0.1996	0.0049	0.0092	0.0114	0.0118	0.0123	0.0007	0.0804
2024	0.1842	0.0046	0.0082	0.0099	0.0102	0.0105	0.0006	0.0774
1990/2024	-74%	-88%	-98%	-68%	-78%	-85%	-75%	-59%
2023/2024	-8%	-8%	-10%	-13%	-14%	-15%	-22%	-4%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	1.0490	0.1487	0.0605	0.0603	0.1846	0.4310	0.1295	0.0100	1.5106
1995	0.9455	0.1364	0.0548	0.0549	0.1678	0.3936	0.1172	0.0090	1.3621
2000	0.9573	0.1192	0.0559	0.0516	0.1588	0.3574	0.1148	0.0097	1.3919
2005	0.3707	0.1184	0.0192	0.0352	0.1038	0.2962	0.0593	0.0014	0.5040

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2010	0.3372	0.1077	0.0176	0.0320	0.0944	0.2692	0.0539	0.0012	0.4499
2011	0.3383	0.1081	0.0179	0.0322	0.0947	0.2701	0.0541	0.0013	0.4515
2012	0.2746	0.0877	0.0150	0.0262	0.0769	0.2192	0.0439	0.0011	0.3676
2013	0.2428	0.0776	0.0136	0.0232	0.0680	0.1938	0.0389	0.0010	0.3260
2014	0.1928	0.0617	0.0113	0.0186	0.0541	0.1541	0.0309	0.0008	0.2593
2015	0.2271	0.0727	0.0132	0.0218	0.0637	0.1816	0.0364	0.0010	0.3047
2016	0.2339	0.0749	0.0134	0.0225	0.0656	0.1869	0.0375	0.0010	0.3159
2017	0.2672	0.0855	0.0149	0.0256	0.0749	0.2136	0.0428	0.0011	0.3584
2018	0.2552	0.0816	0.0143	0.0244	0.0715	0.2040	0.0409	0.0010	0.3416
2019	0.2036	0.0652	0.0132	0.0198	0.0571	0.1628	0.0327	0.0010	0.2750
2020	0.2124	0.0680	0.0121	0.0204	0.0597	0.1696	0.0340	0.0009	0.2909
2021	0.1445	0.0462	0.0090	0.0140	0.0405	0.1155	0.0232	0.0007	0.1950
2022	0.1606	0.0514	0.0094	0.0155	0.0450	0.1284	0.0257	0.0007	0.2158
2023	0.1360	0.0435	0.0082	0.0131	0.0381	0.1087	0.0218	0.0006	0.1830
2024	0.1621	0.0519	0.0093	0.0156	0.0454	0.1296	0.0260	0.0007	0.2171
1990/2024	-85%	-65%	-85%	-74%	-75%	-70%	-80%	-93%	-86%
2023/2024	19%	19%	14%	19%	19%	19%	19%	12%	19%

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	36.0518	0.2138	0.2989	0.1175	0.0935	0.7236	0.0441	0.8131
1995	33.0957	0.1906	0.2686	0.1053	0.0840	0.6486	0.0404	0.7239
2000	28.6858	0.2136	0.2985	0.1169	0.0930	0.7220	0.0354	0.8053
2005	29.6090	0.0037	0.0175	0.0050	0.0048	0.0311	0.0348	0.0340
2010	2.6938	0.0031	0.0117	0.0045	0.0043	0.0236	0.0316	0.0312
2011	2.7035	0.0033	0.0128	0.0048	0.0047	0.0257	0.0317	0.0311
2012	2.1949	0.0034	0.0131	0.0050	0.0049	0.0263	0.0258	0.0254
2013	1.9409	0.0034	0.0133	0.0051	0.0049	0.0267	0.0228	0.0224
2014	1.5435	0.0033	0.0132	0.0050	0.0049	0.0265	0.0181	0.0174
2015	1.8188	0.0037	0.0146	0.0055	0.0054	0.0293	0.0213	0.0205
2016	1.8721	0.0036	0.0145	0.0055	0.0054	0.0290	0.0220	0.0211
2017	2.1386	0.0036	0.0141	0.0054	0.0053	0.0283	0.0251	0.0241
2018	2.0428	0.0035	0.0139	0.0053	0.0052	0.0278	0.0240	0.0230
2019	1.6319	0.0052	0.0207	0.0078	0.0077	0.0414	0.0191	0.0183
2020	1.6990	0.0033	0.0127	0.0048	0.0047	0.0255	0.0200	0.0191
2021	1.1578	0.0032	0.0129	0.0049	0.0048	0.0258	0.0136	0.0130
2022	1.2857	0.0027	0.0108	0.0041	0.0040	0.0215	0.0151	0.0144
2023	1.0890	0.0026	0.0104	0.0039	0.0039	0.0207	0.0128	0.0122
2024	0.0149	0.0025	0.0102	0.0039	0.0038	0.0203	0.0152	0.0146
1990/2024	-100%	-99%	-97%	-97%	-96%	-97%	-65%	-98%
2023/2024	-99%	-2%	-2%	-2%	-2%	-2%	19%	19%

The overview of activity data (energy consumption) for this source category is in [Table 3.5.13](#) below.

Table 3.5.13: Overview of activity data in 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

YEAR	WASTE INCINERATED [kt]	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
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
2023	2.72	8.37	NO	3,297.53	259.71	67.94
2024	3.24	9.43	NO	3,247.26	242.23	81.01
1990/2024	-63%	-98%	-	-59%	-	-
2023/2024	19%	13%	-	-2%	-7%	19%

3.5.4.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024.

The historical data (1990-1999) are not covered by the NEIS; therefore, the emission factors used for the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.5.14](#)).

Table 3.5.14: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NOx	[g/tGJ]	55.45
NM VOC	[g/tGJ]	2.89
SOx	[g/tGJ]	33.80
TSP	[g/tGJ]	5.29
PM _{2.5}	[% of TSP]	45.26%
PM ₁₀	[% of TSP]	67.25%
CO	[g/tGJ]	14.46

Calculations of heavy metal and POP emissions were performed using the T1 and T2 methodologies for industrial waste incineration. The emission factors used to calculate heavy metal and POP emissions are the default EFs from EMEP/EEA GB 2023 ([Table 3.5.15](#) and [Table 3.5.16](#)).

Table 3.5.15: Emission factors for calculating emissions of heavy metals and POPs

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

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
Cr	[mg/GJ]	0.2	13.5	0.013	23
Cu	[mg/GJ]	0.22	17.5	0.0026	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

Table 3.5.16: Emission factors for calculating emissions of heavy metals and POPs

T2	UNIT	EF
Pb	[g/t]	50
Cd	[g/t]	16
Hg	[g/t]	2.3
As	[g/t]	4.7
Cr	[g/t]	14
Cu	[g/t]	40
Ni	[g/t]	8
Se	[g/t]	0.15
Zn	[g/t]	66
PCDD/F	[mg I-TEQ/t]	40
B(a)P	[mg/t]	0.51
B(b)F	[mg/t]	0.07
B(k)F	[mg/t]	0.61
I()P	[mg/t]	0.1
PAHs	[mg/t]	1.29
HCB	[mg/t]	4.7
PCB	[mg/t]	4.5

The methodology for calculating BC emissions is described in [Annex X](#).

3.5.4.3 Completeness

Emissions are well covered.

3.5.4.4 Source-specific Recalculations

Industrial waste incineration emissions for HMs and POPs were allocated in this category. Recalculations of heavy metal and POP emissions were made based on the use of detailed T2 methodology for sewage sludge incineration ([Table 3.5.17](#)).

Table 3.5.17: Differences in emissions (%) in category 1A2c between the previous and current submission caused by recalculations

YEAR	Pb	Cd	Hg	As	Cr	Cu	Ni
1990	68.82	1,537.70	48.31	214.76	199.43	440.30	114.09

YEAR	Pb	Cd	Hg	As	Cr	Cu	Ni
1991	68.87	1,538.64	48.27	214.77	199.56	440.59	114.16
1992	68.05	1,521.81	47.67	212.16	197.14	435.26	112.81
1993	66.69	1,493.64	46.74	207.90	193.12	426.37	110.55
1994	65.88	1,476.99	46.16	205.35	190.74	421.13	109.22
1995	71.10	1,584.10	49.36	220.94	206.07	455.03	117.82
1996	64.59	1,450.17	45.23	201.24	186.92	412.69	107.08
1997	67.98	1,520.17	47.31	211.37	196.87	434.71	112.68
1998	78.41	1,732.26	53.69	242.56	227.62	502.74	129.90
1999	96.87	2,094.98	64.51	296.96	282.27	623.79	160.31
2000	54.57	1,239.65	38.59	170.46	157.48	347.65	90.50
2001	3,047.08	15,154.41	419.65	4,239.66	27,470.01	77,183.31	4,390.90
2002	3,316.47	15,388.99	428.71	4,413.49	31,997.97	965,36.52	4,727.59
2003	3,198.85	15,287.81	486.90	4,896.55	28,146.89	791,28.68	4,623.05
2004	3,386.77	15,480.04	574.47	5,783.54	37,659.98	109,624.71	4,899.93
2005	3,521.82	15,622.67	648.01	6,545.00	55,638.76	173,435.57	5,096.63
2006	3,294.54	15,382.37	325.14	3,426.38	39,173.51	137,566.54	4,595.49
2007	3,574.60	15,724.01	858.82	8,497.82	130,461.72	466,025.38	5,222.13
2008	3,528.73	14,893.59	733.72	7,368.80	59,221.17	288,661.36	5,139.82
2009	3,388.52	14,412.37	535.25	5,478.71	39,449.34	186,849.58	4,888.66
2010	3,397.89	14,513.32	595.73	6,040.68	43,622.04	204,996.82	4,927.84
2011	3,446.70	14,546.35	554.46	5,688.73	45,652.19	236,384.88	4,969.02
2012	3,399.62	14,325.62	451.83	4,700.25	38,126.39	200,730.12	4,851.08
2013	3,399.09	13,932.05	398.39	4,187.14	32,484.16	193,229.81	4,810.94
2014	3,592.70	66,560.01	324.24	3,489.04	38,487.31	374,733.23	4,946.72
2015	3,644.92	77,723.74	343.16	3,690.14	49,021.45	537,686.57	5,027.57
2016	3,574.90	46,916.66	357.06	3,830.56	27,029.29	298,819.07	4,985.51
2017	3,623.18	66,017.36	410.22	4,369.16	42,516.37	445,424.13	5,085.20
2018	3,661.98	79,375.62	400.18	4,273.54	54,703.22	620,697.92	5,114.18
2019	3,645.10	77,930.10	224.12	2,450.59	39,602.34	495,022.93	4,791.46
2020	3,452.71	26,362.03	370.64	3,967.15	14,308.49	161,403.73	4,896.10
2021	3,640.43	68,492.99	253.30	2,759.34	37,091.95	462,971.51	4,866.46
2022	3,653.89	70,599.90	330.86	3,567.55	43,471.57	528,317.02	5,023.57
2023	3,645.58	68,676.51	293.51	3,180.34	39,919.71	492,297.97	4,954.48

YEAR	Se	Zn	PCDD/F	PAHs	HCB	PCB
1990	15.12	62.24	800.87	-19.53	116.31	5.11
1991	15.12	62.27	800.98	-19.52	116.32	5.11
1992	14.94	61.50	798.71	-19.33	116.13	5.05
1993	14.63	60.25	794.83	-19.01	115.79	4.95
1994	14.45	59.51	792.49	-18.82	115.59	4.89
1995	15.53	64.18	806.86	-19.92	116.84	5.28
1996	14.16	58.26	788.62	-18.50	115.25	4.79
1997	14.86	61.31	798.44	-19.22	116.11	5.04
1998	17.02	70.66	824.49	-21.37	118.36	5.83
1999	20.76	86.93	859.27	-24.78	121.27	7.25
2000	11.99	49.04	754.33	-16.12	112.18	4.03
2001	254.45	2,457.44	1,040.04	-75.92	134.91	1,247.03
2002	250.64	1,947.30	1,040.52	-74.76	134.95	2,329.72

YEAR	Se	Zn	PCDD/F	PAHs	HCB	PCB
2003	275.03	1,790.73	1,040.43	-76.04	134.94	1,715.45
2004	332.81	2,145.22	1,041.03	-79.21	134.96	2,844.49
2005	404.39	3,145.92	1,041.50	-82.65	134.98	4,881.11
2006	210.25	3,875.40	1,040.25	-73.29	134.95	2,165.06
2007	667.74	18,336.95	14.27	-89.96	134.98	6,086.56
2008	529.74	7,388.31	14.27	-87.37	134.84	5,620.15
2009	369.18	5,829.22	14.26	-83.06	134.75	3,151.53
2010	422.67	7,439.61	14.26	-85.06	134.77	3,189.12
2011	391.12	7,374.72	14.26	-84.01	134.78	3,925.33
2012	310.06	6,039.49	14.26	-80.64	134.74	3,367.98
2013	269.85	5,093.71	14.26	-78.36	134.66	3,630.77
2014	217.92	5,026.91	54,335.87	-74.44	134.71	17,503.21
2015	232.43	5,908.94	60,859.09	-75.63	134.80	42,747.28
2016	240.96	4,088.18	54,465.21	-76.33	134.45	51,683.49
2017	281.95	5,865.15	68,172.43	-79.03	134.70	33,362.46
2018	275.12	6,700.03	71,362.28	-78.60	134.81	80,499.02
2019	147.37	4,238.79	40,866.75	-66.29	134.82	154,509.33
2020	247.25	2,506.19	44,098.02	-76.87	133.77	2,036,771.26
2021	167.63	4,346.92	45,058.40	-69.11	134.74	9,632,736.12
2022	223.19	5,339.50	58,342.78	-74.86	134.75	10,063,948.47
2023	196	4,851.21	51,817.01	-72.37	134.68	9,579,319.98

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 3.5.18](#).

Table 3.5.18: Activities according to national categorisation included in category 1A2d

CATEGORISATION 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 this category is 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 related to a significant reduction in the use of solid fuels in this category. An overview of the emissions is shown in [Table 3.5.19](#).

Table 3.5.19: Overview of emissions in category 1A2d

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [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
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
2023	1.1085	0.0623	0.1471	0.0136	0.0198	0.0198	0.0198	0.0056	1.0434
2024	1.2195	0.0459	0.0875	0.0016	0.0178	0.0181	0.0182	0.0050	1.4437
1990/2024	-63%	43%	-99%	-	-91%	-92%	-94%	-88%	-74%
2023/2024	10%	-26%	-40%	-89%	-10%	-9%	-8%	-10%	38%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0375	0.0041	0.0231	0.0143	0.0439	0.0315	0.1357	0.2104	0.1390
1995	0.0376	0.0041	0.0233	0.0145	0.0434	0.0312	0.1351	0.2076	0.1383
2000	0.0433	0.0047	0.0280	0.0175	0.0430	0.0311	0.1217	0.2067	0.1407
2005	0.0449	0.0044	0.0315	0.0197	0.0274	0.0217	0.0310	0.1368	0.1007
2010	0.0421	0.0044	0.0324	0.0230	0.0035	0.0069	0.0173	0.0176	0.0629
2011	0.0400	0.0042	0.0315	0.0224	0.0011	0.0033	0.0060	0.0053	0.0503
2012	0.0385	0.0040	0.0300	0.0217	0.0012	0.0036	0.0101	0.0051	0.0494
2013	0.0401	0.0042	0.0312	0.0223	0.0012	0.0034	0.0068	0.0053	0.0511
2014	0.0361	0.0038	0.0285	0.0198	0.0007	0.0025	0.0073	0.0048	0.0481
2015	0.0177	0.0019	0.0141	0.0099	0.0005	0.0013	0.0087	0.0024	0.0265
2016	0.0332	0.0036	0.0262	0.0182	0.0007	0.0024	0.0134	0.0044	0.0464
2017	0.0337	0.0036	0.0265	0.0184	0.0008	0.0024	0.0102	0.0045	0.0467
2018	0.0332	0.0036	0.0262	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	0.0338	0.0036	0.0266	0.0184	0.0007	0.0024	0.0091	0.0045	0.0454
2023	0.0286	0.0031	0.0225	0.0157	0.0006	0.0021	0.0099	0.0038	0.0391
2024	0.0305	0.0032	0.0242	0.0166	0.0006	0.0020	0.0016	0.0040	0.0386
1990/2024	-19%	-22%	4%	16%	-99%	-94%	-99%	-98%	-72%
2023/2024	7%	6%	7%	6%	-9%	-2%	-84%	5%	-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]	PCBs [kg]
1990	0.1076	0.0004	0.0013	0.0006	0.0003	0.0026	0.0822	0.0246

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]
1995	0.1102	0.0004	0.0013	0.0006	0.0003	0.0027	0.0829	0.0250
2000	0.1532	0.0006	0.0018	0.0009	0.0005	0.0038	0.1016	0.0333
2005	0.2257	0.0009	0.0028	0.0013	0.0007	0.0057	0.1231	0.0467
2010	0.2854	0.0012	0.0036	0.0017	0.0008	0.0073	0.1279	0.0564
2011	0.2804	0.0011	0.0035	0.0017	0.0008	0.0072	0.1228	0.0549
2012	0.2668	0.0011	0.0034	0.0016	0.0008	0.0068	0.1169	0.0523
2013	0.2788	0.0012	0.0036	0.0017	0.0008	0.0072	0.1225	0.0548
2014	0.2550	0.0011	0.0033	0.0015	0.0008	0.0066	0.1118	0.0500
2015	0.1254	0.0005	0.0016	0.0008	0.0004	0.0033	0.0544	0.0244
2016	0.2336	0.0010	0.0030	0.0014	0.0007	0.0061	0.1024	0.0459
2017	0.2371	0.0010	0.0031	0.0014	0.0007	0.0062	0.1039	0.0465
2018	0.2338	0.0010	0.0030	0.0014	0.0007	0.0061	0.1025	0.0459
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	0.2380	0.0010	0.0031	0.0014	0.0007	0.0062	0.1045	0.0467
2023	0.2015	0.0008	0.0026	0.0012	0.0006	0.0052	0.0884	0.0396
2024	0.2159	0.0009	0.0028	0.0013	0.0006	0.0056	0.0948	0.0423
1990/2024	101%	112%	120%	113%	99%	114%	15%	72%
2023/2024	7%	7%	7%	7%	7%	7%	7%	7%

The overview of activity data (energy consumption) for this source category is in [Table 3.5.20](#) below.

Table 3.5.20: Overview of activity data in 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	1,631.78	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	34.31	NO	1,843.13	20,943.86	29.79
2021	31.78	NO	1,870.16	22,778.01	31.44
2022	44.16	NO	1,117.16	20,869.41	25.35
2023	43.56	NO	1,202.28	17,652.26	26.59
2024	4.20	NO	1,135.92	18,932.09	26.24
1990/2024	-99%	-	-70%	129%	-
2023/2024	-90%	-	-6%	7%	-1%

3.5.5.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024.

The historical data (1990-1999) are not covered by the NEIS; therefore, the emission factors used for the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.5.21](#)).

Table 3.5.21: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NO _x	[g/tGJ]	178.17
NMVOC	[g/tGJ]	1.73
SO _x	[g/tGJ]	679.85
TSP	[g/tGJ]	16.09
PM _{2.5}	[% of TSP]	66.43%
PM ₁₀	[% of TSP]	75.03%
CO	[g/tGJ]	298.57

The methodology for calculating BC, heavy metals, and POPs is described in [Annex X](#). [Table 3.5.22](#) shows the distribution of fuels to the subsequent categories used in the methodology.

Table 3.5.22: Fuel consumption in TJ in category 1A2d

TYPE OF FUEL	LIQUID FUELS				HARD COAL		BROWN COAL	
TYPE OF BOILER	ALL TYPE OF BOILERS			STATIONERY ENGINES	FIXED BED BOILERS	PULVERISED BED BOILERS	FIXED BED BOILERS	PULVERISED BED BOILERS
THERMAL CAPACITY [MW]	<5	5-50	>100	-	>100	>100	<5	>100
1990	13.32	200.29	213.69	-	851.26	2,140.84	28.10	3,083.01
1991	13.31	200.13	213.52	-	849.06	2,135.30	28.03	3,075.03
1992	13.33	200.51	213.92	-	849.55	2,136.52	28.04	3,076.79
1993	13.29	199.82	213.19	-	849.94	2,137.51	28.05	3,078.21
1994	13.16	198.00	211.24	-	845.97	2,127.52	27.92	3,063.83
1995	13.28	199.78	213.14	-	839.89	2,112.24	27.72	3,041.82
1996	13.20	198.51	211.78	-	849.18	2,135.59	28.03	3,075.45
1997	12.81	192.73	205.62	-	833.90	2,097.18	27.53	3,020.13
1998	12.83	192.95	205.85	-	817.17	2,055.10	26.97	2,959.53
1999	13.24	199.09	212.41	-	822.09	2,067.48	27.14	2,977.36
2000	11.64	175.00	186.71	-	833.05	2,095.05	27.50	3,017.06
2001	11.64	188.45	163.86	0.08	-	1,982.19	24.68	3,099.69
2002	11.72	155.67	234.54	-	-	2,214.57	16.51	3,212.32
2003	-	182.13	144.59	0.06	-	2,215.92	10.43	3,213.84
2004	-	-	126.30	0.02	-	2,013.59	8.01	2,082.64
2005	0.06	2.84	47.67	0.09	-	2,197.98	5.97	1,822.38
2006	-	-	107.35	0.03	-	1,939.77	5.21	2,304.28
2007	-	-	65.77	0.03	-	2,123.96	5.08	1,911.38
2008	0.00	-	33.91	0.02	-	1,672.13	7.35	2,321.07
2009	0.72	-	44.55	0.01	-	2,472.64	7.06	2,676.44

TYPE OF FUEL	LIQUID FUELS				HARD COAL		BROWN COAL	
TYPE OF BOILER	ALL TYPE OF BOILERS			STATIONERY ENGINES	FIXED BED BOILERS	PULVERISED BED BOILERS	FIXED BED BOILERS	PULVERISED BED BOILERS
THERMAL CAPACITY [MW]	<5	5-50	>100	-	>100	>100	<5	>100
2010	0.58	-	48.56	-	-	435.52	7.82	48.50
2011	-	-	13.15	0.02	-	-	9.27	-
2012	0.08	-	28.30	0.01	-	-	14.06	-
2013	-	-	15.83	-	-	-	10.93	-
2014	-	-	21.25	-	-	-	-	-
2015	-	-	30.36	-	-	-	-	-
2016	-	-	45.65	-	-	-	-	-
2017	-	-	33.14	0.03	-	-	-	-
2018	-	-	33.59	0.03	-	-	-	-
2019	-	-	31.50	0.08	-	-	-	-
2020	-	-	32.58	0.02	-	-	-	-
2021	-	-	30.06	0.09	-	-	-	-
2022	-	-	28.57	0.16	-	-	-	-
2023	-	-	32.94	0.20	-	-	-	-
2024	-	-	-	0.24	-	-	-	-

TYPE OF FUEL	GASEOUS FUELS				
TYPE OF BOILER	ALL TYPE OF BOILERS				GAS TURBINES
THERMAL CAPACITY [MW]	<5	5-50	50-100	>100	-
1990	239.30	731.73	2,342.31	440.59	-
1991	237.73	726.94	2,326.97	437.70	-
1992	237.54	726.37	2,325.13	437.36	-
1993	237.47	726.15	2,324.46	437.23	-
1994	237.03	724.80	2,320.11	436.41	-
1995	229.26	701.04	2,244.07	422.11	-
1996	235.95	721.50	2,309.57	434.43	-
1997	228.03	697.27	2,232.00	419.84	-
1998	218.20	667.21	2,135.78	401.74	-
1999	202.57	619.42	1,982.79	372.96	-
2000	235.80	721.06	2,308.14	434.16	-
2001	264.72	823.10	897.87	261.99	-
2002	311.82	761.87	899.19	464.89	-
2003	438.43	811.34	473.88	340.90	-
2004	416.63	894.79	327.10	503.42	-
2005	389.90	652.95	235.68	534.06	-
2006	385.16	636.32	119.38	321.46	2,236.74
2007	314.64	893.44	192.89	317.14	2,455.26
2008	313.03	879.57	255.94	202.08	2,441.41
2009	279.11	809.87	278.33	179.57	2,300.93
2010	333.22	695.38	334.17	153.23	2,296.26
2011	311.58	655.60	211.02	152.83	2,347.29
2012	281.82	610.54	143.01	135.26	2,104.74
2013	301.74	558.01	255.17	116.78	490.16
2014	270.37	531.35	112.87	244.20	473.16

TYPE OF FUEL	GASEOUS FUELS				
TYPE OF BOILER	ALL TYPE OF BOILERS				GAS TURBINES
THERMAL CAPACITY [MW]	<5	5-50	50-100	>100	-
2015	278.01	1,559.03	58.07	276.65	630.30
2016	296.13	500.45	92.40	143.80	787.15
2017	296.58	502.90	82.56	255.45	376.67
2018	279.78	570.64	49.35	436.81	275.11
2019	267.18	559.16	92.74	527.31	574.77
2020	294.70	579.76	81.55	538.83	350.69
2021	294.77	585.33	97.73	406.23	488.30
2022	239.47	312.32	113.45	249.52	217.69
2023	209.15	281.05	87.18	351.09	255.49
2024	233.24	348.89	47.82	271.59	238.32

TYPE OF FUEL	BIOMASS					
TYPE OF BOILER	FIXED BED BOILERS			FLUIDIZED BED BOILERS		PULVERISED BED BOILERS
THERMAL CAPACITY [MW]	<5	5-50	>100	50-100	>100	>100
1990	0.45	679.99	1,829.33	588.45	5,165.74	-
1991	0.45	682.15	1,835.13	590.32	5,182.14	-
1992	0.45	683.83	1,839.63	591.77	5,194.85	-
1993	0.45	685.97	1,845.40	593.62	5,211.14	-
1994	0.47	710.49	1,911.37	614.84	5,397.42	-
1995	0.46	700.11	1,883.44	605.86	5,318.55	-
1996	0.48	723.14	1,945.41	625.79	5,493.55	-
1997	0.50	759.87	2,044.22	657.58	5,772.57	-
1998	0.54	824.99	2,219.38	713.92	6,267.21	-
1999	0.50	754.03	2,028.50	652.52	5,728.19	-
2000	0.67	1,013.63	2,726.86	877.17	7,700.26	-
2001	0.67	1,060.88	2,949.87	1,070.44	7,896.28	-
2002	1.46	978.12	3,268.52	1,534.40	8,768.01	-
2003	-	1,019.78	3,603.26	1,536.84	8,816.43	-
2004	-	1,111.81	19,432.91	1,745.70	9,353.41	-
2005	-	912.94	8,072.91	2,600.90	7,644.96	-
2006	-	736.46	9,121.42	2,466.54	8,842.86	-
2007	-	700.36	9,417.40	2,563.04	9,937.34	-
2008	-	693.91	10,110.10	2,135.26	9,931.45	-
2009	-	768.98	9,878.70	2,762.59	10,339.15	67.03
2010	-	98.76	11,228.71	3,124.28	10,461.06	-
2011	-	-	10,675.95	3,177.46	10,683.05	-
2012	-	-	2,532.86	2,438.77	18,378.74	-
2013	1.23	-	2,684.46	3,555.97	18,235.33	-
2014	3.36	-	9,907.61	1,832.71	10,624.62	-
2015	4.19	-	8,743.71	2,139.64	-	-
2016	3.24	-	18,238.63	2,229.41	-	-
2017	4.77	-	18,684.78	2,095.78	-	-
2018	4.27	-	18,256.11	2,231.44	-	-
2019	3.35	-	17,124.63	1,976.01	-	-
2020	4.66	-	18,930.48	2,038.50	-	-

TYPE OF FUEL	BIOMASS					
TYPE OF BOILER	FIXED BED BOILERS			FLUIDIZED BED BOILERS		PULVERISED BED BOILERS
THERMAL CAPACITY [MW]	<5	5-50	>100	50-100	>100	>100
2021	3.81	-	20,765.45	2,040.20	-	-
2022	2.52	-	18,781.41	2,110.84	-	-
2023	2.06	-	15,826.94	1,849.85	-	-
2024	1.71	-	17,115.87	1,840.75	-	-

3.5.5.3 Completeness

Emissions are well covered.

3.5.5.4 Source-specific Recalculations

No recalculations were made in this submission.

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. Emissions from activities of the food industry were clearly identified as combustion emissions. Therefore, the industrial categories of national classification according to the following **Table 3.5.23** were included here.

Table 3.5.23: Activities according to national categorisation included in category 1A2e

CATEGORISATION 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

The overview of emissions is shown in **Table 3.5.24**. Emissions of main pollutants in this category show an overall decreasing trend, especially emissions of SO_x, heavy metals and POPs are decreasing due to

the decrease in the use of solid fuels within this category (one source of Slovenské cukrovary is out of operation).

Table 3.5.24: Overview of emissions in category 1A2e

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [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
2023	0.2429	0.0557	0.0039	0.0097	0.0426	0.0478	0.0570	0.0121	0.1519
2024	0.2525	0.0767	0.0042	0.0071	0.0402	0.0513	0.0723	0.0103	0.1753
1990/2024	-68%	48%	-100%	-6%	-38%	-51%	-58%	10%	-58%
2023/2024	4%	38%	8%	-27%	-6%	7%	27%	-15%	15%

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
2023	0.0043	0.0020	0.0020	0.0004	0.0037	0.0010	0.0004	0.0003	0.0870
2024	0.0048	0.0023	0.0024	0.0005	0.0040	0.0011	0.0004	0.0003	0.0924
1990/2024	-92%	85%	-72%	-83%	-42%	-87%	-93%	-76%	-27%
2023/2024	10%	10%	19%	19%	9%	7%	11%	13%	6%

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	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
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
2023	0.0178	0.0044	0.0149	0.0049	0.0047	0.0289	0.0008	0.0001
2024	0.0196	0.0049	0.0156	0.0056	0.0054	0.0314	0.0009	0.0001
1990/2024	-80%	-83%	-74%	-74%	-72%	-76%	100%	-100%
2023/2024	10%	11%	5%	14%	15%	9%	10%	-3%

The overview of activity data (energy consumption) for this source category is in [Table 3.5.25](#) below.

Table 3.5.25: Overview of activity data in category 1A2e

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]
1990	486.58	448.38	9,248.51	40.84
1995	498.01	447.23	9,171.20	40.84
2000	488.85	385.14	8,774.43	40.84
2005	604.59	323.08	6,093.54	53.97
2010	0.80	459.72	4,066.54	68.66
2011	1.23	496.14	4,024.59	18.37
2012	12.95	415.15	3,717.15	17.44
2013	29.59	459.88	3,343.55	20.63
2014	6.00	547.16	3,517.81	21.56
2015	11.92	720.47	3,570.57	31.39
2016	27.23	550.43	3,520.30	25.33
2017	30.26	657.52	3,547.82	51.78
2018	42.21	590.46	3,382.68	97.01
2019	13.97	510.69	3,281.77	189.35
2020	11.21	475.44	3,334.02	179.71
2021	13.51	51.08	3,784.04	151.98
2022	16.14	0.57	3,544.39	171.91
2023	188.37	0.42	3,477.95	173.32
2024	47.36	0.40	4,217.31	208.25
1990/2024	-90%	-100%	-54%	410%
2023/2024	-75%	-5%	21%	20%

3.5.6.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024.

The historical data (1990-1999) are not covered by the NEIS; therefore, the emission factors used for the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.5.26](#)).

Table 3.5.26: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NO _x	[g/tGJ]	76.18
NM VOC	[g/tGJ]	5.08
SO _x	[g/tGJ]	85.39
NH ₃	[g/tGJ]	0.73
TSP	[g/tGJ]	16.96
PM _{2.5}	[% of TSP]	37.52%
PM ₁₀	[% of TSP]	59.90%
CO	[g/tGJ]	41.08

HMs and POPs emissions were calculated using Tier 1 emission factors from EMEP/EEA GB 2023 ([Table 3.5.27](#)).

Table 3.5.27: Emission factors for calculating emissions of heavy metals and POPs

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

The methodology for calculating BC emissions is described in [Annex X](#).

3.5.6.3 Completeness

Emissions are well covered.

3.5.6.4 Source-specific Recalculations

No recalculations were made 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: SO_x, NO_x, CO, NMVOC, particulate matter (TSP, PM₁₀, 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 NO_x emissions. 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**. Particulate 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 3.5.28**.

Table 3.5.28: Activities according to national categorisation included in category 1A2f

CATEGORISATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS	SPECIFICATION FOR
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 reason for the decrease in HM and POPs emissions, especially PCDD/F, is the transition from rotary kilns to shaft kilns at one operator's source, i.e. there was a change in the type of fuel used. The overview of emissions is shown in **Table 3.5.29**.

Table 3.5.29: Overview of emissions in category 1A2f

YEAR	NO _x [kt]	NMVOC [kt]	SO _x [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	2.3E-05	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	1.0E-07	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

YEAR	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
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
2023	4.0454	0.1884	0.4184	0.0399	0.0006	0.0007	0.0007	0.0001	8.1800
2024	4.3061	0.1746	0.4533	0.0451	0.0008	0.0008	0.0008	0.0001	8.4551
1990/2024	-24%	136%	-31%	-	-97%	-98%	-98%	-94%	-26%
2023/2024	6%	-7%	8%	13%	18%	17%	16%	12%	3%

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	0.4717	0.0271	0.1255	0.0693	0.1002	0.1577	0.1195	0.0616	1.0340
2012	1.2892	0.0523	0.1333	0.0786	0.0891	0.1385	0.1054	0.0538	0.9108
2013	1.5841	0.0622	0.1429	0.0855	0.0911	0.1411	0.1075	0.0547	0.9283
2014	1.6977	0.0671	0.1577	0.0941	0.1016	0.1576	0.1200	0.0611	1.0367
2015	1.1290	0.0489	0.1466	0.0846	0.1043	0.1629	0.1238	0.0634	1.0702
2016	1.5750	0.0640	0.1629	0.0961	0.1089	0.1694	0.1289	0.0658	1.1136
2017	1.6878	0.0681	0.1706	0.1008	0.1132	0.1759	0.1339	0.0683	1.1566
2018	2.4681	0.0936	0.1914	0.1168	0.1144	0.1764	0.1346	0.0682	1.1621
2019	2.5563	0.0973	0.2012	0.1225	0.1211	0.1867	0.1425	0.0722	1.2301
2020	2.3780	0.0919	0.2006	0.1210	0.1245	0.1924	0.1467	0.0745	1.2667
2021	3.1942	0.1185	0.2222	0.1377	0.1256	0.1927	0.1473	0.0743	1.2708
2022	1.2425	0.0552	0.1745	0.1000	0.1264	0.1976	0.1501	0.0769	1.2977
2023	0.3019	0.0227	0.1325	0.0719	0.1100	0.1736	0.1315	0.0679	1.1375
2024	0.2602	0.0212	0.1301	0.0704	0.1089	0.1718	0.1301	0.0672	1.1258
1990/2024	-6%	-6%	-6%	-6%	-6%	-6%	-6%	-6%	-6%
2023/2024	-14%	-7%	-2%	-2%	-1%	-1%	-1%	-1%	-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]	PCBs [kg]
1990	0.0116	1.8E-05	0.0008	0.0002	0.0001	0.0012	0.0130	0.2921
1995	0.0092	1.5E-05	0.0006	0.0002	0.0001	0.0009	0.0103	0.2303
2000	0.0095	1.5E-05	0.0006	0.0002	0.0001	0.0009	0.0106	0.2383
2005	0.0096	1.5E-05	0.0007	0.0002	0.0001	0.0010	0.0108	0.2423
2010	0.0068	1.1E-05	0.0005	0.0001	0.0001	0.0007	0.0076	0.1703
2011	0.0884	2.5E-05	0.0007	0.0002	0.0001	0.0010	0.0157	0.2626
2012	0.3725	0.0001	0.0006	0.0002	0.0001	0.0010	0.0306	0.2741
2013	0.4707	0.0001	0.0006	0.0002	0.0001	0.0010	0.0363	0.2925
2014	0.0148	0.0001	0.0007	0.0002	0.0001	0.0011	0.0392	0.3232
2015	0.0132	0.0001	0.0007	0.0002	0.0001	0.0011	0.0285	0.3031
2016	0.0151	0.0001	0.0008	0.0002	0.0001	0.0012	0.0373	0.3350
2017	0.0159	0.0001	0.0008	0.0003	0.0001	0.0012	0.0398	0.3505
2018	0.0185	0.0001	0.0008	0.0003	0.0001	0.0013	0.0548	0.3900
2019	0.0194	0.0001	0.0009	0.0003	0.0001	0.0014	0.0569	0.4100
2020	0.0191	0.0001	0.0009	0.0003	0.0001	0.0014	0.0537	0.4098
2021	0.0218	0.0001	0.0009	0.0003	0.0001	0.0015	0.0694	0.4507
2022	0.0156	0.0001	0.0009	0.0003	0.0001	0.0013	0.0322	0.3614

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]
2023	0.0111	1.9E-05	0.0008	0.0002	0.0001	0.0011	0.0131	0.2782
2024	0.0109	1.7E-05	0.0007	0.0002	0.0001	0.0011	0.0122	0.2735
1990/2024	-6%	-6%	-6%	-6%	-6%	-6%	-6%	-6%
2023/2024	-2%	-9%	-1%	-2%	-1%	-1%	-7%	-2%

The overview of activity data (energy consumption) for this source category is in [Table 3.5.30](#) below.

Table 3.5.30: Overview of activity data in 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
2023	2,222.14	2,219.40	4,109.69	123.78	5,766.10
2024	1,934.49	2,300.23	4,275.37	164.46	5,943.71
1990/2024	232%	-64%	-60%	71%	34,667%
2023/2024	-13%	4%	4%	33%	3%

3.5.7.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024.

The historical data (1990-1999) are not covered by the NEIS; therefore, the emission factors used for the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.5.31](#)).

Table 3.5.31: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NO _x	[g/tGJ]	316.96
NM VOC	[g/tGJ]	4.14
SO _x	[g/tGJ]	36.83
NH ₃	[g/tGJ]	0.17
TSP	[g/tGJ]	2.16
PM _{2.5}	[% of TSP]	63.43%
PM ₁₀	[% of TSP]	89.30%
CO	[g/tGJ]	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 2023 emission factors for the manufacture of cement (**2A1**) and Tier 2 EMEP/EEA GB 2023 emission factors for industrial waste incineration (**2A2**) were used for the calculation of HMs and POPs emissions (**Table 3.5.32**).

Table 3.5.32: Emission factors for calculating emissions of heavy metals and POPs

T2	UNIT	MANUFACTURE OF CEMENT	UNIT	INDUSTRIAL WASTE INCINERATION
Pb	[g/t]	0.098	[g/t]	104
Cd	[g/t]	0.008	[g/t]	3.4
Hg	[g/t]	0.049	[g/t]	2.8
As	[g/t]	0.0265	[g/t]	2.14
Cr	[g/t]	0.041	-	0.185
Cu	[g/t]	0.0647	-	0.093
Ni	[g/t]	0.049	[g/t]	0.12
Se	[g/t]	0.0253	-	-
Zn	[g/t]	0.424	-	0.9
PCDD/F	[ng I-TEQ/t]	4.1	[mg I-TEQ/t]	3.5
B(a)P	[g/t]	6.5E-06	[mg/t]	4.2
B(b)F	[g/t]	0.00028	[mg/t]	3.2
B(k)F	[g/t]	0.000077	[mg/t]	3.1
I()P	[g/t]	0.000043	[mg/t]	-
PAHs	[g/t]	0.000407	[mg/t]	10.5
HCB	[µg/t]	4.6	[mg/t]	2
PCBs	[µg/t]	103	[mg/t]	5.3

The methodology for calculating BC emissions is described in **Annex X**.

3.5.7.3 Completeness

Emissions are well covered.

3.5.7.4 Source-specific Recalculations

Recalculations of heavy metal and POP emissions were made based on the use of detailed T2 methodology for industrial waste incineration (**Table 3.5.33**).

Table 3.5.33: Differences in emissions (%) in category 1A2f between the previous and current submission caused by recalculations

YEAR	Pb	Cd	Hg	As	Cr	Cu	Ni
2011	95.37	37.57	5.15	7.38	0.42	0.13	-0.04
2012	481.06	190.02	27.22	39.06	2.21	0.70	-0.20
2013	591.86	233.98	33.95	48.75	2.75	0.88	-0.24
2014	565.85	223.65	32.36	46.45	2.62	0.84	-0.23
2015	339.90	134.12	18.91	27.11	1.53	0.49	-0.14
2016	480.65	189.86	27.20	39.03	2.20	0.70	-0.20
2017	497.94	196.72	28.23	40.52	2.29	0.73	-0.20
2018	746.03	295.26	43.63	62.71	3.55	1.13	-0.31
2019	729.38	288.64	42.57	61.18	3.46	1.10	-0.31
2020	655.60	259.30	37.91	54.46	3.08	0.98	-0.27
2021	885.17	350.69	52.70	75.81	4.29	1.37	-0.38
2022	301.01	118.74	16.67	23.89	1.35	0.43	-0.12
2023	14.66	5.77	0.78	1.12	0.06	0.02	-0.01

YEAR	Zn	PCDD/F	PAHs	HCB	PCB
2011	0.20	-88.87	-2.06	39.99	4.74
2012	1.04	-89.78	-9.21	211.86	25.15
2013	1.30	-89.83	-10.97	264.47	31.41
2014	1.23	-99.70	-10.57	251.98	29.93
2015	0.72	-99.56	-6.79	146.99	17.44
2016	1.04	-99.66	-9.20	211.67	25.13
2017	1.08	-99.67	-9.48	219.78	26.09
2018	1.67	-99.75	-13.25	340.29	40.45
2019	1.63	-99.75	-13.01	331.95	39.46
2020	1.45	-99.73	-11.94	295.44	35.10
2021	2.02	-99.78	-15.14	411.47	48.95
2022	0.63	-99.51	-6.08	129.53	15.37
2023	0.03	-92.19	-0.33	6.09	0.72

3.5.8 Mobile Combustion in Manufacturing Industries and Construction (NFR 1A2gvii)

3.5.8.1 Overview

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 3.5.34**. In the year 2024, an increase in energy consumption was observed.

Table 3.5.34: Overview of emissions in category 1A2gvii

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [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
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

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
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
2023	0.4639	0.0662	0.0003	0.0001	0.0296	0.0296	0.0296	0.0183	0.9212
2024	0.5618	0.0763	0.0004	0.0001	0.0359	0.0359	0.0359	0.0222	0.9535
1990/2024	12%	-10%	7%	10%	13%	13%	13%	13%	-39%
2023/2024	21%	15%	20%	21%	21%	21%	21%	21%	4%

YEAR	Cd [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	B(a)P [t]	B(b)F [t]	PAHs [t]
1990	0.0002	0.0008	0.0286	0.0012	0.0002	0.0168	0.0005	0.0008	0.0013
1995	0.0002	0.0008	0.0279	0.0011	0.0002	0.0164	0.0005	0.0008	0.0013
2000	0.0002	0.0008	0.0272	0.0011	0.0002	0.0160	0.0005	0.0008	0.0013
2005	0.0002	0.0008	0.0265	0.0011	0.0002	0.0156	0.0005	0.0008	0.0012
2010	0.0002	0.0008	0.0258	0.0011	0.0002	0.0152	0.0005	0.0007	0.0012
2011	0.0002	0.0008	0.0257	0.0011	0.0002	0.0151	0.0005	0.0007	0.0012
2012	0.0002	0.0008	0.0256	0.0011	0.0002	0.0150	0.0005	0.0007	0.0012
2013	0.0002	0.0008	0.0255	0.0011	0.0002	0.0150	0.0005	0.0007	0.0012
2014	0.0002	0.0010	0.0340	0.0014	0.0002	0.0200	0.0006	0.0010	0.0016
2015	0.0001	0.0007	0.0221	0.0009	0.0001	0.0130	0.0004	0.0006	0.0010
2016	0.0001	0.0006	0.0187	0.0008	0.0001	0.0110	0.0003	0.0005	0.0009
2017	0.0002	0.0009	0.0289	0.0012	0.0002	0.0170	0.0005	0.0009	0.0014
2018	0.0002	0.0012	0.0391	0.0016	0.0002	0.0230	0.0007	0.0012	0.0018
2019	0.0002	0.0009	0.0306	0.0013	0.0002	0.0180	0.0006	0.0009	0.0014
2020	0.0001	0.0007	0.0238	0.0010	0.0001	0.0140	0.0004	0.0007	0.0011
2021	0.0003	0.0014	0.0476	0.0020	0.0003	0.0280	0.0009	0.0014	0.0022
2022	0.0001	0.0005	0.0170	0.0007	0.0001	0.0100	0.0003	0.0005	0.0008
2023	0.0002	0.0008	0.0255	0.0011	0.0002	0.0150	0.0005	0.0007	0.0012
2024	0.0002	0.0009	0.0306	0.0013	0.0002	0.0180	0.0006	0.0009	0.0014
1990/2024	7%	7%	7%	7%	7%	7%	5%	8%	7%
2023/2024	20%	20%	20%	20%	20%	20%	20%	20%	20%

The overview of activity data (energy consumption) for this source category is in [Table 3.5.35](#) below.

Table 3.5.35: Overview of activity data in category 1A2gvii

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

YEAR	LIQUID FUELS [TJ NCV]	BIOMASS [TJ NCV]
2013	603.27	28.96
2014	789.97	49.93
2015	511.73	34.88
2016	432.97	29.49
2017	663.78	49.36
2018	903.10	61.73
2019	710.20	46.74
2020	546.46	40.76
2021	1,092.45	81.34
2022	392.67	29.00
2023	589.41	40.65
2024	709.78	49.28
1990/2024	-1%	-
2023/2024	20%	21%

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 2023 Tier 1 emission factors were used.

3.5.8.3 Completeness

Emissions are well covered. Notation keys are used according to EMEP/EEA GB 2023.

3.5.8.4 Source-specific Recalculations

No recalculations were made in this submission.

3.5.9 Stationary Combustion in Manufacturing Industries and Construction: Other (NFR 1A2gviii)

3.5.9.1 Overview

This category covers the sources that cannot be clearly identified with a particular activity, but generally, it is the combustion process. Activities listed within this category are shown in [Table 3.5.36](#).

Table 3.5.36: Activities according to national categorisation included in category 1A2gviii

CATEGORISATION 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

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 amounts of waste than in the previous year. Subsequently, in 2006, non-compliant plants ceased their activities. The increase in HMs and PAHs in 2017 correlates with the consumption of solid fuels. The decrease in SO_x emissions since 2022 was caused by the installation of separators, which help to reduce these emissions (operator Bukocel) (*Recommendation No SK-1A2gviii-2024-0001*). The overall trend of these emissions is related to the trend of used biomass fuels. The overview of the emissions is shown in *Table 3.5.37*.

Table 3.5.37: Overview of emissions in category 1A2gviii

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [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	0.0344	1.5360
2023	1.0833	4.7199	0.1504	0.0030	0.1210	0.1635	0.2287	0.0330	1.4464
2024	0.8236	4.6097	0.0627	0.0028	0.1077	0.1458	0.2037	0.0295	1.0204
1990/2024	-68%	3657%	-97%	-90%	-85%	-85%	-86%	-72%	-73%
2023/2024	-24%	-2%	-58%	-6%	-11%	-11%	-11%	-10%	-29%

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

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
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
2023	0.0150	0.0049	0.0055	0.0043	0.0084	0.0029	0.0186	0.0045	0.1795
2024	0.0120	0.0048	0.0027	0.0021	0.0083	0.0025	0.0043	0.0021	0.1808
1990/2024	-38%	-14%	-59%	-78%	-31%	-72%	-98%	-87%	-25%
2023/2024	-20%	-2%	-51%	-50%	-1%	-13%	-77%	-53%	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]	PCBs [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
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
2023	0.0760	0.0034	0.0057	0.0019	0.0014	0.0123	0.0199	0.0083
2024	0.0539	0.0035	0.0057	0.0018	0.0014	0.0125	0.0094	0.0035
1990/2024	-28%	22%	18%	14%	17%	18%	-54%	-71%
2023/2024	-29%	4%	1%	-2%	2%	1%	-53%	-58%

The overview of activity data (energy consumption) for this source category is in [Table 3.5.38](#) below.

Table 3.5.38: Overview of activity data in category 1A2gviii

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [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	6,430.89	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

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
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	184.96	179.94	7,114.92	3,008.66	NO
2021	334.19	192.74	8,067.25	3,018.37	NO
2022	326.45	180.04	7,111.44	2,769.49	NO
2023	313.61	149.81	6,730.28	2,591.56	NO
2024	246.64	88.60	6,149.16	2,068.06	NO
1990/2024	-42%	-96%	-70%	85%	-
2023/2024	-21%	-41%	-9%	-20%	-

3.5.9.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024.

The historical data (1990-1999) are not covered by the NEIS; therefore, the emission factors used for the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.5.39](#)).

Table 3.5.39: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NOx	[g/tGJ]	107.09
NM VOC	[g/tGJ]	5.09
SOx	[g/tGJ]	98.34
NH ₃	[g/tGJ]	1.12
TSP	[g/tGJ]	61.07
PM _{2.5}	[% of TSP]	47.65%
PM ₁₀	[% of TSP]	65.06%
CO	[g/tGJ]	154.29

The methodology for calculating BC, heavy metals, and POPs is described in [Annex X](#). [Table 3.5.40](#) shows the distribution of fuels to the subsequent categories used in the methodology.

Table 3.5.40: Fuel consumption in TJ in category 1A2gviii

TYPE OF FUEL	LIQUID FUELS			HARD COAL	BROWN COAL		
TYPE OF BOILER	ALL TYPE OF BOILERS		STATIONERY ENGINES	FIXED BED BOILERS	FIXED BED BOILERS	FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	<5	5-50	-	<5	<5	<5	5-50
1990	440.87	631.39	81.02	0.01	11.47	75.32	209.61
1991	357.20	511.56	65.64	0.01	9.34	61.37	170.78
1992	285.76	409.25	52.52	0.01	7.61	50.02	139.21
1993	225.68	323.20	41.47	0.01	6.25	41.06	114.27
1994	176.02	252.08	32.35	0.01	5.21	34.22	95.22
1995	135.85	194.56	24.97	0.01	5.22	34.29	95.41
1996	104.25	149.30	19.16	0.01	5.09	33.43	93.02
1997	93.32	133.65	17.15	0.01	4.78	31.37	87.31

TYPE OF FUEL	LIQUID FUELS			HARD COAL	BROWN COAL		
TYPE OF BOILER	ALL TYPE OF BOILERS		STATIONERY ENGINES	FIXED BED BOILERS	FIXED BED BOILERS	FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	<5	5-50	-	<5	<5	<5	5-50
1998	76.06	108.93	13.98	0.01	4.24	27.87	77.55
1999	51.53	73.80	9.47	0.00	3.45	22.65	63.04
2000	55.59	79.62	10.22	0.01	5.84	38.38	106.80
2001	24.07	34.47	4.42	0.01	6.00	39.41	109.68
2002	32.09	45.95	5.90	0.01	5.30	34.84	96.94
2003	71.96	103.05	13.22	0.01	6.65	43.67	121.53
2004	44.49	63.71	8.18	0.01	6.64	43.62	121.38
2005	56.21	80.50	10.33	0.01	5.78	37.99	105.73
2006	61.63	88.26	11.33	0.01	6.48	42.57	118.48
2007	64.96	93.03	11.94	0.01	5.95	39.12	108.86
2008	59.47	85.16	10.93	0.01	5.37	35.29	98.21
2009	71.66	102.62	13.17	0.01	4.49	29.49	82.07
2010	51.28	73.43	9.42	0.01	4.44	29.15	81.12
2011	59.85	14.46	1.66	-	3.52	25.30	121.09
2012	41.31	33.08	30.72	0.00	7.43	21.48	86.53
2013	31.75	15.83	9.36	0.11	2.23	16.75	95.49
2014	13.83	21.25	4.74	0.01	1.95	12.58	74.70
2015	30.83	30.36	6.36	0.01	0.74	13.31	96.34
2016	25.72	45.65	12.93	-	0.81	10.30	93.29
2017	20.37	33.14	40.48	2.31	2.69	7.93	108.92
2018	37.13	33.59	24.58	2.35	2.14	7.01	93.21
2019	23.62	31.50	28.59	2.47	2.88	6.77	103.23
2020	14.74	18.61	13.84	2.49	0.67	5.84	102.06
2021	23.75	29.61	59.07	2.40	3.09	7.48	110.78
2022	22.00	28.57	49.41	2.35	0.69	6.23	94.01
2023	34.52	32.94	13.68	2.19	1.12	5.48	64.18
2024	12.72	-	30.21	2.39	0.94	4.19	24.26

TYPE OF FUEL	GASEOUS FUELS				BIOMASS			
TYPE OF BOILER	ALL TYPE OF BOILERS		STATIONERY ENGINES	GAS TURBINES	FIXED BED BOILERS		FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	<5	5-50	50-100	>100	<5	5-50	<5	5-50
1990	8,349.95	2,523.27	15.81	3.06	267.61	938.37	349.36	2,182.78
1991	8,574.84	2,591.23	16.23	3.14	220.75	774.06	288.18	1,800.55
1992	8,860.20	2,677.46	16.77	3.25	179.51	629.45	234.34	1,464.19
1993	9,183.59	2,775.19	17.39	3.37	143.57	503.42	187.42	1,171.01
1994	9,529.21	2,879.63	18.04	3.49	112.77	395.42	147.21	919.80
1995	9,881.29	2,986.02	18.71	3.62	86.96	304.94	113.53	709.33
1996	10,224.02	3,089.59	19.36	3.75	66.01	231.44	86.17	538.37
1997	10,541.63	3,185.57	19.96	3.86	49.74	174.41	64.93	405.70
1998	10,818.32	3,269.18	20.48	3.96	38.02	133.31	49.63	310.09
1999	11,131.21	3,363.74	21.07	4.08	30.69	107.62	40.07	250.33
2000	9,335.74	2,821.17	17.67	3.42	30.64	107.44	40.00	249.93
2001	10,098.31	3,051.61	19.12	3.70	45.17	158.38	58.97	368.42

TYPE OF FUEL	GASEOUS FUELS				BIOMASS			
TYPE OF BOILER	ALL TYPE OF BOILERS		STATIONERY ENGINES	GAS TURBINES	FIXED BED BOILERS		FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	<5	5-50	50-100	>100	<5	5-50	<5	5-50
2002	9,371.96	2,832.11	17.74	3.43	90.75	318.20	118.47	740.18
2003	9,706.56	2,933.22	18.38	3.56	52.19	183.02	68.14	425.72
2004	8,115.40	2,452.39	15.36	2.97	64.43	225.94	84.12	525.56
2005	7,958.94	2,405.11	15.07	2.92	151.83	532.37	198.20	1,238.37
2006	7,829.08	2,365.87	14.82	2.87	172.97	606.52	225.81	1,410.85
2007	7,305.70	2,207.71	13.83	2.68	368.58	1,292.42	481.17	3,006.34
2008	6,122.86	1,850.27	11.59	2.24	364.92	1,279.59	476.39	2,976.48
2009	4,606.42	1,392.01	8.72	1.69	430.84	1,510.71	562.44	3,514.11
2010	5,327.47	1,609.91	10.09	1.95	427.17	1,497.86	557.65	3,484.23
2011	5,016.16	1,656.02	238.15	68.27	773.83	1,647.19	516.88	3,776.44
2012	5,315.80	1,781.43	27.44	0.78	484.34	1,219.98	507.10	4,246.07
2013	5,368.13	1,751.72	58.16	-	476.85	1,001.46	435.94	3,789.79
2014	4,727.06	1,074.45	115.09	1.01	524.64	1,104.24	326.74	3,452.61
2015	4,898.45	1,069.63	599.21	11.98	448.77	983.41	336.22	3,661.85
2016	4,978.86	1,148.35	723.21	8.21	467.90	1,192.16	367.40	3,262.40
2017	5,420.02	2,403.65	633.71	-	489.67	884.94	408.30	4,053.72
2018	5,637.71	1,235.53	207.30	-	416.74	827.46	373.46	4,206.76
2019	5,177.09	1,210.73	590.78	-	399.90	773.42	381.28	4,353.44
2020	4,918.60	966.82	513.87	-	375.93	849.82	371.15	2,450.55
2021	5,869.13	1,061.03	554.81	-	400.08	1,020.11	392.37	4,075.93
2022	4,778.74	819.85	838.43	-	302.68	858.25	449.95	4,046.65
2023	4,690.41	770.44	553.03	-	320.10	833.33	491.72	2,242.54
2024	3,798.89	806.12	255.76	-	342.38	879.49	447.32	172.02

3.5.9.3 Completeness

Emissions are well covered.

3.5.9.4 Source-specific Recalculations

No recalculations were made in this submission.

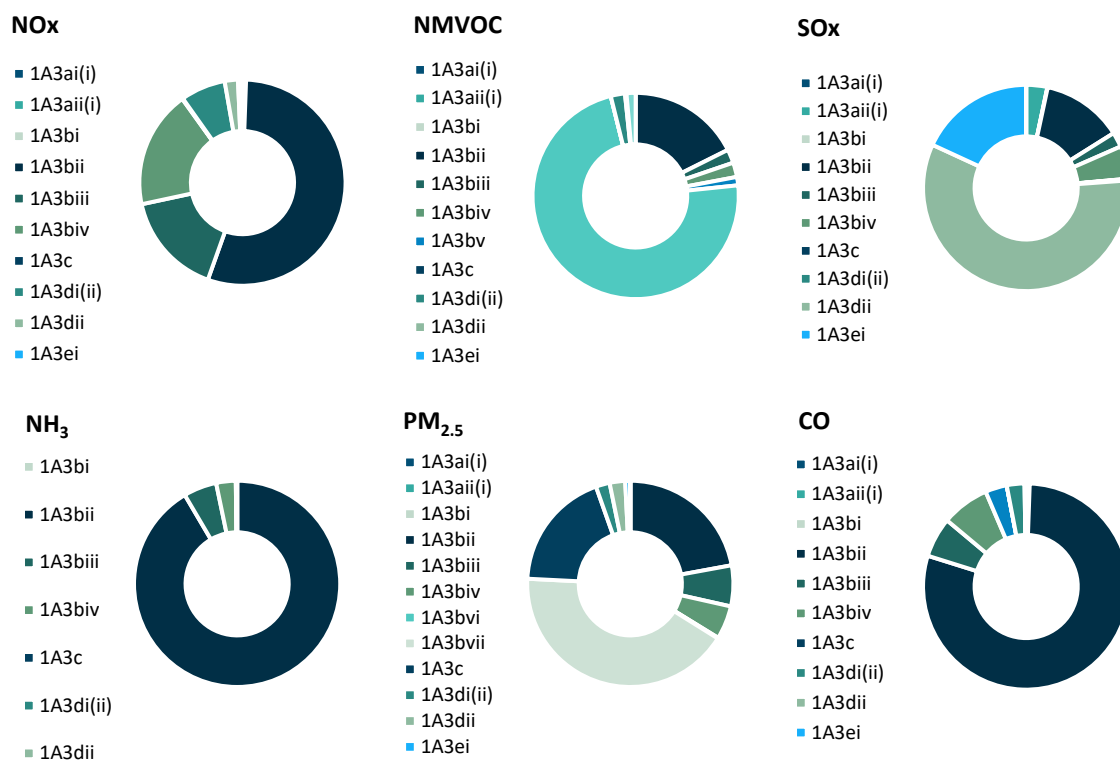
3.6 TRANSPORT (NFR 1A3)

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 an observed shift from public transportation to individual passenger cars in Slovakia. After a decrease in fuel consumption and emissions during the 2020 pandemic, a rise can be observed again. In 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 29.38% (TSP) and 93.52% (SO_x), although emission of ammonia has increased by 1 438.85% and PAH increased by 127.49%, in comparison with the base year. More information about the status of emissions is in [Figure 3.6.1](#).

Ammonia mostly comes from road transportation, exactly 99.93% of it, and the rest is from railways and navigation (0.07%). The emissions from road and non-road transport were calculated by using models, default methodologies and the consistent data series from 1990 to 2024.

Figure 3.6.1: Shares of main pollutants emissions in categories of 1A3 in 2024



The category-specific QA/QC plan is based on the general QA/QC plan described in [Chapter 1.6.1](#) of this report. The sectoral expert prepared the emissions inventory in the transport categories. Slovakia has been dealing with data inconsistency from several statistical sources in the last few years regarding fuel consumption in transport. Therefore, in accordance with our QA/QC Plan, the extensive analysis of available statistical information on liquid fuels in transport began in 2017.

The results were published in the statistical journal in Slovak (2).

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 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 2014-2023:

- 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 3.6.1](#)).

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

Table 3.6.1: Crude oil and crude oil products data flow and utilisation (final user is the SHMÚ)

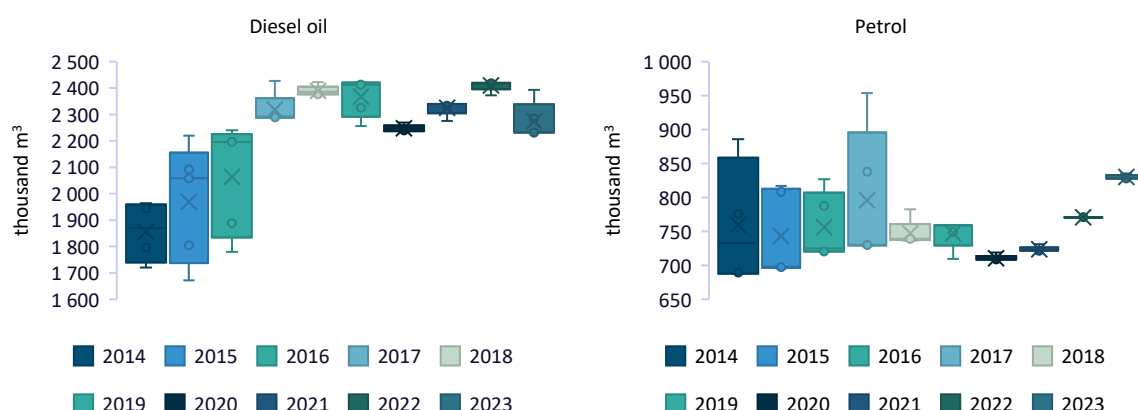
ORIGIN OF DATA	PRIMARY USER	SECONDARY USER
Import-export data (ŠÚ SR - Dept. of Foreign Trade)	Statistical Office of the Slovak Republic (Dept. of Energy Statistics)	EUROSTAT
Data regarding production and sales (companies)		Slovak Hydrometeorological Institute
Data from taxes on sales of biofuels	Financial Administration of the Slovak Republic	Ministry of Economy
Data from taxes on sales of products of crude oil		SK - BIO (5)
Confirmation (certificate) of the sustainability of biofuels	Slovak Hydrometeorological Institute (according to Art. 7a of Directive 98/70/EC)	European Environmental Agency
Data on production and sales (companies)	Slovak State Material Reserves	International Energy Agency (data on crude oil and crude oil products)
		EUROSTAT (natural gas)
Data on fuel sales at gas stations (NEIS)	Ministry of Environment (according to Art. 8) of Directive 98/70/EC)	European Environmental Agency

As shown in **Table 3.6.1** and in **Figure 3.6.2**, 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 (**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.

The main outcome of this analysis is the harmonisation of fuel consumption in the country to the maximum possible level and the lowering of the differences in reporting by different subjects in 2023. 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.) (4; 6; 7) and **thus the overview and comparison of different sources of data was concluded in 2023.**

Figure 3.6.2: Results of fuels consumption comparison according to different sources (thousand m³)



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 are 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 aeroclubs with a predominance 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 2005-2024, EUROCONTROL data on the number of flights, fuel consumption and share of domestic and international flights were used. The emissions of NO_x, SO_x, PMs and CO were taken from the EUROCONTROL file for LTO and Cruise separately and reported in International ([Table 3.6.2](#)) and Domestic aviation LTO cycles ([Table 3.6.3](#)). The fuel consumption in category [1A3ai\(i\)](#) increased compared to the base year 1990 by 152% ([Table 3.6.4](#)). The total consumption of jet kerosene was 316.19 TJ, and the consumption of aviation gasoline was 0.17 TJ allocated in the international aviation LTO cycle in 2024. After a decrease in 2020, there has been a rise in international aviation as a part of the recovery of the sector after the COVID-19 pandemic. From 2005 until 2019, international aviation emissions were increasing. The increase in fuel consumption and emissions was influenced by the arrival of low-cost airlines (Ryanair – based in Bratislava, and WizzAir – based in Košice) and charter flights.

The fuel consumption in category [1A3aii\(i\)](#) decreased compared to the base year 1990 by 61%. The total consumption of jet kerosene was 5.59 TJ, and the consumption of aviation gasoline was 0.24 TJ in the domestic aviation LTO cycle in 2024 ([Table 3.6.3](#)). Since 2005, domestic aviation emissions have been decreasing. This decrease and the whole category is influenced by the fact that the Slovak Republic has no official national airline as Slovak Airlines has been out of business since 2007, SkyEurope since 2009 and the close proximity of other big international airports in Vienna and Budapest.

Table 3.6.2: Overview of emissions from international aviation 1A3ai(i)

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]	Pb [t]
1990	0.1020	0.0012	0.0271	0.0007	0.0007	0.0007	0.0003	0.0680	NE
1995	0.0677	0.0008	0.0180	0.0005	0.0005	0.0005	0.0002	0.0458	NE
2000	0.0776	0.0009	0.0205	0.0005	0.0005	0.0005	0.0002	0.0510	NE
2005	0.0698	0.0008	0.0051	0.0011	0.0011	0.0011	0.0005	0.0632	NE
2010	0.0771	0.0011	0.0049	0.0008	0.0008	0.0008	0.0004	0.0541	NE
2011	0.0782	0.0010	0.0050	0.0008	0.0008	0.0008	0.0004	0.0557	NE
2012	0.0722	0.0010	0.0046	0.0007	0.0007	0.0007	0.0004	0.0564	NE
2013	0.0686	0.0011	0.0044	0.0008	0.0008	0.0008	0.0004	0.0560	NE
2014	0.0700	0.0012	0.0043	0.0008	0.0008	0.0008	0.0004	0.0531	NE
2015	0.0834	0.0012	0.0051	0.0009	0.0009	0.0009	0.0005	0.0613	NE
2016	0.0917	0.0016	0.0056	0.0010	0.0010	0.0010	0.0005	0.0693	NE
2017	0.0997	0.0015	0.0060	0.0009	0.0009	0.0009	0.0004	0.0676	NE
2018	0.1113	0.0015	0.0068	0.0011	0.0011	0.0011	0.0005	0.0747	NE
2019	0.1127	0.0013	0.0069	0.0011	0.0011	0.0011	0.0005	0.0747	0.0024
2020	0.0364	0.0006	0.0022	0.0005	0.0005	0.0005	0.0002	0.0291	0.0017
2021	0.0424	0.0009	0.0026	0.0004	0.0004	0.0004	0.0002	0.0348	0.0019
2022	0.0827	0.0011	0.0049	0.0007	0.0007	0.0007	0.0003	0.0544	0.0017
2023	0.0968	0.0014	0.0063	0.0008	0.0008	0.0008	0.0004	0.0829	0.0022
2024	0.1037	0.0012	0.0061	0.0007	0.0007	0.0007	0.0004	0.0666	0.0022
1990/2024	2%	3%	-77%	8%	8%	8%	8%	-2%	-
2023/2024	7%	-17%	-2%	-6%	-6%	-6%	-6%	-20%	1%

Table 3.6.3: Overview of emissions from domestic aviation 1A3aii(i)

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]	Pb [t]
1990	0.0809	0.0007	0.0226	0.0004	0.0004	0.0004	0.0002	0.0199	NE
1995	0.0537	0.0004	0.0150	0.0003	0.0003	0.0003	0.0001	0.0132	NE
2000	0.0614	0.0005	0.0172	0.0003	0.0003	0.0003	0.0002	0.0151	NE
2005	0.0079	0.0001	0.0006	0.0002	0.0002	0.0002	0.0001	0.0108	NE
2010	0.0043	0.0002	0.0004	0.0002	0.0002	0.0002	0.0001	0.0121	NE
2011	0.0034	0.0002	0.0003	0.0002	0.0002	0.0002	0.0001	0.0112	NE
2012	0.0032	0.0002	0.0003	0.0002	0.0002	0.0002	0.0001	0.0127	NE
2013	0.0027	0.0001	0.0002	0.0002	0.0002	0.0002	0.0001	0.0113	NE
2014	0.0030	0.0001	0.0003	0.0002	0.0002	0.0002	0.0001	0.0094	NE
2015	0.0032	0.0002	0.0003	0.0002	0.0002	0.0002	0.0001	0.0123	NE
2016	0.0029	0.0002	0.0003	0.0002	0.0002	0.0002	0.0001	0.0095	NE
2017	0.0032	0.0001	0.0003	0.0001	0.0001	0.0001	0.0001	0.0097	NE
2018	0.0026	0.0001	0.0002	0.0001	0.0001	0.0001	0.0000	0.0086	NE
2019	0.0017	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0044	0.0008
2020	0.0007	0.0001	0.0001	5.0E-05	5.0E-05	5.0E-05	2.4E-05	0.0030	0.0009
2021	0.0012	0.0001	0.0001	1.4E-05	1.4E-05	1.4E-05	6.8E-06	0.0047	0.0018
2022	0.0012	0.0001	0.0001	1.6E-05	1.6E-05	1.6E-05	7.7E-06	0.0060	0.0024
2023	0.0014	0.0002	0.0001	1.9E-05	1.9E-05	1.9E-05	9.0E-06	0.0066	0.0027
2024	0.0013	0.0002	0.0001	1.8E-05	1.8E-05	1.8E-05	8.5E-06	0.0073	0.0031
1990/2024	-98%	-76%	-99%	-96%	-96%	-96%	-96%	-63%	-
2023/2024	-2%	-34%	-8%	-6%	-6%	-6%	-6%	11%	15%

The overview of the activity data (energy consumption) for this source category is in [Table 3.6.4](#).

Table 3.6.4: Overview of activity data from international aviation 1A3ai(i) and domestic aviation 1A3aai(i)

YEAR	LIQUID FUELS [TJ NCV]: CATEGORY 1A3ai(i)	LIQUID FUELS [TJ NCV]: CATEGORY 1A3aai(i)
1990	125.37	14.80
1995	89.44	10.51
2000	88.48	10.49
2005	263.97	31.99
2010	251.22	19.25
2011	251.22	19.25
2012	235.74	14.50
2013	226.71	12.58
2014	224.15	13.30
2015	264.49	14.02
2016	289.64	13.06
2017	309.96	13.41
2018	349.00	11.01
2019	354.75	7.21
2020	114.61	2.93
2021	133.52	5.13
2022	252.32	5.54
2023	322.36	6.36
2024	316.36	5.83
1990/2024	152%	-61%
2023/2024	-2%	-8%

3.6.2.2 Methodological Issues

The airport traffic in Slovakia is determined only by the origin of the 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 the time series 1990-2004. Tier 1 methodology is based on fuel sold at the airports. For this period, only the 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 the time series 2005-2017. The share is a constant value. The real share of national and international activities for the period 2005-2024 was taken from the EUROCONTROL database directly. Data regarding disaggregation to LTO and cruise phase for the period 1990-2004 ([Table 3.6.5](#)) is taken from EUROCONTROL and the share is based on the real data used for the time series 2005-2017.

Table 3.6.5: Shares of fuel consumption in international and domestic aviation for the period 1990-2004

FUELS	INTERNATIONAL AVIATION 1A3ai(i)	DOMESTIC AVIATION 1A3aai(i)
	1990-2004	
Aviation gasoline	70%	30%
Jet kerosene	95%	5%

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 3.6.5](#)) 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 2023.

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 an annual basis.

From 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 the 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.

In 2024, Slovakia made analysis of jet kerosene and aviation gasoline for heavy metals content. According to this analysis, a new emission factor for lead (Pb) was defined for this inventory ([Table 3.6.6](#)).

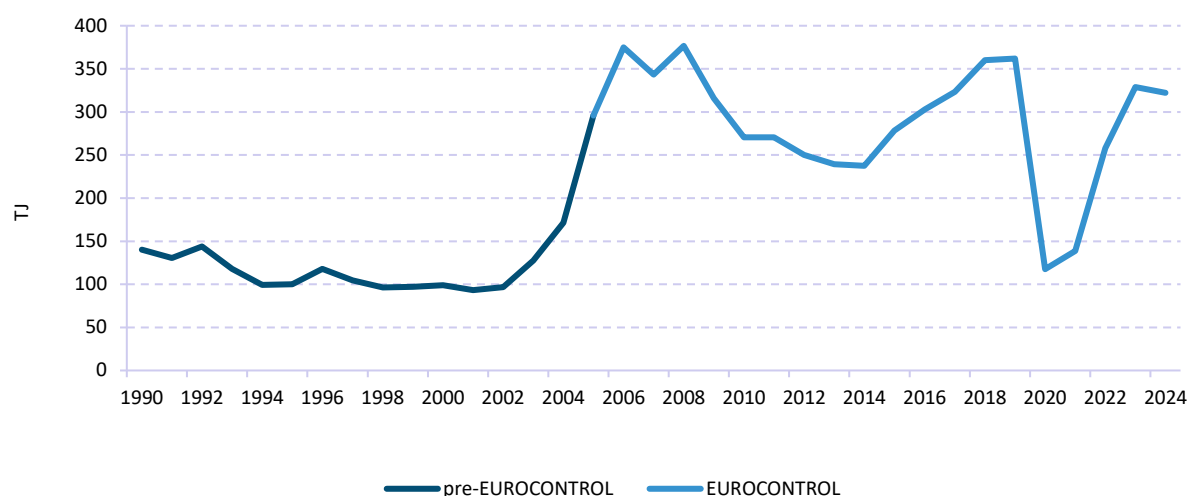
Table 3.6.6: Average emission factors for the pollutants in civil aviation according to EUROCONTROL

FUEL TYPE		EMISSION FACTORS						
		NO _x	NM _{VOC}	SO _x	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	0.00
	international	13.66	0.04	0.84	0.16	3.08	0.48	0.00

3.6.2.3 Completeness

Since 2011, the agreement between the European Commission (the EC) and the EUROCONTROL has been 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 checks, however, this information is not possible to make publicly available. Consistency of the time-series ([Figure 3.6.3](#)) is maintained by using calculated average EFs from EUROCONTROL. The methodology is explained in [Chapter 3.6.2.1](#).

Figure 3.6.3: 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

No recalculations were made in this submission.

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 the interconnection of all municipalities. In recent years, road transport has expanded significantly in the transport of goods and persons. In 2024, the transport network included 546 km of highways, 320 km of motorways and 3,336 km of category 1st class roads. The total road network represented 18,147 km of roads in the Slovak Republic (8) in 2024. Road transportation is the most important and key category with the highest share of emissions and the continually increasing trend in fuels consumption within transport. There is a huge increase in the emission of ammonia compared to the base year – almost 1,498% ([Table 3.6.7](#)). This is caused by the expansion of light commercial vehicles in category EURO 5 and onwards, which have higher EFs than vehicles in category EURO 2, 3 and 4.

Table 3.6.7: Overview of emissions in road transport (1A3b)

YEAR	NOx [kt]	NM VOC [kt]	SOx [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	43.8129	26.0657	2.4180	0.0249	2.8064	3.0529	3.3440	1.3470	193.0129
1995	37.2257	26.6181	1.9042	0.0874	1.9271	2.1443	2.4035	0.9119	209.2321
2000	31.5863	20.1830	0.6929	0.3490	1.4436	1.6694	1.9412	0.7016	168.3104
2005	43.2728	19.8301	0.1934	0.5261	2.2405	2.5892	3.0084	1.1622	170.1213
2010	36.8401	11.7866	0.0285	0.4700	2.1781	2.5618	3.0272	1.1963	89.2107
2011	29.5004	8.1419	0.0267	0.4110	1.6056	1.9666	2.4052	0.8453	58.4767
2012	30.9457	7.9975	0.0283	0.4179	1.6633	2.0481	2.5170	0.8758	56.2936

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
2013	25.0283	5.0610	0.0274	0.4516	1.4275	1.9372	2.4398	0.6471	32.9885
2014	23.3653	4.3562	0.0294	0.3872	1.3127	1.8373	2.3549	0.5738	27.2721
2015	24.7296	4.5518	0.0307	0.3628	1.4597	2.0453	2.6161	0.6314	25.5627
2016	24.1271	3.6070	0.0314	0.4179	1.3639	1.9930	2.6079	0.5902	18.6483
2017	23.2931	4.4091	0.0351	0.3696	1.3910	2.0064	2.6105	0.5589	24.6280
2018	23.1026	3.5897	0.0337	0.3944	1.3141	1.9759	2.6251	0.5337	15.8916
2019	22.2104	3.5624	0.0361	0.3973	1.2973	1.9764	2.6415	0.5125	15.0476
2020	20.1376	3.1194	0.0340	0.3599	1.1764	1.7979	2.3827	0.4728	12.7342
2021	19.7287	3.2470	0.0368	0.3653	1.2049	1.8619	2.5092	0.4539	13.5567
2022	19.7523	5.2310	0.0386	0.3911	1.2375	1.9373	2.6260	0.4545	13.7892
2023	17.8257	5.3202	0.0380	0.4050	1.2013	1.8914	2.5696	0.4311	14.4781
2024	16.7243	5.0521	0.0376	0.3982	1.1336	1.8164	2.4839	0.3912	12.8236
1990/2024	-62%	-81%	-98%	1498%	-60%	-41%	-26%	-71%	-93%
2023/2024	-6%	-5%	-1%	-2%	-6%	-4%	-3%	-9%	-11%

YEAR	Priority HMs [t]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCBs [kg]
1990	9.8710	0.0137	0.0300	0.0274	0.0164	0.0874	0.0002	0.0001
1995	8.6211	0.0114	0.0246	0.0214	0.0146	0.0720	0.0003	0.0001
2000	1.2954	0.0114	0.0237	0.0211	0.0139	0.0700	0.0005	0.0001
2005	1.8905	0.0190	0.0383	0.0357	0.0211	0.1141	0.0007	0.0002
2010	2.3106	0.0281	0.0464	0.0424	0.0281	0.1450	0.0010	0.0002
2011	2.3096	0.0284	0.0444	0.0401	0.0278	0.1408	0.0008	0.0002
2012	2.4155	0.0309	0.0480	0.0434	0.0301	0.1524	0.0009	0.0002
2013	3.0346	0.0352	0.0513	0.0466	0.0321	0.1652	0.0009	0.0002
2014	3.1211	0.0375	0.0543	0.0492	0.0342	0.1752	0.0008	0.0002
2015	3.5157	0.0443	0.0614	0.0549	0.0400	0.2006	0.0009	0.0002
2016	3.7682	0.0470	0.0655	0.0586	0.0425	0.2136	0.0009	0.0002
2017	3.6746	0.0459	0.0646	0.0581	0.0415	0.2101	0.0008	0.0002
2018	3.9537	0.0496	0.0697	0.0625	0.0447	0.2265	0.0008	0.0002
2019	4.0619	0.0514	0.0700	0.0622	0.0457	0.2294	0.0008	0.0002
2020	3.8325	0.0530	0.0623	0.0522	0.0458	0.2134	0.0008	0.0002
2021	3.9114	0.0494	0.0670	0.0595	0.0436	0.2196	0.0007	0.0001
2022	4.1694	0.0518	0.0700	0.0622	0.0454	0.2294	0.0007	0.0001
2023	4.1175	0.0503	0.0668	0.0590	0.0437	0.2199	0.0007	0.0001
2024	4.0930	0.0516	0.0659	0.0573	0.0448	0.2196	0.0006	0.0001
1990/2024	-59%	278%	120%	109%	173%	151%	181%	30%
2023/2024	-1%	3%	-1%	-3%	2%	0%	-8%	-8%

The major share of emissions belongs to passenger cars ([Table 3.6.8](#)). Most of the priority HMs (Pb, Cd and Hg) come from tyre and brake wear abrasion. Most of the NO_x, NMVOC and CO emissions are emitted in the cities ([Table 3.6.9](#)).

Table 3.6.8: Overview of total emissions according to the type of vehicles in 2024

VEHICLE CATEGORY	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	TSP [kt]	CO [kt]	Priority HMs [t]	PAHs [t]
Passenger cars	10.2421	0.9253	0.0236	0.3648	0.2644	10.5428	0.0123	0.1359
Light duty vehicles	3.0204	0.1131	0.0043	0.0207	0.0768	0.8326	0.0017	0.0251
Heavy duty vehicles and buses	3.4405	0.1190	0.0095	0.0122	0.0629	0.9964	0.0037	0.0522

VEHICLE CATEGORY	NOx [kt]	NMVOC [kt]	SOx [kt]	NH ₃ [kt]	TSP [kt]	CO [kt]	Priority HMs [t]	PAHs [t]
Mopeds & motorcycles	0.0213	0.0689	0.0001	0.0005	0.0014	0.4518	0.0001	0.0003
Gasoline evaporation	NA	3.8259	NA	NA	NA	NA	NA	NA
Automobile tyre and brake wear abrasion	NA	NA	NA	NA	1.2432	NA	4.0752	0.0060
Automobile road abrasion	NA	NA	NA	NA	0.8351	NA	NE	NE

Table 3.6.9: Results from COPERT in the distribution for agglomeration mode in 2024

	NOx [kt]	NMVOC [kt]	SOx [kt]	NH ₃ [kt]	PM _{2.5} [kt]	CO [kt]
Urban	8.1112	0.8915	0.0016	0.1109	0.5149	7.9314
Rural	5.9121	0.2621	0.0015	0.1866	0.4566	3.1704
Highway	2.7010	0.0726	0.0006	0.1008	0.1621	1.7218

3.6.3.2 Methodological Issues

The COPERT model 5 (v5.8) 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 the model COPERT 5 is based on the EMEP/EEA GB 2023 methodology. This methodology balances fifteen different emissions, including greenhouse gases from road transport. The preparation of the main 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 the COPERT 5 model are equal, except for fossil petrol. There is a statistically insignificant difference at 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 379 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 (9).

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 to the operating temperature.

The EF 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, NO_x, NH₃, PMs and partially CH₄ 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 3.6.10](#)). Particularly, kilometres (km) travelled are not available in Slovakia. Therefore, new input data on mileage records 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 mileage records 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 mileage records in those years can be calculated, and if the mileage records are divided by the number of years, the average annual mileage record can be obtained. To distribute the number of vehicles to their appropriate COPERT category, the data on mileage 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 (10)).

Table 3.6.10: Overview of input data used in the COPERT 5 model in 2024

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	2,558,153	10,562	Diesel N1-III	137 583	16 348
Petrol Mini	6,159	5,616	Battery electric N1-I	19	5 361
Petrol Small	787,870	4,618	Battery electric N1-II	157	7 619
Petrol Medium	410,786	5,603	Battery electric N1-III	565	13 827
Petrol Large-SUV-Executive	49,318	6,429	Heavy Duty Trucks	57 529	14 063
Petrol 2-Stroke	140	1,918	Petrol >3,5 t	99	865
Petrol Hybrid Mini	24	5,155	Diesel Rigid <=7,5 t	17 011	17 776
Petrol Hybrid Small	14,324	9,979	Diesel Rigid 7,5 - 12 t	10 068	24 293
Petrol Hybrid Medium	54,288	13,680	Diesel Rigid 12 - 14 t	2 639	12 097
Petrol Hybrid Large-SUV-Executive	15,169	16,065	Diesel Rigid 14 - 20 t	3 482	11 810
Petrol PHEV Small	1850	15,265	Diesel Rigid 20 - 26 t	966	5 919
Petrol PHEV Medium	5,030	14,863	Diesel Rigid 26 - 28 t	37	10 580
Petrol PHEV Large-SUV-Executive	2,971	19,361	Diesel Rigid 28 - 32 t	169	4 817
Diesel Mini	352	2,100	Diesel Rigid >32 t	165	2 898
Diesel Small	23,255	10,814	Diesel Articulated 14 - 20 t	22682	65 249
Diesel Medium	921,618	16,103	Diesel Articulated 50 - 60 t	13	29 594
Diesel Large-SUV-Executive	202,318	14,182	CNG Articulated < 40 t	24	25 099
Diesel PHEV Large-SUV-Executive	98	24,090	LNG Articulated < 40 t	110	86 223

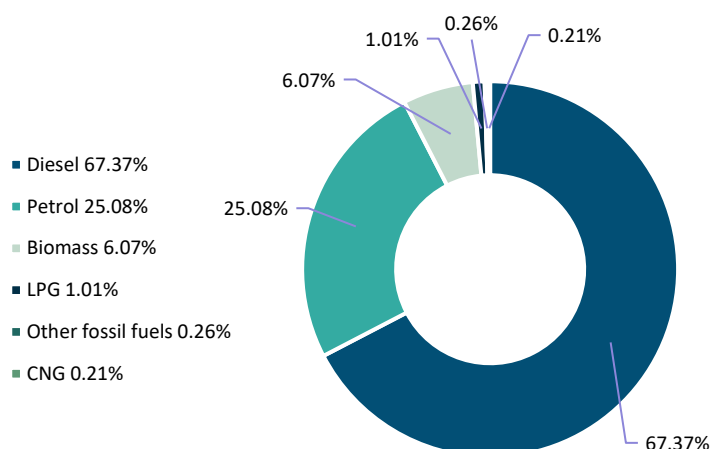
CATEGORY OF ROAD VEHICLE	ACTIVITY DATA		CATEGORY OF ROAD VEHICLE	ACTIVITY DATA	
	NUMBER OF VEHICLES	AVERAGE MILEAGE [km/VEH]		NUMBER OF VEHICLES	AVERAGE MILEAGE [km/VEH]
LPG Bifuel Mini	17	1,859	Buses	6,150	23,886
LPG Bifuel Small	24,659	15,546	Diesel Urban Buses Midi <=15 t	40	52,019
LPG Bifuel Medium	17,947	14,636	Diesel Urban Buses Standard 15 - 18 t	4,984	32,509
LPG Bifuel Large-SUV-Executive	4,484	14,165	Diesel Urban Buses Articulated >18 t	13	6,957
CNG Bifuel Mini	29	1,924	Diesel Coaches Standard <=18 t	615	28,054
CNG Bifuel Small	1,117	13,710	Diesel Coaches Articulated >18 t	216	23,830
CNG Bifuel Medium	468	17,478	Urban Buses Diesel Hybrid	4	26,940
CNG Bifuel Large-SUV-Executive	62	11,181	Urban CNG Buses	74	17,777
Battery electric Mini	644	7,169	Battery electric -	41	23,238
Battery electric Small	1,858	11,135	L-Category	176,807	1,110
Battery electric Medium	4,136	11,110	Petrol Mopeds 2-stroke <50 cm ³	1,497	781
Battery electric Large-SUV-Executive	7,162	19,667	Petrol Mopeds 4-stroke <50 cm ³	25,067	797
Light Commercial Vehicles	257,104	11,112	Petrol Motorcycles 2-stroke >50 cm ³	2915	792
Petrol N1-I	21,603	17,478	Petrol Motorcycles 4-stroke <250 cm ³	52,286	865
Petrol N1-II	8,739	11,181	Petrol Motorcycles 4-stroke 250 - 750 cm ³	51,639	1,477
Petrol N1-III	2,047	12,270	Petrol Motorcycles 4-stroke >750 cm ³	43,281	2,137
Diesel N1-I	15,181	13,463	Petrol Quad & ATVs	56	306
Diesel N1-II	71,210	14,753	Micro-car	66	1,684

Input parameters for the CNG buses have been 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 NO_x 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 can 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 SHMÚ 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 67.37%, followed by petrol with 25.08% share, then biomass (6.07%), LPG (1.01%), Other fossil fuels (fossil part of biofuels) (0.26%) and CNG (0.21%) in 2024 (**Figure 3.6.4**).

Figure 3.6.4: Share of fuels on total consumption in road transport in 2024



The blending of biomass in liquid fuels was considered, and the bio-emissions have been calculated since 2007 (the first year of using blended fuels in transport in Slovakia). The information about fuel 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 3.6.11**).

Table 3.6.11: Estimated activity data and share of biomass for the time series 2007-2024

YEAR	GASOLINE		DIESEL OIL		CNG and LNG	
	BIOMASS SHARE % (energy)	BIOMASS [TJ]	BIOMASS SHARE % (energy)	BIOMASS [TJ]	BIOMASS SHARE % (energy)	BIOMASS [TJ]
2007	2.30%	652.26	4.09%	2,677.29	NO	NO
2008	1.23%	358.17	4.77%	2,795.75	NO	NO
2009	2.58%	706.72	5.14%	3,090.30	NO	NO
2010	2.95%	779.13	5.28%	3,577.88	NO	NO
2011	2.97%	715.87	6.05%	3,741.68	NO	NO
2012	2.94%	710.56	5.79%	3,846.12	NO	NO
2013	3.21%	726.60	6.43%	4,107.36	NO	NO
2014	3.88%	859.33	5.65%	3,766.08	NO	NO
2015	3.33%	747.87	5.74%	4,342.97	NO	NO
2016	3.10%	725.62	6.68%	5,158.95	NO	NO
2017	4.06%	943.49	6.92%	5,464.18	NO	NO
2018	4.52%	1,018.32	6.97%	5,697.80	NO	NO
2019	4.46%	1,042.07	6.45%	5,371.36	NO	NO
2020	6.20%	1,390.40	7.27%	5,401.90	NO	NO
2021	6.20%	1,419.47	6.96%	5,617.89	NO	NO
2022	6.04%	1,645.29	6.95%	5,779.55	NO	NO
2023	5.96%	1,644.39	6.46%	5,231.16	NO	NO
2024	6.07%	1,768.19	6.53%	5,134.54	1.41%	32.28

In ETBE, the bio-component is considered only 47% 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 the Fuel Quality Directive, art. 7a ([Table 3.6.12](#)).

Table 3.6.12: National fossil carbon content in FAME in 2024

FEEDSTOCK	VOLUME [m ³]	C FOSSIL PART	CARBON CONTENT	g FOSSIL CO ₂ /g FAME
Rapeseed	77,617.73	5.30%	75.50%	0.147
Palm oil (waste)	8,095.76	5.50%	71.80%	0.145
Sunflower seed	4,672.02	5.30%	77.20%	0.150
Used cooking oil*	54,787.64	5.40%	74.40%	0.147
NATIONAL AVERAGE	-	5.35%	74.93%	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 3.6.13](#)). The emissions from lube oil are allocated according to the EMEP/EEA GB 2023 and recommendations:

- from 2-stroke vehicles accordingly in the [1A3b](#) categories,
- from 4-stroke vehicles in the [2D3i](#) category.

Table 3.6.13: Overview of lube oil consumption in particular years

YEAR	2-STROKE LUBE OIL [t]	4-STROKE [t]
1990	128.7	1,999.9
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
2023	1.5	5,123.8
2024	1.8	5,751.2

Lube oil composition, including HMs, was analysed and used for emission estimation for the years 2000-2024 (more info in [Chapter 3.6.4.3](#)). For the years 1990-1999, reconstructed data for fuel composition ([Table 3.71](#)), vehicle fleet and estimations in line with [Recommendations No. SK-1A3b-2018-0003](#), [SK-1A3b-2018-0004](#) and [SK-1A3b-2018-0005](#) were used.

The emissions of all heavy metals are dependent on content level ([Table 3.6.14](#)) 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.

Table 3.6.14: 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	1,080.00	20.00	0.0005	0.010	0.0001	1.70	1.70	0.05	0.05
1991	324.00	1,080.00	18.40	0.0005	0.009	0.0001	1.53	1.53	0.05	0.05
1992	324.00	1,080.00	16.96	0.0005	0.008	0.0001	1.36	1.36	0.04	0.04
1993	324.00	1,080.00	15.66	0.0005	0.007	0.0001	1.19	1.19	0.04	0.04
1994	324.00	1,080.00	14.50	0.0005	0.006	0.0001	1.02	1.02	0.03	0.03
1995	324.00	1,080.00	13.45	0.0005	0.005	0.0001	0.85	0.85	0.03	0.03
1996	324.00	1,080.00	12.50	0.0005	0.004	0.0001	0.68	0.68	0.02	0.03
1997	324.00	1,080.00	11.65	0.0005	0.003	0.0001	0.51	0.51	0.02	0.02
1998	324.00	1,080.00	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. The 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 regularly. 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*.

Table 3.6.15 presents the fuels from the three greatest sellers in Slovakia. These sellers also represent different refineries that affect the Slovak market.

Table 3.6.15: 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 from brake wear and engine abrasion. The results of the most sold lube oil brands are displayed in **Table 3.6.16**. These data were used to estimate heavy metal emissions.

Table 3.6.16: Composition of lube oil needed for estimation of country-specific emission factors

LUBE OIL BRANDS	[ppm/wt]										H:C RATIO
	Pb	Cd	Cu	Cr	Ni	Se	Zn	Hg	As	S	
Shell helix	0.098	0.039	0.063	0.069	0.065	0.037	1,523	0.097	0.126	2,166	2.069
Shell Rimula	0.100	0.039	0.101	0.083	0.087	0.037	1,503	0.026	0.156	2,353	2.095
Castrol edge	0.017	0.298	0.010	0.044	0.030	0.037	1,149	0.021	0.159	2,198	2.066
Average	0.072	0.125	0.058	0.065	0.061	0.037	1,392	0.048	0.147	2,239	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 3.6.17**), that most of the deregistered cars were in EURO 1 emission category or older categories.

Table 3.6.17: Number of scrapped passenger cars by age (according to the Automotive Industry Association statistics) in 2009

AGE OF SCRAPPED CARS	EMISSION CATEGORY	TOTAL NUMBER OF SCRAPPED/DEREGISTERED VEHICLES	SHARE OF SCRAPPED VEHICLES ON THE TOTAL FLEET
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%

AGE OF SCRAPPED CARS	EMISSION CATEGORY	TOTAL NUMBER OF SCRAPPED/DEREGISTERED VEHICLES	SHARE OF SCRAPPED VEHICLES ON THE TOTAL FLEET
New registrations	EURO 4	39,275	-

Through deeper analysis ([Table 3.6.18](#)), it was discovered that the 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-year-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 also recorded 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 registrations 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 a decrease in fuel consumption,
- the SSP has a moderate effect on air quality,
- on the other hand, negative outcomes are also important,
- the SSP failed in its 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 3.6.18: *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 OF PC IN 2009	DIFFERENCE	AVERAGE MILEAGE IN 2008	AVERAGE MILEAGE IN 2009	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

NM VOC time-series inconsistency

Non-methane volatile organic compounds 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 2023, emissions from petrol evaporation are the most important

sources:

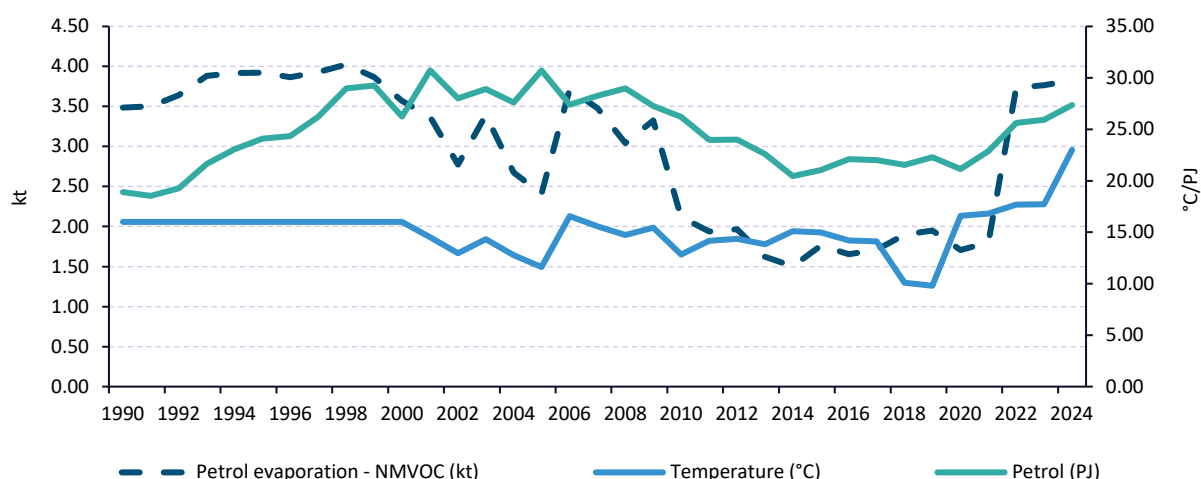
- Breathing losses through the tank vent. Breathing losses are due to the evaporation of fuel in the tank during driving and parking, because of normal diurnal temperature variation.
- Fuel permeation/leakage. Various studies (e.g. CRC, 2004; Reuter et al., 1994) indicate that liquid fuel seepage and 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 minimise its emissions. All inconsistencies in category **1A3bv** can be explained by ambient temperature (**Figure 3.6.5**) (according to **Recommendation No. SK-1A3bv-2018-0001**).

Figure 3.6.5: Ambient air temperature and evaporation emissions correlation



3.6.3.4 Source-specific Recalculations

In the IIR 2026, a recalculation was performed due to the need to update the COPERT model (based on **Recommendation No. SK-1A3b-2024-0001**). The recalculation reflects the transition to COPERT 5 version 9.2 used for the latest submission. Several modifications were implemented in the model, primarily related to the update of emission factors and corrections of certain calculation procedures. Additionally, the latest version introduced new vehicle categories.

Detailed information on the changes between versions 5.8.1 and 9.2 can be found on the COPERT website: <https://copert.emisia.com/copert/versions/>.

Due to insufficiently detailed data on the vehicle fleet, which has been available only since 2013, it was possible to perform the recalculation only from that year. The results of the recalculation can be seen in **Tables 3.6.19-3.6.25**.

Also, based on **Recommendations No. SK-1A3bvi-2025-0001** and **SK-1A3bvi-2025-0002** recalculations for Pb, Cd and PAH emissions from tyre and brake wear were undertaken.

Table 3.6.19: Differences in emissions (%) in category 1A3bi between the previous and current submission caused by recalculations

YEAR	NO _x	NM _{VOC}	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
2013	4.63	-7.49	-0.62	9.15	2.04	2.04	2.04	4.21	-6.57
2014	5.50	-5.28	-0.61	10.06	3.27	3.27	3.27	5.19	-5.19
2015	6.33	-3.35	-0.27	11.81	4.02	4.02	4.02	6.03	-3.65
2016	6.77	1.66	-0.18	11.56	5.37	5.37	5.37	6.41	0.69
2017	6.67	-1.08	-0.47	12.88	4.15	4.15	4.15	6.32	-2.68
2018	6.94	4.89	-0.25	12.00	5.63	5.63	5.63	6.59	2.11
2019	7.14	6.71	-0.12	12.27	5.86	5.86	5.86	6.79	2.86
2020	7.65	11.74	-0.34	13.51	6.31	6.31	6.31	7.27	4.66
2021	7.87	9.91	-0.19	13.89	6.38	6.38	6.38	7.42	4.46
2022	8.15	10.87	0.11	14.01	6.79	6.79	6.79	7.71	5.15
2023	8.04	9.84	0.04	14.29	6.64	6.64	6.64	7.53	5.33

YEAR	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2013	-0.26	-0.20	-0.45	-0.27	-0.69	-0.67	-0.02	-0.39	-0.39
2014	-0.09	-0.23	-0.42	-0.29	-0.59	-0.58	-0.08	-0.37	-0.38
2015	-0.17	-0.15	-0.22	-0.17	-0.28	-0.28	-0.09	-0.21	-0.18
2016	-0.14	-0.13	-0.16	-0.14	-0.19	-0.19	-0.11	-0.16	-0.13
2017	-0.30	-0.28	-0.39	-0.31	-0.48	-0.47	-0.19	-0.36	-0.35
2018	-0.20	-0.19	-0.23	-0.20	-0.26	-0.26	-0.16	-0.22	-0.20
2019	-0.14	-0.14	-0.13	-0.14	-0.12	-0.12	-0.15	-0.13	-0.12
2020	-0.31	-0.30	-0.33	-0.31	-0.35	-0.35	-0.27	-0.32	-0.31
2021	-0.22	-0.23	-0.21	-0.22	-0.19	-0.19	-0.25	-0.21	-0.20
2022	-0.07	-0.10	0.03	-0.06	0.14	0.13	-0.21	-3.7E-05	0.02
2023	-0.13	-0.16	-0.04	-0.12	0.07	0.06	-0.25	-0.07	-0.05

YEAR	PCDD/F	PAHs	HCB	PCB
2013	5.96	5.80	5.96	5.96
2014	6.74	6.55	6.74	6.74
2015	7.63	7.46	7.63	7.63
2016	7.53	7.33	7.53	7.53
2017	8.20	7.93	8.20	8.20
2018	7.78	7.84	7.78	7.78
2019	8.05	8.93	8.05	8.05
2020	8.66	10.36	8.66	8.66
2021	8.98	10.61	8.98	8.98
2022	9.25	11.43	9.25	9.25
2023	9.22	12.01	9.22	9.22

Table 3.6.20: Differences in emissions (%) in category 1A3bii between the previous and current submission caused by recalculations

YEAR	NO _x	NM _{VOC}	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
2013	4.58	-0.16	-4.00	9.22	0.35	0.35	0.35	3.65	-3.42
2014	5.48	3.10	-2.91	9.97	1.63	1.63	1.63	4.66	-1.94
2015	6.34	5.20	-2.77	11.52	2.23	2.23	2.23	5.45	-0.27
2016	6.57	8.30	-2.14	11.12	4.34	4.34	4.34	6.12	3.07
2017	6.69	8.20	-2.16	12.03	2.25	2.25	2.25	5.67	0.04
2018	6.74	11.00	-1.51	10.86	4.61	4.61	4.61	6.30	3.89

2019	6.94	12.58	-0.84	10.69	4.84	4.84	4.84	6.51	4.18
2020	7.41	15.10	-0.88	11.22	5.23	5.23	5.23	6.97	5.07
2021	7.58	16.08	-0.78	11.65	5.21	5.21	5.21	7.08	5.04
2022	7.82	22.72	-0.14	11.33	5.71	5.71	5.71	7.40	5.39
2023	7.63	30.15	-0.22	10.91	5.53	5.53	5.53	7.21	5.27

YEAR	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2013	-3.75	-3.69	-3.91	-3.77	-4.03	-4.02	-3.34	-3.87	-3.89
2014	-2.37	-2.63	-2.81	-2.70	-2.90	-2.90	-2.33	-2.78	-2.79
2015	-2.55	-2.49	-2.69	-2.57	-2.79	-2.79	-2.12	-2.66	-2.68
2016	-1.96	-1.91	-2.08	-1.97	-2.16	-2.15	-1.60	-2.05	-2.06
2017	-1.88	-1.81	-2.05	-1.90	-2.17	-2.16	-1.36	-2.01	-2.03
2018	-1.24	-1.17	-1.41	-1.26	-1.53	-1.52	-0.69	-1.37	-1.39
2019	-0.58	-0.51	-0.74	-0.60	-0.85	-0.85	-0.03	-0.70	-0.72
2020	-0.60	-0.51	-0.78	-0.62	-0.90	-0.89	0.05	-0.73	-0.75
2021	-0.48	-0.39	-0.68	-0.51	-0.81	-0.80	0.19	-0.63	-0.65
2022	0.12	0.19	-0.05	0.10	-0.16	-0.15	0.70	-0.01	-0.03
2023	0.03	0.11	-0.14	0.01	-0.25	-0.24	0.62	-0.10	-0.11

YEAR	PCDD/F	PAHs	HCB	PCB
2013	5.38	5.38	5.38	5.38
2014	6.17	6.17	6.17	6.18
2015	7.06	7.06	7.06	7.06
2016	6.92	6.91	6.92	6.93
2017	7.46	7.44	7.46	7.46
2018	7.07	7.05	7.07	7.07
2019	7.26	7.24	7.26	7.27
2020	7.75	7.73	7.75	7.75
2021	7.96	7.93	7.96	7.96
2022	8.20	8.16	8.20	8.21
2023	8.03	7.97	8.03	8.04

Table 3.6.21: Differences in emissions (%) in category 1A3biii between the previous and current submission caused by recalculations

YEAR	NOx	NM VOC	SOx	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
2013	6.74	5.71	3.06	-3.75	13.27	13.27	13.27	13.02	33.60
2014	9.91	4.97	2.29	-19.78	18.54	18.54	18.54	15.36	36.74
2015	11.86	3.93	1.91	-27.97	19.24	19.24	19.24	14.18	31.67
2016	14.12	2.79	1.26	-35.58	23.15	23.15	23.15	15.21	33.61
2017	17.91	2.71	1.79	-42.61	29.04	29.04	29.04	17.19	36.42
2018	19.14	1.02	1.02	-45.15	31.67	31.67	31.67	17.40	35.74
2019	19.89	-0.83	0.51	-45.13	33.85	33.85	33.85	18.01	35.26
2020	14.37	-0.86	1.81	-36.04	24.55	24.55	24.55	15.08	26.85
2021	19.92	-5.43	0.53	-38.04	38.29	38.29	38.29	19.90	32.24
2022	20.45	-6.98	-0.33	-40.69	38.95	38.95	38.95	19.91	31.84
2023	32.90	-6.67	-0.18	-52.10	55.83	55.83	55.83	24.40	36.18

YEAR	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2013	3.07	3.08	3.07	3.07	3.06	3.06	3.11	3.07	3.07
2014	2.34	2.31	2.29	2.30	2.29	2.29	2.35	2.30	2.30

YEAR	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2015	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
2016	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26
2017	1.79	1.79	1.79	1.79	1.79	1.79	1.80	1.79	1.79
2018	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
2019	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
2020	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81
2021	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
2022	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	-0.33
2023	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18

YEAR	PCDD/F	PAHs	HCB	PCB
2013	5.25	5.23	5.25	5.25
2014	6.05	6.02	6.03	6.04
2015	6.93	6.90	6.93	6.93
2016	6.80	6.79	6.80	6.80
2017	7.32	7.30	7.32	7.31
2018	6.94	6.93	6.94	6.94
2019	7.13	7.12	7.13	7.13
2020	7.62	7.59	7.62	7.61
2021	7.80	7.79	7.80	7.81
2022	8.04	8.01	8.04	8.03
2023	7.86	7.82	7.85	7.83

Table 3.6.22: Differences in emissions (%) in category 1A3biv between the previous and current submission caused by recalculations

YEAR	NOx	NMVOC	SOx	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
2013	9.71	9.74	9.75	9.76	9.71	9.71	9.71	9.61	9.76
2014	10.76	10.79	10.80	10.81	10.76	10.76	10.76	10.66	10.81
2015	12.78	12.81	12.83	12.84	12.78	12.78	12.78	12.64	12.83
2016	12.41	12.44	12.45	12.45	12.41	12.41	12.41	12.31	12.45
2017	14.27	14.29	14.31	14.31	14.26	14.26	14.26	14.15	14.31
2018	13.61	13.63	13.65	13.65	13.61	13.61	13.61	13.48	13.65
2019	13.98	14.01	14.02	14.02	13.98	13.98	13.98	13.86	14.02
2020	15.76	15.80	15.81	15.82	15.77	15.77	15.77	15.62	15.82
2021	16.16	16.18	16.20	16.20	16.16	16.16	16.16	16.05	16.20
2022	15.95	15.97	15.98	15.98	15.95	15.95	15.95	15.87	15.98
2023	16.07	16.09	16.09	16.09	16.08	16.08	16.08	16.02	16.09

YEAR	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2013	9.76	9.76	9.76	9.76	9.75	9.75	9.76	9.76	9.76
2014	10.81	10.81	10.81	10.81	10.80	10.80	10.81	10.81	10.81
2015	12.84	12.84	12.83	12.84	12.83	12.83	12.84	12.84	12.84
2016	12.45	12.45	12.45	12.45	12.45	12.45	12.45	12.45	12.45
2017	14.31	14.31	14.31	14.31	14.31	14.31	14.32	14.31	14.32
2018	13.65	13.65	13.65	13.65	13.65	13.65	13.65	13.65	13.65
2019	14.02	14.02	14.02	14.02	14.02	14.02	14.02	14.02	14.02
2020	15.82	15.82	15.82	15.82	15.81	15.81	15.82	15.82	15.82
2021	16.20	16.20	16.20	16.20	16.19	16.19	16.20	16.20	16.20
2022	15.98	15.98	15.98	15.98	15.98	15.98	15.98	15.98	15.98

YEAR	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2023	16.09	16.09	16.09	16.09	16.09	16.09	16.09	16.09	16.09

YEAR	PCDD/F	PAHs	HCB	PCB
2013	9.77	9.71	9.70	9.74
2014	10.77	10.76	10.74	10.77
2015	12.76	12.78	12.78	12.79
2016	12.42	12.41	12.45	12.50
2017	14.26	14.27	14.27	14.27
2018	13.63	13.61	13.62	13.67
2019	13.96	13.98	13.96	13.99
2020	15.75	15.77	15.78	15.79
2021	16.17	16.16	16.18	16.19
2022	15.98	15.95	15.95	15.98
2023	16.09	16.08	16.09	16.07

Table 3.6.23: Differences in emissions (%) in category 1A3bv between the previous and current submission caused by recalculations

YEAR	NMVOC
2013	3.71
2014	4.37
2015	5.32
2016	5.37
2017	6.13
2018	5.99
2019	6.22
2020	6.62
2021	6.92
2022	4.36
2023	4.14

Table 3.6.24: Differences in emissions (%) in category 1A3bvi between the previous and current submission caused by recalculations

YEAR	ACTIVITY DATA			PM _{2.5}	PM ₁₀	TSP	BC
	PREVIOUS	CURRENT	CHANGE				
2013	25,622.63	27,286.13	6.49	13.89	16.16	14.19	8.48
2014	26,219.55	28,111.87	7.22	14.84	17.18	15.15	9.28
2015	29,587.46	32,027.92	8.25	15.97	18.33	16.29	10.34
2016	31,992.29	34,584.99	8.10	15.88	18.26	16.20	10.21
2017	30,823.93	33,561.45	8.88	16.69	19.11	17.01	10.94
2018	33,379.94	36,184.95	8.40	16.27	18.69	16.59	10.50
2019	34,566.85	37,572.86	8.70	16.59	19.03	16.91	10.78
2020	34,105.67	37,328.39	9.45	17.56	20.01	17.88	11.67
2021	33,110.16	36,325.30	9.71	17.56	20.03	17.89	11.72
2022	35,085.29	38,566.46	9.92	17.81	20.28	18.13	11.95
2023	34,974.03	38,445.88	9.93	17.73	20.19	18.05	11.91

YEAR	Pb	Cd	As	Cr	Cu	Ni	Se	BC
1990	149.02	139.14	-	-	-	-	-	-
1991	160.28	149.17	-	-	-	-	-	-
1992	170.08	157.96	-	-	-	-	-	-
1993	180.74	167.48	-	-	-	-	-	-

YEAR	Pb	Cd	As	Cr	Cu	Ni	Se	BC
1994	180.80	167.26	-	-	-	-	-	-
1995	180.72	166.90	-	-	-	-	-	-
1996	181.51	167.39	-	-	-	-	-	-
1997	185.90	171.11	-	-	-	-	-	-
1998	195.46	179.21	-	-	-	-	-	-
1999	200.86	183.91	-	-	-	-	-	-
2000	195.91	179.12	-	-	-	-	-	-
2001	199.82	182.73	-	-	-	-	-	-
2002	189.73	173.76	-	-	-	-	-	-
2003	189.48	173.43	-	-	-	-	-	-
2004	180.10	164.72	-	-	-	-	-	-
2005	179.45	164.10	-	-	-	-	-	-
2006	171.19	155.19	-	-	-	-	-	-
2007	170.51	155.25	-	-	-	-	-	-
2008	164.22	148.67	-	-	-	-	-	-
2009	167.66	151.64	-	-	-	-	-	-
2010	213.77	194.06	-	-	-	-	-	-
2011	233.65	211.56	-	-	-	-	-	-
2012	228.48	206.45	-	-	-	-	-	-
2013	22.02	19.58	21.60	22.32	22.44	21.08	14.19	14.82
2014	23.22	20.71	22.78	23.54	23.65	22.26	15.15	15.80
2015	24.38	21.86	23.94	24.69	24.81	23.41	16.29	16.94
2016	24.39	21.84	23.95	24.71	24.83	23.41	16.20	16.86
2017	25.35	22.75	24.89	25.67	25.79	24.35	17.01	17.68
2018	24.95	22.34	24.50	25.27	25.39	23.95	16.59	17.26
2019	25.35	22.72	24.90	25.68	25.81	24.34	16.91	17.59
2020	26.24	23.66	25.79	26.56	26.68	25.25	17.88	18.56
2021	26.45	23.77	25.98	26.78	26.91	25.42	17.89	18.57
2022	26.69	24.02	26.23	27.03	27.15	25.66	18.13	18.82
2023	26.59	23.92	26.12	26.92	27.05	25.56	18.05	18.74

Table 3.6.25: Differences in emissions (%) in category 1A3bvii between the previous and current submission caused by recalculations

YEAR	ACTIVITY DATA			PM _{2.5}	PM ₁₀	TSP	BC
	PREVIOUS	CURRENT	CHANGE				
2013	25,622.63	27,286.13	6.49	5.96	5.96	5.96	5.96
2014	26,219.55	28,111.87	7.22	6.71	6.71	6.71	6.71
2015	29,587.46	32,027.92	8.25	7.71	7.71	7.71	7.71
2016	31,992.29	34,584.99	8.10	7.58	7.58	7.58	7.58
2017	30,823.93	33,561.45	8.88	8.23	8.23	8.23	8.23
2018	33,379.94	36,184.95	8.40	7.80	7.80	7.80	7.80
2019	34,566.85	37,572.86	8.70	8.07	8.07	8.07	8.07
2020	34,105.67	37,328.39	9.45	8.90	8.90	8.90	8.90
2021	33,110.16	36,325.30	9.71	8.95	8.95	8.95	8.95
2022	35,085.29	38,566.46	9.92	9.17	9.17	9.17	9.17
2023	34,974.03	38,445.88	9.93	9.13	9.13	9.13	9.13

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 the number of passengers 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 2024, the length of managed railways was 3,629 km, of which the length of electric railways was 1,582 km. Total NO_x emissions from railway transport decreased by 1.6% compared to the previous year and by 76% compared to the base year (**Table 3.6.26**).

Table 3.6.26: Overview of emissions in railways (1A3c)

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	6.1928	0.5496	0.0016	0.0008	0.1619	0.1702	0.1796	0.1052	1.2646
1995	3.3542	0.2977	0.0009	0.0004	0.0877	0.0922	0.0973	0.0570	0.6849
2000	2.5601	0.2272	0.0007	0.0003	0.0669	0.0704	0.0743	0.0435	0.5228
2005	1.7520	0.1555	0.0005	0.0002	0.0458	0.0481	0.0508	0.0298	0.3578
2010	1.5837	0.1405	0.0004	0.0002	0.0414	0.0435	0.0459	0.0269	0.3234
2011	1.3928	0.1236	0.0004	0.0002	0.0364	0.0383	0.0404	0.0237	0.2844
2012	1.1791	0.1046	0.0003	0.0002	0.0308	0.0324	0.0342	0.0200	0.2408
2013	1.4511	0.1288	0.0004	0.0002	0.0379	0.0399	0.0421	0.0247	0.2963
2014	1.3789	0.1224	0.0004	0.0002	0.0361	0.0379	0.0400	0.0234	0.2816
2015	1.6565	0.1383	0.0004	0.0003	0.0311	0.0340	0.0499	0.0202	0.4689
2016	1.6936	0.1417	0.0004	0.0003	0.0319	0.0349	0.0511	0.0207	0.4793
2017	1.6500	0.1385	0.0004	0.0003	0.0312	0.0341	0.0499	0.0202	0.4668
2018	1.6123	0.1357	0.0004	0.0003	0.0305	0.0333	0.0488	0.0198	0.4560
2019	1.5336	0.1335	0.0004	0.0003	0.0298	0.0326	0.0474	0.0194	0.4322
2020	1.3609	0.1191	0.0003	0.0003	0.0266	0.0291	0.0422	0.0173	0.3833
2021	1.5483	0.1378	0.0004	0.0003	0.0307	0.0335	0.0485	0.0199	0.4352
2022	1.5223	0.1349	0.0004	0.0003	0.0300	0.0329	0.0476	0.0195	0.4281
2023	1.4986	0.1332	0.0004	0.0003	0.0296	0.0324	0.0469	0.0193	0.4213
2024	1.3134	0.1173	0.0003	0.0002	0.0261	0.0286	0.0413	0.0170	0.3690
1990/2024	-79%	-79%	-79%	-70%	-84%	-83%	-77%	-84%	-71%
2023/2024	-12%	-12%	-12%	-12%	-12%	-12%	-12%	-12%	-12%

YEAR	PRIORITY HMs [t]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCBs [kg]
1990	0.0012	0.0035	0.0059	4.1E-06	9.3E-07	0.0095	0.0009	1.1818
1995	0.0006	0.0019	0.0032	2.2E-06	5.1E-07	0.0051	0.0005	0.6401
2000	0.0005	0.0015	0.0024	1.7E-06	3.9E-07	0.0039	0.0004	0.4886
2005	0.0003	0.0010	0.0017	1.2E-06	2.6E-07	0.0027	0.0003	0.3344
2010	0.0003	0.0009	0.0015	1.0E-06	2.4E-07	0.0024	0.0002	0.3022
2011	0.0003	0.0008	0.0013	9.1E-07	2.1E-07	0.0021	0.0002	0.2658
2012	0.0002	0.0007	0.0011	7.7E-07	1.8E-07	0.0018	0.0002	0.2250
2013	0.0003	0.0008	0.0014	9.5E-07	2.2E-07	0.0022	0.0002	0.2769
2014	0.0003	0.0008	0.0013	9.1E-07	2.1E-07	0.0021	0.0002	0.2632
2015	0.0003	0.0009	0.0014	1.0E-06	2.3E-07	0.0023	0.0002	0.2896

YEAR	PRIORITY HMs [t]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCBs [kg]
2016	0.0003	0.0009	0.0015	1.0E-06	2.3E-07	0.0024	0.0002	0.2969
2017	0.0003	0.0009	0.0015	1.0E-06	2.3E-07	0.0023	0.0002	0.2902
2018	0.0003	0.0009	0.0014	9.8E-07	2.2E-07	0.0023	0.0002	0.2843
2019	0.0003	0.0008	0.0014	9.6E-07	2.2E-07	0.0022	0.0002	0.2801
2020	0.0003	0.0008	0.0013	8.6E-07	2.0E-07	0.0020	0.0002	0.2500
2021	0.0003	0.0009	0.0014	1.0E-06	2.3E-07	0.0023	0.0002	0.2895
2022	0.0003	0.0009	0.0014	9.8E-07	2.2E-07	0.0023	0.0002	0.2835
2023	0.0003	0.0008	0.0014	9.6E-07	2.2E-07	0.0022	0.0002	0.2798
2024	0.0002	0.0007	0.0012	8.5E-07	1.9E-07	0.0020	0.0002	0.2466
1990/2024	-79%	-79%	-79%	-79%	-79%	-79%	-79%	-79%
2023/2024	-12%	-12%	-12%	-12%	-12%	-12%	-12%	-12%

3.6.4.2 Methodological Issues

The emissions of the pollutants are calculated from the consumed fuels according to the powertrain (railcars or line-haul) and multiplied by the appropriate emission factor. The consumption of diesel oil for motor traction in the Slovak Republic was obtained from the railway companies for all years in time-series and the years 2015-2024 also for each powertrain as seen in [Table 3.6.27](#) (based on [Recommendation No. SK-1A3c-2025-0001](#)).

Table 3.6.27: Overview of fuel consumption for different powertrains in railways (1A3c)

YEAR	RAIL CARS	LINE-HAUL LOCOMOTIVES
	TJ	
2015	60.09	909.88
2016	62.11	928.55
2017	62.07	897.43
2018	62.47	871.64
2019	75.58	758.06
2020	27.22	662.26
2021	34.77	716.39
2022	33.44	712.81
2023	31.10	692.38
2024	25.26	649.88

3.6.4.3 Completeness

The verification process is based on cross-checking 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 (the Ministry of the Environment of the Slovak Republic, the Ministry of Transport and Construction of the Slovak Republic) for evaluation 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

No recalculations were made in this submission.

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 realised 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 realised 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 registered between the Slovak ports. 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 recognised compared to the previous years and compared to the base year (**Table 3.6.28**), despite an increase in tourist 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 3.6.28: Overview of emissions in navigation (international 1A3di(ii) and national 1A3dii)

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	1.4170	0.0342	0.3937	0.0001	0.1066	0.1066	0.1066	0.0019	0.0753
1995	1.2488	0.0302	0.3470	0.0001	0.0940	0.0940	0.0940	0.0016	0.0663
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	0.0012	0.0000	0.0008
2010	0.7293	0.0176	0.2027	0.0001	0.0549	0.0549	0.0549	0.0010	0.0387
2011	0.6472	0.0156	0.1798	0.0001	0.0487	0.0487	0.0487	0.0008	0.0344
2012	0.2257	0.0055	0.0627	0.0000	0.0170	0.0170	0.0170	0.0003	0.0120
2013	0.3554	0.0086	0.0987	0.0000	0.0267	0.0267	0.0267	0.0005	0.0189
2014	0.4132	0.0100	0.1148	0.0000	0.0311	0.0311	0.0311	0.0005	0.0219
2015	0.6218	0.0150	0.1728	0.0001	0.0468	0.0468	0.0468	0.0008	0.0330
2016	0.5202	0.0126	0.1446	0.0001	0.0391	0.0391	0.0391	0.0007	0.0276
2017	0.5126	0.0124	0.1424	0.0001	0.0386	0.0386	0.0386	0.0007	0.0272
2018	0.2972	0.0072	0.0826	0.0000	0.0224	0.0224	0.0224	0.0004	0.0158
2019	0.4425	0.0107	0.1229	0.0000	0.0333	0.0333	0.0333	0.0006	0.0235
2020	0.4476	0.0108	0.1244	0.0000	0.0337	0.0337	0.0337	0.0006	0.0238
2021	0.5056	0.0122	0.1405	0.0001	0.0380	0.0380	0.0380	0.0007	0.0269
2022	0.5011	0.0121	0.1392	0.0001	0.0377	0.0377	0.0377	0.0007	0.0266
2023	0.5144	0.0124	0.1429	0.0001	0.0387	0.0387	0.0387	0.0007	0.0273
2024	0.5088	0.0123	0.1414	0.0001	0.0383	0.0383	0.0383	0.0007	0.0270
1990/2024	-64%	-64%	-64%	-64%	-64%	-64%	-64%	-64%	-64%
2023/2024	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%

YEAR	PRIORITY HMs [t]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCBs [kg]
1990	0.0045	0.0010	0.0006	0.0004	0.0002	0.0022	0.0029	0.0117
1995	0.0040	0.0009	0.0005	0.0004	0.0002	0.0020	0.0025	0.0103
2000	0.0000	3.8E-07	2.3E-07	1.5E-07	6.9E-08	8.4E-07	1.1E-06	4.4E-06
2005	0.0000	1.1E-05	6.7E-06	4.5E-06	2.0E-06	2.4E-05	3.1E-05	0.0001

YEAR	PRIORITY HMs [t]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCBs [kg]
2010	0.0023	0.0005	0.0003	0.0002	0.0001	0.0012	0.0015	0.0060
2011	0.0021	0.0005	0.0003	0.0002	0.0001	0.0010	0.0013	0.0053
2012	0.0007	0.0002	0.0001	0.0001	2.9E-05	0.0004	0.0005	0.0019
2013	0.0011	0.0003	0.0002	0.0001	4.6E-05	0.0006	0.0007	0.0029
2014	0.0013	0.0003	0.0002	0.0001	0.0001	0.0007	0.0008	0.0034
2015	0.0020	0.0004	0.0003	0.0002	0.0001	0.0010	0.0013	0.0051
2016	0.0017	0.0004	0.0002	0.0002	0.0001	0.0008	0.0011	0.0043
2017	0.0016	0.0004	0.0002	0.0001	0.0001	0.0008	0.0010	0.0042
2018	0.0009	0.0002	0.0001	0.0001	0.0000	0.0005	0.0006	0.0025
2019	0.0014	0.0003	0.0002	0.0001	0.0001	0.0007	0.0009	0.0036
2020	0.0014	0.0003	0.0002	0.0001	0.0001	0.0007	0.0009	0.0037
2021	0.0016	0.0004	0.0002	0.0001	0.0001	0.0008	0.0010	0.0042
2022	0.0016	0.0004	0.0002	0.0001	0.0001	0.0008	0.0010	0.0041
2023	0.0016	0.0004	0.0002	0.0001	0.0001	0.0008	0.0010	0.0042
2024	0.0050	0.0002	0.0001	0.0001	0.0008	0.0010	0.0042	0.0042
1990/2024	11%	-78%	-76%	-84%	335%	-54%	46%	-64%
2023/2024	206%	-41%	-34%	-55%	1,098%	27%	303%	-1%

3.6.5.2 Methodological Issues

These subcategories include all emissions from national and international shipping between the ports on the Danube River in 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(iii)) 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 for the first time in IIR 2018.

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 registered a total number of ships and boats operated, except on 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 (Piešťany, 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. The 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, which is **0.84 kg/dm³**.

The emissions are calculated from the consumed fuel by diesel motorboats multiplied by the emission factor. The emission factors are taken from the EMEP/EEA GB 2023. Activity data for domestic navigation are shown in [Table 3.6.29](#).

Table 3.6.29: The amount of diesel oil sold by shipping companies and allocation to the categories 1A3di(ii) and 1A3dii in selected years 2005-2024

YEAR	SHIPPING COMPANIES	SALE OF DIESEL OIL [t]		
		NATIONAL	INTERNATIONAL	TOTAL
		1A3dii	1A3di(ii)	1A3dii + 1A3di(ii)
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
2015	Slovak Shipping and Ports (Danube)	1,981.8	5,945.4	7,927.2
	Slovak Water Management Enterprise	0.0	0.0	0.0

YEAR	SHIPPING COMPANIES	SALE OF DIESEL OIL [t]		
		NATIONAL	INTERNATIONAL	TOTAL
		1A3dii	1A3di(ii)	1A3dii + 1A3di(ii)
	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)	3,239.0	809.8	2,429.2
	Slovak Water Management Enterprise	0.0	0.0	0.0
	Other companies	232.0	2.3	229.7
	Morsevo (Komárno)	824.0	0.0	824.0
	International shipping companies	0.0	0.0	0.0
	Total	4,295.0	812.1	3,482.9
2019	Slovak Shipping and Ports (Danube)	1,327.0	3,981.0	5,308.0
	Slovak Water Management Enterprise	0.0	0.0	0.0
	Other companies	3.3	322.7	326.0
	Morsevo (Komárno)	0.0	760.0	760.0
	International shipping companies	0.0	0.0	0.0
	Total	1,330.3	5,063.7	6,394.0
2020	Slovak Shipping and Ports (Danube)	6,223.0	1,555.8	4,667.23
	Slovak Water Management Enterprise	0.0	0.0	0.0
	Other companies	161.0	161.0	0.0
	Morsevo (Komárno)	94.0	0.0	94.0
	International shipping companies	0.00	0.0	0.0
	Total	6,478.0	1,716.8	4,761.3
2021	Slovak Shipping and Ports (Danube)	1,764.2	5,292.8	7,057.0
	Slovak Water Management Enterprise	0.0	0.0	0.0
	Other companies	95.0	0.0	95.0
	T a M Terminal (Komárno)*	0.0	0.0	0.0
	International shipping companies	0.0	165.0	165.0
	Total	1,859.2	5,457.8	7,317.0
2022	Slovak Shipping and Ports (Danube)	1,569.3	4,707.8	6,277.0
	Slovak Water Management Enterprise	0.0	0.0	0.0
	Other companies	120.0	0.0	120.0
	T a M Terminal (Komárno)	0.0	855.0	855.0
	International shipping companies	0.0	0.0	0.0
	Total	1,689.3	5,562.8	7,252.0
2023	Slovak Shipping and Ports (Danube)	1,614.5	4,843.5	6,458.0
	Slovak Water Management Enterprise	0.0	0.0	0.0

YEAR	SHIPPING COMPANIES	SALE OF DIESEL OIL [t]		
		NATIONAL	INTERNATIONAL	TOTAL
		1A3dii	1A3di(ii)	1A3dii + 1A3di(ii)
	Other companies	85.0	0.0	85.0
	T a M Terminal (Komárno)	0.0	902.0	902.0
	International shipping companies	0.0	0.0	0.0
	Total	1,699.5	5,745.5	7,445.0
2024	Slovak Shipping and Ports (Danube)	1,632.8	4,898.3	6,531.0
	Slovak Water Management Enterprise	0.0	0.0	0.0
	Other companies	118.0	0.0	118.0
	T a M Terminal (Komárno)	0.0	713.0	713.0
	International shipping companies	0.0	0.0	0.0
	Total	1,750.8	5,611.3	7,362.0

* Previous name Morsevo

In 2020, shipping on lakes did not occur because 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 the requested institutions and companies as mentioned in this chapter above.

3.6.5.4 Source-specific Recalculations

No recalculations were made in this submission.

3.6.6 Pipeline Transport (NFR 1A3ei)

3.6.6.1 Overview

There has been 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. The overview of emissions in this category is shown in [Table 3.6.30](#).

Table 3.6.30: Overview of emissions in category 1A3ei

YEAR	NOx [kt]	NM VOC [kt]	SOx [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	3.1069	0.1220	8.5E-04	1.1E-04	1.1E-04	1.1E-04	4.3E-06	0.3638
1995	3.0858	0.1211	8.5E-04	1.1E-04	1.1E-04	1.1E-04	4.3E-06	0.3613
2000	3.1252	0.0871	9.8E-04	1.2E-04	1.2E-04	1.2E-04	4.8E-06	0.4181
2005	3.9738	0.2380	9.6E-04	4.2E-05	4.2E-05	4.2E-05	1.7E-06	0.3650
2010	2.3498	0.1996	3.9E-03	4.0E-05	4.0E-05	4.0E-05	1.6E-06	0.1940
2011	2.4936	0.2109	1.4E-02	2.8E-05	2.8E-05	2.8E-05	1.1E-06	0.1710
2012	0.6886	0.1318	1.2E-05	1.7E-05	1.7E-05	1.7E-05	7.0E-07	0.0823
2013	0.6576	0.1489	3.9E-05	2.0E-05	2.0E-05	2.0E-05	8.4E-07	0.0662
2014	0.1859	0.2599	1.1E-05	4.8E-05	4.8E-05	4.8E-05	1.9E-06	0.0628
2015	0.2273	0.2333	1.7E-05	7.9E-05	7.9E-05	7.9E-05	3.2E-06	0.0486
2016	0.2893	0.2634	1.2E-05	4.6E-05	4.6E-05	4.6E-05	1.9E-06	0.0598
2017	0.2520	0.2149	8.6E-06	8.4E-05	8.4E-05	8.4E-05	3.4E-06	0.0892
2018	0.2089	0.1487	1.3E-05	3.6E-03	3.6E-03	3.6E-03	1.5E-04	0.1216
2019	0.2880	0.1268	1.6E-05	4.6E-03	4.6E-03	4.6E-03	1.8E-04	0.0886
2020	0.1492	0.2162	9.7E-06	2.6E-03	2.6E-03	2.6E-03	1.1E-04	0.0445

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
2021	0.1314	0.1702	1.1E-05	1.6E-03	1.6E-03	1.6E-03	6.8E-05	0.0252
2022	0.0171	0.1388	2.9E-07	2.0E-04	2.0E-04	2.0E-04	1.1E-05	0.0052
2023	0.0055	0.0925	2.7E-07	8.8E-05	8.8E-05	8.8E-05	5.8E-06	0.0032
2024	0.0081	0.0748	1.4E-06	3.9E-04	3.9E-04	3.9E-04	2.0E-05	0.0064
1990/2024	-100%	-39%	-100%	255%	255%	255%	371%	-98%
2023/2024	48%	-19%	427%	339%	339%	339%	252%	100%

The overview of the activity data (energy consumption) for this source category is in [Table 3.6.31](#) below.

Table 3.6.31: Overview of activity data in category 1A3ei

YEAR	LIQUID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]
1990	NO	17,438.08
1995	NO	17,319.30
2000	NO	19,155.22
2005	0.18	23,705.18
2010	1.19	14,802.40
2011	0.82	16,376.63
2012	0.51	7,297.20
2013	0.61	7,629.69
2014	0.19	2,860.05
2015	NO	2,983.61
2016	0.24	4,923.82
2017	0.24	5,287.33
2018	0.23	4,869.17
2019	0.28	6,535.92
2020	0.19	2,763.62
2021	0.23	1,886.90
2022	0.21	163.77
2023	0.27	119.61
2024	0.18	163.87
1990/2024	-	-99%
2023/2024	-33%	37%

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 EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024. The historical data (1990-1999) are not covered by the NEIS; therefore, the emission factors used for the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.6.32](#)).

Table 3.6.32: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NO _x	[g/tGJ]	178.169
NM VOC	[g/tGJ]	6.994
SO _x	[g/tGJ]	0.049
TSP	[g/tGJ]	0.01
PM _{2.5}	[% of TSP]	100%
PM ₁₀	[% of TSP]	100%
CO	[g/tGJ]	20.86

The methodology for calculating BC emissions is described in [Annex X](#).

3.6.6.3 Completeness

Emissions are well covered. Emissions of NH₃, HMs and POPs are reported as NA.

3.6.6.4 Source-specific Recalculations

No recalculations were made in this submission.

3.6.7 Other (NFR 1A3eii)

This category does not occur 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 like those to produce thermal energy in larger combustion activities, except for the simple design of smaller appliances like fireplaces and stoves.

Relevant pollutants are SO_x, NO_x, CO, NM VOC, 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.

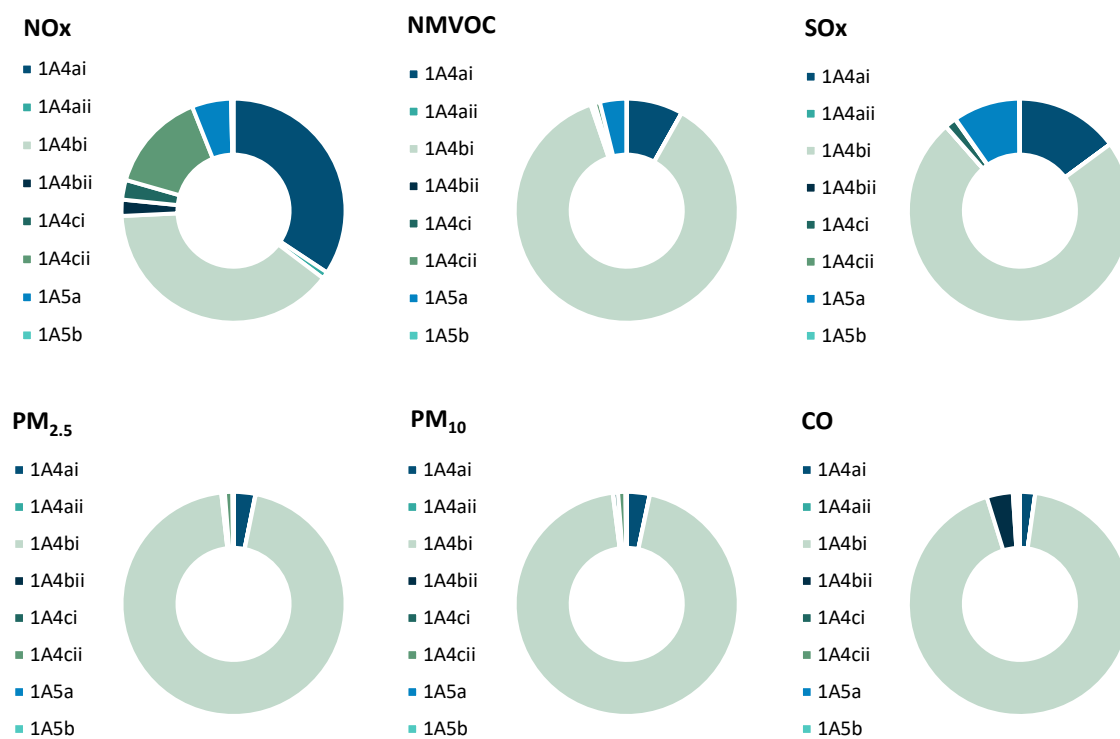
This chapter is focused on emission data from stationary sources with total nominal heat consumption from 0.3 MW to 50 MW (Technological units containing combustion plants having total rated thermal input between 0.3-50 MW and other technological units with a capacity under the defined limit for the 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 3.7.1).

Figure 3.7.1: Shares of main pollutants emissions in categories 1A4 and 1A5 in 2024



3.7.2 Commercial/institutional: Stationary (NFR 1A4ai)

3.7.2.1 Overview

This category covers the sources that cannot be clearly identified with a particular activity, but generally, it is the combustion process. Activities listed within this category are shown in [Table 3.7.1](#).

Table 3.7.1: Activities according to national categorisation included in category 1A4ai

CATEGORISATION 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

The overview of the emissions is shown in [Table 3.7.2](#). Most of the emissions have an overall decreasing trend due to the decrease in the volume of coal used. Emissions of NMVOC, Cd, Cr, Zn and HCB increased significantly due to the preference for biomass fuels as a renewable source and political support of this fuel.

Table 3.7.2: Overview of emissions in 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

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
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
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
2023	2.1357	1.6217	0.1883	NO	0.2562	0.2801	0.3056	0.0705	2.0673
2024	2.2517	1.8384	0.1609	NO	0.2707	0.2920	0.3125	0.0748	2.3063
1990/2024	-18%	709%	-93%	-	-68%	-71%	-79%	5%	-47%
2023/2024	5%	13%	-15%	-	6%	4%	2%	6%	12%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0542	0.0063	0.0118	0.0469	0.0465	0.0616	0.0658	0.0627	0.3398
1995	0.0222	0.0020	0.0058	0.0216	0.0194	0.0269	0.0290	0.0278	0.1232
2000	0.0082	0.0007	0.0032	0.0094	0.0072	0.0101	0.0102	0.0105	0.0445
2005	0.0056	0.0013	0.0041	0.0068	0.0041	0.0044	0.0085	0.0051	0.0484
2010	0.0392	0.0102	0.0097	0.0213	0.0300	0.0256	0.0221	0.0229	0.4260
2011	0.0397	0.0111	0.0100	0.0191	0.0295	0.0230	0.0192	0.0205	0.4565
2012	0.0390	0.0108	0.0113	0.0180	0.0272	0.0201	0.0164	0.0195	0.4378
2013	0.0435	0.0126	0.0122	0.0186	0.0298	0.0208	0.0161	0.0185	0.5034
2014	0.0313	0.0078	0.0120	0.0157	0.0185	0.0140	0.0118	0.0138	0.3074
2015	0.0352	0.0096	0.0128	0.0157	0.0212	0.0141	0.0115	0.0142	0.3745
2016	0.0374	0.0111	0.0121	0.0150	0.0237	0.0139	0.0111	0.0127	0.4329
2017	0.0390	0.0120	0.0126	0.0148	0.0249	0.0140	0.0104	0.0137	0.4681
2018	0.0328	0.0097	0.0116	0.0130	0.0202	0.0118	0.0086	0.0123	0.3834
2019	0.0339	0.0103	0.0122	0.0126	0.0205	0.0109	0.0080	0.0119	0.4029
2020	0.0279	0.0075	0.0125	0.0121	0.0138	0.0072	0.0056	0.0065	0.2752
2021	0.0277	0.0078	0.0122	0.0113	0.0142	0.0067	0.0051	0.0059	0.2926
2022	0.0249	0.0073	0.0103	0.0098	0.0136	0.0065	0.0049	0.0072	0.2764
2023	0.0229	0.0070	0.0096	0.0084	0.0122	0.0049	0.0036	0.0048	0.2616
2024	0.0245	0.0071	0.0112	0.0091	0.0117	0.0046	0.0031	0.0039	0.2623
1990/2024	-55%	14%	-5%	-81%	-75%	-93%	-95%	-94%	-23%
2023/2024	7%	2%	17%	9%	-5%	-6%	-13%	-18%	0%

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	0.0676	0.0029	0.0048	0.0017	0.0014	0.0109	0.0265	0.0101
1995	0.0264	0.0007	0.0013	0.0005	0.0004	0.0029	0.0102	0.0039
2000	0.0144	0.0002	0.0004	0.0002	0.0001	0.0010	0.0038	0.0014
2005	0.0264	0.0007	0.0012	0.0004	0.0003	0.0027	0.0031	0.0012
2010	0.1228	0.0070	0.0115	0.0037	0.0029	0.0251	0.0262	0.0097

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]
2011	0.1362	0.0077	0.0127	0.0041	0.0032	0.0278	0.0294	0.0109
2012	0.1478	0.0075	0.0124	0.0041	0.0031	0.0271	0.0353	0.0136
2013	0.1699	0.0088	0.0146	0.0048	0.0037	0.0319	0.0399	0.0153
2014	0.1372	0.0052	0.0088	0.0030	0.0022	0.0193	0.0384	0.0157
2015	0.1569	0.0066	0.0110	0.0036	0.0028	0.0240	0.0417	0.0168
2016	0.1632	0.0078	0.0130	0.0042	0.0033	0.0283	0.0390	0.0155
2017	0.1740	0.0085	0.0141	0.0046	0.0035	0.0306	0.0413	0.0162
2018	0.1507	0.0068	0.0113	0.0037	0.0028	0.0246	0.0377	0.0150
2019	0.1597	0.0072	0.0120	0.0039	0.0030	0.0262	0.0399	0.0160
2020	0.1439	0.0050	0.0086	0.0029	0.0021	0.0186	0.0405	0.0171
2021	0.1443	0.0053	0.0091	0.0030	0.0023	0.0197	0.0390	0.0163
2022	0.1262	0.0050	0.0085	0.0028	0.0021	0.0184	0.0329	0.0135
2023	0.1198	0.0049	0.0082	0.0027	0.0020	0.0178	0.0306	0.0126
2024	0.1344	0.0049	0.0083	0.0028	0.0021	0.0180	0.0371	0.0156
1990/2024	99%	69%	71%	58%	45%	65%	40%	54%
2023/2024	12%	0%	1%	2%	1%	1%	21%	23%

The overview of the activity data (energy consumption) for this source category is in [Table 3.7.3](#) below.

Table 3.7.3: Overview of activity data in category 1A4ai

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]
1990	375.15	3,778.73	43,061.49	225.84
1995	361.45	3,664.15	43,224.36	216.44
2000	404.13	3,326.20	41,228.63	225.84
2005	164.99	1,176.35	37,589.84	332.87
2010	138.98	1,306.13	28,860.16	3,917.21
2011	115.82	1,011.43	25,399.22	5,151.81
2012	87.79	911.25	24,388.98	6,639.92
2013	60.40	892.57	24,507.10	8,078.16
2014	51.64	615.17	22,211.10	10,867.04
2015	49.81	489.84	23,292.66	11,325.35
2016	40.06	418.85	24,016.88	10,877.96
2017	41.44	450.99	24,660.76	11,105.85
2018	29.51	402.26	22,711.85	9,373.46
2019	71.43	351.29	22,524.90	9,842.97
2020	38.85	137.65	21,982.57	10,333.35
2021	30.19	118.83	23,369.43	10,075.90
2022	31.37	157.88	21,338.48	8,571.72
2023	28.46	72.47	19,316.52	8,340.65
2024	27.23	39.49	19,207.12	9,838.62
1990/2024	-93%	-99%	-55%	4256%
2023/2024	-4%	-46%	-1%	18%

3.7.2.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024. NH₃ emissions from solid biomass combustion are reported as 'NO' because measurements show that NH₃ 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 the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (*Table 3.7.4*).

Table 3.7.4: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NO _x	[g/tGJ]	57.88
NM VOC	[g/tGJ]	4.79
SO _x	[g/tGJ]	46.01
TSP	[g/tGJ]	61.07
PM _{2.5}	[% of TSP]	56.22%
PM ₁₀	[% of TSP]	67.93%
CO	[g/tGJ]	91.27

The methodology for calculating BC, heavy metals, and POPs is described in *Annex X*. *Table 3.7.5* shows the distribution of fuels to the subsequent categories used in the methodology.

Table 3.7.5: Fuel consumption in TJ in category 1A4ai

TYPE OF FUEL	LIQUID FUELS		HARD COAL			BROWN COAL		
TYPE OF BOILER	ALL TYPE OF BOILERS	STATIONERY ENGINES	FIXED BED BOILERS	FLUIDIZED BED BOILERS		FIXED BED BOILERS	FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	<5	-	<5	<5	5-50	<5	5-50	5-50
1990	63.27	537.47	389.75	-	1,319.89	601.73	70.39	459.38
1991	52.56	446.48	336.34	-	1,139.01	519.27	60.74	396.42
1992	43.09	366.03	288.18	-	975.93	444.92	52.05	339.66
1993	34.79	295.55	245.00	-	829.71	378.26	44.25	288.77
1994	31.64	268.76	206.54	-	699.45	318.88	37.30	243.44
1995	27.80	236.17	172.52	-	584.23	266.35	31.16	203.33
1996	20.91	177.66	142.67	-	483.14	220.26	25.77	168.15
1997	15.52	131.83	282.71	-	957.39	436.47	51.06	333.21
1998	12.13	103.04	164.86	-	558.29	254.52	29.77	194.31
1999	10.12	85.95	117.11	-	396.61	180.81	21.15	138.04
2000	7.54	64.07	65.65	-	222.31	101.35	11.86	77.37
2001	12.12	102.92	54.52	-	184.62	84.17	9.85	64.26
2002	21.37	181.52	93.38	-	316.23	144.17	16.86	110.06
2003	23.30	197.92	3.83	-	12.96	5.91	0.69	4.51
2004	25.23	214.32	46.27	-	156.68	71.43	8.36	54.53
2005	20.63	175.21	22.66	-	76.73	34.98	4.09	26.71
2006	18.23	154.91	32.59	-	110.36	50.31	5.89	38.41
2007	5.27	44.73	75.57	-	255.93	116.68	13.65	89.08
2008	1.90	16.14	113.45	-	384.20	175.16	20.49	133.72
2009	6.53	55.50	197.85	-	670.04	305.47	35.73	233.20
2010	11.78	100.04	139.55	-	472.59	215.45	25.20	164.48
2011	10.28	79.55	111.02	-	442.99	180.62	24.83	131.74
2012	7.86	59.34	91.92	-	391.06	150.14	22.82	137.07
2013	6.24	29.34	74.65	-	382.30	152.41	17.00	121.67

TYPE OF FUEL	LIQUID FUELS		HARD COAL			BROWN COAL		
TYPE OF BOILER	ALL TYPE OF BOILERS	STATIONERY ENGINES	FIXED BED BOILERS	FLUIDIZED BED BOILERS		FIXED BED BOILERS	FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	<5	-	<5	<5	5-50	<5	5-50	5-50
2014	5.84	24.35	46.68	-	239.46	108.36	16.77	90.00
2015	5.83	25.36	41.34	-	230.95	99.87	18.21	97.89
2016	5.36	12.91	38.26	-	167.39	95.62	18.24	99.29
2017	3.90	12.36	35.17	-	213.23	85.27	22.74	95.13
2018	2.73	12.53	35.36	-	203.68	69.93	17.02	76.28
2019	3.44	54.74	32.97	-	170.92	56.12	15.98	75.30
2020	1.75	16.48	21.94	-	12.70	44.71	16.77	41.54
2021	2.11	18.19	22.61	-	14.56	34.81	18.89	27.96
2022	1.75	20.28	13.81	-	39.52	33.74	15.91	54.90
2023	1.86	16.96	8.92	0.05	-	18.79	9.75	34.96
2024	1.39	16.56	8.31	0.08	0.97	13.22	7.28	9.62

TYPE OF FUEL	GASEOUS FUELS				BIOMASS		
TYPE OF BOILER	ALL TYPE OF BOILERS		STATIONERY ENGINES	GAS TURBINES	FIXED BED BOILERS	FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	<5	5-50	-	-	<5	<5	5-50
1990	26,645.00	3,355.78	5.92	306.63	252.94	389.36	799.47
1991	24,818.95	3,125.80	5.51	285.62	198.14	305.00	626.25
1992	23,294.29	2,933.78	5.18	268.07	151.97	233.94	480.34
1993	22,736.46	2,863.53	5.05	261.65	113.85	175.26	359.85
1994	20,845.64	2,625.39	4.63	239.89	83.18	128.05	262.91
1995	19,731.12	2,485.02	4.38	227.07	59.37	91.38	187.64
1996	18,812.37	2,369.31	4.18	216.49	41.81	64.35	132.14
1997	18,195.18	2,291.58	4.04	209.39	29.91	46.04	94.53
1998	17,917.37	2,256.59	3.98	206.19	23.08	35.52	72.94
1999	17,455.12	2,198.37	3.88	200.87	20.71	31.89	65.47
2000	16,472.76	2,074.65	3.66	189.57	18.07	27.82	57.12
2001	17,655.40	2,223.60	3.92	203.18	32.82	50.52	103.73
2002	17,071.13	2,150.01	3.79	196.46	27.44	42.23	86.72
2003	16,373.73	2,062.18	3.64	188.43	41.44	63.79	130.99
2004	15,764.07	1,985.39	3.50	181.41	46.17	71.07	145.92
2005	27,291.76	3,437.24	6.06	314.07	64.63	99.49	204.27
2006	30,144.98	3,796.59	6.70	346.91	67.60	104.05	213.65
2007	27,959.88	3,521.38	6.21	321.76	78.93	121.50	249.47
2008	27,601.69	3,476.27	6.13	317.64	217.25	334.42	686.66
2009	22,925.03	2,887.27	5.09	263.82	350.57	539.64	1,108.03
2010	25,502.88	3,211.94	5.67	293.49	675.36	1,039.60	2,134.58
2011	22,991.02	2,378.91	11.73	534.80	747.15	1,079.68	2,845.16
2012	21,535.29	2,583.70	13.32	1,015.10	719.71	1,621.08	3,648.17
2013	20,158.23	3,357.63	5.27	1,713.06	847.90	1,620.28	4,486.99
2014	17,090.50	3,791.11	2.01	4,143.36	486.27	1,404.54	5,094.97
2015	18,137.86	3,295.47	0.50	4,379.71	617.21	1,459.01	5,596.74
2016	18,443.69	3,330.32	0.37	4,373.74	745.98	1,503.41	4,976.07

TYPE OF FUEL	GASEOUS FUELS				BIOMASS		
TYPE OF BOILER	ALL TYPE OF BOILERS		STATIONERY ENGINES	GAS TURBINES	FIXED BED BOILERS	FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	<5	5-50	-	-	<5	<5	5-50
2017	18,857.89	4,070.68	0.12	3,867.49	809.96	1,590.54	5,244.88
2018	16,945.58	2,993.49	0.63	4,960.17	643.37	1,293.63	5,052.71
2019	16,775.61	2,129.62	0.37	5,599.60	683.12	1,446.16	5,366.25
2020	16,128.38	2,100.66	0.43	5,773.27	463.02	1,454.16	5,989.80
2021	16,979.24	2,307.49	0.28	5,758.75	498.46	1,498.72	5,624.96
2022	15,198.76	1,920.43	0.24	5,549.53	470.84	1,358.71	4,521.03
2023	14,020.31	1,921.02	0.27	4,622.69	458.14	1,388.12	4,168.57
2024	13,590.00	1,688.82	0.19	5,375.80	450.81	1,529.59	5,372.32

3.7.2.3 Completeness

Ammonia emissions did not occur in this category until 2014.

3.7.2.4 Source-specific Recalculations

No recalculations were made in this submission.

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**). The results of the separation are shown in *Table 3.7.6*.

Table 3.7.6: Overview of emissions in category 1A4aii

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.1142	0.0118	7.0E-05	2.8E-05	0.0074	0.0074	0.0074	0.0046	0.0377
1995	0.1244	0.0129	7.6E-05	3.1E-05	0.0080	0.0080	0.0080	0.0050	0.0411
2000	0.1346	0.0139	8.3E-05	3.3E-05	0.0087	0.0087	0.0087	0.0054	0.0444
2005	0.1448	0.0150	8.9E-05	3.6E-05	0.0093	0.0093	0.0093	0.0058	0.0478
2010	0.1550	0.0160	9.5E-05	3.8E-05	0.0100	0.0100	0.0100	0.0062	0.0512
2011	0.1570	0.0163	9.6E-05	3.9E-05	0.0101	0.0101	0.0101	0.0063	0.0518
2012	0.1591	0.0165	9.8E-05	3.9E-05	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	1.0E-04	4.0E-05	0.0105	0.0105	0.0105	0.0065	0.0539
2015	0.1958	0.0203	1.2E-04	4.8E-05	0.0126	0.0126	0.0126	0.0078	0.0646
2016	0.1305	0.0135	8.0E-05	3.2E-05	0.0084	0.0084	0.0084	0.0052	0.0431
2017	0.0979	0.0101	6.0E-05	2.4E-05	0.0063	0.0063	0.0063	0.0039	0.0323
2018	0.0653	0.0068	4.0E-05	1.6E-05	0.0042	0.0042	0.0042	0.0026	0.0215
2019	0.1631	0.0169	1.0E-04	4.0E-05	0.0105	0.0105	0.0105	0.0065	0.0539
2020	0.0979	0.0101	6.0E-05	2.4E-05	0.0063	0.0063	0.0063	0.0039	0.0323
2021	0.0979	0.0101	6.0E-05	2.4E-05	0.0063	0.0063	0.0063	0.0039	0.0323
2022	0.1305	0.0135	8.0E-05	3.2E-05	0.0084	0.0084	0.0084	0.0052	0.0431
2023	0.0653	0.0068	4.0E-05	1.6E-05	0.0042	0.0042	0.0042	0.0026	0.0215
2024	0.0653	0.0068	4.0E-05	1.6E-05	0.0042	0.0042	0.0042	0.0026	0.0215
1990/2024	-43%	-43%	-43%	-43%	-43%	-43%	-43%	-43%	-43%
2023/2024	0%	0%	0%	0%	0%	0%	0%	0%	0%

YEAR	Cd [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	B(a)P [t]	B(b)F [t]	PAHs [t]
1990	3.5E-05	0.0002	0.0060	0.0002	3.5E-05	0.0035	0.0001	0.0002	0.0003
1995	3.8E-05	0.0002	0.0065	0.0003	3.8E-05	0.0038	0.0001	0.0002	0.0003
2000	4.1E-05	0.0002	0.0070	0.0003	4.1E-05	0.0041	0.0001	0.0002	0.0003
2005	4.4E-05	0.0002	0.0075	0.0003	4.4E-05	0.0044	0.0001	0.0002	0.0004
2010	4.8E-05	0.0002	0.0081	0.0003	4.8E-05	0.0048	0.0001	0.0002	0.0004
2011	4.8E-05	0.0002	0.0082	0.0003	4.8E-05	0.0048	0.0001	0.0002	0.0004
2012	4.9E-05	0.0002	0.0083	0.0003	4.9E-05	0.0049	0.0001	0.0002	0.0004
2013	NO	NO	NO	NO	NO	NO	NO	NO	NO
2014	5.0E-05	0.0003	0.0085	0.0004	5.0E-05	0.0050	0.0002	0.0003	0.0004
2015	6.0E-05	0.0003	0.0102	0.0004	6.0E-05	0.0060	0.0002	0.0003	0.0005
2016	4.0E-05	0.0002	0.0068	0.0003	4.0E-05	0.0040	0.0001	0.0002	0.0003
2017	3.0E-05	0.0002	0.0051	0.0002	3.0E-05	0.0030	0.0001	0.0002	0.0002
2018	2.0E-05	0.0001	0.0034	0.0001	2.0E-05	0.0020	0.0001	0.0001	0.0002
2019	5.0E-05	0.0003	0.0085	0.0004	5.0E-05	0.0050	0.0002	0.0003	0.0004
2020	3.0E-05	0.0002	0.0051	0.0002	3.0E-05	0.0030	0.0001	0.0002	0.0002
2021	3.0E-05	0.0002	0.0051	0.0002	3.0E-05	0.0030	0.0001	0.0002	0.0002
2022	4.0E-05	0.0002	0.0068	0.0003	4.0E-05	0.0040	0.0001	0.0002	0.0003
2023	2.0E-05	0.0001	0.0034	0.0001	2.0E-05	0.0020	0.0001	0.0001	0.0002
2024	2.0E-05	0.0001	0.0034	0.0001	2.0E-05	0.0020	0.0001	0.0001	0.0002
1990/2024	-43%	-43%	-43%	-43%	-43%	-43%	-43%	-43%	-43%
2023/2024	0%	0%	0%	0%	0%	0%	0%	0%	0%

The overview of the activity data (energy consumption) for this source category is in [Table 3.7.7](#) below. Small irregularities were found during checking activity data (the year 2011). It was caused by incorrect data flow, but did not affect the emissions calculations. Also, the energy consumption for 2024 is based on expert judgment, as there are no statistical data for this category.

Table 3.7.7: Overview of activity data in category 1A4a_{ii}

YEAR	LIQUID FUELS [TJ NCV]	BIOMASS [TJ NCV]
1990	148.79	NO
1995	160.41	NO
2000	175.68	NO
2005	187.30	NO
2010	181.12	8.94
2011	180.85	10.33
2012	184.20	9.97
2013	NO	NO
2014	195.30	13.64
2015	234.58	17.03
2016	156.59	11.20
2017	117.14	8.71
2018	78.53	5.37
2019	196.34	13.46
2020	116.95	8.80
2021	116.98	8.75
2022	156.72	11.71
2023	78.30	5.43
2024	78.65	5.48

YEAR	LIQUID FUELS [TJ NCV]	BIOMASS [TJ NCV]
1990/2024	-47%	-
2023/2024	0%	1%

3.7.3.2 Methodological Issues

Slovakia was able to receive statistical data about fuel combustion from the year 2012. The years 1990-2011 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 2012. After this year, we can observe deviations in fuel consumption, as well as in estimated emissions. For the emission estimation, EMEP/EEA GB 2023 Tier 1 emission factors were used.

3.7.3.3 Completeness

Emissions are well covered. Notation keys are used according to EMEP/EEA GB 2023.

3.7.3.4 Source-specific Recalculations

No recalculations were made in this submission.

3.7.4 Residential: Stationary (NFR 1A4bi)

3.7.4.1 Overview

Households remain a key sector in the national emission inventory and therefore receive increased attention and focused analytical assessment. Household heating represents a major source of particulate matter emissions (approximately 70%), as well as a significant contributor to other air pollutants in Slovakia.

In 2024, the share of emissions from households in total national emissions continued to decline. Overall emission levels, together with fuel consumption, remain relatively stable with a slight downward trend. The decrease observed in 2024 was influenced by meteorological conditions during the heating season, which was warmer than the long-term climatological normal and also warmer than in recent years. Temperature conditions were close to those recorded in the exceptionally warm year 2014.

This category remains dominant for most pollutants (NO_x, SO_x, NMVOC, PM_{2.5}, PM₁₀, TSP, BC, CO, Cd, Hg, As, Cr, Ni, Zn, PCDD/F, PAHs, HCB, PCBs). Emission trends across pollutants show a consistent pattern, strongly correlated with the trend in biomass (wood) combustion in Slovak households. The overview of the emissions is shown in [Table 3.7.8](#).

Table 3.7.8: Overview of emissions in category 1A4bi

YEAR	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	5.1971	136.8648	28.8620	0.0401	78.0516	79.2766	87.0018	5.6817	690.2921
1995	3.6223	63.0227	11.1223	0.0848	33.9134	34.4959	37.6469	2.6490	315.4333
2000	3.8857	47.1180	6.7151	0.1076	24.1816	24.6318	26.7375	2.0141	229.6318
2005	4.1456	48.6813	2.3431	0.2442	21.2167	21.7231	23.1274	2.1639	226.4921
2010	4.0201	46.3647	1.7528	0.2483	19.7923	20.2770	21.5338	2.0660	215.1242
2011	3.6592	43.4006	1.6277	0.2322	18.4853	18.9373	20.1152	1.9278	201.6142
2012	3.7587	47.0031	1.7415	0.2479	19.9385	20.4267	21.6933	2.0831	218.5896
2013	3.6595	43.4082	1.6150	0.2223	18.3873	18.8357	20.0100	1.9162	201.7557
2014	2.7308	25.7014	1.2083	0.1160	11.1513	11.4136	12.1628	1.1293	119.2216
2015	3.2322	35.7571	1.4128	0.1743	15.1971	15.5649	16.5459	1.5760	167.6001
2016	3.4269	38.3712	1.4311	0.1918	15.6133	15.9985	16.9750	1.6418	181.8626

YEAR	NO _x [kt]	NM ₁₀ VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
2017	3.5681	36.5970	1.5957	0.1678	15.6954	16.0702	17.1003	1.6158	174.2116
2018	3.0805	28.2144	1.2823	0.1218	12.1321	12.4204	13.2208	1.2464	135.6463
2019	3.1823	29.4394	1.2590	0.1284	12.6520	12.9556	13.7788	1.3057	142.5483
2020	3.2329	29.3184	1.1654	0.1240	12.4586	12.7600	13.5610	1.3000	142.6604
2021	3.4321	28.3786	1.2029	0.1607	11.9556	12.2422	13.0163	1.1655	139.1554
2022	3.0733	27.2661	1.1738	0.1547	11.5361	11.8145	12.5581	1.1209	135.0051
2023	2.7449	22.0461	0.7716	0.1317	9.1323	9.3588	9.9223	0.9044	109.5910
2024	2.5570	19.5566	0.7955	0.1145	8.1794	8.3796	8.8940	0.8025	97.5311
1990/2024	-51%	-86%	-97%	186%	-90%	-89%	-90%	-86%	-86%
2023/2024	-7%	-11%	3%	-13%	-10%	-10%	-10%	-11%	-11%

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
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	0.3554	0.2014	0.0676	0.0502	0.6647	0.1798	0.0906	0.0375	4.1396
2022	0.3262	0.1907	0.0617	0.0491	0.6462	0.1679	0.0864	0.0338	3.8878
2023	0.2645	0.1621	0.0521	0.0365	0.5297	0.1382	0.0703	0.0263	3.2765
2024	0.2344	0.1409	0.0492	0.0357	0.4695	0.1220	0.0624	0.0232	2.8741
1990/2024	-78%	106%	-86%	-94%	-80%	-72%	-81%	-85%	-28%
2023/2024	-11%	-13%	-6%	-2%	-11%	-12%	-11%	-11%	-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]	PCBs [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

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]
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	5.6810	3.5514	2.7851	1.4354	2.0037	9.7757	2.1509	0.0788
2022	5.4258	3.3746	2.6350	1.3750	1.9199	9.3046	1.4799	0.0681
2023	4.4756	2.7292	2.1049	1.1148	1.5468	7.4957	0.7615	0.0500
2024	3.9135	2.4054	1.8524	0.9851	1.3624	6.6052	0.6556	0.0465
1990/2024	-46%	-82%	-80%	-82%	-80%	-81%	-95%	-93%
2023/2024	-13%	-12%	-12%	-12%	-12%	-12%	-14%	-7%

Fuels are allocated to the respective fuel type for emissions calculations. The overview of activity data (energy consumption) for this source category is in [Table 3.7.9](#) below and shows relatively big decrease in solid fuels consumption. There are probably two reasons for this change. The first is the natural fuel switch and natural equipment replacement, the second is a legislative change that has caused a different way of reporting solid fuel sales. Fuels in the template are allocated following principles from IPCC 2006 Guidelines.

Table 3.7.9: 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	31,270.00	763.53
2013	942.90	230.19	1,177.86	506.85	48,200.08	368.00	27,956.95	886.99
2014	828.07	170.77	913.26	414.61	43,395.60	184.00	14,735.31	380.23
2015	982.83	147.10	955.40	570.61	43,903.00	184.00	22,085.57	792.00
2016	1,025.72	204.57	804.37	641.48	44,697.43	368.00	23,977.58	970.98
2017	1,252.68	217.24	863.90	936.44	49,339.18	368.00	21,219.70	999.81
2018	1,056.04	131.98	652.26	862.55	45,735.20	322.00	15,389.90	828.34
2019	1,100.86	106.96	556.82	899.92	45,951.45	276.00	16,157.06	979.38
2020	1,084.83	63.95	412.97	958.40	47,205.23	276.00	15,582.59	944.56
2021	1,055.43	53.72	453.17	1,082.14	51,715.57	368.00	20,807.33	1,261.27
2022	644.55	56.67	702.01	1,018.33	45,498.76	322.00	19,534.43	1,184.11
2023	297.19	40.48	400.73	765.87	43,453.53	276.00	16,626.68	1,007.85
2024	226.19	53.98	550.05	665.35	41,708.66	276.00	14,490.45	878.36
1990/2024	-91%	-99%	-98%	-	59%	-78%	308%	-
2023/2024	-24%	5%	55%	-6%	-12%	-13%	-6%	-6%

HC – Hard coal
BC – Brown coal

CB – Coal briquettes
NG – Natural gas

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 are not fully covered by the ŠÚ SR. Direct statistics are 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, removing these inconsistencies and harmonising 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 completed. 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 household’s 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 of 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 (13) 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 m² of housing area for 1 year. Total housing area, energy efficiency of houses and climatic 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 conducted in households.

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, and 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 an improved structure of combustion equipment in Households. **Table 3.7.10** shows the boiler structure for 2024.

Table 3.7.10: Households share by type of fuels and type of equipment for the year 2024

2024	TYPE OF EQUIPMENT	BC	HC & COKE	CB	PELETS & WOOD BRIQUETTES	FIREWOOD	OTHER
1	Over-fire boilers	55.9%	68.3%	86.3%	31.0%	44.8%	61.9%

2024	TYPE OF EQUIPMENT	BC	HC & COKE	CB	PELETS & WOOD BRIQUETTES	FIREWOOD	OTHER
2	Under-fire boilers	24.7%	15.0%	4.7%	7.6%	12.7%	19.2%
3	Gasification boilers	2.3%	4.3%	3.4%	13.2%	7.9%	3.4%
4	Automatic boilers	6.9%	7.6%	2.1%	34.9%	2.6%	4.7%
5	Fireplaces, stoves, masonry stoves	10.1%	4.9%	3.4%	9.7%	28.6%	8.1%
6	Modern masonry stoves and pellets stoves	0.1%	-	0.1%	3.6%	3.4%	2.7%
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 of gasification boilers and automatic boilers and 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 pellet stoves, we moved the share to the category of fireplaces, stoves and 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 3.7.11](#) shows the share of plants in 2005, and [Table 3.7.12](#) in 1990.

Table 3.7.11: 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 3.7.12: 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 the results of VEC VŠB 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 (1). 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 3-40), modern masonry/built-in tile stoves and pellet stoves (Table 3-44) were obtained from the EMEP/EEA GB 2023 (Tier 2). The GHG emission factors for relevant fuel types were taken from IPCC Guidelines, Tier 1 methodology. For the category Modern masonry/built-in tile stoves and pellet stoves, emission factors only for combustion of wood, wooden pellets and briquettes were available.

A description of all EF is available in the [Final report on the implementation of the action](#) (14).

3.7.4.3 Completeness

Emissions are well covered.

3.7.4.4 Source-specific Recalculations

A recalculation was carried out for the year 2023 due to the update of activity data related to electricity consumption for space heating and domestic hot water production in households. The revision reflects the availability of more accurate and complete statistical data.

The impact of this recalculation on total emissions is minor, resulting in a decrease of approximately 1–2%, depending on the pollutant concerned. The recalculation does not affect the overall emission trend but improves the consistency and accuracy of the time series. The differences in emissions in category **1A4bi** between the previous and current submissions caused by recalculations are shown in [Table 3.7.13](#).

Table 3.7.13: Differences in emissions (%) in category 1A4bi between the previous and current submission caused by recalculations

YEAR	NO _x	NM _{VOC}	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO
2023	-0.91%	-2.01%	-0.88%	-2.34%	-1.97%	-1.97%	-1.95%	-2.07%	-1.99%

YEAR	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2023	-2.09%	-2.34%	-0.58%	-0.87%	-2.00%	-2.12%	-2.01%	-1.83%	-2.28%

YEAR	PCDD/F	PAHs	HCB	PCB
2023	-2.18%	-2.03%	-0.27%	-1.48%

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 3.7.14](#). 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 3.7.14: Overview of emissions in category 1A4bii

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.0561	0.0274	0.0001	1.6E-05	0.0033	0.0033	0.0033	0.0019	0.9325
1995	0.0731	0.0426	0.0001	2.2E-05	0.0041	0.0041	0.0041	0.0024	1.5080
2000	0.0902	0.0579	0.0001	2.8E-05	0.0050	0.0050	0.0050	0.0029	2.0835

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
2005	0.1072	0.0731	0.0001	3.4E-05	0.0059	0.0059	0.0059	0.0033	2.6589
2010	0.1242	0.0884	0.0001	4.0E-05	0.0068	0.0068	0.0068	0.0038	3.2344
2011	0.1276	0.0914	0.0001	4.1E-05	0.0069	0.0069	0.0069	0.0039	3.3495
2012	0.1310	0.0944	0.0001	4.2E-05	0.0071	0.0071	0.0071	0.0040	3.4646
2013	0.1344	0.0975	0.0002	4.3E-05	0.0073	0.0073	0.0073	0.0041	3.5797
2014	0.1412	0.1036	0.0002	4.6E-05	0.0076	0.0076	0.0076	0.0043	3.8099
2015	0.1412	0.1036	0.0002	4.6E-05	0.0076	0.0076	0.0076	0.0043	3.8099
2016	0.1412	0.1036	0.0002	4.6E-05	0.0076	0.0076	0.0076	0.0043	3.8099
2017	0.1412	0.1036	0.0002	4.6E-05	0.0076	0.0076	0.0076	0.0043	3.8099
2018	0.1412	0.1036	0.0002	4.6E-05	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	4.8E-05	0.0082	0.0082	0.0082	0.0046	3.9169
2023	0.1521	0.1075	0.0002	4.9E-05	0.0083	0.0083	0.0083	0.0047	3.9303
2024	0.1535	0.1080	0.0002	4.9E-05	0.0084	0.0084	0.0084	0.0047	3.9453
1990/2024	174%	294%	227%	198%	157%	157%	157%	147%	323%
2023/2024	1%	0%	1%	1%	1%	1%	1%	1%	0%

YEAR	Cd [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	B(a)P [t]	B(b)F [t]	PAHs [t]
1990	2.7E-05	0.0001	0.0045	0.0002	2.7E-05	0.0027	0.0001	0.0001	0.0002
1995	3.8E-05	0.0002	0.0064	0.0003	3.8E-05	0.0038	0.0001	0.0002	0.0003
2000	4.9E-05	0.0002	0.0083	0.0003	4.9E-05	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
2023	0.0001	0.0004	0.0146	0.0006	0.0001	0.0086	0.0003	0.0004	0.0007
2024	0.0001	0.0004	0.0147	0.0006	0.0001	0.0087	0.0003	0.0004	0.0007
1990/2024	227%	227%	227%	227%	227%	227%	240%	217%	227%
2023/2024	1%	1%	1%	1%	1%	1%	1%	1%	1%

The overview of the activity data (energy consumption) for this source category is in [Table 3.7.15](#) below.

Table 3.7.15: Overview of activity data in category 1A4bii

YEAR	LIQUID FUELS [TJ NCV]	BIOMASS [TJ NCV]
1990	113.48	NO

YEAR	LIQUID FUELS [TJ NCV]	BIOMASS [TJ NCV]
1995	160.40	NO
2000	208.67	NO
2005	256.83	NO
2010	292.40	5.46
2011	298.07	7.70
2012	306.40	8.36
2013	321.14	9.72
2014	333.05	14.69
2015	336.09	13.26
2016	330.90	16.43
2017	327.34	18.73
2018	328.81	17.64
2019	357.78	19.73
2020	350.35	24.56
2021	390.00	27.12
2022	339.82	23.69
2023	348.06	22.90
2024	350.77	23.40
1990/2024	209%	-
2023/2024	1%	2%

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” (14) 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 2023 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

No recalculations were made in this submission.

3.7.6 Agriculture/Forestry/Fishing: Stationary (NFR 1A4ci)

3.7.6.1 Overview

Activities listed within this category are shown in [Table 3.7.16](#).

Table 3.7.16: Activities according to national categorisation included in category 1A4ci

CATEGORISATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR
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 3.7.17](#).

Table 3.7.17: Overview of emissions in category 1A4ci

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.1088	0.0282	0.1466	0.0001	0.0307	0.0701	0.1533	0.0044	0.2780
1995	0.1156	0.0299	0.1557	0.0001	0.0326	0.0744	0.1628	0.0048	0.2952
2000	0.1124	0.0056	0.1689	0.0001	0.0418	0.0955	0.2089	0.0061	0.4136
2005	0.1542	0.0092	0.1420	0.0001	0.0462	0.0948	0.2044	0.0097	0.2216
2010	0.1022	0.0108	0.0266	0.0001	0.0329	0.0795	0.1791	0.0067	0.1218
2011	0.1020	0.0128	0.0194	0.0001	0.0357	0.0892	0.1984	0.0085	0.1267
2012	0.1129	0.0129	0.0292	0.0001	0.0303	0.0713	0.1543	0.0072	0.1518
2013	0.1258	0.0144	0.0336	0.0001	0.0276	0.0689	0.1528	0.0065	0.1589
2014	0.2434	0.0395	0.0698	0.0003	0.0313	0.0862	0.1967	0.0083	0.2094
2015	0.2736	0.0196	0.0908	0.0001	0.0297	0.0678	0.1451	0.0072	0.2131
2016	0.2515	0.0157	0.0722	0.0001	0.0308	0.0754	0.1648	0.0070	0.2072
2017	0.2266	0.0147	0.0555	0.0001	0.0269	0.0602	0.1265	0.0061	0.1891
2018	0.2215	0.0256	0.0564	0.0002	0.0363	0.0699	0.1343	0.0094	0.2005
2019	0.2276	0.0201	0.0552	0.0001	0.0389	0.0696	0.1312	0.0096	0.2027
2020	0.2664	0.0243	0.0415	0.0001	0.0388	0.0813	0.1634	0.0096	0.2010
2021	0.2543	0.0319	0.0412	0.0002	0.0437	0.0881	0.1733	0.0112	0.2333
2022	0.1810	0.0229	0.0307	0.0001	0.0351	0.0610	0.1090	0.0090	0.1555
2023	0.1775	0.0254	0.0247	0.0001	0.0370	0.0676	0.1249	0.0097	0.1647
2024	0.1868	0.0272	0.0177	0.0001	0.0363	0.0601	0.1035	0.0095	0.1735
1990/2024	72%	-3%	-88%	57%	18%	-14%	-32%	117%	-38%
2023/2024	5%	7%	-28%	4%	-2%	-11%	-17%	-1%	5%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0010	0.0000	0.0001	0.0011	0.0006	0.0011	0.0023	0.0001	0.0012
1995	0.0173	0.0005	0.0010	0.0176	0.0114	0.0200	0.0201	0.0016	0.0145
2000	0.0118	0.0005	0.0008	0.0118	0.0078	0.0133	0.0176	0.0012	0.0178
2005	0.0059	0.0005	0.0005	0.0056	0.0040	0.0063	0.0111	0.0007	0.0175
2010	0.0020	0.0005	0.0003	0.0013	0.0015	0.0015	0.0041	0.0004	0.0196
2011	0.0020	0.0006	0.0002	0.0011	0.0016	0.0013	0.0017	0.0003	0.0225
2012	0.0018	0.0005	0.0002	0.0010	0.0014	0.0011	0.0012	0.0001	0.0198
2013	0.0020	0.0006	0.0003	0.0010	0.0015	0.0012	0.0013	0.0001	0.0231
2014	0.0068	0.0030	0.0004	0.0008	0.0057	0.0020	0.0012	0.0004	0.1212
2015	0.0030	0.0012	0.0003	0.0009	0.0025	0.0013	0.0010	0.0003	0.0482
2016	0.0018	0.0006	0.0003	0.0007	0.0014	0.0009	0.0010	0.0003	0.0267
2017	0.0017	0.0006	0.0003	0.0006	0.0014	0.0007	0.0009	0.0003	0.0269
2018	0.0039	0.0017	0.0003	0.0005	0.0032	0.0011	0.0011	0.0003	0.0698
2019	0.0026	0.0011	0.0003	0.0005	0.0022	0.0008	0.0014	0.0003	0.0463
2020	0.0019	0.0008	0.0004	0.0004	0.0016	0.0006	0.0005	0.0003	0.0344
2021	0.0023	0.0010	0.0005	0.0005	0.0018	0.0006	0.0003	0.0003	0.0400
2022	0.0018	0.0008	0.0003	0.0003	0.0014	0.0005	0.0003	0.0002	0.0322
2023	0.0020	0.0009	0.0003	0.0003	0.0017	0.0005	0.0003	0.0002	0.0371
2024	0.0021	0.0010	0.0003	0.0002	0.0018	0.0005	0.0002	0.0003	0.0402
1990/2024	117%	2967%	127%	-77%	173%	-56%	-90%	141%	3170%
2023/2024	5%	7%	5%	-13%	6%	-3%	-4%	25%	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]	PCBs [kg]
1990	0.0005	5.5E-06	8.9E-06	8.8E-06	6.9E-06	3.0E-05	0.0001	0.0001
1995	0.0021	0.0001	0.0001	0.0001	0.0001	0.0005	0.0021	0.0017
2000	0.0033	0.0002	0.0003	0.0002	0.0001	0.0008	0.0015	0.0012
2005	0.0037	0.0003	0.0004	0.0002	0.0001	0.0009	0.0008	0.0006
2010	0.0045	0.0004	0.0006	0.0002	0.0001	0.0012	0.0004	0.0002
2011	0.0052	0.0004	0.0007	0.0002	0.0002	0.0015	0.0004	0.0001
2012	0.0047	0.0004	0.0006	0.0002	0.0002	0.0013	0.0004	0.0001
2013	0.0055	0.0004	0.0007	0.0002	0.0002	0.0015	0.0004	0.0001
2014	0.0243	0.0023	0.0037	0.0012	0.0009	0.0081	0.0013	0.0001
2015	0.0101	0.0009	0.0014	0.0004	0.0004	0.0031	0.0006	0.0001
2016	0.0058	0.0005	0.0007	0.0002	0.0002	0.0016	0.0004	0.0001
2017	0.0058	0.0005	0.0007	0.0002	0.0002	0.0016	0.0004	0.0001
2018	0.0143	0.0013	0.0021	0.0007	0.0005	0.0046	0.0008	0.0001
2019	0.0096	0.0008	0.0013	0.0004	0.0003	0.0029	0.0005	0.0001
2020	0.0079	0.0006	0.0010	0.0003	0.0003	0.0022	0.0006	0.0001
2021	0.0097	0.0007	0.0012	0.0004	0.0003	0.0026	0.0008	0.0002
2022	0.0074	0.0006	0.0009	0.0003	0.0002	0.0021	0.0005	0.0001
2023	0.0082	0.0007	0.0011	0.0003	0.0003	0.0024	0.0006	0.0001
2024	0.0088	0.0007	0.0012	0.0004	0.0003	0.0026	0.0006	0.0001
1990/2024	1839%	13396%	13321%	4145%	4201%	8550%	408%	-2%
2023/2024	7%	7%	7%	7%	7%	7%	2%	-7%

The overview of the activity data (energy consumption) for this source category is in [Table 3.7.18](#) below.

Table 3.7.18: Overview of activity data in category 1A4ci

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]
1990	42.65	210.52	1,015.84	73.46
1995	58.78	206.46	1,086.01	74.42
2000	47.35	197.46	1,060.56	72.61
2005	159.91	100.24	1,930.10	85.17
2010	50.35	38.59	1,677.71	69.99
2011	36.71	18.80	1,500.25	119.47
2012	29.40	14.09	1,356.93	249.89
2013	36.01	13.29	1,590.77	299.07
2014	66.47	9.08	1,755.51	1,240.14
2015	40.08	10.86	1,502.22	1,520.94
2016	98.12	9.76	1,805.38	1,271.10
2017	87.89	10.67	1,537.70	1,164.30
2018	86.26	6.45	1,399.74	1,187.64
2019	115.71	7.73	1,595.10	1,025.93
2020	204.99	5.40	2,189.06	804.42
2021	215.82	2.37	2,582.76	867.13
2022	97.51	2.51	1,361.36	783.71
2023	115.31	1.98	1,205.17	661.37
2024	87.43	0.80	1,227.38	671.90
1990/2024	105%	-100%	21%	815%

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]
2023/2024	-24%	-59%	2%	2%

3.7.6.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are presented in [ANNEX IV](#). NH₃ emissions were calculated in this submission for this category based on activity data (solid biomass in TJ) – using EF for NH₃ = 1 g/GJ (EMEP/EEA GB 2023). 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 2024. 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}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.7.19](#)).

Table 3.7.19: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NOx	[g/tGJ]	81.05
NMVOC	[g/tGJ]	20.98
SOx	[g/tGJ]	109.20
NH ₃ *	[g/tGJ]	1
TSP	[g/tGJ]	114.17
PM _{2.5}	[% of TSP]	20.03%
PM ₁₀	[% of TSP]	45.72%
CO	[g/tGJ]	207.06

*T1 EMEP/EEA GB 2023 EF

The methodology for calculating BC, heavy metals, and POPs is described in [Annex X. Table 3.7.20](#) shows the distribution of fuels to the subsequent categories used in the methodology.

Table 3.7.20: Fuel consumption in TJ in category 1A4ci

TYPE OF FUEL	LIQUID FUELS		HARD COAL	BROWN COAL	GASEOUS FUELS	
TYPE OF BOILER	ALL TYPE OF BOILERS	STATIONERY ENGINES	FIXED BED BOILERS	FIXED BED BOILERS	ALL TYPE OF BOILERS	
THERMAL CAPACITY IN MW	<5	-	<5	<5	<5	5-50
1990	5.28	0.08	1.87	15.74	553.80	111.70
1991	4.12	0.06	12.06	101.35	416.67	84.04
1992	4.10	0.06	20.15	169.37	333.16	67.20
1993	5.03	0.07	26.31	221.23	299.64	60.44
1994	6.72	0.10	30.73	258.32	309.88	62.50
1995	9.01	0.13	33.55	282.05	357.69	72.15
1996	11.73	0.17	34.95	293.84	436.85	88.11
1997	14.70	0.21	35.10	295.09	541.16	109.15
1998	17.77	0.26	34.16	287.20	664.41	134.01
1999	20.75	0.30	32.30	271.59	800.38	161.44
2000	22.81	0.33	22.09	185.72	1,025.35	206.81
2001	26.27	0.38	19.71	165.74	1,169.44	235.88
2002	28.15	0.41	17.95	150.87	1,234.73	249.05
2003	22.41	0.33	13.07	109.86	1,096.25	221.11
2004	31.88	0.46	8.98	75.47	1,208.60	243.77

TYPE OF FUEL	LIQUID FUELS		HARD COAL	BROWN COAL	GASEOUS FUELS	
TYPE OF BOILER	ALL TYPE OF BOILERS	STATIONERY ENGINES	FIXED BED BOILERS	FIXED BED BOILERS	ALL TYPE OF BOILERS	
THERMAL CAPACITY IN MW	<5	-	<5	<5	<5	5-50
2005	22.09	0.32	10.19	85.68	1,363.50	275.02
2006	27.26	0.40	4.07	34.24	1,223.42	246.76
2007	5.07	0.07	3.90	32.75	1,147.03	231.36
2008	4.32	0.06	3.42	28.78	1,342.25	270.73
2009	6.70	0.10	2.87	24.12	1,277.92	257.76
2010	11.70	0.17	2.02	16.95	1,374.05	277.15
2011	2.62	0.08	1.73	14.17	1,307.67	183.36
2012	1.13	0.19	1.31	12.70	1,213.13	139.09
2013	1.39	0.07	0.18	13.22	1,411.85	173.64
2014	0.62	4.81	0.52	8.62	908.38	38.65
2015	0.49	2.41	0.77	10.17	972.69	226.24
2016	1.46	2.51	1.77	7.93	793.75	249.80
2017	1.30	2.39	4.62	5.83	746.41	273.60
2018	1.75	2.40	1.63	4.45	703.40	252.88
2019	3.46	3.10	3.34	3.95	740.92	265.97
2020	0.86	2.90	3.57	1.83	1,059.56	396.05
2021	0.02	2.73	0.47	1.91	1,663.49	385.19
2022	0.00	2.49	1.08	1.42	848.38	306.88
2023	0.00	2.76	0.81	1.17	690.00	263.23
2024	0.03	2.61	0.18	0.63	639.72	212.86

TYPE OF FUEL	GASEOUS FUELS		BIOMASS		
TYPE OF BOILER	STATIONERY ENGINES	GAS TURBINES	FIXED BED BOILERS	FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	5-50	5-50	<5	<5	5-50
1990	-	2.84	-	-	-
1991	-	2.13	-	-	-
1992	-	1.71	-	-	-
1993	-	1.53	-	-	-
1994	-	1.59	-	-	-
1995	-	1.83	-	-	-
1996	-	2.24	0.57	0.10	0.07
1997	-	2.77	3.83	0.65	0.49
1998	-	3.40	7.46	1.27	0.96
1999	-	4.10	11.23	1.91	1.44
2000	-	5.25	13.21	2.25	1.70
2001	-	5.99	23.11	3.93	2.97
2002	-	6.32	26.11	4.44	3.35
2003	-	5.61	25.33	4.31	3.25
2004	-	6.19	23.69	4.03	3.04
2005	-	6.98	22.14	3.77	2.84
2006	-	6.26	21.31	3.63	2.74
2007	-	5.87	22.04	3.75	2.83
2008	-	6.87	24.19	4.12	3.11
2009	-	6.54	26.39	4.49	3.39

TYPE OF FUEL	GASEOUS FUELS		BIOMASS		
TYPE OF BOILER	STATIONERY ENGINES	GAS TURBINES	FIXED BED BOILERS	FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	5-50	5-50	<5	<5	5-50
2010	-	7.04	34.58	5.89	4.44
2011	25.20	4.79	41.87	14.70	3.17
2012	84.83	-	36.83	19.59	-
2013	144.77	-	43.11	16.98	-
2014	865.84	93.10	230.94	7.73	-
2015	1,062.05	-	87.09	13.20	-
2016	981.39	-	45.27	14.76	-
2017	885.90	-	45.42	16.81	-
2018	960.97	-	129.65	20.85	-
2019	965.13	-	83.04	14.02	-
2020	792.14	4.69	61.15	47.21	-
2021	865.89	-	72.61	83.83	-
2022	751.23	-	58.05	46.47	-
2023	598.04	-	68.51	47.16	-
2024	870.35	-	73.26	46.98	-

3.7.6.3 Completeness

Emissions are well covered. The calculation of NH₃ emissions from solid biomass was implemented in this submission (*Recommendation No. 1A4ci-SK-2022-0001*).

3.7.6.4 Source-specific Recalculations

No recalculations were made in this submission.

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 and harvesters, and it is considered a key category for NO_x emissions. The overview of the emissions is shown in *Table 3.7.21*. Only diesel oil is expected to occur in this category in 2024.

Table 3.7.21: Overview of emissions in the category 1A4cii

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [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	2.6994	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
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

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
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	1.2191	0.2019	0.0011	0.0005	0.1090	0.1090	0.1090	0.0633	0.6537
2021	1.0916	0.1842	0.0010	0.0004	0.0995	0.0995	0.0995	0.0578	0.5964
2022	0.9692	0.1665	0.0009	0.0004	0.0899	0.0899	0.0899	0.0522	0.5390
2023	0.9032	0.1665	0.0009	0.0004	0.0899	0.0899	0.0899	0.0522	0.5390
2024	0.9552	0.1736	0.0010	0.0004	0.0937	0.0937	0.0937	0.0544	0.5620
1990/2024	-89%	-86%	-81%	-81%	-80%	-80%	-80%	-80%	-97%
2023/2024	6%	4%	4%	4%	4%	4%	4%	4%	4%

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
2023	0.0005	0.0024	0.0799	0.0033	0.0005	0.0470	0.0014	0.0024	0.0038
2024	0.0005	0.0025	0.0833	0.0034	0.0005	0.0490	0.0015	0.0025	0.0039
1990/2024	-81%	-81%	-81%	-81%	-81%	-81%	-82%	-81%	-81%
2023/2024	4%	4%	4%	4%	4%	4%	4%	4%	4%

Slovakia was able to separate the consumption in this report for category **1A4cii** from other categories previously reported within this category. 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 used in the year 2024 - 1,926.89 TJ of liquid fuels. The overview of activity data (energy consumption) for this source category is in *Table 3.7.22* below. Small irregularities were found during checking activity data (the year 2011). It was caused by incorrect data flow but did not affect the emissions calculations.

Table 3.7.22: Overview of activity data in the category 1A4cii

YEAR	LIQUID FUELS [TJ NCV]	BIOMASS [TJ NCV]
1990	11,205.00	NO
1995	4,894.00	NO
2000	3,478.00	NO
2005	3,437.00	NO
2010	2,822.78	130.63

YEAR	LIQUID FUELS [TJ NCV]	BIOMASS [TJ NCV]
2011	2,792.78	151.16
2012	2,791.86	144.36
2013	2,788.41	153.94
2014	3,105.83	211.21
2015	2,719.59	190.03
2016	2,680.30	186.86
2017	2,476.26	180.39
2018	2,489.92	166.96
2019	2,332.96	156.74
2020	2,222.08	167.26
2021	2,027.59	151.60
2022	1,841.49	137.58
2023	1,840.07	127.67
2024	1,926.89	134.35
1990/2024	-83%	-
2023/2024	5%	5%

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 emissions described in EMEP/EEA GB 2023, and for the emission estimation, EMEP/EEA GB 2023 Tier 1 emission factors were used.

According to the *Recommendations No. SK-1A4cii-2025-0001*, Slovakia recalculated the NO_x emissions. The calculation is based on data obtained from the IS EVO database (Vehicle Registration Information System of the Police), which are represented in *Table 3.7.23* and *Table 3.7.24*. These data have been available since 2013 and are structured similarly to those used for road transport. A key improvement was the inclusion of information on the emission standard of individual machines, which enabled more accurate age distribution analysis and assignment of emission factors in accordance with established methodology. Within the processing, diesel and gasoline engines were differentiated. Diesel engines, which constitute most of the agricultural and forestry machinery, were processed strictly according to the methodology described in this document, i.e., based on IS EVO data, emission standard, or reference year of registration. For gasoline engines, the shares of two-stroke and four-stroke engines were estimated based on the technical correction proposed by TERT, as this information was not reliably specified in the database and is entirely missing for the year 2005. The proportions of agricultural and forestry tractors in the total number of registered machineries were also identified. For the year 2021, a different approach was used due to the absence of tractor categorisation. An average of the values from 2020 and 2022 was used, and the number of tractors was adjusted based on the total figure recorded for 2021. If a machine was not assigned an emission standard in the database, its year of registration was used as a reference for categorisation. Unspecified or partially identified machinery was assigned to the agricultural machinery category. A significant portion of such equipment was listed as “home-made production,” which complicated the determination of technological and age distribution, particularly for accurate emission factor assignment. For this subgroup, conservative assumptions were applied in accordance with available data and were assigned to the oldest emission categories. Since data are only available from 2013 onward, the estimate for the year 2005 was obtained through extrapolation based on the number of tractors in 2003, as

published in the study “Efektívnosť výrobných faktorov v slovenskom poľnohospodárstve a jeho integrácia do Európskej únie (Possibilities of Assessing the Technical Level of Agricultural Enterprises)” (15) . The standard year-on-year addition of tractors was approximately 400-500 units. This way, the approximate number of tractors was judged for 2005. The 2005 tractor numbers were supplemented with an age distribution derived from the post-2013 data to ensure methodological consistency and continuity across periods. Machinery produced before 1999 was grouped into three levels for calculation purposes: machines produced up to and including 1980 (Level 1), between 1981 and 1990 (Level 2), and between 1991 and 1998 (Level 3). From 1999 onward, specific emission standards (Stage I through Stage V) were assigned to database records, which were then used for determining the appropriate emission factors.

Table 3.7.23: Agriculture tractors age distribution

EMISSION STAGE	LEVEL 1	LEVEL 2	LEVEL 3	STAGE I	STAGE II	STAGE IIIA	STAGE IIIB	STAGE IV	STAGE V	TOTAL
2005	5,974	9,945	2,931	1,820	1,928	0	0	0	0	22,598
2020	9,158	15,244	4,493	2,790	2,956	6,702	6,035	13,305	3,104	63,787
2021	9,427	14,433	5,302	2,859	3,087	6,783	6,105	13,153	5,086	66,235
2022	9,624	13,498	6,071	2,905	3,193	6,812	6,128	12,889	7,030	68,150
2023	9,634	15,120	4,323	2,801	3,232	7,276	6,836	13,389	9,987	72,598
2024	9,324	14,604	4,241	2,751	3,215	7,031	6,696	8,522	13,213	69,597

Table 3.7.24: Forestry tractors age distribution

EMISSION STAGE	LEVEL 1	LEVEL 2	LEVEL 3	STAGE I	STAGE II	STAGE IIIA	STAGE IIIB	STAGE IV	STAGE V	TOTAL
2005	39	103	72	95	39	0	0	0	0	348
2020	36	102	69	93	36	194	105	755	204	1,594
2021	38	96	76	93	35	195	101	727	334	1,695
2022	40	91	84	93	35	195	98	694	463	1,793
2023	46	108	44	79	29	197	159	718	614	1,994
2024	50	119	45	69	36	187	156	533	666	1,861

Data processing was carried out using a computational module conceptually like the one applied for road transport, as described in the final report of the project “Improving the allocation of road transport emissions in AEA module and coherence between AEA and PEFA modules”. This module enables systematic assignment of emission factors based on the combination of machinery type, year of manufacture, fuel type, and emission standard.

The calculation of nitrogen oxide emissions was based on emission factors from the EMEP/EEA GB 2023 methodology, specifically Table 3-2, which contains Tier 2 emission factors for off-road machinery. These factors were assigned to each equipment category based on emission stage and engine characteristics. The result is in **Table 3.7.25**.

Table 3.7.25: Impact and results of different approaches calculating NO_x emissions (kt)

	2005	2020	2021	2022	2023
Previous IIR (2025)	2.6627	1.9640	1.7918	1.6195	1.6195
Potential Technical correction	2.8936	0.6305	0.5752	0.5199	0.5199
New methodology	2.6994	1.2191	1.0916	0.9692	0.9032

3.7.7.3 Completeness

Emissions are well covered. Notation keys are used according to EMEP/EEA GB 2023.

3.7.7.4 Source-specific Recalculations

No recalculations were made in this submission.

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 3.7.26](#).

Table 3.7.26: Activities according to national categorisation included in category 1A5a

CATEGORISATION 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 emissions is shown in [Table 3.7.27](#).

Table 3.7.27: Overview of emissions in category 1A5a

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.1893	1.0216	0.3207	0.0415	0.0459	0.0592	0.1011	0.0030	0.2263
1995	0.1965	1.1103	0.3325	0.0449	0.0480	0.0618	0.1051	0.0032	0.2347
2000	0.1586	1.6329	0.3804	0.0088	0.0638	0.0836	0.1498	0.0043	0.3005
2005	0.2006	1.3149	0.3202	0.0644	0.0223	0.0326	0.0804	0.0020	0.1846
2010	0.1378	0.8525	0.1033	0.0698	0.0127	0.0180	0.0358	0.0016	0.1419
2011	0.1822	0.7419	0.1217	0.0743	0.0150	0.0204	0.0399	0.0022	0.1796
2012	0.3709	0.8735	0.2371	0.0661	0.0248	0.0306	0.0514	0.0068	0.2454
2013	0.6246	0.9950	0.2999	0.0705	0.0277	0.0331	0.0528	0.0076	0.3637
2014	0.4541	0.9600	0.2396	0.0677	0.0239	0.0277	0.0396	0.0066	0.2411
2015	0.4118	1.0267	0.2113	0.0769	0.0230	0.0270	0.0403	0.0064	0.2165
2016	0.5171	1.0504	0.2887	0.0811	0.0269	0.0314	0.0460	0.0074	0.2641
2017	0.6564	1.1507	0.3700	0.0829	0.0176	0.0217	0.0362	0.0048	0.2731
2018	0.6208	1.1442	0.3500	0.0887	0.0159	0.0213	0.0446	0.0043	0.2662
2019	0.6420	1.1224	0.3613	0.0901	0.0146	0.0170	0.0216	0.0040	0.3624
2020	0.4040	0.8109	0.1913	0.0886	0.0147	0.0170	0.0207	0.0025	0.3523
2021	0.3872	0.8102	0.1569	0.0895	0.0160	0.0186	0.0228	0.0029	0.3676
2022	0.3478	0.8501	0.1358	0.0850	0.0161	0.0190	0.0232	0.0029	0.3348
2023	0.3374	0.8546	0.0989	0.0878	0.0183	0.0215	0.0268	0.0033	0.3262
2024	0.3717	0.8724	0.1038	0.0878	0.0131	0.0157	0.0203	0.0023	0.3228
1990/2024	96%	-15%	-68%	111%	-72%	-74%	-80%	-25%	43%
2023/2024	10%	2%	5%	0%	-29%	-27%	-24%	-31%	-1%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0909	0.0038	0.0113	0.0890	0.0717	0.1007	0.1267	0.0611	0.1616
1995	0.0365	0.0016	0.0046	0.0358	0.0287	0.0404	0.0638	0.0245	0.0703
2000	0.0096	0.0006	0.0013	0.0093	0.0073	0.0105	0.0554	0.0064	0.0320
2005	0.0037	0.0003	0.0005	0.0035	0.0028	0.0040	0.0272	0.0024	0.0161
2010	0.0019	0.0002	0.0003	0.0018	0.0015	0.0019	0.0051	0.0012	0.0069

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2011	0.0019	0.0001	0.0003	0.0019	0.0013	0.0020	0.0039	0.0005	0.0067
2012	0.0043	0.0004	0.0022	0.0033	0.0015	0.0023	0.0042	0.0011	0.0121
2013	0.0049	0.0006	0.0028	0.0033	0.0016	0.0020	0.0036	0.0014	0.0219
2014	0.0044	0.0004	0.0028	0.0029	0.0010	0.0014	0.0034	0.0013	0.0135
2015	0.0048	0.0005	0.0031	0.0031	0.0010	0.0015	0.0036	0.0013	0.0133
2016	0.0043	0.0005	0.0029	0.0027	0.0010	0.0012	0.0029	0.0020	0.0160
2017	0.0051	0.0005	0.0037	0.0032	0.0009	0.0011	0.0021	0.0021	0.0157
2018	0.0022	0.0002	0.0015	0.0015	0.0007	0.0007	0.0015	0.0015	0.0111
2019	0.0020	0.0004	0.0013	0.0010	0.0007	0.0003	0.0010	0.0014	0.0175
2020	0.0016	0.0002	0.0014	0.0010	0.0004	0.0002	0.0008	0.0013	0.0109
2021	0.0016	0.0002	0.0014	0.0010	0.0004	0.0002	0.0008	0.0013	0.0107
2022	0.0018	0.0002	0.0016	0.0012	0.0004	0.0002	0.0015	0.0012	0.0107
2023	0.0016	0.0002	0.0014	0.0011	0.0003	0.0002	0.0010	0.0010	0.0097
2024	0.0015	0.0002	0.0013	0.0010	0.0003	0.0002	0.0011	0.0009	0.0101
1990/2024	-98%	-95%	-88%	-99%	-100%	-100%	-99%	-98%	-94%
2023/2024	-8%	-1%	-9%	-10%	1%	-4%	7%	-3%	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]	PCBs [kg]
1990	0.0218	0.0004	0.0007	0.0007	0.0006	0.0024	0.0211	0.0141
1995	0.0095	0.0002	0.0003	0.0003	0.0002	0.0011	0.0084	0.0058
2000	0.0034	0.0001	0.0001	0.0001	0.0001	0.0004	0.0020	0.0019
2005	0.0019	0.0001	0.0001	0.0000	0.0000	0.0003	0.0007	0.0008
2010	0.0015	0.0001	0.0001	0.0000	0.0000	0.0002	0.0004	0.0003
2011	0.0017	0.0001	0.0001	0.0000	0.0000	0.0003	0.0003	0.0002
2012	0.0186	0.0001	0.0003	0.0001	0.0001	0.0007	0.0075	0.0034
2013	0.0244	0.0003	0.0006	0.0002	0.0001	0.0013	0.0091	0.0041
2014	0.0246	0.0002	0.0004	0.0002	0.0001	0.0008	0.0101	0.0045
2015	0.0268	0.0002	0.0004	0.0002	0.0001	0.0009	0.0111	0.0050
2016	0.0249	0.0002	0.0004	0.0002	0.0001	0.0009	0.0101	0.0045
2017	0.0319	0.0002	0.0005	0.0002	0.0001	0.0010	0.0132	0.0059
2018	0.0124	0.0001	0.0002	0.0001	0.0000	0.0004	0.0048	0.0021
2019	0.0126	0.0002	0.0004	0.0002	0.0001	0.0009	0.0043	0.0018
2020	0.0114	0.0001	0.0002	0.0001	0.0001	0.0004	0.0042	0.0018
2021	0.0116	0.0001	0.0002	0.0001	0.0001	0.0004	0.0042	0.0018
2022	0.0133	0.0001	0.0002	0.0001	0.0001	0.0004	0.0049	0.0022
2023	0.0121	0.0001	0.0002	0.0001	0.0000	0.0004	0.0045	0.0020
2024	0.0110	0.0001	0.0002	0.0001	0.0000	0.0004	0.0040	0.0018
1990/2024	-50%	-82%	-73%	-89%	-91%	-83%	-81%	-88%
2023/2024	-9%	3%	-1%	-4%	0%	-1%	-12%	-12%

The overview of activity data (energy consumption) for this source category is in [Table 3.7.28](#) below.

Table 3.7.28: Overview of activity data in 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

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
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
2023	12.91	8.16	1,213.62	2,110.72	NO
2024	15.56	6.72	928.24	2,363.26	NO
1990/2024	55%	-98%	-50%	1070%	-
2023/2024	21%	-18%	-24%	12%	-

3.7.9.2 Methodological Issues

Emission data are compiled in the NEIS; therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 2024.

The historical data (1990-1999) are not covered by the NEIS; therefore, the emission factors used for the reconstruction of historical years 1990-1999 (1990-2004 for PM_{2.5}, PM₁₀) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 3.7.29](#)).

Table 3.7.29: Emission factors for calculating emissions of main pollutants in historical years

T3	UNIT	EF
NOx	[g/tGJ]	75.93
NMVOC	[g/tGJ]	2.78
SOx	[g/tGJ]	131.88
NH ₃	[g/tGJ]	2.17
TSP	[g/tGJ]	39.68
PM _{2.5}	[% of TSP]	39.59%
PM ₁₀	[% of TSP]	52.78%
CO	[g/tGJ]	91.77

The methodology for calculating BC, heavy metals, and POPs is described in [Annex X](#). [Table 3.7.30](#) shows the distribution of fuels to the subsequent categories used in the methodology.

Table 3.7.30: Fuel consumption in TJ in category 1A5a

TYPE OF FUEL	LIQUID FUELS		HARD COAL	BROWN COAL	
TYPE OF BOILER	ALL TYPE OF BOILERS	STATIONERY ENGINES	FIXED BED BOILERS	FIXED BED BOILERS	FLUIDIZED BED BOILERS
THERMAL CAPACITY IN MW	<5	-	<5	<5	<5
1990	126.17	25.90	653.28	1,326.06	1,163.32
1991	115.09	23.62	552.34	1,121.16	983.56

TYPE OF FUEL	LIQUID FUELS		HARD COAL	BROWN COAL	
TYPE OF BOILER	ALL TYPE OF BOILERS	STATIONERY ENGINES	FIXED BED BOILERS	FIXED BED BOILERS	FLUIDIZED BED BOILERS
THERMAL CAPACITY IN MW	<5	-	<5	<5	<5
1992	107.81	22.13	463.33	940.50	825.08
1993	103.67	21.28	385.45	782.42	686.39
1994	102.13	20.96	317.91	645.32	566.12
1995	102.61	21.06	259.92	527.61	462.86
1996	104.56	21.46	210.71	427.70	375.21
1997	107.42	22.05	169.48	344.01	301.79
1998	110.63	22.71	135.45	274.95	241.20
1999	113.64	23.32	107.84	218.91	192.04
2000	182.19	37.39	61.64	125.13	109.77
2001	184.63	37.90	51.96	105.47	92.53
2002	96.63	19.83	43.28	87.84	77.06
2003	111.54	22.89	35.48	72.02	63.18
2004	108.64	22.30	25.31	51.38	45.08
2005	93.99	19.29	22.30	45.27	39.72
2006	96.44	19.79	17.86	36.26	31.81
2007	23.90	4.91	19.78	40.15	35.23
2008	20.05	4.12	13.85	28.12	24.67
2009	15.22	3.12	11.03	22.39	19.64
2010	13.26	2.72	11.92	24.20	21.23
2011	8.20	1.82	4.13	27.09	5.44
2012	8.59	4.22	2.79	28.08	7.58
2013	7.31	4.26	0.03	22.65	6.73
2014	8.11	4.61	0.03	16.09	7.37
2015	8.93	3.69	-	16.49	9.62
2016	7.00	2.37	-	11.75	21.85
2017	3.67	2.66	-	10.86	21.84
2018	2.93	3.72	0.52	7.44	17.30
2019	2.62	3.18	-	0.43	17.56
2020	2.04	2.71	-	0.40	15.16
2021	2.16	2.17	-	0.49	14.44
2022	4.69	2.20	-	0.49	11.78
2023	3.09	0.68	-	0.43	7.73
2024	3.44	5.56	-	0.21	6.51

TYPE OF FUEL	GASEOUS FUELS				BIOMASS		
TYPE OF BOILER	ALL TYPE OF BOILERS		STATIONERY ENGINES	GAS TURBINES	FIXED BED BOILERS	FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	<5	5-50	5-50	5-50	<5	<5	5-50
1990	2,811.94	380.40	508.64	213.25	-	-	-
1991	2,463.33	333.24	445.58	186.81	0.60	0.00	-
1992	2,105.95	284.90	380.94	159.71	1.08	0.00	-
1993	1,744.04	235.94	315.47	132.26	1.45	0.00	-
1994	1,052.84	142.43	190.44	79.84	1.74	0.00	-
1995	1,822.96	246.61	329.75	138.25	1.96	0.01	-

TYPE OF FUEL	GASEOUS FUELS				BIOMASS		
TYPE OF BOILER	ALL TYPE OF BOILERS		STATIONERY ENGINES	GAS TURBINES	FIXED BED BOILERS	FLUIDIZED BED BOILERS	
THERMAL CAPACITY IN MW	<5	5-50	5-50	5-50	<5	<5	5-50
1996	2,102.45	284.42	380.30	159.44	2.14	0.01	-
1997	1,973.34	266.96	356.95	149.65	2.28	0.01	-
1998	2,005.85	271.35	362.83	152.12	2.41	0.01	-
1999	1,621.19	219.32	293.25	122.95	2.55	0.01	-
2000	1,175.85	159.07	212.69	89.17	2.49	0.01	-
2001	1,165.50	157.67	210.82	88.39	3.14	0.01	-
2002	852.95	115.39	154.29	64.68	3.08	0.01	-
2003	1,087.19	147.08	196.66	82.45	3.11	0.01	-
2004	914.87	123.76	165.49	69.38	3.51	0.01	-
2005	803.93	108.76	145.42	60.97	4.52	0.01	-
2006	1,477.20	199.84	267.21	112.03	4.93	0.01	-
2007	1,352.75	183.00	244.69	102.59	4.68	0.01	-
2008	827.64	111.96	149.71	62.77	4.38	0.01	-
2009	1,100.29	148.85	199.03	83.44	4.27	0.01	-
2010	862.65	116.70	156.04	65.42	5.02	0.01	-
2011	956.80	114.66	493.20	38.09	5.84	3.22	-
2012	1,201.82	98.83	1,278.76	95.35	6.73	2.29	1,431.33
2013	1,604.43	103.67	2,513.56	167.41	18.89	1.85	1,758.35
2014	514.20	100.05	1,951.28	76.37	5.14	1.57	1,981.61
2015	666.21	94.44	1,568.33	5.21	5.92	12.84	2,173.34
2016	632.44	120.79	2,251.18	5.64	8.57	11.97	1,949.59
2017	692.68	138.05	2,604.35	6.08	4.04	12.43	2,587.66
2018	312.55	128.17	2,470.11	5.17	2.77	9.82	903.69
2019	583.04	40.74	2,144.81	7.21	18.13	0.38	811.26
2020	605.22	122.10	2,274.53	6.28	4.55	25.87	784.46
2021	812.30	120.41	2,154.04	320.92	4.80	29.47	783.90
2022	745.99	136.16	2,258.61	705.88	3.28	28.00	930.57
2023	714.98	122.00	2,001.50	324.92	3.45	24.17	856.54
2024	671.17	146.69	2,081.52	227.52	4.09	17.72	759.45

3.7.9.3 Completeness

Emissions are well covered.

3.7.9.4 Source-specific Recalculations

No recalculations were made in this submission.

3.7.10 Other, Mobile (Including Military, Land Based and Recreational Boats) (NFR 1A5b)

3.7.10.1 Overview

This category was first reported in the year 2018. Emissions of mobile combustion in the military are shown in [Table 3.7.31](#).

Table 3.7.31: Overview of emissions in category 1A5b

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.3198	0.0018	0.0187	7.0E-07	0.0018	0.0018	0.0018	0.0009	0.1393
1995	0.2928	0.0016	0.0171	6.1E-07	0.0017	0.0017	0.0017	0.0008	0.1275
2000	0.0769	0.0004	0.0045	5.1E-07	0.0004	0.0004	0.0004	0.0002	0.0336
2005	0.0851	0.0005	0.0050	4.2E-07	0.0005	0.0005	0.0005	0.0002	0.0371
2010	0.0704	0.0004	0.0041	3.3E-07	0.0004	0.0004	0.0004	0.0002	0.0307
2011	0.0726	0.0004	0.0042	3.1E-07	0.0004	0.0004	0.0004	0.0002	0.0316
2012	0.0654	0.0004	0.0038	2.9E-07	0.0004	0.0004	0.0004	0.0002	0.0285
2013	0.0637	0.0004	0.0037	2.7E-07	0.0004	0.0004	0.0004	0.0002	0.0278
2014	0.0619	0.0004	0.0036	2.5E-07	0.0004	0.0004	0.0004	0.0002	0.0270
2015	0.0772	0.0004	0.0045	2.4E-07	0.0004	0.0004	0.0004	0.0002	0.0336
2016	0.0722	0.0004	0.0042	2.1E-07	0.0004	0.0004	0.0004	0.0002	0.0315
2017	0.0455	0.0003	0.0027	1.8E-07	0.0003	0.0003	0.0003	0.0001	0.0198
2018	0.0564	0.0003	0.0033	1.9E-07	0.0003	0.0003	0.0003	0.0002	0.0246
2019	0.0502	0.0003	0.0029	1.8E-07	0.0003	0.0003	0.0003	0.0001	0.0219
2020	0.0495	0.0003	0.0029	5.8E-08	0.0003	0.0003	0.0003	0.0001	0.0215
2021	0.0499	0.0003	0.0029	8.8E-08	0.0003	0.0003	0.0003	0.0001	0.0217
2022	0.0385	0.0002	0.0022	1.3E-07	0.0002	0.0002	0.0002	0.0001	0.0168
2023	0.0194	0.0001	0.0011	1.1E-07	0.0001	0.0001	0.0001	0.0001	0.0085
2024	0.0236	0.0001	0.0014	6.0E-08	0.0001	0.0001	0.0001	0.0001	0.0103
1990/2024	-93%	-93%	-93%	-91%	-93%	-93%	-93%	-93%	-93%
2023/2024	21%	17%	22%	-45%	20%	20%	20%	19%	21%

The overview of Pb emissions and of energy consumption for this category is in [Table 3.7.32](#) below. Total fuel consumption was 70.94 TJ in 2024. This consumption includes petrol, diesel oil and jet fuel.

Table 3.7.32: Overview of Pb emissions and activity data in category 1A5b

YEAR	Pb [kt]	LIQUID FUELS [TJ NCV]
1990	10.04	318.74
1995	10.71	315.99
2000	13.05	300.32
2005	4.50	199.38
2010	20.21	57.35
2011	12.64	36.82
2012	13.77	37.03
2013	12.58	29.40
2014	14.76	23.53
2015	35.00	26.30
2016	12.53	33.60
2017	20.03	32.70
2018	15.67	25.26
2019	8.32	18.37
2020	15.67	15.74
2021	15.95	14.93
2022	14.72	12.27
2023	12.91	8.16
2024	15.56	6.72
1990/2024	55%	-98%

YEAR	Pb [kt]	LIQUID FUELS [TJ NCV]
2023/2024	21%	-18%

3.7.10.2 Methodological Issues

For the emission estimation, EMEP/EEA GB 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 were made in this submission.

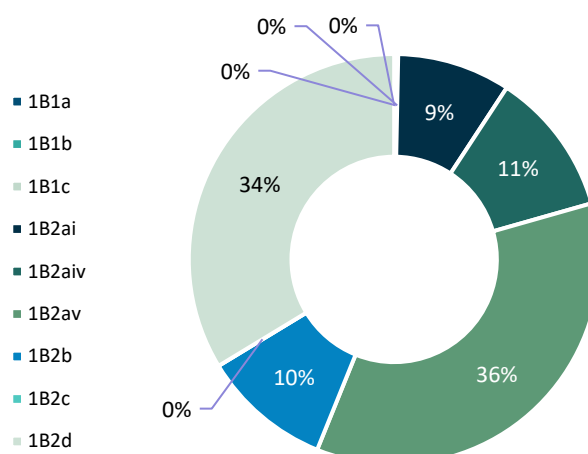
3.8 FUGITIVE EMISSIONS (NFR 1B)

3.8.1 Overview

This chapter covers emissions from leaks and other irregular releases of gases or vapours from a pressurised 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 the closure of some parts 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 has been stabilised 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. Shares of emissions of NMVOC from each category are presented in **Figure 3.8.1**.

Figure 3.8.1: Shares of NMVOC emissions in categories of 1B in 2024



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 was a key category for emissions of NMVOC and TSP until 2023. Emissions in this category had a decreasing trend due to the decrease in activity in the Slovak Republic until the end of the year 2023, when the source ceased to exist. The overview of the emissions and activity data are shown in [Table 3.8.1](#).

Table 3.8.1: Overview of emissions and activity data in 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	3.76	3.0073	0.0188	0.1579	0.3346
2000	3.65	2.9194	0.0182	0.1533	0.3248
2005	2.51	2.0090	0.0126	0.1055	0.2235
2010	2.38	1.9020	0.0119	0.0999	0.2116
2011	2.38	1.9008	0.0119	0.0998	0.2115
2012	2.29	1.8338	0.0115	0.0963	0.2040
2013	2.35	1.8822	0.0118	0.0988	0.2094
2014	2.19	1.7502	0.0109	0.0919	0.1947
2015	1.94	1.5515	0.0097	0.0815	0.1726
2016	1.85	1.4777	0.0092	0.0776	0.1644
2017	1.83	1.4672	0.0092	0.0770	0.1632
2018	1.50	1.2016	0.0075	0.0631	0.1337
2019	1.50	1.2016	0.0075	0.0631	0.1337
2020	0.98	0.7844	0.0049	0.0412	0.0873
2021	1.07	0.8593	0.0054	0.0451	0.0956
2022	0.87	0.6948	0.0043	0.0365	0.0773
2023	0.76	0.6096	0.0038	0.0320	0.0678
2024	NO	NO	NO	NO	NO
1990/2024	-	-	-	-	-
2023/2024	-	-	-	-	-

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 during the period 1990-2023 ([Table 3.8.2](#)).

Table 3.8.2: 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

No recalculations were made in this submission.

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 also reflects on the emissions within this category. This category is key for emissions of PM₁₀, Ni and PCDD/F. An overview of the emissions and activity data is shown in [Table 3.8.3](#).

Table 3.8.3: Overview of emissions and activity data in category 1B1b

YEAR	SOLID FUEL TRANSFORMED [Mt]	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]
1990	2.34	0.0021	0.0180	0.0019	0.0087	0.1427	0.3416	0.8120
1995	1.86	0.0019	0.0143	0.0015	0.0069	0.1131	0.2707	0.6433
2000	1.60	0.0018	0.0123	0.0013	0.0059	0.0974	0.2332	0.5541
2005	1.79	0.0049	0.0134	0.0014	0.0064	0.1061	0.2540	0.6038
2010	1.55	0.0016	0.0119	0.0012	0.0057	0.0946	0.2263	0.5379
2011	1.52	0.0017	0.0117	0.0012	0.0056	0.0927	0.2219	0.5274
2012	1.47	0.0016	0.0113	0.0012	0.0054	0.0897	0.2146	0.5101
2013	1.44	0.0016	0.0111	0.0012	0.0053	0.0878	0.2102	0.4997
2014	1.47	0.0016	0.0113	0.0012	0.0054	0.0897	0.2146	0.5101
2015	1.53	0.0017	0.0118	0.0012	0.0057	0.0933	0.2234	0.5309
2016	1.54	0.0015	0.0119	0.0012	0.0057	0.0939	0.2248	0.5344
2017	1.49	0.0016	0.0115	0.0012	0.0055	0.0909	0.2175	0.5170
2018	1.50	0.0016	0.0116	0.0012	0.0056	0.0915	0.2190	0.5205
2019	1.32	0.0015	0.0102	0.0011	0.0049	0.0805	0.1927	0.4580
2020	1.11	0.0013	0.0085	0.0009	0.0041	0.0677	0.1621	0.3852
2021	1.63	0.0017	0.0125	0.0013	0.0060	0.0992	0.2374	0.5642
2022	1.45	0.0016	0.0112	0.0012	0.0054	0.0885	0.2117	0.5032
2023	1.48	0.0016	0.0113	0.0012	0.0054	0.0898	0.2150	0.5111
2024	1.86	0.0019	0.0143	0.0015	0.0068	0.1129	0.2702	0.6423
1990/2024	-21%	-8%	-21%	-21%	-21%	-21%	-21%	-21%
2023/2024	26%	21%	26%	26%	26%	26%	26%	26%

YEAR	BC [kt]	CO [kt]	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]
1990	0.0699	1.0764	0.8892	0.0164	0.0281	0.0304	0.3978	0.1123	0.2808
1995	0.0554	1.5128	0.7045	0.0130	0.0222	0.0241	0.3152	0.0890	0.2225
2000	0.0477	1.8346	0.6068	0.0112	0.0192	0.0208	0.2715	0.0767	0.1916
2005	0.0520	11.3604	0.6612	0.0122	0.0209	0.0226	0.2958	0.0835	0.2088
2010	0.0463	1.3774	0.5890	0.0109	0.0186	0.0202	0.2635	0.0744	0.1860
2011	0.0454	1.6298	0.5776	0.0106	0.0182	0.0198	0.2584	0.0730	0.1824
2012	0.0439	1.6222	0.5586	0.0103	0.0176	0.0191	0.2499	0.0706	0.1764
2013	0.0430	1.5424	0.5472	0.0101	0.0173	0.0187	0.2448	0.0691	0.1728
2014	0.0439	1.6002	0.5586	0.0103	0.0176	0.0191	0.2499	0.0706	0.1764
2015	0.0457	1.5838	0.5814	0.0107	0.0184	0.0199	0.2601	0.0734	0.1836
2016	0.0460	1.0267	0.5852	0.0108	0.0185	0.0200	0.2618	0.0739	0.1848
2017	0.0445	1.5654	0.5662	0.0104	0.0179	0.0194	0.2533	0.0715	0.1788
2018	0.0448	1.5920	0.5700	0.0105	0.0180	0.0195	0.2550	0.0720	0.1800
2019	0.0395	1.4872	0.5016	0.0092	0.0158	0.0172	0.2244	0.0634	0.1584
2020	0.0332	1.3466	0.4218	0.0078	0.0133	0.0144	0.1887	0.0533	0.1332
2021	0.0486	1.6280	0.6179	0.0114	0.0195	0.0211	0.2764	0.0780	0.1951
2022	0.0433	1.5470	0.5510	0.0102	0.0174	0.0189	0.2465	0.0696	0.1740
2023	0.0440	1.5575	0.5597	0.0103	0.0177	0.0191	0.2504	0.0707	0.1767
2024	0.0553	1.7315	0.7034	0.0130	0.0222	0.0241	0.3147	0.0888	0.2221
1990/2024	-21%	61%	-21%	-21%	-21%	-21%	-21%	-21%	-21%
2023/2024	26%	11%	26%	26%	26%	26%	26%	26%	26%

YEAR	Se [t]	Zn [t]	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]
1990	0.0374	0.5148	7.0200	0.3744	0.4680	0.2340	0.1638	1.2402
1995	0.0297	0.4079	5.5620	0.2966	0.3708	0.1854	0.1298	0.9826
2000	0.0256	0.3513	4.7908	0.2555	0.3194	0.1597	0.1118	0.8464
2005	0.0278	0.3828	5.2200	0.2784	0.3480	0.1740	0.1218	0.9222
2010	0.0248	0.3410	4.6500	0.2480	0.3100	0.1550	0.1085	0.8215
2011	0.0243	0.3344	4.5600	0.2432	0.3040	0.1520	0.1064	0.8056
2012	0.0235	0.3234	4.4100	0.2352	0.2940	0.1470	0.1029	0.7791
2013	0.0230	0.3168	4.3200	0.2304	0.2880	0.1440	0.1008	0.7632
2014	0.0235	0.3234	4.4100	0.2352	0.2940	0.1470	0.1029	0.7791
2015	0.0245	0.3366	4.5900	0.2448	0.3060	0.1530	0.1071	0.8109
2016	0.0246	0.3388	4.6200	0.2464	0.3080	0.1540	0.1078	0.8162
2017	0.0238	0.3278	4.4700	0.2384	0.2980	0.1490	0.1043	0.7897
2018	0.0240	0.3300	4.5000	0.2400	0.3000	0.1500	0.1050	0.7950
2019	0.0211	0.2904	3.9600	0.2112	0.2640	0.1320	0.0924	0.6996
2020	0.0178	0.2442	3.3300	0.1776	0.2220	0.1110	0.0777	0.5883
2021	0.0260	0.3577	4.8780	0.2602	0.3252	0.1626	0.1138	0.8618
2022	0.0232	0.3190	4.3500	0.2320	0.2900	0.1450	0.1015	0.7685
2023	0.0236	0.3240	4.4187	0.2357	0.2946	0.1473	0.1031	0.7806
2024	0.0296	0.4072	5.5530	0.2962	0.3702	0.1851	0.1296	0.9810
1990/2024	-21%	-21%	-21%	-21%	-21%	-21%	-21%	-21%
2023/2024	26%	26%	26%	26%	26%	26%	26%	26%

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 3.8.4](#)).

Table 3.8.4: Default EF used in fugitive emission from solid fuels transformation

T1 (coke)	UNIT	EF
NO _x	g/Mg coke	0.9
NM VOC	g/Mg coke	7.7
SO _x	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	% of 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
NO _x	kg/t	0.07
CO	kg/t	220

3.8.2.3 Completeness

The emissions of HCB and PCB are reported with the notation key NE.

3.8.2.4 Source-specific Recalculations

No recalculations were made in this submission.

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 NM VOC emissions. The definition of included activities is shown in [Table 3.8.5](#).

Table 3.8.5: Activities according to national categorisation included in 1B2ai

CATEGORISATION 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 are shown in [Table 3.8.6](#). The production and transportation of crude oil have shown 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 3.8.6: Overview of emissions and activity data in category 1B2ai

YEAR	CRUDE OIL PRODUCTION [kt]	CRUDE OIL TRANSPORTED [kt]	NMVOC [kt]
1990	73.14	13,581.00	0.8248
1995	74.25	13,581.00	0.8262
2000	59.00	9,300.00	0.5760
2005	31.00	10,662.34	0.6145
2010	13.08	10,075.33	0.5604
2011	15.43	9,919.73	0.5550
2012	11.45	8,417.68	0.4689
2013	9.98	9,788.06	0.5410
2014	8.97	8,945.00	0.4942
2015	9.59	9,932.04	0.5483
2016	8.36	9,171.32	0.5057
2017	5.78	9,582.25	0.5247
2018	5.14	9,460.16	0.5173
2019	4.34	8,997.64	0.4913
2020	2.09	9,974.83	0.5413
2021	4.56	8,819.00	0.4819
2022	2.14	9,595.06	0.5208
2023	1.43	9,626.21	0.5216
2024	1.23	7,462.58	0.4045
1990/2024	-98%	-45%	-51%
2023/2024	-14%	-22%	-22%

3.8.4.2 Methodological Issues

For the calculation of NMVOC emissions, data from the Statistical Office of the Slovak Republic and directly from producers are used. Calculation of the fugitive NMVOC emissions is based on EFs provided in 2019 Refinements to the 2006 IPCC GL. These EFs are providing more detailed calculations on Tier 1 as there are provided separate EFs for exploration, production and transport. Also, this change harmonises emission estimation with GHG emissions. These EFs are shown in [Table 3.8.7](#). EFs for land exploration and production of crude oil in developed countries are used. A conservative approach was used, and the upper limit of EFs was used.

Table 3.8.7: 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)	0.00125	0.000054
Uncertainty	-100% to 800%	-50% to 200%

3.8.4.3 Completeness

The notation key of NA is used for the emissions of main pollutants except SO_x and PCDD/F where the 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 also estimated 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

No recalculations were made in this submission.

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 3.8.8**. Emissions in this category show a decreasing trend, which relates to a decrease in activity.

Table 3.8.8: Overview of emissions and activity data in category 1B2aiv

YEAR	CRUDE OIL REFINED [Mt]	NO _x [kt]	NM VOC [kt]	SO _x [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
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
2023	5.23	0.1829	0.5750	1.2806	0.0105	0.0261	0.0314	0.2143
2024	4.68	0.1637	0.5145	1.1459	0.0094	0.0234	0.0281	0.1918
1990/2024	-25%	-25%	-25%	-25%	-25%	-25%	-25%	-25%
2023/2024	-11%	-11%	-11%	-11%	-11%	-11%	-11%	-11%

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

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	PCDD/F [g I-TEQ]
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
2023	0.0157	0.0026	0.0031	0.0005	0.0005	0.0063	0.0277	0.0005	0.0052	0.0063
2024	0.0140	0.0023	0.0028	0.0005	0.0005	0.0056	0.0248	0.0005	0.0047	0.0056
1990/2024	-25%	-25%	-25%	-25%	-25%	-25%	-25%	-25%	-25%	-25%
2023/2024	-11%	-11%	-11%	-11%	-11%	-11%	-11%	-11%	-11%	-11%

3.8.5.2 Methodological Issues

Emission factors used for the calculation of heavy metals and POPs are the default EF from EMEP/EEA GB 2023 ([Table 3.8.9](#)).

Table 3.8.9: Emission factors in category 1B2aiv

T1	UNIT	EF
NOx	kg/Mg crude oil input	0.035
NMVO	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 the 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

No recalculations were made in this submission.

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 the following **Table 3.8.10**. All data are from the operator – facility data.

Table 3.8.10: Activities according to national categorisation included in the category 1B2av

CATEGORISATION 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					

The overall trend of activity data and NMVOC emissions is shown in **Table 3.8.11**. The emissions in this category show an increasing trend, which relates to an increase in activity.

Table 3.8.11: 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
2022	524.57	1,871.85	37.61	204.25	1.4711
2023	567.07	1,786.11	37.73	200.37	1.5512
2024	598.28	1,732.01	23.88	201.21	1.6098
1990/2024	36%	50%	-	-	41%
2023/2024	6%	-3%	-37%	0.4%	4%

3.8.6.2 Methodological Issues

The main source of NMVOC emissions is gasoline distribution. Other sources of NMVOC emissions are in **Table 3.8.11**. The emission factor for gasoline, according to EMEP/EEA GB 2023, is **EF = 2.2 kg/Mg**

and the emission factor for other fuels, according to the 2019 Refinements to the 2006 IPCC GL, is **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 in compliance with the EMEP/EEA GB 2023.

3.8.6.4 Source-specific Recalculations

No recalculations were made in this submission.

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 3.8.12**. Emissions in this category show an increasing trend, which relates to an increase in activity. This category is key for emissions of NMVOC.

Table 3.8.12: Overview of emissions and activity data in category 1B2b

YEAR	PRODUCTION [mil. m ³]	PROCESSING [mil. m ³]	TRANSMISSION AND STORAGE [mil. m ³]	DISTRIBUTION [mil. m ³]	OTHER [mil. m ³]	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
2023	50.21	50.21	10,940.17	4,179.08	2,815.00	0.3400
2024	40.39	40.39	17,772.88	4,337.25	2,446.00	0.4624
1990/2024	-91%	-91%	-76%	-35%	244,500%	-79%
2023/2024	-20%	-20%	62%	4%	-13%	36%

Data from the Statistical Office of the Slovak Republic and directly from producers are used to calculate NMVOC emissions. The calculation of fugitive NMVOC emissions is based on the EFs listed in the 2019 Refinements to the 2006 IPCC GL. These EFs provide more detailed calculations on Tier 1 as there are provided separate EFs for the exploration, production, processing, transmission, distribution and storage of natural gas. Also, this change harmonises emission estimation with GHG emissions. These EFs are shown in **Table 3.8.13**. EFs for land exploration and production of crude oil in developed countries are used. A conservative approach was used, and the upper limit of EFs was used.

Table 3.8.13: Overview of emission factors for exploration, production, processing, transmission, distribution and storage of natural gas

T1	PRODUCTION [Gg/10 ⁶ m ³ NG]	GATHERING [Gg/10 ⁶ m ³ NG]	PROCESSING [Gg/10 ⁶ m ³ NG]	TRANSMISSION [Gg/10 ⁶ m ³ NG]	DISTRIBUTION [Gg/10 ⁶ m ³ NG]	OTHER (STORAGE) [Gg/10 ⁶ m ³ NG]
NM VOC	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

No recalculations were made in this submission.

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 to some extent only in NG production. It is not occurring in the distribution, transport and transmission of crude oil and natural gas in Slovakia. There are no EFs and methodologies available for NG.

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 NH₃ 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 and flaring from each process.

3.8.8.4 Source-specific Recalculations

No recalculations were made 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 3.8.14](#)). 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 and barbecues).

Table 3.8.14: Overview of emissions and activity data in category 1B2d

YEAR	CNG CARS [vehicles]	APPLIANCES [pcs]	INDUSTRIAL PLANTS [mil. m ³]	NM VOC [kt]
1990	0	1,472,938	3,319.38	1.5061
1995	0	1,477,188	3,528.17	1.5125
2000	40	1,461,904	3,692.88	1.4988
2005	158	1,455,729	3,097.17	1.4867

YEAR	CNG CARS [vehicles]	APPLIANCES [pcs]	INDUSTRIAL PLANTS [mil. m ³]	NMVOC [kt]
2010	289	1,496,033	2,453.04	1.5206
2011	332	1,501,029	2,587.22	1.5269
2012	414	1,505,009	2,470.67	1.5297
2013	1,482	1,506,508	2,470.32	1.5312
2014	1,556	1,509,413	2,123.60	1.5307
2015	1,398	1,510,532	2,136.90	1.5319
2016	1,541	1,514,666	2,165.34	1.5363
2017	1,750	1,514,262	2,214.59	1.5364
2018	1,980	1,519,409	2,279.11	1.5422
2019	2,063	1,522,827	2,365.51	1.5465
2020	2,095	1,527,512	2,416.83	1.5517
2021	2,146	1,529,546	2,707.13	1.5566
2022	2,218	1,532,244	2,087.94	1.5531
2023	2,033	1,511,931	1,977.29	1.5317
2024	2,099	1,504,934	2,094.64	1.5259
1990/2024	-	2%	-37%	1%
2023/2024	3%	0%	6%	-0.4%

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 is used ([Table 3.8.15](#)). The missing data on appliances for the years 1990-1999 were extrapolated based on the distributed NG for these years.

Table 3.15: Emission factors for calculating emissions of NMVOC according to different sources

SEGMENT	VALUE	UNCERTAINTY	UNIT
Natural gas-fuelled vehicles	0.000008	70% to 140%	Tones/car
Appliances in the commercial and residential sector	0.0001	±60%	Tones/appliance
Leakage at industrial plants and power stations	0.01	±60%	Tones/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 were made in this submission.

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CHAPTER 4: INDUSTRIAL PROCESSES AND PRODUCT USE (NFR 2)

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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 are 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 4.1.1](#). The national emission inventory of air pollutants is prepared from several sources to cover all potential sources of pollution.

The data sources:

a/ NEIS database of stationary large and medium sources of air pollution provides facility data for nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) sulphur oxides (SO_x), ammonia (NH₃), total suspended particles (TSP, PM₁₀ and PM_{2.5} are consequently compiled) and carbon monoxide (CO). All data, that come from the database, are considered as T3 methodology. The reporting duties are bound 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 4.1.1: Overview of reported categories, Tier or notation key used in the industrial sector

NFR	LONGNAME OF CATEGORY	METHODOLOGY/TIER					
		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	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	T1	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	T1, 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

NFR	LONGNAME OF CATEGORY	METHODOLOGY/TIER					
		NO _x , NMVOC, SO _x , CO	NH ₃	PM _{2.5} , PM ₁₀ , TZL	BC	HM	POPs
2B10b	Storage, handling and transport of chemical products	T3	T3, NK	T3	NK	NK	NK
METAL INDUSTRY							
2C1	Iron and steel production	T3	T3	T3	T1	T1, T2	T2, NK
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	T3	NK	NK	NK
2H3	Other industrial processes	T3, NK	T3	T3	NK	NK	NK
2I	Wood processing	T3	T3, NK	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 4.2.1 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 because 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 4.2.1: Overview of the emissions in the category 2 – Industry

YEAR	NOx [kt]	NM VOC [kt]	SOx [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	7.1003	46.1594	11.3398	0.2605	2.3378	4.6750	15.4662	0.0372	84.8237
1995	6.7682	44.5311	10.1563	0.2695	2.2857	3.8186	11.8706	0.0818	75.4156
2000	7.9732	39.2656	13.9137	0.2066	2.9472	4.9475	15.1159	0.1084	93.4023
2005	6.7133	39.4370	11.4549	0.2667	1.4781	3.5462	10.3893	0.0906	104.3432
2010	5.9232	29.1419	7.3310	0.1221	0.9559	2.1660	6.7127	0.1161	94.2074
2011	6.6758	33.3473	9.2230	0.2206	0.9439	2.0670	6.4540	0.1138	107.1259
2012	6.3180	27.6370	8.0566	0.2194	0.9191	1.6643	5.1780	0.1161	105.6835
2013	6.1896	28.3741	7.3879	0.1645	0.9606	2.0140	6.3800	0.1027	105.0621
2014	6.8971	30.1647	8.0199	0.1240	1.0435	2.0355	6.5122	0.1097	119.8514
2015	6.4984	33.3735	9.0930	0.1665	1.1808	3.6496	11.7870	0.1104	119.9171
2016	5.8978	31.7032	10.2895	0.2269	0.9090	1.9103	5.9485	0.1091	121.8027
2017	6.9338	29.8603	11.7175	0.2190	0.9744	2.4382	7.7015	0.1166	124.1939
2018	7.5900	32.1591	9.4089	0.2362	0.8714	1.7901	5.4600	0.1141	111.7930
2019	6.1286	28.1697	7.7233	0.2135	0.8244	1.9039	5.1503	0.1209	73.4620
2020	5.7511	28.3341	6.6550	0.2689	0.8325	2.6611	7.4536	0.1020	70.5006
2021	7.0832	28.2189	7.5928	0.2999	0.8543	2.4206	6.5801	0.1184	106.0956
2022	5.2685	25.9680	4.6996	0.2369	0.7018	2.0065	5.5231	0.1134	70.1133
2023	5.7197	26.4530	4.8956	0.2296	0.4910	1.0923	2.8240	0.0883	80.9943
2024	5.6872	28.6487	3.8223	0.2744	0.4977	1.1240	2.9221	0.0815	74.4284
1990/2024	-20%	-38%	-66%	5%	-79%	-76%	-81%	119%	-12%
2023/2024	-1%	8%	-22%	20%	1%	3%	3%	-8%	-8%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	21.0547	0.4533	0.2872	0.7467	1.5903	3.2077	1.4214	0.3109	12.9080
1995	18.0088	0.3215	0.2516	0.6294	1.3825	2.6638	1.1112	0.3120	11.8363
2000	19.3551	0.1498	0.2690	0.5705	0.8909	1.7655	1.0469	0.3190	13.0342
2005	6.6150	0.2282	0.1241	0.5673	1.0257	1.5732	0.3270	0.3878	13.0558
2010	5.1224	0.2652	0.1158	0.5053	1.5634	2.2447	0.2760	0.3604	13.9027
2011	5.2363	0.3009	0.1194	0.4795	1.9454	3.1880	0.2848	0.3716	13.2534
2012	5.5116	0.2782	0.1215	0.4976	1.6348	2.6734	0.3205	0.4290	13.9948
2013	6.0502	0.1735	0.1210	0.5110	1.0592	1.7001	0.3719	0.4540	15.4216
2014	5.8410	0.1713	0.1276	0.5058	1.2699	2.0577	0.3505	0.4562	12.8830
2015	5.7526	0.1698	0.1272	0.4977	1.5399	2.5823	0.3438	0.4702	15.9743
2016	6.0282	0.1755	0.1277	0.5237	1.7659	2.9671	0.3578	0.4802	17.0431
2017	6.5005	0.1843	0.1284	0.5443	1.7304	3.0118	0.3817	0.4898	17.1692
2018	5.9208	0.1730	0.1276	0.5045	1.7421	0.8573	0.3629	0.4893	17.2967
2019	4.7851	0.1540	0.1248	0.3998	1.8641	0.7937	0.3113	0.4197	13.4702
2020	3.5575	0.1337	0.1153	0.3241	1.7216	0.4744	0.2607	0.4739	11.8156
2021	5.7490	0.1796	0.1237	0.5211	1.9322	0.6670	0.3601	0.5298	14.7657
2022	4.7272	0.1560	0.1093	0.3973	1.1499	0.6740	0.3144	0.5173	13.2737
2023	5.3805	0.1473	0.1154	0.4529	1.0788	0.7579	0.3050	0.4617	11.6113
2024	4.2577	0.1366	0.1137	0.3859	1.7461	0.5231	0.2807	0.4819	10.4547
1990/2024	-80%	-70%	-60%	-48%	10%	-84%	-80%	55%	-19%
2023/2024	-21%	-7%	-1%	-15%	62%	-31%	-8%	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	31.9122	0.0124	0.0037	0.0037	0.0020	9.9112	0.0876	20.0067
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
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	8.2704	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
2023	5.5444	0.0008	0.0003	0.0003	0.0003	10.4157	0.0766	20.5610
2024	7.3079	0.0007	0.0003	0.0003	0.0003	9.2001	0.0699	18.1800
1990/2024	-80%	-100%	-100%	-100%	-100%	-28%	-41%	-7%
2023/2024	32%	-10%	-9%	-9%	-9%	-12%	-9%	-12%

As shown in [Figure 4.2.1](#), Iron and steel production (**2C1**) has been the main long-term contributor to NO_x emissions in the industry sector. The most significant decrease was recorded in the period 2001-2009, since then, emissions have had a fluctuating trend. Solvents use (**2D**) contributes by an average of 73% to NMVOC emissions. The emission trend shows a decreasing trend due to stricter limits and technical requirements for solvent use. The most important industrial category for emissions SO_x is Metal production **2C**. These emissions had a decreasing trend until 2009 in the sector industry, and since then, emissions fluctuated. In recent years, further decline has been noticed.

The main contributor to NH₃ emissions is subsector **2B** – Chemical production. Emissions of NH₃ had a slightly decreasing trend. The fluctuations observed between 2004 and 2014 were driven by variations in the urine production industry. Since then, emissions have remained relatively stable; however, the latest interannual increase reached 30%. 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**).

Metal production categories emitted most of the emissions of heavy metals and persistent organic pollutants. Emissions of these pollutants have, in general, a decreasing trend (except for 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 4.2.2](#)).

Figure 4.2.1: Share of emissions of main pollutants in category 2 – Industry in 2024

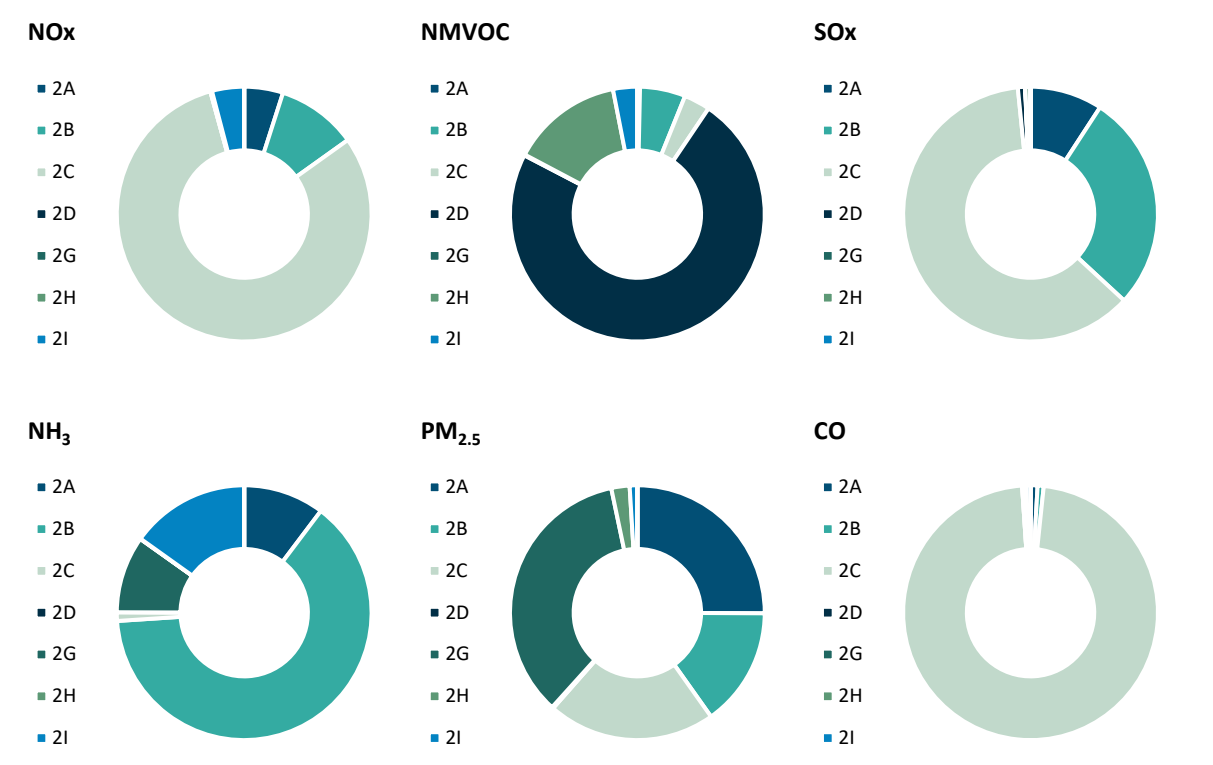
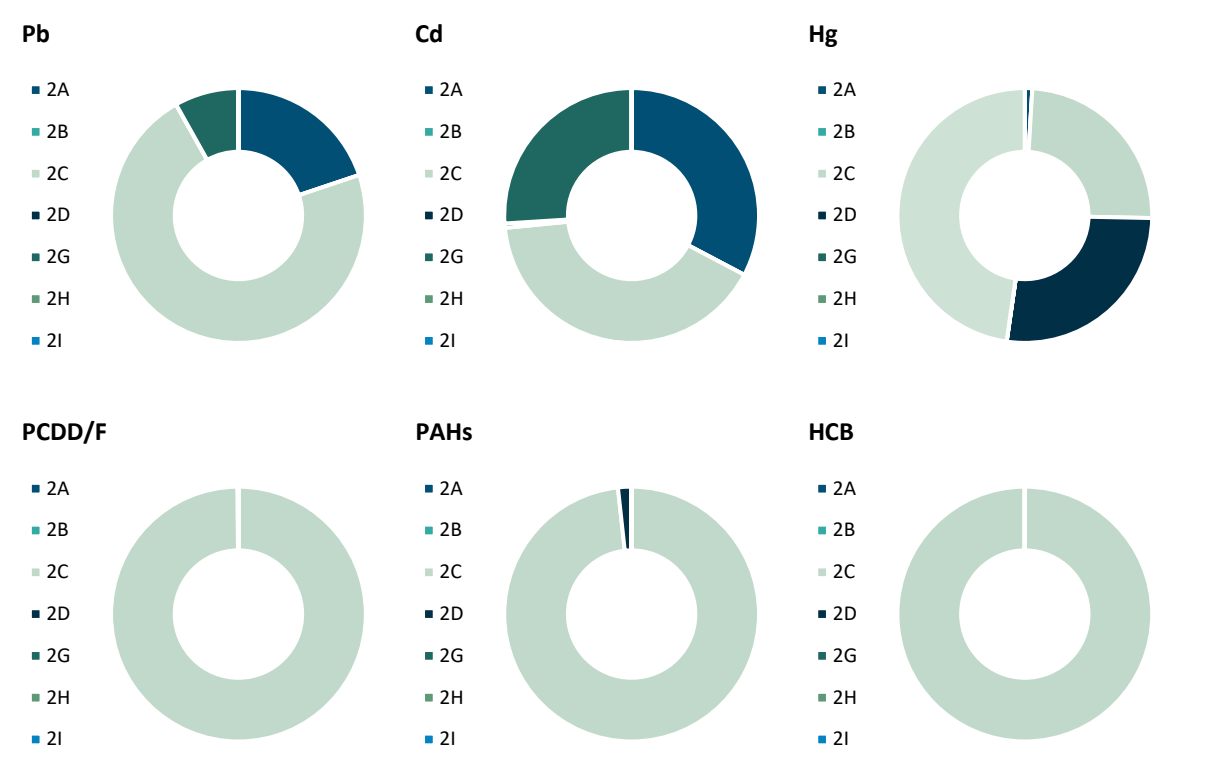


Figure 4.2.2: Share of emissions of heavy metals and POPs in category 2 – Industry in 2024



4.3 RECALCULATIONS, IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

The industry sector undertakes continuing improvements. Several issues were improved during this reporting cycle in categories **2A1**, **2A2**, **2A3**, **2C3** and **2C7a** due to the correction of activity data to more accurate values, correction of errors, or minor changes in notation keys in several categories.

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 significantly from the year 1990, except for SO_x and NH₃, which have an increasing trend, as well as heavy metals (**Table 4.4.1**). Most pollutants show an interannual slight increasing trend.

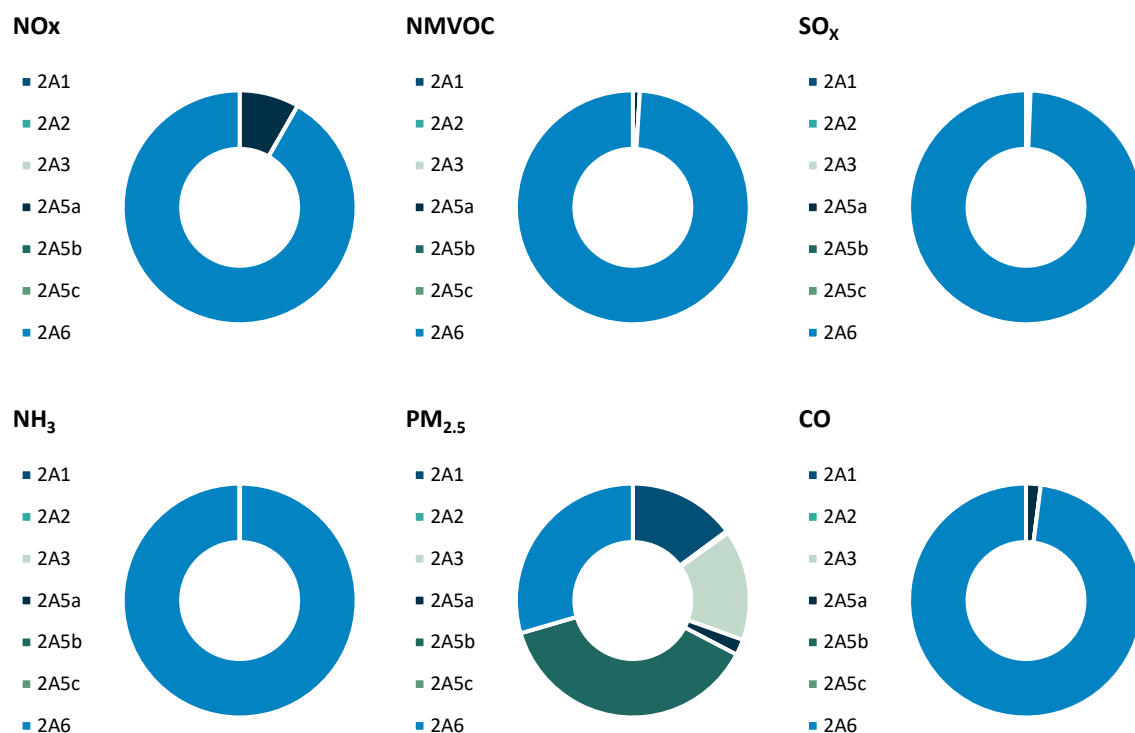
Table 4.4.1: Overview of emissions in the category 2A – Mineral Industry in 2024

YEAR	NO _x [kt]	NMVO C [kt]	SO _x [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	0.1890	1.3494	4.5621	0.0006	0.8216
2023	0.2404	0.0822	0.3405	0.0274	0.1275	0.6103	2.0461	0.0007	0.4784
2024	0.2808	0.0961	0.3513	0.0282	0.1248	0.6171	2.1013	0.0006	0.6588
1990/2024	-19%	-45%	83%	3703%	-68%	-61%	-60%	-76%	-50%
2023/2024	17%	17%	3%	3%	-2%	1%	3%	-13%	38%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.5645	0.0298	0.0007	0.0491	0.0604	0.0016	0.1022	0.2204	0.0863
1995	0.5967	0.0312	0.0007	0.0524	0.0645	0.0017	0.1048	0.2372	0.0904
2000	0.5966	0.0312	0.0007	0.0523	0.0644	0.0017	0.1054	0.2363	0.0905
2005	0.7120	0.0352	0.0008	0.0647	0.0806	0.0020	0.1080	0.3050	0.1035
2010	0.6408	0.0296	0.0007	0.0606	0.0762	0.0017	0.0794	0.2974	0.0885
2011	0.6480	0.0299	0.0007	0.0613	0.0772	0.0017	0.0800	0.3012	0.0895
2012	0.7046	0.0375	0.0009	0.0733	0.0917	0.0021	0.1074	0.3533	0.1114
2013	0.7600	0.0416	0.0010	0.0794	0.0992	0.0023	0.1223	0.3796	0.1230
2014	0.7341	0.0400	0.0010	0.0766	0.0958	0.0022	0.1171	0.3669	0.1184
2015	0.7676	0.0429	0.0010	0.0805	0.1004	0.0024	0.1286	0.3822	0.1265
2016	0.7880	0.0444	0.0011	0.0827	0.1031	0.0025	0.1340	0.3920	0.1307
2017	0.8050	0.0452	0.0011	0.0845	0.1053	0.0025	0.1365	0.4005	0.1333
2018	0.8078	0.0453	0.0011	0.0848	0.1057	0.0025	0.1366	0.4020	0.1336
2019	0.6841	0.0393	0.0009	0.0721	0.0897	0.0022	0.1211	0.3392	0.1155
2020	0.8253	0.0439	0.0011	0.0858	0.1074	0.0025	0.1255	0.4139	0.1304
2021	0.9034	0.0491	0.0012	0.0943	0.1178	0.0027	0.1433	0.4517	0.1453
2022	0.9307	0.0481	0.0012	0.0963	0.1209	0.0027	0.1334	0.4686	0.1435
2023	0.7895	0.0404	0.0010	0.0815	0.1024	0.0023	0.1103	0.3982	0.1205
2024	0.8453	0.0447	0.0011	0.0878	0.1100	0.0025	0.1268	0.4243	0.1328
1990/2024	50%	50%	54%	79%	82%	54%	24%	93%	54%
2023/2024	7%	11%	10%	8%	7%	10%	15%	7%	10%

Shares of NO_x, NMVOC, SO_x, NH₃, PM_{2.5}, and CO emissions in the 2024 NFR categories included in the mineral industry are shown in [Figure 4.4.1](#). Dominant category for all major pollutants (except PM_{2.5}) is Other Mineral Products (**2A6**), as released emissions from cement, lime and glass production are reported under **1A2f** as fuel-based emissions to prevent double counting.

Figure 4.4.1: Shares of emissions of the main pollutants in 2A in 2024



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) into calcium oxide CaO and carbon dioxide CO₂. 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 utilise alternative fuels (refuse-derived fuel – RDF and used tyres, sludge, fly ash, beef and bone meal or similarly categorised 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 4.4.2](#).

Table 4.4.2: Activity data and emissions in the category 2A1 – Cement Production

YEAR	CLINKER PRODUCED [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]
1990	2,835.75	0.0773	0.1824	0.4489	0.0023
1995	2,235.75	0.0610	0.1438	0.3539	0.0018
2000	2,313.71	0.0954	0.2251	0.5541	0.0029
2005	2,352.68	0.0370	0.0872	0.2149	0.0011
2010	1,653.59	0.0256	0.0598	0.1423	0.0008
2011	2,433.86	0.0307	0.0716	0.1704	0.0009
2012	2,126.12	0.0276	0.0644	0.1534	0.0008
2013	2,161.32	0.0365	0.0852	0.2027	0.0011
2014	2,415.34	0.0574	0.1340	0.3190	0.0017
2015	2,506.12	0.0458	0.1068	0.2542	0.0014
2016	2,599.39	0.0495	0.1154	0.2748	0.0015
2017	2,698.82	0.0207	0.0484	0.1151	0.0006
2018	2,695.74	0.0170	0.0396	0.0944	0.0005
2019	2,854.64	0.0275	0.0643	0.1531	0.0008
2020	2,945.23	0.0214	0.0500	0.1191	0.0006
2021	2,937.74	0.0189	0.0441	0.1051	0.0006
2022	3,041.27	0.0196	0.0456	0.1087	0.0006
2023	2,682.07	0.0212	0.0496	0.1180	0.0006
2024	2,655.12	0.0186	0.0433	0.1031	0.0006
1990/2024	-6%	-76%	-76%	-77%	-76%
2023/2024	-1%	-13%	-13%	-13%	-13%

4.4.2.2 Methodological Issues

Activities listed within this category are shown in [Table 4.4.3](#).

Table 4.4.3: Activities according to national categorisation included in 2A1 – Cement Production

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
3.2. Manufacture of cement with a projected production capacity in t/d.

Emission data are compiled in the NEIS. Therefore, the individual-specific EFs could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 4.4.4**). The shares of PM_{2.5} and PM₁₀ in TSP are calculated using average shares from 2005-2009.

Table 4.4.4: Emission factors for calculation of historical years in 2A1 – Cement Production

	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/t CLINKER PRODUCED]	BC* [% of PM _{2.5}]
EF	17	41	158.30	3.00

*EMEP/EEA GB 2023 – Tier 1

4.4.2.3 Completeness

Pollutants originating from combustion activities were reported under the category **1A2f**, as these pollutants cannot be separated in the NEIS database over the whole time series. Therefore, the 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

In the current submission, recalculation for the year 2023 was performed due to the correction of previously estimated activity data (**Table 4.4.5**). The air pollution source operator provided data with a delay. The difference is negligible (under 1%), and emissions were not affected.

Table 4.4.5: Previous and revised activity data in category 2A1 – Cement Production

2A1	AD - CLINKER PRODUCED [kt]		
	PREVIOUS	REVISED	CHANGE
2023	2,658.92	2,682.07	0.87%

4.4.3 Lime Production (NFR 2A2)

4.4.3.1 Overview

All sources are covered by the NEIS database. The production of lime in the Slovak Republic was operated by 4 companies in 6 stationary sources (one operator has entered bankruptcy proceedings during 2024 and the source was not in operation) during the year 2024.

Production of lime, which is chemically calcium oxide (CaO), is performed by the thermal decomposition of limestone at temperatures of 1,040 – 1,300 °C. Therefore, production is a 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 4.4.6**) are presented in the following figures.

Table 4.4.6: Activity data and emissions in the category 2A2 – Lime Production

YEAR	LIME PRODUCED [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]
1990	1,076.00	0.0083	0.0993	0.8279	3.8E-05
1995	803.00	0.0062	0.0741	0.6179	2.8E-05
2000	753.59	0.0056	0.0666	0.5552	2.6E-05

YEAR	LIME PRODUCED [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]
2005	913.08	0.0054	0.0644	0.5365	2.5E-05
2010	828.32	0.0040	0.0480	0.3999	1.8E-05
2011	966.79	0.0024	0.0288	0.2398	1.1E-05
2012	927.35	0.0022	0.0265	0.2206	1.0E-05
2013	834.04	0.0008	0.0096	0.0798	3.7E-06
2014	845.60	0.0021	0.0247	0.2059	9.5E-06
2015	807.78	0.0009	0.0102	0.0854	3.9E-06
2016	817.32	0.0006	0.0075	0.0628	2.9E-06
2017	873.28	0.0006	0.0073	0.0612	2.8E-06
2018	841.10	0.0007	0.0080	0.0667	3.1E-06
2019	782.29	0.0006	0.0071	0.0594	2.7E-06
2020	700.68	0.0005	0.0061	0.0512	2.4E-06
2021	879.54	0.0006	0.0067	0.0560	2.6E-06
2022	776.69	0.0006	0.0070	0.0586	2.7E-06
2023	759.59	0.0004	0.0054	0.0449	2.1E-06
2024	760.31	0.0004	0.0049	0.0406	1.9E-06
1990/2024	-29%	-95%	-95%	-95%	-95%
2023/2024	0%	-10%	-10%	-10%	-10%

4.4.3.2 Methodological Issues

Activities listed within this category are shown in [Table 4.4.7](#).

Table 4.4.7: Activities according to national categorisation included in 2A2 – Lime Production

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
3.3. Manufacture of lime with a projected production capacity of cement clinker in t/d.

Emission data are compiled in the NEIS, therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 4.4.8](#)). Shares of PM_{2.5} and PM₁₀ in TSP are calculated using average shares from 2005-2009.

Table 4.4.8: Emission factors for calculation of historical years in 2A2 – Lime Production

	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/t LIME PRODUCED]	BC* [% of PM _{2.5}]
EF	1	12	769.44	0.46

*EMEP/EEA GB 2023 - Tier 1

4.4.3.3 Completeness

Pollutants originating from combustion activities were reported under the category [1A2f](#), as these pollutants cannot be separated in the NEIS database for the entire time series. Therefore, the 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

The activity data were corrected for years 2010-2023 in line with the number of sources associated with category [2A2](#), from which emissions are included in this category. More sources are included in this category according to the NEIS database compared with the GHG inventory, with which they

were previously harmonised (e.g. lime production source in the paper industry). The values, presented in [Table 4.4.9](#), vary in the range 1-36%. Emissions were not affected by the change, because of an independent way of emission calculation (usually by a continuous emission monitoring system, or discontinuous emission monitoring, where calculation is performed by mass flows and annual operational hours of the source).

Table 4.4.9: Differences in emissions (%) in category 2A2 between the previous and current submission caused by recalculations

2A2	AD - LIME PRODUCED [kt]		
	PREVIOUS	REVISED	CHANGE
2010	822.36	828.32	1%
2011	856.05	966.79	13%
2012	797.33	927.35	16%
2013	716.54	834.04	16%
2014	727.63	845.60	16%
2015	680.20	807.78	19%
2016	663.02	817.32	23%
2017	640.06	873.28	36%
2018	668.99	841.10	26%
2019	586.05	782.29	33%
2020	515.35	700.68	36%
2021	677.83	879.54	30%
2022	688.95	776.69	13%
2023	791.71	759.59	-4%

4.4.4 Glass Production (NFR 2A3)

4.4.4.1 Overview

The emissions from glass production are covered in the registry of the NEIS (4 companies). 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 materials for glass production are silica (SiO₂), Limestone (CaCO₃), dolomite (CaMg (CO₃)₂), soda ash (Na₂CO₃), potash (K₂CO₃), Pb₃O₄, Al₂O₃ and colouring agents are used in the glass production process. The main emissions that originated during the manufacturing are sulphur oxides (SO_x), nitrogen oxides (NO_x) and carbon dioxide (CO₂). 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 (N₂O). DIOX emissions were balanced for the first time in submission 2021. Reported emissions, their trends and activity data from glass production are presented in [Table 4.4.10](#).

Table 4.4.10: Activity data and emissions in the category 2A3 – Glass Production

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	5.3E-05
1995	59.67	92.88	13.23	78.52	0.0897	0.0936	0.0985	5.6E-05
2000	57.96	93.94	13.38	79.41	0.1196	0.1248	0.1314	7.4E-05
2005	116.14	82.25	11.72	69.54	0.0512	0.0535	0.0563	3.2E-05
2010	151.45	44.19	6.29	37.36	0.0106	0.0110	0.0115	6.5E-06

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]
2011	153.95	44.19	6.29	37.36	0.0113	0.0118	0.0124	7.0E-06
2012	160.58	103.83	NO	36.70	0.0079	0.0082	0.0087	4.9E-06
2013	162.43	134.63	NO	35.32	0.0117	0.0122	0.0128	7.2E-06
2014	158.51	125.45	NO	35.99	0.0165	0.0172	0.0181	1.0E-05
2015	155.42	151.18	NO	35.19	0.0187	0.0195	0.0205	1.2E-05
2016	156.25	156.08	NO	40.90	0.0292	0.0305	0.0321	1.8E-05
2017	160.38	157.46	NO	42.51	0.0216	0.0225	0.0237	1.3E-05
2018	161.53	155.98	NO	43.63	0.0445	0.0464	0.0488	2.8E-05
2019	127.75	148.16	NO	36.34	0.0301	0.0314	0.0331	1.9E-05
2020	188.66	128.42	NO	35.24	0.0320	0.0335	0.0352	2.0E-05
2021	196.48	155.62	NO	40.63	0.0270	0.0282	0.0297	1.7E-05
2022	226.30	121.87	NO	39.56	0.0290	0.0303	0.0319	1.8E-05
2023	196.75	97.73	NO	31.06	0.0210	0.0219	0.0230	1.3E-05
2024	196.07	133.00	NO	29.77	0.0191	0.0199	0.0210	1.2E-05
1990/2024	306%	43%	-	-62%	-78%	-78%	-78%	-78%
2023/2024	0%	36%	-	-4%	-9%	-9%	-9%	-9%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.5645	0.0298	0.0007	0.0491	0.0604	0.0016	0.1022	0.2204	0.0863
1995	0.5967	0.0312	0.0007	0.0524	0.0645	0.0017	0.1048	0.2372	0.0904
2000	0.5966	0.0312	0.0007	0.0523	0.0644	0.0017	0.1054	0.2363	0.0905
2005	0.7120	0.0352	0.0008	0.0647	0.0806	0.0020	0.1080	0.3050	0.1035
2010	0.6408	0.0296	0.0007	0.0606	0.0762	0.0017	0.0794	0.2974	0.0885
2011	0.6480	0.0299	0.0007	0.0613	0.0772	0.0017	0.0800	0.3012	0.0895
2012	0.7046	0.0375	0.0009	0.0733	0.0917	0.0021	0.1074	0.3533	0.1114
2013	0.7600	0.0416	0.0010	0.0794	0.0992	0.0023	0.1223	0.3796	0.1230
2014	0.7341	0.0400	0.0010	0.0766	0.0958	0.0022	0.1171	0.3669	0.1184
2015	0.7676	0.0429	0.0010	0.0805	0.1004	0.0024	0.1286	0.3822	0.1265
2016	0.7880	0.0444	0.0011	0.0827	0.1031	0.0025	0.1340	0.3920	0.1307
2017	0.8050	0.0452	0.0011	0.0845	0.1053	0.0025	0.1365	0.4005	0.1333
2018	0.8078	0.0453	0.0011	0.0848	0.1057	0.0025	0.1366	0.4020	0.1336
2019	0.6841	0.0393	0.0009	0.0721	0.0897	0.0022	0.1211	0.3392	0.1155
2020	0.8253	0.0439	0.0011	0.0858	0.1074	0.0025	0.1255	0.4139	0.1304
2021	0.9034	0.0491	0.0012	0.0943	0.1178	0.0027	0.1433	0.4517	0.1453
2022	0.9307	0.0481	0.0012	0.0963	0.1209	0.0027	0.1334	0.4686	0.1435
2023	0.7895	0.0404	0.0010	0.0815	0.1024	0.0023	0.1103	0.3982	0.1205
2024	0.8453	0.0447	0.0011	0.0878	0.1100	0.0025	0.1268	0.4243	0.1328
1990/2024	50%	50%	54%	79%	82%	54%	24%	93%	54%
2023/2024	7%	11%	10%	8%	7%	10%	15%	7%	10%

4.4.4.2 Methodological Issues

Activities listed within this category are shown in [Table 4.4.11](#).

Table 4.4.11: Activities according to national categorisation included in 2A3 – Glass Production

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
3.7. Manufacture of glass, glass products, including glass fibre with projected melting capacity in t/d.

Emission data are compiled in the NEIS database, therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are presented in [ANNEX IV](#).

Emission factors used for the reconstruction of historical years 1990-1999 are calculated by using a weighted average of IEF for each pollutant for the period 2000-2004 ([Table 4.4.12](#)). The shares of PM_{2.5} and PM₁₀ in TSP are calculated using average shares from 2005-2009.

Table 4.4.12: Emission factors for calculation of historical years 2A3 – Glass Production

	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/t GLASS PRODUCED]	BC* [% of PM _{2.5}]
EF	91	95	403.28	0.062

*EMEP/EEA GB 2023 – Tier 1

HMs

Heavy metals are reported by the Tier 2/Tier 1 method. The emissions of heavy metals are processed by the emission factors presented in [Table 4.4.13](#). The methodology distinguishes several types of products. If the emission factor for the higher Tier is not estimated, Tier 1 is used.

Table 4.4.13: Emission factors of heavy metals in 2A3 – Glass Production

EF [g/t (PRODUCT)]/TYPE OF PRODUCT	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
T1 method	1.7	0.13	0.003	0.19	0.23	0.007	0.49	0.80	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 activities were reported under the category [1A2f](#), as these pollutants cannot be separated in the NEIS database over the entire time series. Therefore, the 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

In the current submission, corrections of emission data for Pb, Cd, As, Cr, Ni, and Se are provided for the entire time series since 1990. The recalculation of previously omitted heavy metal emissions was performed in accordance with the latest review [Recommendation No. SK-2A3-2025-0003](#). The results were implemented in the inventory. Tier 1 emission factors were used in the methodology, where Tier 2 factors were not available to complete the calculations of the missing emissions. The percentage change (increase) of individual pollutants is provided in [Table 4.4.14](#). Further investigation on abatement is planned for this category.

Table 4.4.14: Difference in emissions (%) in category 2A3 – Glass Production between the previous and current submission caused by the recalculation

2A3	Pb	Cd	As	Cr	Ni	Se
1990	107.14	415.36	251.20	238.33	782.79	204.48
1991	94.39	328.84	198.88	188.69	619.74	161.89
1992	84.43	272.57	164.85	156.40	513.70	134.19
1993	95.59	336.25	203.35	192.94	633.70	165.54
1994	110.27	439.61	265.86	252.25	828.49	216.42

2A3	Pb	Cd	As	Cr	Ni	Se
1995	95.42	335.18	202.71	192.33	631.69	165.01
1996	96.26	340.41	205.87	195.33	641.54	167.59
1997	94.09	327.04	197.78	187.65	616.34	161.00
1998	76.48	233.24	141.06	133.83	439.57	114.83
1999	156.92	1086.68	657.20	623.54	2,047.97	534.98
2000	97.61	349.01	211.07	200.26	657.75	171.82
2001	95.72	337.04	203.83	193.39	635.18	165.93
2002	89.66	301.04	182.06	172.74	567.35	148.21
2003	92.13	315.31	190.69	180.93	594.24	155.23
2004	94.99	332.51	201.09	190.80	626.65	163.70
2005	56.84	152.52	92.24	87.52	287.44	75.09
2006	70.15	204.93	123.94	117.59	386.22	100.89
2007	48.60	124.15	75.08	71.24	233.98	61.12
2008	47.70	121.21	73.30	69.55	228.43	59.67
2009	35.82	85.15	51.50	48.86	160.48	41.92
2010	27.61	62.84	38.00	36.06	118.42	30.93
2011	27.22	61.82	37.38	35.47	116.50	30.43
2012	51.30	94.81	57.34	54.40	178.68	46.68
2013	61.34	113.35	68.55	65.04	213.62	55.80
2014	59.70	110.33	66.73	63.31	207.94	54.32
2015	70.29	129.90	78.56	74.54	244.82	63.95
2016	73.90	136.58	82.60	78.37	257.39	67.24
2017	73.09	135.08	81.69	77.51	254.57	66.50
2018	72.44	133.87	80.96	76.81	252.29	65.90
2019	84.66	156.46	94.62	89.78	294.86	77.03
2020	50.85	93.98	56.83	53.92	177.11	46.27
2021	58.55	108.21	65.44	62.09	203.93	53.27
2022	41.81	77.28	46.73	44.34	145.63	38.04
2023	38.37	70.91	42.89	40.69	133.64	34.91

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, surface and underground quarrying and mining locations for various materials were occurring during the year 2022 (lignite, oil and natural gas are not included in the category). Amongst them are metallic ores (Fe, Au, Ag, Pb and Zn – surface ore mining is not occurring), magnesite ore and building material (building stones, sandstones and sand and brick raw materials), limestone for cement and lime production, but also some other raw materials (bentonite, perlite, talc and others). The emissions rising from the extractions of these minerals are mainly particulate matters. 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 4.4.15](#)) are presented in the following figures.

Table 4.4.15: Overview of emissions in the category 2A5a – Quarrying and Mining of Minerals Other than Coal

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

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	CO [kt]
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
2023	0.0235	0.0008	0.0071	0.0023	0.0273	0.2278	0.0299
2024	0.0232	0.0009	0.0022	0.0027	0.0326	0.2720	0.0135
1990/2024	191%	478%	-67%	53%	54%	54%	-38%
2023/2024	-1%	15%	-69%	19%	19%	19%	-55%

4.4.5.2 Methodological Issues

Activities listed within this category are shown in [Table 4.4.16](#).

Table 4.4.16: Activities according to national categorisation included in 2A5a – Quarrying and Mining of Minerals Other than Coal

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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 are compiled in the NEIS database, therefore the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are presented in [ANNEX IV](#).

Historical years 1990-1999 are calculated by using a weighted average of the years 2000-2004 for all rising pollutants. Previously used average IEF of the years 2000-2004 was replaced. Shares of PM_{2.5} and PM₁₀ in TSP are calculated using average shares from 2005-2009 ([Table 4.4.17](#)).

Table 4.4.17: Emission factors for calculation of historical years in 2A5a – Quarrying and Mining of Minerals Other than Coal

	NO _x [g/GJ]	NM VOC [g/GJ]	SO _x [g/GJ]	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/GJ]	CO [g/GJ]
EF	136.34	2.77	115.13	1	12	3,020.65	371.80

For Quarries and related stone processing for emission calculation, the official bulletin of the Ministry of Environment can be used ([Table 4.4.18](#)).

Table 4.4.18: 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

4.4.5.3 Completeness

All rising pollutants were reported.

4.4.5.4 Source-specific Recalculations

No recalculations were made in this submission.

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, housing construction and demolition. The overall trends of activity data for affected areas and emissions are shown in *Table 4.4.19*. Fluctuations in emission trends are methodically connected to the activity data. Therefore, the leaps are visible in a few years, for example, 1998 or 2015, where the area of new highways or finished flats increased in national statistics.

Table 4.4.19: Overview of activity data and emissions in 2A5b – Construction and Demolition

YEAR	AF. AREA OF HIGHWAYS AND EXPRESSWAYS [mil. m ²]	AF. AREA OF NEW BUILDINGS FOR ADMINISTRATION [mil. m ²]	AF. AREA OF COMPLETED FLATS [mil. m ²]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]
1990	0.79	0.34	2.59	0.1074	1.0737	3.5836
1995	0.00	0.28	0.64	0.0191	0.1905	0.6323
2000	0.04	0.22	1.81	0.0416	0.4165	1.3863
2005	1.62	0.13	2.16	0.1393	1.3926	4.6558
2010	1.50	0.06	1.59	0.0880	0.8799	2.9428
2011	0.42	0.08	1.36	0.0735	0.7348	2.4540
2012	0.00	0.08	1.42	0.0302	0.3023	1.0068
2013	0.51	0.02	1.45	0.0601	0.6009	2.0080
2014	0.21	0.08	2.31	0.0504	0.5040	1.6812

YEAR	AF. AREA OF HIGHWAYS AND EXPRESSWAYS [mil. m ²]	AF. AREA OF NEW BUILDINGS FOR ADMINISTRATION [mil. m ²]	AF. AREA OF COMPLETED FLATS [mil. m ²]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]
2015	2.04	0.03	2.29	0.2222	2.2219	7.4311
2016	0.34	0.19	2.42	0.0645	0.6453	2.1526
2017	1.02	0.04	2.48	0.1189	1.1893	3.9747
2018	0.00	0.05	2.78	0.0626	0.6259	2.0858
2019	0.52	0.10	2.87	0.0883	0.8832	2.9482
2020	1.86	0.04	3.06	0.1762	1.7621	5.8916
2021	1.11	0.06	2.87	0.1458	1.4582	4.8730
2022	0.47	0.05	3.02	0.1216	1.2160	4.0594
2023	0.07	0.05	2.91	0.0463	0.4627	1.5427
2024	0.07	0.04	2.63	0.0541	0.5412	1.8042
1990/2024	-91%	-88%	2%	-50%	-50%	-50%
2023/2024	0%	-22%	-10%	17%	17%	17%

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 distinguished yet due to the missing activity data. Overview of used emission factors ([Table 4.4.20](#)).

Table 4.4.20: EF used for the calculations in category 2A5b – Construction and Demolition

EF (GB ₂₀₂₃ – division)	PM _{2.5} [kg/m ²]	PM ₁₀ [kg/m ²]	TSP [kg/m ²]
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 the calculation, 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 [Equation 4.4.1](#).

Equation 4.4.1: 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 emissions (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 4.4.21](#) and [Table 4.4.22](#).

Table 4.4.21: Parameters used for the calculations in category 2A5b – Construction and Demolition

PARAMETER	d	CE	s	A _{affected}
Road construction	0.83	0.5	20%	36,000*
Non-residential construction	0.83	0.5	20%	0.8
Construction of apartments	0.75	0	20%	1.3

*m²/km

The Thornthwaite precipitation-evaporation index was calculated using [Equation 4.4.2](#).

Equation 4.4.2: Thornthwaite precipitation-evaporation index calculation

$$PE \text{ index} = 3.16 \sum_{i=0}^{12} \left(\frac{P_i}{1.8 T_i + 22} \right)$$

Where:

P_i – monthly precipitation (in mm)

T_i – mean temperature (in °C)

The Thornthwaite precipitation-evaporation index was calculated using the parameters and the index in [Table 4.4.22](#).

Table 4.4.22: 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
2023	83.58	10.00	86.00
2024	66.50	10.00	66.71

4.4.6.3 Completeness

All rising pollutants were reported.

4.4.6.4 Source-specific Recalculations

No recalculations were made in this submission.

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. The notation keys were applied in accordance with *Recommendation No. SK-2A5c-2025-0001*.

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 the described NFR categories. Reported emissions under the category and their trends are presented below (*Table 4.4.23*). 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 4.4.23: Overview of emissions in the category 2A6 - Other Mineral Products

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [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
2023	0.2168	0.0814	0.3334	0.0274	0.0363	0.0434	0.0897	0.4486
2024	0.2575	0.0951	0.3491	0.0282	0.0368	0.0439	0.0900	0.2575
1990/2024	-24%	-45%	89%	3,703%	-67%	-63%	-40%	-24%
2023/2024	19%	17%	5%	3%	1%	1%	0%	19%

4.4.8.2 Methodological Issues

Activities listed within this category are shown in *Table 4.4.24*.

Table 4.4.24: Activities according to national categorisation included in 2A6 - Other Mineral Products

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1) :
3.4. Production of magnesium oxide from magnesite and production of alkaline refractory materials with a projected production capacity t/d.

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1) :

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 m³ and with a setting density per kiln exceeding 300 kg/m³.

3.9. Production of lightweight non-metallic mineral products with a projected production capacity of m³/d.

3.12. Production of unfired masonry materials and precast units with a projected production capacity of m³/h.

3.13. Industrial production of concrete, mortar or other building materials with a projected production capacity in m³/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 are compiled in the NEIS database, therefore, the individual-specific EFs could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are 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 4.4.25](#) (valid for 2000-2024). Emission factors for the historical years were calculated as a weighted average of the IEF of the period 2000-2004.

Table 4.4.25: Emission factors provided by Bulletin of MoE used for 2A6 - Other Mineral Products

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

The shares of PM_{2.5} and PM₁₀ in TSP are calculated using average shares from 2005-2009 ([Table 4.4.26](#)).

Table 4.4.26: Emission factors for calculation of historical years in 2A6 - Other Mineral Products

	NO _x [g/GJ]	NM VOC [g/GJ]	SO _x [g/GJ]	NH ₃ [g/GJ]	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/GJ]	CO [g/GJ]
EF	159.01	80.81	86.22	0.35	74	79	70.26	605.28

4.4.8.3 Completeness

All rising pollutants were reported.

4.4.8.4 Source-specific Recalculations

No recalculations were made in this submission.

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**).

The activity of categories **2B3**, **2B6** and **2B7** is occurring in the territory of Slovakia. Shares of released emissions of main air pollutants for 2024, including NFR categories, are provided in the figure below (**Figure 4.5.1**).

Emissions from this category have a general decreasing trend in long term perspective. It was caused by firm legislation and the adoption of emissions limits for the main pollutants. Although the annual increase is visible for the emissions of TSP, derived PMs, BC, and ammonia emissions (**Table 4.5.1**). Emissions of PMs originate mostly from category **2B10a**, which includes the production of various organic and inorganic compounds, fertilisers, etc.

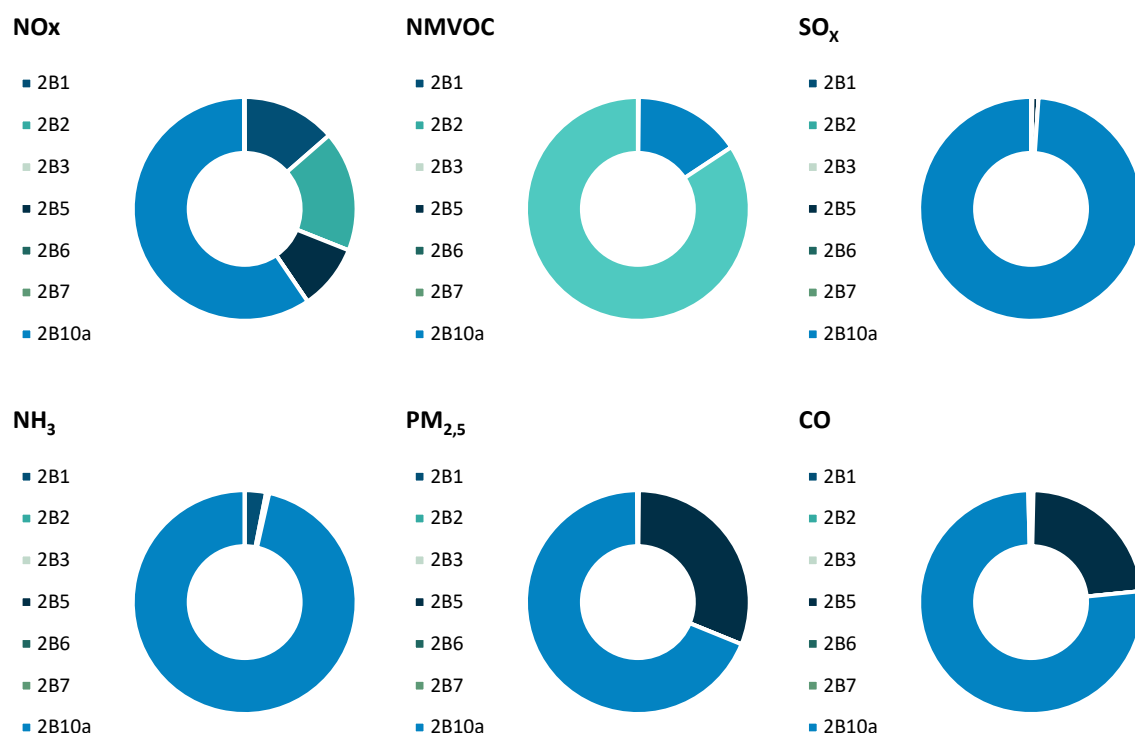
Not all are occurring in the territory of Slovakia. Shares of released emissions of main air pollutants in 2024. NFR categories included are provided in the figure below (**Figure 4.5.1**).

Table 4.5.1: Overview of emissions in category 2B – Chemical Products

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [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

YEAR	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
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
2023	0.7962	1.7021	1.4189	0.1317	0.0659	0.1097	0.1811	0.0007	0.7513
2024	0.5794	1.6563	1.0580	0.1747	0.0752	0.1247	0.2057	0.0009	0.5762
1990/2024	-47%	-73%	-35%	-29%	-64%	-62%	-59%	-73%	-86%
2023/2024	-27%	-3%	-25%	33%	14%	14%	14%	29%	-23%

Figure 4.5.1: Shares of emissions in 2B in 2024 – Chemical Products



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 presented in [Table 4.5.2](#). Emission trends show a decline in long-term sight, but production rose on an annual comparison in 2024, thus the released emissions have the same trend. The emissions of particulate matter from this source decreased significantly in 2004 due to abatement technology installation.

Table 4.5.2: Activity data and emissions in the category 2B1 – Ammonia Production

YEAR	AMMONIA PRODUCED [kt]	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	360.00	0.2136	0.0038	0.0011	0.0036	0.0212	0.0354	0.0590	3.8E-04	0.0702
1995	383.80	0.2277	0.0041	0.0012	0.0038	0.0226	0.0377	0.0629	4.1E-04	0.0748

YEAR	AMMONIA PRODUCED [kt]	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
2000	403.00	0.2182	0.0049	0.0015	0.0040	0.0320	0.0533	0.0888	5.8E-04	0.0161
2005	426.35	0.2711	0.0045	0.0013	0.0043	0.0039	0.0066	0.0109	7.1E-05	0.1064
2010	233.56	0.1274	0.0017	0.0007	0.0023	0.0021	0.0035	0.0058	3.8E-05	0.0427
2011	455.48	0.2496	0.0033	0.0014	0.0046	0.0041	0.0068	0.0113	7.4E-05	0.0837
2012	377.30	0.2037	0.0027	0.0011	0.0038	0.0033	0.0056	0.0093	6.0E-05	0.0683
2013	474.91	0.2436	0.0032	0.0013	0.0047	0.0040	0.0066	0.0111	7.2E-05	0.0776
2014	346.27	0.1799	0.0024	0.0010	0.0035	0.0029	0.0049	0.0082	5.3E-05	0.0573
2015	476.94	0.2279	0.0030	0.0012	0.0048	0.0037	0.0062	0.0104	6.7E-05	0.0764
2016	403.96	0.2017	0.0026	0.0011	0.0040	0.0033	0.0055	0.0092	5.9E-05	0.0676
2017	458.88	0.2253	0.0029	0.0012	0.0046	0.0037	0.0061	0.0102	6.6E-05	0.0755
2018	516.74	0.2354	0.0030	0.0012	0.0052	0.0037	0.0061	0.0102	6.6E-05	0.0787
2019	491.95	0.1449	0.0022	0.0008	0.0049	0.0024	0.0040	0.0066	4.3E-05	0.0490
2020	545.23	0.1540	0.0023	0.0008	0.0055	0.0025	0.0042	0.0070	4.6E-05	0.0519
2021	580.51	0.1647	0.0023	0.0009	0.0058	0.0027	0.0045	0.0075	4.9E-05	0.0554
2022	462.12	0.0753	0.0020	0.0065	0.0046	0.0002	0.0003	0.0004	2.7E-06	0.0018
2023	413.54	0.0638	0.0019	0.0016	0.0041	0.0001	0.0001	0.0002	1.2E-06	0.0015
2024	537.43	0.0787	0.0024	0.0021	0.0054	0.0001	0.0002	0.0003	2.1E-06	0.0020
1990/2024	15%	-63%	-37%	85%	49%	-99%	-99%	-99%	-99%	-97%
2023/2024	-11%	23%	26%	31%	30%	74%	74%	74%	74%	38%

4.5.2.2 Methodological Issues

Activities listed within this category are shown in [Table 4.5.3](#).

Table 4.5.3: Activities according to national categorisation included in 2B1 – Ammonia Production

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):										
4.27 Ammonia production										

Emission data are compiled in the NEIS database, therefore, the individual-specific EFs were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology are presented in [ANNEX IV](#).

Emissions of NH₃ 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 4.5.4](#)). Shares of PM_{2.5} and PM₁₀ in TSP are calculated using average shares from 2005-2009.

Table 4.5.4: Emission factors for calculation of historical years in 2B1 – Ammonia Production

	NO _x [g/t]	NMVOC [g/t]	SO _x [g/t]	NH ₃ * [g/t]	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/t]	BC* [% of PM _{2.5}]	CO [g/t]
EF	593.41	10.67	3.10	10	36	60	163.77	1.8	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

In the current submission, recalculations were performed for the entire timeline of BC emissions. Notation key NA was replaced by EMEP/EEA GB 2023 emission factor of Tier 1, which is also provided

in [Table 4.5.4](#), and emissions were reported within the category. Notation keys for fuels (SF, B, OF) have been harmonised with EMEP/EEA GB 2023 from NO to NA in the entire timeline.

4.5.3 Nitric Acid Production (NFR 2B2)

4.5.3.1 Overview

NO_x emissions have had an overall increasing trend since 1990 due to the increase in the production of nitric acid ([Table 4.5.5](#)). Significant increases and subsequent decreases in NH₃ emissions between 2006/2007 were recorded due to a temporal malfunction at the source. A decrease in 2022 was caused by a single source starting to use new technology to produce Nitric acid.

Table 4.5.5: Overview of activity data and emissions in the category 2B2 – Nitric Acid Production

YEAR	NITRIC ACID PRODUCED [kt]	NO _x [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
2023	471.17	0.2009	0.0049
2024	541.39	0.1011	0.0008
1990/2024	35%	-42%	-79%
2023/2024	15%	-50%	-83%

4.5.3.2 Methodological Issues

The definition of activities covered by category **2B2** is provided in [Table 4.5.6](#). 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 4.5.6: Activities according to national categorisation included in 2B2 – Nitric Acid Production

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
4.22 Production of inorganic acids.

Since 2005, N₂O, NH₃ and NO_x emissions have been 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 modernised in the same way as the other.

Emission data are compiled in the NEIS, therefore, the individual specific EFs 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 used. Values are presented in [Table 4.5.7](#).

Table 4.5.7: Emission factors for calculation of historical years in 2B2 – Nitric Acid Production

	NO _x [g/t]	NH ₃ [g/t]
EF	434.60	9.74

4.5.3.3 Completeness

All rising pollutants were reported.

4.5.3.4 Source-specific Recalculations

In the current submission, notation keys for fuels (SF, GF, B, OF) have been harmonised with EMEP/EEA GB 2023 from NO to NA in the entire timeline.

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 2,000 to 2,100°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 has been used instead of other bituminous coal.

The main emissions from the production of calcium carbide (CaC₂) are dust. However, the reported emissions in the category cover all sub-processes of manufacturing as they are all together in the dataset under the category. Relevant rising emissions from this manufacturing, their trends and activity data ([Table 4.5.8](#)) are presented.

The emissions trend is decreasing from long term perspective. NMVOC increased significantly in 2023 due to increased combustion of natural gas in the process of carbide production. The fluctuation continued in recent years for NO_x, NMVOC and SO_x. The production activity is slowly returning to pre-pandemic levels. Other pollutants show a continual slight decrease.

Table 4.5.8: Overview of activity data and emissions in the category 2B5 – Carbide Production

YEAR	CARBIDE PRODUCED [kt]	NO _x [kt]	NM VOC [kt]	SO _x [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	NO	NO	NO	NO	NO	NO	NO	NO	NO
1995	84.30	0.1968	1.0E-05	0.0144	0.1502	0.2503	0.4172	0.0027	0.0638
2000	88.82	0.3865	1.1E-05	0.0250	0.1586	0.2644	0.4406	0.0029	0.0679
2005	97.03	0.0688	1.2E-05	0.0089	0.1114	0.1856	0.3093	0.0020	0.0660
2010	98.26	0.0561	2.1E-05	0.0027	0.0326	0.0543	0.0905	0.0006	0.2789
2011	107.40	0.0565	1.2E-06	0.0027	0.0310	0.0516	0.0860	0.0006	0.2791
2012	100.48	0.0522	4.4E-06	0.0043	0.0605	0.1008	0.1681	0.0011	0.3169
2013	81.79	0.0433	1.1E-05	0.0058	0.0725	0.1208	0.2013	0.0013	0.3324
2014	74.30	0.0505	2.8E-05	0.0053	0.0707	0.1179	0.1965	0.0013	0.2972
2015	56.18	0.0502	2.2E-05	0.0067	0.0617	0.1028	0.1713	0.0011	0.2817
2016	67.95	0.0590	1.4E-05	0.0083	0.0462	0.0770	0.1284	0.0008	0.3341
2017	71.64	0.0580	3.2E-05	0.0083	0.0482	0.0803	0.1338	0.0009	0.2139
2018	70.15	0.0535	3.1E-05	0.0079	0.0436	0.0726	0.1210	0.0008	0.1890
2019	60.47	0.0600	1.9E-04	0.0083	0.0767	0.1279	0.2132	0.0014	0.1688
2020	47.61	0.0716	3.8E-05	0.0067	0.0547	0.0912	0.1520	0.0010	0.1464
2021	48.48	0.0607	1.0E-04	0.0073	0.0508	0.0847	0.1412	0.0009	0.1597
2022	36.12	0.0516	4.5E-05	0.0102	0.0338	0.0563	0.0938	0.0006	0.1276
2023	42.67	0.0418	7.9E-05	0.0110	0.0258	0.0430	0.0717	0.0005	0.1326
2024	57.23	0.0548	2.3E-05	0.0094	0.0233	0.0388	0.0647	0.0004	0.1329
1990/2024	-	-	-	-	-	-	-	-	-
2023/2024	34%	31%	-71%	-15%	-10%	-10%	-10%	-10%	0%

4.5.5.2 Methodological Issues

The definition of activities covered by category **2B5** is provided in **Table 4.5.9**. The characteristic of involved industrial activity is wider, but the only activity of calcium carbide production belongs to the occurring production activities.

Table 4.5.9: Activities according to national categorisation included in 2B5 – Carbide Production

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
4.25 Production of non-metals, metal oxides or other inorganic compounds such as sodium, calcium, silicon, phosphorus, calcium carbide, silicon carbide.

Emission data are compiled in the NEIS, therefore, the individual-specific EFs 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 PM₁₀ in TSP are calculated using average shares from 2005-2009 (**Table 4.5.10**).

Table 4.5.10: Emission factors for calculation of historical years in 2B5 – Carbide Production

	NO _x [g/t]	NM VOC [g/t]	SO _x [g/t]	TSP [g/t]	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	BC *[% of PM _{2.5}]	CO [g/t]
EF	2,334.16	0.12	171.03	4,949.16	36	60	1.8	757.16

*EMEP/EEA GB 2023 – Tier 1

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, the notation key NO was used, because production started in 1992.

4.5.5.4 Source-specific Recalculations

In the current submission, recalculations were performed for the entire timeline of BC emissions. Notation key NE was replaced by EMEP/EEA GB 2023 emission factor of Tier 1, which is provided in [Table 4.5.10](#), and emissions were reported within the category.

Notation keys for fuels (LF, SF, B, OF) have been harmonised with EMEP/EEA GB 2023 from NO to NA in the timeline, except for the years 1990-1991.

4.5.6 Titanium Dioxide Production (NFR 2B6)

4.5.6.1 Overview

Titanium dioxide is not produced in the Slovak Republic, and the 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 the NO notation key was used.

4.5.8 Chemical Industry: Other (NFR 2B10a)

4.5.8.1 Overview

Emissions of air pollutants show a decreasing trend in the long term. Their overview is provided below in [Table 4.5.11](#). The category includes various activities of the chemical industry, which are detailed and specified in the methodology section.

Table 4.5.11: Overview of emissions in the category 2B10a – Chemical Industry: Other

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [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
2023	0.4896	0.3187	1.4063	0.1227	0.0400	0.0665	0.1092	0.0007	0.6163
2024	0.3442	0.2577	1.0465	0.1685	0.0517	0.0856	0.1406	0.0009	0.4390
1990/2024	-50%	-91%	-35%	-29%	-73%	-71%	-69%	-73%	-89%
2023/2024	-30%	-19%	-26%	37%	29%	29%	29%	29%	-29%

4.5.8.2 Methodological Issues

The definition of activities covered by category **2B10a** is provided in **Table 4.5.12**.

Table 4.5.12: Activities according to national categorisation included in 2B10a – Chemical Industry: Other

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1) :	
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 PM₁₀ in TSP are calculated using average shares from 2005-2009 (**Table 4.5.13**).

Table 4.5.13: Emission factors for calculation of historical years in 2B10a – Chemical Industry: Other

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH ₃ [g/GJ]	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/GJ]	BC* [% of PM _{2.5}]	CO [g/GJ]
EF	352.13	1,476.34	819.68	120.20	42	66	227.33	1.8	2,090.38

*EMEP/EEA GB 2023 – Tier 1

4.5.8.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB 2023.

4.5.8.4 Source-specific Recalculations

Notation key for solid fuels has been harmonised with EMEP/EEA GB 2023 from NO to NA in the entire timeline.

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 4.5.14](#).

Table 4.5.14: Overview of emissions in the category 2B10b – Storage, Handling and Transport of Chemical Products

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	CO [kt]
1990	6.1E-05	3.1138	2.0E-06	1.2E-04	1.7E-06	2.2E-06	2.2E-06	1.3E-05
1995	6.1E-05	3.0553	2.0E-06	1.1E-04	1.7E-06	2.2E-06	2.2E-06	1.3E-05
2000	6.2E-05	2.6163	2.0E-06	5.0E-05	1.7E-06	2.2E-06	2.2E-06	1.3E-05
2005	6.2E-05	1.7804	2.0E-06	6.9E-05	1.7E-06	2.2E-06	2.2E-06	1.3E-05
2010	8.4E-05	1.3799	1.1E-07	NO	9.3E-07	1.2E-06	1.2E-06	4.3E-06
2011	9.7E-05	1.3636	2.3E-07	NO	2.0E-06	2.5E-06	2.5E-06	1.0E-05
2012	5.9E-05	1.1992	1.3E-07	NO	9.4E-07	1.2E-06	1.2E-06	8.8E-06
2013	8.8E-05	1.4284	6.6E-07	NO	4.4E-06	5.5E-06	5.6E-06	3.4E-05
2014	7.7E-05	1.3556	2.5E-07	NO	1.7E-06	2.1E-06	2.1E-06	1.6E-05
2015	1.4E-04	1.6226	2.7E-07	NO	1.8E-06	2.2E-06	2.3E-06	1.7E-05
2016	4.0E-05	1.5281	2.5E-07	NO	1.7E-06	2.1E-06	2.1E-06	1.6E-05
2017	2.3E-04	1.5373	2.1E-06	NO	3.2E-05	4.0E-05	4.0E-05	2.0E-04
2018	1.3E-04	1.5985	2.4E-07	NO	4.6E-05	5.8E-05	5.8E-05	6.3E-04
2019	1.6E-04	1.4921	2.6E-06	NO	6.9E-05	8.6E-05	8.7E-05	8.5E-04
2020	1.6E-04	1.6576	2.8E-06	NO	7.1E-05	8.9E-05	9.0E-05	8.5E-04
2021	1.7E-04	1.7539	3.9E-06	NO	8.2E-05	1.0E-04	1.0E-04	8.4E-04
2022	1.6E-04	1.6840	3.5E-06	NO	8.1E-05	1.0E-04	1.0E-04	8.9E-04
2023	1.6E-04	1.3814	4.1E-06	NO	6.5E-05	8.1E-05	8.2E-05	8.9E-04
2024	5.2E-04	1.3962	7.4E-06	NO	8.2E-05	1.0E-04	1.0E-04	2.3E-03
1990/2024	746%	-55%	275%	-	4,662%	4,662%	4,663%	17,855%
2023/2024	233%	1%	81%	-	27%	27%	27%	164%

4.5.9.2 Methodological Issues

Activities listed within this category are shown in [Table 4.5.15](#).

Table 4.5.15: Activities according to national categorisation included in 2B10b – Storage, Handling and Transport of Chemical Products

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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 2000-2024. 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

Notation keys for fuels (SF, B, OF) have been harmonised with EMEP/EEA GB 2023 from NO to NA in the entire timeline.

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 4.6.1) due to strict legislation and the adoption of emission limits as well as BAT technologies in this industry. However, some pollutants show an increase in interannual comparison in last years.

Table 4.6.1: Overview of emissions in the category 2C – Metal Production

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [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
2023	4.4365	0.7651	3.0983	0.0034	0.0924	0.1257	0.2634	0.0014	78.9870
2024	4.5834	0.9523	2.3518	0.0030	0.1061	0.1432	0.2752	0.0013	72.4032
1990/2024	-14%	173%	-75%	-61%	-93%	-94%	-97%	-94%	-8%
2023/2024	3%	24%	-24%	-12%	15%	14%	4%	-4%	-8%

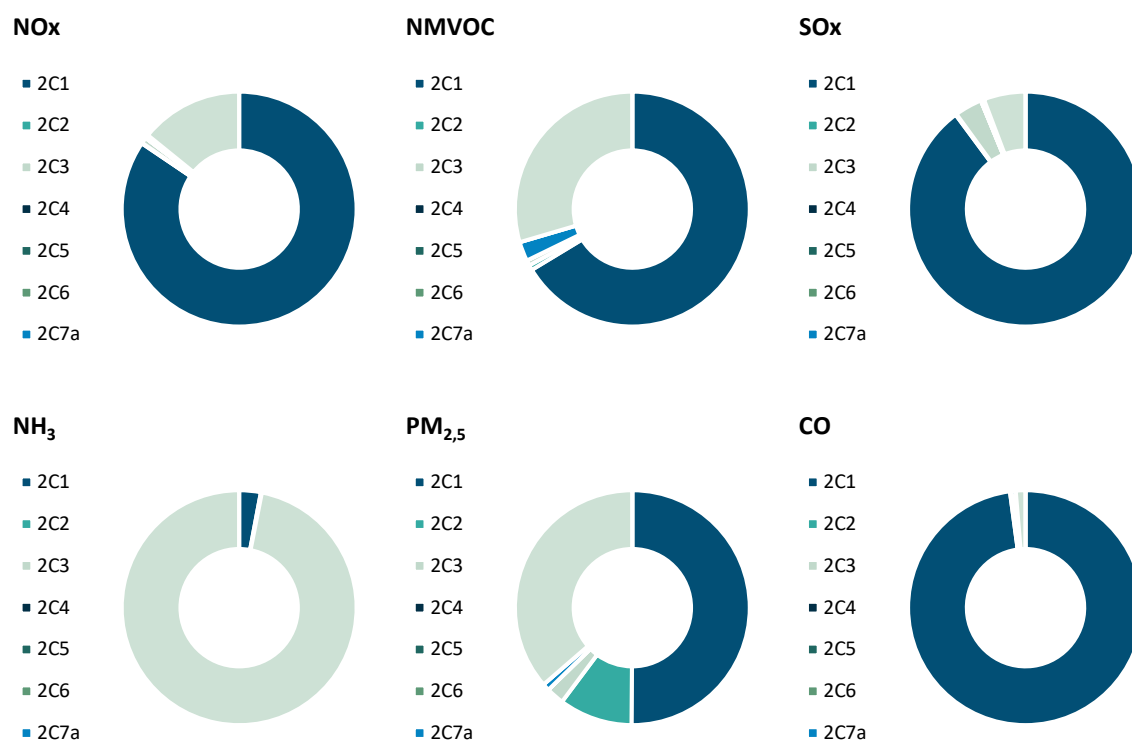
YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	20.4632	0.4196	0.2038	0.6972	1.5284	3.1871	1.3097	0.0903	9.1212
1995	17.3194	0.2641	0.1671	0.5766	1.3156	2.5838	0.9865	0.0746	8.2128
2000	18.3403	0.0890	0.1839	0.5172	0.8178	1.4983	0.9087	0.0825	9.0314

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2005	5.2889	0.1563	0.0390	0.5011	0.9325	1.1883	0.1762	0.0826	7.1292
2010	4.3882	0.1870	0.0302	0.4442	1.4849	2.1420	0.1676	0.0628	6.9609
2011	4.0688	0.2223	0.0343	0.4168	1.8575	2.8447	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
2023	3.7845	0.0667	0.0294	0.3691	0.9596	0.2608	0.1418	0.0633	6.0546
2024	3.0654	0.0556	0.0277	0.2966	1.6285	0.2892	0.1197	0.0573	4.9330
1990/2024	-85%	-87%	-86%	-57%	7%	-91%	-91%	-37%	-46%
2023/2024	-19%	-17%	-6%	-20%	70%	11%	-16%	-9%	-19%

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	6.1E-01	6.1E-01	6.1E-01	7.4E-02	12.4963	0.1195	18.9415
1995	30.4281	2.9E-01	2.9E-01	2.9E-01	3.6E-02	10.3806	0.0975	17.1153
2000	32.1864	7.7E-03	2.2E-03	2.2E-03	1.1E-03	9.5126	0.1080	17.8307
2005	33.6304	1.1E-02	3.2E-03	3.2E-03	1.6E-03	10.8661	0.1048	21.0057
2010	27.3048	1.1E-02	3.3E-03	3.3E-03	1.6E-03	10.4849	0.0744	21.1782
2011	31.9026	1.1E-02	3.3E-03	3.3E-03	1.6E-03	9.8373	0.0876	19.4673
2012	32.8065	1.1E-02	3.2E-03	3.2E-03	1.6E-03	10.3636	0.0943	20.6039
2013	31.1630	1.1E-02	3.3E-03	3.3E-03	1.6E-03	10.7557	0.0918	21.9567
2014	37.1470	1.2E-02	3.4E-03	3.4E-03	1.7E-03	11.5113	0.1137	22.4163
2015	36.8028	1.2E-02	3.4E-03	3.4E-03	1.7E-03	11.0712	0.1122	21.2480
2016	37.2869	1.2E-02	3.5E-03	3.5E-03	1.7E-03	11.7023	0.1114	22.5342
2017	37.6663	1.2E-02	3.5E-03	3.5E-03	1.7E-03	12.0576	0.1124	23.2818
2018	37.1101	1.2E-02	3.5E-03	3.5E-03	1.7E-03	11.8577	0.1098	22.9772
2019	35.3311	1.2E-02	3.5E-03	3.5E-03	1.7E-03	9.5412	0.1040	18.1209
2020	27.0366	1.1E-02	3.0E-03	3.0E-03	1.5E-03	8.1028	0.0755	15.6085
2021	8.5280	1.1E-02	3.3E-03	3.3E-03	1.6E-03	11.6509	0.0963	22.6512
2022	5.8058	5.0E-03	1.4E-03	1.4E-03	7.2E-04	8.9899	0.0567	17.8634
2023	5.5330	1.5E-05	4.3E-06	4.3E-06	2.1E-06	10.2779	0.0766	20.0183
2024	7.2998	NO	NO	NO	NO	9.0419	0.0699	17.6378
1990/2024	-80%	-100%	-100%	-100%	-100%	-28%	-41%	-7%
2023/2024	32%	-100%	-100%	-100%	-100%	-12%	-9%	-12%

The major contributors of emissions of main pollutants, heavy metals and POPs are Iron and steel production and Copper production. Shares of released emissions of air pollutants for the year 2024 in NFR categories 2C are presented in [Figure 4.6.1](#).

Figure 4.6.1: Shares of emissions in 2C in 2024



4.6.2 Iron and Steel Production (NFR 2C1)

4.6.2.1 Overview

Iron and steel processing from raw materials is the cornerstone for many other activities due to the widespread usage of these products as structural materials in various sectors (transport, industry, engineering, construction, etc.). However, it is an energy-intensive industry with a significant impact in terms of air pollution. Nowadays, production takes place in integrated metallurgical plants, which include a production unit for the preparation of iron ore (sintering production or pelletization), a fuel production plant – coke oven, a blast furnace to produce pig iron, and converters for steel production (the descaling of pig iron).

In the Slovak Republic, there is one major producer of sinter, pig iron and steel from primary raw materials, one producer of steel from secondary raw materials and several smaller processors of steel. An overview of the activity data and trends is shown in [Table 4.6.2](#).

Table 4.6.2: Trends in activity data in 2C1 – Iron and Steel Production

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	3,982.00	3,561.00	1,685.12	1,876.38	310.73
1995	3,251.00	3,207.00	1,516.93	1,690.47	314.64
2000	3,598.90	3,166.38	1,652.45	1,867.54	316.36
2005	3,494.50	3,681.42	1,850.11	2,388.01	356.90
2010	2,480.14	3,648.84	2,050.13	2,351.65	331.25
2011	2,920.13	3,346.41	1,794.40	2,166.62	374.22

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]
2012	3,141.77	3,519.76	2,009.26	2,226.93	372.40
2013	3,060.35	3,616.85	1,998.74	2,345.51	711.34
2014	3,790.90	3,862.62	2,114.37	2,325.11	527.85
2015	3,740.27	3,738.49	2,059.96	2,250.98	315.05
2016	3,712.50	3,986.68	2,225.58	2,373.86	293.80
2017	3,747.75	4,107.94	2,235.21	2,477.75	356.80
2018	3,659.90	4,036.85	2,345.02	2,296.82	380.30
2019	3,468.10	3,184.55	1,821.11	1,789.91	327.78
2020	2,516.40	2,753.36	1,821.03	1,298.34	279.95
2021	3,208.70	4,013.94	2,221.20	2,339.40	370.29
2022	1,891.40	3,153.00	1,917.98	1,640.70	365.53
2023	2,552.30	3,594.82	2,045.36	2,030.27	244.94
2024	2,330.50	3,142.44	1,927.18	1,628.33	273.16
1990/2024	-41%	-12%	14%	-13%	-12%
2023/2024	-9%	-13%	-6%	-20%	12%

Tables below **Table 4.6.3** present the emission trend of the pollutants for which **2C1** is a key category. Emissions show an overall decreasing trend due to the continual installation of abatement technologies throughout the production since 1990.

Most of the air pollutant emissions in recent years show a fluctuation in trends related to the activity data. In 2020, one of the blast furnaces was under reconstruction. After the reconstruction in 2021, it started to operate in full operation again, which caused an increase in the related year 2021 compared to the previous year 2020. In 2022, a decrease is visible in the trends of released air pollutants. In 2024, the emissions of PMs and NMVOC rose despite a slight decrease in production volume. NO_x emissions maintain the same level, while emissions of SO_x recorded a decrease. The solely stable and more significant improvement is in emissions of PCDD/F. Since 2021, the ongoing decrease appears due to the new abatement technology to reduce these emissions from sinter production with an efficiency of 98.9%.

Table 4.6.3: Overview of emissions of air pollutants in 2C1 – Iron and Steel Production

YEAR	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	3.2673	0.2250	7.7837	1.1E-03	1.1899	1.8822	8.0395	0.0043	64.0501
1995	2.9719	0.2047	7.0798	9.9E-04	1.0823	1.7120	7.3124	0.0039	58.2577
2000	4.0544	0.1578	11.0293	7.1E-04	1.3392	2.1182	9.0476	0.0048	72.0819
2005	2.6012	0.5416	7.4668	2.1E-05	0.3871	0.6021	2.3878	0.0014	78.0150
2010	2.2977	0.4037	3.8171	1.2E-05	0.1815	0.3135	1.7197	0.0007	71.3394
2011	2.2507	0.4809	4.6387	1.8E-05	0.1950	0.3448	2.0300	0.0007	84.3314
2012	2.5147	0.5077	4.4449	1.6E-05	0.2128	0.3790	2.2720	0.0008	83.4974
2013	2.7281	0.4807	3.5912	2.0E-05	0.2320	0.4129	2.4985	0.0008	85.3261
2014	3.2091	0.5369	3.6345	1.9E-05	0.2742	0.4820	2.8250	0.0010	98.9535
2015	3.0538	0.5460	4.8942	1.5E-05	0.2620	0.4560	2.6219	0.0009	97.6335
2016	2.7957	0.4971	4.4276	3.9E-06	0.2148	0.3825	2.2128	0.0008	96.7478
2017	3.2859	0.5143	6.2832	2.5E-06	0.2156	0.3857	2.2470	0.0008	100.8391
2018	3.5863	0.5405	4.4805	3.0E-06	0.1830	0.3283	1.9362	0.0007	89.0361
2019	2.3250	0.3580	2.9195	2.7E-06	0.0788	0.1337	0.6737	0.0003	52.2224

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
2020	2.5272	0.3661	2.4107	2.5E-05	0.0311	0.0436	0.0920	0.0001	51.6441
2021	3.8258	0.5117	3.1983	3.4E-05	0.0494	0.0708	0.1803	0.0002	86.3580
2022	2.9289	0.3645	1.6522	3.9E-05	0.0350	0.0500	0.1321	0.0001	58.6566
2023	3.8703	0.4813	2.9521	5.0E-05	0.0410	0.0601	0.1810	0.0001	77.7556
2024	3.8707	0.6318	2.1132	8.9E-05	0.0532	0.0762	0.1899	0.0002	70.8601
1990/2024	18%	181%	-73%	-92%	-96%	-96%	-98%	-96%	11%
2023/2024	0%	31%	-28%	78%	30%	27%	5%	30%	-9%

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	1.5686	0.9454	0.0903	9.1212
1995	16.5822	0.0806	0.1662	0.4677	0.7375	1.4026	0.8241	0.0746	8.2128
2000	18.3350	0.0884	0.1839	0.5168	0.8142	1.4922	0.9087	0.0825	9.0314
2005	4.4864	0.0794	0.0383	0.4343	0.3975	0.2520	0.1718	0.0826	7.1292
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
2023	3.7839	0.0663	0.0285	0.3690	0.3357	0.2169	0.1418	0.0633	6.0546
2024	3.0649	0.0548	0.0257	0.2965	0.2715	0.1936	0.1197	0.0573	4.9330
1990/2024	-84%	-39%	-87%	-44%	-67%	-88%	-87%	-37%	-46%
2023/2024	-19%	-17%	-10%	-20%	-19%	-11%	-16%	-9%	-19%

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

YEAR	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]	PCB [kg]
2022	3.7236	8.9812	0.0567	17.8632
2023	3.7771	10.2779	0.0766	20.0182
2024	3.4826	9.0419	0.0699	17.6375
1990/2024	-90%	-15%	-41%	-7%
2023/2024	-8%	-12%	-9%	-12%

4.6.2.2 Methodological Issues

Activities defined in national legislation involved in the category are presented in [Table 4.6.4](#).

Table 4.6.4: Activities according to national categorisation included in 2C1 – Iron and Steel Production

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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 2024).

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. and small others

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 EFs 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 4.6.5](#)). Shares of PM_{2.5} and PM₁₀ in TSP are calculated using average shares from the period 2005-2009. Emissions of BC were calculated using the EMEP/EEA GB 2023 emission factor throughout the entire time series.

Table 4.6.5: Emission factors for calculation of historical years in 2C1 – Iron and Steel Production

	NO _x [g/t]	NM VOC [g/t]	SO _x [g/t]	NH ₃ [g/t]	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/t]	BC* [% of PM _{2.5}]	CO [g/t]
EF	843.79	58.12	2,010.13	0.28	15	23	2,076.19	0.36	16,540.89

* EMEP/EEA GB 2023 – Tier 1

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. (2) 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 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 2002. 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. Emission factors used for calculation are shown in **Table 4.6.6**.

Table 4.6.6: Emission factor for heavy metals and POPs used in calculations for 2C1 – Iron and Steel Production

A	T	P	AT	Pb [g/t]	Cd [g/t]	Hg [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		2021-2024	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	0.000009	0.000000015	0.000084	0.00000045	0.000006	0.15
Pig iron production	-	2003-2024	Dry ESP default EFs	0.000006	0.000000010	0.000056	0.0000003	0.000003	0.015
Steel production	Basic oxygen furnace	1990-2005	Dry ESP Upper EFs	0.025	0.0003	0.0009	0.002	0.002	0.02
Steel production	Basic oxygen furnace	2006-2024	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	2002-2024	wSV Default EFs	1.8	0.03	0.0018	0.18	0.16	0.02
Steel production	Electric furnace	1990-2024	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		2021-2024	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	-	2003-2024	Dry ESP default EFs	NE	NE	0.073	0.002	2.5	NE	2.5

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]
Steel production	Basic oxygen furnace	1990-2005	Dry ESP Upper EFs	0.0005	NE	0.023	0.69	0.1	NE	2.5
Steel production	Basic oxygen furnace	2006-2024	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	2002-2024	wSV Default EFs	0.06	NE	2.7	0.69	0.1	NE	2.5
Steel production	Electric furnace	1990-2024	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 the EMEP/EEA GB 2023.

4.6.2.4 Source-specific Recalculations

In the current submission, notation keys for fuels (B, OF) have been harmonised with EMEP/EEA GB 2023 from NO to NA in the entire timeline.

Further in [Table 4.6.6](#), emission factors were checked and corrected as TERT recommended during the review process ([Recommendation No. SK-2C1-2020-0001](#)).

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 ([Table 4.6.7](#)), emissions of all rising pollutants indicate a decreasing trend due to the installation of abatement technologies. However, a strong drop and almost complete interruption of production in 2023 was caused by a decline due to the unfavourable security situation and the situation driven by the energy crisis during the pandemic period. Recovery of economic activities can be noticed in a visible increase in activity data to the previous level of the year 2022. Although emissions have a stable or declining trend. Datasets are presented below.

Table 4.6.7: Overview of activity data and emissions in the category 2C2 – Ferroalloys Production

YEAR	FERROALLOYS PRODUCED [kt]	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]
1990	169.00	0.4317	0.0376	0.2914	2.2E-05
1995	134.80	0.3443	0.0300	0.2325	1.7E-05
2000	94.73	0.5886	0.0241	0.1150	9.8E-06
2005	108.72	0.0065	0.0121	0.0119	NO
2010	96.83	0.0190	0.0152	0.0260	1.3E-05
2011	75.05	0.0311	0.0089	0.0363	1.1E-05
2012	102.87	0.0257	0.0091	0.0311	1.8E-05
2013	65.68	0.0298	0.0100	0.0319	1.1E-05

YEAR	FERROALLOYS PRODUCED [kt]	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]
2014	47.20	0.0215	0.0159	0.0259	8.1E-06
2015	95.62	0.0232	0.0176	0.0304	6.1E-06
2016	106.27	0.0120	0.0165	0.0226	4.8E-06
2017	129.48	0.0081	0.0195	0.0124	5.4E-06
2018	113.69	0.0107	0.0245	0.0173	5.4E-06
2019	105.52	0.0081	0.0143	0.0195	3.4E-06
2020	88.60	0.0047	0.0124	0.0134	3.7E-06
2021	115.73	0.0046	0.0096	0.0079	9.2E-06
2022	35.43	0.0039	0.0101	0.0033	9.0E-06
2023	4.65	0.0039	0.0096	0.0032	7.5E-06
2024	46.45	0.0041	0.0067	0.0032	4.4E-06
1990/2024	-73%	-99%	-82%	-99%	-80%
2023/2024	898%	3%	-30%	0%	-42%

YEAR	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.1543	0.1956	0.2175	0.0154	2.8995
1995	0.1231	0.1560	0.1735	0.0123	2.3127
2000	0.2957	0.3749	0.4167	0.0296	2.7839
2005	0.0294	0.0373	0.0414	0.0029	0.5220
2010	0.0245	0.0311	0.0346	0.0025	0.0506
2011	0.0173	0.0220	0.0244	0.0017	0.0784
2012	0.0143	0.0181	0.0202	0.0014	0.0782
2013	0.0173	0.0219	0.0244	0.0017	0.1076
2014	0.0180	0.0228	0.0253	0.0018	0.1026
2015	0.0159	0.0201	0.0224	0.0016	0.0943
2016	0.0096	0.0121	0.0135	0.0010	0.1051
2017	0.0113	0.0144	0.0160	0.0011	0.1025
2018	0.0142	0.0180	0.0200	0.0014	0.1273
2019	0.0115	0.0146	0.0162	0.0012	0.0907
2020	0.0086	0.0109	0.0121	0.0009	0.0752
2021	0.0084	0.0106	0.0118	0.0008	0.0823
2022	0.0088	0.0112	0.0125	0.0009	0.1144
2023	0.0116	0.0147	0.0163	0.0012	0.1101
2024	0.0107	0.0136	0.0151	0.0011	0.0908
1990/2024	-93%	-93%	-93%	-93%	-97%
2023/2024	-7%	-7%	-7%	-7%	-18%

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 4.6.8*).

Table 4.6.8: Activities according to national categorisation included in 2C2

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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 EFs 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 PM₁₀ in TSP are calculated using average shares from the period 2005-2009 ([Table 4.6.9](#)). Emissions of BC were calculated using the EMEP/EEA GB 2023 emission factor throughout the entire time series.

Table 4.6.9: Emission factors for calculation of historical years

	NO _x [g/t]	NM VOC [g/t]	SO _x [g/t]	NH ₃ [g/t]	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/t]	BC* [% of PM _{2.5}]	CO [g/t]
EF	2,554.18	222.64	1,724.52	0.13	71	90	1,286.72	10	17,156.55

*EMEP/EEA GB 2023 - Tier 1

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

In the current submission, notation keys for fuels (LF, B, OF) have been harmonised with EMEP/EEA GB 2023 from NO to NA in the entire timeline.

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 ($t = 950^{\circ}\text{C}$). The main additives to cryolite (Na_3AlF_6) are aluminium fluoride (AlF_3) and CaF_2 . In the Slovak Republic, the plants for aluminium production use a modern technology where the majority of HF and other fluorides escape 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 Söderberg process.

There was only one source producing aluminium in the Slovak Republic. At the beginning of January 2023, the production of primary aluminium was completely stopped after 70 years of its production by shutting down the last of 226 furnaces. In the current state, only the technology of the anode production utilises the capacity.

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 Söderberg process (SP) to pre-baked anodes (PBA) ([Table 4.6.10](#)).

Table 4.6.10: Overview of activity data and emissions in the category 2C3 – Aluminium Production

YEAR	Al – SP [kt]	Al – PBA [kt]	NO _x [kt]	NM VOC [kt]	SO _x [kt]
1990	67.40	67.40	0.2258	0.0016	0.7164
1995	32.60	32.60	0.1092	0.0008	0.3465
2000	NO	109.81	0.2916	0.0029	1.1785
2005	NO	159.20	0.6886	0.1461	1.3099
2010	NO	163.00	0.5196	0.0355	1.3825
2011	NO	162.84	0.5497	0.0312	2.2302
2012	NO	160.66	0.5141	0.0283	1.3916
2013	NO	163.30	0.5130	0.0260	1.3879
2014	NO	167.67	0.4927	0.0538	2.0785

YEAR	Al – SP [kt]	Al – PBA [kt]	NOx [kt]	NM VOC [kt]	SOx [kt]
2015	NO	171.33	0.4430	0.0873	1.6566
2016	NO	173.64	0.4425	0.1152	2.8449
2017	NO	173.49	0.5510	0.0487	2.4411
2018	NO	173.72	0.5378	0.0361	2.0605
2019	NO	174.79	0.4974	0.0453	2.0394
2020	NO	151.70	0.4991	0.0473	1.8154
2021	NO	164.00	0.4941	0.0367	2.1134
2022	NO	71.93	0.3999	0.0223	0.9129
2023	NO	0.21	0.0387	0.0241	0.0407
2024	NO	NO	0.0377	0.0070	0.0894
1990/2024	-	-	-83%	347%	-88%
2023/2024	-	-	-3%	-71%	119%

YEAR	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]	PAHs [t]
1990	0.0484	0.0545	0.0591	0.0011	5.7010	1.8939
1995	0.0234	0.0263	0.0286	0.0005	2.7575	0.9161
2000	0.0944	0.1063	0.1152	0.0022	7.8868	0.0132
2005	0.1194	0.1343	0.1457	0.0027	12.9913	0.0191
2010	0.1206	0.1353	0.1471	0.0028	13.4722	0.0196
2011	0.0629	0.0706	0.0767	0.0014	13.5448	0.0195
2012	0.0701	0.0787	0.0855	0.0016	13.3409	0.0193
2013	0.0681	0.0764	0.0831	0.0016	13.3071	0.0196
2014	0.0975	0.1094	0.1189	0.0022	14.0622	0.0201
2015	0.0811	0.0910	0.0990	0.0019	14.2394	0.0206
2016	0.0835	0.0937	0.1018	0.0019	18.0049	0.0208
2017	0.1050	0.1178	0.1281	0.0024	16.5521	0.0208
2018	0.1082	0.1213	0.1319	0.0025	16.4582	0.0208
2019	0.1175	0.1318	0.1433	0.0027	15.5812	0.0210
2020	0.1168	0.1310	0.1424	0.0027	13.1902	0.0182
2021	0.1220	0.1368	0.1487	0.0028	14.1074	0.0197
2022	0.0816	0.0915	0.0995	0.0019	6.9537	0.0086
2023	0.0030	0.0034	0.0036	0.0001	0.2373	0.0000
2024	0.0026	0.0029	0.0032	0.0001	0.0819	NO
1990/2024	-95%	-95%	-95%	-95%	-99%	-
2023/2024	-13%	-13%	-13%	-13%	-65%	-

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 EFs 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 PM₁₀ in TSP are calculated using average shares from the period 2005-2009 ([Table 4.6.11](#)). Emissions of BC were calculated using the EMEP/EEA GB 2023 emission factor throughout the time series.

Table 4.6.11: Emission factors for calculation of historical years for 2C3 – Aluminium Production

	NO _x [g/t]	NMVOC [g/t]	SO _x [g/t]	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/t]	BC* [% of PM _{2.5}]	CO [g/t]
EF	3,350.77	23.11	10,629.29	82	92	876.41	2.3	84,584.75

*EMEP/EEA GB 2023 - Tier 1

POPs

POPs were calculated using Tier 2 emission factors from EMEP/EEA GB 2023 for primary aluminium production (**Table 4.6.12**). The production of aluminium was cancelled during the year 2023. Although production of pre-backed anodes continues, which is a source for polycyclic aromatic hydrocarbons. However, the emission factor relates to Al production, thus the notation key NO is used for the last reported year, 2024.

Table 4.6.12: 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]
Söderberg anodes	1990-1995	9	9	9	1.1	28.1
Pre-baked anodes	1996-2023	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

There was no recalculation in the current submission.

4.6.5 Magnesium Production (NFR 2C4)

4.6.5.1 Overview

From submission 2024, the notation key NO is used for all the emissions in this category. Emissions from magnesite clinker production were reallocated into category **2C7c** to comply with the emission inventory of GHG.

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 2011-2024. Therefore, this activity was included in category **2C5**. The trends of emissions from production and activity data are presented in **Table 4.6.13**.

Table 4.6.13: Activity data and emissions in the category 2C5 – Lead Production

YEAR	LEAD PRODUCED [kt]	NO _x [kt]	NMVOC [kt]	SO _x [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
2011	0.05	2.1E-02	2.4E-04	1.6E-02	5.5E-05	2.2E-04	5.5E-04	1.2E-03
2012	0.20	1.7E-02	2.0E-04	1.4E-02	4.5E-05	1.8E-04	4.5E-04	1.1E-03
2013	0.26	6.2E-03	3.5E-04	4.5E-02	9.6E-05	3.8E-04	9.6E-04	1.4E-03

YEAR	LEAD PRODUCED [kt]	NO _x [kt]	NM VOC [kt]	SO _x [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	CO [kt]
2014	0.29	7.6E-03	5.4E-04	5.8E-02	1.2E-04	4.9E-04	1.2E-03	1.7E-03
2015	0.32	5.4E-03	4.5E-04	2.7E-02	6.7E-05	2.7E-04	6.7E-04	1.2E-03
2016	0.29	8.2E-03	7.4E-04	3.0E-02	8.5E-05	3.4E-04	8.5E-04	1.6E-03
2017	0.30	8.5E-03	7.7E-04	3.1E-02	9.0E-05	3.6E-04	9.0E-04	1.7E-03
2018	0.05	2.7E-03	1.4E-04	3.0E-02	5.5E-05	2.2E-04	5.5E-04	8.5E-04
2019	0.07	7.6E-03	4.5E-04	6.2E-02	1.2E-04	4.7E-04	1.2E-03	2.0E-03
2020	0.13	7.6E-03	4.6E-04	6.2E-02	1.2E-04	4.7E-04	1.2E-03	2.1E-03
2021	0.16	4.3E-06	2.9E-07	2.7E-08	5.9E-07	2.4E-06	5.9E-06	1.7E-06
2022	0.40	4.0E-06	2.7E-07	2.5E-08	5.8E-07	2.3E-06	5.8E-06	1.6E-06
2023	0.42	4.5E-06	3.1E-07	2.8E-08	6.7E-07	2.7E-06	6.7E-06	1.8E-06
2024	0.26	3.8E-06	2.6E-07	2.4E-08	5.4E-07	2.2E-06	5.4E-06	1.5E-06
2011/2024	751%	-100%	-100%	-100%	-99%	-99%	-99%	-100%
2023/2024	-39%	-16%	-15%	-14%	-18%	-19%	-19%	-16%

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	5.5E-05	2.5E-06	5.0E-06	1.5E-05	2.5E-06	1.6E-04	1.3E-07
2012	2.2E-04	1.0E-05	2.0E-05	6.1E-05	1.0E-05	6.5E-04	5.3E-07
2013	2.9E-04	1.3E-05	2.6E-05	7.8E-05	1.3E-05	8.4E-04	6.8E-07
2014	3.2E-04	1.5E-05	2.9E-05	8.8E-05	1.5E-05	9.4E-04	7.6E-07
2015	3.6E-04	1.6E-05	3.2E-05	9.7E-05	1.6E-05	1.0E-03	8.4E-07
2016	3.2E-04	1.5E-05	2.9E-05	8.8E-05	1.5E-05	9.3E-04	7.6E-07
2017	3.3E-04	1.5E-05	3.0E-05	9.1E-05	1.5E-05	9.7E-04	7.9E-07
2018	5.2E-05	2.4E-06	4.8E-06	1.4E-05	2.4E-06	1.5E-04	1.2E-07
2019	7.3E-05	3.3E-06	6.6E-06	2.0E-05	3.3E-06	2.1E-04	1.7E-07
2020	1.4E-04	6.3E-06	1.3E-05	3.8E-05	6.3E-06	4.0E-04	3.3E-07
2021	1.7E-04	7.8E-06	1.6E-05	4.7E-05	7.8E-06	5.0E-04	4.0E-07
2022	4.4E-04	2.0E-05	4.0E-05	1.2E-04	2.0E-05	1.3E-03	1.0E-06
2023	4.7E-04	2.1E-05	4.2E-05	1.3E-04	2.1E-05	1.4E-03	1.1E-06
2024	2.9E-04	1.3E-05	2.6E-05	7.8E-05	1.3E-05	8.3E-04	6.8E-07
1990/2024	-	-	-	-	-	-	-
2023/2024	-39%	-39%	-39%	-39%	-39%	-39%	-39%

4.6.6.2 Methodological Issues

Activities defined in national legislation involved in the category are presented in [Table 4.6.14](#).

Table 4.6.14: Activities according to national categorisation included in 2C5 – Lead Production

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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 4.6.15](#)).

Table 4.6.15: 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

* EMEP/EEA GB 2023 - Tier 1

4.6.6.3 Completeness

All rising pollutants were reported.

4.6.6.4 Source-specific Recalculations

Notation keys for fuels (LF, SF, B, OF) have been harmonised with EMEP/EEA GB 2023 from NO to NA in the timeline. No other recalculation was made in this submission.

4.6.7 Zinc Production (NFR 2C6)

4.6.7.1 Overview

The category is reported with the notation key NO except for 2012-2014, when activity data were recorded. The overview of emissions is shown in [Table 4.6.16](#).

Table 4.6.16: Activity data and emissions in the category 2C6 – Zink Production

YEAR	ZINC PRODUCTION [kt]	SOx [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]
1990	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO
2005	NO	NO	NO	NO	NO
2010	NO	NO	NO	NO	NO
2011	NO	NO	NO	NO	NO
2012	0.04	5.9E-05	NE	5.3E-07	5.7E-07
2013	0.03	4.2E-05	NE	3.8E-07	4.1E-07
2014	0.02	3.2E-05	NE	2.9E-07	3.1E-07
2015	NO	NO	NO	NO	NO
2016	NO	NO	NO	NO	NO
2017	NO	NO	NO	NO	NO
2018	NO	NO	NO	NO	NO
2019	NO	NO	NO	NO	NO
2020	NO	NO	NO	NO	NO
2021	NO	NO	NO	NO	NO
2022	NO	NO	NO	NO	NO
2023	NO	NO	NO	NO	NO
2024	NO	NO	NO	NO	NO
1990/2024	-	-	-	-	-
2023/2024	-	-	-	-	-

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Zn [t]	PCDD/F [g I-TEQ]	PCBs [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

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Zn [t]	PCDD/F [g I-TEQ]	PCBs [kg]
2011	NO	NO	NO	NO	NO	NO	NO
2012	8.8E-06	1.8E-06	1.8E-06	1.3E-06	2.2E-04	2.2E-04	8.8E-08
2013	6.3E-06	1.3E-06	1.3E-06	9.4E-07	1.6E-04	1.6E-04	6.3E-08
2014	4.8E-06	9.6E-07	9.6E-07	7.2E-07	1.2E-04	1.2E-04	4.8E-08
2015	NO	NO	NO	NO	NO	NO	NO
2016	NO	NO	NO	NO	NO	NO	NO
2017	NO	NO	NO	NO	NO	NO	NO
2018	NO	NO	NO	NO	NO	NO	NO
2019	NO	NO	NO	NO	NO	NO	NO
2020	NO	NO	NO	NO	NO	NO	NO
2021	NO	NO	NO	NO	NO	NO	NO
2022	NO	NO	NO	NO	NO	NO	NO
2023	NO	NO	NO	NO	NO	NO	NO
2024	NO	NO	NO	NO	NO	NO	NO
1990/2024	-	-	-	-	-	-	-
2023/2024	-	-	-	-	-	-	-

4.6.7.2 Methodological Issues

Tie 1 methodology from the EMEP/EEA GB 2023 was used to calculate emissions from this source. Emission factors are displayed in [Table 4.6.17](#).

Table 4.6.17 Emission factors in the category 2C6 – Zinc Production

	SO _x [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	1,350	12	13	15	0.2	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 2023. For the period 1990-2013 and 2015-2024, the notation key NO was used.

4.6.7.3 Source-specific Recalculations

There was no recalculation in the current submission.

4.6.8 Copper Production (NFR 2C7a)

4.6.8.1 Overview

Pollutants released during copper production are particulate matter (PM), sulphur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (non-methane VOC and methane (CH₄)), carbon monoxide (CO), carbon dioxide (CO₂), nitrous oxide (N₂O), 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.

Activity data, emissions and trends are shown in [Table 4.6.18](#). The emission trend of these pollutants is decreasing due to the activity within the category, which shows. However, the emissions in 2024 have a decreasing trend except for NMVOC.

Table 4.6.18: Activity data and emissions in the category 2C7a – Copper Production

YEAR	PRIMARY COPPER [kt]	SECONDARY COPPER [kt]	NO _x [kt]	NM VOC [kt]	SO _x [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	4.8E-06	1.4800
1995	8.38	25.13	0.0141	0.0031	0.0087	0.0042	0.0053	0.0128	4.2E-06	1.3023
2000	NO	0.22	0.0000	0.0000	0.0004	0.0000	0.0001	0.0001	4.3E-08	0.0001
2005	NO	33.44	0.0047	0.0036	0.0112	0.0075	0.0095	0.0106	7.5E-06	1.7321
2010	NO	68.51	0.0416	0.0843	0.0944	0.0116	0.0146	0.0682	1.2E-05	3.0990
2011	NO	93.58	0.0383	0.0733	0.0842	0.0093	0.0118	0.0360	9.3E-06	2.6989
2012	NO	72.49	0.0386	0.0467	0.0701	0.0071	0.0089	0.0280	7.1E-06	1.7787
2013	NO	34.23	0.0393	0.0066	0.0236	0.0027	0.0034	0.0051	2.7E-06	0.2434
2014	NO	48.09	0.0169	0.0048	0.0252	0.0019	0.0025	0.0027	1.9E-06	0.1995
2015	NO	65.61	0.0246	0.0165	0.0827	0.0086	0.0109	0.0121	8.6E-06	1.4275
2016	NO	78.29	0.0373	0.0171	0.0938	0.0078	0.0099	0.0110	7.8E-06	1.5884
2017	NO	74.50	0.0212	0.0137	0.0767	0.0067	0.0085	0.0094	6.7E-06	1.2507
2018	NO	77.31	0.0508	0.0088	0.0209	0.0010	0.0013	0.0015	1.0E-06	0.9727
2019	NO	91.22	0.0449	0.0094	0.0231	0.0012	0.0015	0.0017	1.2E-06	1.0432
2020	NO	86.83	0.0942	0.0143	0.0307	0.0029	0.0037	0.0041	2.9E-06	1.4668
2021	NO	88.48	0.0621	0.0176	0.0478	0.0020	0.0026	0.0029	2.0E-06	0.8360
2022	NO	46.24	0.0436	0.0083	0.0464	0.0011	0.0014	0.0015	1.1E-06	0.7837
2023	NO	38.99	0.0219	0.0150	0.0109	0.0016	0.0020	0.0023	1.6E-06	0.2942
2024	NO	84.81	0.0216	0.0255	0.0104	0.0010	0.0013	0.0014	1.0E-06	0.4079
1990/2024	-	345%	34%	614%	6%	-79%	-79%	-90%	-79%	-72%
2023/2024	-	118%	-1%	69%	-4%	-36%	-36%	-36%	-36%	39%

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	3.6E-01	0.9523	0.0001
1995	0.7372	0.1835	0.0008	0.1089	0.5780	1.1812	1.6E-01	1.2567	0.0001
2000	0.0053	0.0005	0.0000	0.0004	0.0035	0.0062	2.9E-05	0.0110	0.0000
2005	0.8026	0.0769	0.0008	0.0669	0.5351	0.9363	4.3E-03	1.6721	0.0001
2010	0.0005	0.1093	0.0016	0.0172	1.0961	1.9182	2.7E-06	3.4254	0.0003
2011	0.0007	0.1493	0.0022	0.0234	1.4973	2.6202	3.6E-06	4.6789	0.0003
2012	0.0005	0.1156	0.0017	0.0182	1.1598	2.0296	2.8E-06	3.6243	0.0003
2013	0.0001	0.0025	0.0008	0.0033	0.5477	0.9585	4.5E-07	1.5404	0.0001
2014	0.0001	0.0036	0.0011	0.0047	0.7695	1.3466	6.3E-07	2.1642	0.0002
2015	0.0002	0.0049	0.0015	0.0064	1.0497	1.8371	8.5E-07	2.9524	0.0002
2016	0.0002	0.0058	0.0018	0.0076	1.2526	2.1921	1.0E-06	3.5230	0.0003
2017	0.0002	0.0055	0.0017	0.0072	1.1921	2.0861	9.7E-07	3.3527	0.0003
2018	0.0002	0.0007	0.0018	NO	1.2369	0.0871	1.0E-06	3.4789	0.0003
2019	0.0002	0.0008	0.0021	NO	1.4595	0.1028	1.2E-06	4.1047	0.0003
2020	0.0002	0.0008	0.0020	NO	1.3893	0.0978	1.1E-06	3.9073	0.0003
2021	0.0002	0.0008	0.0020	NO	1.4157	0.0997	1.2E-06	3.9816	0.0003
2022	0.0001	0.0004	0.0011	NO	0.7399	0.0521	6.0E-07	2.0809	0.0002
2023	0.0001	0.0004	0.0009	NO	0.6238	0.0439	5.1E-07	1.7546	0.0001
2024	0.0002	0.0008	0.0020	NO	1.3569	0.0955	1.1E-06	3.8164	0.0003
1990/2024	-100%	-100%	90%	-	93%	-94%	-100%	301%	258%
2023/2024	118%	118%	118%	-	118%	118%	118%	118%	118%

4.6.8.2 Methodological Issues

Emissions from copper production were allocated into an independent category **2C7a** in submission 2022. Originally, in the national system, NEIS were included in category **2C7c** – Other Metal Production (the definition of activity according to the categorisation of Annex 1 to Decree No. 248/2023 Coll. (1) 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).

Emissions data for the period 2000-2024 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 PM₁₀ in TSP are calculated using average shares from the period 2005-2009 (**Table 4.6.19**).

Table 4.6.19: Emission factors for calculation of historical years in 2C7a – Copper Production

	NO _x [g/t]	NM VOC [g/t]	SO _x [g/t]	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/t]	CO [g/t]
EF	422.07	93.54	258.25	33	42	381.14	38,862.82

Heavy metals and POPs

For calculation of heavy metals and POPs, Tier 2/Tier 1 EF from EMEP/EEA GB 2023 were used (**Table 4.6.20**). 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 4.6.21**).

Table 4.6.20: Emission factor for heavy metals and POPs in the category 2C7a – Copper Production

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	1990-2024	-	-	0.023	-	16	-	-	-	0.9
T2 Primary production	1990-1999	16	15	0.031	7	21	57	19	0.01	-
T2 Secondary production	1990-2024	24	2.3	-	2	-	28	0.13	50	-

Table 4.6.21: Efficiency of the abatement technology for the category 2C7a – Copper Production

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	2018-2024	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

In the current submission, notation keys for fuels (LF, B, OF) have been harmonised with EMEP/EEA GB 2023 from NO to NA in the entire timeline.

Certain discrepancies were found during the validation process of database NEIS for the source of copper production. Therefore, the recalculation was done, and emissions of main pollutants were refined in the current submission ([Table 4.6.22](#)).

Table 4.6.22: Differences in emissions (%) in category 2C7a – Copper Production between previous and current and submission

YEAR	NO _x	NM VOC	SO _x	PM _{2.5}	PM ₁₀	TSP	BC	CO
2023	-84.39	-25.08	-5.60	-70.25	-70.25	-70.25	-70.25	-11.86

4.6.9 Nickel Production (NFR 2C7b)

4.6.9.1 Overview

The category is reported with the notation key NO. This production does not occur in the Slovak Republic.

4.6.10 Other Metal Production (NFR 2C7c)

4.6.10.1 Overview

The trends of emissions from other metal production are presented in [Table 4.6.23](#). 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 4.6.23: Overview of emissions in the category 2C7c – Other Metal Production

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [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
2023	0.5016	0.2350	0.0914	0.0033	0.0352	0.0455	0.0602	0.5897

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	CO [kt]
2024	0.6493	0.2814	0.1356	0.0029	0.0386	0.0493	0.0655	0.9625
1990/2024	-54%	250%	-81%	-55%	-75%	-77%	-83%	-80%
2023/2024	29%	20%	48%	-13%	10%	8%	9%	63%

4.6.10.2 Methodological Issues

Activities defined in national legislation involved in the category are presented in [Table 4.6.24](#).

Table 4.6.24: Activities according to national categorisation included in 2C7c – Other Metal Production

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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 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 2000-2024 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 PM₁₀ in TSP are calculated using average shares from the period 2005-2009 ([Table 4.6.25](#)).

Table 4.6.25: Emission factors for calculation of historical years in 2C7c – Other Metal Production

	NO _x [g/GJ]	NM VOC [g/GJ]	SO _x [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 the EMEP/EEA GB 2023.

4.6.10.4 Source-specific Recalculations

In the current submission, notation keys for fuels (B, OF) have been harmonised from NO to NA in the entire timeline with EMEP/EEA GB 2023.

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. Rising emissions of particulate matters are, for this reason, reported with the notation key IE. The other air pollutants are reported with a notation key, that have been harmonised from NO to NA in the entire timeline with EMEP/EEA GB 2023.

4.7 SOLVENTS (NFR 2D)

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 also relevant for emissions of PMs, TSP, BC and PCDD/F. In the category **2D3i**, emissions of lubricant consumption in transport were added. The categories included in the emission balance are listed in **Table 4.7.1**.

Table 4.7.1: 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
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 4.7.2**. Shares of released emissions of NMVOC in 2024, included in NFR categories **2D**, are presented in **Figure 4.7.1**.

Figure 4.7.1: The share in NMVOC emissions of individual categories in 2D and 2G in 2024

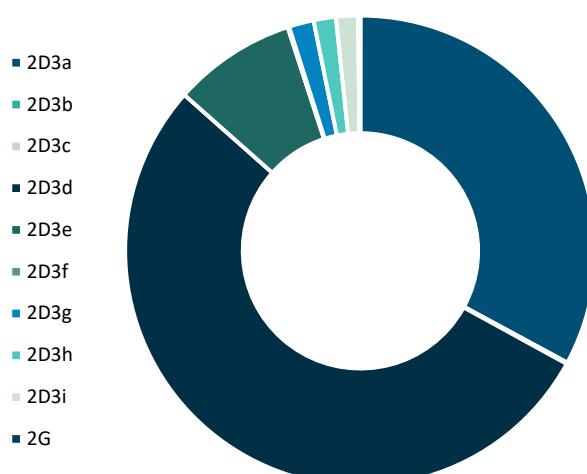


Table 4.7.2: Overview of emissions in the category 2D

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	0.0316	0.0015	0.0028	0.0104	0.0000	0.0004	0.0004	0.0305
2014	22.5021	0.0290	0.0011	0.0023	0.0095	0.0000	0.0003	0.0004	0.0306
2015	25.6429	0.0351	0.0005	0.0020	0.0129	0.0000	0.0004	0.0005	0.0306
2016	23.9248	0.0380	0.0007	0.0015	0.0066	0.0000	0.0004	0.0005	0.0307
2017	21.7249	0.0368	0.0005	0.0012	0.0059	0.0000	0.0004	0.0005	0.0307
2018	24.1538	0.0402	0.0005	0.0011	0.0052	0.0000	0.0004	0.0005	0.0308
2019	20.5470	0.0245	0.0004	0.0010	0.0051	0.0000	0.0004	0.0007	0.0308
2020	20.8513	0.0243	0.0005	0.0011	0.0051	0.0000	0.0004	0.0007	0.0308
2021	19.8864	0.0239	0.0005	0.0016	0.0090	0.0000	0.0004	0.0007	0.0307
2022	17.8903	0.0254	0.0005	0.0015	0.0087	0.0000	0.0004	0.0007	0.0307
2023	18.5773	0.0344	0.0007	0.0017	0.0082	0.0000	0.0004	0.0007	0.0307
2024	20.968	0.0351	0.0009	0.0023	0.0116	0.0000	0.0004	0.0008	0.0306
1990/2024	-46%	138%	-99%	-98%	-96%	-99%	164%	260%	3%
2023/2024	13%	2%	25%	33%	40%	29%	2%	2%	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	0.0005	0.0004	0.0002	0.0023	0.0002	7.8674	0.0060	0.1045

YEAR	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	PCDD/F [g I-TEQ]	PAHs [t]
2014	0.0005	0.0006	0.0002	0.0032	0.0002	5.4387	0.0055	0.1515
2015	0.0006	0.0005	0.0002	0.0021	0.0002	8.8055	0.0103	0.0967
2016	0.0006	0.0006	0.0002	0.0036	0.0002	9.5151	0.0074	0.1692
2017	0.0006	0.0005	0.0002	0.0028	0.0002	9.2343	0.0077	0.1289
2018	0.0006	0.0008	0.0003	0.0037	0.0002	9.9356	0.0090	0.1748
2019	0.0009	0.0008	0.0003	0.0035	0.0003	7.6282	0.0093	0.1624
2020	0.0008	0.0008	0.0003	0.0036	0.0002	7.5528	0.0093	0.1656
2021	0.0008	0.0008	0.0003	0.0043	0.0003	7.4240	0.0108	0.2014
2022	0.0009	0.0008	0.0003	0.0033	0.0003	7.8967	0.0114	0.1514
2023	0.0009	0.0007	0.0003	0.0030	0.0003	5.1499	0.0107	0.1360
2024	0.0009	0.0008	0.0003	0.0034	0.0003	5.2566	0.0074	0.1566
1990/2024	218%	-16%	252%	-48%	82%	42%	-71%	-53%
2023/2024	2%	8%	2%	14%	3%	2%	-30%	15%

4.7.2 Domestic Solvent Use Including Fungicides (NFR 2D3a)

4.7.2.1 Overview

Emissions of NMVOCs have increased in this category due to the trend in activity data. Emissions, their trend and activity data are shown in [Table 4.7.3](#). As expected, the use of soaps and disinfectants has increased during the COVID-19 crisis. A comparison of 2019 and 2020 shows an increase of almost 50%. However, this increase was not reflected in the total emissions, as this area of use represents only a negligible part of emissions in category **2D3a** (ca 3.5%).

Table 4.7.3: Activity data and emissions in the category 2D3a - Domestic Solvent Use Including Fungicides

YEAR	INHABITANTS	NMVOC [kt]	Hg [t]
1990	5,297,774	4.6887	0.0297
1995	5,363,676	4.7589	0.0300
2000	5,400,679	4.4477	0.0302
2005	5,387,285	4.6860	0.0302
2010	5,431,024	3.6796	0.0304
2011	5,394,251	4.7223	0.0302
2012	5,407,579	5.8156	0.0303
2013	5,413,393	4.0732	0.0303
2014	5,418,649	3.8580	0.0303
2015	5,423,800	4.4401	0.0304
2016	5,430,798	5.3332	0.0304
2017	5,437,754	6.4964	0.0305
2018	5,446,771	6.3239	0.0305
2019	5,457,873	6.1607	0.0306
2020	5,459,781	6.4473	0.0306
2021	5,434,712	5.6022	0.0304
2022	5,428,792	5.3771	0.0304
2023	5,424,687	5.2198	0.0304
2024	5,419,451	6.9059	0.0303
1990/2024	2%	47%	2%
2023/2024	0%	32%	0%

4.7.2.2 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 2023 ([Table 4.7.4](#)). Emissions from the insecticides, fungicides and herbicides were calculated using the Tier 2b method; emission factors were taken from EMEP/EEA GB 2023 ([Table 4.7.5](#)). In 2024, an increase is reported in NMVOC emissions (+32 %), mainly due to the increased use of perfumes and toilet waters (+185 %).

Table 4.7.4: *Used solvent contents and emission factors (per t of solvent) for Tier 2a method according to the EMEP/EEA GB 2023*

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 4.7.5: *Used solvent contents and emission factors (per t of product) for Tier 2b method according to the EMEP/EEA GB 2023*

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 2024. 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 4.7.6](#).

Table 4.7.6: Activity data (*consumption = production + import – export*) in the category 2D3a

YEAR	PERFUMES AND TOILET WATERS [kt]	HAIR LACQUERS [kt]	PRE-SHAVE, SHAVING OR AFTERSHAVE PREPARATIONS [kt]	PERSONAL DEODORANTS AND ANTIPERSPIRANTS [kt]
1999	0.89	0.41	1.16	2.16
2000	0.89	0.41	1.16	2.17
2001	0.89	0.41	1.16	2.16
2002	0.89	0.41	1.16	2.16
2003	0.89	0.41	1.16	2.16
2004	0.89	0.41	1.16	2.16
2005	0.89	0.41	1.16	2.17
2006	0.89	0.41	1.16	2.17
2007	0.89	0.41	1.17	2.17
2008	0.89	0.41	1.17	2.18
2009	0.90	0.41	1.17	2.18
2010	0.87	0.26	0.86	1.86
2011	1.58	0.16	1.07	1.60
2012	0.66	0.51	2.74	1.80
2013	0.65	0.10	0.67	1.82
2014	0.53	0.12	0.74	1.85
2015	0.95	0.25	0.84	1.77
2016	0.88	0.22	1.00	2.44
2017	1.28	0.78	1.42	3.27
2018	1.16	0.95	1.31	2.94
2019	1.11	0.81	1.14	2.59
2020	1.27	0.72	1.28	2.39
2021	2.05	0.56	0.83	1.36
2022	1.52	0.58	0.46	1.25
2023	1.19	0.70	0.50	1.26
2024	3.40	0.84	0.77	1.95

YEAR	POLISHES, CREAMS AND SIMILAR PREPARATIONS, FOR FOOTWEAR OR LEATHER [kt]	POLISHES, CREAMS AND SIMILAR PREPARATIONS, FOR THE MAINTENANCE OF WOODEN FURNITURE, FLOORS OR OTHER WOODWORK [kt]	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 [kt]
1999	0.13	0.20	1.66
2000	0.06	0.20	2.35
2001	0.15	0.19	2.59
2002	0.16	0.14	3.37
2003	0.13	0.14	3.58
2004	0.10	0.27	2.88
2005	0.09	0.41	3.27
2006	0.09	0.46	2.68
2007	0.15	0.43	2.68
2008	0.18	0.50	1.67
2009	0.14	0.34	1.67

YEAR	POLISHES, CREAMS AND SIMILAR PREPARATIONS, FOR FOOTWEAR OR LEATHER [kt]	POLISHES, CREAMS AND SIMILAR PREPARATIONS, FOR THE MAINTENANCE OF WOODEN FURNITURE, FLOORS OR OTHER WOODWORK [kt]	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 [kt]
2010	0.20	0.15	1.25
2011	0.24	0.61	1.34
2012	0.26	0.55	5.07
2013	0.29	0.65	3.90
2014	0.29	0.72	3.29
2015	0.24	0.66	3.28
2016	0.17	1.15	3.51
2017	0.26	0.72	3.16
2018	0.17	0.72	3.31
2019	0.14	0.77	3.32
2020	0.12	0.76	4.77
2021	0.15	0.71	4.21
2022	0.87	0.82	4.05
2023	0.16	0.61	4.68
2024	0.20	0.56	5.05

YEAR	WINDSCREEN WIPERS, DEFROSTERS AND DEMISTERS FOR MOTORCYCLES OR MOTOR VEHICLES [kt]	INSECTICIDES [kt]	FUNGICIDES [kt]	HERBICIDES, ANTI- SPROUTING PRODUCTS AND PLANT-GROWTH REGULATORS [kt]
1999	0.03	1.55	1.93	4.57
2000	0.03	1.55	1.93	4.57
2001	0.05	1.55	1.93	4.56
2002	0.06	1.55	1.93	4.56
2003	0.07	1.55	1.93	4.56
2004	0.09	1.55	1.93	4.57
2005	0.12	1.55	1.93	4.57
2006	0.37	1.56	1.93	4.58
2007	0.13	1.56	1.94	4.59
2008	0.68	1.56	1.94	4.60
2009	0.35	1.57	1.95	4.61
2010	0.50	1.19	1.38	3.32
2011	0.14	1.19	1.90	4.56
2012	0.14	1.26	2.19	4.11
2013	0.28	1.29	1.60	5.45
2014	0.17	1.49	1.32	4.17
2015	0.08	2.08	2.04	4.23
2016	0.47	1.96	2.31	4.57
2017	0.43	1.59	2.48	4.68
2018	0.59	1.71	1.99	5.10
2019	0.71	1.97	2.34	6.11
2020	0.53	1.72	2.37	7.74
2021	0.72	1.84	2.14	4.72
2022	0.98	1.83	1.76	5.42
2023	0.88	1.06	6.47	4.23
2024	0.71	1.40	2.56	3.79

4.7.2.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB 2023.

4.7.2.4 Source-specific Recalculations

No recalculations were made in this submission.

4.7.3 Road Paving with Asphalt (NFR 2D3b)

4.7.3.1 Overview

The number of operators varies 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 fee decisions (Act No 190/2023 Coll. on air pollution charges (3)). Discontinuous monitoring can be performed solely by the authorised and accredited person in line with national requirements. The category reports NMVOC, PM_{2.5}, PM₁₀, TSP, BC and PCDD/PCDF emissions. The emissions show a decreasing overall trend ([Table 4.7.7](#)).

Table 4.7.7: Activity data and emissions in the category 2D3b – Road Paving with Asphalt

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	1.6E-02	0.0218	0.1874	9.3E-04	0.0257
1995	170.99	0.0328	7.6E-03	0.0102	0.0873	4.3E-04	0.0120
2000	60.96	0.0117	2.2E-03	0.0030	0.0258	1.3E-04	0.0043
2005	112.99	0.0191	1.2E-04	0.0014	0.0117	6.7E-06	0.0079
2010	105.65	0.0144	7.1E-05	0.0008	0.0069	4.0E-06	0.0074
2011	125.30	0.0182	9.0E-05	0.0011	0.0088	5.1E-06	0.0088
2012	102.25	0.0149	7.0E-05	0.0008	0.0070	4.0E-06	0.0072
2013	85.95	0.0152	8.6E-05	0.0010	0.0086	4.9E-06	0.0060
2014	79.20	0.0137	8.2E-05	0.0010	0.0082	4.7E-06	0.0055
2015	147.30	0.0201	1.2E-04	0.0015	0.0124	7.1E-06	0.0103
2016	105.80	0.0189	5.8E-05	0.0007	0.0058	3.3E-06	0.0074
2017	109.99	0.0187	5.4E-05	0.0006	0.0054	3.1E-06	0.0077
2018	128.39	0.0199	4.7E-05	0.0006	0.0047	2.7E-06	0.0090
2019	132.50	0.0165	4.6E-05	0.0005	0.0046	2.6E-06	0.0093
2020	132.95	0.0151	4.6E-05	0.0005	0.0046	2.6E-06	0.0093
2021	154.80	0.0208	8.4E-05	0.0010	0.0084	4.8E-06	0.0108
2022	163.13	0.0210	8.1E-05	0.0010	0.0081	4.6E-06	0.0114
2023	152.47	0.0180	7.4E-05	0.0009	0.0074	4.2E-06	0.0107
2024	106.09	0.0177	1.1E-04	0.0013	0.0106	6.0E-06	0.0074
1990/2024	-71%	-75%	-99%	-94%	-94%	-99%	-71%
2023/2024	-30%	-2%	42%	42%	42%	42%	-30%

4.7.3.2 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 4.7.8: Industrial activities included in 2D3b according to national categorisation

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):

3.5 Manufacturing of bituminous mixtures with the projected production capacity of the mixture in tons/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 NO_x, SO_x and CO are assumed to have the combustion origin. It is also assumed that VOC, TSP and PMs do not create a significant part of the released emissions from NG. The allocation of NO_x, SO_x 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 authorised measurement according to ISO standard procedures.

Equation 4.7.1: 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 calculation:

Equation 4.7.2: Calculation No 2

$$E [t] = (1 - \eta/100) \times EF [kg/M \text{ of } AD] \times AD [M \text{ of } AD] \times 10^{-3}$$

Where:

EF = Emission Factor

AD = Activity Data (M of AD = Quantity of related Activity Data).

In the case of activity data are fuel, because of mixed sources (combined combustion and technological process), the emissions are performed by the calculation:

Equation 4.7.3: 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, 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 the calculation of PM₁₀ and PM_{2.5} is applicable only for data from 2005 and newer due to the database structure. Emissions are calculated from the values of TSP as their fraction according to the Interim Study 2008 (4) prepared for SHMÚ with the base of the GAINS methodology published by IIASA (5).

Activity data: Some information can be found in the NEIS. The production is independently obtained from the Research Institute of Engineering Constructions, which is authorised by the Slovak Association

for Asphalt Roads (SAAV) for collecting and verification of data. The activity data are 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 the UNEP Toolkit for Asphalt mixing:

$EF (PCDD/F) = 0.00007 \text{ [mg/Mg Asphalt]}$

Historical data: The emissions are taken from the NEIS for the years 2005 to 2024.

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 the share from TSP in the previous years, 2005-2009.

$EF (NMVOC) = 0.19 \text{ [g/Mg Asphalt]}$

$EF (TSP) = 0.51 \text{ [g/Mg Asphalt]}$

$EF (PM_{2.5}) = 8.71\% \text{ of } EF (TSP)$

$EF (PM_{10}) = 11.65\% \text{ of } EF (TSP)$

4.7.3.3. Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB 2023.

4.7.3.4 Source-specific Recalculations

No recalculations were made in this submission.

4.7.4 Asphalt Roofing (NFR 2D3c)

4.7.4.1 Overview

The category reports NMVOC, PM_{2.5}, PM₁₀, TSP and BC emissions. Emissions have an overall decreasing trend ([Table 4.7.9](#)). Two operators producing asphalt shingles were identified. One operator operated in the period 1990-2014, and the second in 2013-2024.

Table 4.7.9: Activity data and emissions in the category 2D3c – Asphalt Roofing

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	1.1E-03
1995	65.92	0.0237	0.0419	0.0525	0.0530	5.4E-04
2000	46.47	0.0163	0.0454	0.0570	0.0575	5.9E-04
2005	32.28	0.0058	0.0038	0.0047	0.0048	4.9E-05
2010	25.26	0.0024	0.0014	0.0017	0.0017	1.8E-05
2011	28.10	0.0024	0.0015	0.0019	0.0019	2.0E-05
2012	27.59	0.0023	0.0014	0.0018	0.0018	1.9E-05
2013	40.99	0.0029	0.0014	0.0018	0.0018	1.8E-05
2014	59.42	0.0026	0.0011	0.0013	0.0013	1.4E-05
2015	37.91	0.0010	0.0004	0.0005	0.0005	5.2E-06
2016	66.37	0.0020	0.0006	0.0008	0.0008	8.4E-06
2017	50.56	0.0013	0.0004	0.0006	0.0006	5.7E-06
2018	68.53	0.0021	0.0004	0.0005	0.0005	5.6E-06
2019	63.68	0.0019	0.0004	0.0005	0.0005	5.1E-06
2020	64.96	0.0022	0.0004	0.0006	0.0006	5.8E-06
2021	78.96	0.0022	0.0004	0.0005	0.0006	5.7E-06

YEAR	ASPHALT USED FOR ROOFING [kt]	NM VOC [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]
2022	59.39	0.0021	0.0004	0.0005	0.0005	5.3E-06
2023	53.34	0.0024	0.0006	0.0008	0.0008	8.4E-06
2024	61.40	0.0023	0.0008	0.0010	0.0010	1.0E-05
1990/2024	-53%	-95%	-99%	-99%	-99%	-99%
2023/2024	15%	-3%	23%	23%	23%	23%

4.7.4.2 Methodological Issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.7.10: Industrial activities included in 2D3c according to national categorisation

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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). The source uses fuel directly in the technological process. Therefore, the 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) are obtained from statistics and is harmonised with the GHG emission inventory.

Historical data: The emissions are taken from the NEIS for the years 2005 to 2024.

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 2023.

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 (PM₁₀) = 99% of EF (TSP)

EF (BC) = 0.013% of EF (PM_{2.5})

4.7.4.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB 2023.

4.7.4.4 Source-specific Recalculation

No recalculations were made in this submission.

4.7.5 Coating Applications (NFR 2D3d)

4.7.5.1 Overview

The category reports NMVOC emissions. Emissions have an overall decreasing trend ([Table 4.7.11](#)). Looking at the trend in more detail, most activities in this category show a constant or slightly increasing trend. On the other hand, activity data from small sources have a decreasing trend since 2015. This is also in line with the decreasing trend in the use of water-based paints and varnishes, which are mostly used in small sources. The general decrease is due to the application of 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. Since the COVID-19 crisis, the emissions have fluctuated around an approximately constant value.

Table 4.7.11: Activity data and emissions in the category 2D3d – Coating Applications

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
2023	86.79	10.8199
2024	87.07	11.2457
1990/2024	-	-31%
2023/2024	0%	4%

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 4.7.12: Industrial activities included in 2D3d according to national categorisation

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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
c) car repair – vehicle spraying in car paint shops)

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):

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 m^3/day
- b) mechanical processing of disintegrated wooden mass such as sawdust, shavings, and chips with a projected processing capacity in 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. (6) as amended defined limit ≥ 0.6 t/yr. for the obligation of solvents evidence and registering in 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 considered 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 the balance sheets of organic solvents for individual releases. The quantity of VOC is calculated by the equations:

Equation 4.7.4.: 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 4.7.5: 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 4.7.6: 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 calculated differently 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 → 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 2024. 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 4.7.13: 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
2023	49,054	37,738
2024	48,525	38,540

Table 4.7.14: 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

YEAR	EM SS	EM NEIS
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
2019	5,184	4,150
2020	7,549	3,235
2021	7,466	3,241
2022	6,315	3,256
2023	7,414	3,406
2024	7,168	4,078

4.7.5.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB 2023.

4.7.5.4 Source-specific Recalculations

No recalculations were made in this submission.

4.7.6 Degreasing (NFR 2D3e)

4.7.6.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend ([Table 4.7.15](#)). The peak of recorded emissions in 2011 relates to the activity data from statistics, namely the decrease in exported acetone and the increased amount of imported acetone. When comparing data on acetone import, export and production around 2011, it can be stated that the peak is due to a shift from the predominant production and export of acetone to its predominant import (the import increased from 645 tons in 2010 to 6,325 tons in 2011). Since then, the import has been almost stable in the range of 2-3 kt (the export decreased from 14,037 tons in 2010 to 4,913 tons in 2011). Since then, the export of acetone has been negligible, below 300 tons. The production of acetone decreased from 15,980 tons in 2010 to 5,884 tons in 2011. Since then, the production has been negligible, below 200 tons.

Table 4.7.15: 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

YEAR	SOLVENTS USED [kt]	NM VOC [kt]
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
2023	1.50	1.4118
2024	1.85	1.7762
1990/2024	-83%	-83%
2023/2024	24%	26%

4.7.6.2 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 4.7.16: Industrial activities included in 2D3e according to national categorisation

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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. (6) as amended defined the limit ≥ 0.6 t/yr. for the obligation of solvent evidence and registering in 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 considered in final emissions.

$$E_{TOTAL} = E_{SMALL SOURCES} + E_{NEIS}$$

Calculations in the NEIS: the methods of Calculations in the NEIS can be found 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), 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 → Calculation of Total Solvents Consumption

Total Solvents Consumption – Industrial Solvents Consumption = Small Sources

Table 4.7.17: 2D3e – Emission of NM VOC (t) in the division of small sources and industrial sources

YEAR	EM SS	EM NEIS
2005	6,680	202

YEAR	EM SS	EM NEIS
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
2023	1,344	68
2024	1,705	71

4.7.6.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB 2023.

4.7.6.4 Source-specific Recalculations

No recalculations were made in this submission.

4.7.7 Dry Cleaning (NFR 2D3f)

4.7.7.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend ([Table 4.7.18](#)).

Table 4.7.18: Activity data and emissions in the category 2D3f – Dry Cleaning

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

YEAR	SOLVENTS USED [kt]	NM VOC [kt]
2021	0.02	0.0199
2022	0.03	0.0232
2023	0.03	0.0222
2024	0.02	0.0214
1990/2024	-73%	-67%
2023/2024	-6%	-4%

4.7.7.2 Methodological Issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.7.19: Industrial activities included in 2D3f according to national categorisation

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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 tons/year
b) a projected amount of bleached or dyed textiles or fibres in tons/day

The number of operators has declined from 127 to approximately 100 in the past 10 years, which is the driver of the decline. No small sources are on the territory of SR, because the 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 the balance sheets of organic solvents for individual releases. The quantity of VOC is calculated by the equations:

Equation 4.7.7: 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 4.7.8: 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 4.7.9: 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 calculated differently for direct and indirect emissions.

Historical data: The emissions are taken from the NEIS for the years 2005 to 2024. 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.

4.7.7.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB 2023.

4.7.7.4 Source-specific Recalculations

No recalculations were made in this submission.

4.7.8 Chemical Products (NFR 2D3g)

4.7.8.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend ([Table 4.7.20](#)). The most remarkable decline was in 2006. The decline is caused by the modernization of the operation facilities of pharmaceutical producers (4.20 categorisation according to Annex No. 6 of Decree No 410/2012 Coll. (6)). The application of the EU directive (Directive 2004/42/CE (7) 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) also contributed to the decrease in emissions, as it caused changes in the manufacture of footwear (6.11 categorisation according to the Annex No. 6 of Decree No 410/2012 Coll.). The economic crisis in 2019 caused the closure of several companies, making the impact of the modernised manufacturers on emissions dominant.

Table 4.7.20: Activity data and emissions in the category 2D3g – Chemical Products

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	1.3E-05	6.5E-05	0.0008	0.0065	6.5E-05	0.3319
1995	8.21	65.92	3.4669	6.6E-06	3.3E-05	0.0004	0.0033	3.3E-05	0.1681
2000	9.14	46.47	2.7194	4.6E-06	2.3E-05	0.0003	0.0023	2.3E-05	0.1185
2005	10.21	32.28	2.7519	3.2E-06	1.6E-05	0.0002	0.0016	1.6E-05	0.0823
2010	10.51	25.26	0.6295	2.5E-06	1.3E-05	0.0002	0.0013	1.3E-05	0.0644
2011	9.02	28.10	0.7138	2.8E-06	1.4E-05	0.0002	0.0014	1.4E-05	0.0717
2012	9.41	27.59	0.7165	2.8E-06	1.4E-05	0.0002	0.0014	1.4E-05	0.0703
2013	8.77	40.99	0.6870	4.1E-06	2.0E-05	0.0002	0.0020	2.0E-05	0.1045
2014	9.03	59.42	0.7091	5.9E-06	3.0E-05	0.0004	0.0030	3.0E-05	0.1515
2015	9.33	37.91	0.5895	3.8E-06	1.9E-05	0.0002	0.0019	1.9E-05	0.0967
2016	9.97	66.37	0.5772	6.6E-06	3.3E-05	0.0004	0.0033	3.3E-05	0.1692
2017	10.08	50.56	0.5635	5.1E-06	2.5E-05	0.0003	0.0025	2.5E-05	0.1289
2018	9.76	68.53	0.5674	6.9E-06	3.4E-05	0.0004	0.0034	3.4E-05	0.1748
2019	9.38	63.68	0.5044	6.4E-06	3.2E-05	0.0004	0.0032	3.2E-05	0.1624
2020	8.39	64.96	0.4253	6.5E-06	3.2E-05	0.0004	0.0032	3.2E-05	0.1656
2021	7.85	78.96	0.5070	7.9E-06	3.9E-05	0.0005	0.0039	3.9E-05	0.2014
2022	8.26	59.39	0.5329	5.9E-06	3.0E-05	0.0004	0.0030	3.0E-05	0.1514
2023	6.99	53.34	0.4639	5.3E-06	2.7E-05	0.0003	0.0027	2.7E-05	0.1360
2024	7.59	61.40	0.3585	6.1E-06	3.1E-05	0.0004	0.0031	3.1E-05	0.1566
1990/2024	4%	-53%	-91%	-53%	-53%	-53%	-53%	-53%	-53%
2023/2024	9%	15%	-23%	15%	15%	15%	15%	15%	15%

4.7.8.2 Methodological Issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.7.21: Industrial activities included in 2D3g according to national categorisation

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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
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 tonnes/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 the non-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 2023. The emission factors used for the calculation are listed in [Table 4.7.22](#).

Table 4.7.22: 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 the balance sheets of organic solvents for individual releases. The quantity of VOC is calculated by the equations:

Equation 4.7.10: 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 4.7.11: 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 4.7.12: 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 calculated differently for direct and indirect emissions

The activities of 6.10 were included here according to EMEP/EEA GB 2023 **2D3g** Table 3-13 manufacturing of shoes, and similarly 6.11 according to the EMEP/EEA GB 2023 Table 3-14 Leather tanning instead of 2D3i, where the activities were before.

The other emissions are recorded from sources in the NEIS categorisation, but emissions are assumed not to relate to technology (NO_x, SO_x, NH₃, PM_{2.5}, PM₁₀, TSP, CO) were allocated to the **1A2gviii** to be in line with EMEP/EEA GB 2023.

Historical data: The emissions are taken from the NEIS for the years 2005 to 2024. 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 2023.

4.7.8.4 Source-specific Recalculations

No recalculations were made in this submission.

4.7.9 Printing (NFR 2D3h)

4.7.9.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (**Table 4.7.23**). The most significant decrease was recorded between 2006 and 2008, which can be attributed to the gradual application of Directive 2004/42/CE (7) 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.

Table 4.7.23: Activity data and emissions in the category 2D3h – Printing

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

YEAR	SOLVENTS USED [kt]	NM VOC [kt]
2020	3.99	0.6416
2021	4.67	0.6694
2022	4.74	0.6840
2023	4.26	0.3701
2024	4.02	0.3215
1990/2024	-10%	-85%
2023/2024	-6%	-13%

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.

Table 4.7.24: Industrial activities included in 2D3h according to national categorisation

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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 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 the 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 → 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 2024. 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.

4.7.9.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB 2023.

4.7.9.4 Source-specific Recalculations

No recalculations were made in this submission.

4.7.10 Other Solvent Use (NFR 2D3i)

4.7.10.1 Overview

The category reports NMVOC emissions. Emissions of NMVOC from the NEIS database are shown in [Table 4.7.25](#). Emissions in this category, calculated from lubricant consumption in transport, are presented in [Table 4.7.26](#).

Table 4.7.25: Overview of emissions of NMVOC in the category 2D3i – Other Solvent Use

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
2023	0.85	0.2491
2024	0.69	0.3185
1990/2024	23%	-25%
2023/2024	-18%	28%

Table 4.7.26: 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
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	0.0316	0.0004	0.0004	0.0002	0.0005	0.0002	0.0002	0.0002	0.0001	7.8674
2014	0.0290	0.0003	0.0004	0.0002	0.0005	0.0002	0.0002	0.0002	0.0002	5.4387
2015	0.0351	0.0004	0.0005	0.0002	0.0005	0.0002	0.0002	0.0002	0.0002	8.8055
2016	0.0380	0.0004	0.0005	0.0003	0.0006	0.0002	0.0002	0.0003	0.0002	9.5151
2017	0.0368	0.0004	0.0005	0.0003	0.0006	0.0002	0.0002	0.0003	0.0002	9.2343
2018	0.0402	0.0004	0.0005	0.0003	0.0006	0.0004	0.0003	0.0003	0.0002	9.9356
2019	0.0245	0.0004	0.0007	0.0003	0.0008	0.0004	0.0003	0.0003	0.0002	7.6282
2020	0.0243	0.0004	0.0007	0.0003	0.0008	0.0004	0.0003	0.0003	0.0002	7.5528
2021	0.0239	0.0004	0.0007	0.0003	0.0008	0.0004	0.0003	0.0003	0.0002	7.4240

YEAR	SOx [kt]	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2022	0.0254	0.0004	0.0007	0.0003	0.0009	0.0004	0.0003	0.0003	0.0002	7.8967
2023	0.0344	0.0004	0.0007	0.0003	0.0008	0.0004	0.0003	0.0003	0.0002	5.1499
2024	0.0351	0.0004	0.0007	0.0003	0.0009	0.0004	0.0003	0.0003	0.0002	5.2566
1990/2024	138%	164%	281%	193%	300%	193%	252%	252%	193%	42%
2023/2024	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%

4.7.10.2 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 4.7.27](#).

Table 4.7.27: Industrial activities included in 2D3i according to national categorisation

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
4.35 Industrial extraction of vegetable oil and animal fat and vegetable oil refining with a projected consumption of organic solvents in tons/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 tons/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 2024. 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.

4.7.10.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB 2023.

4.7.10.4 Source-specific Recalculation

Recalculation was made due to the lubricant use recalculation in the COPERT model since 2013. It was caused by the software update of the COPERT model, where corrections of several emission factors and the addition of new vehicle categories were made.

Table 4.7.28: Differences in emissions (%) in category 2D3i between the previous and current submission caused by recalculations

YEAR	SOx	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2013	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%
2014	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%
2015	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
2016	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
2017	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%
2018	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
2019	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%
2020	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%
2021	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
2022	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

4.8 OTHER PRODUCT USE (NFR 2G)

4.8.1. 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 (8).

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.

Table 4.8.1 below shows a significant increase in emissions in this category from 1990 due to an increase in tobacco and fireworks use. In **Table 4.8.1**, the emission trend of NMVOC is also shown.

Table 4.8.1: 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
2023	0.0129	0.0340	0.0031	0.0292	0.1899	0.1900	0.1900	0.0854	0.3948
2024	0.0117	0.0312	0.0013	0.0268	0.1743	0.1743	0.1743	0.0784	0.3588
1990/2024	867%	865%	1193%	865%	865%	865%	865%	865%	867%
2023/2024	-9%	-8%	-57%	-8%	-8%	-8%	-8%	-8%	-9%

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

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Zn [t]
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
2023	0.8061	0.0395	0.0001	0.0014	0.0160	0.4945	0.0498	0.2863
2024	0.3466	0.0355	0.0000	0.0006	0.0069	0.2311	0.0307	0.1324
1990/2024	1193%	870%	1193%	1193%	1193%	1130%	984%	1137%
2023/2024	-57%	-10%	-57%	-57%	-57%	-53%	-38%	-54%

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
2023	0.0007	0.0008	0.0003	0.0003	0.0003	0.0017
2024	0.0006	0.0007	0.0003	0.0003	0.0003	0.0016
1990/2024	865%	865%	865%	865%	865%	865%
2023/2024	-8%	-8%	-8%	-8%	-8%	-8%

4.8.2 Methodological Issues

The 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 for the whole time series. Following *Recommendation No. SK-2G-2022-0001*, the activity data were checked, and the data for tobacco combustion for the years 2005 and 2007 were reconsidered and replaced by the value calculated as a trend. For calculations of fireworks, *Equation 4.8.1* for the period 1991-2024 was used:

Equation 4.8.1: Amount of product used in the Slovak Republic in a particular year

$$\text{Product total} = \text{Product import total} - \text{Product export total}$$

There was a single producer of tobacco products, which operated until 2008; therefore, production data are confidential. The operator produced cigarettes until the year 2004 and cigars and cigarillos until the year 2008, hence **Equation 4.8.1** was used for cigarettes for the period 2005-2024 and cigars and cigarillos for the period 2009-2024. For the previous periods, it was assumed that the production was equal to export and only import data entered into the calculations. **Table 4.8.2** shows the results of these calculations.

Table 4.8.2: 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
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
2023	7.03	1.03
2024	6.45	0.44

Emission factors for the calculations originate from the Tier 2 methodology in EMEP/EEA GB 2023 (**Table 4.8.3, 4.8.4**). The condensable component of PMs is included in emission factors for tobacco combustion; for the use of fireworks, this information is unknown.

Table 4.8.3: Emission factors in the category Other Product Use – Use of fireworks

POLLUTANT	NO _x	SO _x	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	3,020	51.94	99.92	109.83	7150	784	1.48	0.057	1.33	15.6	444	30	260

Table 4.8.4: Emission factors in the category Other Product Use – Tobacco combustion

POLLUTANT	NO _x	NM _{VOC}	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

4.8.3 Completeness

All rising pollutants were reported.

4.8.4 Source-specific Recalculations

No recalculations were made in this submission.

4.9 OTHER PROCESSES (NFR 2H)

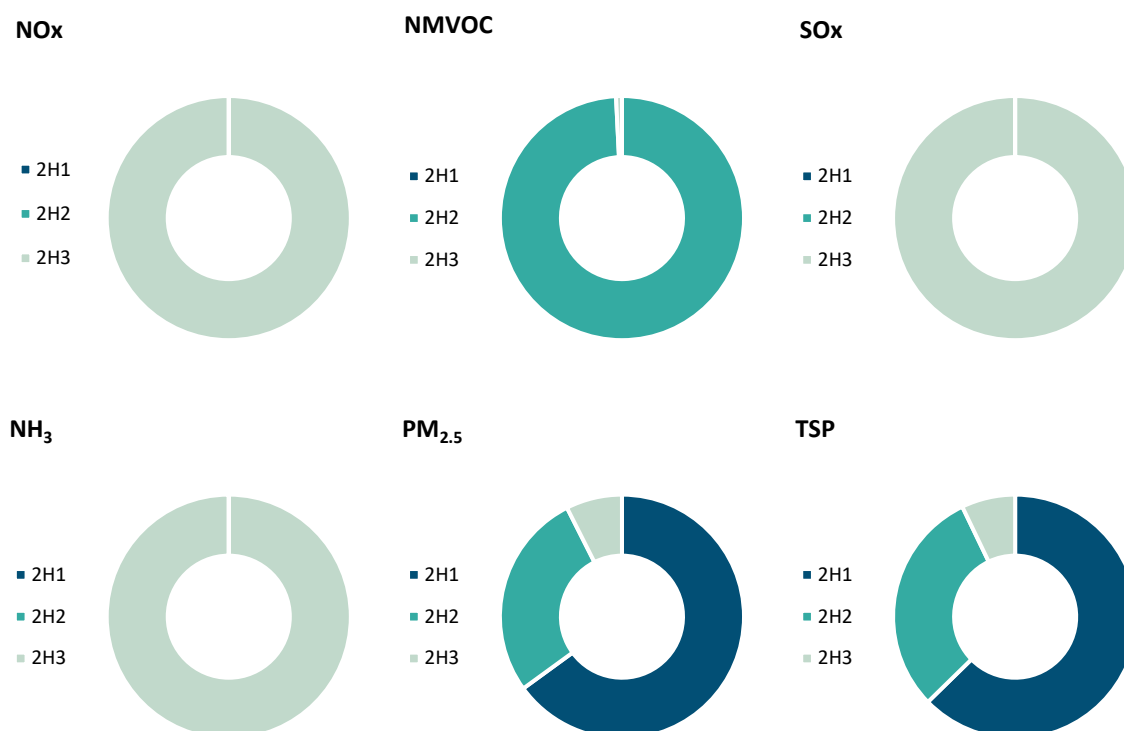
The chapter is divided into 3 industrial activities: Pulp and paper industry (2H1), Food and beverages industry (2H2) and other industrial processes (2H3). An overview of emissions and their trends is listed in [Table 4.9.1](#). Emissions, except NMVOC and SO_x, have a long-term decreasing trend, due to the installation of abatement technologies on the plants during the time series. Emissions of NMVOC have an increasing trend. From the interannual comparison, especially the emissions SO_x show a significant rise, due to the change in the production process of one operator in category 2H3.

Table 4.9.1: Overview of emissions in the category 2H – Other Processes

YEAR	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	2.45E-04	0.8000	3.5E-06	1.8E-03	0.0183	0.0682	0.1674	0.0005	4.1E-05
1995	2.81E-04	2.0257	4.0E-06	2.1E-03	0.0291	0.1089	0.2671	0.0007	4.7E-05
2000	8.14E-05	3.2407	2.0E-07	5.9E-03	0.0389	0.1454	0.3565	0.0010	3.3E-05
2005	7.23E-04	4.1588	1.8E-05	1.4E-06	0.0547	0.2133	0.5295	0.0013	1.1E-04
2010	1.15E-04	3.7559	2.9E-07	7.9E-07	0.0146	0.0545	0.1336	0.0003	7.5E-05
2011	1.56E-04	3.9198	2.3E-07	1.2E-06	0.0265	0.1020	0.2525	0.0006	1.2E-04
2012	3.08E-04	3.5611	2.6E-07	1.1E-06	0.0232	0.0897	0.2223	0.0005	1.0E-04
2013	1.16E-04	4.2448	3.4E-07	7.7E-07	0.0305	0.1189	0.2953	0.0007	5.7E-05
2014	8.92E-04	4.4789	1.2E-03	4.7E-07	0.0171	0.0655	0.1617	0.0004	3.1E-05
2015	1.42E-03	4.1181	2.0E-03	1.2E-07	0.0102	0.0377	0.0923	0.0002	1.1E-04
2016	2.07E-03	4.4331	3.0E-03	1.0E-05	0.0095	0.0342	0.0832	0.0002	1.4E-03
2017	2.10E-03	4.4627	3.0E-03	6.3E-08	0.0106	0.0384	0.0935	0.0002	NO
2018	2.13E-03	4.1313	3.1E-03	6.3E-08	0.0101	0.0363	0.0883	0.0002	NO
2019	2.10E-03	4.2741	3.0E-03	1.5E-08	0.0095	0.0337	0.0859	0.0002	NO
2020	1.38E-03	4.0504	2.0E-03	1.5E-08	0.0129	0.0477	0.1167	0.0003	NO
2021	7.27E-04	4.3422	1.1E-03	2.0E-05	0.0134	0.0496	0.1215	0.0003	NO
2022	6.40E-04	4.5571	9.3E-04	3.1E-05	0.0120	0.0440	0.1075	0.0002	NO
2023	1.40E-05	4.5409	1.3E-04	1.3E-04	0.0089	0.0319	0.0776	0.0001	NO
2024	2.48E-05	4.0633	2.5E-02	1.3E-04	0.0116	0.0430	0.1055	0.0002	NO
1990/2024	-90%	408%	714,147%	-93%	-37%	-37%	-37%	-57%	-
2023/2024	77%	-11%	18,683%	0%	30%	35%	36%	38%	-

Shares of NO_x, NMVOC, SO_x, NH₃ and PM_{2.5} emissions in NFR categories are shown in [Figure 4.9.1](#).

Figure 4.9.1: Shares of emissions in 2H in 2024



4.9.1 Pulp and Paper Industry (NFR 2H1)

4.9.1.1 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 depend on the feedstock's nature and the end product's desired qualities.

Several companies were operating during the year 2024 in the pulp and paper industry in the Slovak Republic. Among them, only one is categorised as a medium source, the rest are large sources. In [Table 4.9.2](#) can be seen that emissions of all pollutants decreased in general since the year 1990.

Table 4.9.2: Activity data and emissions in the category 2H1- Pulp and Paper Industry

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

YEAR	PULP PRODUCED [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]
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
2023	630.23	0.0054	0.0192	0.0462	0.0001
2024	622.18	0.0075	0.0272	0.0661	0.0002
1990/2024	247%	-57%	-58%	-59%	-57%
2023/2024	-1%	38%	42%	43%	38%

4.9.1.2 Methodological Issues

Activities assigned in this category are listed in [Table 4.9.3](#).

Table 4.9.3: Activities according to national categorisation included in 2H1 – Pulp and Paper Industry

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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 are compiled in the NEIS database, therefore, the individual-specific EFs 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](#).

Historical years from 1990 to 1999 were calculated using a weighted average of implied emission factors from the period 2000-2004. Shares of PM_{2.5} and PM₁₀ 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 4.9.4](#)).

Table 4.9.4: Emission factors for calculation of historical years and BC in 2H1- Pulp and Paper Industry

	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/t]	BC* [% of PM _{2.5}]
EF	11	41	895.06	2.60

*EMEP/EEA GB – Tier 1

4.9.1.3 Completeness

Heavy metals, PCDD/F and HCB are reported with the notation key NA, other POPs are reported using the notation key NE in compliance with the EMEP/EEA GB 2023. Combustion emissions (NO_x, NMVOC, SO_x, NH₃, CO) are allocated to the category [1A2d](#), therefore, the notation key IE is used.

4.9.1.4 Source-specific Recalculations

No recalculations were made in this submission.

4.9.2 Food and Beverages Industry (NFR 2H2)

4.9.2.1 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.

An 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 4.9.5**).

Table 4.9.5: Activity data and emissions in the category 2H2 – Food and Beverages Industry

YEAR	BREAD TYPICAL EUROPE [kt]	WHITE BREAD [kt]	CAKES, BISCUITS AND BREAKFAST CEREALS [kt]	MEAT, FISH AND POULTRY [kt]	SUGAR [kt]	MARGARINE AND SOLID COOKING FATS [kt]	ANIMAL FEED [kt]	COFFEE ROASTING [kt]
1990	20.78	0.69	23.26	27.70	27.31	3.23	89.05	0.70
1995	53.57	1.77	55.40	71.42	70.41	8.34	229.57	1.81
2000	86.40	2.85	89.35	115.18	113.55	13.45	370.24	2.92
2005	110.04	3.63	113.81	146.71	144.63	17.13	471.57	3.72
2010	99.62	2.60	104.58	147.54	148.34	8.86	136.37	1.90
2011	95.83	2.81	111.24	137.07	177.92	8.20	110.75	2.10
2012	93.42	2.74	108.67	120.52	138.43	7.17	170.19	2.20
2013	89.11	2.60	113.03	105.81	176.89	15.06	252.29	2.01
2014	91.30	2.60	109.42	105.81	199.58	13.89	214.47	2.03
2015	89.74	2.62	109.74	111.79	171.19	13.55	234.04	2.23
2016	87.18	2.88	125.61	125.36	197.12	13.92	213.44	2.35
2017	87.61	2.63	129.23	152.41	187.72	14.02	272.23	2.50
2018	83.71	2.56	112.52	171.34	150.28	13.59	257.50	2.22
2019	84.98	2.50	109.26	167.77	155.77	14.01	282.46	2.43
2020	86.05	1.77	106.51	150.43	148.80	13.88	281.11	2.29
2021	83.50	1.36	184.00	162.62	158.67	13.71	220.44	2.45
2022	85.57	9.05	124.83	167.19	172.01	12.04	260.17	2.53
2023	93.51	12.42	132.10	200.03	131.46	11.41	322.70	2.69
2024	99.61	11.41	135.22	204.26	150.52	12.20	312.20	2.60
1990/2024	379%	1,564%	481%	637%	451%	277%	251%	270%
2023/2024	7%	-8%	2%	2%	15%	7%	-3%	-4%

YEAR	WINE UNSPECIFIED COLOUR [10 ³ hl]	BEER INCLUDING DE- ALCOHOLIZED [10 ³ hl]	SPIRITS UNSPECIFIED SORT [10 ³ hl]	OTHER SPIRITS [10 ³ hl]	NMVOC [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]
1990	57.94	732.38	14.65	11.12	0.7775	0.0004	0.0014	0.0035
1995	149.37	1,888.14	37.77	28.67	1.9999	0.0009	0.0036	0.0091
2000	240.90	3,045.16	60.92	46.23	3.2254	0.0005	0.0018	0.0045
2005	275.86	3,878.63	77.59	58.88	4.1057	0.0021	0.0083	0.0209
2010	278.16	3,001.63	79.58	57.95	3.6624	0.0014	0.0057	0.0142
2011	314.22	2,973.17	78.00	61.24	3.8930	0.0015	0.0060	0.0149
2012	372.24	2,998.38	77.76	51.89	3.5270	0.0012	0.0049	0.0121
2013	416.45	2,961.11	88.83	46.12	4.2182	0.0016	0.0065	0.0162
2014	384.73	2,727.39	92.62	45.63	4.4477	0.0018	0.0073	0.0181
2015	358.94	2,491.48	87.08	52.08	4.0845	0.0020	0.0079	0.0198

YEAR	WINE UNSPECIFIED COLOUR [10 ³ hl]	BEER INCLUDING DE- ALCOHOLIZED [10 ³ hl]	SPIRITS UNSPECIFIED SORT [10 ³ hl]	OTHER SPIRITS [10 ³ hl]	NMVOC [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]
2016	364.97	2,283.41	91.54	51.67	4.3965	0.0017	0.0069	0.0173
2017	415.07	2,399.34	94.51	78.75	4.4384	0.0020	0.0079	0.0197
2018	370.19	2,092.58	101.59	79.68	4.1083	0.0020	0.0080	0.0200
2019	395.24	2,017.91	105.17	79.97	4.2466	0.0016	0.0064	0.0199
2020	424.26	2,501.31	94.58	66.76	4.0228	0.0018	0.0073	0.0182
2021	361.49	2,270.48	107.15	83.41	4.3093	0.0015	0.0059	0.0147
2022	354.95	2,361.28	111.99	83.80	4.5273	0.0025	0.0100	0.0249
2023	341.94	2,224.85	130.26	93.00	4.5179	0.0025	0.0101	0.0253
2024	369.02	2,265.84	84.02	64.13	4.0317	0.0032	0.0127	0.0319
1990/2024	537%	209%	474%	477%	419%	798%	798%	798%
2023/2024	8%	2%	-35%	-31%	-11%	26%	26%	26%

4.9.2.2 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 2005-2024. Historical data were extrapolated using GDP as surrogate data.

Emission data of PMs were compiled in the NEIS database, therefore, the individual-specific EFs 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](#).

Historical years from 1990 to 1999 were calculated using a weighted average of implied emission factors from the period 2000-2004. Shares of PM_{2.5} and PM₁₀ 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 the EMEP/EEA GB 2023 ([Table 4.9.6](#)).

Table 4.9.6: Emission factors for calculation of NMVOC in the category 2H2 – Food and Beverages Industry

	NMVOC [kg/t] or [kg/hl]	PM _{2.5} [% of TSP]	PM ₁₀ [% of TSP]	TSP [g/t]
Bread typical Europe	4.5	10.00	40.00	9.13
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			

4.9.2.3 Completeness

All rising pollutants were reported. Notation keys were used following EMEP/EEA GB 2023.

4.9.2.4 Source-specific Recalculations

No recalculations were made in this submission.

4.9.3 Other Industrial Processes (NFR 2H3)

4.9.3.1 Overview

This category includes various sources such as body shops, grain silos, galvanic lines, etc. [Table 4.9.7](#) 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 visible increase in emissions of NH₃ in 2021 was caused by a new source – the fermentation hall for biodegradable waste, which started operation in 2021. The interannual increase is visible in all pollutants, except PM_{2.5}. Especially, emissions of SO_x show substantially significant rise, due to the change in production process of one operator in category 2H3. The operator was awarded permission for one particular source run activity under new technical limits, conditions and production volume.

Table 4.9.7: Overview of emissions in the category 2H3 – Other Industrial Processes

YEAR	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	CO [kt]
1990	2.4E-04	0.0225	3.5E-06	1.8E-03	0.0004	0.0014	0.0034	4.1E-05
1995	2.8E-04	0.0258	4.0E-06	2.1E-03	0.0005	0.0016	0.0039	4.7E-05
2000	8.1E-05	0.0153	2.0E-07	5.9E-03	0.0001	0.0005	0.0012	3.3E-05
2005	7.2E-04	0.0530	1.8E-05	1.4E-06	0.0008	0.0030	0.0074	1.1E-04
2010	1.1E-04	0.0935	2.9E-07	7.9E-07	0.0012	0.0041	0.0100	7.5E-05
2011	1.6E-04	0.0268	2.3E-07	1.2E-06	0.0017	0.0059	0.0145	1.2E-04
2012	3.1E-04	0.0341	2.6E-07	1.1E-06	0.0016	0.0059	0.0143	1.0E-04
2013	1.2E-04	0.0267	3.4E-07	7.7E-07	0.0013	0.0048	0.0116	5.7E-05
2014	8.9E-04	0.0312	1.2E-03	4.7E-07	0.0016	0.0058	0.0142	3.1E-05
2015	1.4E-03	0.0336	2.0E-03	1.2E-07	0.0014	0.0048	0.0116	1.1E-04
2016	2.1E-03	0.0367	3.0E-03	1.0E-05	0.0014	0.0043	0.0102	1.4E-03
2017	2.1E-03	0.0243	3.0E-03	6.3E-08	0.0010	0.0031	0.0073	NO
2018	2.1E-03	0.0231	3.1E-03	6.3E-08	0.0010	0.0028	0.0065	NO
2019	2.1E-03	0.0275	3.0E-03	1.5E-08	0.0011	0.0033	0.0076	NO
2020	1.4E-03	0.0275	2.0E-03	1.5E-08	0.0009	0.0027	0.0064	NO
2021	7.3E-04	0.0328	1.1E-03	2.0E-05	0.0010	0.0028	0.0064	NO
2022	6.4E-04	0.0298	9.3E-04	3.1E-05	0.0010	0.0027	0.0062	NO
2023	1.4E-05	0.0230	1.3E-04	1.3E-04	0.0009	0.0026	0.0061	NO
2024	2.5E-05	0.0316	2.5E-02	1.3E-04	0.0009	0.0031	0.0075	NO
1990/2024	-90%	40%	714,147%	-93%	117%	122%	123%	-
2023/2024	77%	38%	18,683%	0%	-4%	17%	23%	-

4.9.3.2 Methodological Issues

Activities listed in [Table 4.9.8](#) were reported in this category.

Table 4.9.8: Activities according to national categorisation included in 2H3 – Other Industrial Processes

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):
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 PM₁₀ in TSP are calculated using average shares from the period 2005-2009 ([Table 4.9.9](#)). Activity data for the calculation of implied emission factors are the total energy used in this category.

Table 4.9.9: Emission factors for calculation of historical years 2H3 – Other Industrial Processes

	NO _x [g/GJ]	NM VOC [g/GJ]	SO _x [g/GJ]	NH ₃ [g/GJ]	PM _{2.5} [% of TSP]	PM ₁₀ [% of 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

4.9.3.3 Completeness

Notation keys are reported in compliance with the EMEP/EEA GB 2023. The notation key for the CO in the period 2017-2024 is NO.

4.9.3.4 Source-specific Recalculations

No recalculations were made in this submission.

4.10 WOOD PROCESSING (NFR 2I)

4.10.1 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.

An overview of emissions and their trends is presented in [Table 4.10.1](#). Emission trends in this category decrease in general. Although the interannual change shows an increase. In the last reported year, the increase is evident, mainly for NH₃ emissions. It originates from one producer of agglomerated materials and its rise in production.

Table 4.10.1: Overview of emissions in the category 2I – Wood Processing

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	CO [kt]
1990	0.3117	0.2996	2.3E-03	0.0026	0.0492	0.1962	0.4900	0.3966
1995	0.3017	0.2901	2.2E-03	0.0025	0.0477	0.1899	0.4744	0.3840
2000	0.2549	0.1294	1.6E-03	0.0006	0.0747	0.1865	0.4660	0.2749
2005	0.3207	0.4017	1.8E-03	0.0058	0.0306	0.1213	0.3026	0.4673
2010	0.0759	0.2189	2.5E-03	0.0002	0.0104	0.0382	0.0939	0.3387
2011	0.1658	0.2091	2.3E-03	NO	0.0075	0.0300	0.0751	0.0925
2012	0.1614	0.1947	2.2E-03	NO	0.0081	0.0323	0.0808	0.0924
2013	0.1167	0.1756	1.1E-03	NO	0.0066	0.0262	0.0656	0.0761
2014	0.5389	0.3945	4.2E-05	0.0001	0.0071	0.0285	0.0713	0.4715
2015	0.2167	0.5026	3.8E-05	0.0083	0.0045	0.0178	0.0446	0.4119
2016	0.1600	0.2590	4.0E-05	0.0083	0.0044	0.0175	0.0437	0.1440
2017	0.2112	0.5449	4.4E-05	0.0093	0.0041	0.0165	0.0412	0.2100
2018	0.3401	0.7039	4.6E-05	0.0096	0.0038	0.0152	0.0379	0.3539
2019	0.3445	0.5681	5.4E-05	0.0082	0.0040	0.0160	0.0399	0.3448
2020	0.2344	0.5166	9.8E-05	0.0002	0.0045	0.0180	0.0450	0.2705

YEAR	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	CO [kt]
2021	0.2709	0.7482	1.2E-04	0.0002	0.0052	0.0207	0.0518	0.4497
2022	0.2151	0.6291	1.7E-04	0.0030	0.0055	0.0220	0.0549	0.3439
2023	0.2338	0.7514	2.1E-04	0.0377	0.0058	0.0230	0.0576	0.3827
2024	0.2320	0.8817	1.2E-04	0.0415	0.0048	0.0194	0.0484	0.4314
1990/2024	-26%	194%	-95%	1519%	-90%	-90%	-90%	9%
2023/2024	-1%	17%	-44%	10%	-16%	-16%	-16%	13%

4.10.2 Methodological Issues

The definition of activities covered by category **2I** is provided in [Table 4.10.2](#). The activity is involved in **2D3d**, where only VOC is balanced. Other rising emissions (NO_x, SO_x, NMVOC, NH₃, TSP, PM_{2.5}, PM₁₀, CO) are reported here.

Table 4.10.2: Activities according to national categorisation included in 2I – Wood Processing

CATEGORISATION ACCORDING TO THE ANNEX NO. 1 TO DECREE NO. 248/2023 COLL. (1):	
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 to 1999 were calculated using a weighted average of implied emission factors from the period 2000-2004. Shares of PM_{2.5} and PM₁₀ in TSP are calculated using average shares from the period 2005-2009 ([Table 4.10.3](#)). Activity data for the calculation of implied emission factors are the total energy used in this category.

Table 4.10.3: Emission factors for calculation of historical years in 2I – Wood Processing

	NO _x [g/GJ]	NM VOC [g/GJ]	SO _x [g/GJ]	NH ₃ [g/GJ]	PM _{2.5} [% of TSP]	PM ₁₀ [% of 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

4.10.3 Completeness

Notation keys are reported in compliance with the EMEP/EEA GB 2023.

4.10.4 Source-specific Recalculations

Notation keys for fuels (OF) have been harmonised with EMEP/EEA GB 2023 from NO to NA in the entire timeline.

4.11 PRODUCTION OF POPS (NFR 2J)

4.11.1 Overview

This activity is not occurring in the Slovak Republic, therefore, the notation key NO was used.

4.12 CONSUMPTION OF POPS AND HEAVY METALS (NFR 2K)

4.12.1 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. The category reports the emissions of Hg and PCBs. The trends of emissions and activity data are presented in [Table 4.12.1](#).

Table 4.12.1: Activity data and emissions in the category 2K - Consumption of Pops and Heavy Metals

YEAR	INHABITANTS	Hg [t]	PCBs [kg]
1990	5,297,774.00	0.0530	0.5298
1995	5,363,676.00	0.0536	0.5364
2000	5,400,679.00	0.0540	0.5401
2005	5,387,285.00	0.0539	0.5387
2010	5,431,024.00	0.0543	0.5431
2011	5,394,251.00	0.0539	0.5394
2012	5,407,579.00	0.0541	0.5408
2013	5,413,392.50	0.0541	0.5413
2014	5,418,649.00	0.0542	0.5419
2015	5,423,800.00	0.0542	0.5424
2016	5,430,798.00	0.0543	0.5431
2017	5,437,754.00	0.0544	0.5438
2018	5,446,770.50	0.0545	0.5447
2019	5,454,147.00	0.0545	0.5454
2020	5,458,827.00	0.0546	0.5459
2021	5,441,991.00	0.0544	0.5442
2022	5,431,026.00	0.0543	0.5431
2023	5,426,853.00	0.0543	0.5427
2024	5,422,284.00	0.0542	0.5422
1990/2024	2%	2%	2%
2023/2024	0%	0%	0%

4.12.2 Methodological Issues

Emissions of Hg and PCBs are calculated by the Tier 1 method according to EMEP/EEA GB 2023. Activity data were obtained from the ŠÚ SR – number national population - Mid-year population.

$$E = \text{Inhabitants} * EF_{\text{Default}}$$

Other pollutants (NO_x, NMVOC, SO_x, NH₃, PMs, TSP, BC, CO, POPs) are reported in compliance with EMEP/EEA GB 2023 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 4.12.2](#).

Table 4.12.2: *Emission factors in the category 2K*

	Hg [g/capita]	PCBs [g/capita]
EF	0.01	0.1

4.12.3 Completeness

Notation keys were used in compliance with the EMEP/EEA GB 2023.

4.12.4 Source-specific Recalculations

No recalculations were made in this submission.

4.13 OTHER PRODUCTION, CONSUMPTION, STORAGE, TRANSPORTATION OR HANDLING OF BULK PRODUCTS (NFR 2L)

4.13.1 Overview

The category is reported with the notation key NO. This production is not occurring in the Slovak Republic.

4.14 REFERENCES

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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	PATRICIA NAVRÁTILOVÁ

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 (NH₃), particulate matter (PM), total suspended particulate (TSP), the non-methane volatile organic compound (NMVOC) and nitrogen oxides (NO_x) emissions are analysed according to the EMEP/EEA GB hen principles of good practice in agriculture are taken into account. The emissions of NH₃, NO_x, 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 NH₃, NO_x and N₂O 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 2024 (1), 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 (ŠÚ 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

The share of the agriculture and food industry in the national economy has decreased in the macro-economic indicators (intermediate consumption, sectoral employment, gross production) except gross value added, and sectoral employment in 2024 compared to 2023 and increased in parameter employee's average wage by 3.7%. The share of foreign agri-food trade in exports (-1.7%) and imports decreased by -0.6%. The decrease in gross agricultural production was caused by a decrease in the value of plant production by -7.8%, with a simultaneous decrease in animal production by -5.2%, while the overall increase in gross agricultural production was mainly contributed by an increase in prices by 1.7%, with a simultaneous increase in the number of subsidies for products. Agriculture, according to data, achieved a negative moderate interannual economic result in 2024. The subsidies from the

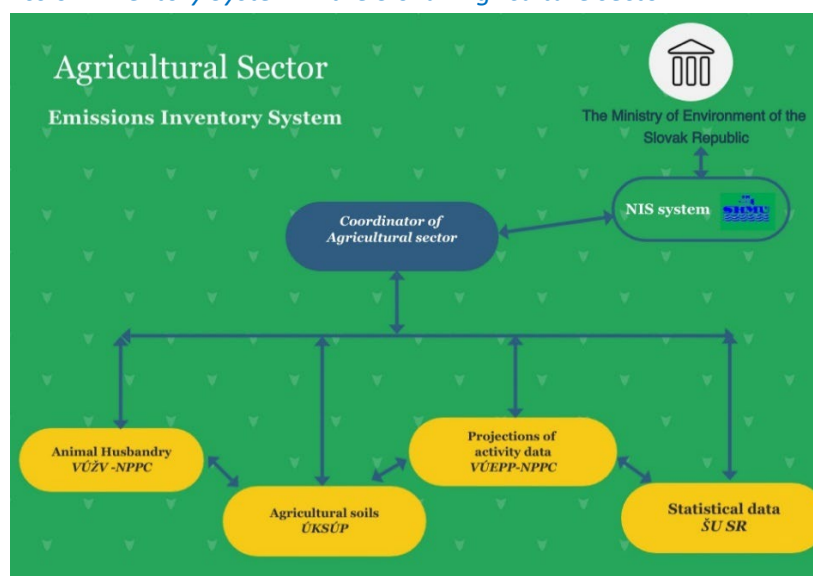
Common Agricultural Policies (CAP) played the stabilised role of financial support for Slovak agriculture, which helped the majority of the farmers avoid the negative economic situation.

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. Number of livestock ([Table 5.1.1](#)) decreased in population of cattle (-3%), sheep (-4.3%) and goats (-10.3%) and increased in population of poultry (+1.9%), horses (+10.7%), rabbits (+8.4%) and swine (+2.1%).

The emissions balance is compiled annually based on the sectoral statistics on animal livestock, animal performance and consumption of organic and inorganic fertilizers, in recent years on the regional level. The Ministry of Agriculture and Rural Development of the Slovak Republic (MPRV SR) issues annual agricultural statistics in the Green Report, part of which is dedicated to agriculture and food. Activity data are also available in the Statistical Yearbooks published by the Statistical Office of the Slovak Republic (ŠÚ SR).

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 (ŠÚ 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. The Emission Inventory System in the Slovak [Agriculture sector](#) is described in [Figure 5.1.1](#). In the 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 5.1.1: 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 stay in the business and to be competitive in this sector. The EU policy supported the use of 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 more balanced feeding rations, changing of

housing systems, and new storage capacity for organic waste, which was supported by Decree No 410/2012 Coll (2) and Nitrates Directive (3) and subsidies from the Common Agriculture Policy.

Table 5.1.1: Overview of the GHG gases and Tiers reported in the Agriculture sector according to the CRF categories in 2024

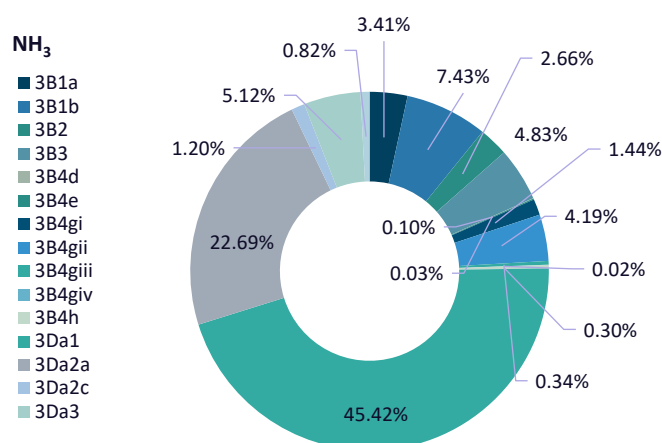
CATEGORY (CODE AND NAME)	TIER/POLLUTANTS
3B1a Dairy cattle	NH ₃ -T3, NO _x -T2, PM-T1, NMVOC-T2, TSP-T1
3B1b Non-dairy cattle	NH ₃ -T3, NO _x -T2, PM-T1, NMVOC-T2, TSP-T1
3B2 Sheep	NH ₃ -T3, NO _x -T2, PM-T1, NMVOC-T1, TSP-T1
3B3 Swine	NH ₃ -T3, NO _x -T2, PM-T1, NMVOC-T1, TSP-T1
3B4d Goats	NH ₃ -T2, NO _x -T2, PM-T1, NMVOC-T1, TSP-T1
3B4e Horses	NH ₃ -T3, NO _x -T2, PM-T1, NMVOC-T1, TSP-T1
3B4gi Laying hens	NH ₃ -T3, NO _x -T2, PM-T1, NMVOC-T1, TSP-T1
3B4gii Broilers	NH ₃ -T3, NO _x -T2, PM-T1, NMVOC-T1, TSP-T1
3B4giii Turkeys	NH ₃ -T3, NO _x -T2, PM-T1, NMVOC-T1, TSP-T1
3B4giv Other poultry	NH ₃ -T3, NO _x -T2, PM-T1, NMVOC-T1, TSP-T1
3B4h Other animals – Rabbits	NH ₃ -T1, NO _x -T1, PM-T1, NMVOC-T1, TSP-T1
3Da1 Inorganic N-fertilizers	NH ₃ -T2, NO _x -T1
3Da2 Animal manure applied to the soil	NH ₃ -T3, NMVOC-T2, NO _x -T2
3Da3 Urine and dung deposited by grazing animals	NH ₃ -T2, NMVOC-T2, NO _x -T2
3Da4 Crop residues applied to soils	NH ₃ -T1
3Dc Farm-level agricultural operations including storage, handling and transport of agricultural products	PM _s -T2, TSP-T1
3De Cultivated Crops	NMVOC-T1

5.2 EMISSION TRENDS

5.2.1 Ammonia (NH₃)

The sector of agriculture is a dominant contributor to NH₃ emissions, with a share of 87% of the national total in 2024. The largest share of ammonia emissions was generated by **3D** Agricultural soils, which produced 16.7 kt (75%) of NH₃ within the sector in 2024. The significant source of NH₃ emissions is the Inorganic N-fertilizers, with a share of 45.4%, followed by the Animal manure applied to soils category, representing 22.7% of the total NH₃ emissions in 2024. Emissions from **3B1** Cattle, **3B3** Swine and **3B2** Sheep produced 4.07 kt of NH₃ (18.3%) in the sector in 2024. [Figure 5.2.1](#) shows the distribution of significant categories of ammonia from agriculture for 2024.

Figure 5.2.1: NH₃ emissions per subsectors in %



Agricultural NH₃ emissions have decreased by 72% since 1990 and decreased by 14% compared to the previous year ([Table 5.2.1](#) and [Figure 5.2.3](#)). The main driver for this drop was the significant decrease in 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 have made complementary emission reductions. More information is available in [ANNEX VI](#). The emission from agricultural soils has continued to be the dominant contribution compared to emissions from animal production, which correlated with the overall economic and production situation in the agricultural sector.

Figure 5.2.2: NH₃ emission trend by sectors

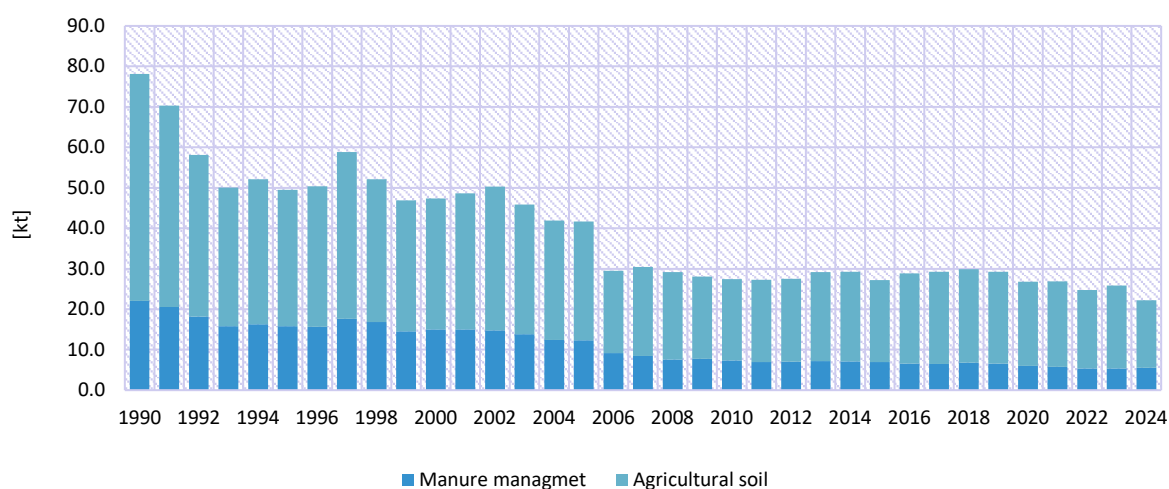


Table 5.2.1: NH₃ emission time-series by sub-sectors in kt

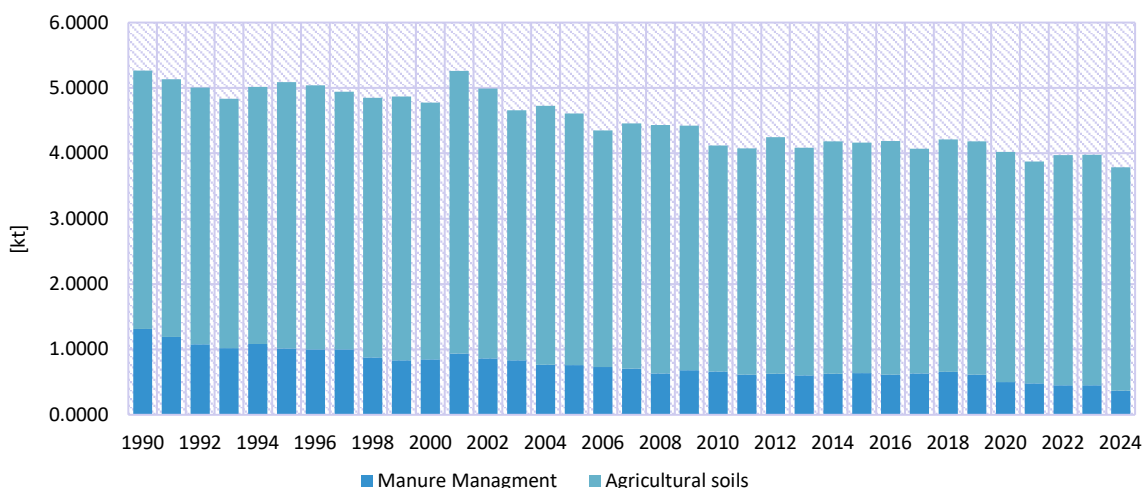
YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	[kt]		
1990	22.0916	56.0473	78.1389
1995	15.8241	33.6795	49.5037
2000	15.0019	32.3325	47.3344
2005	12.3240	29.3312	41.6552

YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	[kt]		
2010	7.3087	20.1606	27.4694
2011	6.9587	20.3294	27.2881
2012	7.0317	20.5144	27.5461
2013	7.1706	22.0371	29.2076
2014	7.1187	22.1673	29.2860
2015	6.9758	20.2586	27.2344
2016	6.5405	22.2921	28.8326
2017	6.4760	22.7799	29.2559
2018	6.7995	23.0809	29.8804
2019	6.5464	22.7364	29.2827
2020	5.9795	20.8523	26.8318
2021	5.7776	17.8056	26.8486
2022	5.4081	19.3476	24.7557
2023	5.3491	20.4733	25.8225
2024	5.4915	16.6939	22.1854
1990/2024	-75%	-70%	-72%
2005/2024	-55%	-43%	-47%

5.2.2 Particulate Matters

In 2024, agriculture accounted for 2.3% (0.30 kt) of PM_{2.5}, 20.23% (3.78 kt) of PM₁₀ and 18.03% (4.12 kt) of the national total, TSP emissions. The Agriculture sector is not a key source of particulate matter. The contribution of the **3Dc** was 90.3% (3.42 kt) to the total PM₁₀ emissions from the sector.

Figure 5.2.3: PM₁₀ emission trends by sectors



PM_{2.5}, PM₁₀ and TSP emissions from agriculture have decreased in the 2005-2024 period ([Table 5.2.2](#) and [Figure 5.2.3-5.2.4](#)) as a result of the decreasing emissions from **3B** Manure management and decreasing partial emissions from **3D** Agricultural Soils. In **3D** Agricultural Soils is a visible increase in emissions due to the increase sowing areas of oil plants and wheat. The overall trend of PM₁₀ emissions from Agriculture is shown in [Figure 5.2.3](#).

Figure 5.2.4: PM_{2.5} emission trends by sectors

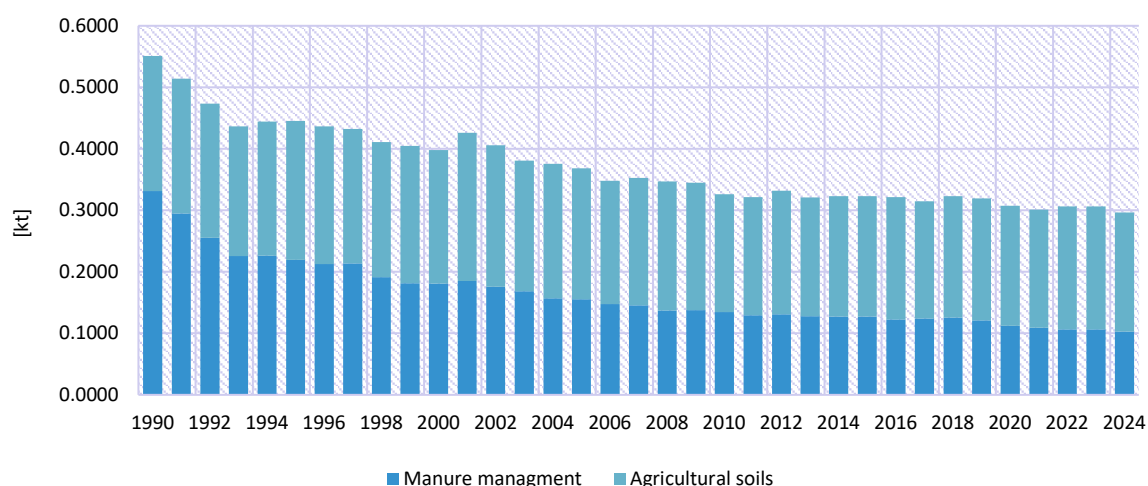


Table 5.2.2: TSP emission time-series by sub-sectors in kt

YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	[kt]		
1990	5.3109	3.1003	8.4112
1995	4.3122	3.0016	7.3137
2000	3.3669	2.9029	6.2697
2005	2.9317	3.0286	5.9602
2010	2.5224	2.9983	5.5207
2011	2.3316	3.0103	5.3419
2012	2.4129	3.0068	5.4197
2013	2.3008	3.0085	5.3093
2014	2.3416	2.9970	5.3386
2015	2.4112	2.9976	5.4089
2016	2.3219	2.9934	5.3153
2017	2.3657	2.9806	5.3463
2018	2.4572	2.9945	5.4517
2019	2.2818	2.9885	5.2703
2020	1.7528	2.9797	4.7325
2021	1.6462	2.8956	4.5418
2022	1.5510	2.8847	4.4358
2023	1.5170	2.8847	4.4018
2024	1.2843	2.8356	4.1198
1990/2024	-76%	-9%	-51%
2005/2024	-56%	-6%	-31%

5.2.3 Non-methane Volatile Organic Compounds (NMVOC)

In 2024, Agricultural NMVOC emissions consisted of 7.0 kt and 8.8% share of the national total ([Table 5.2.3](#)). The primary agricultural source of NMVOC emissions is the **3B** Manure management, accounting for 7.9% of the national total NMVOC emissions (6.29 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. NMVOC emissions have decreased by 67% over the

period 1990-2024, as a result of the decline of livestock and the effect of implemented mitigation measures in ammonia emissions after 2006.

Table 5.2.3: NMVOC emission time-series by sub-sectors in kt

YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	[kt]		
1990	20.7542	0.3691	21.1233
1995	13.3678	0.3256	13.6934
2000	11.1354	0.2963	11.4317
2005	9.6986	0.4724	10.1711
2010	7.9115	0.4558	8.3674
2011	7.7646	0.5269	8.2915
2012	7.7237	0.4397	8.1634
2013	7.5687	0.5797	8.1483
2014	7.4605	0.6807	8.1412
2015	7.6285	0.5664	8.1949
2016	7.3160	0.6958	8.0118
2017	7.4369	0.6399	8.0768
2018	7.0130	0.6515	7.6645
2019	6.7984	0.6127	7.4111
2020	6.3397	0.6522	6.9919
2021	6.1272	0.8123	6.9395
2022	5.9264	0.7322	6.6586
2023	6.4123	0.8832	7.2955
2024	6.2902	0.7236	7.0138
1990/2024	-70%	+96%	-66%
2005/2024	-33%	+78%	-28%

5.2.4 Nitrogen Oxides (NOx)

In 2024, Agricultural NOx emissions consisted of 7.12 kt and a share of 13.6% of the national total. Agricultural NOx emissions have decreased by 41.3% since 1990 ([Table 5.2.4](#)). The primary drivers of this drop are the significant decrease in the emissions from cattle and swine, due to the dramatic decline in the livestock population. Focusing on the period between 2016 and 2024, NOx emissions from the agricultural sector decreased due to a decrease in inorganic fertilizer use.

Table 5.2.4: NOx emission time-series by sub-sectors in kt

YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	[kt]		
1990	0.4998	16.7197	17.2195
1995	0.1547	6.3168	6.4715
2000	0.1402	6.5182	6.6584
2005	0.1347	6.8573	6.9920
2010	0.1630	7.8169	7.9799
2011	0.1603	8.3347	8.4950
2012	0.1549	7.4819	7.6368
2013	0.1540	8.0695	8.2235
2014	0.1519	8.2819	8.4388

YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	[kt]		
2015	0.1454	7.8950	8.0404
2016	0.1407	8.3289	8.4695
2017	0.1256	7.9551	8.0807
2018	0.1334	8.3262	8.4595
2019	0.1287	8.2275	8.3562
2020	0.1244	7.9860	8.1104
2021	0.1218	7.9308	8.0527
2022	0.1167	7.3191	7.4357
2023	0.1143	6.9455	7.0598
2024	0.1164	7.0011	7.1170
1990/2024	-77%	-58%	-59%
2005/2024	-14%	+2%	+2%

5.3 CATEGORY-SPECIFIC IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

According to the Final Review Report 2025 of national air pollution emission inventories, recommendations in the Agriculture sector were received:

Two significant adjustments concerning ammonia (NH₃) emissions in the agriculture sector were implemented into Slovakia's emission inventory. These were identified as key categories with the major impact on the emission inventory.

3Da1 Inorganic N fertilizers (including urea application) category, it was noted that in the 2025 submission, Slovakia used Tier 2 level emission factors (EF) from the 2019 version of the EMEP/EEA Guidebook. Since an updated version of the guidebook with revised emission factors was published in 2023, the difference in estimated emissions over the entire time series 1990–2023 exceeded the materiality threshold. In line with good practice, emission factors from the latest version of the methodological guidebook should be used. The review team (TERT) therefore calculated a technical correction (TC) for the years 2005 and 2020–2023. The category was revised based on the updated emission factors. More details are available in [Chapter 5.9.2](#).

3Da4 Crop residues applied to soils category, it was found that Slovakia used the Tier 1 method to estimate NH₃ emissions for the years 1990–2023, with the implied emission factor (0.0413 kg NH₃/kg N in plant residues) being higher than the default factor given in the EMEP/EEA Guidebook 2023 (0.034 kg NH₃/kg N). The default emission factor was mistakenly considered to be expressed as NH₃-N instead of NH₃, and therefore unnecessarily recalculated using the 17/14 coefficient. In this case as well, TERT calculated a technical correction for the years 2005 and 2020–2023. The category was revised based on recommendations. More detailed information is available in [Chapter 5.9.7](#).

Based on the NECD review 2025, **two** further findings were identified in the agriculture sector that require methodological or documentation adjustments in the next inventory submission. No technical correction (TC) was calculated for 2025.

3B Manure management category, for the pollutant PM₁₀ (years 2005, 2020–2022), TERT noted that recalculations were applied across the entire time series but were not carried out for PM_{2.5} emissions. At the same time, it was identified that in the calculation of particulate matter (PM) emissions, the

proportion of time animals spend housed was not taken into account, even though according to the EMEP/EEA Guidebook, it is good practice to apply Tier 1 emission factors only to housed animals and account for the rest of the year through scaling of the emission factor. As a result, PM emissions may be overestimated. TERT recommended that Slovakia correct the aggregation of PM_{2.5} emissions and update the PM emission calculation methodology so that Tier 1 emission factors are scaled according to the proportion of the year spent housed for individual categories of livestock. More detailed information is available in [Chapter 5.8.5](#).

3De – Cultivated crops category, for pollutant NMVOC (1990–2023), TERT identified an inconsistency in IIR documentation ([Table 5.5.1](#)), where dry matter content values for rye, barley, and oats did not match the crop types used in production statistics. The stated values referred to whole-crop cereals harvested green for silage, while crop yield statistics concerned grain with substantially higher dry matter content. This mismatch could lead to an underestimation of NMVOC emissions. More detailed information is available in [Chapter 5.10.2](#).

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 GB₂₀₂₃.

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 the 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 is provided. In the last two years, the QA/QC procedures have significantly improved. QA/QC provides an additional opportunity to cross-check 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 have significantly improved.

The QA/QC is extended by a 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 5.5](#)).

Table 5.5.1: Overview of these recalculations and corrections implemented in the 2026 submission

	CATEGORY	YEAR	POLLUTION	DESCRIPTION	REFERENCES
15. FEBRUARY 2026					
1	3.B Manure management- 3B1b,3B1a,3B2,3B3,3B4d, 3B4e,3B4gi,3B4gii,3B4giii,3 B4giv	1990- 2023	NOx	Revision of Nex values was done, previous values were calculated in spreadsheets, new values were	5.8.4

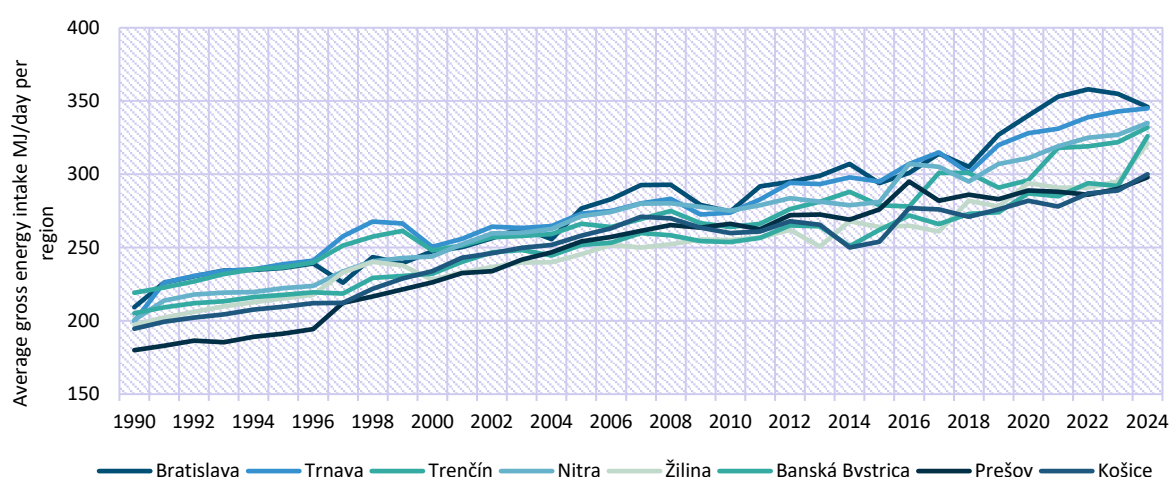
	CATEGORY	YEAR	POLLUTION	DESCRIPTION	REFERENCES
15. FEBRUARY 2026					
				calculated in Structured Query Language.	
2	3.B Manure management 3B1a, 3B1b, 3B2,3B3,3B4d,3B4e,3B4gi, 3B4gii,3B4giii,3B4giv	1990- 2005	NH ₃	Revision of Nex values was done, previous values were calculated in spreadsheets, new values were calculated in Structured Query Language.	5.8.4
3	3B1a, 3B1b, 3B2,3B3,3B4d,3B4e,3B4gi, 3B4gii,3B4giii,3B4giv	2006- 2023	NH ₃	Implementation of new abatement techniques and revision of Efs.	5.8.4 Annex VI.
4	3Da2a Animal manure applied to soils	1990- 2005	NO _x , NH ₃	3B revisions impacted in the 3Da2a category	5.9.8
5	3Da3 Urine and dung deposited by grazing animals	1990- 2005	NO _x , NH ₃	3B revisions impacted in the 3D3 category	5.8.4 5.9.8
6	3Da2c Other organic fertilisers applied to soils	1990- 2023	NH ₃ , NO _x	Revision of the share of Nitrogen from other organic fertilizers	5.8.4 5.9.8
7	3Da1 Inorganic N-fertilizers (includes also urea application)	1990- 2023	NH ₃	Implementations of Tier 2 EFs from EMEP/EEA Guidebook 2023 . Implementation of technical correction number SK-3Da1-2025-0001.	5.9.8
8	3Da4 Crop residues applied to soils	1990- 2023	NH ₃	Implementation of technical correction number SK-3Da4-2025-0001.	5.9.8
9	3B2 Manure management - Sheep	1990- 2023	PM ₁₀ , PM _{2.5}	Correction of the aggregation error of Number of livestock Rams was excluded from calculations. Implementation of observation number: SK-3B2-2025-0001	5.8.5
10	3B2 Manure management all livestock categories	1990- 2023	TSP, PM _{2.5} , PM ₁₀	Update the calculation method for PM emissions by scaling the Tier 1 emission factors to account for the fraction of the year that each livestock category spends in housing	5.8.5
11	3De Cultivated crops, NMVOC	1990- 2023	NMVOC	Dry matter content of rye, barley, and oats was revised according to the recommendation number SK-3De-2025-0001.	5.10.3
12	3B3 Manure management - Swine	1990- 2023	NMVOC	Correction of wrong transcription between the spreadsheet and the template	5.8.4
13	3B3 Manure management - Sheep	2005	NMVOC	Correction of wrong transcription between the spreadsheet and the template	5.8.4
14	3B3 Manure management - Non-dairy cattle	2009	NMVOC	Correction of wrong transcription between the spreadsheet and the template	5.8.4
15	3Df Use of pesticides	2023	HCB	The revision of pesticide consumption was conducted. Extrapolated values was exchanged for statistical values	5.12.3

5.6 NATIONAL CIRCUMSTANCES AND TIME-SERIES CONSISTENCY

Slovak farmers have adapted to changes in agriculture since 1990. They invested in the development of their farms to avoid bankruptcy and to be self-competitive in this sector. The EU policy supported the use of 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, such as changing of housing systems, a decrease in pasture time and new storage capacity for organic waste, which was supported by Regulation No 389/2005 Coll. (4) and Nitrates Directive (3). These measures are well advanced and copy the practices used in Western European countries. Therefore, default parameters for Western Europe are used in the inventory. The most significant animals regarding emissions in Slovakia are cattle and swine.

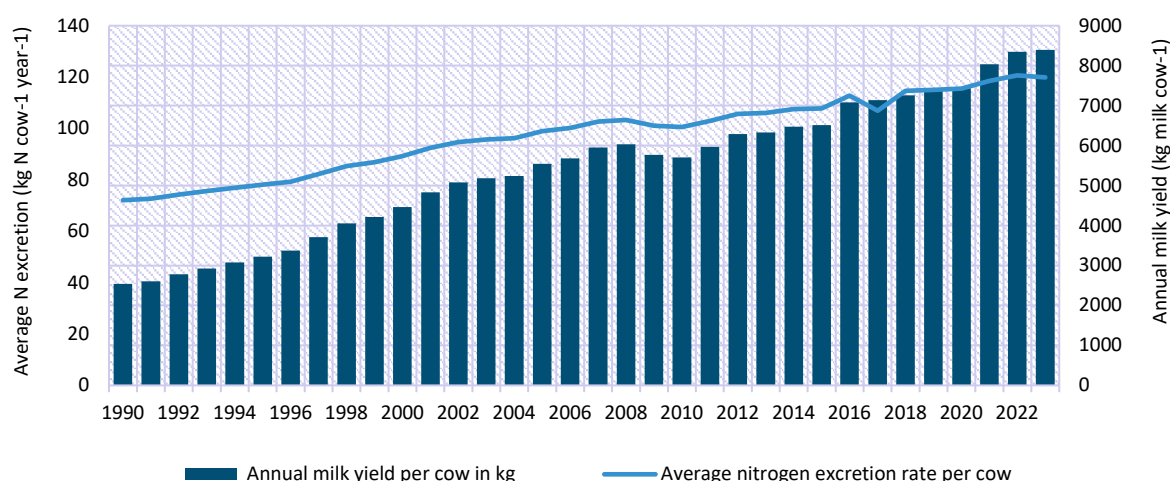
Cattle breeding in the Slovak Republic is comparable with Western European countries, which is documented by a high milk yield of dairy cattle and high daily weight gains of non-dairy cattle. To maintain a high milk yield and high daily gains, food rich in proteins and cereals is important.

Figure 5.6.1: Trend in average gross energy intake (MJ/day) in different Slovak regions



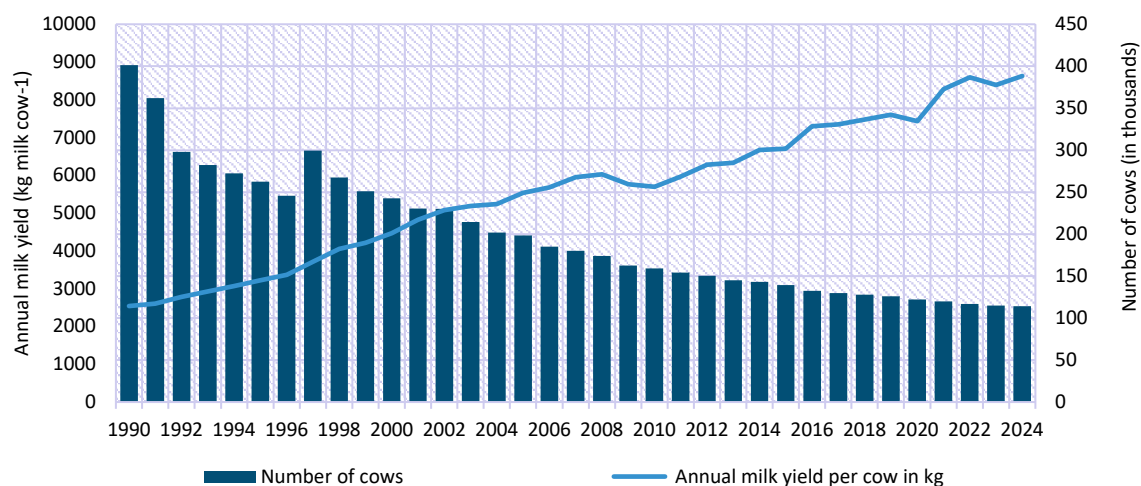
Dairy cows in the Slovak Republic produced an average of 25.31 litres/day, depending on the region of the country. Lower milk production relates to feeding. In this case, pasture is included in the feeding ratio. It is typical for semi-intensive farming in regions such as Košice, Prešov, Banská Bystrica or Žilina. These circumstances are documented in [Figures 5.6.1](#) and [5.6.2](#). Highly productive dairy cows (milked 25-30 litres/day) need to be fed by approximately 8 kg of cereals with excellent digestibility and high nutrition. An annual increase in milk productivity is evidence of increasing productivity in animal production. Balanced and sustainable farming in Slovakia has an impact on the high value of AGEI (325.31 MJ/head/day) ([Figure 5.6.1](#)).

Figure 5.6.2: 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 72% in 2024 compared to 1990 (**Figure 5.6.3**). Milk production increased by up to 263% in 2024 compared to 1990 and by 7% compared to the previous year, 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 10,000 kg of milk per head per year.

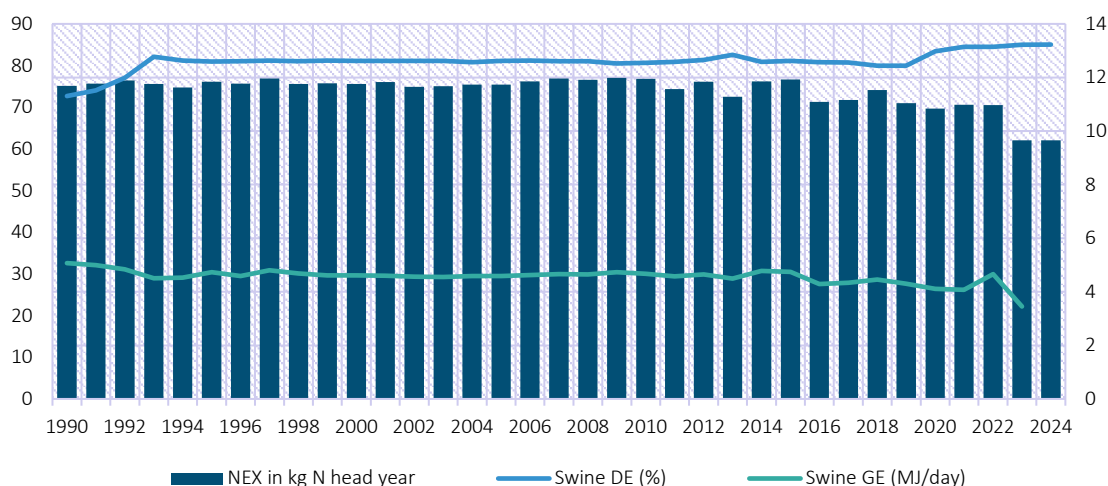
Figure 5.6.3: Trend in dairy cattle population and dairy milk production (kg/head/day)



The pig farming system in the Slovak Republic is divided into two types - breeding and fattening 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 meal, rapeseed meal, and brewing malt. The resultant feeding rations have a high nutritional value and are easily digestible (**Figure 5.6.4**). After 1990, the digestibility of the 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. In 2021, a visible increase of digestibility of feeding doses occurred. This value was estimated by VÚŽV and correlated with an increase in pig performance in that year.

Figure 5.6.4: Trend of feed digestibility, nitrogen excretion rate and gross energy intake of swine in the Slovak Republic



The opposite trend is visible in the last 4 years mainly in breeding pigs. The decrease in crude proteins, cereals had an impact on the decrease of monitored parameters. 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 pigs.

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, NO_x , TSP, PM_{10} , $\text{PM}_{2.5}$

Methods: T1 and T2

Emission factors: D, CS

Key sources: Yes

Significant subcategories: Cattle, Swine, Poultry

The emissions of NH_3 , NO_x , TSP, NMVOC and PM were estimated from category **3B** Manure management. NO_x 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, PM₁₀ 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 a survey on manure management practices used. A questionnaire survey in farms was performed in cooperation with the NPPC-VÚŽV and other research institutions during the year 2014. Farmers reported the total amount of solid and liquid manure produced and the amount of manure, which was processed in anaerobic digesters by regions. This survey defined more accurately the number of days on pasture for cattle, sheep, goats and horses. Manure left on the pasture was estimated based on this data. The time series was completed by extrapolation. In the 2024 submission, new data were implemented in poultry and swine categories. This survey was provided by the 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's default value for nitrogen excretion was used. More information is in [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 estimate 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 5.8.1](#).

Table 5.8.1: Additional parameters for estimation of nitrogen excretion rate

PARAMETER	UNITS*	SOURCES
Crude protein per litre of milk	85 g per liter	A Sommer Nutrition for cattle (5)
Share of protein in calf meat	21.5%	Biotechnology nutrition and health (6)
Usability for maintenance	2%	A Sommer Nutrition for cattle (5)
Usability for pregnancy	20%	A Sommer Nutrition for cattle (5)
Nitrogen overage -dairy cattle	25%	Expert judgement
Nitrogen overage - other cattle	20%	Expert judgement
Share of protein in beef meat	21%	Biotechnology nutrition and health (6)
The conversion factor from CP to N	6.25	2006 IPCC GL p.10.58 (7)
Time without milking	60 days	Plemenársky informačný systém (8)
Crude protein for pregnancy begin part of pregnancy	680 g/day	A Sommer Nutrition for cattle (5)
Crude protein for pregnancy begin part of pregnancy	765 g/day	A Sommer Nutrition for cattle (5)

*consistent in all time-series

The nitrogen excretion rate was determined for the whole time-series with methods according to the publication *Nutrition for Cattle* (5). 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:

$$\begin{aligned}
 CP_{m-Total} &= \left[(4.93 * H^{0.75} * U_m) - \left(\frac{CP_m}{100} * U_m \right) \right] \\
 CP_{l-Total} &= \left[(MY * CP_l) - \left(\frac{MY * 1000}{100 * SP_l} \right) \right] \\
 CP_{p-Total} &= \frac{C_{p1} + C_{p2}}{100} * U_p \\
 Total_{CP} &= \frac{(CP_{m-Total} + CP_{l-Total}) * lactation\ period}{1000} + \frac{(CP_{m-Total} + CP_{p-Total}) * time\ without\ milking}{1000} * 365 \\
 N_{intake\ (T)} &= \left(\frac{\frac{Total_{CP}}{100}}{6.25} \right) \\
 NEX_{(T)} &= N_{intake\ (T)} + (N_{intake\ (T)} * O_N)
 \end{aligned}$$

Non-dairy cattle:

$$\begin{aligned}
 CP_{m-Total} &= \left[(4.93 * H^{0.75} * U_m) - \left(\frac{CP_m}{100} * U_m \right) \right] \\
 CP_{dg-Total} &= \left[(200 + (4.43 * H^{0.75})) * dg \right] * SP_m \\
 Total_{CP} &= \frac{(CP_{m-Total} + CP_{dg-Total})}{1000} * 365 \\
 N_{intake\ (T)} &= \left(\frac{\frac{Total_{CP}}{100}}{6.25} \right) \\
 NEX_{(T)} &= N_{intake\ (T)} + (N_{intake\ (T)} * O_N)
 \end{aligned}$$

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 and poultry – a country-specific nitrogen excretion rate was used for the swine and 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.

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 were taken according to the publication *P. Nutrition for Pigs* (9) and *Nutrition for Poultry* (10). 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.

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

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 summarised in **Tables 5.8.2 - 5.8.8**. The results for swine for 2019 were presented in **Tables 5.8.2-5.8.3**. 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:

$$NEX_{(T)} = N_{\text{intake}(T)} * (1 - N_{\text{retention}})$$

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 5.8.2: Country-specific regional parameters for swine for the period of 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

1990		A	B	C	D	E	F	G	H
	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
FATTENING PIGS (50-80 kg)	CP (%)	14.70	14.30	15.20	14.80	14.40	14.30	14.70	14.10
	N-intake (kg N/animal/day)	0.047	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 Bystrica, G: Prešov, H: Košice

Table 5.8.3: Country-specific regional parameters for swine for the period of 2024

2024		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)	0.100	0.092	0.087	0.084	0.062	0.087	0.074	0.072
	NEX (kg N/animal/year)	25.53	23.63	22.19	21.34	15.95	22.18	18.78	18.46
GILTS PREGNANT	CP (%)	13.6%	14.0%	12.4%	13.0%	13.6%	13.3%	13.8%	12.8%
	N-intake (kg N/animal/day)	0.045	0.046	0.041	0.043	0.045	0.044	0.045	0.042
	NEX (kg N/animal/year)	11.383	11.748	10.397	10.918	11.383	11.120	11.538	10.668
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)	0.055	0.057	0.051	0.053	0.055	0.054	0.056	0.052
	NEX (kg N/animal/year)	14.130	14.584	12.907	13.553	14.130	13.804	14.323	13.243
HOGS	CP (%)	15.9%	15.9%	15.9%	15.9%	15.9%	15.9%	15.9%	15.9%
	N-intake (kg N/animal/day)	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	NEX (kg N/animal/year)	13.278	13.279	13.278	13.278	13.278	13.278	13.278	13.278
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)	0.026	0.027	0.024	0.025	0.026	0.025	0.026	0.024
	NEX (kg N/animal/year)	6.633	6.846	6.059	6.362	6.633	6.480	6.724	6.217
	CP (%)	14.3%	15.0%	14.1%	14.5%	12.6%	14.3%	12.7%	13.7%

2024		A	B	C	D	E	F	G	H
FATTENING PIGS UP (TO 20 kg)	N-intake (kg N animal/day)	0.015	0.015	0.014	0.015	0.013	0.015	0.013	0.014
	NEX (kg N/animal/year)	3.723	3.914	3.681	3.791	3.291	3.719	3.315	3.580
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)	0.026	0.028	0.026	0.027	0.023	0.026	0.024	0.025
	NEX (kg N/animal/year)	6.748	7.094	6.672	6.871	5.965	6.740	6.009	6.488
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)	0.039	0.041	0.038	0.039	0.034	0.039	0.034	0.037
	NEX (kg N/animal/year)	9.889	10.397	9.778	10.069	8.742	9.877	8.806	9.508
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)	0.049	0.051	0.048	0.049	0.043	0.049	0.043	0.047
	NEX (kg N/animal/year)	12.409	13.047	12.270	12.636	10.970	12.395	11.051	11.932
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)	0.054	0.057	0.054	0.055	0.048	0.054	0.048	0.052
	NEX (kg N/animal/year)	13.844	14.556	13.689	14.097	12.239	13.828	12.329	13.311

Regions: A: Bratislava, B: Trnava, C: Trenčín, D: Nitra, E: Žilina, F: Banská Bystrica, G: Prešov, H: Košice

Table 5.8.4: Country-specific regional parameters for poultry

2024	N RETENTION (%)	N-INTAKE (kg N animal/day)	N _{EX} (kg N/animal/year)
BREEDING BROILERS	0.300	0.004	0.898
DUCKS	0.002	0.006	1.295
FATTENING BROILERS	0.001	0.003	0.739
GEESE	0.002	0.007	1.739
LAYING HENS INCLUDING COCKS	0.300	0.003	0.794
TURKEYS	0.003	0.010	2.412

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 to 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 species 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:

$$N_2O_{EM} = \left[\sum \left[\sum (N * N_{EX} * AWMS) \right] * EF \right] * \frac{44}{28}$$

Where:

$N_{2O_{EM}}$ = direct N_2O emissions from manure management in kg N_2O ; N = number of livestock species respectively category, N_{EX} = annual average N-excretion/head of species respectively category in kg N/animal, $AMWS$ = percentage of total annual nitrogen excretion for each livestock category, that is managed in manure management systems in the country, EF = default emission factor for direct N_2O emissions from manure management system in kg N_2O -N/kg N in manure management system, $44/28$ = conversion of N_2O -N emissions to N_2O emissions.

Table 5.8.5: 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	75.84	589	16.56	82.62	0.82	NO
Dairy cows Žilina region	66.07	589	5.93	75.34	18.73	NO
Dairy cows Banská Bystrica region	71.66	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 5.8.6: Country-specific regional parameters for dairy cattle in 2024

CATEGORIES	N_{EX}	BODY MASS	LIQUID	SOLID	PASTURE	ANAEROBIC DIGESTER
	[kg N head/year]	[kg]	[%]			
Dairy cows Bratislava region	142.36	600	0.00	99.52	0.48	0.00
Dairy cows Trnava region	139.27	600	8.11	77.00	1.34	13.55
Dairy cows Trenčín region	132.20	600	7.58	77.29	6.18	8.95
Dairy cows Nitra region	137.42	600	16.49	80.47	0.64	2.40
Dairy cows Žilina region	122.78	595	5.89	57.30	30.10	6.70
Dairy cows Banská Bystrica region	127.43	599	13.95	69.60	10.74	5.70
Dairy cows Prešov region	113.39	593	6.35	70.74	20.25	2.67
Dairy cows Košice region	115.16	597	3.04	77.63	10.78	8.55

Table 5.8.7: Country specific regional parameters for poultry in 1990-2024

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	-	75.00	25.00
Fattening broilers	0.74	1.02	-	-	100.00
Breeding broilers	0.90	1.02	-	-	100.00
Turkeys	2.41	3.28	-	-	100.00
Geese	1.74	1.53	50.00	50.00	50.00
Ducks	1.30	2.05	50.00	50.00	50.00

Table 5.8.8: N_{EX} and share (%) for different domestic livestock and share in AWMS in 2024

CATEGORIES		N_{EX}	LIQUID	SOLID	PASTURE	OTHER (LITTER)
		[N kg/head]	[%]			
NON-DAIRY CATTLE	Suckler cows	40.35	-	45.21	54.79	-
	Calves in 6 months (milk type)	19.96	-	-	100.00	-
	Heifer (milk type)	38.42	-	97.55	2.45	-
	Heifer (pregnant) (milk type)	57.56	-	97.55	2.45	-
	Fattening (milk type)	46.48	10.00	90.00	-	-
	Oxen (milk type)	93.79	-	100.00	-	-
	Breeding bull (milk type)	66.21	-	100.00	-	-
	Calves in 6 months (beef type)	12.18	-	40.00	60.00	-
	Heifer (beef type)	38.29	-	45.21	54.79	-
	Heifer (pregnant) (beef type)	54.73	-	45.21	54.79	-
	Fattening (beef type)	42.61	20.00	80.00	-	-
	Oxen (beef type)	68.41	-	100.00	-	-
	Breeding bull (beef type)	43.35	-	75.34	24.66	-
	2024*	47.87	2.46	71.17	26.37	-
SHEEP	Mature ewes (milk type)	7.88	-	49.59	50.41	-
	Mature ewes (beef type)	9.20	-	45.20	54.80	-
	Growing lambs (milk type)	4.27	-	49.59	50.41	-
	Growing lambs pregnant (milk type)	7.23	-	49.59	50.41	-
	Growing lambs (beef type)	6.24	-	45.21	54.79	-
	Growing lambs pregnant (beef type)	8.54	-	45.21	54.79	-
	2024*	7.22	-	48.08	51.92	-
	Rams (milk type)	10.51	-	100.00	-	-
	Rams (beef type)	11.83	-	100.00	-	-
	2024*	11.17	-	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	-
	2024*	6.94	-	49.60	50.40	-
HORSES	Young horses up to 1 year	17.32	70.00	-	30.00	-
	Young horses from 1 to 3 year	39.86	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	-
	2024*	44.65	70.00	-	30.00	-
Others	Rabbits	4.6	-	68.00	32.00	-

* weighted average

5.8.2.1 Methodological Issues – NH_3 and NO_x

Emissions of NO_x and NH_3 from **3B1** Cattle, **3B2** Sheep, **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 NH₃ 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 5.8.6 - 5.8.8](#). Solid storage of manure was found to be the most frequent AMWS for cattle. The regional differences for horses, goats and poultry categories were not considered.

NH₃ 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 is 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 a natural crust cover were implemented into the 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 5.8.9: Country-specific liquid NH₃ emission factors for the period 2006-2024

SPECIFIC EFs	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS, LAYING HENS, GEESE, TURKEYS, DUCKS, HORSES, SHEEP	BREEDING PIGS	FATTENING PIGS
YEARS	LIQUID [kg NH ₃ /kg N]				
2006	0.2166	0.2168	NO	0.0980	0.1007
2007	0.2128	0.2145	NO	0.0971	0.0978
2008	0.2092	0.2108	NO	0.0933	0.0957
2009	0.2077	0.2105	NO	0.0848	0.0880
2010	0.2063	0.2081	NO	0.0823	0.0885
2011	0.2026	0.2065	NO	0.0801	0.0885
2012	0.2027	0.2064	NO	0.0786	0.0858
2013	0.2035	0.2056	NO	0.0796	0.0856
2014	0.2033	0.2062	NO	0.0757	0.0787
2015	0.2040	0.2074	NO	0.0761	0.0814
2016	0.2035	0.2066	NO	0.0732	0.0759
2017	0.2023	0.2067	NO	0.0747	0.0755
2018	0.2033	0.2059	NO	0.0748	0.0737
2019	0.2016	0.2050	NO	0.0737	0.0765
2020	0.2017	0.2049	NO	0.0753	0.0744
2021	0.2005	0.2054	NO	0.0738	0.0708
2022	0.2002	0.2050	NO	0.0705	0.0706
2023	0.2021	0.2057	NO	0.0732	0.0693
2024	0.2029	0.2057	NO	0.0744	0.0741

Table 5.8.10: Country-specific solid NH₃ emission factors for the period 2006-2024

SPECIFIC EFs	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS
YEARS	SOLID [kg NH ₃ /kg N]					
2006	0.2720	0.2685	0.2980	0.0800	0.0996	0.1365
2007	0.2743	0.2692	0.2888	0.0646	0.1600	0.2400
2008	0.2736	0.2702	0.2900	0.0660	0.1600	0.2400

SPECIFIC EFs	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS
YEARS	SOLID [kg NH ₃ /kg N]					
2009	0.2731	0.2706	0.2947	0.0658	0.1600	0.2400
2010	0.2768	0.2773	0.2984	0.0636	0.1600	0.2400
2011	0.2794	0.2775	0.2967	0.0654	0.1600	0.2400
2012	0.2774	0.2784	0.2915	0.0667	0.1600	0.2400
2013	0.2788	0.2816	0.2897	0.0630	0.1600	0.2400
2014	0.2799	0.2835	0.2872	0.0628	0.1600	0.2400
2015	0.2788	0.2814	0.2904	0.0644	0.1600	0.2400
2016	0.2798	0.2813	0.2943	0.0649	0.1600	0.2400
2017	0.2805	0.2815	0.2945	0.0667	0.1600	0.2400
2018	0.2822	0.2813	0.2953	0.0651	0.1600	0.2400
2019	0.2811	0.2798	0.2950	0.0660	0.1600	0.2400
2020	0.2797	0.2817	0.2953	0.0646	0.1600	0.2400
2021	0.2785	0.2831	0.2954	0.0672	0.1600	0.2400
2022	0.2791	0.2834	0.2957	0.0651	0.1600	0.2400
2023	0.2759	0.2839	0.2937	0.0642	0.1600	0.2400
2024	0.2756	0.2837	0.2946	0.0620	0.1600	0.2400

SPECIFIC EFs	DUCKS	HORSES	BREEDING PIGS	FATTENING PIGS	SHEEP
YEARS	SOLID [kg NH ₃ /kg N]				
2006	0.1365	0.3500	0.2083	0.1800	0.2800
2007	0.2400	0.3500	0.2093	0.1934	0.2383
2008	0.2400	0.3500	0.2059	0.1914	0.2410
2009	0.2400	0.3500	0.2407	0.2123	0.1826
2010	0.2400	0.3500	0.2481	0.2103	0.1717
2011	0.2400	0.3500	0.2572	0.2088	0.2800
2012	0.2400	0.3500	0.2580	0.2118	0.2800
2013	0.2400	0.3500	0.2679	0.2197	0.2800
2014	0.2400	0.3500	0.2670	0.2297	0.2800
2015	0.2400	0.3500	0.2692	0.2292	0.2800
2016	0.2400	0.3500	0.2719	0.2446	0.2800
2017	0.2400	0.3500	0.2683	0.2482	0.2800
2018	0.2400	0.3135	0.2682	0.2598	0.2800
2019	0.2400	0.3013	0.2714	0.2538	0.2592
2020	0.2400	0.3000	0.2512	0.2585	0.2677
2021	0.2400	0.3033	0.2535	0.2632	0.2535
2022	0.2400	0.3435	0.2514	0.2670	0.2678
2023	0.2400	0.3442	0.2489	0.2673	0.2700
2024	0.2400	0.3500	0.2548	0.2494	0.2702

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.

Table 5.8.11: Country-specific NH₃ emission factors for 3B1a Dairy cattle and background data for the period 1990-2024

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	589.4073	6.9628	70.6904	4.7546
1995	590.2079	8.8287	76.7438	5.1743
2000	591.0165	12.2360	87.7743	6.0509
2005	594.7639	15.1795	97.4854	6.7559
2010	597.8083	15.6194	99.0895	5.4258
2011	597.8601	16.3473	101.4797	5.6382
2012	598.0753	17.2197	104.2673	5.7409
2013	598.3667	17.3421	104.6763	5.8222
2014	598.4987	18.2749	107.7839	6.2549
2015	598.5711	18.3813	107.9831	5.7261
2016	598.6455	19.9936	113.1353	6.0250
2017	598.7007	20.1439	113.9912	5.6189
2018	598.7471	20.4882	115.0983	6.2548
2019	598.8890	20.8233	115.4579	6.1257
2020	598.8890	22.3792	120.4434	6.1324
2021	598.9815	22.6801	121.1391	6.1574
2022	597.7525	23.5471	123.5761	6.2581
2023	597.7612	23.6866	123.6719	6.1391
2024	597.7604	25.3067	128.4138	6.1456

*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 (11), the Annual Census of Domestic Livestock in the Slovak Republic (12), the Statistical Yearbooks 1990–2024, and the research results from projects and studies provided by several organisations 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 the Livestock Census annually on 31st December.

Due to a different regionalisation of Slovakia in the 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 the 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 the 2017 submission, the 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 the regional level were provided by the ŠÚ SR in 2016. Detailed statistical information is available at the regional level and emissions are estimated by the 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 the nutrition of calves (low productive cows) and are included in the non-dairy cattle category. In addition, non-dairy cattle include breeding bulls, oxen, calves, heifer pregnant, un-pregnant heifers and fattening bulls. This categorisation is consistent in whole time series. The number of livestock decreased compared to the previous year in the population of cattle (-3%), sheep (-4.3%) and goats (-10.3%) and increased in the population of poultry (+1.9%), horses (+10.7%), rabbits (+8.4%) and swine (+2.1%). The highest declines were recorded in the swine category (-83.7%) compared to 1990. The main reason for this decrease is the data gap on self-sufficiency - small household farmers and morbidity of animals. Since 2005, livestock numbers have decreased for all farmed species.

Table 5.8.12: Animal population according to the districts for the year 2024

REGION		A	B	C	D	E	F	G	H
DAIRY CATTLE		4,491	18,974	13,865	17,889	19,802	14,558	17,441	7,119
NON-DAIRY CATTLE	Suckling cows	1,667	1,978	4,310	1,900	9,581	18,543	23,941	11,407
	Calves in 6 month (milk sort)	1,608	9,332	5,620	7,612	6,656	4,492	5,642	2,206
	Heifer (milk sort)	1,092	5,574	4 644	5 733	7 688	5 147	6 400	2 579
	Heifer (pregnant) (milk sort)	1,327	4,520	3 052	6 654	4 990	3 053	3 527	1 635
	Fattening (milk sort)	419	8,309	3 656	5 603	3 610	3 296	3 458	1 666
	Oxen (milk sort)	2	3	93	14	380	29	13	4
	Breeding bull (milk sort)	17	70	77	140	271	320	418	194
	Calves in 6 month (beef sort)	597	973	1 747	809	3 220	5 721	7 745	3 535
	Heifer (beef sort)	405	581	1 444	609	3 720	6 556	8 786	4 133
	Heifer (pregnant) (beef sort)	493	471	949	707	2 415	3 889	4 841	2 621

REGION		A	B	C	D	E	F	G	H
	Fattening (beef sort)	155	866	1 137	595	1 747	4 198	4 747	2 669
	Oxen (beef sort)	1	1	29	1	184	38	18	6
	Breeding bull (beef sort)	34	141	155	280	541	639	836	389
SHEEP	Mature ewes	1,698	1,376	20 037	4 906	49 711	59 928	38 637	14 590
	Growing lambs	716	555	6 897	2 341	12 690	18 225	9 072	3 849
	Growing lambs (pregnant)	145	61	2 343	505	7 353	8 478	5 471	1 463
	Other mature sheep	46	36	559	135	1 427	1 710	1 103	401
SWINE	Breeding swine	6,487	16,685	4 471	9 122	339	7 714	499	639
	Fattening swine	12,891	164,608	33 592	105 149	1 718	24 520	5 127	18 752
HORSES	Horses (0-1year)	47	11	30	75	24	21	42	69
	Horses (1-3year)	31	94	132	255	79	70	82	57
	Stallions	209	41	97	86	46	79	74	90
	Mares	356	213	460	498	535	807	476	448
	Castrated stallions	328	159	307	308	361	508	281	300
GOATS	Mature goats	250	238	984	393	1 545	1 328	940	943
	Growing goats (pregnant)	56	7	40	67	578	80	107	59
	Other mature goats	180	97	152	86	237	334	464	454
POULTRY	Laying hens and roosters	509,830	101,972	209 238	562 871	368 666	323 140	15 561	180 154
	Breeding broilers	290,624	51,923	87 814	469 732	0	227 303	30	169 410
	Fattening broilers	28,313	416,582	735 613	1 417 874	508 355	1 776 895	99 270	1 092 618
	Turkeys	4	9,712	168	140 784	32 881	10	7	5
	Ducks	0	26,971	5	159	40	35	11	36
	Geese	0	16	4	0	0	15	3	4
	Rabbits	4,932,892							

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 number of individual animal categories was recorded in the year 2024. By the end of 2024, there were 416.68 thousand head of cattle in Slovakia, which was 13 thousand head less compared to the previous year (-3%). The declining trend in the number of milking cows continued in 2024, with their count reaching only 114.14 thousand head by the end of the year, which is 0.8 thousand head less than in 2023 (-0.7%).

The population of suckling cows decreased during the year, reaching 73.33 thousand head by the end of 2024, showing a year-on-year decrease of 1.2 hundred head (-0.17%). The share of suckling cows in the total number of cows decreased by 25.3 percentage points year-on-year to 63.9%. In the cattle fattening sector, there were 46.1 thousand head of cattle, a decrease of 7.5 thousand head (-14.0%) compared to the previous year.

Selected reproductive indicators of cattle (excluding households) slightly improved interannually. The number of calves born per 100 cows decreased by 1.27 head. Average daily weight gains in cattle fattening reaching 0.734 kg per head per day in 2024. Milk utility increased to 8,630.4 kg of milk per dairy cow per year, an increase of 222.4 kg (+2.58%).

In the year 2024, there was a slight increase in the number of pigs in Slovakia. The total number of pigs reached 412.31 thousand head, showing an interannual increase of 9.28 thousand head (+2.3%). The number of breeding sows increased by 1.9 thousand head (+4.3%) to reach 45.96 thousand head.

The total number of poultry reached 9,854.7 thousand head, representing an increase of 1.9% compared to the status on 31 December 2023. Among them, the number of hens reached 2 220.7 thousand head, showing an interannual decrease of 20.1.7%. The number of roosters reached 50 723 head (-40.7%) and showed an interannual decrease of 34.8 thousand head. The number of chicks was higher by 747 hundred head compared to the previous year. The number of geese decreased by 525 head (-92.6%), whereas the number of ducks decreased by 4,607 head (-14.5%) compared to the previous year, and turkeys increased by 36.8 thousand heads compared to the previous year (+25.0%). Sheep farming in Slovakia has shown a fluctuating trend year-on-year. By the end of the year 2024, there were 276.5 thousand head of sheep, which was a decrease of 12.3 thousand head (-4.3%) compared to the previous year. The number of ewes decreased by 1.1 thousand head (-0.6%) to reach 190.88 thousand head.

The average wool shearing per sheep per year reached 1.8 kg (+7.7%).

5.8.4 Category-specific Recalculations

In 2025, a new software system called SKAgri was developed to calculate greenhouse gas (GHG) and pollutant (ZL) emissions. A key change in its implementation in the emissions inventory was the revision of the essential parameter Nitrogen excretion rate (N_{EX}), which is critical for quantifying emissions of ammonia (NH_3) and nitrogen oxides (NO_x). The differences in the calculations are mainly mathematical in nature, with the most significant deviations in the categories Cattle, Swine, Poultry, and partially Sheep in the period 1990–2023. The NEX calculation methodology remained unchanged. Another significant change was the revision of emission factors for NH_3 in 2006–2023, which included the implementation of an expanded set of emission reduction measures. This set was compiled by a working group composed of representatives of the Ministry of the Environment of the Slovak Republic, the Ministry of Agriculture and Rural Development of the Slovak Republic, and their assigned institutions. The initiative arose from the observation that, after the full implementation of the EMEP/EEA Guidebook 2023, Slovakia was not meeting its NH_3 emission commitments.

Table 5.8.13: Previous and revised NH_3 and NO_x emissions from manure management

YEAR	NH_3 [kt]		CHANGE	NO_x [kt]		CHANGE
	PREVIOUS	REVISED		PREVIOUS	REVISED	
1990	14.5561	22.0916	+51.8%	0.3010	0.4998	+66.0%
1991	12.8985	20.5817	+59.6%	0.2586	0.2148	-16.9%
1992	11.6585	18.2161	+56.2%	0.2289	0.1933	-15.6%
1993	10.1098	15.8135	+56.4%	0.1943	0.1643	-15.4%

YEAR	NH ₃ [kt]		CHANGE	NO _x [kt]		CHANGE
	PREVIOUS	REVISED		PREVIOUS	REVISED	
1994	10.1218	16.2968	+61.0%	0.1909	0.1640	-14.1%
1995	9.8614	15.8241	+60.5%	0.1806	0.1547	-14.3%
1996	9.6399	15.6715	+62.6%	0.1805	0.1549	-14.2%
1997	9.6118	17.6592	+83.7%	0.1781	0.1492	-16.2%
1998	8.5888	16.8021	+95.6%	0.1618	0.1368	-15.5%
1999	8.1714	14.5511	+78.1%	0.1558	0.1325	-15.0%
2000	8.4167	15.0019	+78.2%	0.1640	0.1402	-14.5%
2001	8.7311	15.0093	+71.9%	0.1630	0.1407	-13.7%
2002	8.4294	14.7782	+75.3%	0.1590	0.1382	-13.1%
2003	8.0467	13.8054	+71.6%	0.1447	0.1351	-6.6%
2004	7.2508	12.4345	+71.5%	0.1447	0.1274	-12.0%
2005	7.3843	12.3240	+66.9%	0.1530	0.1347	+17.6%
2006	6.0366	9.1314	+51.3%	0.1561	0.1836	+43.3%
2007	5.7237	8.4437	+47.5%	0.1268	0.1817	+49.9%
2008	5.0456	7.5639	+49.9%	0.1181	0.1770	+41.5%
2009	5.2490	7.7450	+47.6%	0.1201	0.1699	+39.1%
2010	5.0262	7.3087	+45.4%	0.1172	0.1630	+42.5%
2011	4.6245	6.9587	+50.5%	0.1125	0.1603	+34.5%
2012	4.8516	7.0317	+44.9%	0.1152	0.1549	+36.3%
2013	4.5550	7.1706	+57.4%	0.1130	0.1540	+23.8%
2014	4.9326	7.1187	+44.3%	0.1227	0.1519	+23.8%
2015	4.7913	6.9758	+45.6%	0.1175	0.1454	+23.7%
2016	4.3567	6.5405	+50.1%	0.1127	0.1407	+24.8%
2017	4.5853	6.4760	+41.2%	0.1154	0.1256	+8.8%
2018	4.7955	6.7995	+41.8%	0.1216	0.1334	+9.7%
2019	4.6945	6.5464	+39.4%	0.1197	0.1287	+7.5%
2020	4.3965	5.9795	+36.0%	0.1172	0.1244	+6.1%
2021	4.1529	5.7776	+39.1%	0.1120	0.1218	+8.8%
2022	3.9757	5.4081	+36.0%	0.1074	0.1167	+8.7%
2023	3.9106	5.3491	+36.8%	0.1086	0.1143	+5.2%

5.8.5 Particular Matters (PM₁₀, PM_{2.5} and 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.

Total PM_{2.5} from manure management decreased from 0.43 kt in 1990 to 0.10 kt in 2024, which is a decrease of -69.0% compared to a basic year and a decrease of nearly -0.2% compared to the previous year. Total PM₁₀ from manure management decreased from 1.4kt in 1990 to 0.37 kt in 2024, which is a decrease of 72.2% compared to 1990 and a decrease of -0.2% compared to the previous year. Total TSP from manure management decreased from 4.78 kt in 1990 to 5.31 kt in 2024, which is a decrease of 75.8% and a decrease of -15.3% 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:

$$E_{\text{Particular matters}} = AAP_{\text{animal}} \times EF_{\text{pollutant\_animal}}$$

Where:

AAP = annual average population. Number of animals of a particular category that are present, on average, within the year, **EF_{pollutant_animal}** = default emissions factors for pollutants.

5.8.5.2 Emission Factors (PM₁₀, PM_{2.5} and TSP)

PM₁₀, 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 5.8.14](#)). The same emission factors were used for all years.

Table 5.8.14: Default emissions PM and TSP factors

CATEGORIES	EMISSION FACTOR FOR TSP	EMISSION FACTOR FOR PM ₁₀	EMISSION FACTOR FOR 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	0.10
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	0.10
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
GOATS	0.14	0.06	0.02
MATURE EWES	0.14	0.06	0.02
GROWING LAMBS PREGNANT	0.14	0.06	0.02
GROWING LAMBS UNPREGNANT	0.14	0.06	0.02
RAMS	0.14	0.06	0.02
MATURE EWES	0.14	0.06	0.02
GROWING LAMBS PREGNANT	0.14	0.06	0.02
GROWING LAMBS UNPREGNANT	0.14	0.06	0.02
RAMS	0.14	0.06	0.02
RABBITS	0.02	0.01	0.004

5.8.5.3 Activity Data

The number of livestock is described in [Chapter 5.8.3](#).

5.8.5.4 Category-specific Recalculations

In category **3B** Manure management, based on the TERT recommendation, a revision of PM₁₀ (1990-2023) and PM_{2.5} emission calculations was implemented. Originally, the proportions of time when animals are housed were not taken into account, which led to an overestimation of PM emissions according to the EMEP/EEA Guidebook 2023. The implementation of Tier 1 emission factors scaled according to the proportion of housing for individual categories of farm animals led to a recalculation of the entire time series of TSP, PM₁₀, and PM_{2.5} emissions.

The recalculations in TSP and PMs emissions from manure management are summarised in [Table 5.8.15](#).

Table 5.8.15: Previous and revised TSP, PM_{2.5} and PM₁₀ emissions from manure management

YEAR	PM ₁₀ [kt]		CHANGE	PM _{2.5} [kt]		CHANGE	TSP [kt]		CHANGE
	P	R		P	R		P	R	
1990	1.4936	1.3159	-11.9%	0.4340	0.3315	-23.6%	5.7407	5.3109	-7.5%
1991	1.3559	1.1922	-12.1%	0.3884	0.2947	-24.1%	5.4042	5.0073	-7.3%
1992	1.2244	1.0789	-11.9%	0.3361	0.2552	-24.1%	4.8557	4.5027	-7.3%
1993	1.1354	1.0177	-10.4%	0.2953	0.2255	-23.6%	4.6741	4.3825	-6.2%
1994	1.2361	1.0812	-12.5%	0.2969	0.2265	-23.7%	4.7176	4.3881	-7.0%
1995	1.1385	1.0154	-10.8%	0.2838	0.2195	-22.7%	4.6212	4.3122	-6.7%
1996	1.1088	0.9980	-10.0%	0.2727	0.2126	-22.0%	4.4887	4.2022	-6.4%
1997	1.0875	0.9994	-8.1%	0.2710	0.2139	-21.1%	4.2783	4.0394	-5.6%
1998	0.9672	0.8780	-9.2%	0.2410	0.1912	-20.7%	3.7874	3.5465	-6.4%
1999	0.9233	0.8321	-9.9%	0.2295	0.1816	-20.9%	3.6241	3.3797	-6.7%
2000	0.9355	0.8466	-9.5%	0.2274	0.1808	-20.5%	3.6089	3.3669	-6.7%
2001	1.0196	0.9376	-8.0%	0.2285	0.1851	-19.0%	4.0163	3.7888	-5.7%
2002	0.9486	0.8655	-8.8%	0.2194	0.1760	-19.8%	3.7216	3.4914	-6.2%
2003	0.9162	0.8341	-9.0%	0.2103	0.1685	-19.9%	3.5952	3.3660	-6.4%
2004	0.8383	0.7641	-8.9%	0.1953	0.1568	-19.7%	3.1860	2.9746	-6.6%
2005	0.8359	0.7619	-8.9%	0.1933	0.1555	-19.6%	3.1440	2.9317	-6.8%
2006	0.8034	0.7301	-9.1%	0.1842	0.1478	-19.8%	3.0912	2.8776	-6.9%
2007	0.7779	0.7075	-9.1%	0.1812	0.1456	-19.6%	2.9448	2.7366	-7.1%
2008	0.6969	0.6320	-9.3%	0.1712	0.1371	-19.9%	2.6286	2.4276	-7.6%
2009	0.7459	0.6828	-8.5%	0.1705	0.1378	-19.2%	2.8028	2.5962	-7.4%
2010	0.7261	0.6614	-8.9%	0.1678	0.1346	-19.8%	2.7244	2.5224	-7.4%
2011	0.6721	0.6113	-9.0%	0.1616	0.1295	-19.9%	2.5254	2.3316	-7.7%
2012	0.6936	0.6287	-9.4%	0.1639	0.1310	-20.1%	2.6168	2.4129	-7.8%
2013	0.6668	0.6022	-9.7%	0.1606	0.1280	-20.3%	2.4998	2.3008	-8.0%
2014	0.6890	0.6256	-9.2%	0.1617	0.1274	-21.2%	2.5418	2.3416	-7.9%
2015	0.6992	0.6371	-8.9%	0.1601	0.1274	-20.4%	2.6082	2.4112	-7.6%
2016	0.6715	0.6119	-8.9%	0.1544	0.1228	-20.5%	2.5138	2.3219	-7.6%
2017	0.6944	0.6334	-8.8%	0.1555	0.1241	-20.2%	2.5613	2.3657	-7.6%
2018	0.7146	0.6569	-8.1%	0.1567	0.1256	-19.8%	2.6472	2.4572	-7.2%
2019	0.6692	0.6155	-8.0%	0.1508	0.1208	-19.9%	2.4640	2.2818	-7.4%
2020	0.5433	0.5001	-8.0%	0.1397	0.1120	-19.8%	1.9243	1.7528	-8.9%
2021	0.5219	0.4803	-8.0%	0.1368	0.1092	-20.2%	1.8143	1.6462	-9.3%

YEAR	PM ₁₀ [kt]		CHANGE	PM _{2.5} [kt]		CHANGE	TSP [kt]		CHANGE
	P	R		P	R		P	R	
2022	0.4953	0.4528	-8.6%	0.1341	0.1066	-20.5%	1.7217	1.5510	-9.9%
2023	0.4939	0.4525	-8.4%	0.1334	0.1066	-20.1%	1.6856	1.5170	-10.0%

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 5.8.16-Table 5.8.18](#)).

NMVOC for cattle is based on the following equations (13):

$$\begin{aligned}
 E_{NMVOC\ i} &= AAP_{animal} \times (E_{NMVOC.silage\ store} + E_{NMVOC.silage\ feeding} + E_{NMVOC.house} + E_{NMVOC.appl} + E_{NMVOC.graz}) \\
 E_{NMVOC.silage\ store\ i} &= MJ \times x_{house} \times (EF_{NMVOC.silage\ feeding} \times Frac_{of\_maxsilage}) \times Frac_{silage\_store} \\
 E_{NMVOC.silage\ feeding} &= MJ \times x_{house} \times (EF_{NMVOC.feed\ silage\ i} \times Frac_{of\_maxsilage}) \\
 E_{NMVOC.house} &= MJ \times x_{house} \times (EF_{NMVOC.silage}) \\
 E_{NMVOC.manure\ store} &= E_{NMVOC.house} \times x_{house} \times \left(\frac{E_{NH_3\ storage}}{E_{NH_3\ house}} \right) \\
 E_{NMVOC.appl} &= E_{NMVOC.house} \cdot x_{house} \cdot \left(\frac{E_{NH_3\ applt}}{E_{NH_3\ house}} \right) \\
 E_{NMVOC.graz} &= MJ \times (1 - x_{house}) \cdot EF_{NMVOC.graz}
 \end{aligned}$$

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 5.8.16: 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 _{solid_application} [kt]	E _{pasture} [kt]
1990	95 606	0.5146	0.3797	0.8662	0.0818	1.0196	0.6286	5.3622	1.2122
1991	90 071	0.5026	0.3079	0.8008	0.0663	0.9426	0.5096	4.9572	1.1030
1992	90 184	0.5053	0.2615	0.6729	0.0563	0.7920	0.4329	4.1652	0.9279
1993	90 728	0.5057	0.2506	0.6491	0.0540	0.7640	0.4149	4.0181	0.8945
1994	91 556	0.5057	0.2447	0.6378	0.0527	0.7507	0.4050	3.9483	0.8783
1995	92 447	0.5057	0.2385	0.6255	0.0514	0.7363	0.3948	3.8724	0.8608
1996	92 731	0.5057	0.2254	0.5943	0.0485	0.6995	0.3730	3.6791	0.8173
1997	94 338	0.5049	0.2752	0.7550	0.0592	0.8887	0.4555	4.6739	1.0338
1998	95 625	0.5004	0.2538	0.6993	0.0546	0.8231	0.4201	4.3291	0.9571
1999	96 477	0.5062	0.2517	0.6648	0.0542	0.7826	0.4166	4.1158	0.9141
2000	98 771	0.5052	0.2466	0.6606	0.0531	0.7776	0.4081	4.0898	0.9069
2001	100 412	0.5110	0.2407	0.6511	0.0516	0.7623	0.3980	4.0280	0.8929
2002	101 109	0.5101	0.2313	0.6718	0.0496	0.7868	0.3825	4.1560	0.9143
2003	101 531	0.5125	0.2305	0.6279	0.0494	0.7347	0.3812	3.8841	0.8605
2004	101 827	0.5147	0.2179	0.5938	0.0466	0.6938	0.3602	3.6722	0.8136
2005	102 927	0.5151	0.2077	0.6052	0.0444	0.7057	0.3432	3.7421	0.8235
2006	104 118	0.5173	0.2318	0.5591	0.0488	0.5809	0.3413	3.1431	0.7770
2007	104 676	0.5174	0.2055	0.5664	0.0432	0.5929	0.3020	3.1742	0.7752
2008	105 371	0.5186	0.1998	0.5504	0.0419	0.5745	0.2936	3.0841	0.7533
2009	103 978	0.5175	0.1927	0.4997	0.0400	0.5193	0.2810	2.7797	0.6885
2010	103 901	0.5190	0.1955	0.4845	0.0406	0.5086	0.2849	2.6908	0.6710
2011	105 628	0.5228	0.1981	0.4783	0.0409	0.5062	0.2887	2.6537	0.6645
2012	106 895	0.5215	0.1913	0.4816	0.0395	0.5055	0.2785	2.6730	0.6658
2013	107 906	0.5223	0.1979	0.4618	0.0372	0.4833	0.2896	2.5639	0.6444
2014	104 803	0.5199	0.1774	0.4690	0.0328	0.4842	0.2591	2.5996	0.6448
2015	109 602	0.5168	0.1575	0.4625	0.0289	0.4702	0.2302	2.5629	0.6288
2016	111 167	0.5131	0.1618	0.4596	0.0296	0.4677	0.2363	2.5465	0.6270
2017	112 583	0.5118	0.1404	0.4300	0.0251	0.4354	0.2043	2.3796	0.5821
2018	104 551	0.5101	0.1700	0.4467	0.0308	0.4575	0.2490	2.4869	0.6145
2019	104 535	0.5094	0.1483	0.4475	0.0269	0.4565	0.2175	2.4935	0.6067
2020	104 898	0.5148	0.1475	0.4347	0.0269	0.4420	0.2163	2.4236	0.5908
2021	116 507	0.5163	0.1322	0.4447	0.0127	0.3683	0.1547	2.0069	0.5967
2022	117 893	0.5135	0.1298	0.4411	0.0133	0.3963	0.1443	1.8990	0.5913
2023	126 105	0.5135	0.1293	0.3011	0.0170	0.2842	0.2030	1.5855	0.5913
2024	126 105	0.5135	0.1293	0.3011	0.0170	0.2842	0.2030	1.5855	0.5913

*all parameters are weighted averages representing aggregation in level SR

Table 5.8.17: 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 _{solid_application} [kt]	E _{pasture} [kt]
1990	45,558	0.2539	0.6173	2.1166	0.1329	2.0473	1.0217	10.7673	1.8868
1991	44,203	0.2520	0.5178	1.9257	0.1115	1.8680	0.8572	9.8247	1.7783
1992	46,541	0.2475	0.4388	1.6435	0.0945	1.5928	0.7264	8.3773	1.5742
1993	46,395	0.2451	0.3792	1.3933	0.0816	1.3764	0.6276	7.2392	1.3847
1994	45,463	0.2369	0.3431	1.2694	0.0739	1.2682	0.5680	6.6700	1.2919
1995	46,019	0.2441	0.3593	1.2711	0.0773	1.2458	0.5947	6.5522	1.2969

NON-DAIRY CATTLE	BE [MJ/year]	FRACTION OF SILAGE	E _{Housing_slurry} [kt]	E _{Housing_solids} [kt]	E _{Storage_slurry} [kt]	E _{Storage_FYM} [kt]	E _{Slurry_application} [kt]	E _{Soild_application} [kt]	E _{pasture} [kt]
1996	45,711	0.2487	0.3425	1.2328	0.0737	1.2087	0.5669	6.3568	1.2507
1997	40,483	0.2872	0.3612	1.1410	0.0778	1.1753	0.5978	6.1811	1.1284
1998	41,767	0.2955	0.3291	1.0400	0.0708	1.0787	0.5447	5.6734	1.0552
1999	42,762	0.2800	0.3360	1.0068	0.0723	1.0446	0.5562	5.4937	1.0233
2000	43,489	0.2769	0.3164	0.9887	0.0681	1.0336	0.5237	5.4359	1.0321
2001	43,695	0.2846	0.3020	0.9496	0.0648	0.9925	0.4995	5.2384	1.0069
2002	44,186	0.2720	0.2835	0.9456	0.0608	0.9970	0.4689	5.2618	1.0367
2003	44,306	0.2654	0.2856	0.9242	0.0612	0.9637	0.4723	5.0886	1.0121
2004	44,813	0.2703	0.2656	0.8549	0.0569	0.8959	0.4391	4.7349	0.9480
2005	45,349	0.2687	0.2543	0.8875	0.0544	0.9372	0.4204	4.9600	0.9618
2006	46,333	0.2599	0.2798	0.8567	0.0590	0.7931	0.4208	4.3315	0.9562
2007	46,527	0.2606	0.2549	0.8657	0.0538	0.8320	0.3838	4.4469	0.9527
2008	47,247	0.2503	0.2734	0.9389	0.0575	0.8645	0.4023	4.6333	0.9276
2009	47,214	0.2608	0.2310	0.7745	0.0482	0.7223	0.3372	3.8524	0.8774
2010	48,384	0.2301	0.2327	0.7724	0.0484	0.7251	0.3396	3.8283	0.8914
2011	48,585	0.2289	0.2346	0.7659	0.0486	0.7257	0.3423	3.9037	0.8835
2012	48,599	0.2227	0.2335	0.8041	0.0484	0.7548	0.3404	3.9549	0.9292
2013	49,187	0.2255	0.2442	0.7968	0.0462	0.7630	0.3580	3.8838	0.9280
2014	47,343	0.2365	0.2191	0.8290	0.0407	0.7708	0.3209	4.0728	0.9678
2015	50,233	0.2242	0.1943	0.8249	0.0359	0.7580	0.2847	4.0495	0.9664
2016	50,099	0.2156	0.1984	0.8180	0.0366	0.7546	0.2905	4.0098	0.9606
2017	51,499	0.2213	0.1887	0.8192	0.0342	0.7449	0.2758	3.9726	0.9523
2018	45,000	0.2221	0.2222	0.8591	0.0407	0.7912	0.3267	4.2110	1.0059
2019	44,998	0.2211	0.2003	0.8540	0.0367	0.7852	0.2950	4.2016	0.9933
2020	45,200	0.2232	0.2038	0.8702	0.0375	0.7945	0.3002	4.2592	1.0056
2021	48,187	0.2181	0.1884	0.8561	0.0182	0.6455	0.2228	3.4154	1.0022
2022	48,290	0.2166	0.1848	0.8564	0.0197	0.7027	0.2099	3.2783	1.0020
2023	51,933	0.2185	0.1842	0.6108	0.0249	0.5836	0.2946	3.0838	1.0020
2024	48,904	0.2118	0.1842	0.6108	0.0249	0.5836	0.2946	30838	1.0020

*all parameters are weighted averages representing aggregation in level SR

Table 5.8.18: Overview of emissions factors for dairy cattle categories

NMVOC EMISSION FACTORS							
EF _{NMVOC} :Silage feeding*	[kg NMVOC]	0.000200	0.000200	0.000200	0.000200	0.000200	0.000200
	[kg/MJ feed intake]						
EF _{NMVOC} house*	[kg NMVOC]	0.000035	0.000035	0.000035	0.000035	0.000035	0.000035
	[kg/MJ feed intake]						
EF _{NMVOC} graz*	[kg NMVOC]	0.000007	0.000007	0.000007	0.000007	0.000007	0.000007
	[kg/MJ feed intake]						

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 summarised in [Table 5.8.19](#). There is no evidence about adding silage to the feeding ratio for other animal categories.

Table 5.8.19: 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
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 were made due to a wrong transcription between the spreadsheet and the template in last year. In 2023, submission correction of calculation errors in the distribution of swine population to the categories. The total number of animals in the category remains unchanged. Emissions of NMVOC from manure management were recalculated. The animal subcategory of Weaners had aggregated „Breeding pigs 21–50 kg“ and „Fattening pigs up to 50 kg“. This was modified in this submission for Weaners to account only for the first group, remainder of the animals were aggregated in the animal subcategory Fattening pigs, in which this group has been assigned a lower NMVOC emission factor. In addition, an incorrect cell reference caused EF to be multiplied by zero for two of the three subcategories under Breeding swine from 1990 to 2023, causing the main share of the underestimation in the 2024 submission.

Table 5.8.20: The impact of recalculations of NMVOC emissions from manure management

YEAR	NMVOC [kt]		CHANGE
	2024	2025	
1990	20.7542	20.7542	0.0%
1991	17.3810	17.7023	+1.8%
1992	15.3319	15.6155	+1.8%
1993	13.6321	13.9165	+2.1%
1994	13.3634	13.6537	+2.2%
1995	13.0719	13.3678	+2.3%
1996	12.6945	12.9741	+2.2%
1997	12.9103	13.1601	+1.9%
1998	11.6342	11.8563	+1.9%
1999	10.9882	11.1808	+1.8%
2000	10.9504	11.1354	+1.7%
2001	11.2118	11.3679	+1.4%
2002	10.8132	11.0164	+1.9%
2003	10.3670	10.5273	+1.5%
2004	9.5978	9.7026	+1.1%
2005	9.5942	9.6986	+1.1%

YEAR	NMVOC [kt]		CHANGE
	2024	2025	
2006	8.8119	8.9214	+1.2%
2007	8.7357	8.8240	+1.0%
2008	8.1824	8.2475	+0.8%
2009	8.3059	8.1422	-2.0%
2010	7.8593	7.9115	+0.7%
2011	7.7121	7.7646	+0.7%
2012	7.6653	7.7237	+0.8%
2013	7.5086	7.5687	+0.8%
2014	7.3798	7.4605	+1.1%
2015	7.5759	7.6285	+0.7%
2016	7.2430	7.3160	+1.0%
2017	7.3627	7.4369	0.0%
2018	6.9664	7.0130	+0.7%
2019	6.7511	6.7984	+0.7%
2020	6.2847	6.3397	+0.9%
2021	6.1037	6.1272	+0.4%
2022	5.8993	5.9264	+0.5%
2023	6.3804	6.4123	+0.5%

5.9 AGRICULTURAL SOILS (NFR 3D)

Emitted gas: NH₃, NMVOC, NO_x, TSP, PM₁₀, PM_{2.5}

Methods: Tier 1, Tier 2

Emission factors: D

Key sources: Yes

Significant subcategories: Inorganic N-fertilizers, Animal manure applied to the soils

The NFR sector **3D** contains NH₃ and NO_x 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. 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 has been stable with small fluctuations caused by changes in animal population and inter-annual changes in categories **3D1** – Inorganic Nitrogen Fertilizers.

Table 5.9.1: NH₃ 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	3Da4 CROP RESIDUES APPLIED TO SOILS
1990	11.2810	38.2183	4.3E-03	0.0394	5.8531	0.6125
1995	3.8765	25.6568	2.7E-03	0.0363	3.6838	0.3990
2000	4.4202	24.1357	1.1E-03	0.0744	3.4545	0.2365
2005	6.1834	20.0203	3.5E-03	0.0083	2.8322	0.2521

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	3Da4 CROP RESIDUES APPLIED TO SOILS
2010	6.8726	10.7089	8.7E-03	0.0542	2.3226	0.1937
2011	7.1930	10.5315	4.5E-03	0.1050	2.3162	0.1792
2012	7.7678	10.2515	7.5E-03	0.1072	2.2116	0.1688
2013	9.0144	10.3693	4.9E-03	0.2796	2.1824	0.1865
2014	9.4360	10.0078	3.0E-03	0.3929	2.1249	0.2026
2015	8.2534	9.6528	3.5E-03	0.1577	2.0225	0.1687
2016	10.5436	9.2535	4.9E-03	0.3285	1.9640	0.1976
2017	12.0995	8.4927	1.6E-03	0.3102	1.7147	0.1613
2018	11.9247	8.8854	1.2E-03	0.3145	1.7722	0.1828
2019	11.8115	8.6654	2.0E-04	0.3506	1.7173	0.1914
2020	10.4755	8.2428	4.2E-06	0.2549	1.6855	0.1937
2021	11.0170	7.9264	4.3E-06	0.2999	1.6455	0.1823
2022	9.8124	7.5369	4.3E-06	0.2550	1.6013	0.1421
2023	11.0761	7.4309	NO	0.2108	1.5604	0.1950
2024	10.0771	5.0329	NO	0.2661	1.1367	0.1811

Table 5.9.2: NO_x emissions (kt) in agricultural soils according to the subcategories in particular years

YEAR	3D NO _x 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	8.8902	3.7510	1.3E-02	0.0197	4.0456	16.7197
1995	2.7835	1.8756	8.3E-03	0.0181	1.6312	6.3168
2000	3.3844	1.6294	3.4E-03	0.0372	1.4638	6.5182
2005	3.9904	1.4972	1.1E-02	0.0041	1.3548	6.8573
2010	4.2605	1.7622	2.7E-03	0.0271	1.7644	7.8169
2011	4.8222	1.6960	1.4E-03	0.0525	1.7626	8.3347
2012	4.0402	1.6922	2.3E-03	0.0536	1.6937	7.4819
2013	4.5433	1.6997	1.5E-03	0.1398	1.6852	8.0695
2014	4.7614	1.6827	9.0E-04	0.1965	1.6404	8.2819
2015	4.5909	1.6508	1.1E-03	0.0788	1.5734	7.8950
2016	5.0494	1.5816	1.5E-03	0.1642	1.5321	8.3289
2017	4.9016	1.5244	5.0E-04	0.1551	1.3734	7.9951
2018	5.1591	1.6067	4.0E-04	0.1573	1.4028	8.3262
2019	5.1413	1.5562	1.0E-04	0.1753	1.3546	8.2275
2020	5.1071	1.4287	1.0E-06	0.1274	1.3228	7.9860
2021	5.0998	1.3906	1.0E-06	0.1499	1.2905	7.9308
2022	4.6139	1.3119	1.0E-06	0.1275	1.2659	7.3191
2023	4.3042	1.3010	NO	0.1054	1.2349	6.9455
2024	4.2792	1.3478	NO	0.1330	1.2410	7.0011

Figure 5.9.1: The share of NH_3 emissions by categories within agricultural soils in 2024

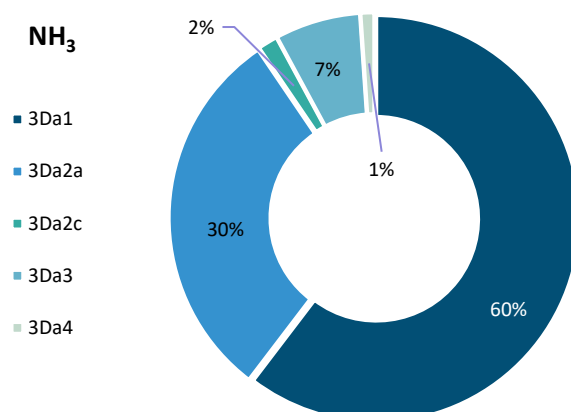
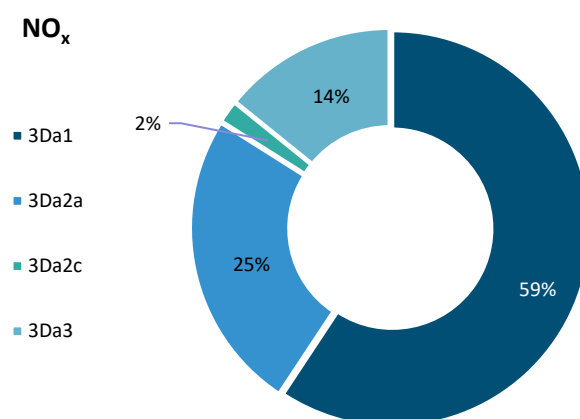


Figure 5.9.2: The share of NO_x emissions by categories within agricultural soils in 2024



5.9.1 Activity Data

Data on sown areas were taken from the ŠÚ SR. Data is available on 20 May every year ([Table 5.9.3](#)).

Table 5.9.3: A Sowing area in thousand hectares for the years 1990-2024

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

YEAR	WHEAT	RYE	OIL PLANTS	GRASS	BARLEY	OAT
	[ha]					
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
2023	405,775	11,756	272,899	501,258	113,619	10,083
2024	380,773	7,709	270,344	497,855	117,236	12,349
1990/2024	-8%	-81%	+303%	-39%	-41%	-14%
2023/2024	-6%	-34%	-1%	-1%	+3%	+22%

5.9.2 Inorganic N Fertilizers (NFR 3Da1)

The amounts of synthetic fertilisers applied to cultivated soils were very low in the last 15 years. At present, the consumption of synthetic fertilizers applied to agricultural soils has increased again. This fact is the main driver in increasing emissions in the sector. The potential for the volatilisation of ammonia emissions can vary in a wide range. The best available information on NH₃ emissions from cultivated soils in the Slovak Republic is based on the amount of applied nitrogen fertilizers. Emissions also depend on the type of fertilizers, soil parameters (pH), meteorological conditions and time of fertilizers' application concerning crop development. Data on the quantity of applied nitrogen fertilizers were provided by the ŠÚ SR.

5.9.2.1 Activity Data

Activity data on synthetic fertilizers consumption are based on the combination of two databases. IFASTAT and the 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 types of fertilizers was taken from the IFASTAT (1990-2017). The data were disseminated according to Act No 202/2008 Coll. (14) on fertilizers. The farmers have an obligation to report the amount of applied fertilizers to the UKSÚP each year. The UKSÚP as the institution in charge of managing databases, runs the validation each year.

The consumption of synthetic fertilizers decreased during the last decade of the 20th century, from 222 kt in 1990 to 107 kt in 2024 (-51.9%). Consumption of synthetic fertilizers increased by +7.2% in 2024 compared with 2005 and then decreased by almost -0.6% in comparison with the year 2023. 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 5.9.4: Input parameters in 3Da1 Inorganic N fertilizers

YEAR	TYPE OF FERTILIZERS [t]				
	AMMONIUM NITRATE	AMMONIUM SULPHATE	CALC. AMM. NITRATE	NITROGEN SOLUTIONS	OTHER N STRAIGHT
1990	85,356	22,156	55,114	1,731	NO
1995	16,000	6,100	24,200	7,600	NO
2000	2,200	4,900	29,000	10,000	8,700
2005	3,000	10,000	31,000	9,000	NO
2010	4,000	9,000	33,000	2,000	NO
2011	2,000	1,000	40,000	17,000	6,000
2012	NO	1,000	41,000	18,000	7,000

YEAR	TYPE OF FERTILIZERS [t]				
	AMMONIUM NITRATE	AMMONIUM SULPHATE	CALC. AMM. NITRATE	NITROGEN SOLUTIONS	OTHER N STRAIGHT
2013	NO	2,000	45,000	18,000	12,000
2014	2,000	2,000	45,000	15,000	15,000
2015	2,000	1,300	44,000	17,000	14,000
2016	2,000	1,600	42,800	18,100	13,600
2017	NO	2,000	40,000	23,600	NO
2018	1,100	1,103	31,983	16,463	25,966
2019	880	1,365	34	16,814	53,258
2020	1,413	1,346	85	NO	75,610
2021	1,394	1,744	34,465	40	34,138
2022	714	1,393	32,489	0	31,181
2023	4,605	14,140	23,248	0	18,824
2024	3,938	15,150	23,638	0	16,813

YEAR	TYPE OF FERTILIZERS [t]				
	UREA	AMMONIUM PHOSPHATE	NK COMPOUND	NPK COMPOUND	OTHER NP
1990	8,239	1,939	NO	49,220	500
1995	3,787	NO	NO	11,400	500
2000	3,553	900	11,956	12,600	800
2005	8,317	5,000	18,443	15,000	NO
2010	11,873	1,000	19,640	26,000	NO
2011	13,969	1,000	27,586	12,000	NO
2012	19,004	1,000	NO	12,000	2,000
2013	25,581	1,000	NO	10,000	NO
2014	28,036	1,000	NO	10,000	1,000
2015	19,473	1,000	NO	14,000	2,000
2016	30,536	3,300	NO	12,300	2,000
2017	37,741	1,600	900	12,000	4,700
2018	41,299	1,125	NO	9,939	NO
2019	39,779	1,717	3,348	10,982	355
2020	39,434	NO	NO	9,461	328
2021	40,615	0	18	11,193	3,888
2022	35,930	0	32	10,090	3,517
2023	40,900	1,212	39	7,427	784
2024	39,209	306	0	7,400	527

5.9.2.2 Methodological Issues

NH₃ emissions from Inorganic-N fertilizers were calculated using the Tier 2 methodology according to the EMEP/EEA GB 2023. To reflect average Slovak conditions, the emission factors for a cool climate and a pH value lower than 7 were chosen. NO_x was calculated using the simpler Tier 1 methodology. Slovakia still uses emission factors from the previous version of the EMEP/EEA GB 2023.

Table 5.9.5: Emission factors per fertilizer type

TYPE OF FERTILIZERS	EMISSION FACTOR FOR NORMAL PH [g NH ₃ (kg N applied) ⁻¹]
Ammonium nitrate (AN)	24
Ammonium sulphate (AS)	84
Calcium ammonium nitrate (CAN)	24
N solutions	87

TYPE OF FERTILIZERS	EMISSION FACTOR FOR NORMAL PH [g NH ₃ (kg N applied ⁻¹)]
Other straight N compounds	24
Urea	195
Ammonium phosphates (AP)	84
NK Mixtures	24
NPK Mixtures	84
NP Mixtures	84

Table 5.9.6: Input parameters and EFs in 3Da1 Inorganic N fertilizers in particular years

YEAR	NITROGEN INPUT INTO SOILS	EMISSION FACTOR FOR NH ₃	EMISSION FACTOR FOR NO _x	NH ₃	NO _x
	[kg/year]	[kg NH ₃ /kg N]	[kg NO _x /kg N]	[kt]	[kt]
1990	222,255,000	0.0508	0.04	11.2810	8.8902
1995	69,587,000	0.0557	0.04	3.8765	2.7835
2000	84,609,000	0.0522	0.04	4.4202	3.3844
2005	99,760,000	0.0620	0.04	6.1834	3.9904
2010	106,513,000	0.0645	0.04	6.8726	4.2605
2011	120,555,000	0.0597	0.04	7.1930	4.8222
2012	101,004,000	0.0769	0.04	7.7678	4.0402
2013	113,581,390	0.0794	0.04	9.0144	4.5433
2014	119,036,050	0.0793	0.04	9.4360	4.7614
2015	114,773,000	0.0719	0.04	8.2534	4.5909
2016	126,235,769	0.0835	0.04	10.5436	5.0494
2017	122,541,152	0.0987	0.04	12.0995	4.9016
2018	128,976,885	0.0925	0.04	11.9247	5.1591
2019	128,532,971	0.0919	0.04	11.8115	5.1413
2020	127,676,520	0.0820	0.04	10.4755	5.1071
2021	127,494,597	0.0864	0.04	11.0170	5.0998
2022	115,346,776	0.0851	0.04	9.8124	4.6139
2023	107,607,314	0.0996	0.04	11.0761	4.3042
2024	106,980,141	0.0942	0.04	10.0771	4.2792
1990/2024	-52%	-	-	-11%	-52%
2023/2024	-1%	-	-	-9%	-1%

5.9.3 Animal Manure Applied to the Soils (NFR 3Da2a) NH₃, 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 utilisation of NH₃, PMs, NMVOC, N₂O and NO_x losses. A detailed description of the methods applied for the calculation of N₂O 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, a country-specific methodology was applied.

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 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 decrease.

5.9.3.1 Activity Data

See [Chapter 5.8.3](#).

5.9.3.2 Methodological Issues - NH₃, NO_x

Default NH₃ 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 the default by approximately -10%.

Table 5.9.7: 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	0.5337	0.5392	NO	NO	0.2442	0.3540
2007	0.5319	0.5398	NO	NO	0.2308	0.3403
2008	0.5319	0.5398	NO	NO	0.2166	0.3229
2009	0.5325	0.5382	NO	NO	0.2401	0.3156
2010	0.5270	0.5400	NO	NO	0.2250	0.3015
2011	0.5152	0.5361	NO	NO	0.2359	0.3221
2012	0.5131	0.5351	NO	NO	0.2273	0.3135
2013	0.5139	0.5347	NO	NO	0.2151	0.3075
2014	0.5157	0.5364	NO	NO	0.2061	0.2936
2015	0.5143	0.5381	NO	NO	0.2052	0.2778
2016	0.5116	0.5329	NO	NO	0.2064	0.2528
2017	0.5110	0.5318	NO	NO	0.2000	0.2598
2018	0.5111	0.5324	NO	NO	0.2129	0.2956
2019	0.5093	0.5319	NO	NO	0.2163	0.2871
2020	0.5074	0.5336	NO	NO	0.2183	0.2845
2021	0.5071	0.5364	NO	NO	0.2158	0.2835
2022	0.5074	0.5370	NO	NO	0.2055	0.2720
2023	0.5065	0.5370	NO	NO	0.2068	0.2766
2024	0.5065	0.5349	NO	NO	0.2560	0.2765

Table 5.9.8: 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
YEARS	SOLID [kg NH ₃ /kg N]					
2006	0.4571	0.4533	0.1122	0.0902	0.0876	0.0968
2007	0.4564	0.4482	0.1013	0.0818	0.3398	0.3915
2008	0.4594	0.4474	0.1041	0.0696	0.3381	0.3855

SPECIFIC EFs	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	LAYING HENS	GEESE	TURKEYS
YEARS	SOLID [kg NH ₃ /kg N]					
2009	0.4528	0.4439	0.0818	0.0648	0.3750	0.4436
2010	0.4503	0.4425	0.0762	0.0830	0.3745	0.4383
2011	0.4485	0.4440	0.0709	0.0929	0.0833	0.0947
2012	0.4508	0.4441	0.0686	0.0968	0.0252	0.0281
2013	0.4510	0.4461	0.0863	0.1247	0.2267	0.2295
2014	0.4467	0.4459	0.0666	0.1078	0.0391	0.0443
2015	0.4590	0.4475	0.0661	0.0815	0.0320	0.0372
2016	0.4625	0.4515	0.0731	0.0811	0.1250	0.1466
2017	0.4645	0.4552	0.0741	0.0847	0.1153	0.1335
2018	0.4694	0.4563	0.0817	0.0710	0.0820	0.0942
2019	0.4692	0.4542	0.0622	0.0627	0.1165	0.1340
2020	0.4695	0.4512	0.0414	0.0896	0.1137	0.1238
2021	0.4685	0.4514	0.0533	0.0963	0.0900	0.0942
2022	0.4684	0.4481	0.0503	0.0833	0.1508	0.1586
2023	0.4713	0.4485	0.0465	0.0888	0.1198	0.1198
2024	0.4703	0.4482	0.0452	0.0790	0.0975	0.975

SPECIFIC EFs	DUCKS	HORSES	BREEDING SWINE	FATTENING SWINE	SHEEP
YEARS	SOLID [kg NH ₃ /kg N]				
2006	0.0968	0.5152	0.3313	0.3119	0.7122
2007	0.3915	0.6238	0.3331	0.3150	0.6393
2008	0.3855	0.6171	0.3518	0.3267	0.6322
2009	0.4436	0.5889	0.3215	0.3332	0.6808
2010	0.4383	0.5635	0.3370	0.3535	0.6759
2011	0.0947	0.5663	0.2771	0.3064	0.6560
2012	0.0281	0.5400	0.2751	0.3128	0.6569
2013	0.2295	0.5389	0.3021	0.3160	0.6408
2014	0.0443	0.4923	0.2541	0.3082	0.6182
2015	0.0372	0.5202	0.2492	0.2773	0.5916
2016	0.1466	0.4984	0.2357	0.2503	0.5751
2017	0.1335	0.5303	0.2391	0.2566	0.5770
2018	0.0942	0.5311	0.2175	0.1977	0.5637
2019	0.1340	0.5361	0.2206	0.2212	0.5717
2020	0.1238	0.5700	0.2153	0.2427	0.5332
2021	0.0942	0.6075	0.2121	0.2478	0.5525
2022	0.1586	0.5655	0.1938	0.2349	0.5485
2023	0.1198	0.5271	0.1912	0.2421	0.5184
2024	0.0975	0.4957	0.1460	0.2730	0.5067

The default NO_x emission factor of the EMEP/EEA GB 2023 for spreading was used, NH₃ emissions were calculated by using the nitrogen flow approach, similarly to the calculation of EFs for emissions from housing and storage.

5.9.3.3 Methodological Issues- – NMVOC

Cattle

All references for calculation are in [Chapter 5.8.6.2](#). The used notation key is IE.

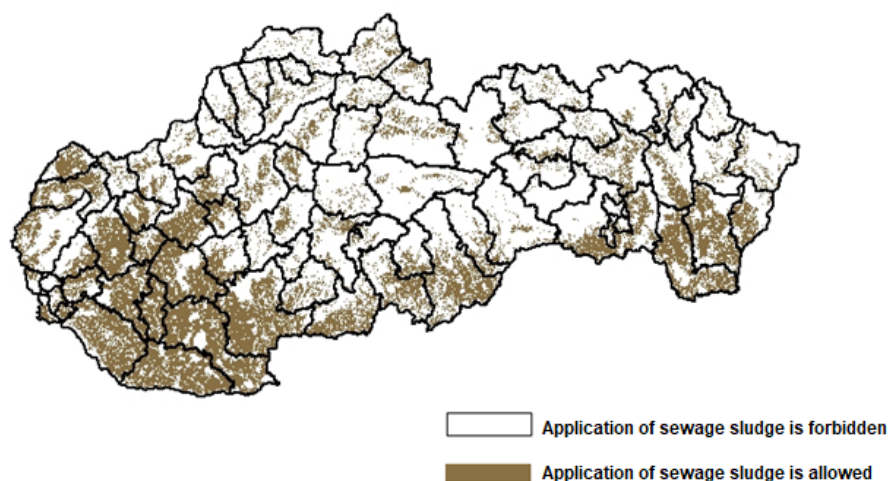
5.9.4 Sewage Sludge Applied to Soils (NFR 3Da2b)

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 stabilised 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. The application of other sludge is prohibited by Slovak law.

5.9.4.1 Activity Data

Activity data on sewage sludge consumption in agriculture ([Table 5.9.9](#)) are 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 2015–2024, therefore notation key NO was used. The data are consistent across 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 (15) by the Soil Science and Conservation Research Institute. Based on the presented publication, the sludge contains 3.31% nitrogen.

Figure 5.9.3: The map of sensitive parts of Slovakia where sludge cannot be applied



5.9.4.2 Methodological Issues - NH₃. NO_x

Default methodology, Tier 1 and default emission factors were used for the estimation of direct NH₃ and NO_x emissions from sewage sludge applied to soils. The methodology followed the EMEP/EEA GB 2023. The Percentage of pure nitrogen in sewage sludge was provided by the Soil Science and Conservation Research Institute (15).

Emissions were estimated using these equations:

$$A_{\text{sewage sludge}} = N_{\text{sewage sludge}} * P_N$$

$$NO_{\text{sewage sludge}} = A_{\text{sewage sludge}} * EF_{NO}$$

$$NH_3 \text{ sewage sludge} = A_{\text{sewage sludge}} * EF_{NH_3}$$

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} , EF_{NH_3} = emissions factors for NH_3 and NO kg NO respectively NH_3 .

Table 5.9.9: Input parameters and EFs in 3Da2b – Sewage Sludge in particular years

YEAR	MUNICIPAL SLUDGE	INDUSTRIAL SLUDGE	INPUT INTO SOIL	N-INPUT FROM SEWAGE SLUDGE	NH_3	NO_x
	[t]	[t]	[t]	[kg]	[kt]	[kt]
1990	6,832.04	3,159.86	9,991.90	330,732.89	4.3E-02	1.3E-02
1995	4,043.24	2,251.16	6,294.40	208,344.64	2.7E-02	8.3E-03
2000	1,254.44	1,342.46	2,596.90	85,957.39	1.1E-02	3.4E-03
2005	5,870.00	2,231.03	8,101.03	268,143.98	3.5E-02	1.1E-02
2010	923.00	1,101.85	2,024.85	67,022.69	8.7E-03	2.7E-03
2011	358.00	685.38	1,043.38	34,536.00	4.5E-03	1.4E-03
2012	1,254.00	478.34	1,732.34	57,340.36	7.5E-03	2.3E-03
2013	518.00	627.02	1,145.02	37,900.23	4.9E-03	1.5E-03
2014	8.00	687.50	695.50	23,021.05	3.0E-03	9.0E-04
2015	0.00	812.65	812.65	26,898.68	3.5E-03	1.1E-03
2016	0.00	1,133.63	1,133.63	37,523.20	4.9E-03	1.5E-03
2017	0.00	362.15	362.15	11,987.19	1.6E-03	5.0E-04
2018	0.00	287.40	287.40	9,513.06	2.0E-04	4.0E-04
2019	0.00	48.94	498.94	1,619.81	2.0E-04	1.0E-04
2020	NO	1.00	1.00	32.00	4.2E-06	1.0E-06
2021	NO	1.00	1.00	33.00	4.3E-06	1.0E-06
2022	NO	1.00	1.00	33.00	4.3E-06	1.0E-06
2023	NO	NO	NO	NO	NO	NO
2024	NO	NO	NO	NO	NO	NO

5.9.5 Other Organic Fertilizers Applied to Soils (NFR 3Da2c)

Emissions of NH_3 and NO_x from compost applied to soils contributed less than 1% to the emissions from agricultural soils in 2024.

5.9.5.1 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 5.9.12**) is provided by the UKSÚP. The Data are converted into nitrogen content (**NC**). Conversion factors are presented in **Table 5.9.11**.

Data are available from 2000 to 2024. 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 5.9.10: Share pure nitrogen from other nitrogen fertilizers in%

TYPE OF FERTILIZERS	P _N	SOURCES
	%	
Fugate	0.38	Digestát vo výžive a hnojení repky (16) / ÚKSÚP
Compost	0.7	ÚKSÚP
Natural harmony (organic waste from pharmaceutical production (17)	2.4	ÚKSÚP
Straw	0.82	Dusíkaté hnojenie po zbere obilnín (18)
Vitahum (organic - humus fertilizer made from natural substances) (18)	0.7	ÚKSÚP
Green fertilizers	0.5	ÚKSÚP

Table 5.9.11: Input parameters in the category 3D12c – Other Organic Fertilizers applied to soils

YEAR	FUGATE		COMPOST		NATURAL HARMONY	
	OW	NC	OW	NC	OW	NC
1990	NO	NO	33,429.5	234.0	NO	NO
1991	NO	NO	34,303.0	336.2	NO	NO
1992	NO	NO	35,176.5	246.2	NO	NO
1993	NO	NO	36,050.0	252.4	NO	NO
1994	NO	NO	36,923.5	361.9	NO	NO
1995	NO	NO	37,797.0	264.6	NO	NO
1996	NO	NO	38,670.5	270.7	NO	NO
1997	NO	NO	39,544.0	387.5	NO	NO
1998	NO	NO	40,417.5	282.9	NO	NO
1999	NO	NO	41,291.0	289.0	NO	NO
2000	NO	NO	74,922.6	524.0	NO	NO
2001	NO	NO	40,885.1	286.2	NO	NO
2002	NO	NO	36,422.3	255.0	NO	NO
2003	NO	NO	34,225.2	239.6	NO	NO
2004	NO	NO	42,904.1	300.3	NO	NO
2005	NO	NO	7,005.6	49.0	NO	NO
2006	NO	NO	13,877.5	97.1	NO	NO
2007	NO	NO	21,761.9	152.3	NO	NO
2008	NO	NO	21,317.4	149.2	NO	NO
2009	NO	NO	25,363.8	177.6	NO	NO
2010	NO	NO	40,096.8	280.7	NO	NO
2011	NO	NO	50,582.7	354.1	11,107.0	266.8
2012	108,181.0	995.0	18,291.4	128.0	205.2	4.92
2013	301,580.0	2,775.0	63,145.2	442.0	394.4	9.47
2014	382,111.0	3,515.0	85,906.6	601.3	17,819.0	427.7
2015	543,489.0	5,000.0	90,967.1	636.8	46,392.0	1,089.0
2016	391,789.0	2,651.0	46,700.7	318.1	48,703.0	1,137.0
2017	732,884.0	2,842.0	46,649.1	326.5	25,389.0	583.0
2018	720,233.0	2,790.0	43,256.7	410.8	30,791.0	731.0
2019	776,427.0	3,057.0	37,617.5	300.1	41,518.0	994.0
2020	800,393.0	2,936.0	43,556.5	249.9	NO	NO
2021	796,945.0	3,347.0	60,046.8	401.4	NO	NO
2022	793,655.0	2,812.0	56,181.0	375.0	NO	NO

YEAR	FUGATE		COMPOST		NATURAL HARMONY	
	OW	NC	OW	NC	OW	NC
2023	559,798.0	2,277.0	7,892.0	349.0	NO	NO
2024	901,768.0	3,111.5	23,235.2	214.4	NO	NO

YEAR	HAY		VITAHUM		GREEN FERTILIZERS	
	OW	NC	OW	NC	OW	NC
1990	NO	NO	28,290.0	198.0	12,013.2	60.1
1991	NO	NO	26,501.0	185.5	11,752.5	58.8
1992	NO	NO	24,713.0	173.0	11,492.7	57.5
1993	NO	NO	22,924.0	160.5	11,231.0	56.2
1994	NO	NO	21,136.0	148.0	10,970.0	54.9
1995	NO	NO	19,348.0	135.4	10,709.4	53.6
1996	NO	NO	17,559.0	122.9	10,448.7	52.2
1997	NO	NO	15,771.0	110.4	10,187.9	51.0
1998	NO	NO	13,982.0	97.9	9,927.2	49.6
1999	NO	NO	12,194.0	85.4	9,666.4	48.3
2000	NO	NO	50,641.0	354.3	10,245.0	51.2
2001	NO	NO	54,338.0	380.4	18,285.0	91.4
2002	NO	NO	42,810.0	299.7	10,920.0	54.6
2003	NO	NO	9,321.0	65.3	6,206.0	31.3
2004	NO	NO	2,845.0	19.9	18,989.5	95.0
2005	NO	NO	3,552.0	24.9	5,905.0	29.5
2006	NO	NO	10,828.0	75.8	7006.0	35.0
2007	8,867.7	72.7	8,758.0	61.3	3,540.4	17.7
2008	90,977.0	746.0	7,185.0	50.3	13,533.9	67.7
2009	68,636.6	568.8	195.0	1.4	16,642.3	83.2
2010	36,773.7	301.5	4,999.0	35.0	11,955.6	59.8
2011	66,704.1	547.0	2,261.0	15.8	25,837.0	129.2
2012	25,019.7	205.2	NO	NO	1,401.3	7.1
2013	30,697.6	251.7	500.0	3.5	2,546.7	12.7
2014	40,911.8	355.5	NO	NO	6,374.8	31.9
2015	26,554.1	217.7	1,015.0	7.1	4,036.1	20.2
2016	NO	NO	NO	NO	NO	NO
2017	NO	NO	17,928.0	125.5	NO	NO
2018	NO	NO	NO	NO	NO	NO
2019	NO	NO	4,500.0	31.5	NO	NO
2020	NO	NO	NO	NO	NO	NO
2021	NO	NO	NO	NO	NO	NO
2022	NO	NO	NO	NO	NO	NO
2023	NO	NO	NO	NO	NO	NO
2024	NO	NO	NO	NO	NO	NO

5.9.5.2 Methodological Issues – Methods – NO_x, NH₃

Default methodology Tier 1 according to EMEP/EEA GB 2023, and default emission factor (0.08 kg NH₃ kg⁻¹ waste N applied and 0.04 kg.NO) were used for the estimation of NO_x and NH₃ emissions from compost applied to soils. The percentage of nitrogen in used compost was provided by the Soil Science and Conservation Research Institute (15). Amount of compost applied to soils provided by the UKSÚP. Emissions were estimated using these equations:

$$A_{\text{compost}} = N_{\text{compost}} * P_N$$

$$NO_{\text{compost}} = A_{\text{compost}} * EF_{NO}$$

$$NH_3_{\text{compost}} = A_{\text{compost}} * EF_{NH_3}$$

Where:

N_{compost} = the input of pure nitrogen in compost applied to the soil in kg, N_{compost} = the amount of compost from the composting plant, P_N = 1 tonne of compost = 7 kg N.

Table 5.9.12: Emission factors and emissions in 3Da2c – Other organic fertilizers applied to soils

YEARS	EMISSION FACTORS FOR NH ₃	EMISSION FACTORS FOR NO _x	NH ₃	NO _x
	[kg NH ₃ /kg N]	[kg NO _x /kg N]	[kt]	[kt]
1990	0.08	0.04	0.0394	0.0197
1995	0.08	0.04	0.0363	0.0181
2000	0.08	0.04	0.0744	0.0372
2005	0.08	0.04	0.0083	0.0041
2010	0.08	0.04	0.0542	0.0271
2011	0.08	0.04	0.1050	0.0525
2012	0.08	0.04	0.1072	0.0536
2013	0.08	0.04	0.2796	0.1398
2014	0.08	0.04	0.3929	0.1965
2015	0.08	0.04	0.1577	0.0788
2016	0.08	0.04	0.3285	0.1642
2017	0.08	0.04	0.3102	0.1551
2018	0.08	0.04	0.3145	0.1573
2019	0.08	0.04	0.3506	0.1753
2020	0.08	0.04	0.2549	0.1274
2021	0.08	0.04	0.2999	0.1499
2022	0.08	0.04	0.2550	0.1275
2023	0.08	0.04	0.2108	0.1054
2024	0.08	0.04	0.2661	0.1330
1990/2024	-	-	+238%	435%
2023/2024	-	-	+26%	-17%

5.9.6 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 the 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 5.9.13](#).

5.9.6.1 Activity Data

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 are not available, but significant differences can be found in this regard. NH₃ and NO_x emissions from pasture were based on the proportion of the pasture for housing that was made by the NPPC - VÚŽV. Activity data are summarised

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.

5.9.6.2 Methodological Issues – NH₃, NO_x

The estimation of NH₃ and NO_x 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 5.9.13: *Input parameters, EFs and emissions in 3Da3- Urine and dung deposited by grazing animals*

YEARS	NITROGEN EXCRETED DURING PASTURE	IMPLIED EMISSION FACTORS FOR NH ₃	IMPLIED EMISSION FACTORS FOR NO _x	NH ₃	NO _x
	[kg/year]	[kg NH ₃ /kg N]	[kg NO _x /kg N]	[kt]	[kt]
1990	16,028.47	0.1187	0.0797	5.8531	4.0456
1995	13,305.53	0.1003	0.0676	3.6838	1.6312
2000	10,787.81	0.1045	0.0702	3.4545	1.4638
2005	10,666.44	0.0979	0.0660	2.8322	1.3548
2010	11,529.70	0.0838	0.0576	2.3226	1.7644
2011	11,436.53	0.0839	0.0576	2.3162	1.7626
2012	11,901.62	0.0837	0.0575	2.2116	1.6937
2013	11,996.42	0.0822	0.0564	2.1824	1.6852
2014	12,260.94	0.0821	0.0562	2.1249	1.6404
2015	12,360.93	0.0811	0.0555	2.0225	1.5734
2016	12,257.27	0.0812	0.0554	1.9640	1.5321
2017	12,100.14	0.0804	0.0550	1.7147	1.3734
2018	12,709.60	0.0805	0.0547	1.7722	1.4028
2019	12,537.01	0.0801	0.0542	1.7173	1.3546
2020	12,425.25	0.0803	0.0539	1.6855	1.3228
2021	12,793.73	0.0785	0.0526	1.6455	1.2905
2022	12,873.09	0.0785	0.0524	1.6013	1.2659
2023	13,042.89	0.0782	0.0521	1.5604	1.2349
2024	13,615.68	0.0779	0.0523	1.1367	1.2410

5.9.6.3 Methodological Issues –NMVOC

Cattle

All references for calculation are in [Chapter 5.8.6.2](#). The used notation key is IE.

5.9.7 Crop Residue (NFR 3Da4)

Directly after the 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 the soil take place. The knowledge of nutrient potential in crop residues by crop rotation is mostly relevant in the present requirements of sustainable land use – greening in plant production. Incorporation of crop residues into the soil is used as a sustainable agricultural practice due to its high nutritional potential.

Table 5.9.14: Input parameters and EFs in the category 3Da4 – 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	0.6125
1995	2,152,852	63,386	65,755,818	0.3990
2000	2,080,004	45,812	40,680,816	0.2365
2005	1,721,125	68,071	58,191,208	0.3137
2010	1,617,786	54,870	44,086,328	0.2884
2011	1,680,333	71,666	58,053,855	0.2521
2012	1,703,613	63,316	49,566,275	0.1937
2013	1,716,326	63,796	56,186,635	0.1865
2014	1,745,299	79,312	72,472,343	0.2026
2015	1,728,043	66,540	60,237,610	0.1687
2016	1,717,480	85,743	75,505,655	0.1976
2017	1,722,049	67,595	58,749,087	0.1613
2018	1,725,424	76,863	64,962,867	0.1828
2019	1,750,468	76,280	65,934,371	0.1914
2020	1,736,499	81,026	70,272,930	0.1937
2021	1,741,541	74,003	66,749,560	0.1823
2022	1,733,440	62,543	55,418,400	0.1421
2023	1,663,263	78,338	69,378,870	0.1950
2024	1,661,356	72,977	59,262,840	0.1811

Total NH₃ emissions from crop residues represented 0.18 Gg of NH₃ from 59,262,840 kg of nitrogen in crop residues returned to soils in 2024. 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 (-0.11%). In 2024, the harvested area was 1 661.36 kha.

Between 2005 and 2024, the production of most agricultural crops showed an increasing trend. The production of potatoes increased by +79%, beans +73%, oat +33%, barley +30%, soya +26%, wheat +26%, oil plants +17%, meadows +29%, rye +12%, sugar beet +13%, maize for silage +6% and maize +4% during the given period. The decrease was recorded for tobacco by -73%, lens -58%, peas -42%, other leguminous plants -37%, clover -6% and lantern -13%.

Methodological Issues

According to the EMEP/EEA GB 2023, nitrogen input from crop residues was estimated using 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 the fraction of above-ground residues of crops removed annually for a purpose such as feed bedding and construction is not available. The stems and leaves are usually utilised as fodder for 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 (19), 20 kg N/ha for sugar beet was taken as a country-specific value. The default values were considered for other crops. The values are presented in [Table 5.9.15](#).

Table 5.9.15: Parameters used to estimate emissions from crop residues

CROP TYPE	N _(AG)	N _(BG)	SLOPE	INTERCEPT	RS _{(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		
Wheat	0.006	0.009	1.510	0.520	0.230	0.890	-
Rye	0.005	0.011	1.090	0.880	0.220	0.880	-
Barley	0.007	0.014	0.980	0.590	0.220	0.890	-
Oat	0.007	0.008	0.910	0.890	0.250	0.890	-
Maize	0.006	0.007	1.030	0.610	0.220	0.870	-
Potato	0.019	0.014	0.100	1.060	0.200	0.220	-
Sugar beet	-	-	-	-	-	-	20
Oil plants	0.008	0.008	1.130	0.850	0.190	0.910	-
Tobacco	0.015	0.012	0.300	0.000	0.540	0.900	-
Maize for silage	0.015	0.007	0.000	0.000	0.540	0.900	-
Meadows	0.015	0.012	0.300	0.000	0.800	0.900	-
Peas	0.008	0.008	1.130	0.850	0.190	0.910	-
Lens	0.008	0.008	1.130	0.850	0.190	0.910	-
Beans	0.008	0.008	1.130	0.850	0.190	0.910	-
Other leguminous plants	0.027	0.022	0.300	0.000	0.400	0.900	-
Soya	0.008	0.008	0.930	1.350	0.190	0.910	-
Clover	0.025	0.016	0.300	0.000	0.800	0.900	-
Alfaalfa	0.027	0.019	0.290	0.000	0.400	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 N₂O 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 years 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 (21) and Storage of agricultural fertilizers (22) and Removal and storage of fertilizers (23)). Publications were provided with litter requirements per species and categories per day in kilograms. Nitrogen input from straw was not available in the presented publications. Nitrogen input from straw was taken from the article Nitrogen fertilization after harvesting cereals (23) In the 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 purposes in Slovakia.

The amount of forage consumed by livestock was removed from the below-ground biomass in meadows. Maize for silage is used 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 (24) 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 agrotechnical practice. For areas of meadows, this means maintaining all areas by

mowing, grazing and additionally mulching according to altitude and in the 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 the presented information, it was impossible to derivate share for **Frac_{Remove}**. The review analysis of inventories was done, and only in the Polish inventory **Frac_{Remove}** parameter was derived. Poland is a neighbouring country with similar agricultural conditions, and value was taken into the Slovak inventory. Used **Frac_{Remove}** and **Frac_{Incorp}** values are presented in **Tables 5.9.16** and **5.9.17**.

Table 5.9.16: Parameters used to estimate emissions from crop residues

TYPE OF CROP	FRAC _{Incorp}	FRAC _{Remove}
Wheat	1	0.17
Rye	1	0.17
Barley	1	0.17
Oat	1	0.17
Maize	1	0
Potato	1	0
Sugar beet	1	0
Oil plants	1	0
Tobacco	1	0
Maize for silage	1	1
Meadows	0.20	0.95
Peas	1	0
Lens	1	0
Beans	1	0
Other leguminous plants	1	0
Soya	1	0
Clover	0.33	0
Alfalfa	0.25	0

Table 5.9.17: 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
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

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]		[%]
2022	181,063	1,112,213	16.28
2023	197,405	1,162,191	16.99
2024	106,865	1,105,871	9.66

5.9.7.1 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 Equation 11.7 IPCC 2019 RF):

$$\text{Crop}_{(T)} = \text{Yield Fresh}_{(T)} * \text{DRY}$$

Where:

Crop_(T) = harvested dry matter yield for crop T in kg d.m./ha, **Yield Fresh_(T)** = kg of fresh weight per ha, **DRY** = dry matter fraction of harvested crop T in kg of d.m.

Table 5.9.18: Growing areas and total nitrogen in crops and legumes in 2024

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	350,358.20	4,846.66	21 438 284
	Ray	7,351.94	2,787.48	195 272
	Barley	126,485.16	4,186.94	6 209 096
	Oat	11,975.04	2,368.89	256 611
OTHER	Maize	147,276.42	6,284.28	8 613 804
	Potato	6,028.81	6,226.62	187 084
	Sugar beet	23,554.66	0.00	471 093
	Oil plants	286,104.71	2,249.05	7 902 515
	Tobacco	4.18	268.28	14
	Maize for silage	59,299.41	25,313.97	5 674 171
	Meadows	497,146.00	2,375.48	3 213 391
NITROGEN FIXING CROPS	Peas	7,751.13	1,342.22	127 795
	Lens	526.10	497.76	3 219
	Beans	148.26	1,461.89	2 662
	Other leguminous plants	11,748.83	1,158.67	265 998
	Soya	67,839.27	2,002.25	1 409 933
	Clover	12,942.58	4,103.87	692 970
	Alfalfa	45,941.23	5,502.30	2 598 857
2024 TOTAL		1 662 481.94	72,976.60	59,262,769

5.9.8 Category-specific Recalculations

Technical corrections from the Technical Expert Review in 2025 were implemented. For category **3Da1 Inorganic N-fertilizers (including urea application)**, NH₃, 1990–2023 (**Recommendation No. SK-3Da1-2025-0001**), Tier 2 emission factors (EF) from the EMEP/EEA Guidebook 2019 were used in the previous 2025 submission. Due to the revision of these EFs in the EMEP/EEA Guidebook 2023 and the exceeded

significance threshold for differences in emissions, the updated Tier 2 EFs from the latest version were applied to the entire time series 1990–2023.

For category *3Da4 Crop residues applied to soils*, NH₃, 1990–2023 (*Recommendation No. SK-3Da4-2025-0001*), it was found that the Tier 1 method submitted led to an implied EF of 0.0413 kg NH₃ kg⁻¹ N of crop residues, which exceeds the default EF of 0.034 kg NH₃ kg⁻¹ N from the EMEP/EEA Guidebook 2023 due to an incorrect assumption of units (NH₃-N instead of NH₃) and the subsequent unnecessary conversion by a factor of 17/14. This was corrected by applying the correct default Tier 1 EF to the entire time series, eliminating the overestimation of emissions above the significance threshold. These TCs were fully implemented in the current emission inventory and reflected in the revised NH₃ emission estimates.

In 2025, a new SKAgri software system for calculating greenhouse gas (GHG) and pollutant (ZL) emissions was implemented in the emissions inventory. The main change was a revision of the nitrogen excretion rate (NEX) parameter, which is essential for quantifying NH₃ and NO_x emissions, with mathematical deviations mainly in the categories Cattle, Swine, Poultry, and partially Sheep (1990–2023); the NEX methodology remained unchanged. Another adjustment was the revision of NH₃ emission factors (2006–2023) with an expanded set of reduction measures developed by a working group of the Ministry of the Environment of the Slovak Republic, the Ministry of Agriculture and Rural Development of the Slovak Republic, and relevant institutions, in response to non-compliance with commitments following the application of the EMEP/EEA Guidebook 2023. These changes have an impact on categories *3Da2a Animal manure applied to soils* and *3Da3 Urine and Dung Deposited by Grazing Animals*.

Table 5.9.20: Extended list of implemented measures

STAGE	FORM	NAME OF MEASURE	REDUCTION
housing	solid	high frequent cleaning	0.5
housing	liquid	slated floor	0.2
housing	solid	biological treatment of litter	0.6
housing	solid	manure conveyor forced drying	0.8
housing	solid	ventilation with recuperation	0.7
housing	not included	other	0
housing	not included	no abatement	0
storage	solid	solid lid or roof covering	0.8
storage	liquid	surface covered with peat, straw, oil or other material	0.4
storage	liquid	surface covered with foil / plastic sheeting	0.6
storage	liquid	formation of a natural crust	0.4
storage	solid	biotechnological additives	0.4
storage	solid	bioreactors	0.85
storage	not included	other	0
storage	solid	solid	1
storage	not included	no abatement	0
application	liquid	shallow injection	0.6
application	liquid	deep injection	0.9
application	solid	incorporation within 4-12 hours	0.5
application	solid	incorporation within 24 hours	0.3
application	liquid	trailing hose	0.3

STAGE	FORM	NAME OF MEASURE	REDUCTION
application	solid	broadcast spreading	0.4
application	solid	exported	1
application	not included	other	0
application	not included	no abatement	0

The impact of the recalculations is shown in *Table 5.9.19*.

Table 5.9.19: Previous and revised NH₃ emissions from Animal manure applied to soils (%)

YEAR	NH ₃ [kt]		CHANGE (%)	NOx [kt]		CHANGE
	PREVIOUS	REVISED		PREVIOUS	REVISED	
1990	25.1965	38.2183	+51.68%	2.5220	3.7510	+48.73%
1991	22.3974	35.9758	+60.62%	2.2545	2.3209	+2.95%
1992	19.6706	30.4730	+54.92%	1.9964	2.1064	+5.51%
1993	17.2101	26.4406	+53.63%	1.7600	1.9174	+8.94%
1994	16.7197	26.5355	+58.71%	1.7217	1.9066	+10.74%
1995	16.1831	25.6568	+58.54%	1.6805	1.8756	+11.61%
1996	15.8208	25.4048	+60.58%	1.6458	1.8470	+12.23%
1997	15.3563	28.0199	+82.47%	1.5985	1.7924	+12.13%
1998	13.6874	25.7929	+88.44%	1.4263	1.6445	+15.30%
1999	13.2014	23.7766	+80.11%	1.3662	1.5973	+16.92%
2000	13.5043	24.1357	+78.73%	1.3978	1.6294	+16.57%
2001	13.8049	24.6188	+78.33%	1.4443	1.6857	+16.71%
2002	13.2708	23.9906	+80.78%	1.3882	1.6424	+18.31%
2003	12.7628	22.3261	+74.93%	1.3331	1.5968	+19.78%
2004	11.5955	20.2333	+74.49%	1.1988	1.4760	+23.12%
2005	11.9337	20.0203	+67.76%	1.2222	1.4972	+22.34%
2006	9.9911	12.8193	+28.31%	1.5129	2.1132	+39.68%
2007	9.5873	12.2423	+27.69%	1.2198	2.0012	+64.06%
2008	8.6828	11.6140	+33.76%	1.1004	1.8410	+67.30%
2009	8.7474	11.1221	+27.15%	1.1127	1.8501	+66.27%
2010	8.4985	10.7089	+26.01%	1.0830	1.7622	+62.71%
2011	8.0595	10.5315	+30.67%	1.0035	1.6960	+69.01%
2012	8.3465	10.2515	+22.82%	1.0431	1.6922	+62.23%
2013	8.0246	10.3693	+29.22%	1.0038	1.6997	+69.33%
2014	8.2798	10.0078	+20.87%	1.0442	1.6827	+61.15%
2015	8.2798	9.6528	+16.58%	1.0432	1.6508	+58.24%
2016	7.9438	9.2535	+16.49%	0.9868	1.5816	+60.28%
2017	7.9935	8.4927	+6.25%	0.9996	1.5244	+52.50%
2018	8.5103	8.8854	+4.41%	1.0491	1.6067	+53.15%
2019	8.2416	8.6654	+5.14%	1.0130	1.5562	+53.62%
2020	7.4764	8.2428	+10.25%	0.9184	1.4287	+55.56%
2021	7.1260	7.9264	+11.23%	0.8652	1.3906	+60.73%
2022	6.9391	7.5369	+8.61%	0.8507	1.3119	+54.21%
2023	6.8858	7.4309	+7.92%	0.8613	1.3010	+51.05%

Table 5.9.21: Previous and revised NH₃ emissions from Crop residues applied to soils

YEAR	NH ₃		CHANGE
	PREVIOUS	REVISED	
1990	1.6315	0.6125	-62.46%

YEAR	NH ₃		CHANGE
	PREVIOUS	REVISED	
1991	1.7350	0.6437	-62.90%
1992	1.5437	0.5694	-63.11%
1993	1.3561	0.4756	-64.93%
1994	1.5401	0.4782	-68.95%
1995	1.4268	0.3990	-72.04%
1996	1.3540	0.3911	-71.12%
1997	1.4228	0.3497	-75.42%
1998	1.3189	0.3277	-75.15%
1999	1.1788	0.3452	-70.72%
2000	0.9169	0.2365	-74.21%
2001	1.2689	0.3137	-75.28%
2002	1.2277	0.2884	-76.51%
2003	0.9489	0.2125	-77.61%
2004	1.3831	0.2830	-79.54%
2005	1.2937	0.2521	-80.51%
2006	1.1382	0.2243	-80.29%
2007	1.0745	0.2107	-80.39%
2008	1.4597	0.2139	-85.35%
2009	1.2250	0.2016	-83.54%
2010	1.0015	0.1937	-80.66%
2011	1.3141	0.1792	-86.36%
2012	1.0973	0.1688	-84.62%
2013	1.2800	0.1865	-85.43%
2014	1.645	0.2026	-87.68%
2015	1.3672	0.1687	-87.66%
2016	1.7093	0.1976	-88.44%
2017	1.3340	0.1613	-87.91%
2018	1.4728	0.1828	-87.59%
2019	1.4936	0.1914	-87.19%
2020	1.5901	0.1937	-87.82%
2021	1.5368	0.1823	-88.14%
2022	1.2736	0.1421	-88.84%
2023	1.5741	0.1950	-87.61%

5.10 NMVOC EMISSIONS FROM CULTIVATED CROPS (NFR 3DE)

Data on cultivated areas and crop yields were taken from the ŠÚ SR. Data are available on 20 May every year. According to the NECD *Recommendation No. SK-3De-2023-0001*, the cultivated areas were expanded by Barley, Oats and other cultivated crops. FAOSTAT data in TERT files were exchanged with country data reported by the Statistical Office of the Slovak Republic. *Tables 5.10.1* and *5.10.2* provided data from 2005 to 2024.

5.10.1 Activity Data

FAOSTAT data in TERT files were replaced by country data reported by the Statistical Office of the Slovak Republic. [Tables 5.10.1](#) and [5.10.2](#) provided data from 2005 to 2024.

Table 5.10.1: Cultivated areas in the time-series

YEAR	CROPS - CULTIVATED AREAS [HA]						
	WHEAT	RAY	OIL PLANTS	GRASS (MAT<10°C)	BARLEY	OATS	OTHER CULTIVATED CROPS
2005	375,801	32,500	215,547	881,283	222,000	24,500	189,749
2010	349,700	29,370	280,000	876,484	138,930	17,240	230,237
2011	364,000	13,358	261,600	874,224	136,325	16,158	264,034
2012	388,700	28,568	225,100	871,338	147,994	15,773	249,978
2013	368,200	35,408	254,800	868,171	121,304	13,901	266,724
2014	380,200	29,369	243,400	864,681	138,826	15,367	249,313
2015	379,400	15,175	247,400	858,601	138,920	16,422	265,645
2016	417,700	12,843	254,000	855,882	115,364	14,834	248,254
2017	374,781	10,380	292,854	853,757	121,026	15,932	241,925
2018	404,014	13,008	282,076	851,685	124,574	14,122	230,061
2019	408,168	14,292	259,801	850,600	126,887	12,817	243,169
2020	390,872	13,045	269,463	850,027	132,885	13,408	240,338
2021	356,969	10,181	289,801	506,922	117,205	16,342	558,707
2022	410,247	9,452	295,793	508,950	108,782	10,701	505,269
2023	405,775	11,756	272,899	501,258	113,619	10,083	533,805
2024	380,773	7,709	270,344	497,855	117,236	12,349	531,407

Table 5.10.2: Crop yields in the time-series

YEAR	CROPS – CROP YIELDS [t/ha]						
	WHEAT	RAY	OIL PLANTS	GRASS (MAT<10°C)	BARLEY	OATS	OTHER CULTIVATED CROPS
2005	4.31	2.84	2.12	2.04	3.62	2.00	NA
2010	3.85	2.41	2.06	2.07	3.48	2.12	NA
2011	3.82	2.63	2.02	2.00	3.14	1.79	NA
2012	4.87	3.10	2.54	1.84	4.18	2.06	NA
2013	4.06	2.87	2.23	2.08	3.45	2.17	NA
2014	3.46	2.23	1.88	2.31	2.72	1.67	NA
2015	4.50	3.18	2.23	2.13	3.87	2.37	NA
2016	3.29	3.14	2.04	2.36	3.18	2.14	NA
2017	4.58	3.86	2.42	2.25	3.68	2.20	NA
2018	5.46	3.67	3.06	2.22	4.87	2.52	NA
2019	5.51	3.60	2.30	2.34	4.78	2.71	NA
2020	5.84	3.51	3.07	2.31	5.08	2.62	NA
2021	4.74	3.26	2.66	2.56	4.53	2.36	NA
2022	4.78	2.74	2.83	2.06	3.92	2.31	NA
2023	6.12	3.38	3.11	2.75	5.28	2.10	NA
2024	5.45	3.17	2.47	2.64	4.70	2.66	NA

5.10.2 Methodological Issues

Emissions were estimated using the combination of EMEP/EEA GB 2023 Tier 2 methodology for wheat, rye, oil plants, barley, oats and Tier 1 for other crops (the Tier 1 emission factor of 0.86 kg ha⁻¹). The mentioned emission factor is presented in Table 3-1 of EMEP/EEA GB 2023 Agricultural soils 2024. Tier 2 emission factors were estimated based on country-specific information about crop yield, dry matter content, and crop areas by crop type. Implied emission factors in 2024 are presented in [Table 5.10.3](#).

Table 5.10.3: Implied emission factors in 2024

TYPE OF CROPS	IMPLIED EMISSION FACTORS [kg NMVOC/ha/year]
Wheat	0.32
Rye	1.01
Oil plants	1.19
Grass (mat<10°C)	0.05
Barley	0.30
Oats	0.14

Information about dry matter content was taken from two data sources for oil plants, and wheat was the primary source of data from the 2019 IPCC Refinement (Table 11.1A); for others were dry matter content was taken from the publication Principles of Using the Potential of Silage and Conservation High-quality and Hygienic Preparations in Producing harmless canned feed (In Slovak language). The implemented contents are lower compared to the 2019 IPCC Values. [Table 5.10.4](#) presents all implemented dry matter contents and includes a transparent data source description.

Table 5.10.4: Dry Matter Contents in 1990-2024

TYPE OF CROPS	DRY MATTER CONTENTS [kg/kg]	SOURCE OF DATA
Wheat	0.86	2019 IPCC Refinement
Rye	0.86	Principles of using the potential of silage and conservation of high-quality and hygienic preparations in producing harmless canned feed, p.12. Table 5. (26)
Oil plants	0.91	2019 IPCC Refinement
Grass (mat<10°C)	0.38	Principles of using the potential of silage and conservation of high-quality and hygienic preparations in producing harmless canned feed, p.25. Table 10. (26)
Barley	0.86	Principles of using the potential of silage and conservation of high-quality and hygienic preparations in producing harmless canned feed, p.12. Table 5. (26)
Oats	0.86	Principles of using the potential of silage and conservation of high-quality and hygienic preparations in producing harmless canned feed, p.12. Table 10. (26)

5.10.3 Category-Specific Recalculations

In category **3De**, emissions changed due to the implementation of a revised approach to estimate NMVOC emissions based on TERT [Recommendation No. SK-3De-2023-0001](#). Country-specific data were identified, which allowed for the development of Tier 2 estimates using crop yields. Details of the updated method are available in [Chapter 5.10](#). [Table 5.10.5](#) indicates markedly increased emissions in the category **3De**.

Table 5.10.5: Previous and revised NMVOC emissions from Cultivated Crops

YEAR	NMVOC		CHANGE
	PREVIOUS	REVISED	
1990	0.4346	0.3691	-15.07%

YEAR	NMVOC		CHANGE
	PREVIOUS	REVISED	
1991	0.4540	0.3914	-13.79%
1992	0.3993	0.3549	-11.12%
1993	0.2996	0.2612	-12.82%
1994	0.3544	0.3092	-12.75%
1995	0.3681	0.3256	-11.55%
1996	0.3806	0.3414	-10.30%
1997	0.4086	0.3675	-10.06%
1998	0.3869	0.3418	-11.66%
1999	0.3701	0.3310	-10.56%
2000	0.3718	0.2963	-20.31%
2001	0.5444	0.4907	-9.86%
2002	0.5261	0.4839	-8.02%
2003	0.4398	0.4075	-7.34%
2004	0.5488	0.4994	-9.00%
2005	0.5175	0.4724	-8.71%
2006	0.5198	0.4774	-8.16%
2007	0.4880	0.4500	-7.79%
2008	0.6293	0.5886	-6.47%
2009	0.5640	0.5264	-6.67%
2010	0.4990	0.4558	-8.66%
2011	0.5693	0.5269	-7.45%
2012	0.4795	0.4397	-8.30%
2013	0.6237	0.5797	-7.05%
2014	0.7284	0.6807	-6.55%
2015	0.6128	0.5664	-7.57%
2016	0.7436	0.6958	-6.43%
2017	0.6831	0.6399	-6.32%
2018	0.6935	0.6515	-6.06%
2019	0.6606	0.6127	-7.25%
2020	0.6988	0.6522	-6.67%
2021	0.8460	0.8123	-3.98%
2022	0.7578	0.7322	-3.38%
2023	0.9191	0.8832	-3.91%

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

Pollution TSP was calculated using the Tier 1 methodology from EMEP/EEA GB 2023. PM_{2.5} and PM₁₀ were calculated using the Tier 2 EMEP/EEA GB 2023 methodology. Emission factors for a 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 TSP emissions to be lower than PM₁₀ emissions, which indicates an overestimation of PM₁₀ emissions. TSP emissions incorporated PM₁₀ and PM_{2.5} and other fractions of particulate matter. Tier 2 approach had to be implemented because the NFR 3Dc category is the key category of PM₁₀ emissions.

Table 5.11.1: Used emission factors in kg/ha (according to the NECD recommendation A9/SK-3Dc-2023-0001 of the SVK NECD Final Review Report 2024)

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	0.43
Oat	0.25	3.40	0.25	0.66
Other arable	0.25	NO	NO	NO
Grass	0.25	0.25	NO	NO
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	NO	NO	NO
Grass	0.015	0.0100	NO	NO

Emissions of TSP were calculated with the following equation (Tier 1 approach):

$$E_{TSP} = AR_{area} \times EF_{pollutant}$$

Where:

E_{TSP} = emissions PM₁₀ and PM_{2.5} (kg.a⁻¹), $EF_{pollutant}$ = annual default emission factor in (kg ha⁻¹), AR_{area} = the annual sown area of the crop in ha.

Emissions of PM₁₀ and PM_{2.5} were calculated with the following equation (Tier 2 approach):

$$E_{PM} = \sum_{t=1}^L \sum_{n=0}^{N_{t,k}} EF_{PM_{t,k}} * A_t \times n$$

Where:

E_{PM} = emissions PM₁₀ and PM_{2.5} (kg.a⁻¹), EF_{PM} = annual default emission factor in (kg ha⁻¹), A_t = the annual sown area of the crop in ha, n_t = the number of times the k_{t,h} operation is performed on the crop in a⁻¹.

Table 5.11.2: Frequency of operations in 1990-2024

CROP	SOIL CULTIVATION	HARVESTING	CLEANING	DRYING
Wheat	4	1	1	1
Rye	4	1	1	1
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 on sown areas were taken from the ŠÚ SR. Data are available on 20 May every year (according to the NECD Recommendation No A7/SK-3D-2023-0001 of the SVK NECD Final Review Report 2024).

Table 5.11.3: 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
2023	405,775	11,756	272,899	501,258	113,619	10,083
2024	380,773	7709	270,334	497,855	117,236	12,349

5.11.3 Category-specific Recalculations

Recalculations are not occurring in this category.

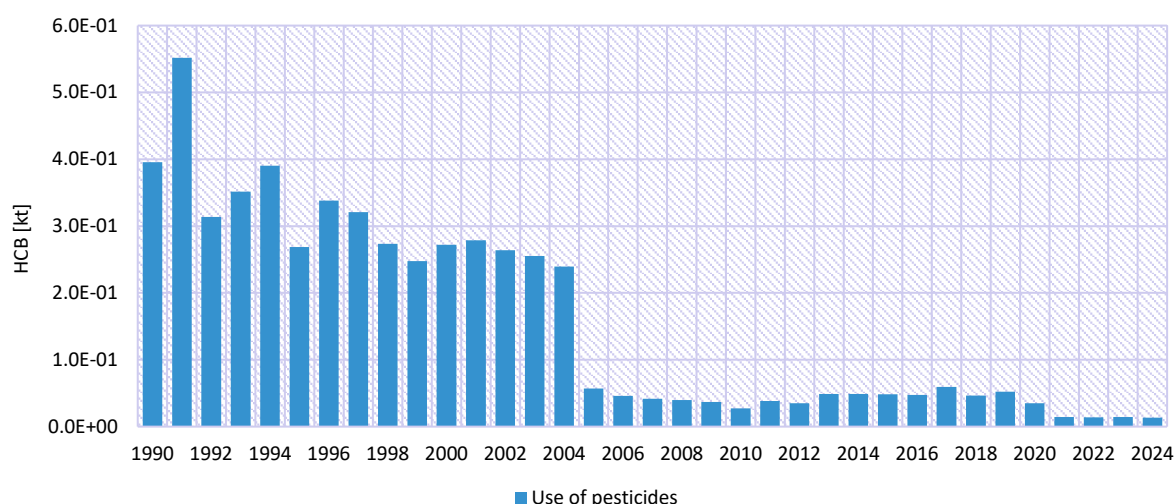
5.12 AGRICULTURE OTHER INCLUDING USE OF PESTICIDES (NFR 3DF)

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

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 5.12.1: Emissions of HCB from used pesticides



5.12.2 Activity Data

Data on pesticide consumption were provided by the Central Control and Testing Institute in Agriculture. Consumptions are collected annually directly from the Farmers' base of Government Regulation of the Slovak Republic No 186/2012 Coll. (25) on the review of authorised plant protection products. The situation of using pesticides in the Slovak Republic, such as propazine, atrazine, endosulfan, lindane, simazine and pentachlorophenol was not obligated. Atrazine was not used since 2006 and was also not obligated. Only clopiralid, chlorothalonil and picloram are used. The total consumption of pesticides by active substances is available in [Table 5.12.1](#).

Table 5.12.1: 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

YEAR	NAME OF PESTICIDE [kg]					
	ATRAZIN	CLOPIRALID	CHLOROTHALONIL	ENDOSULFAN	PICLORAM	SIMAZIN
2010	NO	6,324	3,418	NO	1,094	NO
2011	NO	6,517	7,594	NO	1,199	NO
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
2023	NO	4,383	131	NO	1,196	NO
2024	NO	3,858	0	NO	1488	NO

5.12.3 Category-specific Recalculations

No recalculations were made.

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. (26) 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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6.1 OVERVIEW OF THE SECTOR

This chapter represents emissions from the activities involved in the NFR categories listed in [Table 6.1.1](#). 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 methods. Emissions from waste incineration with energy use were allocated to the energy sector ([NFR 1A](#)).

Table 6.1.1: Categories included in the Waste sector and method used for calculations (NFR 5)

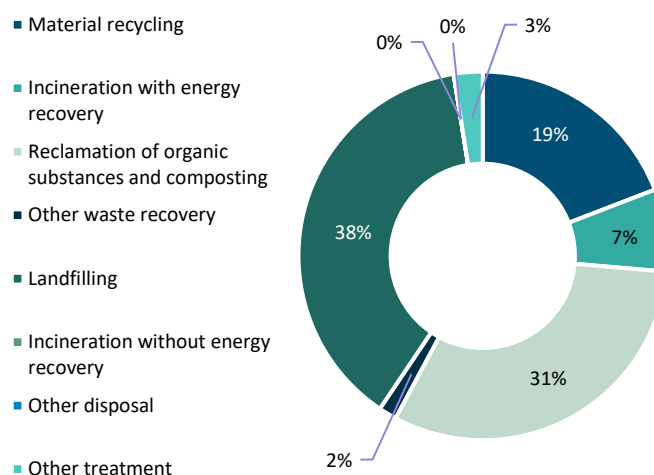
NFR Code	LONGNAME	METHOD
5A	Biological treatment of waste - Solid waste disposal on land	T2/T3
5B1	Biological treatment of waste - Composting	T2
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	T1
5C1a	Municipal waste incineration	T3/T2
5C1bi	Industrial waste incineration	T2
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 into three ways of treatment:

- 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);
- Disposal** (landfilling ([Chapter 6.4](#)) and incineration without energy recovery ([Chapter 6.6](#)) – included in the inventory, other disposal – not involved)
- Waste temporarily stored in place of origin – not included in the inventory.

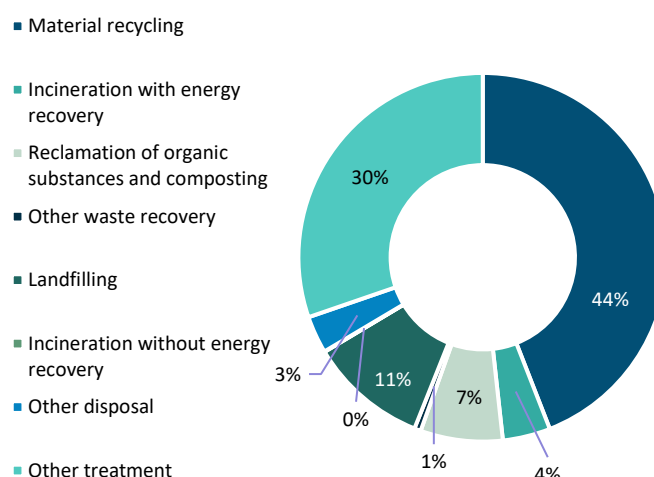
According to the annual statistics of the Statistical Office of the Slovak Republic, the total municipal waste produced in the Slovak Republic in 2024 was 2,649.37 kt. The amount of municipal waste produced increased compared to the previous year (3%). The generation of municipal waste per capita (488.61) in the Slovak Republic is still below the European average. However, the predominant waste treatment is still landfilling (38%). The amount of waste recovered stayed stable in 2024 to 59%. In 2023, prevailed waste recovery treatment was reclamation of organic substances and composting (44% of recovered waste, 32% of all waste); in 2024, it was also reclamation of organic substances and composting (44% of recovered waste, 31% of all waste). The share of material recycling increased slightly (1%), and energy utilisation decreased by 7%. [Figure 6.1.1](#) shows a detailed breakdown of municipal waste treatment.

Figure 6.1.1: Municipal waste treatment in the Slovak Republic in 2024



In 2024, total industrial and other waste was produced in the amount of 10,080.78 kt. The amount decreased by 8% compared to 2023. The largest share represents waste from construction and demolition (45%), which has decreased by 12% annually.

Figure 6.1.2: Industrial waste treatment in the Slovak Republic in 2024



In general, in most waste categories, the **condensable component of PMs** is not included in emission factors.

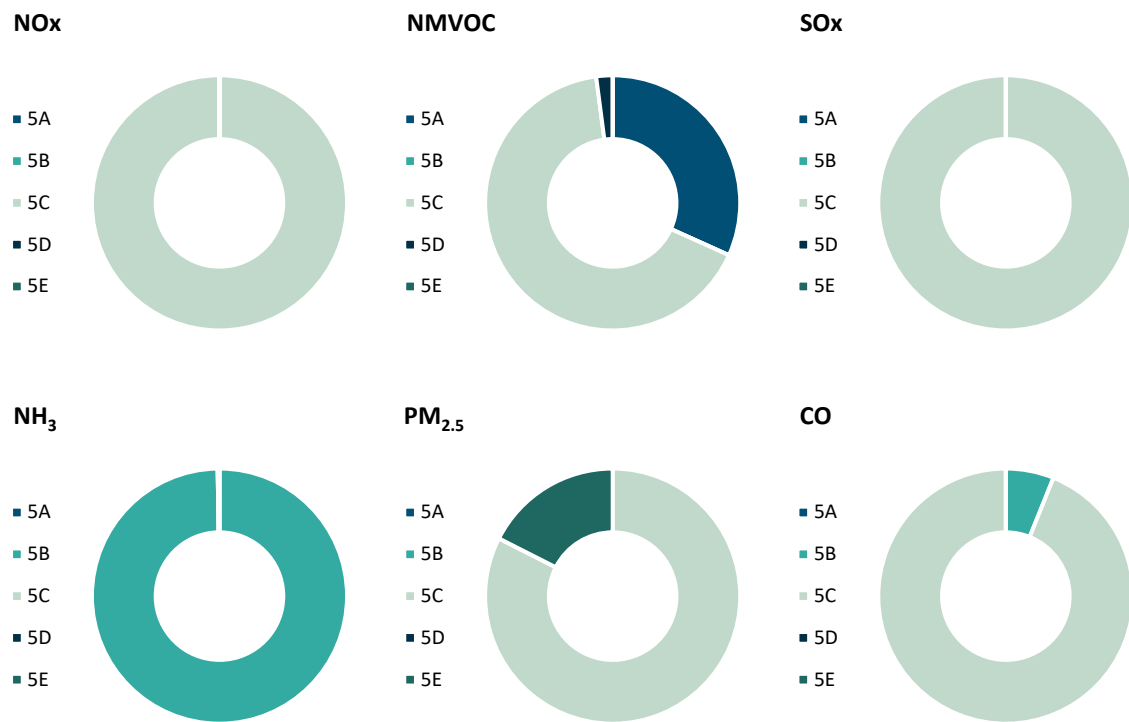
Emissions of air pollutants (excluding NMVOC and NH₃) in this sector are emitted into the air by waste incineration plants. The trend in the incineration categories is decreasing until 2008. Since 2009, emissions of all main pollutants have increased. Emissions of heavy metals and POPs have generally decreased.

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 significantly since 1990.

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 6.1.2](#). 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 6.1.3](#). For main pollutants, emissions of NO_x, SO_x 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 6.1.3: Share of subsectors of the waste sector on emissions of the main pollutants in 2024



[Figure 6.1.4](#) presents emissions of HMs and POPs are all emitted mostly from sources in the category of waste incineration (5C).

Figure 6.1.4: Share of subsectors of the waste sector on emissions of the HMs and POPs in 2024

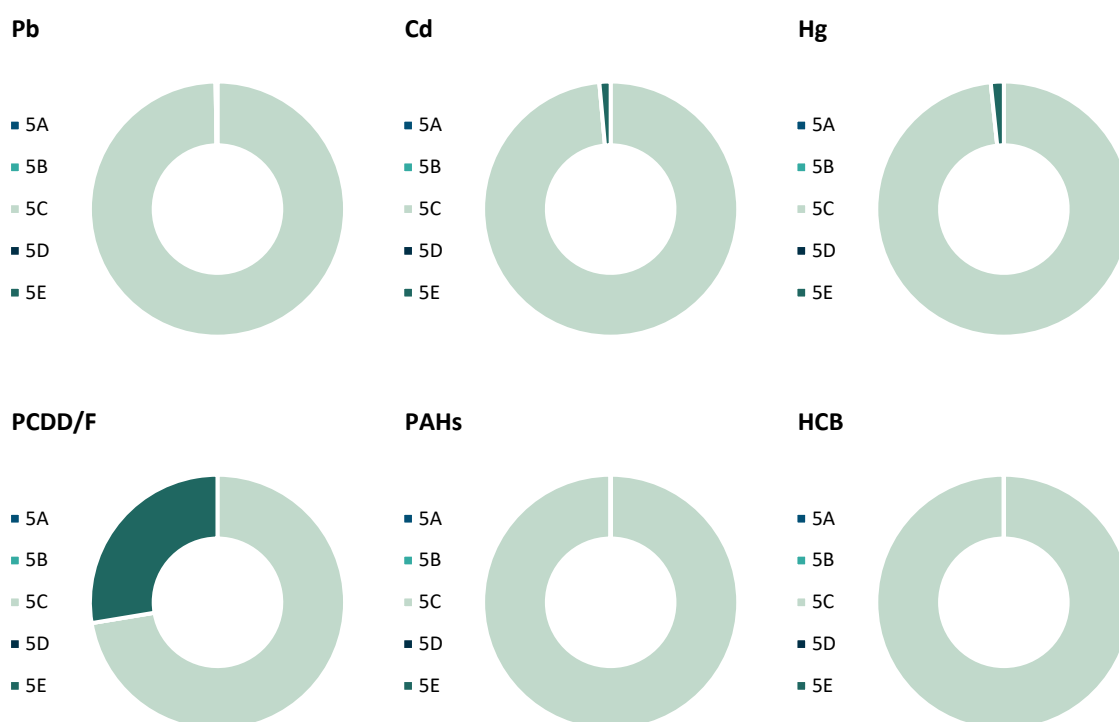


Table 6.1.2: The overview of the pollutants in the Waste sector and their trends

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.2184	0.2666	0.0289	1.5248	0.5943	0.6654	0.7534	0.1136	7.3165
1995	0.1916	0.2413	0.0283	1.4356	0.5442	0.6092	0.6937	0.0975	6.3532
2000	0.2728	0.3206	0.0315	1.2755	0.7038	0.7854	0.8521	0.1435	9.1705
2005	0.4334	0.4609	0.0559	1.2154	1.0406	1.1601	1.2439	0.2309	14.6377
2010	0.4347	0.4853	0.0289	1.2231	1.0533	1.1602	1.2274	0.2337	14.9114
2011	0.4170	0.4778	0.0267	1.3364	1.0259	1.1212	1.1779	0.2250	14.4448
2012	0.2596	0.3572	0.0304	1.7740	0.7028	0.7656	0.8057	0.1359	8.9119
2013	0.2659	0.3617	0.0333	2.3088	0.7001	0.7650	0.8076	0.1366	8.9336
2014	0.4967	0.5431	0.0348	2.7906	1.1421	1.2510	1.3136	0.2689	17.2888
2015	0.4803	0.5292	0.0368	2.9483	1.1456	1.2589	1.3281	0.2581	16.7144
2016	0.4586	0.5192	0.0298	2.7710	1.0795	1.1677	1.2117	0.2492	16.1422
2017	0.4469	0.5113	0.0366	2.8617	1.0657	1.1508	1.1929	0.2432	15.8668
2018	0.4739	0.5271	0.0388	2.7410	1.1068	1.2056	1.2596	0.2553	16.6243
2019	0.4532	0.5086	0.0381	2.5173	1.0463	1.1420	1.1951	0.2428	15.7978
2020	0.3826	0.4505	0.0364	2.6393	0.9045	0.9821	1.0245	0.2015	13.4247
2021	0.3929	0.4555	0.0350	2.4848	0.9136	0.9858	1.0218	0.2051	13.6729
2022	0.3817	0.4465	0.0324	2.3245	0.9027	0.9767	1.0150	0.2031	13.6954
2023	0.3530	0.4206	0.0339	2.3350	0.8299	0.8973	0.9317	0.1872	12.6103
2024	0.4019	0.4538	0.0307	2.5298	0.9249	1.0004	1.0379	0.2148	14.3548
1990/2024	84%	70%	6%	66%	56%	50%	38%	89%	96%
2023/2024	14%	8%	-10%	8%	11%	11%	11%	15%	14%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.8337	0.0581	0.2129	0.1015	0.0147	0.0814	0.0081	0.0107	1.8439
1995	0.8207	0.0557	0.2120	0.0895	0.0147	0.0773	0.0080	0.0092	1.5866

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2000	0.9032	0.0650	0.2306	0.1250	0.0158	0.0924	0.0087	0.0136	2.3256
2005	1.1559	0.1011	0.1898	0.2002	0.0351	0.1625	0.0197	0.0220	3.8121
2010	0.7925	0.0801	0.1299	0.1945	0.0268	0.1358	0.0147	0.0224	3.8348
2011	0.6053	0.0728	0.1450	0.1843	0.0257	0.1332	0.0140	0.0216	3.6981
2012	0.5493	0.0686	0.0948	0.1204	0.0343	0.1326	0.0189	0.0133	2.3150
2013	0.6178	0.0784	0.0982	0.1242	0.0419	0.1538	0.0233	0.0135	2.3600
2014	0.5966	0.0899	0.0978	0.2207	0.0389	0.1771	0.0217	0.0260	4.4709
2015	0.7715	0.0913	0.0930	0.2155	0.0367	0.1660	0.0203	0.0249	4.2768
2016	0.2463	0.0754	0.0617	0.2003	0.0384	0.1695	0.0211	0.0242	4.1673
2017	0.2446	0.0830	0.0463	0.1983	0.0468	0.1911	0.0259	0.0237	4.1120
2018	0.4730	0.0900	0.0673	0.2107	0.0452	0.1893	0.0252	0.0248	4.2881
2019	0.4786	0.0863	0.0600	0.2010	0.0430	0.1790	0.0240	0.0237	4.0786
2020	0.3795	0.0791	0.0648	0.1688	0.0436	0.1712	0.0243	0.0199	3.4217
2021	0.2168	0.0726	0.0719	0.1683	0.0417	0.1676	0.0232	0.0204	3.4803
2022	0.2807	0.0744	0.0654	0.1677	0.0415	0.1669	0.0231	0.0200	3.4434
2023	0.2102	0.0591	0.0601	0.1516	0.0306	0.1319	0.0169	0.0184	3.1387
2024	0.1979	0.0668	0.0576	0.1732	0.0355	0.1524	0.0197	0.0211	3.6066
1990/2024	-76%	15%	-73%	71%	141%	87%	143%	96%	96%
2023/2024	-6%	13%	-4%	14%	16%	15%	16%	15%	15%

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	191.5825	0.3309	0.5410	0.6776	1.2E-07	1.5496	0.3579	0.1067
1995	189.5489	0.2834	0.4632	0.5802	1.2E-07	1.3268	0.3544	0.1059
2000	190.1034	0.4194	0.6856	0.8586	1.4E-07	1.9636	0.3852	0.1152
2005	202.7178	0.6776	1.1078	1.3874	2.9E-07	3.1728	0.2972	0.1126
2010	111.5389	0.6889	1.1262	1.4105	2.6E-07	3.2256	0.1872	0.0756
2011	82.8286	0.6648	1.0869	1.3613	2.5E-07	3.1130	0.2224	0.0730
2012	66.6546	0.4006	0.6550	0.8203	3.1E-07	1.8759	0.1305	0.0556
2013	89.1413	0.4022	0.6576	0.8236	3.9E-07	1.8834	0.1283	0.0603
2014	83.3569	0.7958	1.3010	1.6294	3.7E-07	3.7261	0.1301	0.0573
2015	82.8336	0.7618	1.2455	1.5599	3.6E-07	3.5673	0.1108	0.0626
2016	8.2098	0.7400	1.2099	1.5153	3.8E-07	3.4653	0.0685	0.0303
2017	6.8129	0.7225	1.1812	1.4794	4.2E-07	3.3830	0.0469	0.0263
2018	14.9783	0.7563	1.2365	1.5486	4.3E-07	3.5415	0.0694	0.0423
2019	14.6256	0.7192	1.1758	1.4726	4.3E-07	3.3675	0.0499	0.0398
2020	11.4785	0.5970	0.9761	1.2224	4.6E-07	2.7955	0.0521	0.0375
2021	6.2848	0.6094	0.9963	1.2479	5.0E-07	2.8536	0.0517	0.0321
2022	8.7001	0.6029	0.9858	1.2346	4.3E-07	2.8233	0.0627	0.0336
2023	6.9651	0.5558	0.9087	1.1381	3.6E-07	2.6026	0.0512	0.0277
2024	5.9416	0.6382	1.0435	1.3069	4.0E-07	2.9886	0.0475	0.0266
1990/2024	-97%	93%	93%	93%	231%	93%	-87%	-75%
2023/2024	-15%	15%	15%	15%	10%	15%	-7%	-4%

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 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 waste treatment 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 6.1.3).

Table 6.1.3: The overview of the activity data source and methodology used for the Waste categories

NFR	TIER	AD SOURCE	NEIS CATEGORIES	METHOD FOR	ALLOC./
			(DECREE NO 410/2012)	2021 REPORTING	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	$E_{TOTAL} = 100\% \text{ NEIS}$	1A1a
5C1bi	T2	NEIS	-	$E_{TOTAL} = AD * EF_{GB2023}$	
	T2	NEIS**	NEIS	$E_{TOTAL} = 100\% \text{ NEIS}$	1A1b,1A2c, 1A2f
5C1bii	T2	NEIS	-	$E_{TOTAL} = AD * EF_{GB2023} - 1 - ATE$	
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	-	-	$E_{TOTAL} = AD * EF_{GB2023}$	
5D1	T1/T2/T3	ŠÚ SR VÚVH SR	-	$E_{TOTAL} = AD * EF_{GB2023}$	
	T3	NEIS* ¹	NEIS	$E_{TOTAL} = 100\% \text{ NEIS}$	
5D2	T1	ŠÚ SR	-	$E_{TOTAL} = AD * EF_{GB2023}$	
	T3	NEIS* ¹	NEIS	$E_{TOTAL} = 100\% \text{ NEIS}$	
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. The 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 was 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 2026.

Recommendation No. SK-5B1-2025-0001 asks to provide a clear description of the activity data used and any aggregations undertaken. This is described in [Chapter 6.5.2](#).

Recommendation No. SK-5C-2025-0001 recommends that Slovakia include a more detailed description of the methodology used for emissions resulting from waste incineration with energy recovery. This is described in [Chapters 3.4.2, 3.4.3 and 3.5.4](#).

Several other improvements were implemented in this submission. Emissions from the categories [5C1bi](#) and [5C1bii](#) were recalculated because of the conversion-factor corrections for POPs ([Chapters 6.6.3.3 and 6.6.3.4](#)).

Emissions from sludge gas flaring were reallocated from [5D](#) in compliance with the GHG inventory to category [1A5a](#).

Activity data correction was implemented in category [5D1](#) ([Chapter 6.7.2](#)).

In the category [5E](#), another type of land use was included in the calculation ([Chapter 6.8](#)).

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 the extended responsibility of producers and transfers the organisation and financing of 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 landfilling of bio-waste entered into force (7). [Table 6.4.1](#) shows the activity data and emissions from this category.

Table 6.4.1: 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	2,933.27	0.10	0.00	0.00	0.00
1995	26.85	2,394.27	0.10	0.00	0.00	0.00
2000	30.90	1,886.08	0.11	0.00	0.00	0.00
2005	36.47	1,794.18	0.13	0.00	0.00	0.00
2010	41.86	2,030.78	0.15	0.00	0.00	0.00
2011	43.37	1,759.22	0.16	0.00	0.00	0.00
2012	44.28	1,487.65	0.16	0.00	0.00	0.00
2013	44.88	1,701.31	0.16	0.00	0.00	0.00
2014	44.46	1,914.97	0.16	0.00	0.00	0.00
2015	45.13	1,644.90	0.16	0.00	0.00	0.00
2016	45.13	1,374.82	0.16	0.00	0.00	0.00
2017	45.15	1,267.71	0.16	0.00	0.00	0.00
2018	45.18	1,160.60	0.16	0.00	0.00	0.00
2019	44.85	2,147.29	0.16	0.00	0.00	0.00
2020	44.43	3,133.99	0.16	0.00	0.00	0.00
2021	44.22	2,892.13	0.16	0.00	0.00	0.00
2022	42.85	2,650.27	0.15	0.00	0.00	0.00
2023	41.52	2,608.15	0.15	0.00	0.00	0.00
2024	40.00	2,692.99	0.14	0.00	0.00	0.00
1990/2024	43%	-8%	43%	-8%	-8%	-8%
2023/2024	-4%	3%	-4%	3%	3%	3%

In comparison with the base year, emissions of NMVOC in this category show an increasing trend 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 6.4.2](#).

Table 6.4.2: 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
2023	0.49	1.66
2024	0.58	8.60
2005/2024	-94%	996%
2023/2024	-68%	419%

6.4.2 Methodological Issues

Activity data for this category were 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 6.4.3](#)). Emission factors used for calculation are shown in [Table 6.4.3](#).

Table 6.4.3: 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]
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

No recalculations were made in this submission.

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. (9) imposes on municipalities the obligation to collect kitchen waste and its subsequent recovery from 1.1.2021.

From this category, only emissions of NH₃ are emitted. An overview of the emission trend is shown in [Table 6.5.1](#).

Table 6.5.1: Overview of emissions in category 5B

YEAR	NH ₃ [kt]
1990	0.4283
1995	0.4385
2000	0.4391
2005	0.5118
2010	0.6818
2011	0.9327
2012	1.3802
2013	1.9948
2014	2.5401
2015	2.7119
2016	2.6107
2017	2.7939
2018	2.7061
2019	2.5041
2020	2.6296
2021	2.4774
2022	2.3180
2023	2.3293
2024	2.5250
1990/2024	489%
2023/2024	8%

Shares of emissions of NH₃ in the individual categories are shown in [Figure 6.5.1](#).

Figure 6.5.1: Share of NH₃ emissions of individual categories in 5B in 2024



6.5.2 Composting (NFR 5B1)

6.5.2.1 Overview of the Category

In 2006 (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 NH₃ emissions from this category, has been continually increasing. This increase was caused by improving composting plants' capacity and political pressure on municipalities to create conditions for kitchen and garden waste from households to be composted, which was strengthened by Decree No 348/2020 (11).

Sewage sludge and industrial sludge are included in the total amount of industrial waste (**Recommendation No. SK-5B1-2025-0001**).

The emission of NH₃ and activity data from this source are displayed in **Table 6.5.2**.

Table 6.5.2: Overview of the activity data, emissions and trends in the category of Composting of waste

YEAR	COMPOSTED MUNICIPAL WASTE [kt]	COMPOSTED INDUSTRIAL WASTE [kt]	COMPOSTED SEWAGE SLUDGE [t]	COMPOSTED INDUSTRIAL SLUDGE [t]	NH ₃ [kt]	CO [kt]
1990	20.00	629.00	NE	NE	0.4283	0.3634
1995	35.46	629.00	NE	NE	0.4385	0.3721
2000	36.35	629.00	NE	NE	0.4391	0.3726
2005	45.00	579.15	NE	1,037.00	0.4119	0.3495
2010	90.72	578.54	47,140.00	6,369.00	0.4417	0.3748
2011	99.84	652.55	50,111.00	9,977.00	0.4966	0.4213
2012	122.76	726.56	46,446.00	7,099.00	0.5606	0.4756
2013	130.67	619.85	45,261.00	7,727.00	0.4953	0.4203
2014	145.11	728.11	36,524.00	4,632.00	0.5763	0.4890

YEAR	COMPOSTED MUNICIPAL WASTE [kt]	COMPOSTED INDUSTRIAL WASTE [kt]	COMPOSTED SEWAGE SLUDGE [t]	COMPOSTED INDUSTRIAL SLUDGE [t]	NH ₃ [kt]	CO [kt]
2015	200.49	934.99	34,689.00	3,248.00	0.7494	0.6359
2016	212.48	713.26	34,695.00	3,353.00	0.6110	0.5184
2017	317.37	767.38	34,416.00	3,460.00	0.7159	0.6075
2018	378.56	783.56	32,982.00	3,520.00	0.7670	0.6508
2019	441.87	655.10	32,217.00	3,361.00	0.7240	0.6143
2020	662.87	789.44	36,562.00	3,893.00	0.9585	0.8133
2021	736.98	680.71	37,289.00	3,191.00	0.9357	0.7939
2022	754.80	996.19	33,509.00	1,905.00	1.1557	0.9806
2023	800.72	752.22	31,050.00	4,418.88	1.0249	0.8696
2024	834.09	727.70	34,606.00	3,667.54	1.0308	0.8746
1990/2024	4070%	16%	-	-	141%	141%
2023/2024	4%	-3%	11%	-17%	1%	1%

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*” (8) 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 have been collected and published since 1997. Methodology and emission factors of Tier 2 – Windrow composting of garden and park waste from EMEP/EEA GB 2023 were applied ([Table 6.5.3](#)). As a part of the change, the emissions of CO were added to the inventory.

Table 6.5.3: Emission factors in the category of Composting of waste

POLLUTANT	NH ₃	CO
Unit	[kg/t]	[kg/t]
Value	0.66	0.56

6.5.2.3 Completeness

Notation keys were used according to the EMEP/EEA GB 2023.

6.5.2.4 Source-specific Recalculations

No recalculations were made 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. (11). 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. (12), which provides price regulation in the electricity sector, entered into force, emissions started to increase in 2014. [Table 6.5.4](#) shows the NH₃ emission trend in this category.

Table 6.5.4: 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	91.34	0.0998
2010	219.67	0.2401
2011	399.09	0.4361
2012	749.98	0.8196
2013	1,372.03	1.4994
2014	1,796.88	1.9637
2015	1,795.72	1.9625
2016	1,829.76	1.9997
2017	1,901.41	2.0780
2018	1,774.35	1.9391
2019	1,628.87	1.7801
2020	1,529.10	1.6711
2021	1,410.77	1.5418
2022	1,063.59	1.1623
2023	1,193.54	1.3044
2024	1,367.28	1.4942
2005/2024	1397%	1397%
2023/2024	15%	15%

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, and an amount of waste, energy crops and others were added to the calculation of the total 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 were used according to the EMEP/EEA GB 2023.

6.5.3.4 Source-specific Recalculations

No recalculations were made in this submission.

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 2024 (14):

- Two large MSW incinerators with energy utilisation;

- Five ISW incinerators (three of them with energy utilisation, one of them is co-incinerating industrial sludge);
- One clinical waste incinerator without energy utilisation;
- Six facilities co-incinerating ISW (cement and lime kilns).

Not all emissions from waste incineration follow the same trend. Main pollutants (except NMVOC), heavy metals and POPs are increasing as the amount of incinerated waste is growing slowly, but some of the heavy metals and POPs emissions (Pb, Hg, PCDDF) have decreased as many abatement technologies to reduce them were installed ([Table 6.6.1](#)).

In this submission, emissions in categories [5C1bi](#) and [5C1bii](#) were recalculated because of the correction of the conversion factor for POPs.

Table 6.6.1: 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	0.2184	0.1577	0.0289	0.4559	0.5264	0.6137	0.1136	6.9531
1995	0.1916	0.1354	0.0283	0.3985	0.4631	0.5469	0.0975	5.9811
2000	0.2728	0.1992	0.0315	0.5651	0.6464	0.7127	0.1435	8.7979
2005	0.4334	0.3202	0.0559	0.8895	1.0086	1.0920	0.2309	14.2882
2010	0.4347	0.3243	0.0289	0.8748	0.9812	1.0480	0.2337	14.5366
2011	0.4170	0.3133	0.0267	0.8284	0.9234	0.9797	0.2250	14.0235
2012	0.2596	0.1898	0.0304	0.5101	0.5726	0.6123	0.1359	8.4363
2013	0.2659	0.1910	0.0333	0.5160	0.5806	0.6228	0.1366	8.5133
2014	0.4967	0.3745	0.0348	0.9810	1.0896	1.1518	0.2689	16.7998
2015	0.4803	0.3585	0.0368	0.9579	1.0710	1.1398	0.2581	16.0786
2016	0.4586	0.3481	0.0298	0.8859	0.9738	1.0174	0.2492	15.6238
2017	0.4469	0.3402	0.0366	0.8629	0.9478	0.9896	0.2432	15.2593
2018	0.4739	0.3561	0.0388	0.9233	1.0220	1.0756	0.2553	15.9735
2019	0.4532	0.3386	0.0381	0.8812	0.9764	1.0290	0.2428	15.1835
2020	0.3826	0.2816	0.0364	0.7275	0.8046	0.8462	0.2015	12.6114
2021	0.3929	0.2874	0.0350	0.7285	0.8001	0.8355	0.2051	12.8790
2022	0.3817	0.2843	0.0324	0.7259	0.7994	0.8371	0.2031	12.7149
2023	0.3530	0.2617	0.0339	0.6675	0.7344	0.7682	0.1872	11.7406
2024	0.4019	0.3004	0.0307	0.7626	0.8376	0.8745	0.2148	13.4802
1990/2024	84%	91%	6%	67%	59%	43%	89%	94%
2023/2024	14%	15%	-10%	14%	14%	14%	15%	15%

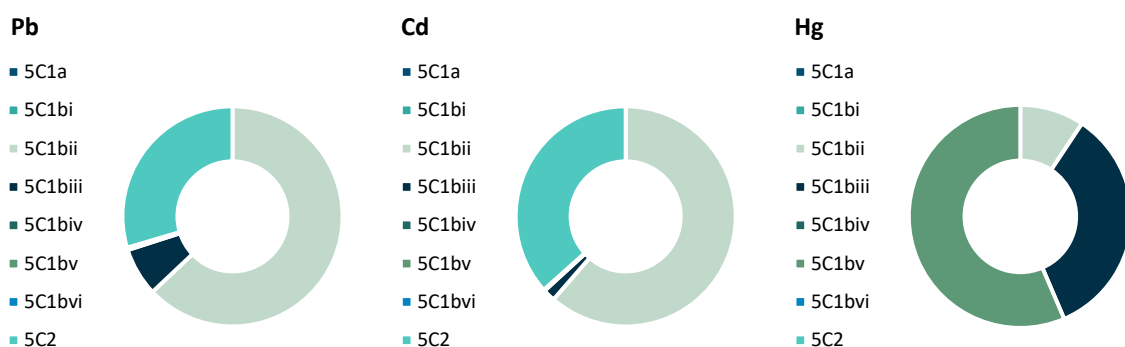
YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.8333	0.0573	0.2121	0.1002	0.0135	0.0786	0.0081	0.0107	1.8439
1995	0.8202	0.0548	0.2111	0.0881	0.0134	0.0743	0.0080	0.0092	1.5866
2000	0.9028	0.0642	0.2297	0.1237	0.0145	0.0896	0.0087	0.0136	2.3256
2005	1.1554	0.1002	0.1889	0.1988	0.0338	0.1594	0.0197	0.0220	3.8121
2010	0.7920	0.0791	0.1288	0.1928	0.0252	0.1321	0.0147	0.0224	3.8348
2011	0.6048	0.0716	0.1438	0.1825	0.0239	0.1292	0.0140	0.0216	3.6981
2012	0.5487	0.0674	0.0936	0.1186	0.0326	0.1286	0.0189	0.0133	2.3150
2013	0.6173	0.0774	0.0971	0.1225	0.0403	0.1500	0.0233	0.0135	2.3600
2014	0.5962	0.0889	0.0968	0.2192	0.0375	0.1738	0.0217	0.0260	4.4709
2015	0.7710	0.0902	0.0919	0.2138	0.0351	0.1621	0.0203	0.0249	4.2768
2016	0.2457	0.0743	0.0606	0.1985	0.0367	0.1655	0.0211	0.0242	4.1673
2017	0.2440	0.0818	0.0451	0.1964	0.0450	0.1869	0.0259	0.0237	4.1120
2018	0.4725	0.0890	0.0663	0.2090	0.0436	0.1855	0.0252	0.0248	4.2881

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2019	0.4781	0.0853	0.0591	0.1995	0.0416	0.1756	0.0240	0.0237	4.0786
2020	0.3790	0.0781	0.0637	0.1672	0.0420	0.1676	0.0243	0.0199	3.4217
2021	0.2162	0.0715	0.0708	0.1666	0.0401	0.1638	0.0232	0.0204	3.4803
2022	0.2802	0.0733	0.0644	0.1660	0.0399	0.1633	0.0231	0.0200	3.4434
2023	0.2098	0.0581	0.0591	0.1501	0.0292	0.1286	0.0169	0.0184	3.1387
2024	0.1975	0.0659	0.0567	0.1717	0.0341	0.1490	0.0197	0.0211	3.6066
1990/2024	-76%	15%	-73%	71%	152%	90%	143%	96%	96%
2023/2024	-6%	13%	-4%	14%	17%	16%	16%	15%	15%

YEAR	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]	PCBs [kg]
1990	190.1791	0.3309	0.5410	0.6776
1995	188.0717	0.2834	0.4632	0.5802
2000	188.6982	0.4194	0.6856	0.8586
2005	201.1858	0.6776	1.1078	1.3874
2010	109.7271	0.6889	1.1262	1.4105
2011	80.8292	0.6648	1.0869	1.3613
2012	64.7017	0.4006	0.6550	0.8203
2013	87.2747	0.4022	0.6576	0.8236
2014	81.7217	0.7958	1.3010	1.6294
2015	80.9313	0.7618	1.2455	1.5599
2016	6.2477	0.7400	1.2099	1.5153
2017	4.7595	0.7225	1.1812	1.4794
2018	13.1184	0.7563	1.2365	1.5486
2019	12.9529	0.7192	1.1758	1.4726
2020	9.6870	0.5970	0.9761	1.2224
2021	4.4162	0.6094	0.9963	1.2479
2022	6.9139	0.6029	0.9858	1.2346
2023	5.3219	0.5558	0.9087	1.1381
2024	4.3015	0.6382	1.0435	1.3069
1990/2024	-98%	93%	93%	93%
2023/2024	-19%	15%	15%	15%

Waste incineration contributes mostly to emissions of heavy metals and POPs. The figures below stand for shares of emissions through the categories of **5C**.

Figure 6.6.1: Share of emissions of individual categories in 5C in 2024



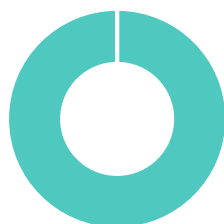
PCDD/F

- 5C1a
- 5C1bi
- 5C1bii
- 5C1biii
- 5C1biv
- 5C1bv
- 5C1bvi
- 5C2



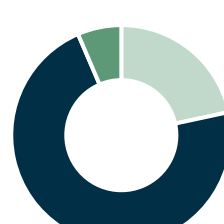
PAHs

- 5C1a
- 5C1bi
- 5C1bii
- 5C1biii
- 5C1biv
- 5C1bv
- 5C1bvi
- 5C2



HCB

- 5C1a
- 5C1bi
- 5C1bii
- 5C1biii
- 5C1biv
- 5C1bv
- 5C1bvi
- 5C2



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 6.6.2**. As shown, the amount of incinerated municipal waste shows a slightly increasing trend since 1990, due to the gradual prioritisation 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. The KOSIT incineration plant was reconstructed in 2005, including the installation of a new air pollution control system that significantly reduced emissions starting in 2006. (**Table 6.6.2**).

Table 6.6.2: Overview of the activity data, emissions and trends in the category of Municipal waste incineration

YEAR	MSW [kt]	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]
1990	179.61	0.3233	0.0036	0.3053	0.0005	1.6524	2.4606	3.2868
1995	159.34	0.2868	0.0032	0.2709	0.0005	1.4660	2.1830	2.9160
2000	220.21	0.3964	0.0044	0.3744	0.0007	1.2825	1.9098	2.5510
2005	193.18	0.2224	0.0016	0.0385	0.0006	0.0055	0.0082	0.0110
2010	191.93	0.1381	0.0018	0.0066	0.0006	0.0007	0.0010	0.0013
2011	204.13	0.1628	0.0018	0.0069	0.0006	0.0005	0.0007	0.0009
2012	180.55	0.1578	0.0020	0.0063	0.0005	0.0009	0.0013	0.0017
2013	181.52	0.1398	0.0026	0.0075	0.0005	0.0008	0.0012	0.0016
2014	211.89	0.1504	0.0023	0.0109	0.0006	0.0012	0.0018	0.0023
2015	200.76	0.1239	0.0021	0.0067	0.0006	0.0008	0.0012	0.0016
2016	216.54	0.1426	0.0016	0.0087	0.0006	0.0008	0.0012	0.0016
2017	231.89	0.1450	0.0016	0.0096	0.0007	0.0011	0.0016	0.0021

YEAR	MSW [kt]	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]
2018	245.61	0.1541	0.0018	0.0094	0.0007	0.0009	0.0013	0.0017
2019	243.04	0.1619	0.0007	0.0055	0.0007	0.0013	0.0019	0.0026
2020	234.51	0.1515	0.0008	0.0051	0.0007	0.0008	0.0013	0.0017
2021	230.71	0.1564	0.0008	0.0047	0.0007	0.0008	0.0012	0.0015
2022	239.15	0.1757	0.0007	0.0039	0.0007	0.0009	0.0013	0.0018
2023	254.65	0.1936	0.0008	0.0064	0.0008	0.0009	0.0014	0.0018
2024	229.13	0.1568	0.0007	0.0044	0.0007	0.0007	0.0010	0.0013
1990/2024	42%	-40%	-78%	-98%	42%	-100%	-100%	-100%
2023/2024	6%	10%	18%	64%	6%	4%	4%	4%

YEAR	BC [kt]	CO [kt]	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]
1990	5.8E-02	0.1257	18.6791	0.6107	0.5029	0.3844	0.0332	0.0167
1995	5.1E-02	0.1115	16.5718	0.5418	0.4462	0.3410	0.0295	0.0148
2000	4.5E-02	0.1541	22.9021	0.7487	0.6166	0.4713	0.0407	0.0205
2005	1.9E-04	0.0479	7.6674	0.2525	0.2096	0.1592	0.0158	0.0091
2010	2.3E-05	0.0096	0.0086	0.0033	0.0054	0.0019	0.0036	0.0048
2011	1.6E-05	0.0084	0.0092	0.0035	0.0057	0.0020	0.0038	0.0051
2012	3.0E-05	0.0076	0.0081	0.0031	0.0051	0.0018	0.0033	0.0045
2013	2.9E-05	0.0082	0.0081	0.0031	0.0051	0.0018	0.0034	0.0045
2014	4.1E-05	0.0173	0.0093	0.0036	0.0059	0.0020	0.0039	0.0054
2015	2.9E-05	0.0083	0.0090	0.0034	0.0056	0.0020	0.0037	0.0050
2016	2.9E-05	0.0088	0.0095	0.0037	0.0061	0.0021	0.0040	0.0056
2017	3.7E-05	0.0133	0.0100	0.0039	0.0065	0.0021	0.0043	0.0061
2018	3.0E-05	0.0114	0.0104	0.0042	0.0069	0.0022	0.0045	0.0067
2019	4.5E-05	0.0074	0.0104	0.0041	0.0068	0.0022	0.0045	0.0066
2020	2.9E-05	0.0068	0.0099	0.0040	0.0066	0.0021	0.0043	0.0064
2021	2.7E-05	0.0096	0.0097	0.0039	0.0065	0.0020	0.0043	0.0063
2022	3.1E-05	0.0085	0.0100	0.0041	0.0067	0.0021	0.0044	0.0066
2023	3.3E-05	0.0088	0.0106	0.0043	0.0071	0.0022	0.0047	0.0071
2024	2.3E-05	0.0081	0.0097	0.0039	0.0064	0.0020	0.0042	0.0062
1990/2024	-100%	-93%	-100%	-99%	-99%	-99%	-86%	-57%
2023/2024	4%	3%	6%	6%	6%	5%	6%	7%

YEAR	Ni [t]	Se [t]	Zn [t]	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]	PCBs [kg]
1990	0.0216	0.0021	0.1616	628.6224	0.0008	0.0006	0.0006
1995	0.0191	0.0019	0.1434	557.7038	0.0007	0.0005	0.0005
2000	0.0264	0.0026	0.1982	770.7454	0.0009	0.0007	0.0007
2005	0.0124	0.0023	0.0986	258.2458	0.0008	0.0006	0.0006
2010	0.0078	0.0022	0.0518	0.6718	0.0008	0.0006	0.0006
2011	0.0082	0.0024	0.0551	0.7145	0.0009	0.0007	0.0006
2012	0.0072	0.0021	0.0487	0.6319	0.0008	0.0006	0.0006
2013	0.0073	0.0021	0.0490	0.6353	0.0008	0.0006	0.0006
2014	0.0088	0.0025	0.0572	0.7416	0.0009	0.0007	0.0007
2015	0.0081	0.0023	0.0542	0.7026	0.0008	0.0006	0.0006
2016	0.0090	0.0025	0.0585	0.7579	0.0009	0.0007	0.0007
2017	0.0099	0.0027	0.0626	0.8116	0.0010	0.0007	0.0007
2018	0.0108	0.0029	0.0663	0.8596	0.0010	0.0008	0.0008
2019	0.0106	0.0028	0.0656	0.8507	0.0010	0.0008	0.0008

YEAR	Ni [t]	Se [t]	Zn [t]	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]	PCBs [kg]
2020	0.0103	0.0027	0.0633	0.8208	0.0010	0.0008	0.0007
2021	0.0102	0.0027	0.0623	0.8075	0.0010	0.0007	0.0007
2022	0.0107	0.0028	0.0646	0.8370	0.0010	0.0008	0.0007
2023	0.0115	0.0030	0.0688	0.8913	0.0011	0.0008	0.0008
2024	0.0100	0.0027	0.0619	0.8020	0.0010	0.0007	0.0007
1990/2024	-47%	42%	-57%	-100%	42%	42%	42%
2023/2024	7%	6%	6%	6%	6%	6%	6%

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 (8) were used to calculate emissions in this category. There are no MSW incinerators without energy recovery in the Slovak Republic; 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, NH₃, CO, TSP, PM_{2.5} and PM₁₀ data from the NEIS database for the period 2005-2020 were applied. For the period 1990-2004, extrapolated data based on the 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. (15) 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 choice 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/EEA GB 2023 for heavy metals and POPs were used in calculations of emissions, except for selen and indeno(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 2023 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 were recorded; only emission factors for uncontrolled plants were used.

Values of emission factors are given in **Table 6.6.3**, and values of abatement technology efficiency, separately for each operator, are given in **Table 6.6.4**.

Table 6.6.3: 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

Table 6.6.4: 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 does not occur in the Slovak Republic; therefore, the 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

No recalculations were made in this submission.

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 its 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 follow the new standards or were decommissioned.

From the total of 12 non-MSW incinerators and co-incineration plants working in 2024, 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;
- 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
- Fecupral Ltd., Prešov (0,15t/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 Sĺnie (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 into 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 6.6.5** shows activity data of waste incineration with and without energy recovery and its allocation into NFR categories.

In the previous submission, it was reported that waste was incinerated with energy recovery within the category **2B10a**. This issue was researched, resulting in the removal of the data. The reported waste was the waste gases from the production processes, which were not incinerated and were considered to be reported incorrectly.

Following **Recommendation No. SK-5C-2025-0001**, the description of the methodology for the non-municipal waste incineration with energy recovery can be found in the energy sector chapter.

Table 6.6.5: 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]	5C1bi [kt]	5C1bii [kt]	5C1biii [kt]
1990	49.87	10.32	13.00	35.05	1.82	6.13	0.78	3.41
1995	46.69	10.22	13.02	32.20	1.47	6.07	0.77	3.38
2000	41.82	11.10	13.01	27.70	1.11	6.60	0.84	3.67
2005	59.86	13.35	11.98	7.40	40.48	8.45	2.21	2.68
2010	180.75	8.89	1.47	6.73	172.55	5.56	1.67	1.66
2011	204.78	7.33	5.39	6.75	192.64	3.69	1.59	2.06
2012	213.32	6.77	3.33	5.48	204.51	3.42	2.24	1.11
2013	255.89	7.67	12.51	4.80	238.57	3.84	2.78	1.05
2014	295.81	7.01	3.73	3.81	288.27	3.33	2.59	1.09
2015	289.03	8.47	3.55	4.51	280.97	5.21	2.39	0.87
2016	302.04	3.33	3.25	4.52	294.28	0.21	2.58	0.53
2017	323.33	3.49	3.84	5.31	314.18	0.00	3.19	0.30
2018	319.12	5.70	2.16	5.10	311.86	2.16	3.05	0.48
2019	351.96	5.58	2.39	4.30	345.27	2.39	2.91	0.28
2020	372.64	4.79	1.51	4.28	366.85	1.53	2.95	0.32
2021	390.89	3.16	1.48	2.88	386.52	NO	2.82	0.34
2022	314.92	3.85	1.85	3.21	309.86	0.59	2.81	0.45
2023	343.80	2.67	1.60	2.72	339.48	0.35	1.94	0.38
2024	343.14	2.73	1.62	3.24	338.28	NO	2.40	0.33
1990/2024	588%	-74%	-88%	-91%	18488%	-	208%	-90%
2023/2024	-0.2%	2%	1%	19%	-0.4%	-	24%	-13%

6.6.3.2 Category-specific Recalculations

In this submission, several recalculations were made in categories **5C1bi** and **5C1bii** because of the conversion factor corrections in POPs.

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 were included in the calculation. Activity data and resulting emissions are shown in [Table 6.6.6](#).

Table 6.6.6: Overview of activity data and emissions in the category 5C1bi

Year	IW [kt]	IS [kt]	NO _x [kt]	NM VOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]
1990	6.13	NE	0.0110	0.0001	0.0104	0.0564	0.0840	0.1122	0.0020
1995	6.07	NE	0.0109	0.0001	0.0103	0.0558	0.0831	0.1110	0.0020
2000	6.60	NE	0.0119	0.0001	0.0112	0.0607	0.0904	0.1207	0.0021
2005	1.63	6.82	0.0152	0.0002	0.0144	0.0778	0.1158	0.1547	0.0027
2010	NO	5.56	0.0100	0.0001	0.0095	0.0512	0.0762	0.1018	0.0018
2011	NO	3.69	0.0066	0.0001	0.0063	0.0339	0.0505	0.0675	0.0012
2012	NO	3.42	0.0062	0.0001	0.0058	0.0315	0.0468	0.0626	0.0011
2013	NO	3.84	0.0069	0.0001	0.0065	0.0353	0.0526	0.0702	0.0012
2014	NO	3.33	0.0060	0.0001	0.0057	0.0306	0.0456	0.0609	0.0011
2015	NO	5.21	0.0094	0.0001	0.0089	0.0480	0.0714	0.0954	0.0017
2016	NO	0.21	0.0004	0.0000	0.0004	0.0019	0.0028	0.0038	0.0001
2017	NO	0.00	NO	NO	NO	NO	NO	NO	NO
2018	NO	2.16	0.0039	0.0000	0.0037	0.0199	0.0297	0.0396	0.0007
2019	NO	2.39	0.0043	0.0000	0.0041	0.0220	0.0328	0.0438	0.0008
2020	NO	1.53	0.0027	0.0000	0.0026	0.0141	0.0209	0.0280	0.0005
2021	NO	0.00	NO	NO	NO	NO	NO	NO	NO
2022	NO	0.59	0.0011	0.0000	0.0010	0.0054	0.0081	0.0108	0.0002
2023	NO	0.35	0.0006	0.0000	0.0006	0.0032	0.0048	0.0065	0.0001
2024	NO	NO	NO	NO	NO	NO	NO	NO	NO
1990/2024	-	-	-	-	-	-	-	-	-
2023/2024	-	-	-	-	-	-	-	-	-

YEAR	CO [kt]	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Zn [t]
1990	0.0043	0.6377	0.0208	0.0172	0.0131	0.0172	0.0131	7.4E-04	0.0055
1995	0.0042	0.6311	0.0206	0.0170	0.0130	0.0170	0.0130	7.3E-04	0.0055
2000	0.0046	0.6859	0.0224	0.0185	0.0141	0.0185	0.0141	7.9E-04	0.0059
2005	0.0059	0.8790	0.0287	0.0237	0.0181	0.0237	0.0181	1.0E-03	0.0076
2010	0.0039	0.5783	0.0189	0.0156	0.0119	0.0156	0.0119	6.7E-04	0.0050
2011	0.0026	0.3834	0.0125	0.0103	0.0079	0.0103	0.0079	4.4E-04	0.0033
2012	0.0024	0.3555	0.0116	0.0096	0.0073	0.0096	0.0073	4.1E-04	0.0031
2013	0.0027	0.3991	0.0130	0.0107	0.0082	0.0107	0.0082	4.6E-04	0.0035
2014	0.0023	0.3461	0.0113	0.0093	0.0071	0.0093	0.0071	4.0E-04	0.0030
2015	0.0036	0.5422	0.0177	0.0146	0.0112	0.0146	0.0112	6.3E-04	0.0047
2016	0.0001	0.0216	0.0007	0.0006	0.0004	0.0006	0.0004	2.5E-05	0.0002
2017	NO	NO	NO	NO	NO	NO	NO	NO	NO
2018	0.0015	0.2252	0.0074	0.0061	0.0046	0.0061	0.0046	2.6E-04	0.0019
2019	0.0017	0.2488	0.0081	0.0067	0.0051	0.0067	0.0051	2.9E-04	0.0022
2020	0.0011	0.1589	0.0052	0.0043	0.0033	0.0043	0.0033	1.8E-04	0.0014
2021	NO	NO	NO	NO	NO	NO	NO	NO	NO
2022	0.0004	0.0616	0.0020	0.0017	0.0013	0.0017	0.0013	7.1E-05	0.0005
2023	0.0002	0.0367	0.0012	0.0010	0.0008	0.0010	0.0008	4.2E-05	0.0003
2024	NO	NO	NO	NO	NO	NO	NO	NO	NO

YEAR	CO [kt]	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Zn [t]
1990/2024	-	-	-	-	-	-	-	-	-
2023/2024	-	-	-	-	-	-	-	-	-

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]
1990	21.4607	2.6E-05	2.0E-05	1.9E-05	6.4E-05	0.0123	0.0325
1995	21.2387	2.5E-05	1.9E-05	1.9E-05	6.4E-05	0.0121	0.0322
2000	23.0841	2.8E-05	2.1E-05	2.0E-05	6.9E-05	0.0132	0.0350
2005	29.5805	3.5E-05	2.7E-05	2.6E-05	8.9E-05	0.0169	0.0448
2010	19.4636	2.3E-05	1.8E-05	1.7E-05	5.8E-05	0.0111	0.0295
2011	12.9012	1.5E-05	1.2E-05	1.1E-05	3.9E-05	0.0074	0.0195
2012	11.9648	1.4E-05	1.1E-05	1.1E-05	3.6E-05	0.0068	0.0181
2013	13.4320	1.6E-05	1.2E-05	1.2E-05	4.0E-05	0.0077	0.0203
2014	11.6480	1.4E-05	1.1E-05	1.0E-05	3.5E-05	0.0067	0.0176
2015	18.2468	2.2E-05	1.7E-05	1.6E-05	5.5E-05	0.0104	0.0276
2016	0.7270	8.7E-07	6.6E-07	6.4E-07	2.2E-06	0.0004	0.0011
2017	NO	NO	NO	NO	NO	NO	NO
2018	7.5773	9.1E-06	6.9E-06	6.7E-06	2.3E-05	0.0043	0.0115
2019	8.3720	1.0E-05	7.7E-06	7.4E-06	2.5E-05	0.0048	0.0127
2020	5.3464	6.4E-06	4.9E-06	4.7E-06	1.6E-05	0.0031	0.0081
2021	NO	NO	NO	NO	NO	NO	NO
2022	2.0721	2.5E-06	1.9E-06	1.8E-06	6.2E-06	0.0012	0.0031
2023	1.2355	1.5E-06	1.1E-06	1.1E-06	3.7E-06	0.0007	0.0019
2024	NO	NO	NO	NO	NO	NO	NO
1990/2024	-	-	-	-	-	-	-
2023/2024	-	-	-	-	-	-	-

6.6.3.3.1 Methodological Issues

Data from the NEIS database was used to analyse industrial waste incineration sources without energy recovery. The use of statistical data was reconsidered after a detailed analysis and comparison with other sources. Statistical data were assumed to be highly overestimated. Detailed descriptions can be found in [ANNEX VIII](#). In this submission, Tier 2 methodology for uncontrolled incineration of Municipal waste from the EMEP/EEA GB 2023 was used to calculate emissions in this category. Emission calculations for Cr, Cu, Zn, B(a)P, B(b)F, B(k)F and PCB were added in this submission. Emission factors are shown in [Table 6.6.7](#).

The **condensable component of PMs** is not included in EFs.

Table 6.6.7: Emission factors in the category Industrial waste incineration without E recovery

POLLUTANT	NO _x	NMVOC	SO _x	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	1.8	0.02	1.70	9.2	13.7	18.3	3.5	0.7

POLLUTANT	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]
Value	104	3.4	2.8	2.14	0.185	0.093	0.12	0.9

POLLUTANT	PCDD/F	B(a)P	B(b)F	B(k)F	PAHs	HCB	PCB
Unit	mg/t I-TEQ	mg/t	mg/t	mg/t	mg/t	g/t	mg/t
Value	3.5	4.2	3.2	3.1	10.5	0.002	5.3

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 in compliance with the EMEP/EEA GB 2023.

6.6.3.3.3 Source-specific Recalculations

Recalculations in this category result from conversion-factor corrections in POPs (**Table 6.6.8**).

Table 6.6.8: Differences of emissions in the category 5C1bi between the previous submission and the current submission caused by recalculations

YEAR	PCDD/F	B(a)P	B(b)F	B(k)F	PAHs	PCBs
	CHANGE					
1990	99900%	-100%	-100%	-100%	-100%	-100%
1991	99900%	-100%	-100%	-100%	-100%	-100%
1992	99900%	-100%	-100%	-100%	-100%	-100%
1993	99900%	-100%	-100%	-100%	-100%	-100%
1994	99900%	-100%	-100%	-100%	-100%	-100%
1995	99900%	-100%	-100%	-100%	-100%	-100%
1996	99900%	-100%	-100%	-100%	-100%	-100%
1997	99900%	-100%	-100%	-100%	-100%	-100%
1998	99900%	-100%	-100%	-100%	-100%	-100%
1999	99900%	-100%	-100%	-100%	-100%	-100%
2000	99900%	-100%	-100%	-100%	-100%	-100%
2001	99900%	-100%	-100%	-100%	-100%	-100%
2002	99900%	-100%	-100%	-100%	-100%	-100%
2003	99900%	-100%	-100%	-100%	-100%	-100%
2004	99900%	-100%	-100%	-100%	-100%	-100%
2005	99900%	-100%	-100%	-100%	-100%	-100%
2006	99900%	-100%	-100%	-100%	-100%	-100%
2007	99900%	-100%	-100%	-100%	-100%	-100%
2008	99900%	-100%	-100%	-100%	-100%	-100%
2009	99900%	-100%	-100%	-100%	-100%	-100%
2010	99900%	-100%	-100%	-100%	-100%	-100%
2011	99900%	-100%	-100%	-100%	-100%	-100%
2012	99900%	-100%	-100%	-100%	-100%	-100%
2013	99900%	-100%	-100%	-100%	-100%	-100%
2014	99900%	-100%	-100%	-100%	-100%	-100%
2015	99900%	-100%	-100%	-100%	-100%	-100%
2016	99900%	-100%	-100%	-100%	-100%	-100%
2017	-	-	-	-	-	-
2018	99900%	-100%	-100%	-100%	-100%	-100%
2019	99900%	-100%	-100%	-100%	-100%	-100%
2020	99900%	-100%	-100%	-100%	-100%	-100%
2021	-	-	-	-	-	-
2022	99900%	-100%	-100%	-100%	-100%	-100%
2023	99900%	-100%	-100%	-100%	-100%	-100%

6.6.3.4 Hazardous Waste Incineration (NFR 5C1bii)

Emissions in this category are generally increasing (**Table 6.6.9**) due to legislation prioritising waste incineration over landfilling.

Table 6.6.9: Overview of activity data and emissions in the category 5C1bii

YEAR	HW INCINERATED [kt]	NOx [kt]	NM VOC [kt]	SOx [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]
1990	0.78	0.0020	0.0007	0.0109	8.6E-04	3.2E-03	0.0406	3.0E-05
1995	0.77	0.0019	0.0006	0.0108	8.5E-04	3.2E-03	0.0402	3.0E-05
2000	0.84	0.0021	0.0007	0.0118	2.1E-04	7.8E-04	0.0099	7.3E-06
2005	2.21	0.0055	0.0019	0.0310	8.6E-05	3.3E-04	0.0040	3.0E-06
2010	1.67	0.0042	0.0014	0.0103	2.4E-05	9.3E-05	0.0011	8.4E-07
2011	1.59	0.0040	0.0013	0.0116	2.1E-05	8.0E-05	0.0009	7.3E-07
2012	2.24	0.0056	0.0019	0.0190	2.6E-05	9.9E-05	0.0011	9.2E-07
2013	2.78	0.0069	0.0023	0.0208	3.6E-05	1.4E-04	0.0016	1.3E-06
2014	2.59	0.0065	0.0022	0.0196	3.3E-05	1.3E-04	0.0015	1.2E-06
2015	2.39	0.0060	0.0020	0.0185	3.0E-05	1.1E-04	0.0013	1.1E-06
2016	2.58	0.0065	0.0022	0.0203	1.4E-05	4.2E-05	0.0004	5.0E-07
2017	3.19	0.0080	0.0027	0.0280	1.8E-05	5.2E-05	0.0005	6.1E-07
2018	3.05	0.0076	0.0026	0.0257	1.7E-05	5.0E-05	0.0005	5.9E-07
2019	2.91	0.0073	0.0024	0.0248	1.6E-05	4.8E-05	0.0005	5.6E-07
2020	2.95	0.0074	0.0025	0.0254	1.6E-05	4.8E-05	0.0005	5.7E-07
2021	2.82	0.0071	0.0024	0.0256	1.6E-05	4.6E-05	0.0004	5.4E-07
2022	2.81	0.0070	0.0024	0.0231	1.5E-05	4.6E-05	0.0004	5.4E-07
2023	2.05	0.0051	0.0017	0.0254	1.1E-05	3.4E-05	0.0003	3.9E-07
2024	2.40	0.0060	0.0020	0.0220	1.3E-05	3.9E-05	0.0004	4.6E-07
1990/2024	208%	208%	208%	101%	-98%	-99%	-99%	-98%
2023/2024	17%	17%	17%	-14%	17%	17%	17%	17%

YEAR	CO [kt]	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Zn [t]
1990	0.0121	0.0390	0.0125	0.0018	0.0037	0.0109	0.0312	0.0062	0.0001
1995	0.0120	0.0386	0.0124	0.0018	0.0036	0.0108	0.0309	0.0062	0.0001
2000	0.0130	0.0420	0.0134	0.0019	0.0039	0.0118	0.0336	0.0067	0.0001
2005	0.0343	0.1107	0.0354	0.0051	0.0104	0.0310	0.0886	0.0177	0.0003
2010	0.0259	0.0835	0.0267	0.0038	0.0078	0.0234	0.0668	0.0134	0.0003
2011	0.0246	0.0795	0.0254	0.0037	0.0075	0.0223	0.0636	0.0127	0.0002
2012	0.0348	0.1121	0.0359	0.0052	0.0105	0.0314	0.0897	0.0179	0.0003
2013	0.0431	0.1390	0.0445	0.0064	0.0131	0.0389	0.1112	0.0222	0.0004
2014	0.0401	0.1295	0.0414	0.0060	0.0122	0.0363	0.1036	0.0207	0.0004
2015	0.0371	0.1197	0.0383	0.0055	0.0113	0.0335	0.0958	0.0192	0.0004
2016	0.0400	0.1292	0.0413	0.0059	0.0121	0.0362	0.1033	0.0207	0.0004
2017	0.0494	0.1595	0.0510	0.0073	0.0150	0.0447	0.1276	0.0255	0.0005
2018	0.0473	0.1527	0.0489	0.0070	0.0144	0.0428	0.1222	0.0244	0.0005
2019	0.0451	0.1454	0.0465	0.0067	0.0137	0.0407	0.1163	0.0233	0.0004
2020	0.0457	0.1474	0.0472	0.0068	0.0139	0.0413	0.1179	0.0236	0.0004
2021	0.0438	0.1412	0.0452	0.0065	0.0133	0.0395	0.1130	0.0226	0.0004
2022	0.0436	0.1405	0.0450	0.0065	0.0132	0.0393	0.1124	0.0225	0.0004
2023	0.0317	0.1024	0.0328	0.0047	0.0096	0.0287	0.0819	0.0164	0.0003
2024	0.0372	0.1201	0.0384	0.0055	0.0113	0.0336	0.0961	0.0192	0.0004
1990/2024	208%	208%	208%	208%	208%	208%	208%	208%	208%
2023/2024	17%	17%	17%	17%	17%	17%	17%	17%	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	31.2243	4.0E-07	5.5E-08	4.8E-07	7.8E-08	1.0E-06	0.0037	0.0035
1995	30.9013	3.9E-07	5.4E-08	4.7E-07	7.7E-08	1.0E-06	0.0036	0.0035
2000	33.5863	4.3E-07	5.9E-08	5.1E-07	8.4E-08	1.1E-06	0.0039	0.0038
2005	67.4298	1.1E-06	1.6E-07	1.4E-06	2.2E-07	2.9E-06	0.0104	0.0100
2010	49.1784	8.5E-07	1.2E-07	1.0E-06	1.7E-07	2.2E-06	0.0078	0.0075
2011	40.3485	8.1E-07	1.1E-07	9.7E-07	1.6E-07	2.1E-06	0.0075	0.0072
2012	47.0167	1.1E-06	1.6E-07	1.4E-06	2.2E-07	2.9E-06	0.0105	0.0101
2013	68.3570	1.4E-06	1.9E-07	1.7E-06	2.8E-07	3.6E-06	0.0131	0.0125
2014	63.1876	1.3E-06	1.8E-07	1.6E-06	2.6E-07	3.3E-06	0.0122	0.0117
2015	56.8010	1.2E-06	1.7E-07	1.5E-06	2.4E-07	3.1E-06	0.0113	0.0108
2016	1.0334	1.3E-06	1.8E-07	1.6E-06	2.6E-07	3.3E-06	0.0121	0.0116
2017	1.2760	1.6E-06	2.2E-07	1.9E-06	3.2E-07	4.1E-06	0.0150	0.0144
2018	1.2216	1.6E-06	2.1E-07	1.9E-06	3.1E-07	3.9E-06	0.0144	0.0137
2019	1.1635	1.5E-06	2.0E-07	1.8E-06	2.9E-07	3.8E-06	0.0137	0.0131
2020	1.1789	1.5E-06	2.1E-07	1.8E-06	2.9E-07	3.8E-06	0.0139	0.0133
2021	1.1299	1.4E-06	2.0E-07	1.7E-06	2.8E-07	3.6E-06	0.0133	0.0127
2022	1.1242	1.4E-06	2.0E-07	1.7E-06	2.8E-07	3.6E-06	0.0132	0.0126
2023	0.8192	1.0E-06	1.4E-07	1.2E-06	2.0E-07	2.6E-06	0.0096	0.0092
2024	0.9611	1.2E-06	1.7E-07	1.5E-06	2.4E-07	3.1E-06	0.0113	0.0108
1990/2024	-97%	208%	208%	208%	208%	208%	208%	208%
2023/2024	17%	17%	17%	17%	17%	17%	17%	17%

6.6.3.4.1 Methodological Issues

Data from the NEIS database were used for hazardous waste incineration sources without energy recovery. The use of statistical data was reconsidered after a detailed analysis and comparison with other sources. Statistical data were assumed to be highly overestimated. Detailed descriptions can be found in [ANNEX VIII](#). Since the 2023 submission, hazardous waste has been excluded from category **5C1bi** and has been allocated to this category. Abatement technology installed at the incineration plants is included in the methodology.

Tier 2 methodology from the EMEP/EEA GB 2023, where the emission factors for uncontrolled sludge incineration were used to calculate emissions in this category (except for PCDD/PCDF, where the emission factor 40 mg/t of waste was used). Emission factors and abatement technology efficiencies are shown in [Table 6.6.10](#).

The **condensable component of PMs** is not included in EFs.

Table 6.6.10: Emission factors in the category Hazardous waste incineration without E recovery

POLLUTANT	NOx	NM VOC	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	2.5	0.84	14	1.1	4.1	52	3.5	15.5
ABATEMENT EFFICIENCY								
Acid gas abatement			76%					
Particle abatement only				98.4%	98.3%	98.4%		
WID-compliant plants				99.5%	99.6%	99.7%		

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	50	16	2.3	4.7	14.	40	8	0.15	66

POLLUTANT	PCDD/F	B(a)P	B(a)P	B(k)P	I()P	PAHs	HCB	PCBs
Unit	[mg/t I-TEQ]	[mg/t]	[mg/t]	[mg/t]	[mg/t]	[mg/t]	[mg/t]	[mg/t]
VALUE	40	0.51	0.07	0.61	0.1	1.29	4.7	4.5
ABATEMENT EFFICIENCY								
Controlled combustion; good APC system	99%							

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 in compliance with EMEP/EEA GB 2023.

6.6.3.4.3 Source-specific Recalculations

Recalculations in this category result from conversion-factor corrections in POPs (**Table 6.6.11**).

Table 6.6.11: Differences of emissions in the category 5C1bii between the previous submission and the current submission caused by recalculations

YEAR	PCDD/F	B(a)P	B(b)F	B(k)F	I()P	PAHs	HCB	PCBs
	CHANGE							
1990	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
1991	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
1992	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
1993	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
1994	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
1995	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
1996	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
1997	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
1998	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
1999	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2000	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2001	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2002	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2003	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2004	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2005	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2006	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2007	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2008	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2009	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2010	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2011	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2012	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2013	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2014	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2015	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2016	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2017	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2018	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2019	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2020	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%

YEAR	PCDD/F	B(a)P	B(b)F	B(k)F	I()P	PAHs	HCB	PCBs
	CHANGE							
2021	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2022	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
2023	99900%	-100%	-100%	-100%	-100%	-100%	-100%	-100%

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 (16) (17) (18) (19) 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 incinerating clinical waste, mostly small ones within the hospital facility area; in 2024, 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, dioxins and furans and polycyclic aromatic hydrocarbons, which can be present in hospital waste or can be formed during the combustion and post-combustion 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 (CO₂). 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 6.6.12](#) shows emissions released into the air from this activity using the methodology described below.

Table 6.6.12: 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]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]
1990	3.41	0.0061	0.0024	0.0038	3.4E-03	5.1E-03	7.8E-03
1995	3.38	0.0061	0.0024	0.0037	3.3E-03	5.0E-03	7.8E-03
2000	3.67	0.0066	0.0026	0.0037	3.5E-03	5.2E-03	8.0E-03
2005	2.68	0.0048	0.0019	0.0029	2.5E-03	3.8E-03	5.8E-03
2010	1.66	0.0030	0.0012	0.0011	9.0E-04	1.4E-03	2.1E-03
2011	2.06	0.0037	0.0014	0.0011	5.0E-04	7.6E-04	1.2E-03
2012	1.11	0.0020	0.0008	0.0003	1.8E-05	2.8E-05	4.1E-05
2013	1.05	0.0019	0.0007	0.0003	1.7E-05	2.7E-05	3.9E-05
2014	1.09	0.0020	0.0008	0.0003	1.7E-05	2.8E-05	4.0E-05
2015	0.87	0.0016	0.0006	0.0002	1.4E-05	2.2E-05	3.2E-05
2016	0.53	0.0010	0.0004	0.0001	8.5E-06	1.4E-05	2.0E-05
2017	0.30	0.0005	0.0002	0.0001	4.7E-06	7.6E-06	1.1E-05
2018	0.48	0.0009	0.0003	0.0001	7.6E-06	1.2E-05	1.8E-05
2019	0.28	0.0005	0.0002	0.0001	4.5E-06	7.2E-06	1.0E-05
2020	0.32	0.0006	0.0002	0.0001	5.0E-06	8.0E-06	1.2E-05
2021	0.34	0.0006	0.0002	0.0001	5.3E-06	8.6E-06	1.2E-05
2022	0.45	0.0008	0.0003	0.0001	7.1E-06	1.1E-05	1.7E-05

YEAR	CW INCINERATED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]
2023	0.38	0.0007	0.0003	0.0001	5.9E-06	9.5E-06	1.4E-05
2024	0.33	0.0006	0.0002	0.0001	5.2E-06	8.3E-06	1.2E-05
1990/2024	-90%	-90%	-90%	-98%	-100%	-100%	-100%
2023/2024	-13%	-13%	-13%	-13%	-13%	-13%	-13%

YEAR	BC [kt]	CO [t]	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]
1990	1.8E-04	0.0051	0.1228	0.0102	0.1842	0.0003	0.0014	0.0205	0.0010
1995	1.8E-04	0.0051	0.1215	0.0101	0.1823	0.0003	0.0014	0.0203	0.0010
2000	1.8E-04	0.0055	0.1321	0.0110	0.1981	0.0004	0.0015	0.0220	0.0011
2005	1.3E-04	0.0040	0.0966	0.0080	0.1449	0.0003	0.0011	0.0161	0.0008
2010	4.8E-05	0.0025	0.0598	0.0050	0.0898	0.0002	0.0007	0.0100	0.0005
2011	2.7E-05	0.0031	0.0740	0.0062	0.1110	0.0002	0.0008	0.0123	0.0006
2012	9.4E-07	0.0017	0.0400	0.0033	0.0600	0.0001	0.0004	0.0067	0.0003
2013	8.9E-07	0.0016	0.0379	0.0032	0.0568	0.0001	0.0004	0.0063	0.0003
2014	9.2E-07	0.0016	0.0392	0.0033	0.0589	0.0001	0.0004	0.0065	0.0003
2015	7.3E-07	0.0013	0.0312	0.0026	0.0468	0.0001	0.0003	0.0052	0.0003
2016	4.5E-07	0.0008	0.0192	0.0016	0.0289	0.0001	0.0002	0.0032	0.0002
2017	2.5E-07	0.0004	0.0107	0.0009	0.0161	0.0000	0.0001	0.0018	0.0001
2018	4.1E-07	0.0007	0.0173	0.0014	0.0259	0.0000	0.0002	0.0029	0.0001
2019	2.4E-07	0.0004	0.0102	0.0009	0.0153	0.0000	0.0001	0.0017	0.0001
2020	2.7E-07	0.0005	0.0114	0.0009	0.0171	0.0000	0.0001	0.0019	0.0001
2021	2.9E-07	0.0005	0.0122	0.0010	0.0182	0.0000	0.0001	0.0020	0.0001
2022	3.8E-07	0.0007	0.0162	0.0014	0.0243	0.0000	0.0002	0.0027	0.0001
2023	3.2E-07	0.0006	0.0135	0.0011	0.0203	0.0000	0.0002	0.0023	0.0001
2024	2.8E-07	0.0005	0.0118	0.0010	0.0177	0.0000	0.0001	0.0020	0.0001
1990/2024	-100%	-90%	-90%	-90%	-90%	-90%	-90%	-90%	-90%
2023/2024	-13%	-13%	-13%	-13%	-13%	-13%	-13%	-13%	-13%

YEAR	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]	PCBs [kg]
1990	136.4435	1.4E-07	0.3411	0.0682
1995	135.0321	1.4E-07	0.3376	0.0675
2000	130.6964	1.5E-07	0.3669	0.0734
2005	102.0242	1.1E-07	0.2683	0.0537
2010	38.8978	6.6E-08	0.1662	0.0332
2011	25.4686	8.2E-08	0.2056	0.0411
2012	4.4481	4.4E-08	0.1112	0.0222
2013	4.2085	4.2E-08	0.1052	0.0210
2014	4.3596	4.4E-08	0.1090	0.0218
2015	3.4647	3.5E-08	0.0866	0.0173
2016	2.1375	2.1E-08	0.0534	0.0107
2017	1.1896	1.2E-08	0.0297	0.0059
2018	1.9180	1.9E-08	0.0479	0.0096
2019	1.1338	1.1E-08	0.0283	0.0057
2020	1.2657	1.3E-08	0.0316	0.0063
2021	1.3508	1.4E-08	0.0338	0.0068
2022	1.8029	1.8E-08	0.0451	0.0090
2023	1.5021	1.5E-08	0.0376	0.0075
2024	1.3137	1.3E-08	0.0328	0.0066

YEAR	PCDD/F [g I-TEQ]	PAHs [t]	HCb [kg]	PCBs [kg]
1990/2024	-99%	-90%	-90%	-90%
2023/2024	-13%	-13%	-13%	-13%

Emissions of both pollutants spiked in 2005, then dropped sharply in 2006 due to strict EU legislation and emission limits adopted upon Slovakia's European Union accession. Emissions rose slightly from 2009 but declined after 2011 due to stringent limits on clinical waste incinerators. Most hospitals closed their on-site plants, as operations proved costly with insufficient capacity, while alternatives like waste sterilisation became more available in Slovakia.

6.6.3.5.1 Methodological Issues

Activity data for this source of pollution is the NEIS database, which holds detailed information about amounts and types of waste incinerated in each plant for the years 2000-2024. Historical data were extrapolated using the trend of the category of 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 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, who also burn other hazardous waste and use the heat to produce energy, it was assumed that 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 2000, when these data were published as part of the Waste Management Program for the period 2001-2005. This program is updated every five 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 6.6.13](#) shows the analysis of the distribution of clinical waste burned by combustion technologies from 1990 to 2024.

Table 6.6.13.: 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	82%	18%
2001	79%	21%
2002	63%	37%
2003	62%	38%
2004	48%	52%
2005	44%	56%
2006-2024	0%	100%

Operators of clinical waste were assigned to abatement technology based on data from Waste Management Programs and the NEIS database (after 2005).

Emission factors and efficiencies of abatement technologies, which were used in calculations for incineration without energy recovery, are shown in [Table 6.6.14](#).

Table 6.6.14: Emission factors and abatement technology efficiencies in the category of Clinical waste incineration

POLLUTANT	NO _x	CO	NMVOC	SO _x	PM _{2.5}	PM ₁₀	TSP	BC*
Unit	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[% of TSP]	[% of TSP]	[kg/t]	[% of TSP]
Value	1.8	1.5	0.7	1.1	43	65	2.3	2.3
ABATEMENT EFFICIENCY								
Acid gas abatement				76%				
Particle abatement only					98.4%	98.3%	98.4%	

POLLUTANT	Pb	Cd	Hg	As	Cr	Cu	Ni	PCDD/F	Total 4 PAHs	HCB	PCB
Unit	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[mg I-TEQ/t]	[mg/t]	[g/t]	[g/t]
Value	36	3	54	0.1	0.4	6	0.3	40	0.04	0.1	0.02
ABATEMENT EFFICIENCY											
Controlled combustion; minimal APC system								90%			

6.6.3.5.2 Completeness

All rising pollutants are recorded and reported.

6.6.3.5.3 Source-specific Recalculations

No recalculations were made in this submission.

6.6.4 Sewage Sludge Incineration (NFR 5C1biv)

This activity does not occur in the Slovak Republic.

6.6.5 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 PM₁₀ emissions driven by the activity data. As shown in [Table 6.6.15](#), cremation shows an increasing trend in Slovakia, though in 2017, a slight decrease and subsequently an increase in 2018 were recorded. Since then, the number of cremated bodies has increased. In 2020 and 2021, it was a result of the COVID-19 pandemic. Since the end of the pandemic (since 2022), the number of cremated bodies has been decreasing.

Table 6.6.15: Overview of activity data, emissions and emission trends in the category of Cremation

YEAR	HUMAN BODIES CREMATED [body]	NO _x [kt]	NMVOC [kt]	SO _x [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	10 241	0.0084	0.0001	0.0012	0.0004	0.0004	0.0004	0.0014
2010	13 202	0.0109	0.0002	0.0015	0.0005	0.0005	0.0005	0.0018
2011	12 611	0.0104	0.0002	0.0014	0.0004	0.0004	0.0005	0.0018
2012	12 659	0.0104	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
2014	15 243	0.0126	0.0002	0.0017	0.0005	0.0005	0.0006	0.0021

YEAR	HUMAN BODIES CREMATED [body]	NOx [kt]	NMVOC [kt]	SOx [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	CO [kt]
2015	16 773	0.0138	0.0002	0.0019	0.0006	0.0006	0.0006	0.0023
2016	16 903	0.0139	0.0002	0.0019	0.0006	0.0006	0.0007	0.0024
2017	14 545	0.0120	0.0002	0.0016	0.0005	0.0005	0.0006	0.0020
2018	18 309	0.0151	0.0002	0.0021	0.0006	0.0006	0.0007	0.0026
2019	20 395	0.0168	0.0003	0.0023	0.0007	0.0007	0.0008	0.0029
2020	23 879	0.0197	0.0003	0.0027	0.0008	0.0008	0.0009	0.0033
2021	30 915	0.0255	0.0004	0.0035	0.0011	0.0011	0.0012	0.0043
2022	21 438	0.0177	0.0003	0.0024	0.0007	0.0007	0.0008	0.0030
2023	22 258	0.0184	0.0003	0.0025	0.0008	0.0008	0.0009	0.0031
2024	22 434	0.0185	0.0003	0.0025	0.0008	0.0008	0.0009	0.0031
1990/2024	273%	273%	273%	273%	273%	273%	273%	273%
2023/2024	1%	1%	1%	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	0.0002	3.0E-05	0.0090	0.0001	0.0001	0.0001	0.0001	0.0001	0.0010
1995	0.0002	3.4E-05	0.0100	0.0001	0.0001	0.0001	0.0001	0.0001	0.0011
2000	0.0002	3.8E-05	0.0112	0.0001	0.0001	0.0001	0.0001	0.0001	0.0012
2005	0.0003	5.2E-05	0.0153	0.0001	0.0001	0.0001	0.0002	0.0002	0.0016
2010	0.0004	6.6E-05	0.0197	0.0002	0.0002	0.0002	0.0002	0.0003	0.0021
2011	0.0004	6.3E-05	0.0188	0.0002	0.0002	0.0002	0.0002	0.0002	0.0020
2012	0.0004	6.4E-05	0.0189	0.0002	0.0002	0.0002	0.0002	0.0003	0.0020
2013	0.0005	7.8E-05	0.0232	0.0002	0.0002	0.0002	0.0003	0.0003	0.0025
2014	0.0005	7.7E-05	0.0227	0.0002	0.0002	0.0002	0.0003	0.0003	0.0024
2015	0.0005	8.4E-05	0.0250	0.0002	0.0002	0.0002	0.0003	0.0003	0.0027
2016	0.0005	8.5E-05	0.0252	0.0002	0.0002	0.0002	0.0003	0.0003	0.0027
2017	0.0004	7.3E-05	0.0217	0.0002	0.0002	0.0002	0.0003	0.0003	0.0023
2018	0.0005	9.2E-05	0.0273	0.0002	0.0002	0.0002	0.0003	0.0004	0.0029
2019	0.0006	1.0E-04	0.0304	0.0003	0.0003	0.0003	0.0004	0.0004	0.0033
2020	0.0007	1.2E-04	0.0356	0.0003	0.0003	0.0003	0.0004	0.0005	0.0038
2021	0.0009	1.6E-04	0.0461	0.0004	0.0004	0.0004	0.0005	0.0006	0.0050
2022	0.0006	1.1E-04	0.0319	0.0003	0.0003	0.0003	0.0004	0.0004	0.0034
2023	0.0007	1.1E-04	0.0332	0.0003	0.0003	0.0003	0.0004	0.0004	0.0036
2024	0.0007	1.1E-04	0.0334	0.0003	0.0003	0.0003	0.0004	0.0004	0.0036
1990/2024	273%	273%	273%	273%	273%	273%	273%	273%	273%
2023/2024	1%	1%	1%	1%	1%	1%	1%	1%	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]	PCBs [kg]
1990	0.0002	7.9E-08	4.3E-08	3.9E-08	4.2E-08	2.0E-07	0.0009	0.0025
1995	0.0002	8.9E-08	4.9E-08	4.3E-08	4.7E-08	2.3E-07	0.0010	0.0028
2000	0.0002	9.9E-08	5.4E-08	4.8E-08	5.3E-08	2.5E-07	0.0011	0.0031
2005	0.0003	1.4E-07	7.4E-08	6.6E-08	7.2E-08	3.5E-07	0.0015	0.0042
2010	0.0004	1.7E-07	9.5E-08	8.5E-08	9.2E-08	4.5E-07	0.0020	0.0054
2011	0.0003	1.7E-07	9.1E-08	8.1E-08	8.8E-08	4.3E-07	0.0019	0.0052
2012	0.0003	1.7E-07	9.1E-08	8.2E-08	8.8E-08	4.3E-07	0.0019	0.0052
2013	0.0004	2.1E-07	1.1E-07	1.0E-07	1.1E-07	5.3E-07	0.0023	0.0064
2014	0.0004	2.0E-07	1.1E-07	9.8E-08	1.1E-07	5.2E-07	0.0023	0.0062
2015	0.0005	2.2E-07	1.2E-07	1.1E-07	1.2E-07	5.7E-07	0.0025	0.0069
2016	0.0005	2.2E-07	1.2E-07	1.1E-07	1.2E-07	5.7E-07	0.0025	0.0069

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]
2017	0.0004	1.9E-07	1.0E-07	9.4E-08	1.0E-07	4.9E-07	0.0022	0.0060
2018	0.0005	2.4E-07	1.3E-07	1.2E-07	1.3E-07	6.2E-07	0.0027	0.0075
2019	0.0006	2.7E-07	1.5E-07	1.3E-07	1.4E-07	6.9E-07	0.0031	0.0084
2020	0.0006	3.2E-07	1.7E-07	1.5E-07	1.7E-07	8.1E-07	0.0036	0.0098
2021	0.0008	4.1E-07	2.2E-07	2.0E-07	2.2E-07	1.0E-06	0.0046	0.0127
2022	0.0006	2.8E-07	1.5E-07	1.4E-07	1.5E-07	7.3E-07	0.0032	0.0088
2023	0.0006	2.9E-07	1.6E-07	1.4E-07	1.6E-07	7.5E-07	0.0033	0.0091
2024	0.0006	3.0E-07	1.6E-07	1.4E-07	1.6E-07	7.6E-07	0.0034	0.0092
1990/2024	273%	273%	273%	273%	273%	273%	273%	273%
2023/2024	1%	1%	1%	1%	1%	1%	1%	1%

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 6.6.16](#)).

The inclusion/exclusion of the *condensable component of PMs* is unknown.

Table 6.6.16: Emission factors in the category of Cremation

POLLUTANT	NO _x	NM VOC	SO _x	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]						[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 were made in this submission.

6.6.5 Open Burning of Waste (5C2)

6.6.5.1 Overview of the Category

Open burning of waste is against the law of the Slovak Republic (Act No 79/2015 Coll. about Waste. (5), Act No 314/2001 Coll. on fire protection (20) and Civil Code No 40/1964 Coll. (21)). It is forbidden to perform the open burning of agricultural waste. The only exception is for the open burning of forest residues.

In general, emissions in this category have an increasing trend as this activity used in forest management also increased. The significant increase in emissions in 2005 was caused by the aftermath of a wind calamity in 2004, when over 12,000 ha of forest, mainly in the national park High Tatras, was

destroyed by an extreme wind that reached hurricane force and the subsequent attack on the fallen trees and surrounding areas by wood-destroying insects (*Recommendation No. SK-5C2-2024-0001*). 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 6.6.17*.

Table 6.6.17: Overview of activity data, emissions and emission trends in the category of Open burning of waste

YEAR	TOTAL MASS OF BIOMASS BURNED [kt]	NO _x [kt]	NM VOC [kt]	SO _x [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
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
2023	176.45	0.3282	0.2594	0.0053	0.6635	0.7287	0.7605
2024	202.61	0.3768	0.2978	0.0061	0.7618	0.8368	0.8733
1990/2024	93%	94%	93%	93%	93%	93%	93%
2023/2024	15%	15%	15%	15%	15%	15%	15%

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

YEAR	BC [kt]	CO [kt]	Pb [t]	Cd [t]	As [t]	Cu [t]	Se [t]	Zn [t]
2022	0.2030	12.6672	0.0613	0.0249	0.1512	0.0479	0.0191	3.2539
2023	0.1871	11.7050	0.0565	0.0229	0.1394	0.0441	0.0176	2.9997
2024	0.2148	13.4393	0.0648	0.0263	0.1601	0.0507	0.0203	3.4444
1990/2024	93%	94%	93%	93%	93%	93%	93%	93%
2023/2024	15%	15%	15%	15%	15%	15%	15%	15%

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	PAHs [t]
1990	1.0505	0.3309	0.5410	0.6776	1.5495
1995	0.8995	0.2833	0.4632	0.5802	1.3267
2000	1.3312	0.4193	0.6856	0.8586	1.9635
2005	2.1510	0.6776	1.1078	1.3874	3.1727
2010	2.1868	0.6888	1.1262	1.4105	3.2255
2011	2.1105	0.6648	1.0869	1.3613	3.1130
2012	1.2717	0.4006	0.6549	0.8203	1.8758
2013	1.2768	0.4022	0.6576	0.8236	1.8833
2014	2.5262	0.7957	1.3010	1.6294	3.7261
2015	2.4185	0.7618	1.2455	1.5599	3.5672
2016	2.3493	0.7400	1.2099	1.5153	3.4653
2017	2.2936	0.7225	1.1812	1.4794	3.3830
2018	2.4010	0.7563	1.2365	1.5486	3.5415
2019	2.2830	0.7192	1.1758	1.4726	3.3675
2020	1.8953	0.5970	0.9761	1.2224	2.7955
2021	1.9347	0.6094	0.9963	1.2478	2.8536
2022	1.9141	0.6029	0.9858	1.2346	2.8233
2023	1.7645	0.5558	0.9087	1.1381	2.6026
2024	2.0261	0.6382	1.0435	1.3069	2.9886
1990/2024	93%	93%	93%	93%	93%
2023/2024	15%	15%	15%	15%	15%

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 ([Table 6.6.18](#)). To maintain consistency with GHG inventory, emissions of NO_x and CO were calculated using emission factors and methodology from IPCC 2006 Guidelines, **Chapter 2.4: Non-CO₂ Emissions** (2). The inclusion/exclusion of the **condensable component of PMs** is unknown.

Table 6.6.18: Emission factors in the category of Open burning of waste

POLLUTANT	NO _x	NM VOC	SO _x	PM _{2.5}	PM ₁₀	TSP
Unit	[g/kg dm]	[kg/t waste]	[kg/t waste]	[kg/t waste]	[kg/t waste]	[kg/t waste]
Value	3	1.47	0.03	3.76	4.13	4.31

POLLUTANT	BC	CO	Pb	Cd	As	Cu	Se
Unit	[% of PM _{2.5}]	[g/kg dm]	[g/t waste]	[g/t waste]	[g/t waste]	[g/t waste]	[g/t waste]
Value	28.2	107	0.32	0.13	0.79	0.25	0.10

POLLUTANT	Zn	PCDD/F*	B(a)P	B(b)F	B(k)F	PAHs
Unit	[g/t waste]	[μg/t]	[g/t waste]	[g/t waste]	[g/t waste]	[g/t waste]
Value	17.00	10	3.15	6.45	5.15	14.75

*T1

6.6.4.2 Completeness

All rising pollutants are recorded and reported.

6.6.4.3 Source-specific Recalculations

No recalculations were made in this submission.

6.7 WASTEWATER HANDLING (NFR 5D)

6.7.1 Overview

This sector includes emissions of the main pollutants from domestic and industrial wastewater treatment. In these categories, 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 were 0.0094 kt in 2024. Compared to the previous years, these emissions continue to decrease, which is caused mainly by building and connecting houses to the sewage systems.

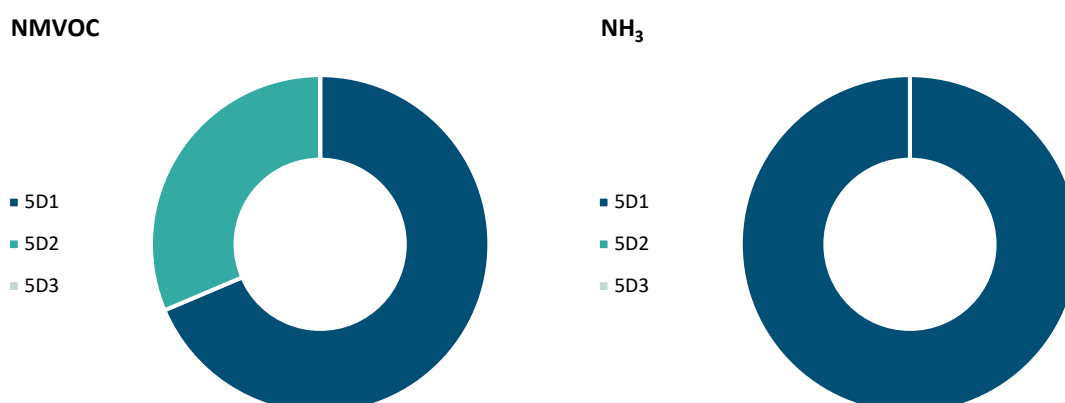
Table 6.7.1 shows trends of emissions from domestic and industrial wastewater over the years.

Table 6.7.1: Overview of emission trends in the category of Wastewater handling

YEAR	NMVOC [kt]	NH ₃ [kt]
1990	0.0084	1.0964
1995	0.0092	0.9971
2000	0.0102	0.8363
2005	0.0094	0.7037
2010	0.0103	0.5413
2011	0.0084	0.4037
2012	0.0079	0.3939
2013	0.0091	0.3140
2014	0.0085	0.2505
2015	0.0083	0.2364
2016	0.0086	0.1604
2017	0.0085	0.0678
2018	0.0083	0.0349
2019	0.0086	0.0132
2020	0.0089	0.0097
2021	0.0089	0.0073
2022	0.0079	0.0065
2023	0.0094	0.0057
2024	0.0094	0.0048
1990/2024	12%	-100%
2023/2024	-0.2%	-17%

Shares of NMVOC emission in 2024 NFR categories included in the wastewater treatment are shown in **Figure 6.7.1**.

Figure 6.7.1: Share in NMVOC and NH₃ emissions of individual categories in 5D in 2024



Slovak legislation and wastewater treatment practices mandate that sewage sludge be stabilised directly at the treatment plant—for instance, Act No 188/2003 Coll. (23) requires stabilisation before any indirect application to agricultural land. Per Slovak Technical Norm 75 640 ("Sewage Treatment Plants for more than 500 population equivalents"), WWTPs up to 10,000 p.e. must use aerobic sludge stabilisation, while larger plants require anaerobic stabilisation with biogas production. [Tables 6.7.2](#) and [6.7.3](#) provide information on the data sources regarding the distribution of domestic and industrial sludge treatment.

Table 6.7.2: WWT distribution of domestic sludge

YEAR	TOTAL GEN.	TOTAL USE	DIRECT AGR. LAND APPLIC.	COMPOST	INCINER. WITH ENERGY USE	LANDFILL	TEMPORARY STORED ON-SITE
tons							
1990	55,000.00	45,207.00	-	-	-	-	-
1995	55,000.00	32,687.00	-	-	-	-	-
2000	56,279.00	35,358.00	-	-	-	13,796.00	7,125.00
2005	56,360.00	39,120.00	5,870.00	33,250.00	-	8,530.00	8,710.00
2010	54,760.00	48,063.00	923.00	47,140.00	-	16.00	6,681.00
2011	58,718.00	50,469.00	358.00	50,111.00	-	2,306.00	5,946.00
2012	58,760.00	50,896.00	1,254.00	46,446.00	3,196.00	1,615.00	6,195.00
2013	57,433.00	50,787.00	518.00	45,261.00	5,008.00	1,666.00	4,980.00
2014	56,883.00	52,570.00	8.00	36,524.00	16,038.00	1,073.00	3,240.00
2015	56,242.00	51,602.00	-	34,689.00	16,913.00	1,709.00	2,932.00
2016	53,054.00	45,738.00	-	34,695.00	11,043.00	2,359.00	4,957.00
2017	54,517.00	46,654.00	-	34,416.00	12,238.00	2,636.00	5,227.00
2018	55,929.00	44,659.00	-	32,982.00	11,677.00	2,451.00	8,819.00
2019	54,832.00	45,149.00	-	32,217.00	12,932.00	2,296.00	7,387.00
2020	55,519.00	48,490.00	-	36,562.00	11,928.00	2,302.00	4,727.00
2021	54,764.00	50,042.00	-	37,289.00	12,753.00	456.00	4,266.00
2022	55,049.00	43,835.00	-	33,509.00	10,326.00	1,540.00	9,674.00
2023	56,420.00	46,747.00	-	31,050.00	15,697.00	490.00	9,183.00
2024	55,476.00	48,958.00	-	34,606.00	11,535.00	575.00	5,943.00

Table 6.7.3: WWT distribution of industrial treatment sludge since 2005

YEAR	TOTAL GEN.	TOTAL USE	DIRECT AGR. LAND APPLIC.	COMPOST	INCINER. WITHOUT ENERGY USE	INCINER. WITH ENERGY USE	LANDFILL	TEMPORARY STORED ON- SITE
tons								
2005	10,307.50	5,577.49	2,231.03	1,036.79	1,500.55	0.20	785.04	23.88
2010	25,571.48	19,769.44	1,101.85	6,368.68	1,223.43	4.86	11,057.78	12.85
2011	29,387.82	19,459.99	685.38	9,977.16	810.93	110.20	7,620.30	256.02
2012	22,566.50	18,483.23	478.34	7,099.45	752.07	791.01	6,350.59	3,011.77
2013	19,631.92	17,166.54	627.02	7,727.26	844.30	876.04	1,455.95	5,635.96
2014	12,376.76	8,433.92	687.50	4,632.10	1,763.30	1,031.14	1,236.62	114.40
2015	11,485.20	7,499.74	812.65	3,247.83	1,146.94	1,348.76	898.21	45.36
2016	13,651.28	12,199.67	1,133.63	3,353.41	45.70	1,975.42	5,641.33	50.18
2017	22,210.86	15,537.80	362.15	3,459.67	0.00	1,206.09	1,063.31	9,446.58
2018	49,668.71	40,461.52	287.32	3,520.00	476.30	2,831.18	1,005.62	32,341.10
2019	12,934.55	9,222.94	48.94	3,400.98	526.24	2,137.08	1,694.00	1,415.70
2020	32,611.49	28,610.84	0.97	3,893.47	336.06	989.47	6,445.02	16,945.85
2021	20,724.22	10,991.74	0.88	3,191.06	0.00	1,012.59	6,037.18	750.03
2022	14,239.80	10,176.13	0.75	1,904.88	130.24	924.68	5,597.65	1,617.93
2023	16,129.89	10,179.35	4.81	4,418.88	353.01	1,063.52	1,656.55	2,682.58
2024	31,980.65	19,529.76	192.89	3,667.54	0.00	1,094.15	8,601.83	5,973.35

6.7.2 Domestic Wastewater Handling (NFR 5D1)

6.7.2.1 Overview of the Category

Council Directive 91/271/EEC (24) 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.

Generally, about two-thirds of the population discharges wastewater through sewers, and one-third uses 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, the 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. **Table 6.7.4** shows the emission trend of NH₃.

Table 6.7.4: 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]	NM VOC [kt]	NH ₃ [kt]
1990	370,257.35	685,274	0.0056	1.0964
1995	402,528.74	623,177	0.0060	0.9971
2000	447,129.41	522,718	0.0067	0.8363
2005	411,842.63	439,790	0.0062	0.7037
2010	454,069.00	338,340	0.0068	0.5413
2011	364,941.00	252,302	0.0055	0.4037
2012	337,545.00	246,164	0.0051	0.3939

YEAR	DOMESTIC WW DISCHARGED [th.m ³]	POPULATION USING DRY TOILETS [inhab]	NMVOC [kt]	NH ₃ [kt]
2013	400,954.00	196,245	0.0060	0.3140
2014	377,445.00	156,568	0.0057	0.2505
2015	362,142.00	147,745	0.0054	0.2364
2016	385,463.00	100,235	0.0058	0.1604
2017	382,392.00	42,345	0.0057	0.0678
2018	369,599.00	21,801	0.0055	0.0349
2019	381,036.00	8,252	0.0057	0.0132
2020	404,305.00	6,034	0.0061	0.0097
2021	400,700.00	4,590	0.0060	0.0073
2022	351,547.00	4,038	0.0053	0.0065
2023	430,924.00	3,572	0.0065	0.0057
2024	429,835.00	2,975	0.0064	0.0048
1990/2024	16%	-100%	16%	-100%
2023/2024	0%	-17%	0%	-17%

As shown in [Table 6.7.4](#), emissions of NMVOC from water treatment decreased from 1996 to 2003, since 2004 emissions show an increasing trend due to the increase in households connected to a public sewage system and water supply. The emission trend of NH₃ 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) was used to calculate emissions of NMVOCs 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 to other pollutants.

Data from the NEIS database for the incineration of residual gases, previously reported under the [5D1](#) category, were reallocated to the Energy category [1A5a](#) in compliance with the GHG inventory.

The NEIS database contains data from the year 2000 for pollutants: NO_x, NMVOC, SO_x, NH₃, TSP and CO. Emissions of PM_{2.5} and PM₁₀ 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 411/2012 Coll. (25) and emission factors are in [ANNEX I](#) of the Decree. The share of PM_{2.5} and PM₁₀ emissions was determined from the following sources:

- TESO Praha a.s.: Drafting of emission factors for the Ministry of the Environment (26);
- Communication of the Department of Air Protection, which determines the emission factors and ratios of PM₁₀ and PM_{2.5} 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 the energy audit and energy assessment, as amended (27);
- Communication 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 (28);
- Jana Smutná: Emission factors in the Czech Republic (overview study) (29).

Emission factors for historical years for NO_x, NMVOC, SO_x, NH₃, 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 6.7.5](#).

Table 6.7.5: Historical emission factors for biogas incineration reallocated into the category 1A5a

POLLUTANT	NO _x	NMVOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	CO
Unit	[g/m ³]	[g/m ³]	[g/m ³]	[g/m ³]	[of TSP]	[of TSP]	[g/m ³]	[g/m ³]
Value	0.01	0.24	0.01	0.09	98.4%	98.5%	0.002	0.01

For the usage of dry toilets, the principle of calculation consisted of determining the percentage of use of dry toilets in Slovak households (based on information from the censuses of 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 using Tier 2 emissions factors for dry toilets from EMEP/EEA GB 2023 ([Table 6.7.6](#)).

Table 6.7.6: Emission factors for wastewater treatment in the category of Domestic wastewater handling

POLLUTANT	NMVOC	NH ₃
Unit	[mg/m ³]	[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

Emissions were recalculated for the period 2021-2023 due to activity data for the correction for the use of dry toilets ([Table 6.7.7](#)).

Table 6.7.7: Differences of emissions in the category 5D1 between the previous submission and the current submission caused by recalculations

YEAR	NH ₃		
	PREVIOUS	REVISED	CHANGE
2021	0.0087	0.0073	-16%
2022	0.0087	0.0065	-26%
2023	0.0087	0.0057	-34%

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 1990-2024. 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 6.7.8: Overview of emissions and trends in the category of Industrial wastewater handling

YEAR	INDUSTRIAL WASTEWATER DISCHARGED [th.m ³]	NMVOC WATER TREAT. [kt]
1990	191,163.24	0.0029
1995	207,824.90	0.0031
2000	230,852.15	0.0035

YEAR	INDUSTRIAL WASTEWATER DISCHARGED [th.m ³]	NMVOC WATER TREAT. [kt]
2005	212,633.64	0.0032
2010	230,670.00	0.0035
2011	198,242.00	0.0030
2012	190,699.00	0.0029
2013	202,692.00	0.0030
2014	189,387.00	0.0028
2015	188,578.00	0.0028
2016	189,571.00	0.0028
2017	187,218.00	0.0028
2018	186,178.00	0.0028
2019	189,901.00	0.0028
2020	190,970.00	0.0029
2021	194,804.00	0.0029
2022	173,822.00	0.0026
2023	197,014.00	0.0030
2024	196,575.00	0.0029
1990/2024	3%	3%
2023/2024	-0.2%	-0.2%

In [Table 6.7.8](#), activity data, emissions and their trends are displayed. Emissions of NH₃ have increased since 2016 due to the increase in 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**.

Data from the NEIS database for the incineration of residual gases, previously reported under the **5D1** category, were reallocated to the Energy category **1A5a** in compliance with the GHG inventory.

The NEIS database contains data from the year 2000 for pollutants: NO_x, NMVOC, SO_x, NH₃, TSP and CO. Emissions of PM_{2.5} and PM₁₀ are calculated within the database from the year 2005. These data represent emissions from biogas flaring. Emissions of PM_{2.5} and PM₁₀ 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 411/2012 (25) and emission factors are in [ANNEX I](#) of the Decree. The share of PM_{2.5} and PM₁₀ emissions was determined from the following sources:

- TESO Praha a.s.: Drafting of emission factors for the Ministry of the Environment (26);
- Communication of the Department of Air Protection, which determines the emission factors and ratios of PM₁₀ and PM_{2.5} 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 (27);
- Communication 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 (28);
- Jana Smutná: Emission factors in the Czech Republic (overview study) (29).

Emission factors for historical years for NO_x, NMVOC, SO_x, NH₃, 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 6.7.9](#).

Table 6.7.9: Historical emission factors for biogas incineration reallocated into the category 1A5a

POLLUTANT	NO _x	NMVOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	CO
Unit	[g/m ³]	[g/m ³]	[g/m ³]	[g/m ³]	[of TSP]	[of TSP]	[g/m ³]	[g/m ³]
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

No recalculations were made in this submission.

6.7.4 Other Wastewater Handling (NFR 5D3)

This activity is not occurring in the Slovak Republic; therefore, the 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 [Tables 6.8.1](#) and [6.8.2](#) overview of statistical activity data and emission trends is displayed.

Table 6.8.1: 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

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]
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
2023	627.00	83.00	947.00	454.00	169.00
2024	588.00	75.00	942.00	430.00	232.00
1990/2024	-4%	-26%	31%	-28%	-13%
2023/2024	-6%	-10%	-1%	-5%	37%

Table 6.8.2: Overview of emissions in the category Other waste

YEAR	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	Pb [t]	Hg [t]
1990	0.1384	0.1384	0.1384	0.0004	0.0008
1995	0.1456	0.1456	0.1456	0.0004	0.0009
2000	0.1386	0.1386	0.1386	0.0004	0.0008
2005	0.1511	0.1511	0.1511	0.0004	0.0009
2010	0.1785	0.1785	0.1785	0.0005	0.0010
2011	0.1974	0.1974	0.1974	0.0006	0.0012
2012	0.1927	0.1927	0.1927	0.0006	0.0011
2013	0.1840	0.1840	0.1840	0.0005	0.0011
2014	0.1610	0.1610	0.1610	0.0005	0.0009
2015	0.1876	0.1876	0.1876	0.0005	0.0011
2016	0.1936	0.1936	0.1936	0.0006	0.0011
2017	0.2027	0.2027	0.2027	0.0006	0.0012
2018	0.1834	0.1834	0.1834	0.0005	0.0011
2019	0.1651	0.1651	0.1651	0.0005	0.0010
2020	0.1769	0.1769	0.1769	0.0005	0.0010
2021	0.1850	0.1850	0.1850	0.0005	0.0011
2022	0.1767	0.1767	0.1767	0.0005	0.0010
2023	0.1623	0.1623	0.1623	0.0005	0.0010
2024	0.1621	0.1621	0.1621	0.0005	0.0009
1990/2024	17%	17%	17%	17%	17%
2023/2024	-0.10%	-0.10%	-0.10%	-0.04%	-0.04%

YEAR	Cd [t]	As [t]	Cr [t]	Cu [t]	PCDD/F [g I-TEQ]
1990	0.0008	0.0013	0.0012	0.0028	1.4034
1995	0.0009	0.0013	0.0013	0.0030	1.4772
2000	0.0008	0.0013	0.0012	0.0028	1.4052
2005	0.0009	0.0014	0.0013	0.0031	1.5320
2010	0.0010	0.0017	0.0016	0.0037	1.8118
2011	0.0012	0.0018	0.0017	0.0041	1.9994
2012	0.0011	0.0018	0.0017	0.0040	1.9529
2013	0.0011	0.0017	0.0016	0.0038	1.8666
2014	0.0009	0.0015	0.0014	0.0033	1.6352
2015	0.0011	0.0017	0.0017	0.0039	1.9023
2016	0.0011	0.0018	0.0017	0.0040	1.9621
2017	0.0012	0.0019	0.0018	0.0042	2.0533
2018	0.0011	0.0017	0.0016	0.0038	1.8600
2019	0.0010	0.0015	0.0015	0.0034	1.6727

YEAR	Cd [t]	As [t]	Cr [t]	Cu [t]	PCDD/F [g I-TEQ]
2020	0.0010	0.0016	0.0016	0.0036	1.7915
2021	0.0011	0.0017	0.0016	0.0038	1.8686
2022	0.0010	0.0016	0.0016	0.0036	1.7862
2023	0.0010	0.0015	0.0014	0.0033	1.6432
2024	0.0009	0.0015	0.0014	0.0033	1.6401
1990/2024	17%	18%	18%	17%	17%
2023/2024	-0.04%	-0.06%	-0.05%	-0.03%	-0.18%

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 6.8.1](#)). Emissions from fires were calculated by multiplying activity data (number of fires) by emission factors from EMEP/EEA GB 2023 ([Table 6.8.3](#)). Historical data (1990-1998) were extrapolated.

Table 6.8.3: 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.

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CHAPTER 7: OTHER AND NATURAL EMISSIONS (NFR 6, NFR 11)

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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, the 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.

Forest fires are important sources of many particulates and trace gases produced, including the products of incomplete combustion (CO, NMVOCs) and nitrogen and sulphur. In [Table 7.3.1](#), emissions in this category are shown.

Table 7.3.1: Overview of emissions in the category Forest fires

YEAR	NO _x [kt]	NMVOC [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.0894	0.1160	0.0088	0.0100	0.2629	0.3213	0.4966	0.0237	3.1876
1995	0.0301	0.0352	0.0027	0.0030	0.0893	0.1091	0.1687	0.0080	1.0749
2000	0.4458	0.4636	0.0352	0.0399	1.3296	1.6251	2.5114	0.1197	15.9000
2005	0.2720	0.2640	0.0201	0.0227	0.8123	0.9929	1.5344	0.0731	9.7018
2010	0.1048	0.0960	0.0073	0.0083	0.3139	0.3836	0.5929	0.0283	3.7395
2011	0.2219	0.2013	0.0153	0.0173	0.6644	0.8121	1.2550	0.0598	7.9148
2012	0.9397	0.8417	0.0640	0.0724	2.8135	3.4387	5.3143	0.2532	33.5153
2013	0.1520	0.1351	0.0103	0.0116	0.4552	0.5563	0.8598	0.0410	5.4226
2014	0.1079	0.0959	0.0073	0.0082	0.3231	0.3949	0.6102	0.0291	3.8490
2015	0.1992	0.1763	0.0134	0.0152	0.5962	0.7287	1.1262	0.0537	7.1046
2016	0.0993	0.0874	0.0066	0.0075	0.2971	0.3631	0.5612	0.0267	3.5402
2017	0.1692	0.1488	0.0113	0.0128	0.5065	0.6190	0.9567	0.0456	6.0348

YEAR	NO _x [kt]	NM _{VOC} [kt]	SO _x [kt]	NH ₃ [kt]	PM _{2.5} [kt]	PM ₁₀ [kt]	TSP [kt]	BC [kt]	CO [kt]
2018	0.1414	0.1242	0.0094	0.0107	0.4232	0.5172	0.7993	0.0381	5.0419
2019	0.2645	0.2311	0.0176	0.0199	0.7920	0.9680	1.4960	0.0713	9.4354
2020	0.2708	0.2363	0.0180	0.0203	0.8109	0.9910	1.5316	0.0730	9.6600
2021	0.0915	0.0795	0.0060	0.0068	0.2740	0.3349	0.5176	0.0247	3.2643
2022	0.6901	0.6053	0.0460	0.0521	2.0660	2.5251	3.9024	0.1859	24.6122
2023	0.0170	0.0147	0.0011	0.0013	0.0509	0.0622	0.0961	0.0046	0.6059
2024	0.0471	0.0409	0.0031	0.0035	0.1411	0.1724	0.2665	0.0127	1.6808
1990/2024	-47%	-65%	-65%	-65%	-46%	-46%	-46%	-46%	-47%
2023/2024	177%	177%	177%	177%	177%	177%	177%	177%	177%

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	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
2023	0.0283	0.0017	0.0023	0.0010	0.0006	0.0056	0.0005	0.0034
2024	0.0784	0.0047	0.0063	0.0027	0.0018	0.0154	0.0014	0.0094
1990/2024	-46%	-46%	-46%	-46%	-46%	-46%	-46%	-46%
2023/2024	177%	177%	177%	177%	177%	177%	177%	177%

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 provided data about area burned by wildfires to the air pollutants 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 NO_x and CO were calculated using emission factors and methodology from IPCC 2006 Guidelines, **Chapter 2.4: Non-CO₂ Emissions** (1). POPs were calculated using country-specific emission factors (2). **Table 7.3.3** shows the emission factors used to estimate emissions in this category.

Table 7.3.2: 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

YEAR	AREA AFFECTED BY WILDFIRES [ha]	BIOMASS BURNED BY WILDFIRES [kt]	BIOMASS BURNED BY CONTROLLED FIRES [kt]	TOTAL BIOMASS BURNED [kt]
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	1,683.46	312.61	127.17	439.78
2013	270.26	50.58	127.68	178.26
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	1,210.55	229.56	191.41	420.96
2023	29.46	5.65	176.45	182.10
2024	81.73	15.68	202.61	218.29
1990/2024	-65%	-46%	93%	63%
2023/2024	177%	177%	15%	20%

Table 7.3.3: Emission factors in the category of Forest fires – temperate forests

POLLUTANT	NMVOC	SO _x	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	NO _x
Unit	[kg/ha area burned]			[g/kg dm]			[% of PM _{2.5}]	[g/kg dm]	
Value	500	38	43	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

Emissions of NO_x and CO were recalculated because one type of land use was not included in the previous calculation ([Table 7.3.4](#)).

Table 7.3.4: Differences of emissions in category 11B between the previous submission and the current submission caused by recalculations

YEAR	NO _x			CO		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1990	0.0876	0.0894	2.0%	3.1254	3.1876	2.0%
1991	0.0796	0.0812	1.9%	2.8402	2.8947	1.9%

YEAR	NO _x			CO		
	PREVIOUS	REVISED	CHANGE	PREVIOUS	REVISED	CHANGE
1992	0.1847	0.1882	1.9%	6.5889	6.7108	1.9%
1993	0.4611	0.4692	1.8%	16.4474	16.7363	1.8%
1994	0.0155	0.0158	1.6%	0.5543	0.5631	1.6%
1995	0.0298	0.0301	1.3%	1.0616	1.0749	1.3%
1996	0.0926	0.0937	1.2%	3.3027	3.3414	1.2%
1997	0.0153	0.0155	1.1%	0.5460	0.5522	1.1%
1998	0.0143	0.0144	1.1%	0.5085	0.5139	1.1%
1999	1.1424	1.1537	1.0%	40.7458	41.1481	1.0%
2000	0.4432	0.4458	0.6%	15.8074	15.9000	0.6%
2001	0.0770	0.0774	0.5%	2.7466	2.7614	0.5%
2002	0.2938	0.2953	0.5%	10.4777	10.5310	0.5%
2003	0.7807	0.7846	0.5%	27.8442	27.9855	0.5%
2004	0.0702	0.0705	0.5%	2.5023	2.5145	0.5%
2005	0.2708	0.2720	0.5%	9.6578	9.7018	0.5%
2006	0.0930	0.0933	0.3%	3.3163	3.3273	0.3%
2007	0.3568	0.3580	0.3%	12.7266	12.7670	0.3%
2008	0.0628	0.0630	0.3%	2.2409	2.2474	0.3%
2009	0.2754	0.2760	0.2%	9.8227	9.8439	0.2%
2010	0.1046	0.1048	0.2%	3.7318	3.7395	0.2%
2011	0.2215	0.2219	0.2%	7.8992	7.9148	0.2%
2012	0.9378	0.9397	0.2%	33.4491	33.5153	0.2%
2013	0.1517	0.1520	0.2%	5.4117	5.4226	0.2%
2014	0.1077	0.1079	0.2%	3.8410	3.8490	0.2%
2015	0.1987	0.1992	0.2%	7.0887	7.1046	0.2%
2016	0.0990	0.0993	0.2%	3.5321	3.5402	0.2%
2017	0.1688	0.1692	0.2%	6.0215	6.0348	0.2%
2018	0.1411	0.1414	0.2%	5.0310	5.0419	0.2%
2019	0.2640	0.2645	0.2%	9.4157	9.4354	0.2%
2020	0.2703	0.2708	0.2%	9.6402	9.6600	0.2%
2021	0.0913	0.0915	0.2%	3.2578	3.2643	0.2%
2022	0.6887	0.6901	0.2%	24.5624	24.6122	0.2%
2023	0.0170	0.0170	0.2%	0.6047	0.6059	0.2%

7.4 OTHER NATURAL EMISSIONS (NFR 11C)

7.4.1 Overview of the category

This category is not calculated in this submission because further research needs to be done to obtain the activity data.

7.5 REFERENCES

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CHAPTER 8: RECALCULATIONS, PROJECTIONS, LPS AND GRIDDED DATA

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8.1 RECALCULATIONS AND IMPROVEMENTS

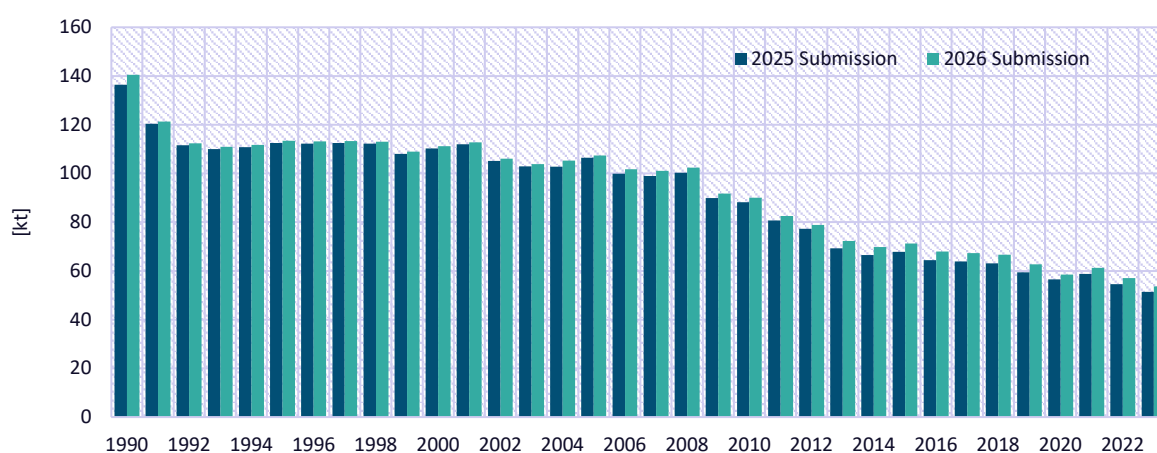
8.1.1 Overview by Gases

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.

8.1.1.1 NO_x (as NO₂)

The impact of recalculations on the NO_x emission total in this submission is shown in [Figure 8.1.1](#). Minor changes in [1A3b](#) were caused by the implementation of the updated COPERT model. In the agriculture sector. Emissions of NO_x changed in [3Da2a](#) and [3Da3](#) categories due to activity data correction and their harmonisation with the GHG inventory. Also, new mitigation technologies were applied to the calculations of manure management.

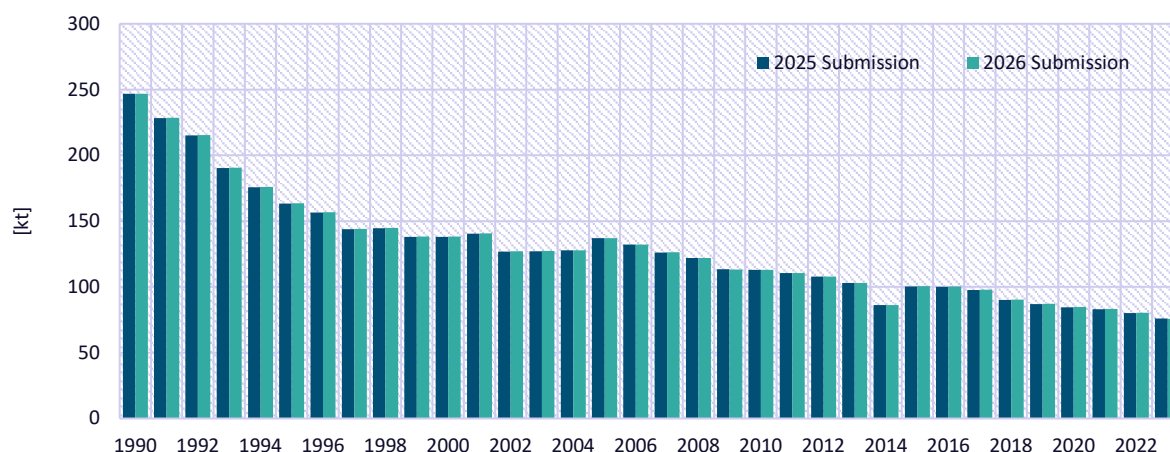
Figure 8.1.1: Comparison of the total NO_x emissions between the 2025 final submission and the 2026 final submission



8.1.1.2 NMVOC

As shown in [Figure 8.1.2](#), the decrease in emissions in 2023 was caused by recalculations in category [1A4bi](#), as the data were corrected because of an error. The slight increase since 1990 was caused by recalculation in the category [3B3](#) due to activity data correction and their harmonisation with the GHG inventory. Also, new mitigation technologies were applied to the calculations of manure management. Since 2013, the recalculation was caused by recalculations in the categories of [1A3b](#) related to the implementation of the updated COPERT model.

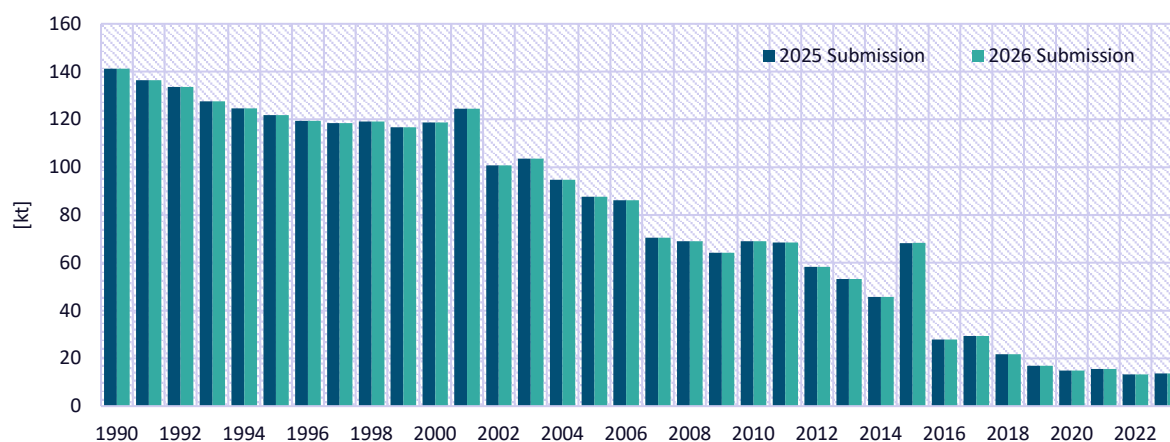
Figure 8.1.2: Comparison of the total NMVOC emission between the 2025 final submission and the 2026 final submission



8.1.1.3 SO_x (as SO₂)

Minimal increase in emissions since 2013 ([Figure 8.1.3](#)) was caused by recalculations in the categories of [1A3b](#) and [2D3i](#) in the use of lubricants in transport due to the implementation of the updated COPERT model.

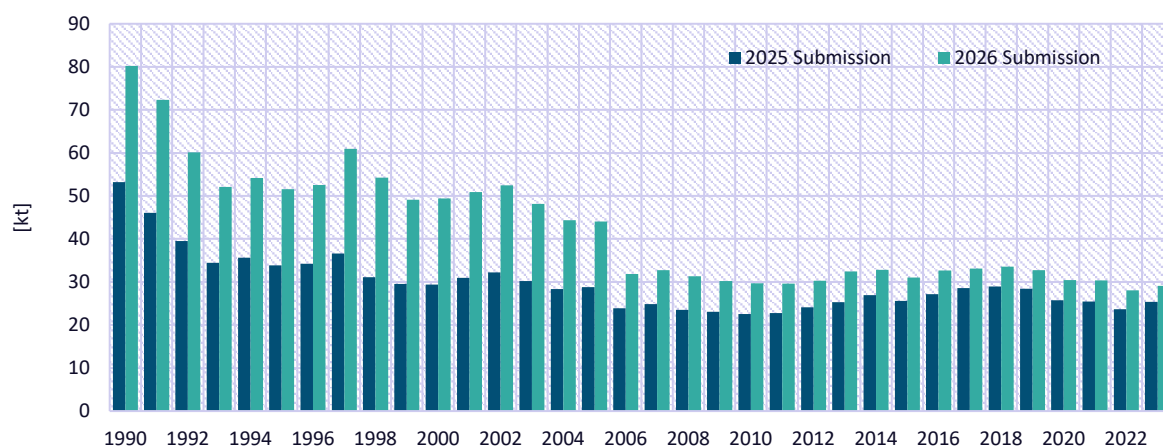
Figure 8.1.3: Comparison of the total SO_x emission between the 2025 final submission and the 2026 final submission



8.1.1.4 NH₃

The impact of recalculations on the NH₃ emission total in this submission is shown in [Figure 8.1.4](#). Emissions of NH₃ were recalculated due to activity data correction and their harmonisation with the GHG inventory. Also, new mitigation technologies were applied to the calculations of manure management.

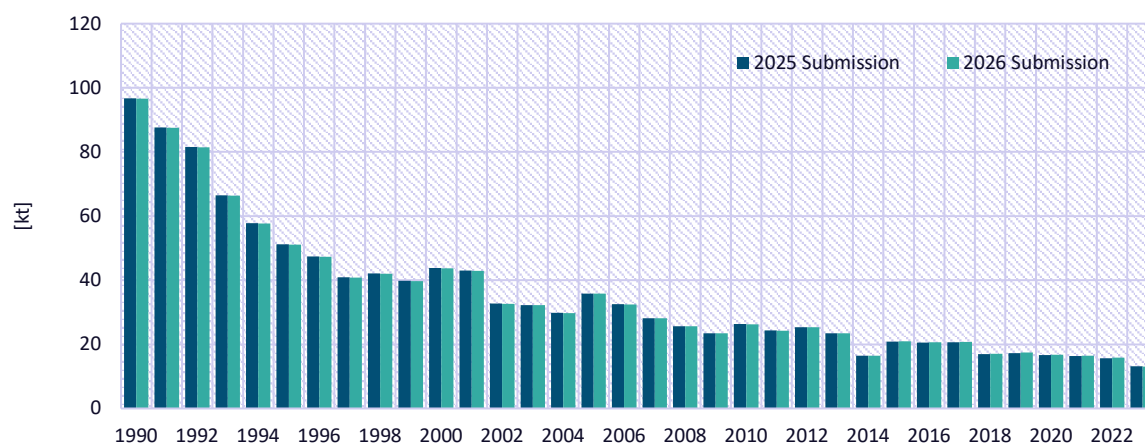
Figure 8.1.4: Comparison of the total NH_3 emission between the 2025 final submission and the 2026 final submission



8.1.1.5 $\text{PM}_{2.5}$

An overview of the changes is shown in [Figure 8.1.5](#). A slight decrease in emissions in the period 1990-2011 was caused by recalculations in category [3B](#) due to activity data correction and their harmonisation with the GHG inventory. Since 2013, the main source of the emission increase was recalculations in the categories of [1A3b](#) as a result of the implementation of the updated COPERT model. The decrease in 2023 was caused by error correction in category [1A4bi](#).

Figure 8.1.5: Comparison of the total $\text{PM}_{2.5}$ emission between the 2025 final submission and the 2026 final submission

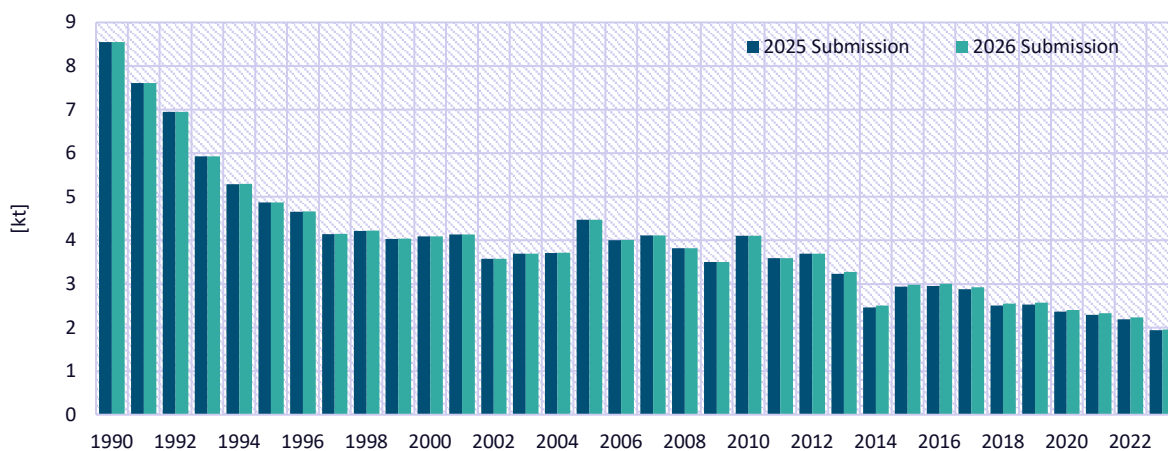


8.1.1.6 TSP, PM_{10} , BC

PM_{10} 's emissions recalculations have a very similar reason to recalculations of $\text{PM}_{2.5}$. A slight decrease in emissions in the period 1990-2011 was caused by recalculations in category [3B](#) due to activity data correction and their harmonisation with the GHG inventory. Since 2013, the main source of the emission increase was recalculations in the categories of [1A3b](#) because of the implementation of the updated COPERT model. The decrease in 2023 was caused by error correction in category [1A4bi](#). Increase of BC emissions was caused by adding the calculation of BC in the categories [2B1](#) and [2B5](#).

An overview of the changes in BC emissions is shown in [Figure 8.1.6](#).

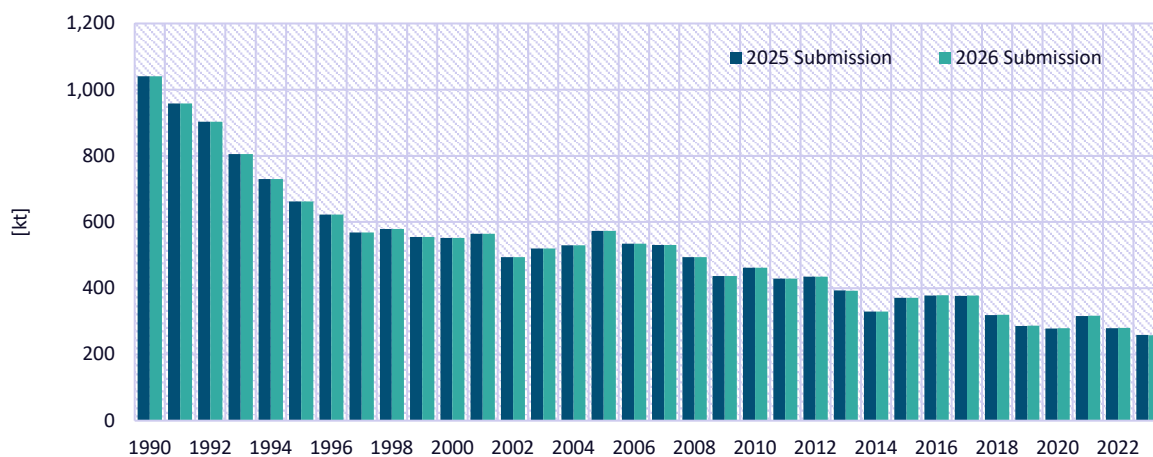
Figure 8.1.6: Comparison of the total BC emission between the 2025 final submission and the 2026 final submission



8.1.1.7 CO

Since 2013, the main source of the emission increase was recalculations in the categories of **1A3b** due to the implementation of the updated COPERT model and a decrease in 2023 in category **1A4bi** as the error was corrected. An overview of the changes is shown in [Figure 8.1.7](#).

Figure 8.1.7: Comparison of the total CO emission between the 2025 final submission and the 2026 final submission



8.1.1.8 Priority Heavy Metals (Pb, Cd, Hg)

Emissions increased due to recalculations of waste incineration with energy recovery in categories **1A1b**, **1A2c** and **1A2f** as the higher Tier EF were used. Other important recalculations were conducted in category **1A3bvi** with the implementation of the updated COPERT model and calculation of more HMs using Tier 1 methodology in category **2A3**. The changes are presented in **Figure 8.1.8 – Figure 8.1.10**.

Figure 8.1.8: Comparison of the total Pb emission between the 2025 final submission and the 2026 final submission

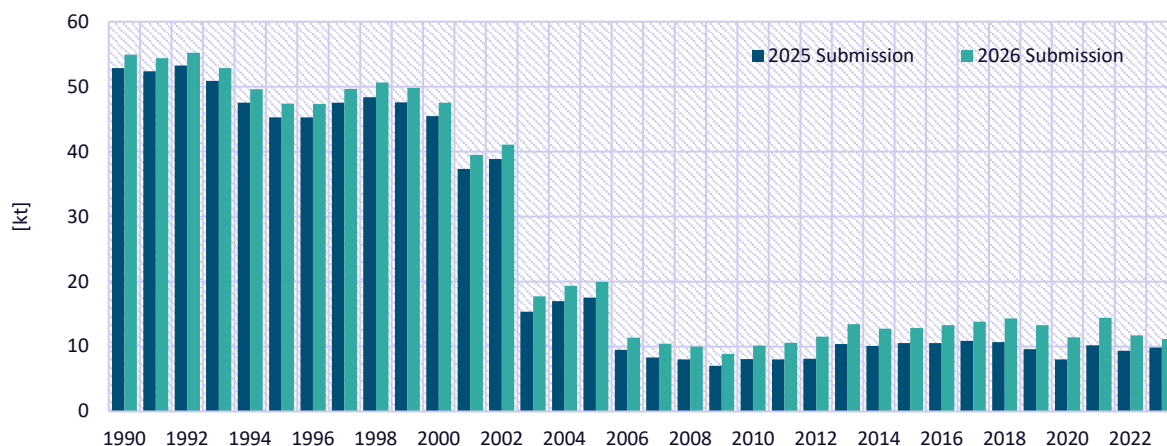


Figure 8.1.9: Comparison of the total Cd emission between the 2025 final submission and the 2026 final submission

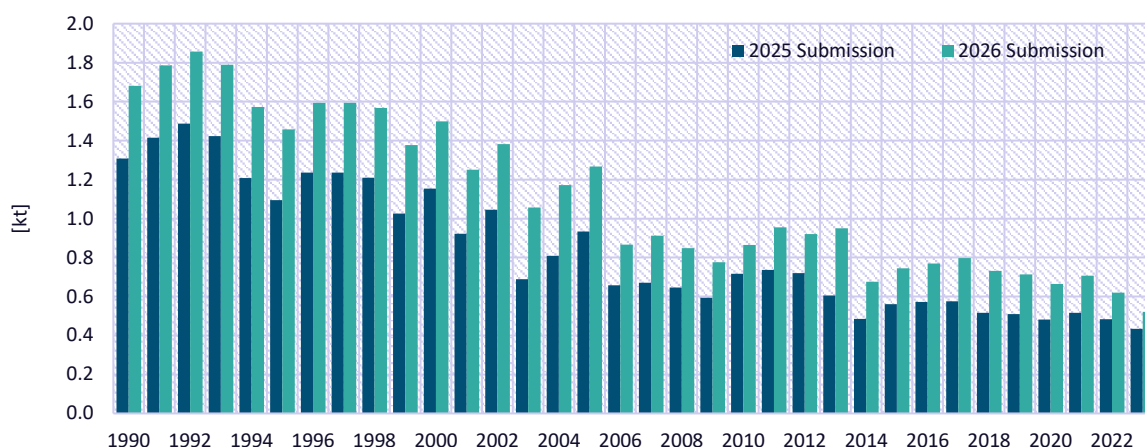
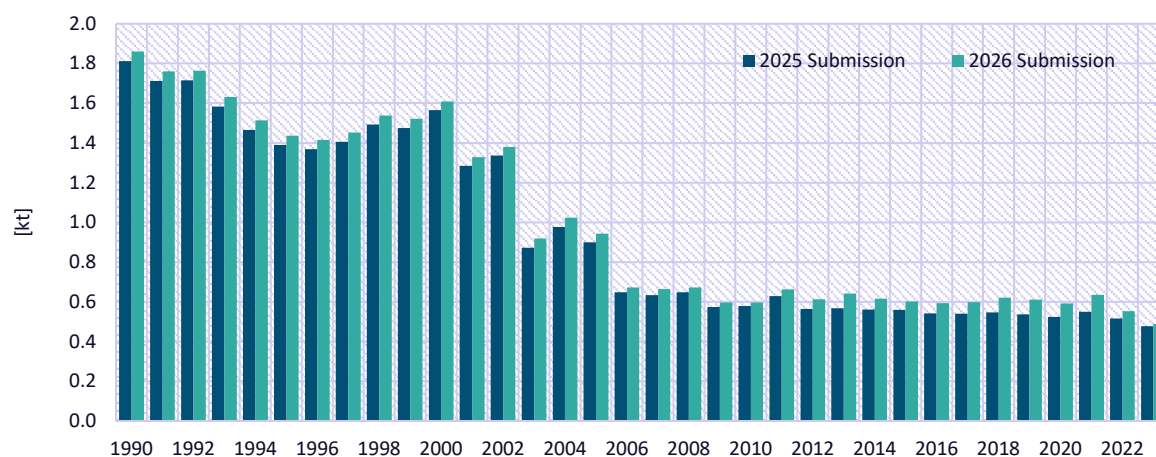


Figure 8.1.10: Comparison of the total Hg emission between the 2024 final submission and the 2025 final submission



8.1.1.9 POPs

Emissions changed mainly due to conversion factor correction in the categories **5C1bi** and **5C1bii** and recalculations of waste incineration with energy recovery in categories **1A1b**, **1A2c** and **1A2f** (Figures 8.1.11-8.1.14).

Figure 8.1.11: Comparison of the total PCDD/F emission between the 2025 final submission and the 2026 final submission

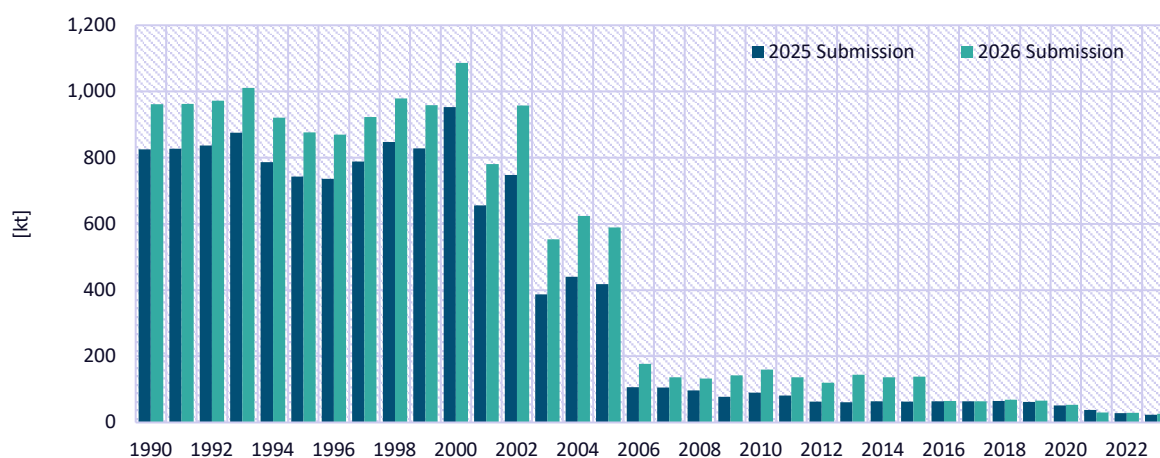


Figure 8.1.12: Comparison of the total PAHs emission between the 2025 final submission and the 2026 final submission

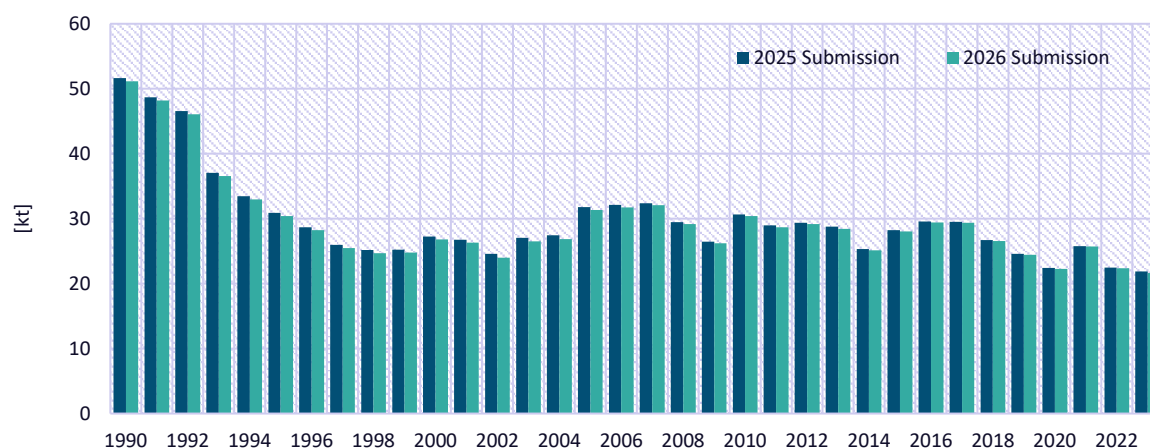


Figure 8.1.13: Comparison of the total HCB emission between the 2025 final submission and the 2026 final submission

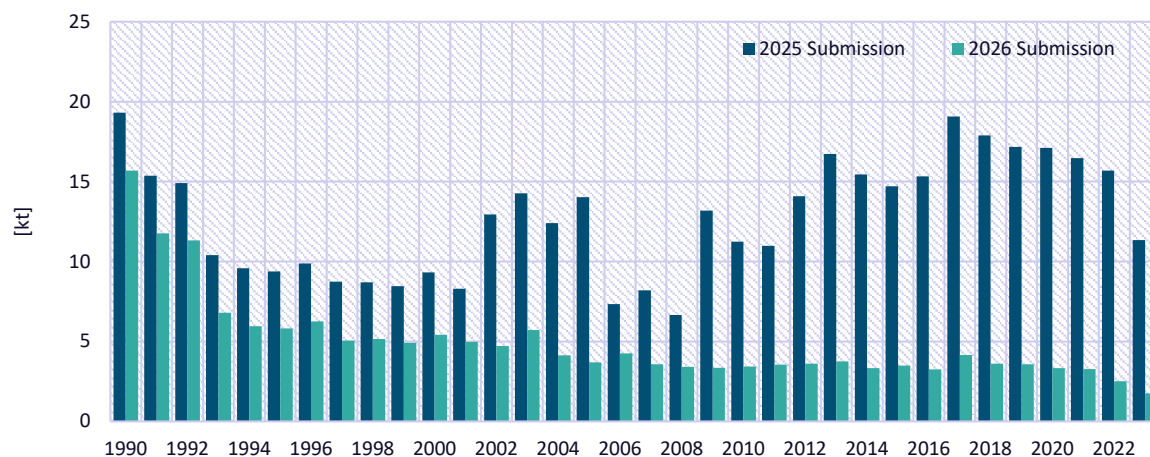
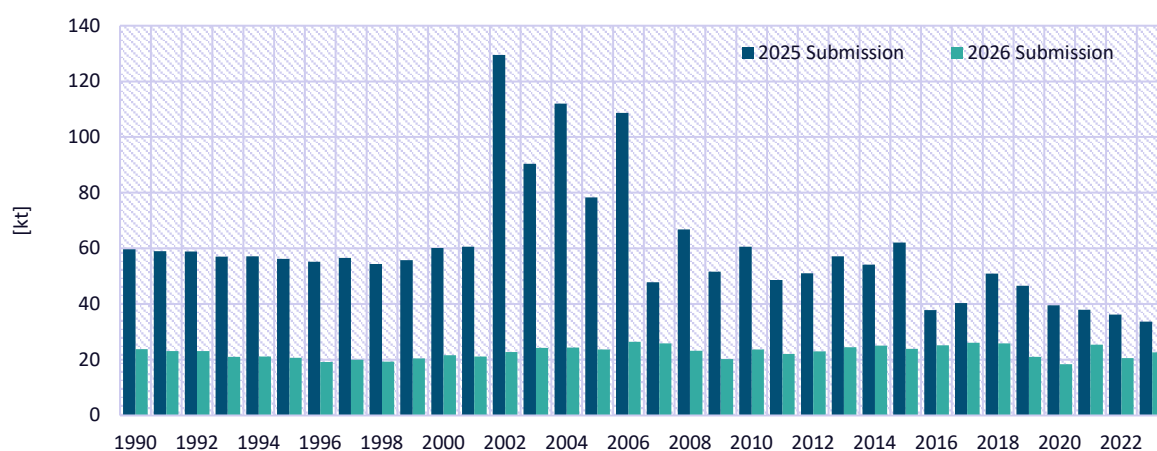


Figure 8.1.14: Comparison of the total PCBs emissions between the 2025 final submission and the 2026 final submission



8.1.2 Recalculations between the First and the Final version of the National Inventory

Some errors in the calculations were corrected after submitting the first version of the inventory. Also, BC calculations for **2B1** and **2B5** were added. These changes are shown in **Tables 8.1.1-8.1.3**.

Table 8.1.1: Recalculations between the first and the final version of the national inventory 2026 – main pollutants and PMs

YEAR/POLLUTANT	NO _x	NMVOC	SO _x	PM2.5	PM10	TSP	BC	CO
1990	-	-	-	-	-	-	0.25%	-
1991	-	-	-	-	-	-	0.47%	-
1992	-	-	-	-	-	-	0.41%	-
1993	-	-	-	-	-	-	0.70%	-
1994	-	-	-	-	-	-	0.84%	-
1995	-	-	-	-	-	-	0.97%	-
1996	-	-	-	-	-	-	1.32%	-
1997	-	-	-	-	-	-	1.29%	-
1998	-	-	-	-	-	-	1.26%	-
1999	-	-	-	-	-	-	1.35%	-
2000	-	-	-	-	-	-	1.47%	-
2001	-	-	-	-	-	-	1.65%	-
2002	-	-	-	-	-	-	1.86%	-
2003	-	-	-	-	-	-	2.12%	-
2004	-	-	-	-	-	-	2.54%	-
2005	-	-	-	-	-	-	3.10%	-
2006	-	-	-	-	-	-	3.32%	-
2007	-	-	-	-	-	-	3.60%	-
2008	-	-	-	-	-	-	3.41%	-
2009	-	-	-	-	-	-	3.42%	-
2010	-	-	-	-	-	-	3.38%	-
2011	-	-	-	-	-	-	3.59%	-
2012	0.04%	0.70%	0.01%	1.19%	0.98%	0.83%	4.68%	0.81%
2013	0.09%	1.50%	0.03%	2.62%	2.10%	1.71%	5.97%	1.84%
2014	0.12%	2.23%	0.04%	4.71%	3.45%	2.67%	6.10%	2.74%
2015	0.17%	2.71%	0.04%	5.27%	3.86%	2.85%	7.49%	3.48%
2016	0.23%	3.64%	0.12%	6.99%	5.38%	4.37%	8.88%	4.60%
2017	0.30%	4.58%	0.14%	8.91%	6.76%	5.28%	10.47%	5.75%
2018	0.32%	5.19%	0.20%	11.62%	8.45%	6.69%	11.45%	7.20%
2019	0.41%	6.28%	0.33%	13.75%	9.95%	8.06%	13.10%	9.56%
2020	0.53%	7.84%	0.42%	17.16%	11.93%	9.31%	16.54%	12.10%

Table 8.1.2: Differences in emissions in % between the first and the final version of the national inventory 2025– heavy metals

YEAR/POLLUTANT	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2012	0.07%	0.65%	0.08%	0.05%	0.43%	0.04%	0.15%	0.03%	0.38%
2013	0.12%	1.28%	0.15%	0.10%	0.81%	0.03%	0.26%	0.06%	0.63%
2014	0.16%	2.25%	0.19%	0.12%	1.09%	0.04%	0.37%	0.08%	0.87%
2015	0.23%	2.94%	0.28%	0.17%	1.33%	0.05%	0.47%	0.12%	1.08%

YEAR/POLLUTANT	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2016	0.29%	3.70%	0.37%	0.22%	1.62%	0.06%	0.63%	0.16%	1.29%
2017	0.36%	4.65%	0.46%	0.27%	2.10%	0.08%	0.79%	0.20%	1.74%
2018	0.37%	5.39%	0.47%	0.29%	2.26%	0.08%	0.92%	0.22%	1.85%
2019	0.47%	6.54%	0.56%	0.38%	2.59%	0.10%	1.10%	0.29%	2.43%
2020	0.65%	8.59%	0.69%	0.53%	3.36%	0.12%	1.46%	0.39%	3.26%

Table 8.1.3: Differences in emissions in % between the first and the final version of the national inventory 2025– POPs

YEAR/POLLUTANT	PCDD/F	BaP	BbF	BkF	I()P	PAHs	HCB	PCBs
2012	0%	1%	1%	1%	2%	1%	0%	0%
2013	0%	3%	3%	2%	3%	2%	0%	0%
2014	0%	6%	4%	3%	7%	3%	0%	0%
2015	0%	6%	5%	4%	7%	3%	0%	0%
2016	1%	8%	6%	5%	9%	4%	0%	0%
2017	1%	11%	8%	7%	12%	5%	0%	0%
2018	1%	14%	10%	8%	17%	6%	1%	0%
2019	2%	16%	12%	9%	19%	8%	1%	0%
2020	3%	21%	16%	12%	24%	11%	1%	0%

8.2 PROJECTIONS OF EMISSIONS

8.2.1 Introduction

The general methodology for the emission projections calculations was based on the same structure as the national emissions inventory for air pollutants. The data structure for activities, input emission factors and emission data calculations is based on the Nomenclature for Reporting (NFR). The outputs are aggregated.

Dynamic changes in global politics and economic developments in recent years and months have also had a significant impact and have complicated 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 2025.

The modelling of emission projections was provided consistent with the GHG emission projections reported on 15 March 2023 under Regulation (EU) 2018/1999 (1) of the European Parliament and of the Council of 11 December 2018 on Energy Union Governance and Climate Action.

Even with the 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 privatisation, and historical data can hardly be used for future development extrapolation.

The year 2022 was determined as the base year for modelling of emissions projections for the actualised scenario for which verified data sets were available from the national emission inventory reported in March 2024.

8.2.2 Scenario Definition

Projections of air pollutant emissions were prepared with the base year 2022 for the years 2025-2050 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 2022).

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.

8.2.3 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 by new information from producers.

Transport – Actualisation based on a new methodology with model COPERT using new assumptions and data.

Agriculture – Changes were driven by the improvement of methodology; a new model was implemented.

WAM scenario for NMVOC was included. Published policies and measures after 2022 from the national strategies were considered in the WAM scenario.

Waste – New calculations, and improved methodology together with GHG emission projections estimations.

8.2.4 Aggregated Air Pollutants Emission Projections

The actualisation of the emission projection led to some changes in comparison with previously reported projections. In the tables below are presented national totals of air pollutant emissions and a comparison to the absolute values of emission targets.

Table 8.2.1: WEM scenario emission projection trends and targets

TOTAL EMISSIONS OF SLOVAKIA (kt)	2005	2010	2015	2020	TARGET 2020-2029	2022*	2025	2030	TARGET 2030	2040	2050
NO _x	106.67	88.36	68.41	56.39	68.27	54.65	56.78	52.66	54.65	43.74	40.56
NMVOC	135.20	111.21	98.70	82.68	110.86	82.49	77.73	72.61	82.49	62.79	55.19
SO _x	87.60	69.05	68.25	14.86	37.67	13.30	10.74	10.26	13.30	9.56	8.59
NH ₃	34.61	30.31	32.90	30.54	29.41	27.51	30.27	28.80	27.51	30.27	30.39
PM _{2.5}	36.52	26.99	21.25	17.08	23.37	17.85	16.14	13.85	17.85	9.90	7.12

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

Table 8.2.2: WAM scenario emission projection trends and targets

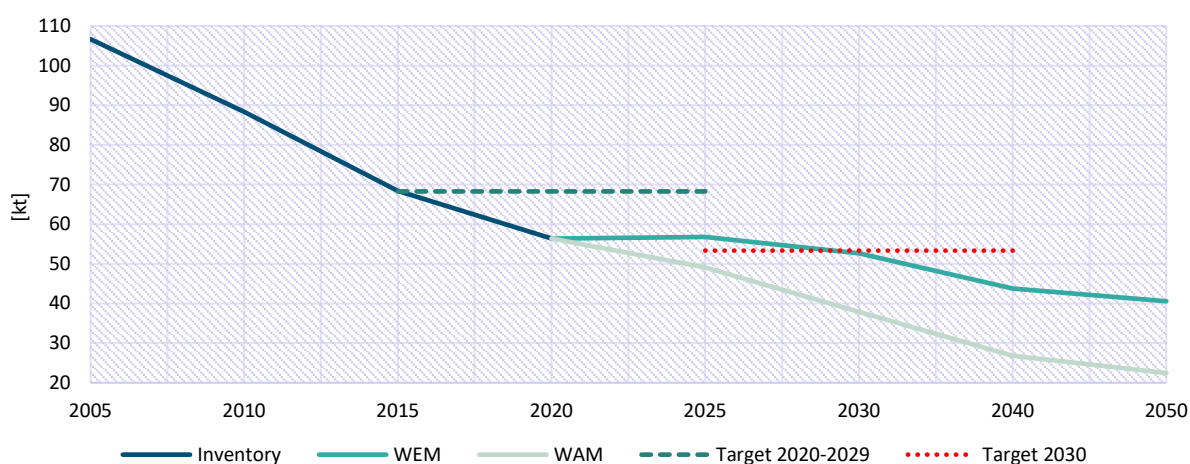
TOTAL EMISSIONS OF SLOVAKIA (kt)	2005	2010	2015	2020	TARGET 2020-2029	2022*	2025	2030	TARGET 2030	2040	2050
NO _x	106.67	88.36	68.41	56.39	68.27	54.65	49.11	37.90	54.65	26.79	22.45
NM VOC	135.20	111.21	98.70	82.68	110.86	82.49	73.94	64.66	82.49	48.37	41.15
SO _x	87.60	69.05	68.25	14.86	37.67	13.30	10.66	8.03	13.30	5.84	4.59
NH ₃	34.61	30.31	32.90	30.54	29.41	27.51	20.75	20.78	27.51	19.75	19.43
PM _{2.5}	36.52	26.99	21.25	17.08	23.37	17.85	15.52	12.10	17.85	6.89	4.86

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

8.2.4.1 NO_x emissions

Figure 8.2.1 shows a general view of trends of emissions of NO_x and estimated emissions projections based on encountered measures. Emissions slightly decrease and adopted and planned measures should be sufficient to meet the 2030 target, which will be very tight even in the WAM scenario.

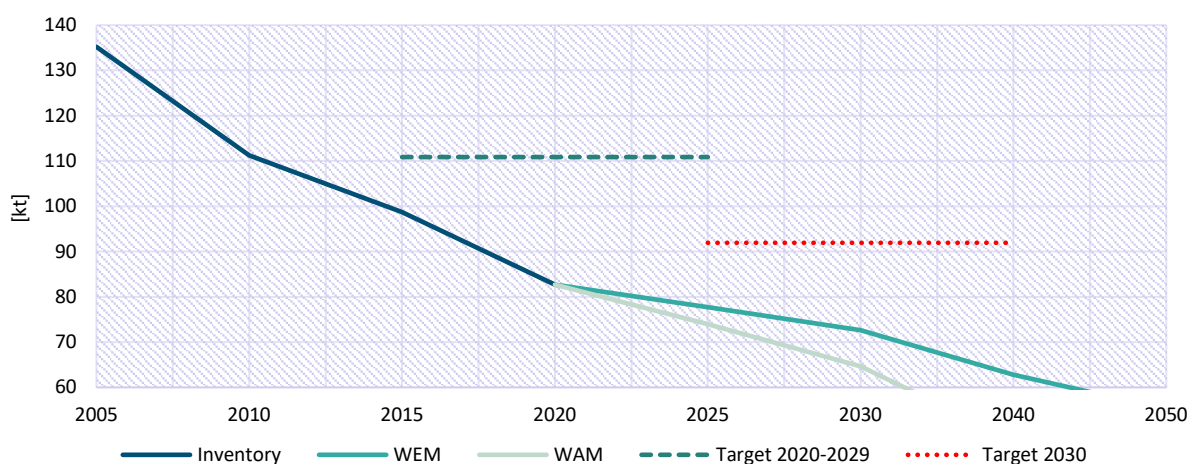
Figure 8.2.1: Emission projections trends for pollutant NO_x



8.2.4.2 NMVOC emissions

Figure 8.2.2 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.

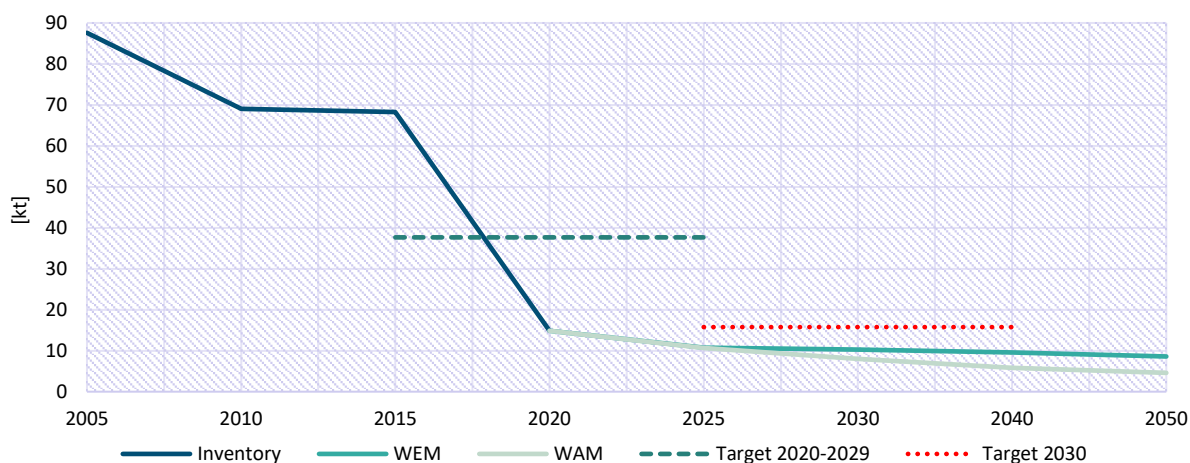
Figure 8.2.2: Emission projections trends for pollutant NMVOC



8.2.4.3 SO_x emissions

Figure 8.2.3 shows the general view of trends of SO_x emissions. After implementing strong measures in the energy sector, Slovakia should achieve the 2030 target in the WAM scenario.

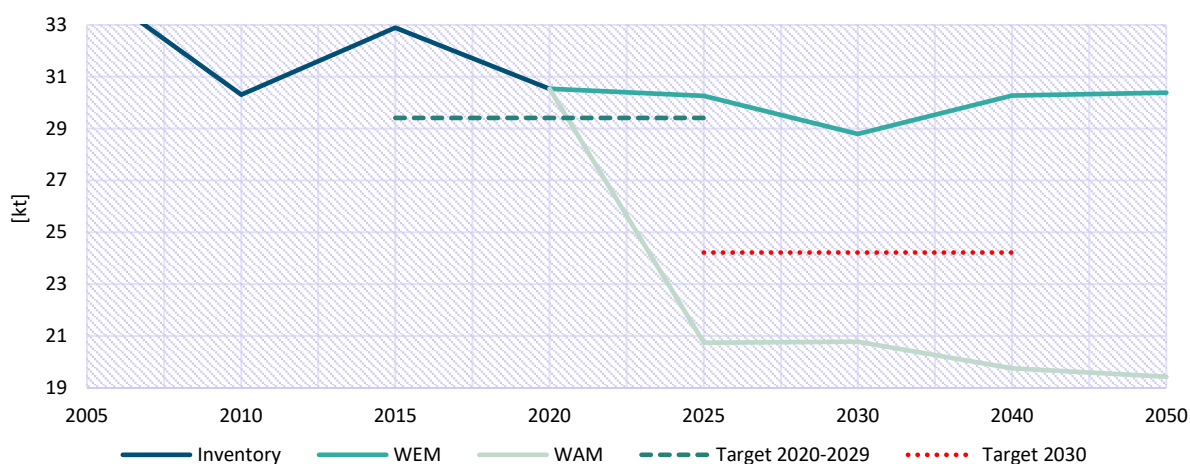
Figure 8.2.3: Emission projections trends for pollutant SO_x



8.2.4.4 NH₃ emissions

Figure 8.2.4 shows a general view of trends in NH₃ 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.

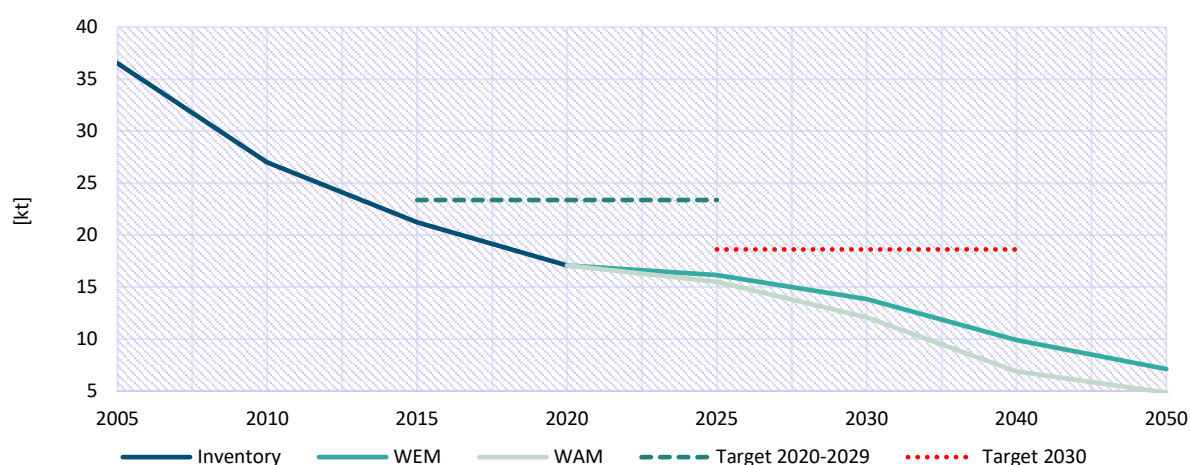
Figure 8.2.4: Emission projections trends for pollutant NH_3



8.2.4.5 $\text{PM}_{2.5}$ emissions

Figure 8.2.5 shows the estimated trend of $\text{PM}_{2.5}$ emissions. This is a key pollutant, and the future target achievement mainly depends on development in the household and transport sectors. For now, trends of emissions seem to be within the margin of the target of 2030.

Figure 8.2.5: Emission projections trends for pollutant $\text{PM}_{2.5}$



8.2.5 Emission Projections in the Energy Sector

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 **AP** but also on **GHG** 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 with earlier emission projections, the analysis incorporated data derived from the CPS model (Compact Primes for Slovakia). This model was specifically designed, adapted, and implemented by the Institute for Environmental Policy under the Slovak Ministry of the Environment. Detailed explanations of the CPS model's framework and applications are available in the 2023 emission projections report. The outputs from the CPS model were subsequently integrated into the TIMES model, a more granular analytical tool developed and utilised by SHMÚ (Slovak Hydro-meteorological Institute). TIMES-Slovakia 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 EU ETS trading scheme.

8.2.5.1 Methodologies and Key Assumptions/Trends

Energy and Industry model: TIMES

There are several sources of input data, among which the most important are the National Emission Information System (NEIS) and activity data from the Slovak statistical office (ŠÚ SR).

Some input parameters for the calculation of AP projections in TIMES-Slovakia, from industry and energy, are provided by the CPS + macroeconomic 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.

Fuel 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.

The NEIS remains a major source of data for inventory in the key categories and sectors (Energy, Industry) for the main pollutants.

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. Categories of the energy sector are the key categories for most of the main pollutants.

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**). Energy industries are a substantial contributor to most air pollutants.

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.

The 2025 Projection Report, which forms the basis for this report, shows how AP emissions might develop up to 2050, assuming the framework data are in place and the parametrisation of the instruments.

Table 8.2.3: Main parameters applied in emission projections

ITEM	UNITS	2022	2025	2030	2035	2040	2045	2050
Gross domestic product: Constant prices	EUR million	109 782	97 678	108 257	117 475	125 398	132 773	139 622
Population	1 000 people	5 429	5 410	5 339	5 260	5 195	5 135	5 075
EU ETS 1 carbon price	EUR/EUA	88*	95	95	100	100	160	190
International coal import prices	EUR/GJ	10.9	4.1	4.1	4	3.8	3.8	4
International oil import prices	EUR/GJ	16.7	12.4	13.9	15.4	15.8	17.2	19.7
International gas import prices	EUR/GJ	35.1	9.4	9	8.2	10.1	9.9	9.6

Even with the 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 privatisation, and historical data can hardly be 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 (2) on effort sharing in the sectors not included in the emission trading plays an important role.

8.2.5.2 Model Description

Table 8.2.4: SWOT analysis of the TIMES model

STRENGTHS	OPPORTUNITIES
Compatibility with the emission model for emission inventories Detailed data breakdown The database is compatible with EU data and national data Detailed sectoral breakdown Available Emission Trading System Finding the objective function (optimal solution) Stochastic modelling Seasonal availability User constraint options (environmental, energy, monetary, supply, production, subsidies...)	Incorporate new technologies into the model (CHP, HP, ELE) Attach transport (all transport categories) Versatile use on different geographical levels (Regional breakdown 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 a lack of macroeconomic and technology data GAMS solvers need to be paid separately	Disconnected from macroeconomic models Too many pre-calculations are needed Lack of economic data Lack of technology data (Investment cost for new technology) The whole structure needed to be built up from scratch

TIMES (an acronym for *The Integrated MARKAL-EFOM System*) is an economic model generator for local, national, multi-regional, or global energy systems, which provides a technology-rich basis for representing energy dynamics over a multi-period time horizon. It is usually applied to the analysis of the entire energy sector, but may also be applied to study single sectors such as the electricity and district heat sectors. Estimates of end-use energy service demands (e.g., car road travel; residential lighting; steam heat requirements in the paper industry; etc.) are provided by the user for each region to drive the reference scenario. In addition, the user provides estimates of the existing stocks of energy-related equipment in all sectors, and the characteristics of available future technologies, as well as present and future sources of primary energy supply and their potential.

All VEDA-TIMES model input data are organised in Excel workbooks (or files). VEDA2.0 then integrates information from all these workbooks into internal databases to facilitate management of the model data and to prepare and submit a TIMES model, generated and solved with the GAMS sub-system. The main goal of the model TIMES ([Figure 8.2.6](#)) is to find an energy system that meets all demands over the entire time period at the least costs. The scenarios are used specifically for region needed 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 optimisation 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.

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 optimisation 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-Slovakia** assumes perfect foresight, which is to say that all investment decisions are made in each period with full knowledge of future events. It optimises 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.

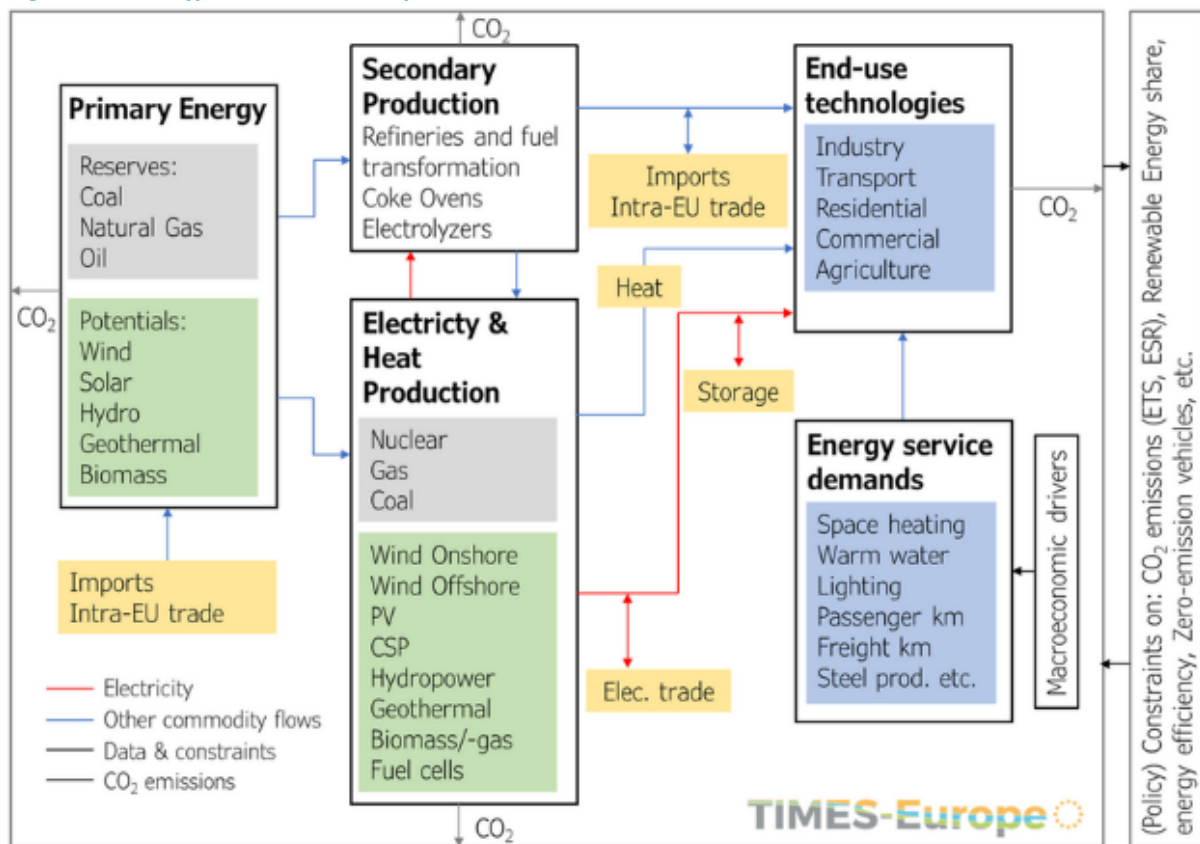
Calculation includes various policies and measures (in numerical formulation) defined according to the **WEM** and **WAM**.

The model itself operates with several sectors:

- POWER (Public electricity and heat production)
- IRON (Iron and Steel production)
- FAT (Food processing)
- CHEM (Chemical production)
- NMM (Non Metallic mineral)
- NFM (Non Ferrous metal)
- PPP (Pulp paper and print)

- OTH (Other categories)
- SUPP (Refinery and Petrochemicals)

Figure 8.2.6: Different elements of the TIMES model



Before preparing input data for the model, it is necessary to prepare a balance sheet, i.e. so. Called the spider, which represents the network of progress and processing of incoming commodities - fuels and materials in the process of processing, energy production, distribution and final consumption of products and energy. In the entire scheme (Figure 3.13), there are several levels that more or less coincide with the energy statistics data processing system for the Statistical Office of the Slovak Republic:

- Primary fuels – simulations of their import or extraction.
- Material inputs. This represents, for individual sources, a summary of material inputs that participate in the formation of AP. For example, by the decomposition of carbonates contained in them, inputs to lime plants, cement plants, ceramic production, glass plants, etc.
- Secondary fuels. In the specific conditions of the Slovak Republic, these are petroleum products, i.e. their production in the **Slovnaft refinery** together with the refinery gas that is burned in this complex. Furthermore, there are technical gases such as blast furnace gas, coke oven gas and converter gas, all produced and consumed within metallurgy.
- Fuel-mix represents the simulation of the entry of fuels into energy or production processes. At this level, based on the composition of the fuel mixture, the aggregated GHG emission factor is defined for individual appliances and, if necessary, also the other APs.
- Production of energy carriers - electricity and heat. A mixture of fuels enters each such set, and electricity and heat leave in heating and power plants, and only heat in heating plants.

Within the framework of the scheme, the distribution of the produced heat is used directly by the source or enters the remote supply system - DH.

- Integration of energy and material flows for the enterprise. This applies to enterprises with their own consumption of electricity and heat, which they produce themselves. Here, the flow of heat and electricity from own consumption is integrated with the material flow as well as the external supply of electricity and heat. In the latter case, the balance of import and export of electricity or heat is calculated.
- Simulation of the public electricity and heat distribution network.
- Simulation of final consumption - Demand according to macroeconomic and/or production indicators = assumption of product volumes, value added (VA) sectors, etc.

AP Emission Projections in Households – Excel Sheet Model

Emissions from combustion in households were modelled separately in the MS Excel sheet model, where the improvement of efficiency, equipment status, structure and good practice.

The projection calculation is based on inputs from CPS model calculations by the Institute of Environmental Policy (IEP) and in line with the prepared National Energy and Climate Plan.

Information was obtained from the questionnaire surveys in households, and newly implemented and planned measures were considered. 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.

8.2.5.3 Scenarios, Parameters and PAMs

List of policies and measures which have been considered in the [scenario with measures \(WEM\)](#):

TIMES-Slovakia 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.

The 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 (3)).
- Energy Labelling Directive (Directive 2010/30/EU (4)).
- Energy Performance of Buildings Directive, Energy Efficiency Directive (Directive 2012/27/EU (5)).
- Completion of the internal energy market, including provisions of the 3rd package (Directive 2009/73/EC (6), Directive 2009/72/EC (7)) - Regulation (EC) No 715/2009 (8), Regulation (EC) No 714/2009 (9).
- Directive on the promotion of the use of energy from renewable sources - "RES Directive" - incl. amendment on ILUC (Directive 2009/28 EC (10) as amended by Directive (EU) 2015/1513 (11)).

- EU ETS Directive 2003/87/EC (12) as amended by Directive 2004/101/EC (13) (international credits), Directive 2008/101/EC (14) (aviation), Directive 2009/29/EC (15) (revision for 2020 climate and energy package), Regulation (EU) No 176/2014 (16) (back-loading), Decision (EU) 2015/1814 (17) (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 (18) and Large Combustion Plant Directive 2001/80/EC (19)) - **Directive 2010/75/EU** (20).
- Increasing energy efficiency with several 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 building 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 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 (e.g. 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 the Thermal power plant **Nováky** and **Vojany** combustion brown and hard coal.

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 COVID-19 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 on GHG emissions reductions but also have impact on **AP emissions**. It contains:

- GHG emissions reduction;
- EU ETS CO₂ emissions reduction;
- Non-EU ETS GHG emissions reduction;
- 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 2024 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 (Blok 04) after 2026;

- Installation of two 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 in the Energy and Manufacturing industry.

8.2.5.4 Emission Projections in the Energy Sector

These projections cover 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 [Tables 8.2.5-8.2.9](#).

Category 1A1 energy industries include the power installations for the production of electricity and heat, and the combined heat power installations (CHP) [1A1a](#). The emissions from the combustion of municipal waste are included because of the energy recovery from the combustion process. The emissions from the refineries are allocated in category [1A1b](#). Emissions from petroleum refining, classified by code [1A1b](#), concern all combustion activities required to support the refining of petroleum products. Manufacture of Solid Fuels and Other Energy Industries [1A1c](#). The activity covers coke production and emissions associated with combustion in the coke oven. It is the key category for NO_x, SO_x, PM_{2.5}, PM₁₀, and TSP.

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 projections depend on fuel and process activity. Relevant pollutants are generally as described for combustion: NO_x, SO_x, CO, NMVOC. 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 Košice)

Small combustion (1A4 and 1A5) 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. Emissions strongly depend on fuel, combustion technologies, as well as on operational practices and maintenance. Households' heating is a very significant contributor to particulate matter PM_{2.5}, PM₁₀, CO and TSP (approximately 80% as well as other emissions in Slovakia). Projection emissions from leaks and other irregular releases of gases or vapours from a pressurised 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.

Projections of fugitive emissions from the transport and distribution of fossil fuels (oil and natural gas) are important because Slovakia is a critical transit country for oil and natural gas from East-European countries to the European Union. This category is a key category for projections of NMVOC and TSP.

For the period from 2023 onwards, all mines are categorised as "closed mines" (WEM and WAM scenarios). The emission factor for fugitive methane emissions from abandoned mines was estimated based on emission factors from the **EMEP/EEA GB 2023**. The modelling of emission projections in the Energy sector was based on sectoral trends and development from the CPS-Slovakia, and actualisation was made by taking into account the results of the model **TIMES-Slovakia** in the Energy Industry (**1A3 excluded**). The outputs from modelling were also determined by the reduction potential of measures to reduce emissions. The next tables show trends of emissions for individual pollutants.

NOx emissions

Table 8.2.5: NOx emissions in the Energy sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A1	19.10	13.04	8.49	5.47	5.26	4.00	4.03	3.68	3.39
1A2	15.32	11.74	10.85	8.41	9.35	9.78	10.01	10.58	10.97
1A4	9.19	8.89	8.88	8.37	7.76	7.08	6.64	5.84	5.20
1A5	0.20	0.13	0.48	0.45	0.38	0.35	0.32	0.32	0.32
1B	0.20	0.19	0.21	0.23	0.19	0.19	0.17	0.16	0.14
1 Energy	44.00	33.99	28.91	22.92	22.94	21.39	21.16	20.59	20.01

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A1	19.10	13.04	8.49	5.47	5.26	3.94	3.14	2.06	1.59
1A2	15.32	11.74	10.85	8.41	9.35	9.80	8.24	5.98	4.46
1A4	9.19	8.89	8.88	8.37	7.76	7.08	6.21	4.79	4.24
1A5	0.20	0.13	0.48	0.45	0.38	0.35	0.32	0.32	0.32
1B	0.20	0.19	0.21	0.23	0.19	0.17	0.17	0.13	0.10
1 Energy	44.00	33.99	28.91	22.92	22.94	21.34	18.08	13.29	10.71

* Base year 2022; 1990 – 2022 based on the AP inventory submission 15. 3. 2024

NM VOC emissions

Table 8.2.6: NM VOC emissions in the Energy sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A1	2.68	1.92	1.83	1.19	1.00	0.97	0.98	0.91	0.83
1A2	5.33	4.91	5.72	5.69	5.26	5.60	5.68	6.00	6.23
1A4	49.24	47.58	37.91	31.62	33.69	29.15	24.40	16.05	9.90
1A5	0.47	0.57	0.82	0.55	0.60	0.55	0.51	0.51	0.51
1B	6.77	6.32	5.60	4.84	4.12	4.22	4.13	3.92	3.21
1 Energy	64.50	61.29	51.88	43.89	44.68	40.49	35.70	27.40	20.68

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A1	2.68	1.92	1.83	1.19	1.00	0.95	0.64	0.40	0.25
1A2	5.33	4.91	5.72	5.69	5.26	5.36	5.48	5.50	5.03
1A4	49.24	47.58	37.91	31.62	33.69	29.09	21.88	10.31	5.87
1A5	0.47	0.57	0.82	0.55	0.60	0.55	0.51	0.51	0.51
1B	6.77	6.32	5.60	4.84	4.12	3.83	3.80	2.80	2.03
1 Energy	64.50	61.29	51.88	43.89	44.68	39.79	32.32	19.52	13.68

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

**WAM scenario for NM VOC emissions is higher than the WEM scenario due to higher biomass consumption in households projected with higher EFs.

SOx emissions

Table 8.2.7: SOx emissions in the Energy sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A1	60.82	52.75	52.04	3.22	4.03	2.44	2.38	2.09	1.81
1A2	10.01	4.94	3.29	1.47	1.33	1.17	1.20	1.23	1.25
1A4	3.40	2.34	1.93	1.57	1.58	1.20	0.82	0.55	0.45
1A5	0.32	0.10	0.21	0.19	0.14	0.12	0.11	0.11	0.11
1B	1.37	1.34	1.46	1.58	1.32	1.29	1.21	1.14	0.95
1 Energy	75.92	61.47	58.94	8.03	8.40	6.22	5.72	5.12	4.58

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A1	60.82	52.75	52.04	3.22	4.03	2.38	2.06	1.20	0.71
1A2	10.01	4.94	3.29	1.47	1.33	1.35	1.03	0.85	0.73
1A4	3.40	2.34	1.93	1.57	1.58	1.20	0.77	0.45	0.38
1A5	0.32	0.10	0.21	0.19	0.14	0.12	0.11	0.11	0.11
1B	1.37	1.34	1.46	1.58	1.32	1.21	1.20	0.93	0.71
1 Energy	75.92	61.47	58.94	8.03	8.40	6.27	5.17	3.54	2.63

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

NH₃ emissions

Table 8.2.8: NH₃ emissions in the Energy sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A1	0.08	0.03	0.05	0.02	0.03	0.03	0.03	0.03	0.03
1A2	0.02	0.02	0.04	0.07	0.08	0.09	0.09	0.11	0.12
1A4	2.06	2.09	1.60	1.39	1.54	1.48	1.37	0.96	0.60
1A5	0.00	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	0.01	0.01	0.00	0.00	0.00
1 Energy	2.17	2.15	1.69	1.48	1.66	1.61	1.50	1.10	0.76

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A1	0.08	0.03	0.05	0.02	0.03	0.03	0.01	0.00	0.00
1A2	0.02	0.02	0.04	0.07	0.08	0.09	0.09	0.07	0.06
1A4	2.06	2.09	1.60	1.39	1.54	1.48	1.22	0.59	0.32
1A5	0.00	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	0.01	0.00	0.00	0.00	0.00
1 Energy	2.17	2.15	1.69	1.48	1.66	1.60	1.32	0.66	0.38

PM_{2.5} emissions

Households (1A4) are a dominant contributor to PM_{2.5} emissions.

Table 8.2.9: PM_{2.5} emissions in the Energy sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A1	8.08	0.89	0.67	0.27	0.29	0.28	0.39	0.42	0.43
1A2	0.72	0.41	0.23	0.25	0.24	0.25	0.27	0.32	0.36
1A4	22.44	20.99	16.25	13.38	14.24	12.40	10.09	6.37	3.77
1A5	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01
1B	0.13	0.12	0.11	0.09	0.10	0.10	0.09	0.086	0.072
1 Energy	31.40	22.42	17.28	13.99	14.90	13.04	10.85	7.20	4.64

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A1	8.08	0.89	0.67	0.27	0.29	0.29	0.30	0.29	0.29
1A2	0.72	0.41	0.23	0.25	0.24	0.26	0.26	0.27	0.26
1A4	22.44	20.99	16.25	13.38	14.24	12.37	9.04	4.04	2.18
1A5	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01
1B	0.13	0.12	0.11	0.09	0.10	0.09	0.09	0.08	0.06
1 Energy	31.40	22.42	17.28	13.99	14.90	13.03	9.70	4.69	2.80

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

Projections of AP emissions in the Energy sector

Based on available data from the national emissions inventory, updated forecasts of emissions trends to 2030 and 2050 were prepared using models and tools to prepare emission projections. In this step, the existing (valid, adopted) policies and measures implemented so far were included in the projections. Here we are discussing the scenario with measures, or more precisely, with existing measures (the WM - with measures- scenario) and with additional measures - WAM. The following figures display emission trend and projections in the sector – **Energy (1A) – transport 1A3 excluded**.

Figure 8.2.7: NO_x emissions trends in the Energy sector

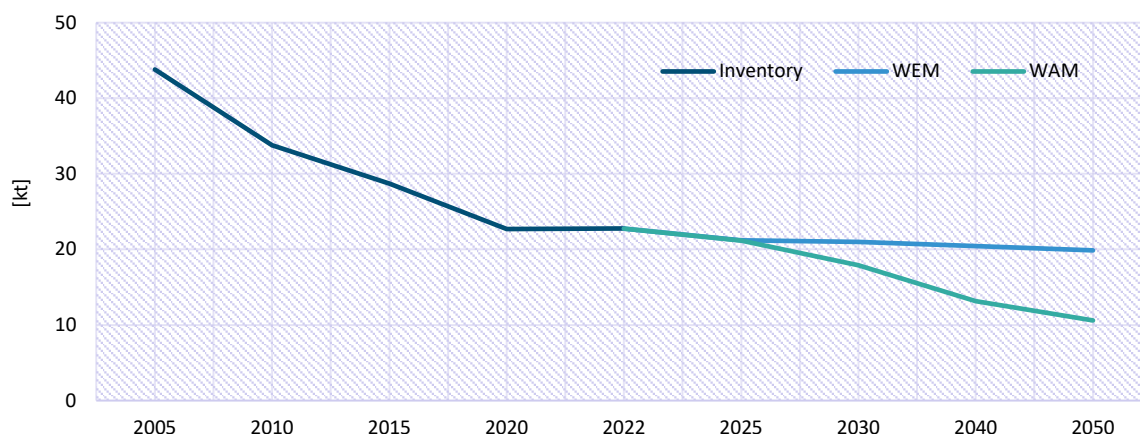


Figure 8.2.8: NMVOC emissions trends in the Energy sector

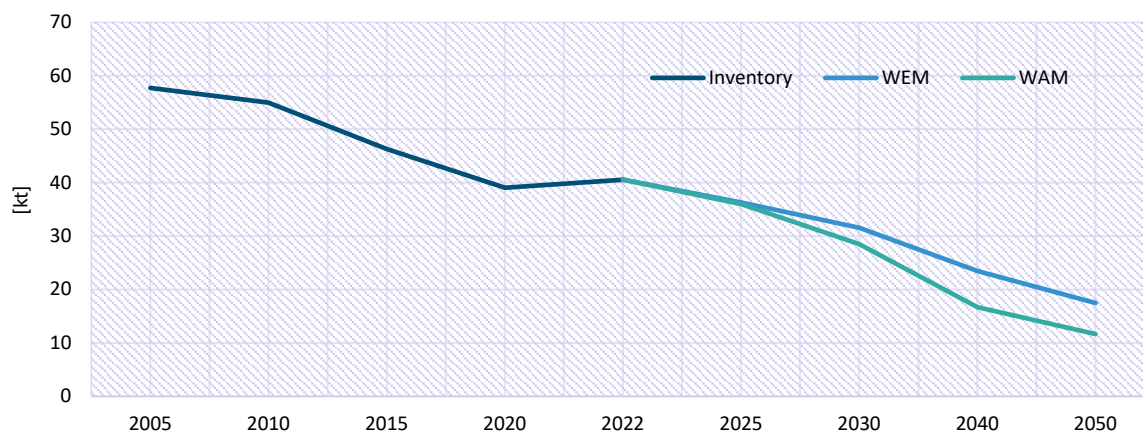


Figure 8.2.9: SO_x emissions trends in the Energy sector

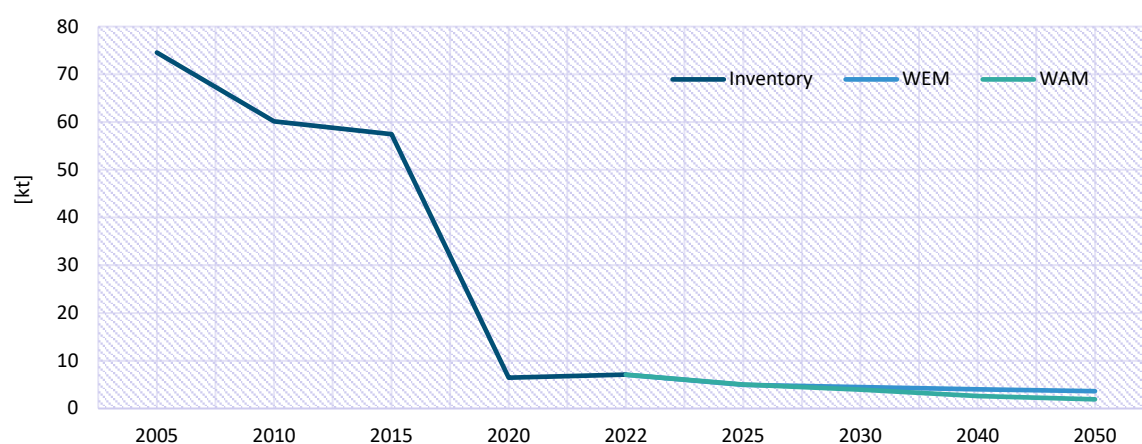


Figure 8.2.10: NH₃ emissions trends in the Energy sector

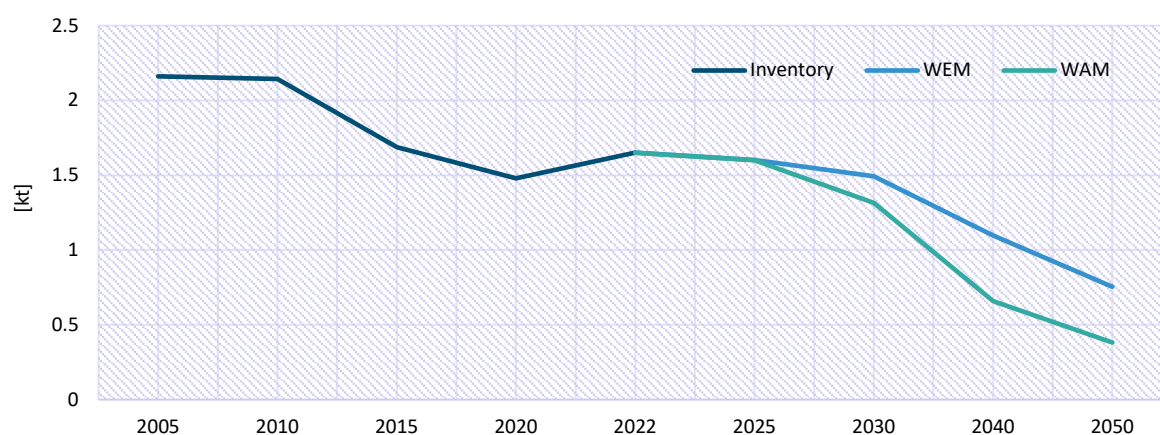
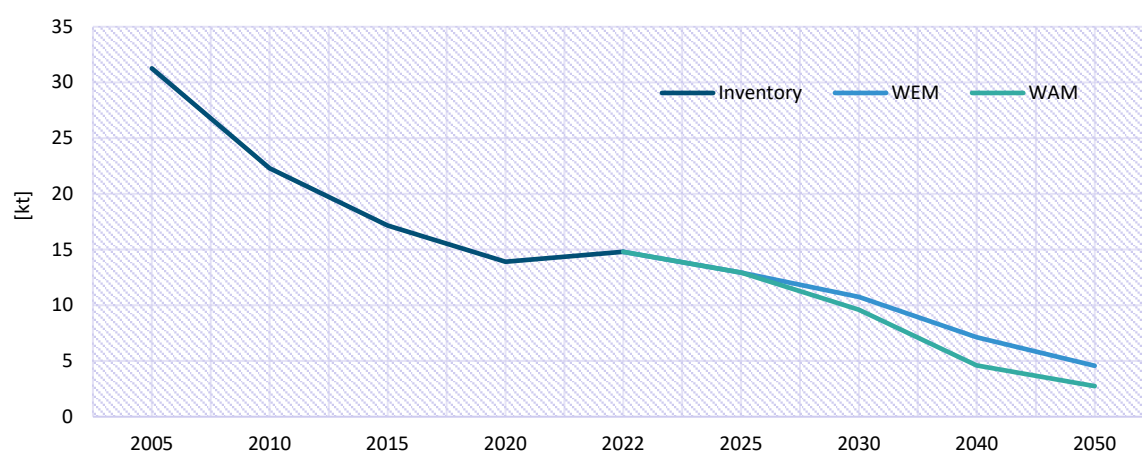


Figure 8.2.11: PM_{2,5} emissions trends in sector Energy sector



Emission reduction is visible across all sectors (1A) as well as pollutants. This reduction aligns with Slovakia's National Energy and Climate Plan (NECP), and NAPCP exceeds EU-wide targets. Key drivers include the coal phase-out, industrial electrification, and EU Emissions Trading System (ETS 2) expansion to buildings/transport (2027). Emissions in the energy sector - fuel combustion come mainly

from the energy industry (production of electricity and heat), processing industry, construction, fuel pipeline transport and other energy industries. The most important sources of emissions are emissions from electricity and heat production, oil refineries and iron and steel production. Emissions from road, rail, air and ship transport are listed separately in the subsection below. As it is visible, both scenarios contain decarbonisation measures, known as the phase-out of solid fossil fuel in Slovakia's biggest thermal power plant in Vojany and Nováky, which led to a significant decrease of SO_x, CO, NO_x, and TSP in category **1A1a**. The closure of Nováky (2023) and Vojany (2024) coal plants eliminated 98% of SO_x and 74% of PM emissions from category **1A1a**.

Emissions of air pollutants in the **WAM scenario** are projected to decline across all sectors between 2025 and 2035, with the most significant reductions expected in the electricity and heat sector. These declines stem from increased renewable energy capacity (solar, wind) and stricter pollution controls. In the **WEM scenario**, a less ambitious electrification pathway (based on SEPS data) is applied, though both scenarios assume the operational start of the MOCHOVCE IV nuclear reactor. By 2030, NO_x emissions are projected to fall by 52% compared to 2005. NMVOC by 45%, SO_x by 93%, NH₃ by 30%, and PM 2.5 by 65% levels in the baseline **scenario - WEM**, and by the **WAM scenario**, the reduction is follow: NO_x by 59%, NMVOC by 50%, SO_x by 95%, NH₃ by 39%, and PM 2.5 by 69%. Slovakia's national targets for reducing air pollution are only fully met under the WAM pathway. Post-2035, further reductions are expected, but limited policy frameworks currently detail how major cuts by 2040 will be achieved.

Key drivers for short-term reductions include:

- Electrification of the Košice steelworks (reducing industrial combustion emissions – **1A1c**, **1A2a**).
- Transition to electric vehicles (lowering NO_x and PM from transport) – **1A3**.
- Closure of coal-fired plants (Nováky in 2023, Vojany in 2024), significantly reducing SO_x, CO, NO_x and PM – **1A1a**.
- ETS 2 implementation (2027) for buildings and transport, incentivising cleaner technologies
- Post-coal transition challenges: The Horná Nitra region now relies on a hybrid system: Biomass district heating (30 MW capacity, funded by EU Just Transition Mechanism). Geothermal pilot in Košice.

Air Pollutants from Electricity Production

Slovakia's phase-out of coal (Nováky plant closed in 2023, Vojany in 2024) has reduced significantly SO_x and PM emissions but raised challenges for the regional heat supply. The Horná Nitra region, previously reliant on coal, now requires sustainable alternatives. Options include biomass heat sources, heat pumps, and natural gas backups. The government is prioritising solutions that balance air quality improvements with economic feasibility. In 2022, the Slovak authorities finalised their territorial just transition plan and submitted it under the Just Transition Mechanism. The Prievidza Thermal Energy Management (PTH) project includes three main components: renewable energy sources (existing biomass boilers, heat pumps, and possibly solar sources) and small cogeneration units in the HBP complex in the municipality of Cigeľ, as well as hot-water gas boilers on the outskirts of Prievidza, plus a hot water transport pipeline from Cigeľ to Prievidza. The installed capacity is 51.1 MW thermal, including solar sources. It solely addresses the heat supply for the city of Prievidza

Vojany Plant: The shutdown of its 1,210 MW coal units eliminated a major source of PM, NO_x and SO_x. Residual gas-fired units (220 MW) operated flexibly until 2024. Historically, solid fuels—primarily lower-quality brown coal and lignite mined in the Slovak Republic—were intensively used for this

purpose. Due to proactive environmental policies by the Slovak Ministry of Environment, the use of solid and liquid fossil fuels has gradually decreased in recent years, replaced by increased consumption of natural gas and biomass, alongside improved energy efficiency in industries. This phenomenon is termed decoupling—a state where production growth does not align with emission trends, as emissions decline instead.

[Air pollutants from Fuel Production \(Refinery\)](#)

Slovakia's Bratislava refinery (5.5-million-ton capacity) is a major emitter of SO_x and NMVOCs due to its processing of high-sulphur crude. Recent shifts to non-Russian oil reduced sulphur intake by 4x in 2023, but technological limitations hinder deeper cuts. Emission reductions in this sector are linked to declining fossil fuel use in transport (modelled via **COPERT**). The WAM scenario projects steeper declines due to synergies with electric mobility and hydrogen adoption.

[Steel Production \(Manufacture Industrial Combustion\)](#)

U.S. Steel Košice's post-pandemic recovery has led to increased production, resulting in higher SO_x, NO_x, and PM emissions. Planned shifts to electric arc furnaces (replacing blast furnaces) alongside the phase-out of coke battery operations, sinter production, and a transition from combustion of energy-grade coal (category 1A2a) to natural gas in its main heat and electricity installations (which deliver high-pressure steam and electricity) could achieve significant emission reductions:

- PM: ~42.8% reduction,
- NO_x: ~35% reduction,
- SO_x: ~60% reduction,
- CO: ~79% reduction.

However, ownership uncertainties and potential delays in adopting hydrogen-based iron ore reduction threaten progress. Current projections assume the WAM scenario's furnace transition (planned for 2026) proceeds as scheduled.

[Air Pollutants from Fertilizer Production](#)

The major ammonia production DUSLO Šaľa, reliant on natural gas, emits significant NO_x and NH₃. A proposed shift to hybrid hydrogen (grey + green) was excluded from projections due to data gaps. An external study found minimal near-term impact on air pollutant reductions. Ammonia production in Slovakia, primarily based on the traditional Haber-Bosch synthesis with a high carbon footprint, faces multiple sustainability challenges. Despite existing national strategies such as the National Energy and Climate Plan (NECP) and the National Emission Reduction Programme (NAPCP), modelling of the WAM (With Additional Measures) and WEM (With Existing Measures) scenarios indicates that implemented measures lack the ambition needed for significant pollutant reduction.

The **WEM** scenario, which assumes a continuation of current trends without new policies, predicts only marginal improvements in AP emissions. This is primarily due to reliance on fossil-based hydrogen (methane) and limited investments in low-carbon technologies, such as electrolyzers for green hydrogen or carbon capture systems (CCUS). The **WAM** scenario also does not reflect structural transformations in practice.

[Air pollutants from Heat Production](#)

Decarbonising district heating focuses on cutting PM and SO_x by replacing coal with:

- Biomass/biogas systems (lower PM vs. coal).
- Heat pumps (zero direct emissions).

- Natural gas (transitional, with stricter EU air quality rules).

CHP plants and waste heat integration are prioritised to align with EU air quality directives. Support for insulation of family homes. Support for connecting households to district heating.

Air pollutants from Households

Probably the most important sector for PM_{2.5} emissions and a significant amount of NO_x and NMVOC emissions. Based on the information from the questionnaire survey, files with higher data quality were used, and on this basis, estimates of a natural improvement in the structure of household heating equipment were made. The replacement rate was extrapolated based on historical survey data.

The WEM scenario projects a significant reduction in solid fossil fuel consumption and a balanced trend in gas consumption. These two trends will lead to decreasing of emission by 2030, keeping them at a lower level than in 2022. Emissions of PM_{2.5} decrease by almost 30%, SO_x by 57% and NMVOC by 27%. In the WAM scenario, there is a more significant reduction in emissions by 2030. This reduction will be mainly due to significant savings in heating. Due to investments in insulation and more efficient equipment. There will be a decrease in the consumption of natural gas (-19.7%) and solid fuels (-76.1%). Emissions of PM_{2.5} decrease by almost 37%, SO_x by 61% and NMVOC by 34% compared to 2022.

After 2030, the share of heat pumps in heating will increase the use of heat pumps will lead to partial savings in final energy consumption. These will be significantly supported, especially in the WAM scenario, by investments in improving the thermal insulation properties of buildings. The final energy consumption of fuels for heating and hot water (excluding electricity consumption) in households sector between 2030 and 2050 will decrease by 45% in the WEM scenario and by 70% in the WAM scenario.

Due to decarbonisation, the WAM scenario will also see a significant shift away from natural gas, which will be gradually replaced by biogas, hydrogen and a mix of synthetic gases. In the WEM scenario, the share of natural gas will also be significantly reduced, mainly in favour of electricity. Due to the significant electrification of heating (especially through the use of heat pumps), the use of biomass will decrease between 2030 and 2050 in both scenarios.

Energy Efficiency

Slovakia's 50.8% energy intensity reduction (2000–2015) lowered associated pollutants from power generation. Future gains depend on industrial efficiency upgrades and stricter emission standards for energy-intensive sectors. Energy Efficiency Concept for the Slovak Republic (21) - describes energy-saving measures based on advanced and environmentally-friendly technologies, making a significant contribution to reducing greenhouse gas and pollutant emissions.

Renewable Energy

Hydropower: Limited expansion potential, but existing plants aid in reducing grid-related pollutants. Geothermal: Underutilised (48,500 GWh potential) but could displace coal in district heating (e.g., Košice pilot). Data gaps in the TIMES model hinder precise projections.

Air Pollutants from Fugitive Emissions

The trend is steadily decreasing as an outcome of the introduction of new technologies, methodologies and the partial closing 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 has been stabilised 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. Production of coke in **WAM** shows a phase-out trend that also reflects the emissions within this category. This category is key for emissions of TSP, PM₁₀ and CO.

Pollutants from mining, post-mining activities, solid fuel transformation, oil/gas transmission, and distribution were projected. These emissions include particulate matter (PM), sulfur dioxide (SO_x), nitrogen oxides (NO_x), and volatile organic compounds (TOC). In Slovakia, fugitive air pollutants account for ~1% of total emissions, with a declining trend due to stricter regulations. Based on trends in coal mining, oil/gas activity, and fuel transformation, projections under the **WEM** (With Existing Measures) and **WAM** (With Additional Measures) scenarios were calculated and are summarised in [Tables 8.2.5 – 8.2.9](#) and [Figures 8.2.12 – 8.2.16](#).

- **1B1 Solid Fuels**

WEM: Assumes current dust control measures (e.g., water spraying in mines). All mines classified as "closed" post-2023, with residual PM emissions from abandoned sites. **WAM:** Additional investments in filtration systems and the electrification of mining equipment.

- **1B2 Oil and Gas**

WEM: Baseline leakage rates (2015–2022 average). Limited upgrades to compressor stations. **WAM:** WAM's LDAR (Leak Detection and Repair) program targets 1,200 km of pipelines, potentially avoiding 740 t/year NMVOC emissions.

Figure 8.2.12: NO_x emissions trends in fugitive emissions

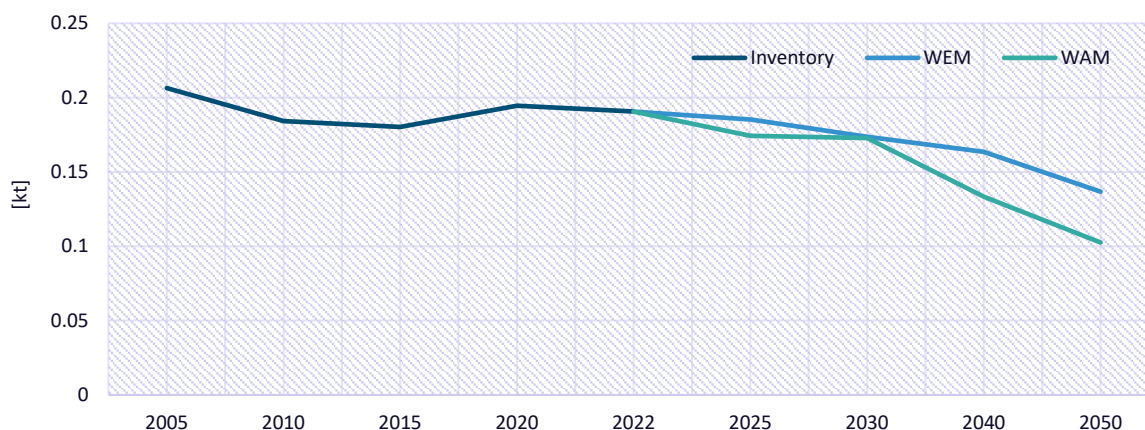


Figure 8.2.13: NMVOC emissions trends in fugitive emissions

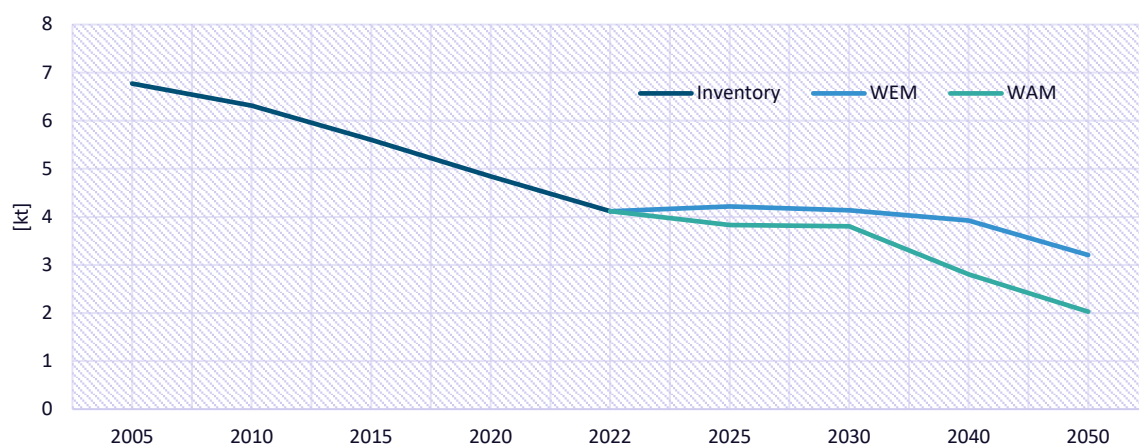


Figure 8.2.14: SO_x emissions trends in fugitive emissions

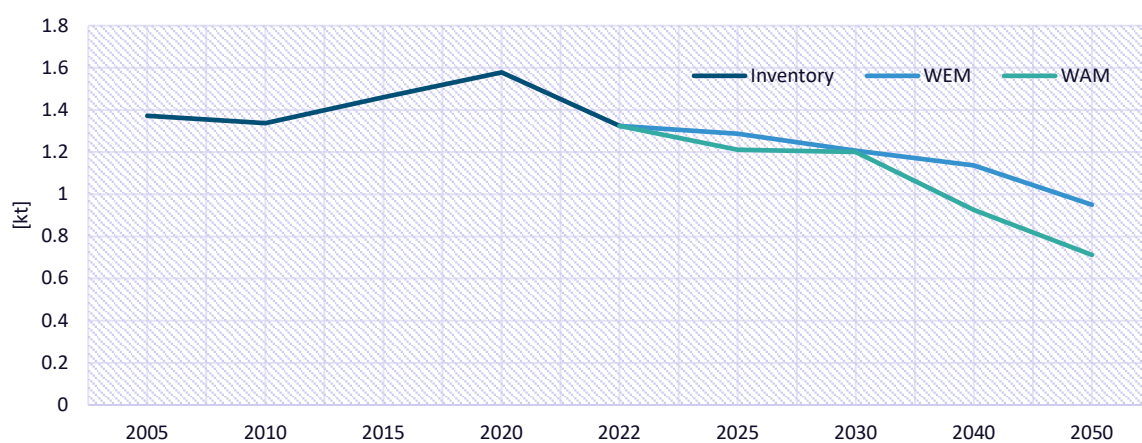


Figure 8.2.15: NH₃ emissions trends in fugitive emissions

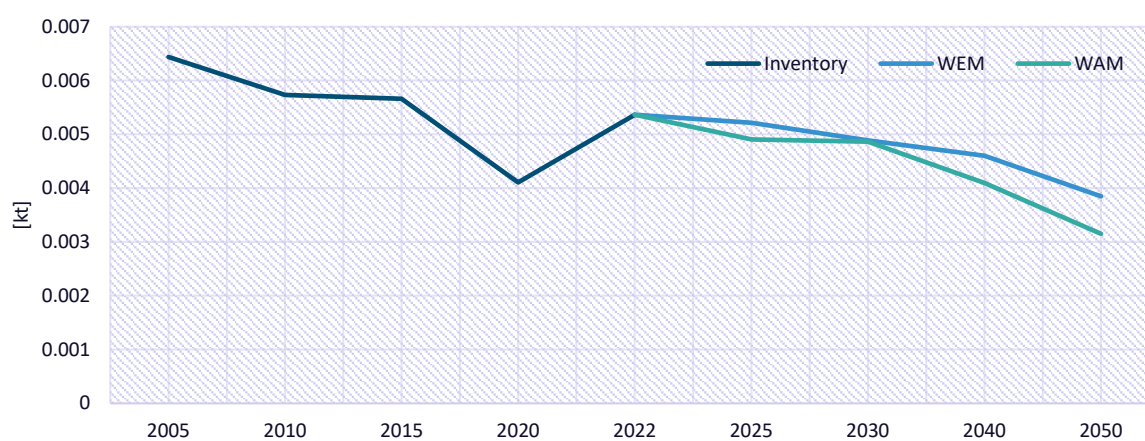
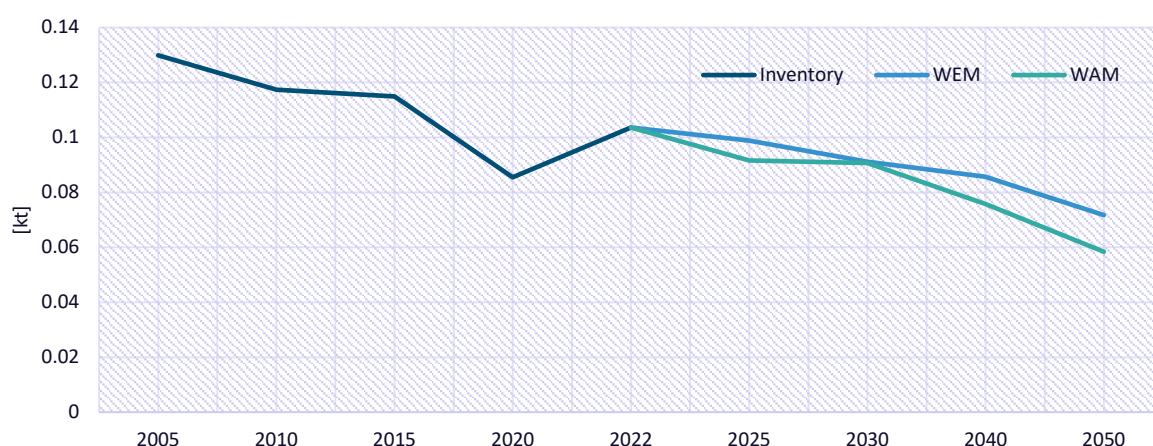


Figure 8.2.16: $PM_{2.5}$ emissions trends in fugitive emissions



8.2.6 Emission Projections in the Transport Sector

The transport sector consists of five subcategories:

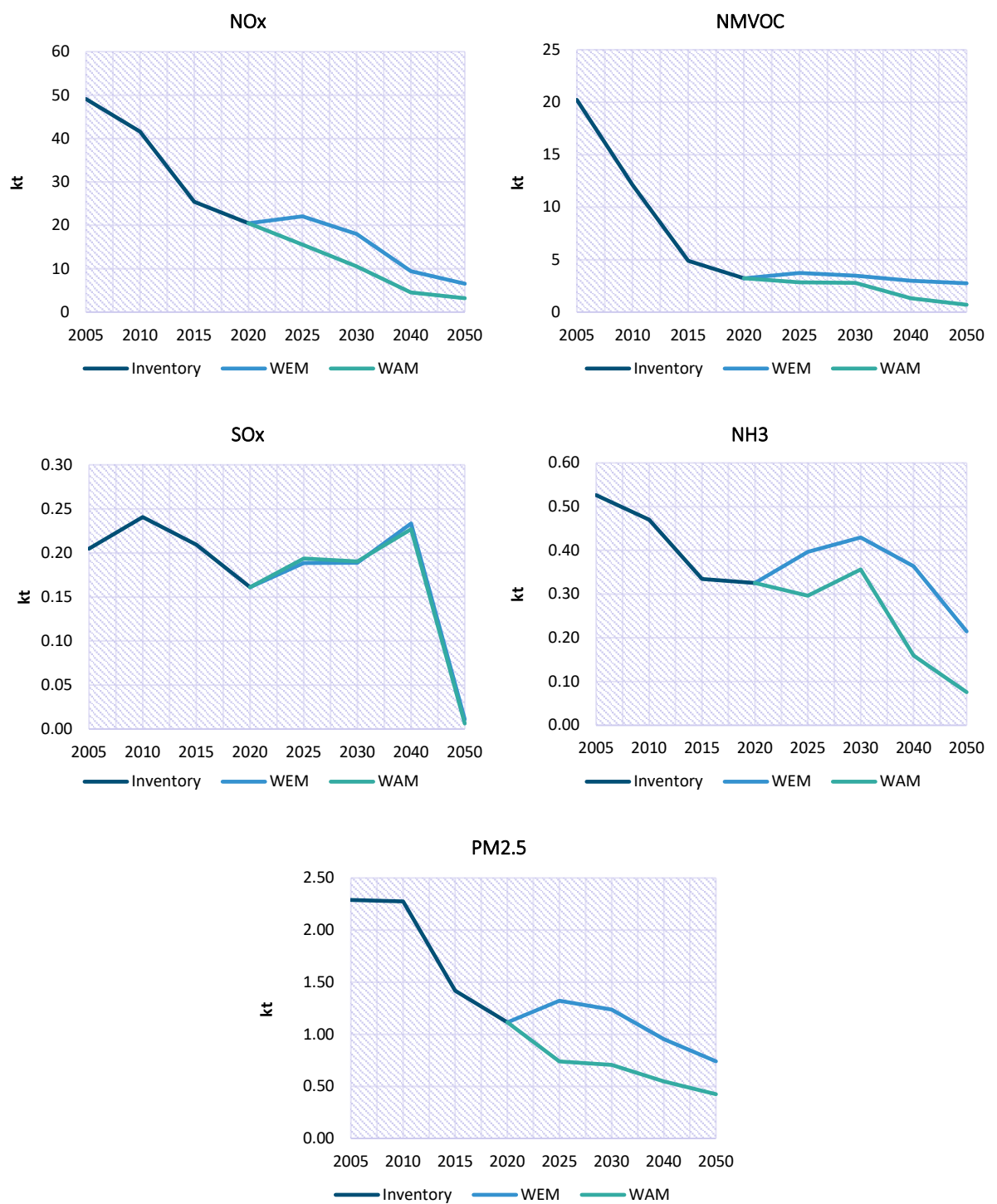
- **1A3a** Air transport
- **1A3b** Road transport
- **1A3c** Rail transport
- **1A3d** Water transport
- **1A3e** Other mode of transport (e.g. pipeline transport)

The largest contributor to air pollution in the transport sector is road transport, specifically the use of diesel heavy-duty vehicles (HDVs) and passenger cars. The transport sector includes emissions from various sources, including road transport (passenger cars, light-commercial vehicles, heavy-duty vehicles, buses, mopeds, and motorcycles), as well as emissions from petrol evaporation, tyre and brake wear, and road abrasion. Additionally, it includes emissions from air, rail, maritime, and pipeline transport (such as the transportation of natural gas). However, the majority of emissions in 2019 originated from road transport. Therefore, Slovakia's focus and detailed analysis are primarily directed towards the potential reduction of emissions from road transport, while the ARIMA model is employed for other transportation categories.

The starting point for gaining control over emissions is a thorough understanding of the current situation and an awareness of how emission trends have changed, both quantitatively and compositionally. By relying on official sources, a detailed, comprehensive, and consistent dataset on vehicles and their activity can be compiled. This dataset serves as the foundation for accurately calculating national-level emissions using advanced emissions modelling tools.

Both the WEM and WAM scenarios demonstrate diverse trends in terms of air pollutants. Emissions of NO_x , NMVOC, and the WAM scenario for NH_3 indicate a decrease in emissions, while other pollutants show an increase in emissions ([Figure 8.2.17](#), [Tables 8.2.10 - 8.2.15](#)) due to varying factors. The rising trend of SO_x and NH_3 emissions is caused by the extensive use of diesel-fuelled vehicles, while the increase in $PM_{2.5}$ emissions is attributed to the introduction and expansion of electric vehicle usage. Electric vehicles, being heavier, result in higher tyre and brake wear emissions.

Figure 8.2.17: Air pollutants emissions trends in the Transport



NOx emissions

Table 8.2.10: NOx emissions in the Transport sector

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A3b road	43.27	36.84	22.84	18.49	17.75	19.82	15.71	7.06	4.10
1A3acde non road	5.82	4.74	2.59	1.99	2.12	2.25	2.30	2.38	2.44
1A3	49.09	41.58	25.43	20.48	19.87	22.07	18.01	9.45	6.54

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A3b road	43.27	36.84	22.84	18.49	17.75	13.33	8.25	2.14	0.76
1A3acde non road	5.82	4.74	2.59	1.99	2.12	2.25	2.30	2.38	2.44
1A3	49.09	41.58	25.43	20.48	19.87	15.57	10.55	4.53	3.20

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

NMVOC emissions

Table 8.2.11: NMVOC emissions in the Transport sector

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A3b road	19.83	11.79	4.50	2.88	4.95	3.41	3.18	2.71	2.41
1A3acde non road	0.39	0.36	0.39	0.35	0.29	0.32	0.30	0.27	0.33
1A3	20.22	12.15	4.89	3.23	5.24	3.73	3.48	2.99	2.75

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A3b road	19.83	11.79	4.50	2.88	4.95	2.52	2.48	1.04	0.37
1A3acde non road	0.39	0.36	0.39	0.35	0.29	0.32	0.30	0.27	0.33
1A3	20.22	12.15	4.89	3.23	5.24	2.84	2.78	1.32	0.70

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

SOx emissions

Table 8.2.12: SOx emissions in the Transport sector

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A3b road	0.19	0.03	0.03	0.03	0.04	0.03	0.03	0.02	0.01
1A3acde non road	0.01	0.21	0.18	0.13	0.14	0.16	0.16	0.21	0.00
1A3	0.20	0.24	0.21	0.16	0.18	0.19	0.19	0.23	0.01

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A3b road	0.19	0.03	0.03	0.03	0.04	0.04	0.03	0.01	0.01
1A3acde non road	0.01	0.21	0.18	0.13	0.14	0.16	0.16	0.21	0.00
1A3	0.20	0.24	0.21	0.16	0.18	0.19	0.19	0.23	0.01

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

NH₃ emissions

Table 8.2.13: NH₃ emissions in the Transport sector

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A3b road	0.53	0.47	0.33	0.33	0.38	0.40	0.43	0.36	0.21
1A3acde non road	0.00	0.00	0.00	0.00	0.0003	0.00	0.00	0.00	0.00
1A3	0.53	0.47	0.33	0.33	0.38	0.40	0.43	0.36	0.21

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A3b road	0.53	0.47	0.33	0.33	0.38	0.30	0.36	0.16	0.08
1A3acde non road	0.00	0.00	0.00	0.00	0.0003	0.00	0.00	0.00	0.00
1A3	0.53	0.47	0.33	0.33	0.38	0.30	0.36	0.16	0.08

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

PM_{2.5} emissions

Table 8.2.14: PM_{2.5} emissions in the Transport sector

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A3b road	2.24	2.18	1.34	1.05	1.02	1.25	1.16	0.87	0.65
1A3acde non road	0.05	0.10	0.08	0.06	0.07	0.07	0.07	0.08	0.09
1A3	2.29	2.28	1.42	1.11	1.09	1.32	1.24	0.95	0.74

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
1A3b road	2.24	2.18	1.34	1.05	1.02	0.67	0.63	0.47	0.34
1A3acde non road	0.05	0.10	0.08	0.06	0.07	0.07	0.07	0.08	0.09
1A3	2.29	2.28	1.42	1.11	1.09	0.74	0.70	0.55	0.42

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

8.2.6.1 Methodologies and Key Assumptions/Trends (Road transport)

Input (historical) data for the calculation of air pollution emission projections from road transport are the IS EVO (Vehicle Registration Information System) database provided by the Ministry of Interior of the Slovak Republic – Police department (DI PPZ), the database of the Periodical Technical Inspection (PTI) of the Ministry of Transport and Construction of the Slovak Republic (MDV SR) and the transport indicators from the CPS+ model (Compact PRIMES model) provided by the Institute of Environmental Policy of the Ministry of Environment of the Slovak Republic (IEP MŽP SR). The Sybil database is also an important input source of information in the preparation of emission projections and input parameters. This database is being prepared by EMISIA based on:

- EUROSTAT statistical data (national statistics)
- Project outputs (FLEETS, TRAACS, NMP project) for all EU countries
- EC Statistical Pocketbooks
- ACEA (The European Automobile Manufacturers' Association)
- ACEM (The Motorcycle Industry in Europe)
- CO₂ monitoring database (operated by the EEA)
- EAFO
- NGVA EUROPE/NGV GLOBAL

- UNFCCC reports
- Weibull's distribution for preparing the age structure until 2050

The data in this database are based on the same input parameters as the EU Reference Scenario for Slovakia, which was discussed and presented in 2018-2019. The EU Reference Scenario for Slovakia was modelled using the PRIMES model and its transport module TREMOVE. The fleet development trends are therefore based on the same parameters and complex calculations, considering changes in the market as well as dynamic developments in the sector. This model is not directly applicable to Slovak conditions, as it requires a lot of detailed data, which Slovakia does not have.

Using trends from the Sybil database, an estimate of fleet development was prepared based on real data for the years 2013-2022. The data for this time period were obtained from IS EVO as a by-product of a project. Data and emissions before 2013, i.e. the period 1990-2012, were compiled according to official DI PPZ statistics and historical emission inventories.

Another important factor for calculating emissions and energy demand is the average value of annual mileage in each vehicle category and the average value of total vehicle kilometres travelled in each category. These data for the historical years 1990-2012 were taken from emission inventories. Subsequently, for the years 2013-2022, these figures were calculated using the information contained in the Slovak Technical Control database. Specifically, it is the information from the odometer about the kilometres driven. Using the VIN, the data are matched with the data from IS EVO. A detailed description of the methodology was published in the first phase of the project "Improving the allocation of road transport emissions in the AEA module" (22).

The COPERT model itself operates with 5 vehicle categories:

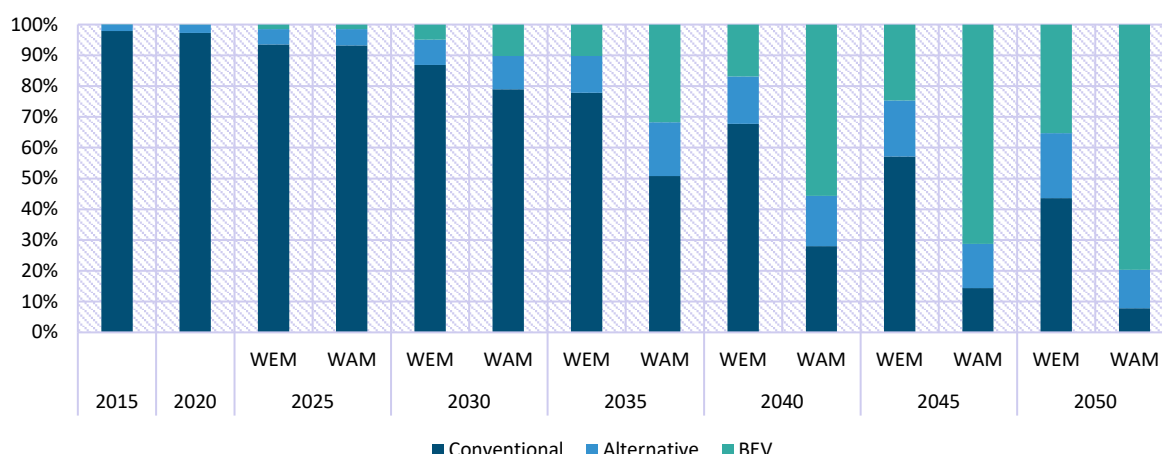
- Passenger cars (M1)
- Light-commercial vehicles (N1)
- Heavy-duty vehicles- trucks (N2 and N3)
- Buses (M2 and M3)
- L-category (L1 to L7)

Estimates for the period 2023-2050 were taken directly from the Sybil database and then broken down into individual fuel bases, segments (by engine capacity or vehicle weight) and emission standards. The model works with up to 620 separate data streams in total. The number of vehicles in each data stream each year is determined by an age composition matrix and a "survival rate" calculated from the data of the above-mentioned projects, the Weibull distribution, and EUROSTAT data.

Vehicle engines (fuel types) are subdivided and described in detail in the model, but for the purpose of this report, the different types of engines are divided into three groups: conventional, alternative, and zero-emission (BEV). Conventional engines are diesel and gasoline with their bio-component. CNG, LPG, LNG, hybrid (both diesel and petrol) and plug-in hybrid (both diesel and petrol) are being considered as alternative engines. BEV is currently represented by electric and hydrogen engines.

The overall evolution of the fleet can be seen in [Figure 8.2.18](#).

Figure 8.2.18: Fleet development by fuel types in WEM and WAM scenarios

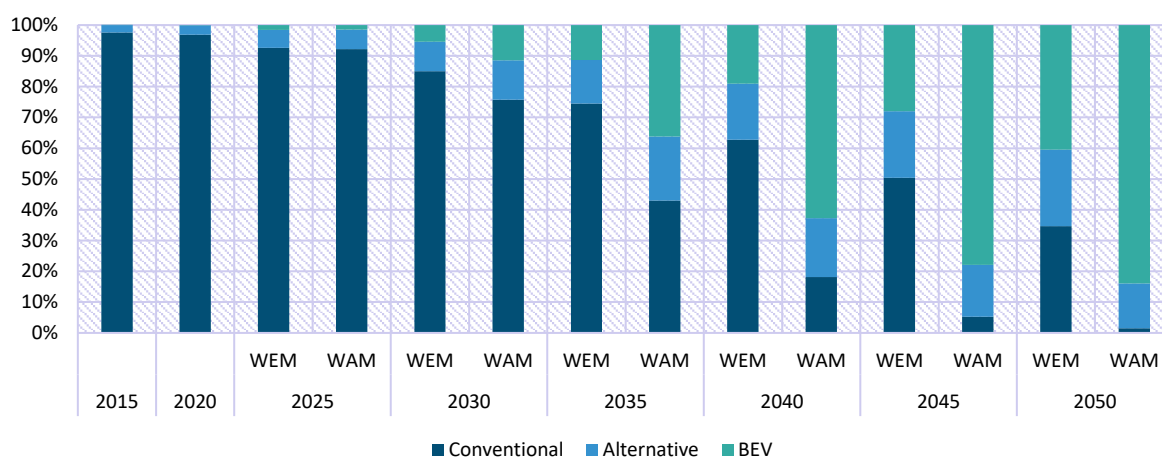


Passenger cars (M1)

Passenger cars account for the largest share of the fleet. In recent years, there has been a significant increase in their number. The main assumption for the projections is that the number of passenger cars in the fleet has still not at its peak. It is expected to peak around 2040, followed by a gradual and slow decline in the number of passenger cars, also driven by a declining demographic curve.

WEM scenario expects conventional passenger car sales will peak in 2030 ([Figure 8.2.19](#)). In the case of the WAM scenario, this peak could happen earlier, sometime around the year 2026. For alternative engines, there is a slightly lower increase in the WAM, and this is due to the greater weight given to BEV in the fleet development for this scenario, which has exponential growth up to 2050.

Figure 8.2.19: Development of passenger cars in WEM and WAM scenarios

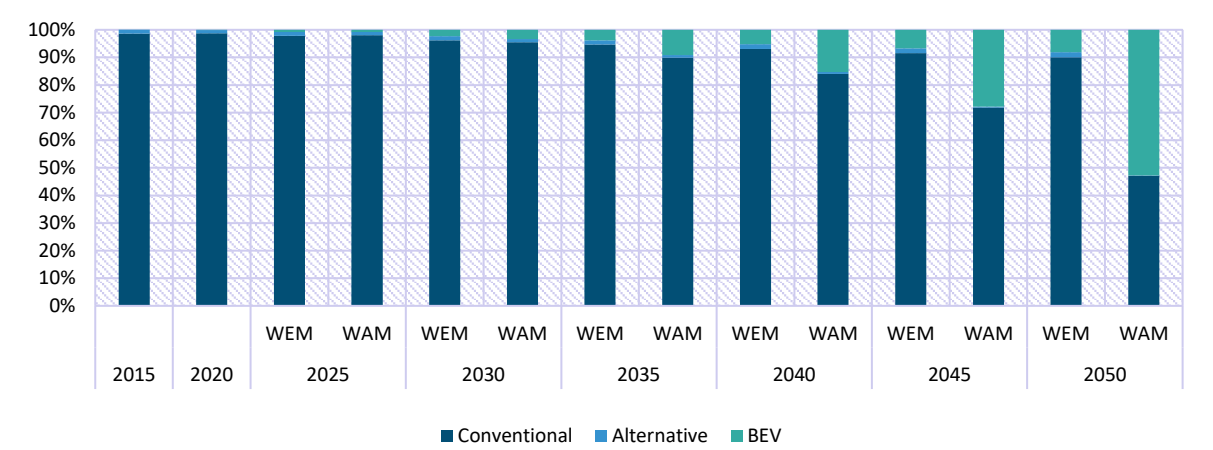


Light-commercial vehicles (LCV or N1)

The light-commercial vehicle category (category N1 - up to 3.5 tonnes) has undergone a significant change, moving from a category of no major importance in the 1990s to one of the key categories for future decarbonisation. The reason for its significant growth and the assumption of further growth is mainly due to the development of courier services and the "last mile" transport of goods. If the Slovak Republic does not try to decarbonise this part of road transport, the number of these conventionally fuelled vehicles (petrol and diesel) could reach up to 350 000 vehicles in 2050 ([Figure 8.2.20](#)). For LCVs, there is little expectation of a turnover to alternative fuels, as there would be a reduction in transport

space, and hence the WAM scenario will not affect this category. For the overall decarbonisation of road transport, it will be necessary to decarbonise, in particular, the 'last mile' in the form of zero-emission vehicles.

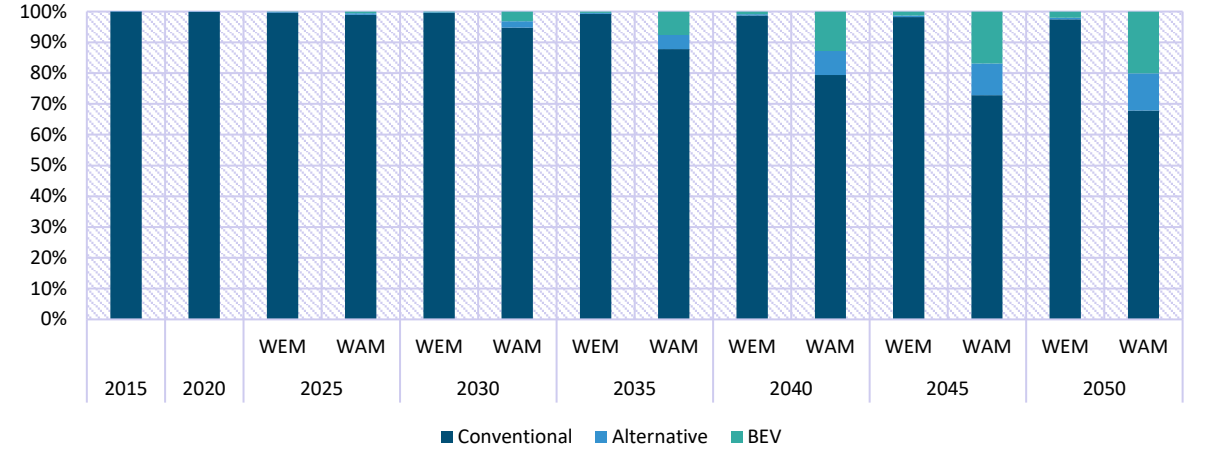
Figure 8.2.20: Development of light-commercial vehicles fleet in WEM and WAM scenarios



Heavy-duty vehicles – trucks (HDV or N2 and N3)

The heavy-duty vehicles category (traditional freight transport) is also extremely specific within road transport, mainly because of the possibilities of replacing conventional fuels with alternative fuels. This often leads to greenwashing campaigns about emission-free transport in the form of LNG/CNG. Decarbonisation is challenging due to the need for an extremely high range and engine power. In the WEM scenario, there is a steady increase in the number of HDVs ([Figure 8.2.21](#)) as the production of goods that will need to be transported over medium and long distances is projected to increase by the CPS+ model. Alternative fuels can contribute to reducing GHG emissions, but cannot be the ultimate solution in this category. The WAM scenario assumes a significant change and an exponential increase and shift away from conventional fuels towards BEV. This is limited, as for the other categories, only by the production capacities of the car manufacturers.

Figure 8.2.21: Development of HDV fleet in WEM and WAM scenarios



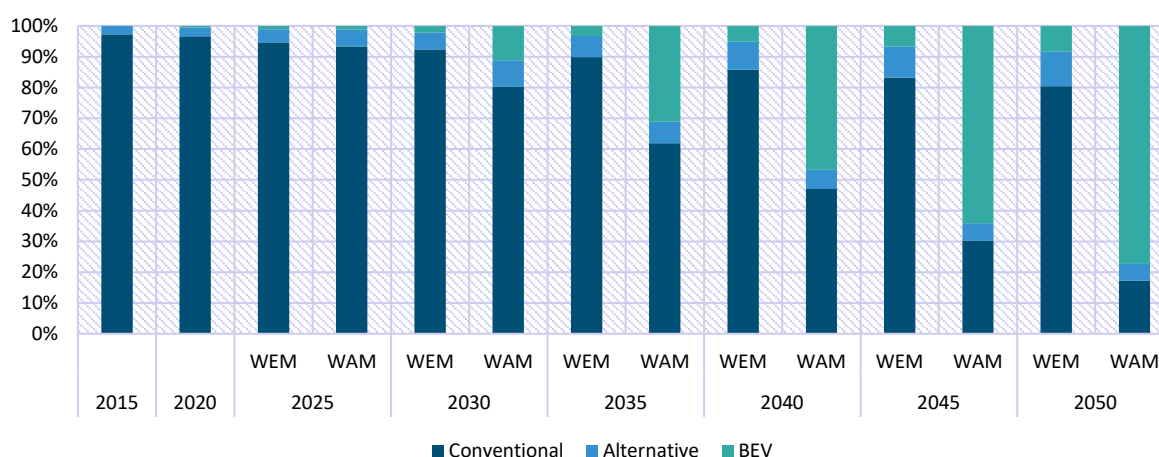
Buses (M2 and M3)

In the case of public passenger transport (PPT), there is no difference between the development in the WEM and WAM fleet scenario in the total number of vehicles, but there is a turnover of the fleet

([Figure 8.2.22](#)). The WAM scenario assumes a shift of passengers to rail and a densification of PPT intervals, which is reflected in higher annual bus mileage. This assumption was subsequently reflected in the model. Given the small share in road transport, no major interventions in the form of measures to support the fleet turnover have been necessary.

The decline in alternative fuel buses between 2015 and 2020 is mainly due to the phasing out of CNG buses. This trend is changing with the gradual introduction of hybrid buses and their gradual growth, replacing not only conventional buses but also older CNG-powered buses.

Figure 8.2.22: Development of buses in WEM and WAM scenarios



L-category (L1 to L7)

This category includes all two- and three-wheel vehicles. In addition to these, all-terrain vehicles (ATVs) and micro-cars are included. The term micro-car is used in the model to unite all vehicles of category L (1-7) that use diesel as a source of energy. Overall, this category consists of:

- Mopeds
- Motorbikes
- ATVs
- Buggies
- Micro-cars

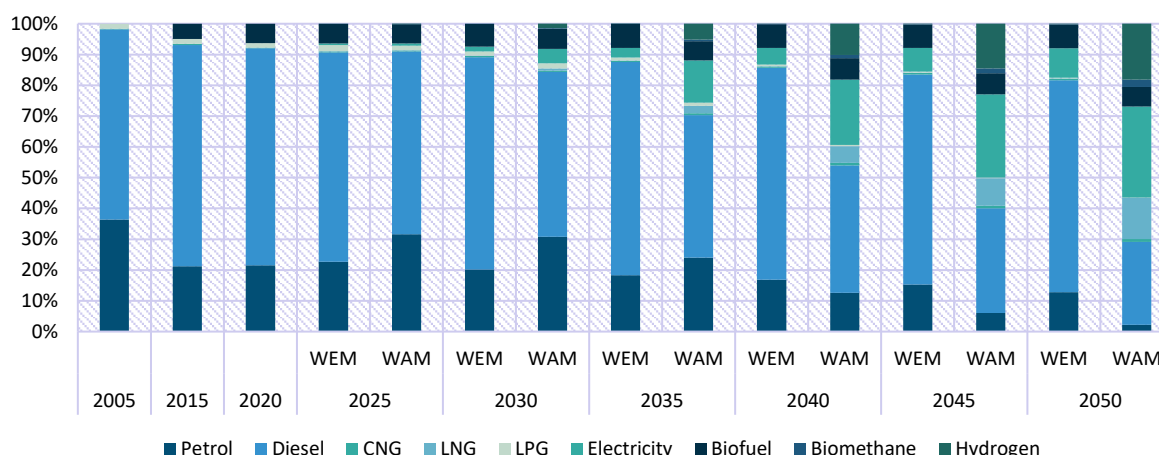
This is the smallest and least important vehicle category in terms of emissions. These vehicles account for around 0.3% of greenhouse gas emissions, and projections show that this trend should not change, with the massive decarbonisation of the passenger car category seeing the share rise to around 1% in 2050.

Energy Consumption

In terms of energy, according to the WEM scenario, in Slovakia, diesel oil will dominate consumption until 2050. Its consumption will slowly decrease in this scenario, but will still account for up to 69% of the total energy consumption of road transport in 2050.

From other alternative fuels will be the most dominant electricity consumption, rising gradually from a share of 2% (2,178 TJ or 605 GWh) in 2030 to around 10% (7,710 TJ or 2 140 GWh) in 2050 ([Figure 8.2.23](#)).

Figure 8.2.23: Historical evolution of the energy demand for road transport for the years 1990 – 2020 and WEM and WAM scenarios development assumptions



In the WAM scenario, significant diversification and an overall decline in fuel and energy consumption are expected in 2050. In this case, electricity will be the most used source of fuel, accounting for 1% (856 TJ or 240 GWh) in 2030 and up to 30% (15,400 TJ or 4,300 GWh) of the total energy demand in 2050. Diesel oil will still have a similarly important but significantly smaller share, with a share of 54% in 2030, falling to half (27%) in 2050. This significant share, despite strong decarbonisation, is mainly due to the heavy-duty vehicles' category, which is extremely difficult to decarbonise while maintaining the parameters required of them.

8.2.6.2 Model Description (Road transport)

Input data for the calculation of emission projections from road transport are databases provided by the Traffic Inspectorate of the Presidium of the Police Force of the Slovak Republic (IS EVO - Information System of Vehicle Registration) and the Ministry of Transport and Construction of the Slovak Republic (STK=PTI – Periodical Technical Inspection), transport indicators from the CPS+ model (IEP MŽP SR), which was developed for the needs of the Low Carbon Strategy.

An important aspect in the preparation is the Sybil database. This database is being prepared by EMISIA on the basis of:

- EUROSTAT statistics (national statistics),
- Project outputs (FLEETS, TRAACS, NMP project) for all EU countries,
- EC Statistical Pocketbooks,
- ACEA (The European Automobile Manufacturers' Association),
- ACEM (The Motorcycle Industry in Europe),
- CO₂ monitoring database (operated by the EEA),
- EAFO (European Alternative Fuels Observatory),
- NGVA EUROPE/NGV GLOBAL (The Natural & Bio Gas Vehicle Association),
- UNFCCC reports,
- Proprietary algorithms for the preparation of the age structure up to 2050.

The data in this database are based on the same input parameters as the EU reference scenario for Slovakia. The EU reference scenario for Slovakia was modelled using PRIMES and its transport module TREMOVE. However, for the conditions of Slovakia, as a small country, this model is directly inapplicable, as it requires many detailed data, which Slovakia does not have.

Using trends from the Sybil database, an estimate of fleet development was prepared based on real data for the years 2013-2022. The data for this time were obtained from IS EVO. Data and emissions before 2013, i.e. the period 1990-2012, were compiled from official Traffic Inspectorate of Police statistics and historical emission inventories.

Another important factor for calculating emissions and energy demand is the average value of annual mileage in each vehicle category and the average value of total vehicle kilometres travelled in each category. These data for the historical years 1990-2012 were taken from emission inventories. Subsequently, for the years 2013-2022, these data were calculated using the information contained in the Vehicle Technical Inspection (VTI) database.

The model itself operates with 5 vehicle categories:

- Passenger vehicles (M1)
- Light-commercial vehicles (N1)
- Heavy-duty vehicles - trucks (N2 and N3)
- Buses (M2 and M3)
- L-category (L1 to L7)

Table 8.2.15: SWOT analysis of the COPERT CLI model

STRENGTHS	OPPORTUNITIES
Compatibility with the emission model for emission inventories Detailed data breakdown The database used is compatible with EU data and national data	Incorporate new technologies into the model Versatile use on different geographical levels Versatile use of time series
TREATS	WEAKNESS
Easy data entry Basic software is free	Disconnected from macroeconomic models Disconnected from national energy models (needs to feed outcomes to energy models) Too many pre-calculations are needed

Estimates for the period 2023-2050 were taken directly from the Sybil database. These estimates are based on European statistics and qualified estimates by transport experts. Subsequently divided into individual fuel bases, segments (by engine capacity or vehicle weight) and emission standards, the model works with up to 620 separate data streams in total. The number of vehicles in each data stream each year is determined by an age composition matrix and a "survival rate" calculated based on data from the above-mentioned projects and EUROSTAT data.

The COPERT model is used for the actual calculation using the CLI module (Command Line Interface), which allows new technologies that are not directly defined by the model to be brought into the model. This includes emissions-intensive technologies such as LNG, flexi-fuel, e-fuel or hydrogen engines.

The COPERT model always reflects and incorporates the latest developments and scientific knowledge into emissions calculations. The emission calculation methodology is described in the EMEP/CORINAIR Atmospheric Emissions Inventory Guidebook 2023 (EMEP/EEA GB 2023) on tailpipe emissions from road transport. The model has roughly 50 predefined (and modifiable) parameters, ranging from environmental conditions (air temperature and humidity) to parameters detailing the generation of emissions in individual vehicle types. When using the CLI module, many of these parameters are unavailable and set to the default value.

Basic emission factors are integrated in the model, which are adjusted based on user-supplied input parameters. Emission factors are defined for each air pollutant separately. Actual values for 2020 were used for the model, except for new technologies, where it was necessary to supply emission factors directly.

In terms of technology and the use of different technologies within a single vehicle (plug-in hybrids, CNG, LPG), basic settings were used. In the case of CNG and LPG, it is assumed that 100% of these fuels are used at the expense of petrol, and in the case of plug-in hybrids, the split is 75% in favour of petrol and diesel and 25% in favour of electricity (electric motor). The low share of electric motor use is based on several studies summarised by the ICCT (International Council on Clean Transportation).

Minimum and maximum temperatures have also been introduced into the model, which affect emissions to some extent. The regional climate model KNMI-RACMO22E and its optimistic scenario RCP2.6 were used.

8.2.6.3 Scenarios, Parameters and PAMs (Road transport)

Slovakia prepared two scenarios for road transport: the WEM and WAM scenarios. The WEM scenario describes the development of the vehicle fleet and GHG emissions using only existing measures in force until the end of 2022. In contrast, the WAM scenario foresees several additional measures and policies that will need to be put in place both nationally and locally. The policies and measures used are based directly on legislation or on national and EU strategies and action plans. The reference year to compare with the WAM scenario was 2005. The reason for choosing this year as a reference year for comparison is that in 1990, road transport in Slovakia was not yet developed in all areas and did not reflect the current situation. In 1990, the light-commercial vehicle segment, which plays an important role today and especially in the future, was almost non-existent. At the same time, the last validated year with real values was determined to be 2022.

The policies affecting emissions from road transport can be split to three types: energy policies, transport policies and environmental policies. Energy policies and measures focus mainly on energy efficiency and renewable energy sources in transport. Transport policies and measures focus on transport infrastructure and intensity, and environmental policies and measures focus directly on reducing emissions of greenhouse gases and pollutants. The policies and measures taken into account in each scenario are based on a number of national documents:

- Low-Carbon Development Strategy of the Slovak Republic until 2030 with a view to 2050 (NUS SR) (23)
- Action plan for the development of electromobility in Slovakia (24)
- National Air Pollution Control Program (NAPCP) (25)
- Strategic plan for the development of transport in Slovakia up to 2030 (26)
- Integrated National Energy and Climate Plan of Slovakia (NECP) (27)
- Review and update of the National Policy Framework for the Development of the Alternative Fuels Market (28)
- EU hydrogen strategy (29)

In addition to these documents, separate acts and European directives also intervene in the preparation of individual scenarios:

- Act No 277/2020 Coll. (30) amending Act No 309/2009 Coll. on the Promotion of Renewable Energy Sources and High Efficiency Combined Heat and Power Generation

- Regulation (EU) 2018/1999 (31) of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action
- Regulation (EU) 2021/1119 (32) of the European Parliament and of the Council establishing the framework for achieving climate neutrality

WEM Scenario

The baseline scenario is the WEM (With Existing Measures) scenario, which includes only policies and measures in place by the end of 2022. The WEM scenario contains only five known measures that affect the energy mix and the vehicle fleet. They are:

- Act No 277/2020, which is a partial national transposition of consolidated Directive (EU) 2018/2001 of the European Parliament and of the Council (RED III) on the promotion of the use of energy from renewable sources
- Sale of low-emission vehicles (electric hybrids or plug-in hybrids) or directly zero-emission vehicles (battery electric cars and fuel-cell electric cars)
- Energy efficiency
- Regulation (EU) 2019/631 (33) of the European Parliament and of the Council of 17 April 2019 setting CO₂ emission performance standards for new passenger cars and light-commercial vehicles
- Regulation (EU) 2019/1242 (34) of the European Parliament and of the Council of 20 June 2019 setting CO₂ emission performance standards for new heavy-duty vehicles

The RED III Directive on the promotion and use of energy from renewable sources is currently still not fully transposed into national legislation. Its validity and inclusion in the WEM scenario were necessary and mandatory based on the scenario preparation framework. The RED III Directive sets new targets for the blending of renewable fuels (biofuels) into fossil fuels.

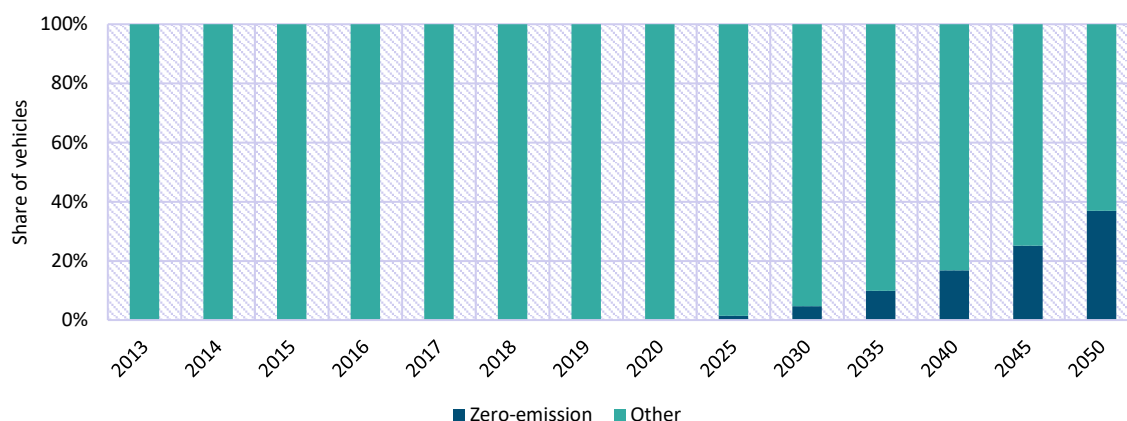
Table 8.2.16: The new, increased targets

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
7.6%	8.0%	8.2%	8.6%	8.8%	9.2%	9.5%	10.0%	10.4%	10.8%	11.4%

At the same time as this increased target, the possibility of double-counting of the energy share of advanced biofuels has also been introduced. However, the double counting of advanced biofuels has no impact on the production of greenhouse gas emissions.

The historical and projected promotion of zero-emission vehicles (BEV) can be seen in [Figure 8.2.24](#). Total BEV accounts for 4.9% of the vehicle fleet in 2030, 35% in 2050, according to the WEM scenario and 9.2% in 2030 and 44% in 2050, according to the WAM scenario. Passenger cars account for the largest share of eBEV, accounting for 75% in 2022, 86% in 2025 and up to 93% of all BEV on the road in 2030 and up to 96% in 2050 in the WAM scenario.

Figure 8.2.24: Share of zero-emission vehicles in the total vehicle fleet of the Slovak Republic - historical development and projections to 2050



Energy efficiency is converted into the model identically to the real options. The potential for improving combustion and engine efficiency to the level of "ultra-efficiency" was estimated at 15% in the ERTRAC report for passenger cars with spark-ignition engines. For diesel engines for passenger cars, this estimate was a 12% improvement by 2050, but for light and heavy duty vehicles, there is only a 10% level by making the engine more efficient. In the model, it is represented by a coefficient directly reducing the outputs of energy demand and emissions. Both EU regulations (2019/631 and 2019/1242) are also incorporated into the model this way.

WAM Scenario

The WAM (With Additional Measures) scenario is built on policies and measures, strategies and action plans that have not been put into force before 2020. The list of policies and measures used is summarised in [Table 8.2.17](#).

Table 8.2.17: List of policies and measures used in the WAM scenario

NAME OF THE MEASURE	SCENARIO	SHORT DESCRIPTION FOR WAM
Regulation for CO ₂ emission standards for new passenger cars & light commercial vehicles	WEM, WAM	WEM: 2021 Targets WAM: 2025, 2030, 2035 targets (Fit for 55) achieved
Regulation for CO ₂ emission standards for new heavy-duty vehicles	WAM	2030, 2035, 2040 targets partially achieved
Freight Modal Shift	WEM, WAM	WEM: Low Modal Shift - e.g. Trucks to Rail WAM: High Modal Shift - e.g. Trucks to Rail
Passenger Modal Shift	WAM	High Modal Shift - e.g. cars to cycling or public transport
Euro 7: Council adopts new rules on emission limits for cars, vans and trucks	WAM	In compliance
Support for the use of low-emission vehicles	WEM, WAM	WEM: Moderate transition to low-emission forms of transport WAM: High transition to low-emission forms of transport
Promotion of biofuels	WEM, WAM	WEM: In compliance WAM: High increase in the share of biofuels

NAME OF THE MEASURE	SCENARIO	SHORT DESCRIPTION FOR WAM
Low-emission zones in cities	WAM	UVAR for conventional vehicles
Regulation for CO ₂ emission standards for new heavy-duty vehicles	WAM	2030, 2035, 2040 targets partially achieved

The measure to support the continuation of direct support for the use of low-emission vehicles is mentioned in the Action Plan for the Development of Electromobility in the Slovak Republic and is also referred to in the National Air Pollution Control Program. In this measure, the penetration of electric vehicles in the passenger car segment is assumed to be more efficient, up to twice as strong, than in the WEM scenario.

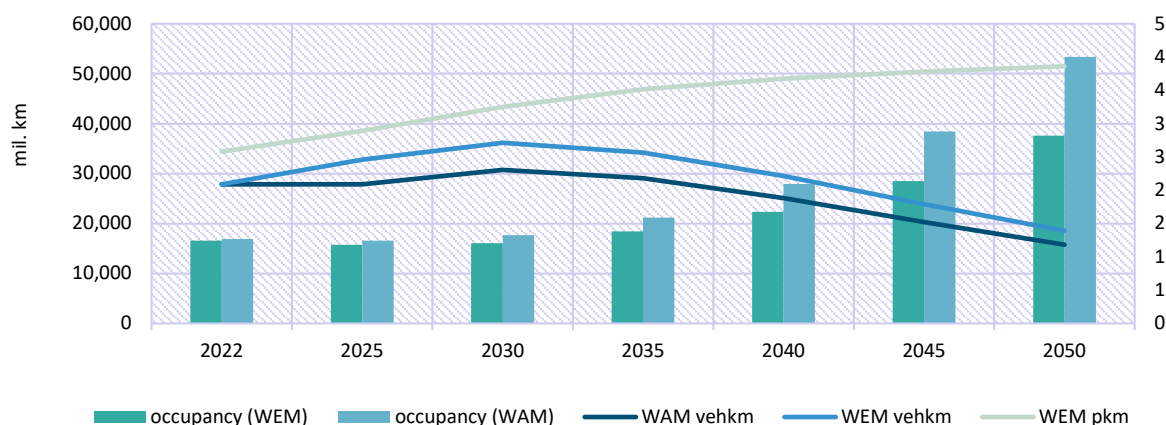
Stricter technical and emission inspections should result in the capture and removal of the oldest and non-compliant vehicles from transport. Strict rules are now in place for technical and emission inspection stations, but despite these measures, there is still circumvention of the rules. According to some research, there can be up to 60% of tampered heavy-duty vehicles. This measure is expected to have a gradually diminishing effect under the influence of positive changes in the behaviour of vehicle owners. In the model, this measure manifests itself as a change in the age structure of the passenger car fleet.

Modal shift in passenger transport implies a shift of passengers from passenger vehicle transport to public passenger transport (PPT) or cycling in cities. As a result, the occupancy rate of passenger vehicles is expected to increase by 50% compared to 2022, reducing in particular the number of kilometres travelled by passenger vehicles up to 33% by 2050. The transfer of passengers to the PPT will go in two directions at the same time: road PPT and rail PPT. In the case of the rail PPT, it is expected that there will be an improvement in the quality of transport as well as the restoration of several railway connections. The prerequisite for this is the approved new Transport Service Plan for railway passenger transport. In the case of bus services, it is expected that there will be a slight increase in kilometres travelled. This effect on public bus services was reflected in a 10% increase in average annual mileage.

For shorter distances and in the city, it is also possible to use bicycle transport in addition to PPT. This possibility should also result from the National Strategy for the Development of Cycling Transport and Cycling Tourism in the Slovak Republic. It is estimated that it could reduce the share of road passenger transport in cities up to 10% by 2030. For the purposes of the projections, more conservative estimates of 6% have been used (3% for the traffic peak and 3% for off-peak traffic).

The input data are pkm (person-km), which is a macroeconomic indicator from the CPS+ model for the Low Carbon Development Strategy of the Slovak Republic. From this data, the vehicle occupancy was then calculated, to which the increased occupancy was applied. It was then possible to calculate the new mileage with increased vehicle occupancy while maintaining passenger kilometres ([Figure 8.2.25](#)).

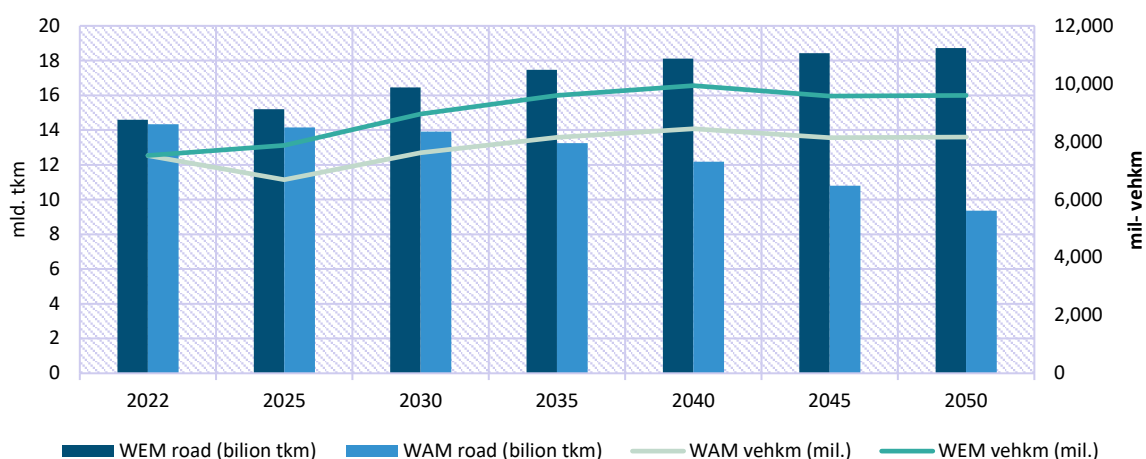
Figure 8.2.25: Changes in passenger vehicle occupancy, annual passenger vehicle miles travelled, and passenger vehicle miles travelled by the CPS+ model



Modal shift in freight transport or the movement of goods in Slovakia, is currently mainly carried out by freight road transport. From this point of view, modal shift in freight transport is more than necessary. According to the freight modal shift policy, the volume of goods transported by trucks is expected to decrease by 50% by 2050. This goal is foreseen in the Low Carbon Development Strategy of the Slovak Republic. As a consequence of shifting some of the goods to the railways, the annual vehicle mileage will be reduced, and ultimately, the number of trucks will also be reduced. A possible reduction in the number of trucks has not been estimated, as the WAM scenario currently only assumes a reduction in annual mileage.

The calculation procedure is analogous to the modal shift in passenger transport. In this case, tonne-kilometres (tkm) play a role, which were also obtained from the CPS+ model for the Low Carbon Development Strategy of the Slovak Republic as a macroeconomic indicator ([Figure 9.26](#)).

Figure 8.2.26: Changes in freight transport, annual boarding and goods transported by road and rail (billion tkm)



The most effective measure in this scenario appears to be the phasing out of fossil-fuelled cars and light-commercial vehicles and their replacement by electric and hydrogen vehicles, especially for last mile goods movements. A complete ban on the sale of these pure fossil fuel vehicles (diesel and petrol) is due to take place in 2035. This measure will result in an exponential growth of BEVs in the light-

commercial vehicle category. This measure will also be facilitated by the introduction of low-emission zones in cities.

The introduction of hydrogen passenger vehicles, similar to trucks, was estimated in the European Hydrogen Strategy report to reach a maximum possible implementation rate of 20% of the vehicle fleet by 2050. In Slovakia, this level is reduced to 10% in the WAM scenario following a consensus of experts in the field.

The addition of bio-based methane (bio-methane) to vehicle fuels is now common practice in other EU countries. In Slovakia, this obligation will be introduced by the amendment of Act N. 309/2009 on the Promotion of Renewable Energy Sources and High Efficiency Combined Production. This amendment introduces an obligation to add a bio-component to compressed natural gas (CNG) and liquefied natural gas (LNG) from 2023.

Table 8.2.18: Determinations of the minimum energy content of this bio-ingredient

2023	2024	2025	2026	2027	2028	2029	2030
2.0%	3.0%	4.0%	6.0%	8.0%	10.0%	12.0%	14.0%

Even at the highest achievable share in 2030 (14% of the bio-based component), this does not have a significant reduction impact on emissions and traffic intensity in the scenario.

8.2.6.4 Emission Projections in Road Transport

NOx emissions

The NOx emissions are continuously decreasing (Figure 8.2.27), and according to the WEM scenario, 65% of the remaining emissions in 2050 are from freight transport. The decrease in emissions is based on fleet turnover towards newer technologies (EURO 6 D/E and EURO 7), but with only a minor inclination towards alternative fuels. On the other hand, the WAM scenario shows a higher diversification of fuel technologies and a significant reduction in emissions by 2050. (Figure 9.28)

Figure 8.2.27: Historical emissions and projections of NOx emissions according to the WEM scenario

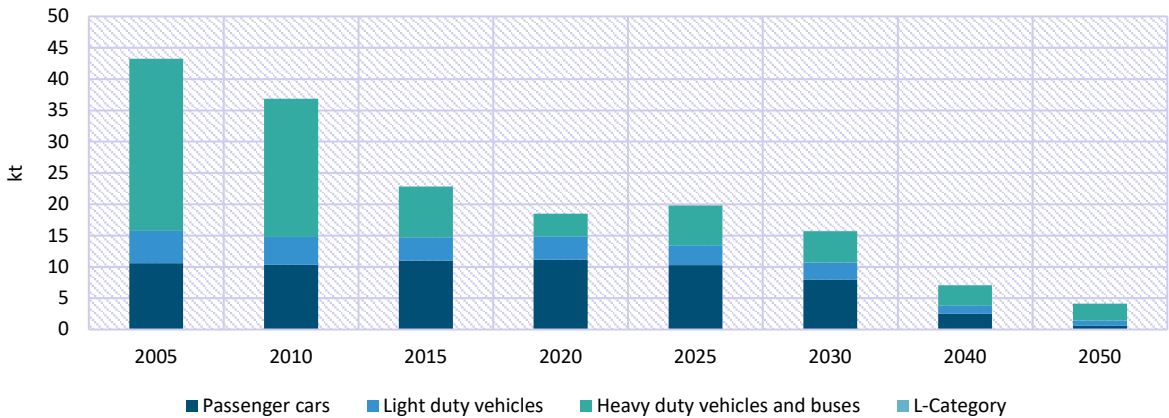
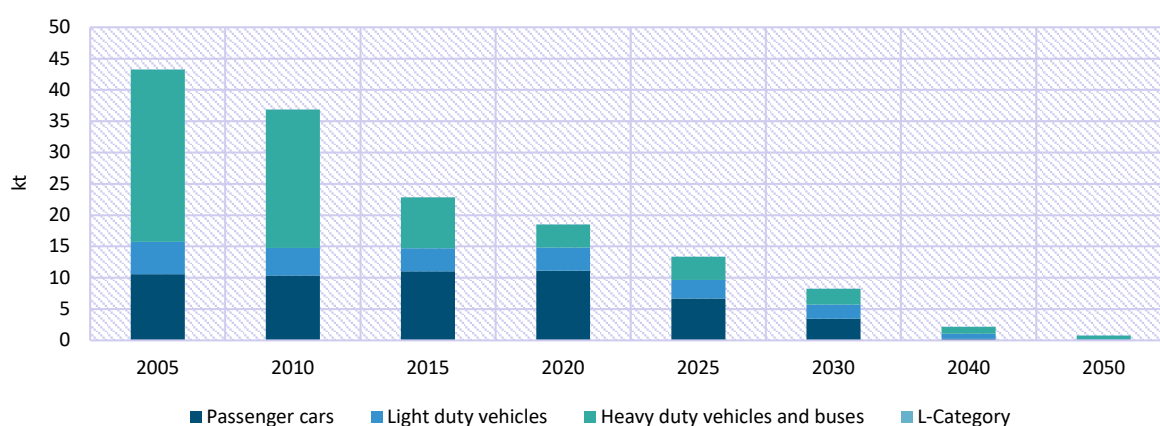


Figure 8.2.28: Historical emissions and projections of NO_x emissions according to the WAM scenario



PM_{2.5} emissions

Most of the PM_{2.5} emissions come from tyre and brake wear abrasion, and road abrasion. Reduction of these emissions is possible only by decreasing the total traffic. In the WAM scenario ([Figure 8.2.29](#)), these emissions from electric and fuel cell electric vehicles are accounted for in the vehicle category since the COPERT model is currently unable to distinguish between exhaust and non-exhaust emissions for new vehicle categories. Even though the total emissions are 50% lower than the emissions in the WEM scenario ([Figure 8.2.30](#)).

A fraction of PM is also reported as black carbon (BC). There is a slight increase in these emissions in the WAM scenario from passenger cars. This increase is a result of the aforementioned missing capability of the COPERT model and higher average mileage. In the WAM scenario, it is assumed that there will be a more radical turnover of the vehicle fleet, which temporarily increases the total mileage of the fleet. BC is calculated as a fraction of PM_{2.5}, and these emissions come not only from exhaust emissions but also from brake and tyre wear and road abrasion. The emissions from the last source depend only on the total mileage of the vehicle fleet, these emissions will be temporarily higher. With the predicted decrease in traffic after 2030, the emissions of PM_{2.5} and BC will also decrease.

Figure 8.2.29: Historical emissions and projections of PM_{2.5} emissions according to the WEM scenario

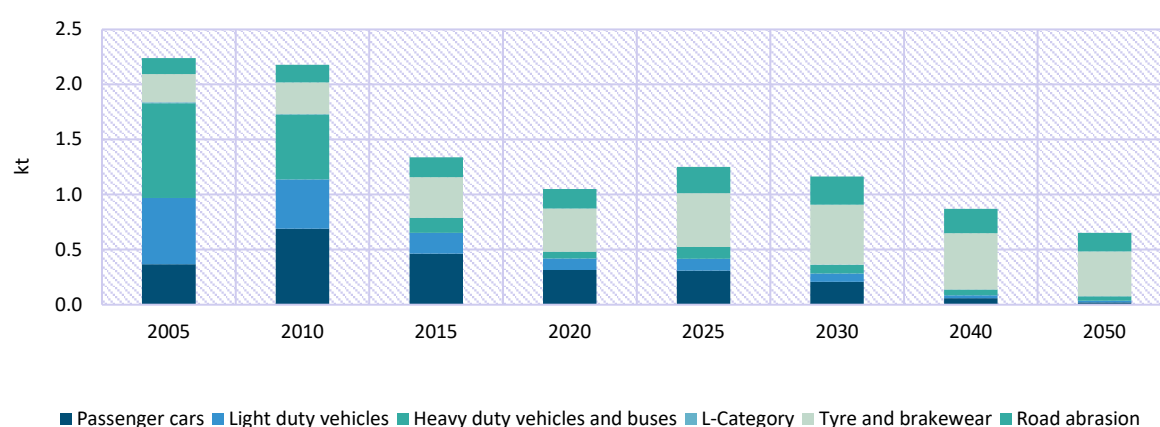
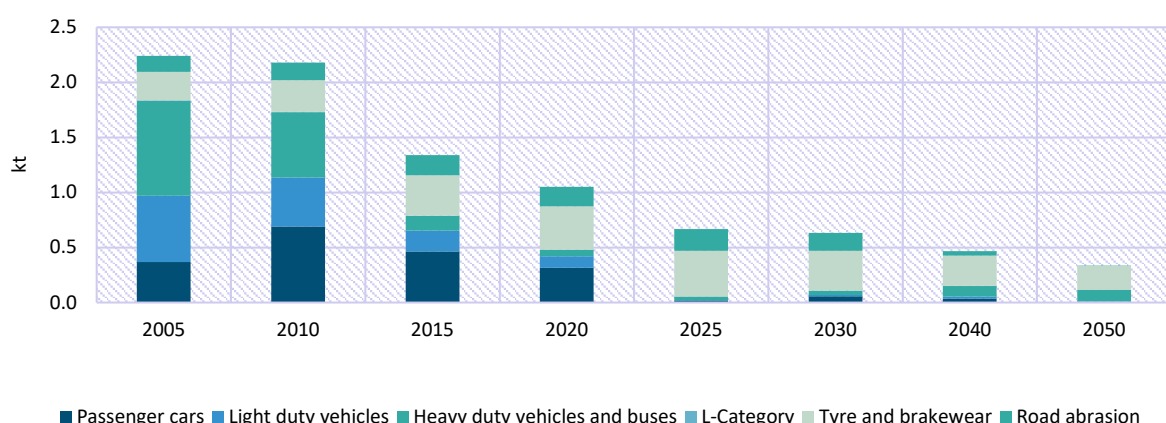


Figure 8.2.30: Historical emissions and projections of PM_{2.5} emissions according to the WAM scenario



NM VOC emissions

The most important source of NMVOC emissions from road transport is gasoline evaporation from passenger cars. These emissions depend on the technological advantage of the vehicle and the ambient temperature. There is a predicted decrease in NMVOC emissions in the WEM scenario, but only a slight change in the ratio between the two major categories (**Figure 8.2.31**). In the WAM scenario (**Figure 8.2.32**), passenger cars (17 %) and gasoline evaporation (79 %) are responsible for 97% of NMVOC emissions in 2030, while in 2050, 82% of NMVOC emissions come from gasoline evaporation. At the same time, there is a significant decrease in these emissions, which is caused by the electrification of road transport.

Figure 8.2.31: Historical emissions and projections of NMVOC emissions according to the WEM scenario

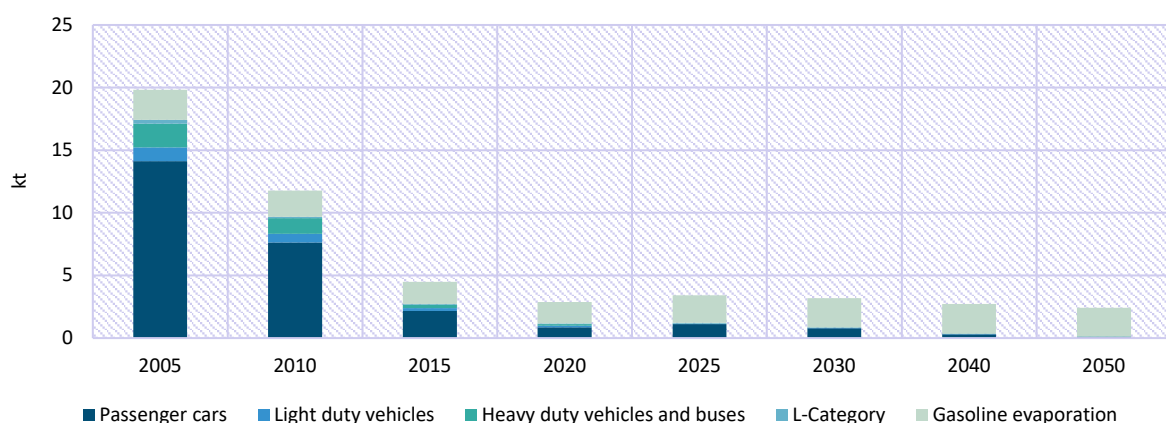
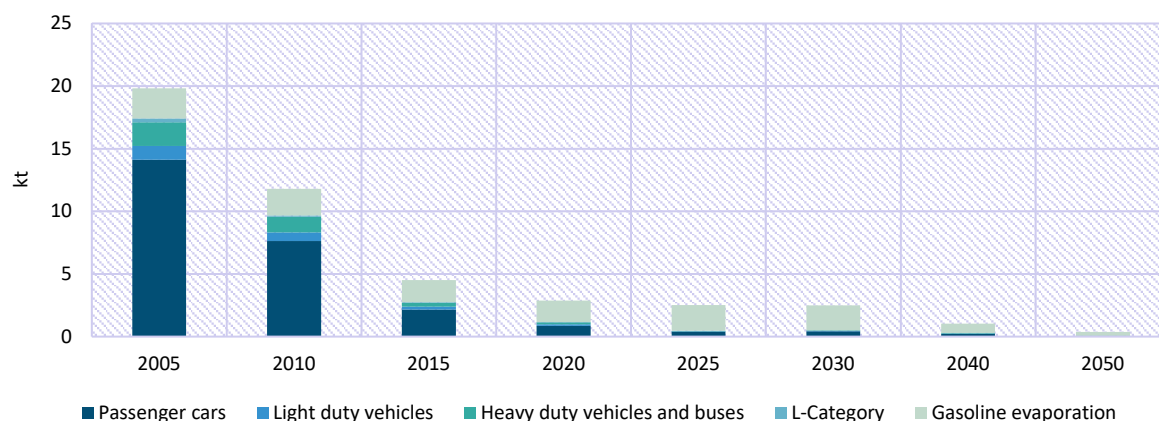


Figure 8.2.32: Historical emissions and projections of NMVOC emissions according to the WAM scenario



SOx emissions

Sulphur oxide emissions significantly decreased after 2005 as a result of banning high-sulphur content fuels. These emissions depend on the fuel consumption, and in the WEM scenario ([Figure 8.2.33](#)), a decrease in SOx is assumed after 2030. The tipping point of SOx in the WAM scenario ([Figure 8.2.34](#)) is assumed to be much earlier, around the year 2025.

Figure 8.2.33: Historical emissions and projections of SOx emissions according to the WEM scenario

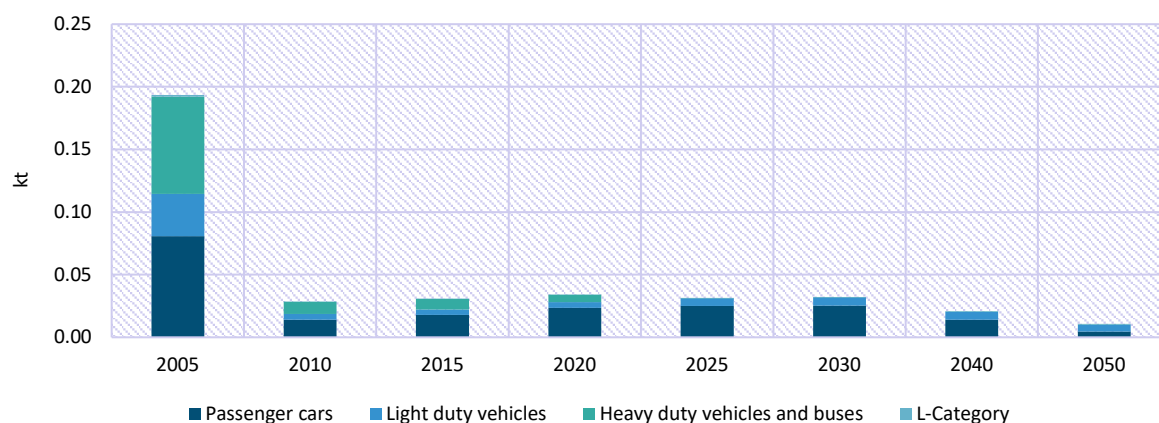
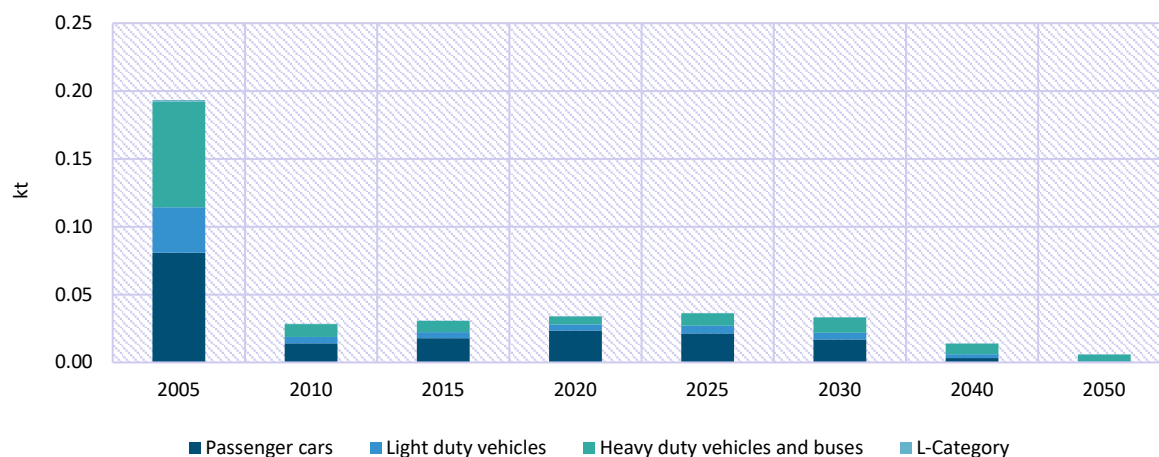


Figure 8.2.34: Historical emissions and projections of SOx emissions according to the WAM scenario



NH₃ emissions

Ammonia emission trends are mainly a result of a phenomenon known as "emission control technology rebound" or "emission shifting." This phenomenon slows down the possible reduction of ammonia emissions in road transport. This will cause the ammonia emission according to the WEM scenario to stay at the same level as in 2020 (**Figure 8.2.35**). In the WAM scenario (**Figure 8.2.36**), alternative fuels (electricity and hydrogen) are introduced, and ammonia emissions will fall to 35% of the emissions compared to the WEM scenario by 2050.

Figure 8.2.35: Historical emissions and projections of NH₃ emissions according to the WEM scenario

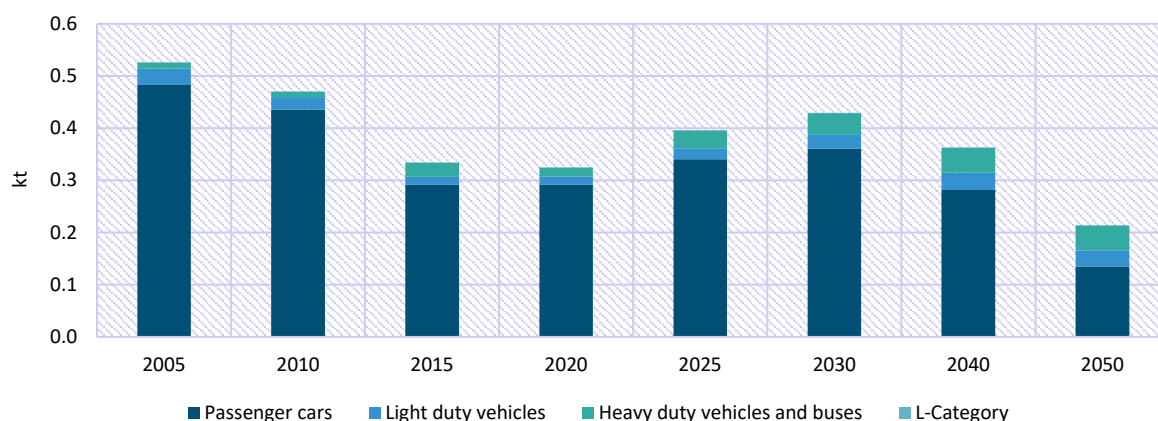
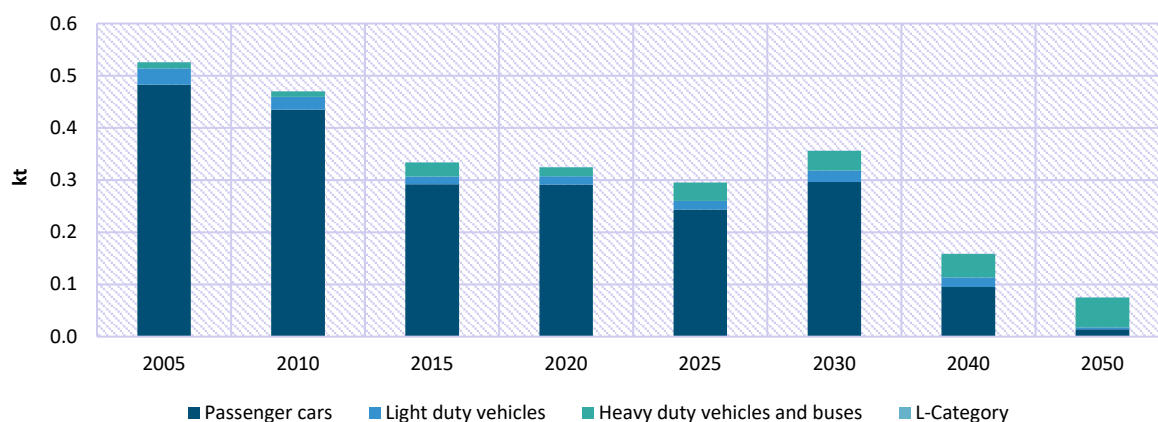


Figure 8.2.36: Historical emissions and projections of NH₃ emissions according to the WAM scenario



8.2.6.5 Emission Projections in other Transport Categories (1A3.a, c, d, e)

In addition, projections of air pollutants from non-road transport in the Slovak Republic have been prepared (according to **Recommendation No. SK-1A3a,c,d,e-2021-0004**), but their relevance is currently negligible compared to overall air pollution emission projections, so only the WEM scenario has been prepared. The highest ratio of non-road transport has the NO_x with a 12% share (excluding SO_x as these emissions from the whole transport are negligible). Projections of non-road emissions were calculated using ARIMA (AutoRegressive Integrated Moving Average) modelling. Emissions from pipeline transport have been prepared based on information about projections of long-distance transmission of natural gas through the pipeline system. The outcomes are in **Tables 8.2.10 – 8.2.14**.

8.2.7 Emission Projections in the IPPU Sector

8.2.7.1 Methodologies and Key Assumptions/Trends

Emission projections from industrial processes (IPPU) primarily arise from non-combustion activities. A core assumption for the sector remains the durability of equipment and availability of raw materials, with GDP trends continuing to drive production demand. While emission reductions are typically tied to declines in output, modernisation and decarbonisation measures now offer pathways to cut emissions without sacrificing productivity. In Slovakia, iron and steel production remains the largest contributor to IPPU emissions.

Slovakia's metal production sector, deeply rooted in its industrial history, has rebounded post-pandemic. After a 40% production drop in 2020 due to COVID-19, output stabilised by 2022, aligning with pre-pandemic levels. However, geopolitical tensions (e.g., the Ukraine conflict) and energy market volatility in 2022 introduced new challenges, including rising natural gas prices and supply chain disruptions. Despite this, the sector aims to maintain production through investments in electric arc furnaces (EAFs) and phased closure of coke batteries and sinter plants.

In the iron and steel sector, it is possible to reduce **AP** emissions by reducing the consumption of coke as a fuel for energy processes and as a reducing agent in blast furnaces. However, this would result in a reduction in steel production and hence economic problems for the region. One of the most recent measures in the iron and steel sector is electric arc furnaces (**EAF**) or **Phase-out Coke battery alongside with Sinter production decommissioning**. The current set of measures foresees investments in technology, which should lead to significant emission savings in the sector.

The share of enterprises in the non-metallic and chemical industries is also significant. One of the most effective measures in reducing emissions in the non-metallic industry is waste recovery. Specific waste mineral wastes can, by their chemical composition, replace natural raw materials such as limestone or clay that must be extracted from nature. Many of them also contribute to reducing emissions of air pollutants. Waste recovery (e.g., using mineral by-products to replace limestone/clay) remains a top measure, cutting both raw material extraction and PM/SO_x emissions.

The trend in the chemical industry is influenced by various segments. Slovakia has a strong tradition in all major segments of the chemical industry, including oil refining, fertilizer production, and rubber and plastics. The product portfolio is also influenced by the strong automotive and electronics sectors in Slovakia, which serve as regular high-capacity clients for various companies in the chemicals and plastics industries.

No closure of existing chemical facilities is currently anticipated or planned. As regards the trend in emissions from the chemical industry, it is expected to be constant, and no significant decrease is foreseen. However, the largest reductions in this sector could be due to reductions in the production or consumption of fuels by cars and trucks, or reductions in the consumption of artificial fertilisers in agriculture. By transforming the production of petroleum-based fuels to the production of green hydrogen as a fuel using RES, or by producing more advanced biofuels and bioplastics.

Sectors **2D** and **2G** are key sources for NMVOC emissions. The calculations of emission projections are based on following parameters: gross value added for relevant sector, expected population trend and extrapolation of trends from the past. Since these are key categories, in the future it will be necessary to improve the methodology for calculating emissions projections.

8.2.7.2 Model Description

Model description used for the EU ETS part of IPPU emissions (large sources of technological emissions) is provided in [Chapter 8.2.5](#). MS Excel tools were used for modelling emission projections in the sources outside of the EU ETS system. Emission projections were prepared in accordance with the methodology of the **EMEP/EEA air pollutant emission inventory guidebook 2023**. The calculation analysis tool is based on the Excel platform, and the calculation includes different policies and measures (in numerical formulation) defined according to the WEM and WAM scenarios. The model that was developed in connection with the implementation of Regulation (EU) 2018/841 (35) of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU.

8.2.7.3 Scenarios, Parameters and PAMs

The IPPU sector allocates emissions from sources regulated by the EU ETS Directive 2003/87/EC (12) of the European Parliament and of the Council and non-EU ETS sources (ESR).

While EU ETS emissions have their reduction mechanisms set by the allocation of allowances at the operator level, ESR emissions are not sectorally regulated, and the ESR reduction target is set only at the level of the country as a whole. It is therefore very important to identify potential areas for reduction, regulation or promotion. This sector accounts for process (technological) emissions, i.e. not emissions from fossil fuel combustion (which are accounted for in the Energy or Buildings sectors).

ESR emissions in categories [2A2-2I](#) were mainly prepared by forecasting the development of value added for the identified industrial category, and also based on population trends. In the absence of relevant direct policies and measures in these sectors, it is very difficult to predict developments up to 2050. It is likely to be influenced only by the availability of raw materials, energy and material prices, and supply and demand. We foresee regulation mainly at the EU level. The nature of process (technological) emissions does not allow much room for manoeuvre for their regulation (they are dependent on chemical reactions and processes).

The base (reference) year for modelling the AP emission projections was the latest revised inventory year 2022 in all scenarios.

Projections of air pollutants emissions for the EU ETS emissions component have been developed for the years 2022–2050 under the following scenarios:

Two scenarios, **WEM** and **WAM**, have been prepared for the purpose of determining the target for 2030 and subsequently for 2050 in the different categories of industrial activities.

The data sources: The NEIS database of stationary large and medium sources of air pollution, providing facility data for nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), sulphur oxides (SO_x), ammonia (NH₃), total suspended particles (TSP, PM₁₀ and PM_{2.5} are consequently compiled) and carbon monoxide (CO). All data that comes from the database is considered as T3 methodology.

The policies and measures taken into account in each scenario are based on a number of national documents:

- Low Carbon Development Strategy of the Slovak Republic until 2030 with a view to 2050 (NUS SR) (23)
- National Air Pollution Control Programme (**NAPCP**) (25)
- Integrated National Energy and Climate Plan of Slovakia (**NECP**) (27)

In addition to these documents, separate laws and European legislation also intervene in the preparation of individual scenarios. Act No 277/2020 Coll. (30), which amends Act No 309/2009 Coll. on the Promotion of Renewable Energy Sources and High Efficiency Combined Production, significantly interferes with the preparation of laws. Within the framework of common European legislation, these are mainly directives setting emission limits and the European Parliament's Energy Union Governance Regulation 2018/1999 (31), complemented by Regulation 2021/1119 (32), which establishes a framework for achieving climate neutrality.

The policies and measures used were taken from the Low Carbon Strategy of the Slovak Republic (LCDS), from the National Air Pollution Control Programme, and from the Slovak Recovery Plan.

The reduction potential presented is based on the WEM and WAM scenarios reported for emission projections in 2021 under Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action.

The specification of the WAM scenario according to the Low Carbon Development Strategy of the Slovak Republic depends on the logic of the draft EU scenarios and in particular, on the EUCO3030 scenario, which sets the EU target for energy efficiency for 2030 at 30%.

Most of the above measures were applied at the level of the CPS-PRIMES model, from which trends in energy consumption or other parameters were taken for modelling emissions in the TIMES model.

Existing Measures Scenario (WEM) - includes policies and measures adopted and implemented at EU and national level by the end of 2021. In industrial processes, improving energy efficiency is essential for productivity growth, which is part of sustainable growth in added value.

The scenario with additional measures (WAM) is equivalent to the Dcarb2 scenario of the CPS-PRIMES model. In the IPPU sector, the outputs from CPS-PRIMES were used to obtain trends in the different industry types.

The trend of emission projections below the ESR in categories **2A** to **2I** is very complicated to express due to the lack of legislative and market mechanisms, which are mainly driven by energy policy. The trend of emission projections depends on the technologies used, which are mainly influenced by the EU ETS Directive; therefore, emission reductions cannot be expected as production grows.

8.2.7.4 Emission Projections in the IPPU Sector

The modelling of emission projections in the IPPU sector was based on sectoral trends and development from the CPS model, and actualisation was made by taking into account the results of the model TIMES-Slovakia and new information from producers. Significant impact has been planned for new installations in steel production.

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 are recorded in the NEIS database and cannot, in some cases, be 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).

Mineral Industry

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**). 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.

Chemical Products

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. Emissions of NO_x originate mostly from category 2B10a, which includes the production of various organic and inorganic compounds, fertilizers etc.

Metal Production

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). The major contributors to emissions of main pollutants are Iron and steel production 2C1.

Solvents and Other Product Use

The sector solvents, covers NFR categories 2D3a, 2D3b, 2D3c, 2D3d, 2D3e, 2D3f, 2D3g, 2D3h, 2D3i and 2G. Categories 2D3b and 2D3c are relevant emissions of PMs and TSP. 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

Other Processes

The category is divided into 3 industrial activities: Pulp and paper industry (2H1), Food and beverages industry (2H2) and other industrial processes (2H3).

Wood Processing

The present chapter 2I 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 and NMVOC.

NO_x emissions

The NO_x emission projections in the IPPU sector are mostly driven by the EU ETS emissions from metal production, in addition to the chemical industry. The trends according to the WEM and WAM scenarios are provided in **Table 8.2.19**.

Table 8.2.19: NO_x emissions in the Industry sector

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
2A	0.45	0.33	0.23	0.29	0.31	0.34	0.34	0.35	0.35
2B	0.75	0.52	0.79	0.86	0.75	0.83	0.83	0.78	0.72
2C	4.90	4.86	5.01	4.19	3.90	4.11	4.11	4.13	4.14
2D, G, H	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
2 I,J,K,L	0.32	0.08	0.22	0.23	0.22	0.20	0.20	0.20	0.20
2 Industry	6.44	5.80	6.27	5.60	5.19	5.51	5.51	5.48	5.43

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
2A	0.45	0.33	0.23	0.29	0.31	0.31	0.31	0.31	0.32
2B	0.75	0.52	0.79	0.86	0.75	0.79	0.79	0.61	0.50
2C	4.90	4.86	5.01	4.19	3.90	4.11	1.19	1.19	1.17
2D, G, H	0.01	0.02	0.02	0.00	0.00	0.02	0.02	0.02	0.02
2 I,J,K,L	0.32	0.08	0.22	0.23	0.00	0.20	0.20	0.20	0.20
2 Industry	6.44	5.80	6.27	5.58	4.96	5.44	2.51	2.33	2.21

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

NM VOC emissions

NM VOC emission projections in the IPPU sector arise mainly from Coating applications, Domestic solvent use and Degreasing. Significant impact has also Food and beverage industry. The trends according to the WEM and WAM scenarios are provided in [Table 8.2.20](#).

Table 8.2.20 NM VOC emissions in the Industry sector

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
2A	0.16	0.05	0.07	0.09	0.15	0.16	0.16	0.17	0.17
2B	3.17	1.99	2.20	2.10	2.03	2.11	2.11	2.00	1.82
2C	0.78	0.66	0.79	0.69	0.67	0.74	0.74	0.74	0.75
2D, G, H	35.12	26.19	29.76	24.87	22.13	22.04	22.04	21.52	21.10
2 I,J,K,L	0.40	0.22	0.50	0.52	0.63	0.59	0.59	0.59	0.59
2 Industry	39.63	29.12	33.33	28.26	25.60	25.64	25.64	25.01	24.42

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
2A	0.16	0.05	0.07	0.09	0.15	0.15	0.15	0.15	0.15
2B	3.17	1.99	2.20	2.10	2.03	1.99	1.97	1.44	1.10
2C	0.78	0.66	0.79	0.69	0.67	1.97	0.37	0.38	0.38
2D, G, H	35.12	26.19	29.76	24.87	22.13	20.58	19.35	18.22	17.88
2 I,J,K,L	0.40	0.22	0.50	0.52	0.63	0.59	0.59	0.59	0.59
2 Industry	39.63	29.12	33.33	28.26	25.60	25.29	22.44	20.78	20.10

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

SO_x emissions

The SO_x emission projections in the IPPU sector are mostly driven by the emissions from metal production, and in addition to the chemical industry. The trends according to the WEM and WAM scenarios are provided in [Table 8.2.21](#).

Table 8.2.21: SO_x emissions in the Industry sector

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
2A	0.50	0.33	0.36	0.45	0.35	0.38	0.38	0.39	0.39
2B	1.08	1.20	1.37	1.27	1.50	1.58	1.58	1.43	1.22
2C	9.85	5.77	7.32	4.91	2.82	2.33	2.33	2.34	2.35
2D, G, H	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03
2 I,J,K,L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 Industry	11.45	7.33	9.08	6.65	4.70	4.32	4.32	4.19	3.99

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050

2A	0.50	0.33	0.36	0.45	0.35	0.34	0.34	0.35	0.35
2B	1.08	1.20	1.37	1.27	1.50	1.49	1.44	0.87	0.50
2C	9.85	5.77	7.32	4.91	2.82	2.33	0.83	0.82	0.81
2D, G, H	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03
2 I,J,K,L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 Industry	11.45	7.33	9.08	6.65	4.70	4.19	2.64	2.07	1.69

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

NH₃ emissions

The NH₃ emission projections in the IPPU sector are, in general, negligible; the largest share comes from the chemical industry, primarily from Nitric Acid and Calcium Carbide. The trends of emissions are provided in [Table 8.2.22](#), and both scenarios are projected based on sectoral value added, respectively, projected demand.

Table 8.2.22: NH₃ emissions in the Industry sector

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
2A	0.00	0.01	0.02	0.03	0.07	0.07	0.07	0.08	0.08
2B	0.22	0.07	0.09	0.20	0.12	0.13	0.13	0.11	0.10
2C	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
2D, G, H	0.03	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04
2 I,J,K,L	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2 Industry	0.26	0.12	0.16	0.26	0.23	0.25	0.25	0.23	0.22

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
2A	0.00	0.01	0.02	0.03	0.07	0.07	0.07	0.07	0.07
2B	0.22	0.07	0.09	0.20	0.12	0.12	0.11	0.07	0.04
2C	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
2D, G, H	0.03	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04
2 I,J,K,L	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2 Industry	0.26	0.12	0.16	0.26	0.23	0.23	0.23	0.18	0.15

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

PM_{2.5} emissions

The PM_{2.5} emission projections in the IPPU sector do not have a significant source, and also their shares in the national totals are very small. The trends of emissions are provided in [Table 8.2.23](#).

Table 8.2.23: PM_{2.5} emissions in the Industry sector

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
2A	0.38	0.16	0.17	0.11	0.11	0.15	0.15	0.16	0.16
2B	0.20	0.08	0.15	0.08	0.04	0.09	0.09	0.09	0.08
2C	0.63	0.40	0.45	0.21	0.17	0.11	0.11	0.11	0.11
2D, G, H	0.23	0.26	0.24	0.23	0.25	0.26	0.26	0.25	0.25
2 I,J,K,L	0.03	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01
2 Industry	1.47	0.91	1.02	0.64	0.59	0.61	0.61	0.61	0.60

WAM	2005	2010	2015	2020	2022*	2025	2030	2030	2030
2A	0.38	0.16	0.17	0.11	0.11	0.14	0.14	0.15	0.15
2B	0.20	0.08	0.15	0.08	0.04	0.08	0.08	0.07	0.05

WAM	2005	2010	2015	2020	2022*	2025	2030	2030	2030
2C	0.63	0.40	0.45	0.21	0.17	0.10	0.08	0.08	0.08
2D, G, H	0.23	0.26	0.24	0.23	0.25	0.26	0.26	0.25	0.25
2 I,J,K,L	0.03	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01
2 Industry	1.47	0.91	1.02	0.64	0.59	0.59	0.57	0.55	0.53

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

Air Pollutant Emissions from Iron and Steel Production

Industrial processes in Slovakia have long been dominated by traditional sectors, including metallurgy, iron and steel production, coke and refined petroleum product manufacturing, chemical production, paper/pulp industries, food processing, mineral product manufacturing, and related activities. This sector also encompasses solvent use and other product applications (e.g., pyrotechnics). SOx emissions primarily originate from iron and steel production (22% in 2022) and aluminium manufacturing (nearly 15%, with additional contributions from oil refining).

The metal processing industry remains the largest contributor. While PM_{2.5} emissions have shown a declining trend, the IPPU (Industrial Processes and Product Use) sector contributes minimally to these emissions. However, under the WAM (With Additional Measures) scenario, significant reductions in AP (Air Pollutant) emissions – particularly SOx from fuel refining and CO from coke production – are anticipated through:

- Decommissioning of coke oven batteries
- Cessation of sinter production
- Reduced petroleum processing aligned with transport sector decarbonisation pathways

Air Pollutant Emissions from Mineral Production

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 utilise alternative fuels (refuse-derived fuel – RDF and used tyres, sludge, fly ash, beef and bone meal or similarly categorised fuel waste) and raw materials for energy and resource recovery. The plant provides a yearly report on types and amounts of alternative fuel used.

Cement production is a major contributor to industrial air pollution, releasing particulate matter (PM), nitrogen oxides (NOx), sulfur dioxide (SO₂), and non-volatile organic compounds (NMVOCs). In Slovakia, this sector is critical for meeting infrastructure demands but requires stringent emission controls to align with EU air quality standards.

Replacement of an existing electrostatic precipitator by a bag textile filter, including reconstruction and modification of the housing and connecting pipes, installation of new internal parts of the filter, compressed air regeneration system and necessary auxiliaries. The bag filter will significantly reduce electricity consumption compared to the electrostatic filter and can achieve the lowest dust particle limits defined by the BAT Directive for cement production.

WAM Scenario cuts emissions by 30–35% through alternative fuels (Biomass) and reduction of refinery coke and waste. It concerns mainly NOx, CO and SOx. The installation of DECONOX is related to the reduction of organic carbon emissions (TOCs), the reduction of carbon monoxide (CO) emissions and the reduction of nitrogen oxides (NOx) emissions, which mainly come from alternative raw materials. The installation of the equipment will make it possible to reach the lowest limits defined by the BAT Directive for cement production.

Slovakia's cement industry faces dual challenges: meeting production demands while reducing air pollutants. The WAM scenario provides that alternative raw materials (e.g., blast furnace slag) could reduce process emissions by 20% in 2050 compared to 2022.

Air Pollutant Emissions from Chemical Production

Chemical production also has a long-term presence in the Slovak industry, e.g. production of urea, nitric acid, mineral fertilizers (Duslo, a. s.) and various other chemicals (FORTISCHEM, a. s.). This category is not one of the most significant sources of pollutant emissions.

Nitric acid production consumes approximately 20% of all ammonia produced. The production volume increased in 2022 compared to 2021; despite this, a decrease in N₂O emissions of approximately 16% was recorded, thanks to the use of secondary YARA catalysts. In this category, the WAM scenario does not include any fundamental measures to reduce air pollutants. One of the measures in future projections may be the so-called green hydrogen, which will replace natural gas as a raw material in the production of ammonia and the installation of catalytic systems for the decomposition of N₂O in the production of nitric acid. Both scenarios are quite conservative due to conservative assumptions over almost all sectors. Use of BAT technologies in industry represents only a significant measure in this sector.

Air Pollutant Emissions from use of Solvents

A significant influence on emissions in this area is the volume of production. HFCs (hydrofluorocarbons) and SF₆ (sulfur hexafluoride) are the fastest-growing emissions in this sector, resulting from industrial demand for these substances in construction, building insulation, electrical engineering, and the automotive industry.

Production volumes critically influence sectoral emissions. HFCs (hydrofluorocarbons) and SF₆ (sulfur hexafluoride) represent the fastest-growing emission categories, driven by industrial demand for these substances in:

- Construction (thermal insulation)
- Electrical engineering (switchgear manufacturing)
- Automotive industry (air conditioning systems)

The use of solvents is a significant source of emissions. A wide range of substances is used in both industry and households, which also contain non-methane volatile organic compounds (NMVOC), leading to NMVOC emissions. These include pure organic solvents or various mixtures used in industry, cleaning agents, paints, thinners, adhesives, cosmetics, toiletries, and various household or automotive care products. Emissions from road asphalt application are also included. The versatile use of these substances leads to complex tracking of their flows. Some categories are estimated (particularly emissions from household products). NMVOC emission projections in the IPPU sector arise mainly from the Coating applications, Domestic solvent use and Degreasing. Significant impact has also Food and beverages industry. The trends according to the WEM and WAM scenarios are relatively stable, and we expect a slight decrease in accordance with BAT use.

Air Pollutant Emissions from Other Processes

The category is divided into 3 industrial activities: Pulp and paper industry (2H1), Food and beverages industry (2H2) and other industrial processes (2H3). Emissions of PMs and NH₃ have a decreasing trend due to the installation of abatement technologies on the plants during the time series. Emissions of

NO_x, NMVOC, SO_x and CO have a substantially increasing trend, but this category does not belong among key categories for the Slovak Republic, and both scenarios are based on sectoral value added.

Air Pollutant Emissions from Wood Processing

The category wood processing 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 PM_{2.5}, PM₁₀ and TSP. Emission projections in this category decrease slightly in general for both scenarios.

The following figures display the inventory and projection of the main pollutants:

Figure 8.2.37: Historical emissions and projections of NO_x emissions according to the WEM and WAM scenarios in the Industry sector

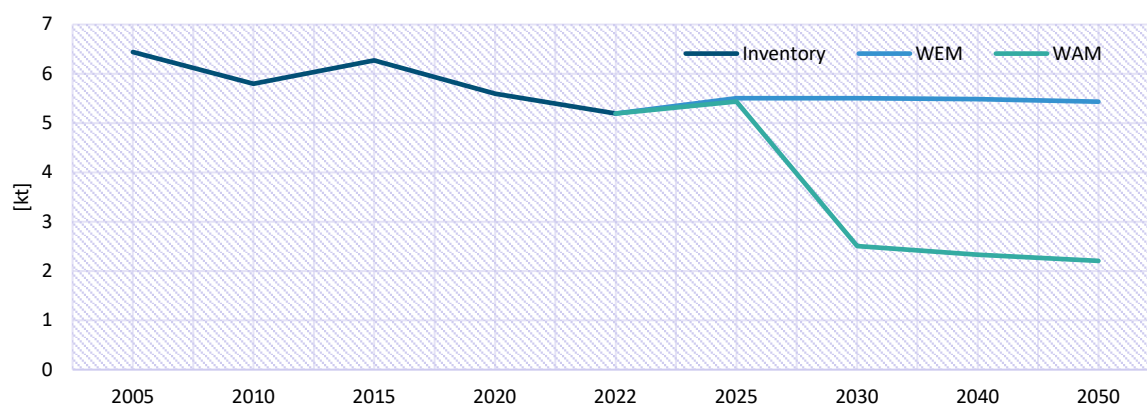


Figure 8.2.38: Historical emissions and projections of NMVOC emissions according to the WEM and WAM scenarios in the Industry sector

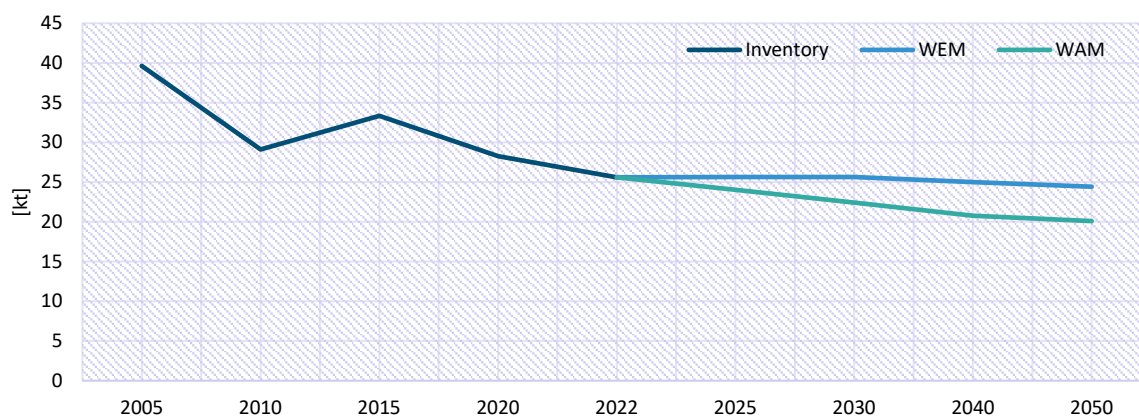


Figure 8.2.39: Historical emissions and projections of SO_x emissions according to the WEM and WAM scenarios in the Industry sector

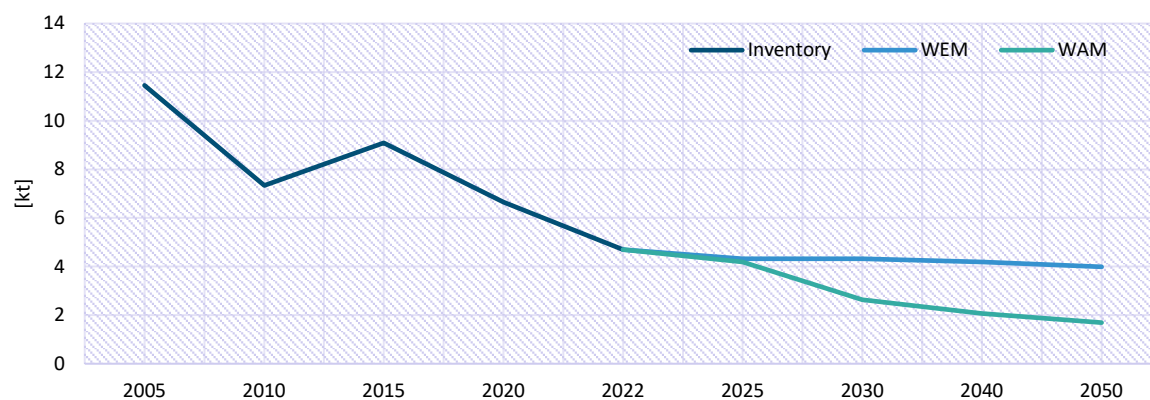


Figure 8.2.40: Historical emissions and projections of NH₃ emissions according to the WEM and WAM scenarios in the Industry sector

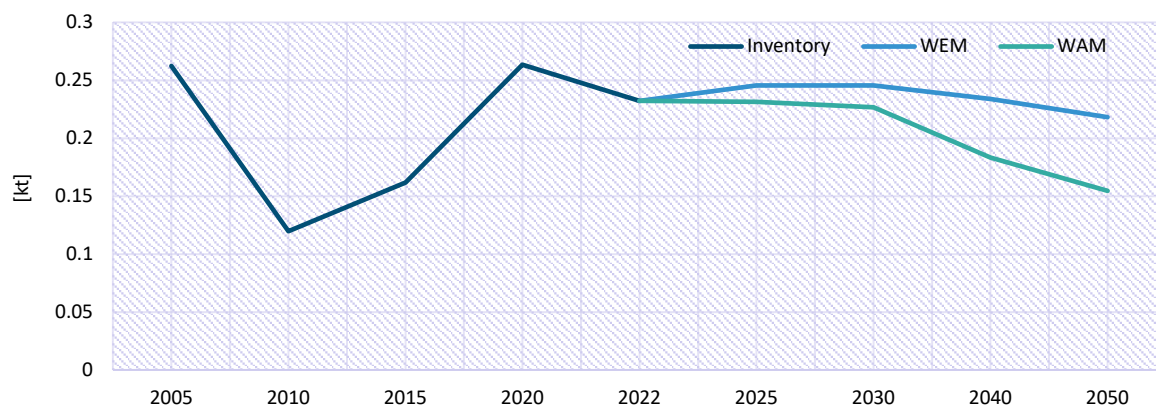
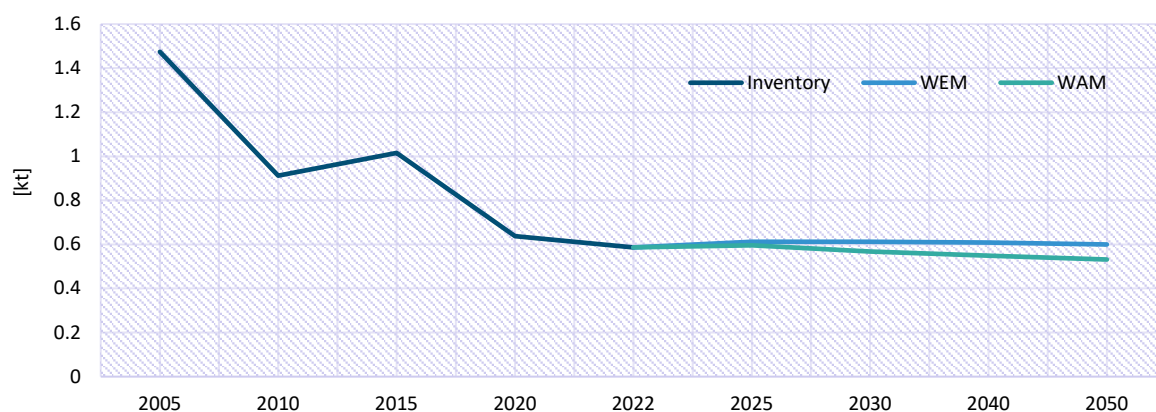


Figure 8.2.41: Historical emissions and projections of PM_{2.5} emissions according to the WEM and WAM scenarios in the Industry sector



8.2.8 Emission Projections in the Agriculture Sector

8.2.8.1 Methodologies and Key Assumptions/Trends

Emission calculation: The Slovak Hydrometeorological Institute compiles an annual emissions balance and uses emission factors according to the EMEP/EEA GB 2023. During the preparation of projected emissions of ammonia, the same input data, policies and measures were considered as in the preparation of projected GHG emissions. Emissions of NO_x and NH₃ from manure storage and application were estimated, taking into account the abatement 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 **3D** Agricultural soils are calculated with the Tier 2 methodology and emission factors for wet climate outlined in EMEP/EEA GB 2023. The same emissions factors were used for all years.

NMVOC was estimated 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 the Tier 2 methodology by EMEP/EEA GB 2023. NMVOC emissions from other animal categories were calculated using the Tier 1 methodology and emission factors outlined in the EMEP/EEA GB 2023. NMVOC emissions from Agricultural soils were calculated using the Tier 1 methodology and emission factors outlined in EMEP/EEA GB 2023.

The NH₃ and NO_x emission projections were estimated according to the EMEP/EEA GB 2023 Guidebook methodologies; the Slovak Republic did not use the specific model for forecasting emissions. NH₃ and NO_x emission projections were modelled following the Tier 2 approach based on analysing the nitrogen cycle. To prepare the model for agricultural emissions projections, it is necessary to obtain a wide range of input data and parameters along with their historical time series. (Selected activity data is available in the Annex of this report according to the NECD recommendation. Emissions projections have been modelled in various areas of the agricultural sector for different pollutants (NH₃, NMVOC, PM, NO_x, TSP).

The revision of projections was done due to new policies and measures, with calculated costs for the use of individual measures. The analysis was done in the National Food and Agriculture Centre and was conducted by the Ministry of Environment of the Slovak Republic. Emission projection revision was done in the Slovak Hydrometeorological Institute.

Activity data

The available time series of input data have varied lengths (the longest covering the period 1970-2022, the shortest covering the period 2003-2022) and were obtained from various sources (Green Report of the Slovak Republic, Statistical Office of the Slovak Republic, situational and outlook reports of NPPC-VÚEPP, Central Control and Testing Institute of Agriculture - ÚKSUP). This chapter was included based on **Recommendation No. SK-3B-2019- 0002** from National Air Pollution Projection Review.

The input data required for the preparation of projections are as follows:

- Number of cattle in the head (data available by regions for the period 1990-2022, source: Statistical Office of the Slovak Republic - ŠÚ SR)
- Number of pigs in the head (1990-2022, ŠÚ SR, data available by regions)
- Number of sheep in the head (1990-2022, ŠÚ SR, data available by regions)
- Number of poultry in the head (1990-2022, ŠÚ SR, data available by regions)
- Number of goats in the head (1990-2022, ŠÚ SR, data available by regions)

- Number of horses in the head (1990-2022, ŠÚ SR, data available by regions)
- Milk yield per cow - average annual milk yield per dairy cow in kilograms (1990-2019, ŠÚ SR, data available by regions)
- Milk yield per ewe - average annual milk yield per dairy ewe in kilograms (1990-2019, ŠÚ SR, data available by regions)
- Consumption of nitrogen fertilizers in tons (1990-2022, sources: IFASTAT and ÚKSUP), data available for Slovakia by types

The input data for the given time period were subsequently processed for use in preparing projections of parameters in Slovak agriculture for 2022-2040. The exponential smoothing model SAS 9.3 was modelled at the Research Institute of Agricultural and Food Economics in Bratislava (NPPC-VÚEPP). Subsequently, projections of input parameters such as livestock populations and quantities of applied organic and mineral fertilizers were calculated until 2040-2050 at the Slovak Hydrometeorological Institute (SHMÚ) using the exponential smoothing function in MS Excel's forecasting tool, Projections. The principle of exponential smoothing is an adaptive method for forecasting time series, which means that the values of parameters in the model change over time. The forecast is based on smoothing weights that assign different importance to individual observations. The most recent observations have the highest weight, exponentially decreasing to the past. The values of the weights are optimised by the statistical software itself.

Slovakia still uses the Grade 1 method in the 2023 submission due to the unavailability of public policies and strategies. In terms of data revision, SHMÚ conducted a review of livestock numbers and fertilizer consumption using exponential smoothing. The results underwent a thorough review process involving relevant ministries (Ministry of Environment of SR, Ministry of Agriculture and Rural Development of SR), research institutes (National Agriculture and Food System, Institute of Environmental Policy), and other entities such as breeding unions and NGOs. Information was included based on [*Recommendation No. SK-3B-2021- 0002*](#).

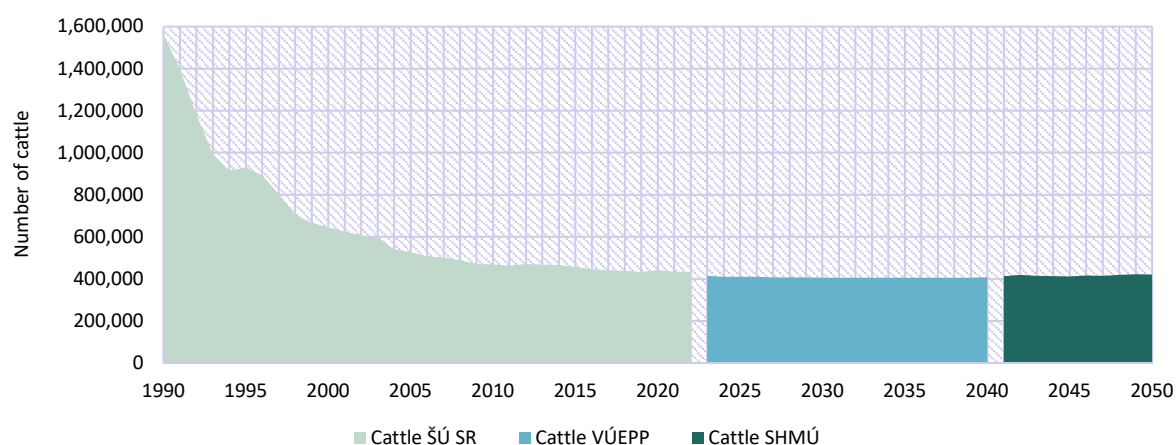
The input from breeding unions provided a more accurate view of the development of livestock numbers in Slovakia. Furthermore, it is mentioned that future Common Agricultural Policy (CAP) measures are expected to impact increasing the mentioned livestock species, particularly through increased grazing breeding. Additionally, the consumption of inorganic fertilizers was modified based on planned European Farm to Fork Strategies and national measures to reduce urea use

[Number of cattle](#)

Due to the transformation of the Slovak Republic into a market economy, there was a significant decline in the cattle population compared to the base year of 1990, especially in the first four years. The population dropped to approximately 993000 head in 1993, and although at a slower pace, this downward trend continued in the following years. By 2004 (Slovakia's accession to the EU), the cattle population was already only about one-third of the 1990 level, reaching 540,000 head. Thanks to higher subsidies under the EU Common Agricultural Policy, this decline was mitigated, and in 2020, Slovakia recorded 433,175 head of cattle, representing a decrease of approximately 72% compared to 1990.

According to an analysis that was conducted, the cattle population, especially the meat breeds predominantly raised on pasture, is expected to increase. Given the current state of the cattle population, the dairy cattle population is likely to decline while the meat cattle population is projected to increase to around 420,768 head by 2050.

Figure 8.2.42: Development of the number of cattle (1990-2023) and their projections until 2050

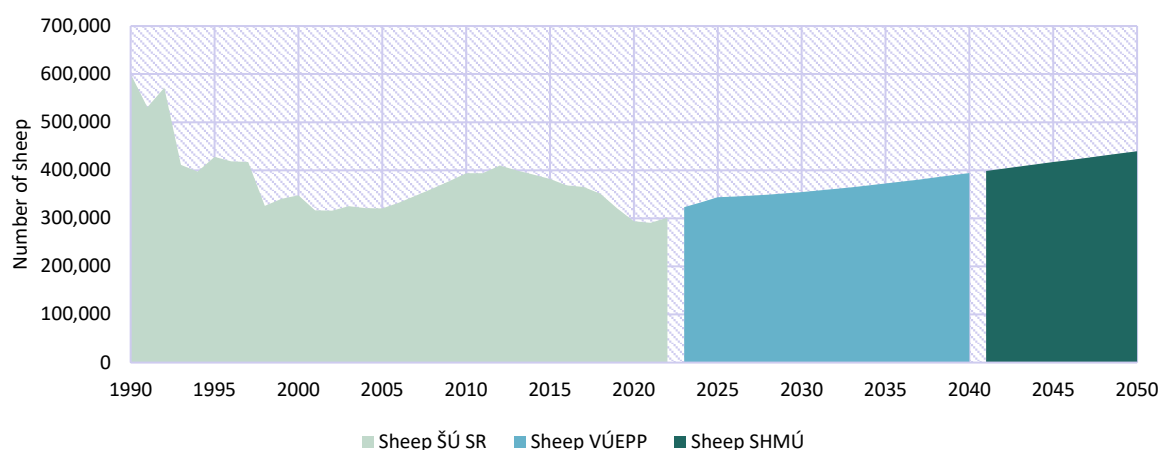


Number of sheep

Slovakia had the highest number of sheep in the 1990s, as the centrally planned economy system was coming to an end, with the population reaching approximately double the current level ([Figure 8.2.43](#)). However, their development exhibited a cyclical pattern. After a decline from 698,000 head in 1970 to 541,000 head in 1976, there was a gradual increase to nearly 600,000 head in 1990, followed by another decline to around 400,000 head in 2001 and 2002. After reaching this minimum, the sheep population in Slovakia began to stabilise, reaching almost 410,000 head in 2012. In recent years, there has been a decline to less than 301,131 head in 2022, which is just over half of the population at the beginning of the observation period.

Sheep farming in Slovakia has a tradition mainly due to favourable conditions and an abundance of pastures. The model predicts an increase in the sheep population, expecting 439,518 head in Slovakia by 2050.

Figure 8.2.43: Development of the number of sheep (1990-2023) and their projections until 2050

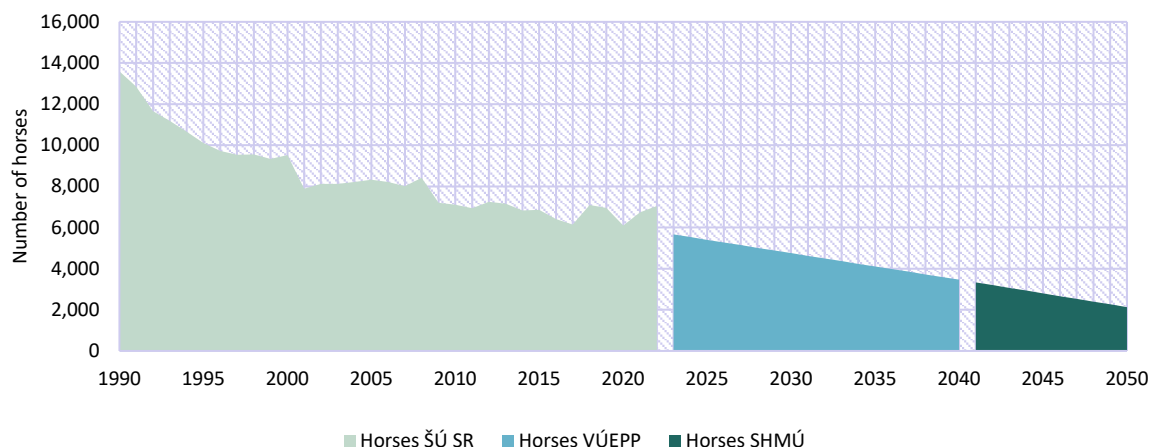


Number of horses

The highest number of horses in Slovakia was recorded in 1990 (13,595 head). Throughout the observed period, it is evident that the horse population has generally had a declining trend. This downward trend can be attributed to the transformation of the agricultural sector after 1990 and the transition to a market mechanism. The decline represents approximately two-thirds compared to the level at the beginning of the observation period (1990). The declining trend during the observed period

(Figure 9.44) also had an impact on the analysis of projections until 2050, which indicates that the horse population in Slovakia is expected to continue to decline. By 2050, the projected number of horses in Slovakia is only 2,132 head (-84%).

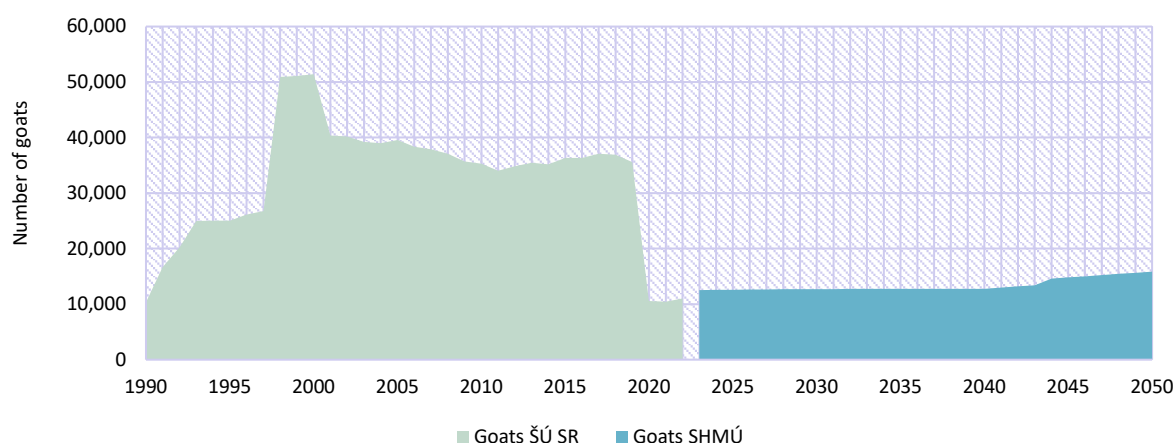
Figure 8.2.44: Development of the number of horses (1990-2023) and their projections until 2050



Number of goats

The data for goat populations in Slovakia are available from 2000 onwards, with extrapolated data for the period from 1990 to 2000 based on ŠÚ SR records. The number of goats decreased by more than a fifth in 2001 compared to the previous year (from 51.4 thousand to 40.4 thousand head) (Figure 8.2.45). Following this sharp decline, there was a gradual decrease in the goat population throughout the next decade, stabilising at just over 34 thousand head in 2011. In 2020, the goat population further decreased to 11 thousand head. This decline continued in 2021 (10 thousand head) and was caused by the poor economic situation among breeders. Compared to 1990, this represents an increase of 3%. Based on the annual fluctuations in population, the model predicts a gradual increase in the goat population in Slovakia in the future, albeit at a slower pace. From the level of 11.008 thousand head in 2022, the goat population is projected to reach approximately 15.9 thousand head by 2050. The increase in population will also be supported by financial subsidies for pastoral farming methods from the upcoming EU Common Agricultural Policy (CAP) for the years 2023-2027.

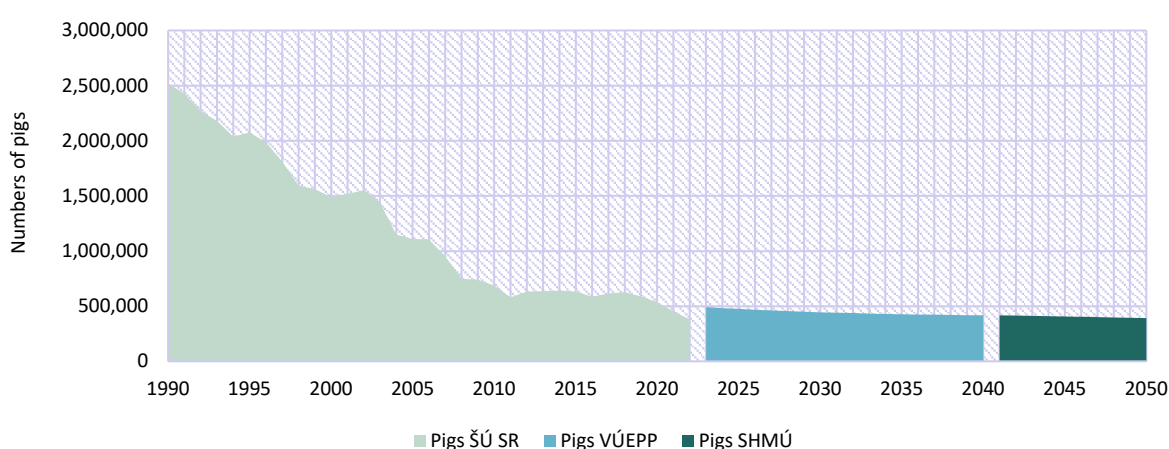
Figure 8.2.45: Development of the number of goats (1990-2023) and their projections until 2050



Number of pigs

Similar to the stocks of cattle and sheep, we can observe high numbers of pigs in the 1990s (**Figure 8.2.46**). In 1990, there were 2.52 million pigs registered in Slovakia, reaching the maximum level. Since 1991, during the transformation to a market economy, there has been a continuous decline in the pig population from the level of 2.43 million pigs, which continued even after the country acceded to the EU (1.15 million pigs in 2004), until reaching the lowest point in 2016 (586,000 pigs), representing a decrease of almost 76% compared to 1990. Only in recent years, in 2017 and 2018, we observed a slight increase in the pig population, with 627,000 pigs recorded in Slovakia in 2018. In 2019, a decline in pig numbers was recorded. The reasons for this decline are of an economic nature. Based on the results of the modelling, a decrease in pig numbers can be expected from the level of 492,000 pigs in 2022 to approximately 393,000 pigs in 2050.

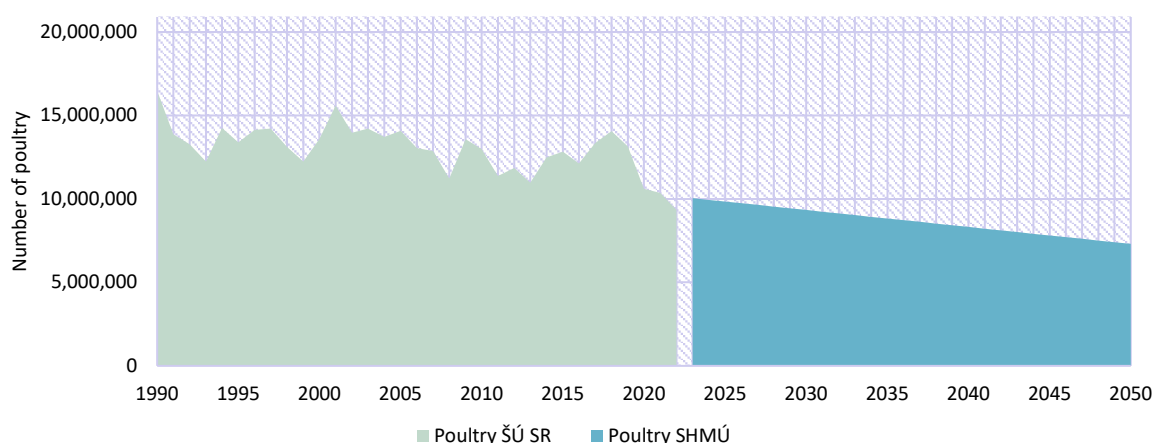
Figure 8.2.46: Development of the number of pigs (1990-2023) and their projections until 2050



Number of poultry

A relatively dynamic trend can be observed in the poultry stocks (**Figure 8.2.47**). In the period leading up to 1990, poultry numbers remained at around 16.3-16.6 million birds, but in the following three years, they decreased by approximately a quarter (to 12.2 million birds in 1993). This was followed by a period of frequent fluctuations in poultry stocks in Slovakia, with the peak level after 1990 reached in 2001 (15.6 million birds) and the lowest point recorded in 2019 (less than 11 million birds). In 2020, the poultry population was at the level of 10.6 million birds, which is roughly 36% compared to the beginning of the analysed period. The results of projection modelling suggest that poultry numbers will decrease to approximately 8.3 million birds by 2040 and to less than 7.3 million birds by 2050.

Figure 8.2.47: Development of the number of poultry (1990-2022) and their projections until 2050

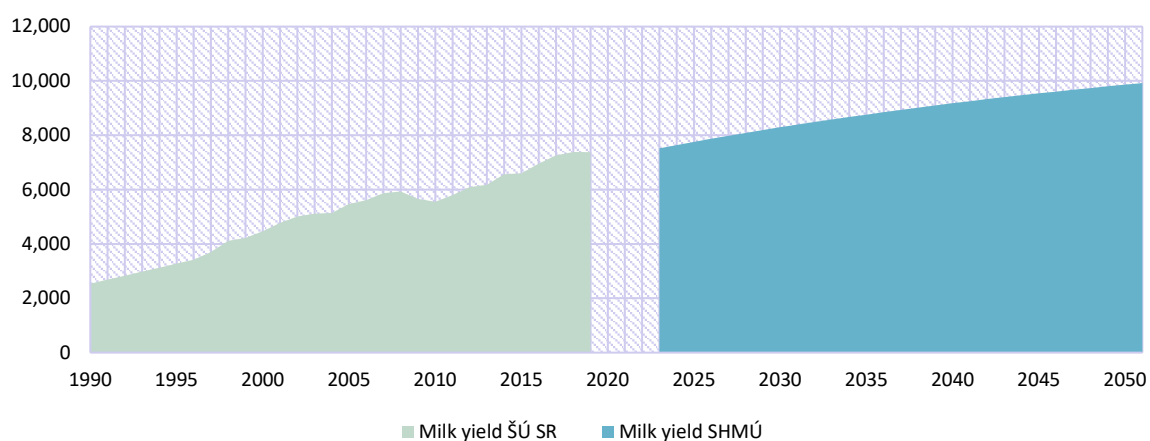


Milk yield of cows

This parameter was forecasted at the regional level. The model results indicate a growing trend in milk production per cow, which is expected to continue in the coming years. The average value could increase from 8,362 litres per cow in 2022 to nearly 9,919 litres per cow in 2050. **Figure 8.2.48** illustrates the trend of average milking yield for the entire Slovak Republic.

The increase in milking yield until 2050 will depend on several factors, primarily the composition of the cattle population in Slovakia in terms of the prevalence of meat or dairy breeds. Nutrition is also a crucial factor in increasing milking yield. Modernising and improving housing conditions also play a significant role in enhancing cow productivity.

Figure 8.2.48: Development of milk yield (1990-2022) and its projections until 2050

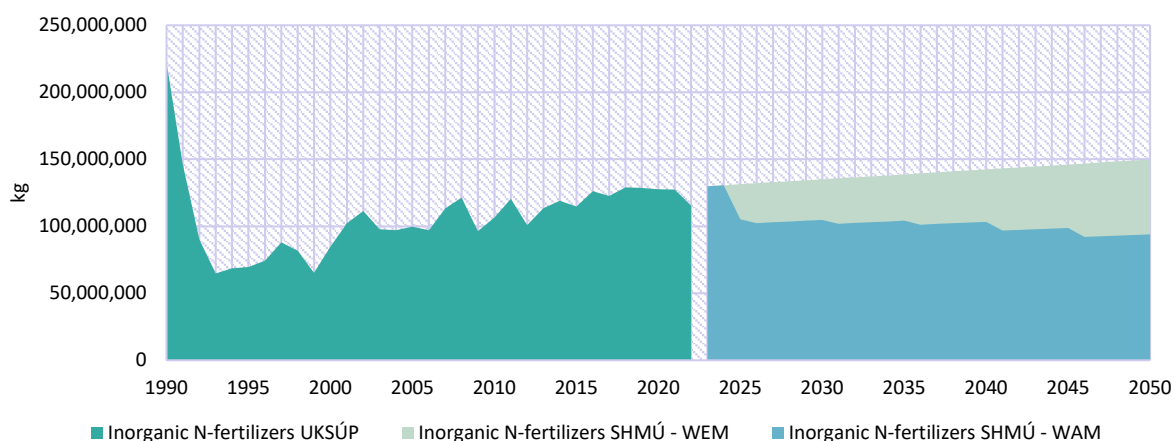


Consumption of Inorganic nitrogen fertilizers

Data on the consumption of inorganic nitrogen fertilizers were available in the database of the Statistical Office of the Slovak Republic (ŠÚ SR) from 1990 to 2020. The consumption of nitrogen fertilizers in the first year of observation was 69.6 thousand tons of pure nitrogen nutrients, characterised by alternating periods of growth and decline with a slight upward trend (**Figure 8.2.49**). The minimum consumption of nitrogen fertilizers, 65.4 thousand tons, was recorded in Slovakia in 1999. Particularly in the recent years of the observed period, this indicator was significantly above average and reached its maximum level in 2022 at 115 thousand tons, representing an increase of almost 59% compared to 2005. In comparison to 1990, their consumption decreased by 42%.

It is expected that the consumption of nitrogen fertilizers will continue to increase until 2023, stabilising at a level of approximately 149 thousand tons. In the WAM scenario, the consumption of fertilizers is projected to decline after 2024 to a level similar to that of 2001, at approximately 105 thousand tons. Subsequently, by 2050, fertilizer consumption is expected to decrease to 93.9 thousand tons of pure nitrogen applied to the soil. Information was included based on [Recommendations No. SK-3D-2023- 0001](#) and [SK-3D-2019- 0001](#).

Figure 8.2.49: Development of Inorganic N-fertilizers consumption (with urea) (1990-2022) and their projections until 2050



8.2.8.2 Model Description

The principle of exponential smoothing is based on adaptive methods for time series parameters projections; the projections of parameters are 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.

The algorithm in the system Python was developed, which is an automated version of the N-Tool, developed following the methodology EMEP/EEA GB 2023.

The calculation model is based on regional differences, which means the input parameters and number of livestock were modelled on a regional (district) level. After this redistribution was implemented, to calculate emission projections.

Measures in compound feed (CF) composition: The measures in the CP composition concerned the addition of additives reducing NH_3 emissions. In order to determine the costs for their application, it was necessary to establish the consumption of the CP and their price in relation to the livestock species (LFA) and their categories cited above. To determine the consumption of CP we used the manuals Nutrient requirements for pigs, Nutrient requirements and nutritional value of feed for poultry, as well

as data from livestock associations (Pig Breeders Association, Union of Poultry Breeders, Association of Meat Cattle Breeders, Slovak Holstein Association...) and farmers (Hyza, Branko...). We determined the consumption of CP per animal (of a given species and category) and per day. We then converted it to all animals of a given species and category per day and multiplied by 365 to obtain the consumption of CP for each category of a given species per year. We then obtained the price of CF for the species and category (€/t and €/q of feed, respectively) through compound feed manufacturers and farmers. We multiplied the consumption of CF of a given species and category by the price of CF attributable to that species and category. Thus, we obtained the total price of CF for each category of the species. By summing them, we determined the resulting price of CP for the species. We repeated the above for all the species quoted above. We increased the final price of CP by 2% (feed manufacturers', farmers' data), which covers the cost of adding additives to the CP to reduce NH₃ emissions. However, the final price of CF had to be increased by a further 8 % (feed manufacturers' figure), which covers the cost of feed treatment (heat treatment, granulation), bagging and transport. The resulting price of CF was thus increased by 10 %, which quantifies the total cost of reducing NH₃ emissions when using the addition of additives to the CF, its treatment, bagging and transport.

In the case of additives - synthetic essential amino acids (SAMA), which also reduce NH₃ emissions, monogastric animals (pigs, poultry) can incorporate them into the CP or premixes as standard, i.e. they are 100% available to all farmers, and therefore the applicability in livestock farms has been kept at 100%.

Manure and slurry storage measures: For manure and slurry storage, we have chosen only one measure to reduce NH₃ emissions, namely covering the manure and slurry stores with a plastic sheet. This can be made of plastic, tent canvas or any other suitable material. This measure best met the requirements of BAT techniques as it reduced NH₃ emissions by 60%, the cost per kg of emission reduction per year was 1.3€, i.e. it did not require a large financial investment compared to converting storage lagoons to high tanks or building hard covers over existing tanks.

The calculation of the investment for the measure was based on the cost per kg of NH₃/year reduction, which we obtained from the Code of Good Agricultural Practice for the reduction of ammonia emissions from livestock farming and land application of fertilisers, and the amount of NH₃ emitted from storage for the livestock species quoted above. To determine the amount of NH₃ emitted from storage for the given livestock species and their categories, we used the ammonia emission inventory for the year 2022, where the emission factor for storage was input into the calculation of the amount of NH₃ emitted, which was calculated from the amount of excreted nitrogen (N_{ex}, expressed in kg/animal/year) calculated in the calculation of N₂O emissions (a very accurate Tier 2 procedure using the new methodology of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). In addition to the amount of nitrogen excreted and the contribution of this amount to ammonia emissions, the volatilisation of manure and slurry in storage also entered into the calculation of NH₃ emissions from storage. The amount of ammonia emitted from storage was expressed per animal (species and category) and year, i.e. as an emission factor (EF). From the EF of all categories of a given species, the NH₃ emissions from storage were calculated by multiplying the EF of a given category by the number of animals of that category to determine the ammonia emissions from storage from all categories of a given species. We then calculated the amount of reduction in NH₃ emissions from storage for each category of a given species, by the % reduction in the amount of emissions by the measure used. We further adjusted the amount of ammonia emission reduction from storage after the measure for the % of its applicability to farmers. Finally, we multiplied the amount of reduction in NH₃ emissions from storage by the cost per kg of its reduction per year to determine the

cost of reducing its emissions after application of the measure in a given percentage of farms within each category of a given species. By summing the costs for each category of a given species, we determined the cost of reducing NH₃ after the measure and its application for that species.

Measures for manure and slurry application: The calculation was based on manure production management, where the amount of manure and slurry entered into the application. For manure, we chose one measure to reduce emissions from the application, namely incorporation within 4 hours after application, with a maximum ammonia emission reduction efficiency of 65% and a reduction cost per kg NH₃/year of 1.5 euros. For slurry, we used 3 measures to reduce NH₃ emissions, namely band application with a trailing hose with a foot with a max efficiency of 60% and a cost of 1.5 euro/kg NH₃/year, subsurface application with an open slot with an efficiency of 70% and a cost of 1.5 euro/kg NH₃/year, and incorporation of surface-applied slurry within 4 hours with a max efficiency of 65% and a cost of 1.0 euro/kg NH₃/year. The above measures were applied in cattle and pig farming. In poultry farming, only 1 measure was used, namely the incorporation of manure within 4 hours after application, as in this case, it was always only manure application and not slurry application. In selecting the measures, we again used the BAT system and selected measures that are highly effective, available and feasible at a 'reasonable' financial cost.

To calculate costs, we used the Code of Good Agricultural Practice for reducing ammonia emissions from livestock and fertilizer land application and the NH₃ emission inventory for 2022. The application EFs (amount of emissions per animal and year) were entered into the application emission calculation. For their calculation, Nex (from the calculation of N₂O emissions by the Tier 2 procedure of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories), the ammonia fraction of this amount, and the volatilisation of manure and slurry at application were used. Subsequently, from the EF of the application of each category of a given species, the NH₃ emissions from the application were determined by multiplying the EF of a given category by the number of animals of that category. We then used the % reduction in NH₃ emissions after application of the measure to obtain the amount of emissions after application of the measure for all categories of a given species. Next, we used the % application of the measure to farmers to calculate the % application of the measure to farmers, thus obtaining the amount of emissions from each category of a given species after application of the measure and application to farmers. We further multiplied the amount of reduction by the cost per kg of NH₃ reduction per year to obtain the total cost of reduction for all categories of a given species.

Table 8.2.24: SWOT analysis of the Agri-model

STRENGTHS	OPPORTUNITIES
Compatibility with the emission model for emission inventories	Incorporate new technologies into the model
Detailed data breakdown	Versatile use of time-series
The national database used is compatible with EU data	
TREATS	WEAKNESS
Easy data entry	Disconnected from macroeconomic models
Basic software is free	Too many pre-calculations are needed
	Missing measurable indicators in national policies and strategies
	Data inconsistencies in the projection estimation process

Most implemented measures have a measurable effect on the emission inventory. List of policies and measures taken into account in emissions by individual scenarios and their effect (antagonistic,

synergic). The limiting factor during the preparation of projections was the lack of details of the measures and their implementation plans within the Agriculture sector. Lack of information makes it difficult to implement and evaluate their impact. For this reason, an expert estimate of selected parameters was used during the preparation of the projections or European goals were used. It is therefore necessary to supplement the further specification of measures in the future for a more correct setting of models:

- Mechanism of implementation.
- Supporting resources requirements.
- Monitoring of implemented measures at the farm level, respectively, the business entity.

8.2.8.3 Scenarios, Parameters and PAMs

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 were set for the entire European Union, but the Slovak Republic has not set binding reduction targets resulting from the Farm to Fork strategy (36).

The Low Carbon Strategy of the Slovak Republic (23) 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 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 much 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. They 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 often have different synergistic 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, two scenarios were prepared:

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 2022. The measures considered in the **WEM** scenario prevent NH₃ emissions by storing manure and manure more efficiently and 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 248/2023 Coll. (37), which implements certain provisions of the Air Act. The

implementation of this measure has an impact on NH₃ and NO_x 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 equalisation by analysing previous emission trends. The **WEM** scenario has an increasing trend of nitrogen oxide emission projections, mainly due to Slovakia's expected continued revival of crop production. 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 (38), 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. 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. A transition period was implemented in the emission projections, which aligns with the transition period for limiting urea (2020-2025) – [Table 8.2.26](#). 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 urea reduction had a gradual trend, shown in [Table 8.2.26](#). Limiting urea also affects CO₂ emissions from agriculture, and especially NH₃ emissions.

The **WAM** scenario includes mitigation measures that have a synergistic effect. The measure adopted from NUS SR 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. The information on the validity of the legislation was unavailable. Therefore, an expert judgement was used.

The potential for reducing ammonia emission, NMVOC emissions in agriculture is mainly related to the efficiency of manure management, in particular the handling and storage of manure and slurry and their application to the soil in a low-emission manner. Some measures are included in Decree No 248/2023 Coll. (37) of the Ministry of the Environment of the Slovak Republic and are also valid for farms classified under Act No 39/2013 Coll. (39) on Integrated Pollution Prevention and Control. Mitigation measures included in the current legislation have been included in the WEM scenario. Currently, a revision of the Decree of the MŽP SR No 248/2023 Coll. is underway, as well as an amendment to the Air Act No 146/2023 Coll. (40), in order to introduce the obligation to comply with

the principles of Good Agricultural Practice. Measures to reduce ammonia (NH₃) emissions from livestock farming were applied to the key sources of these emissions, namely cattle, pig, and poultry farms. In selecting the measures, the "BAT" (Best Available Techniques) approach was followed, meaning that the most effective, accessible, and economically feasible options were used. The measures themselves were categorised into three groups: those related to the composition of feed mixtures, and those concerning the storage and application of manure and slurry. Financial capital of €29,440,465 (Pigs 7,392,790, Cattle 6,678,726, Poultry 15,368,949) is needed to implement measures to reduce ammonia emissions from livestock, which are the key producers. The measures consist of the addition of additives (reducing ammonia emissions) to the feed mixtures, covering the manure stores with plastic sheeting, ploughing in the manure and incorporating the manure within 4 hours of application, band application of the manure by means of a trailing hose with a foot and subsurface application of the manure in the form of an open slit.

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 23.2% of organic manure from pigs would be recovered in biogas plants. Cattle and pigs are key categories of animals with the highest emission recovery potential; the potentials were chosen as expert judgment. Biogas from stations is a promising source of renewable electricity and heat, which can be used at the local level. Information was included based on [Recommendation No. SK-3B-2019-0002](#)

Table 8.2.25: Efficiency of used abatements

ABATEMENT EFFICIENCY OF MEASURES	REDUCTION POTENTIAL	REFERENCES
Storage of Manure or Slurries		
Fixed hatch or roof	80%	Code Good Agricultural Practice (41)*
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* (41)
Deep injection	90%	
Incorporation within 12 hours	50%	
Incorporation within 24 hours	30%	
Incorporation within 4 hours	65%	

*In Slovak

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 optimisation of nitrogen substances in the ratio. The measure was used in the estimation of nitrogen excretion per 1 animal per year in cattle. Based on the meta-analysis (42), the estimate of the mitigation potential compared to the reference value was in the range of 17±6% N_{EX}.

Emissions of NH₃ from manure and manure storage in the WAM scenario were modelled by taking into account the measures of introducing requirements to reduce emissions from livestock farms.

Another implemented measure, which has an impact on NH₃ and NO_x 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 NH₃ and NO_x from the application of inorganic nitrogen fertilizers (category 3.D 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. This measure's implementation impacts the reduction of NH₃ and NO_x 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 reducing 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 NH₃ and NO_x.

The implemented measure taken from the Low Carbon Strategy (23) 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 NO_x emissions by reducing the total consumption of inorganic fertilizers in the resulting consumption summary. The information on the validity of the legislation was unavailable. Therefore, an expert judgement was used. The reduction of urea had a gradual course, which is shown in **Table 8.2.26**.

Table 8.2.26: 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 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 8.2.27**.

Table 8.2.27: List of implemented policies and measures in projections according to the scenarios

STRATEGIC DOCUMENT LEGISLATION	SCENARIO	GAS / CATEGORY	MEASURE	EFFECT OF THE MEASURE
Code of good agricultural practice (41) National Air Pollution Control Programme (25) Low carbon strategy (23) Decree of the Ministry of the Environment of the Slovak Republic No 248/2023 Coll. (37)	WEM	NH ₃ , NMVOC - 3B 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 (41)	WAM	NH ₃ , NMVOC – Manure management	Application of amino acids in feeding doses	synergistic

STRATEGIC DOCUMENT LEGISLATION	SCENARIO	GAS / CATEGORY	MEASURE	EFFECT OF THE MEASURE
Low carbon strategy (23)	WAM	NH ₃ - storage of manure and manure	Effectively process animal waste and use biogas, especially as a local energy source	synergistic
	WAM	NH ₃ , NO _x - 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 (36)	WAM	NH ₃ , NO _x , HCB, agricultural land	Reduction of inorganic nitrogen fertilizers by 20 % compared to 2030	synergistic

8.2.8.4 Emission Projections in the Agriculture Sector

NMVOC emissions

NMVOC emission projections were prepared using the WEM and WAM scenarios. 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. Projection by the WEM scenario followed the Ordinance of the Government of the Slovak Republic No 248/2023 Coll.

Figure 8.2.50: Emission projections trends for pollutant NMVOC in the Agriculture sector

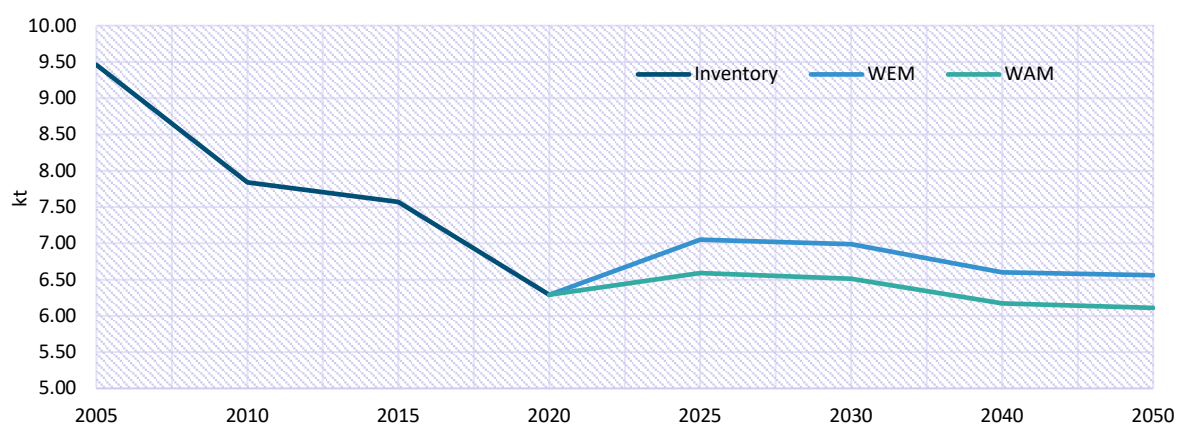


Table 8.2.28: NMVOC emissions in the Agriculture sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
3B	9.30	7.68	7.41	6.13	5.79	7.18	7.13	6.74	6.70
3D	0.16	0.16	0.16	0.16	0.13	0.14	0.14	0.14	0.14
3 Agriculture	9.46	7.84	7.57	6.29	5.92	7.05	6.99	6.60	6.56

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
3B	9.30	7.68	7.41	6.13	5.79	6.45	6.372	6.03	5.97
3D	0.16	0.16	0.16	0.16	0.13	0.14	0.14	0.14	0.14
3 Agriculture	9.46	7.84	7.57	6.29	5.92	6.59	6.51	6.17	6.11

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

NH₃ and NO_x emissions

Sector agriculture is a dominant contributor to NH₃ emissions, with approximately 90% share of the national total. The largest share of ammonia emissions was generated by **3D** Agricultural soils, which produced approximately 70% of NH₃ within the sector. The key source in Agricultural Soils in the Animal manure applied to soils, where abatements were implemented (Incorporation within 12 and 24 hours,

deep injection of manure), followed by the category Inorganic N-fertilizers representing approximately 20% of the total NH₃ emissions, where no abatements were implemented, due to missing policies. Emissions from **3B1** Cattle, **3B3** Swine and **3B2** Sheep are key emission sources of NH₃.

Projections of NH₃ and NO_x emissions from manure and manure management and agricultural soils were prepared in the WEM and WAM scenarios.

The WEM scenario is conservative and does not envisage further measures to reduce emissions. The emission trend in the WEM scenario has a stable increasing trend (*Figure 8.2.51*) of NO_x emissions. In the WEM scenario, higher consumption of inorganic nitrogen fertilizers is included compared to the recorded values in historical years. The year 2020 and 2021 was particularly affected by the pandemic, which led to higher prices of natural gas and subsequently increased prices of inorganic N-fertilizers. As a result, farmers reduced their consumption of these fertilizers.

For the projection, the impact of the pandemic year was avoided, and the projection was prepared without considering the influence of the pandemic. Similar trends were observed in animal production, where there was a decrease in the number of pigs, goats, and poultry. If this negative trend continues beyond the post-pandemic years, the projections will be adjusted accordingly in future submissions.

Figure 8.2.51: Emission projections trends for pollutant NH₃ in the Agriculture sector

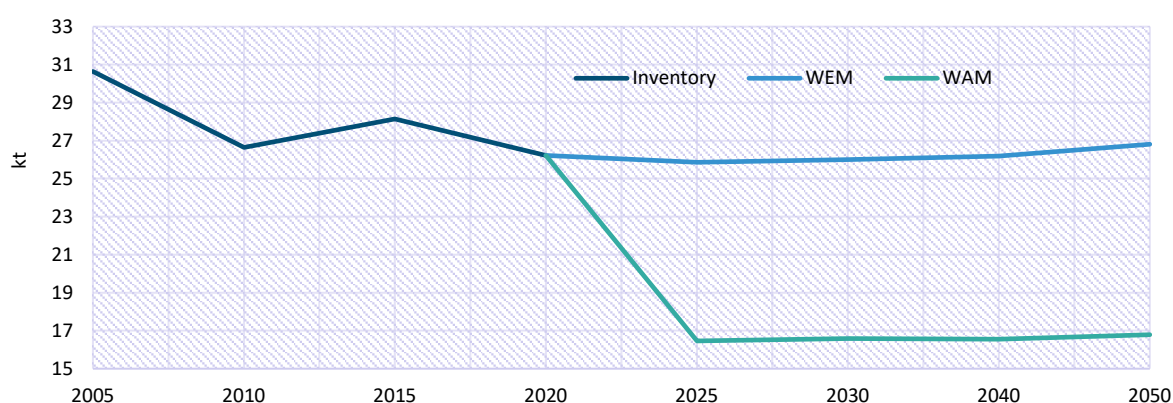


Table 8.2.29: NH₃ emissions in the Agriculture sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
3B	9.14	7.71	7.48	6.26	5.72	6.73	6.64	6.55	6.55
3D	21.50	18.93	20.67	19.96	17.35	19.13	19.37	19.64	20.26
3 Agriculture	30.64	26.64	28.15	26.22	23.07	25.86	26.00	26.19	26.81

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
3B	9.14	7.71	7.48	6.26	5.72	4.89	4.90	4.87	4.90
3D	21.50	18.93	20.67	19.96	17.35	11.57	11.70	11.69	11.88
3 Agriculture	30.64	26.64	28.15	26.22	23.07	16.46	16.59	16.56	16.78

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

Agricultural NO_x emissions have increased. The NO_x emissions from agricultural soils, especially Inorganic N-fertilizers application, are a key source of emissions. 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 the decrease in livestock. Agriculture is an insignificant source of NO_x emissions, and no policies and measures are available.

Figure 8.2.52: Emission projections trends for pollutant NOx in the Agriculture sector

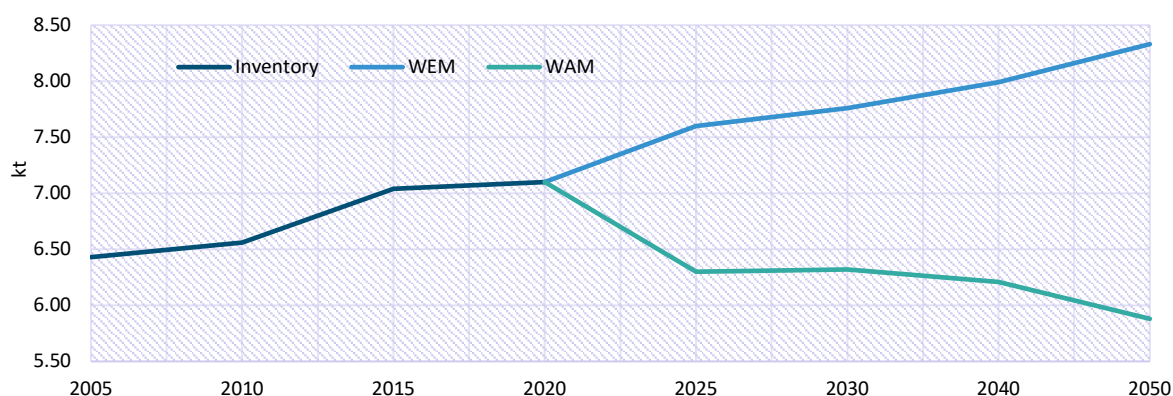


Table 8.2.30: NOx emissions in the Agriculture sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
3B	0.18	0.14	0.14	0.14	0.12	0.12	0.12	0.12	0.12
3D	6.26	6.42	6.90	6.97	6.43	7.48	7.64	7.86	8.21
3 Agriculture	6.43	6.56	7.04	7.10	6.55	7.60	7.76	7.99	8.33

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
3B	0.18	0.14	0.14	0.14	0.12	0.12	0.12	0.12	0.12
3D	6.26	6.42	6.90	6.97	6.43	6.18	6.20	6.09	5.76
3 Agriculture	6.43	6.56	7.04	7.10	6.55	6.30	6.32	6.21	5.88

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

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%.

PM_{2.5}, PM₁₀, TSP emissions

The PM_{2.5}, PM₁₀ and TSP emissions were calculated in one scenario due to missing strategic documents and mitigation measures for emissions emitted in Manure management and Agricultural soils. The agricultural PM_{2.5}, PM₁₀ and TSP emissions from Agricultural Soils have decreased trend from 2005 to 2020, and the decrease will continue until 2050 due to a decrease in cropped areas of oat, barley and rye. Agriculture is an insignificant source of PM_{2.5}, PM₁₀ and TSP emissions, and no policies and measures are available. The decrease in PM_{2.5} emissions by 2050 in the WEM scenario compared to 1990 is at the level of -62% and then decreases by 40% compared to 2005.

The decrease in PM₁₀ emissions by 2050 in the WEM scenario compared to 1990 is at the level of -41% and then decreases by 35% compared to 2005.

The decrease in TSP emissions by 2050 in the WEM scenario compared to 1990 is at the level of -50% and then decreases by 34% compared to 2005.

Figure 8.2.53: Emission projections trends for pollutant PM_{2.5} in the Agriculture sector

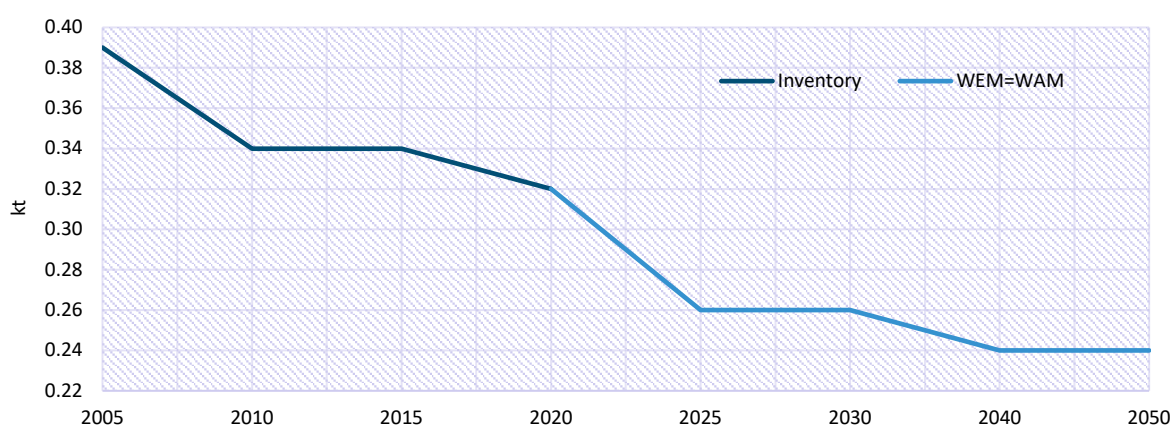


Table 8.2.31: PM_{2.5} emissions in the sector Agriculture in kt

WEM=WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
3B	0.19	0.17	0.16	0.14	0.13	0.10	0.10	0.10	0.10
.D	0.20	0.18	0.18	0.18	0.17	0.16	0.16	0.14	0.14
3 Agriculture	0.39	0.34	0.34	0.32	0.30	0.26	0.26	0.24	0.24

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

Table 8.2.32: PM₁₀ emissions in the sector Agriculture in kt

WEM=WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
3B	0.79	0.70	0.67	0.52	0.48	0.50	0.49	0.46	0.43
3D	3.66	3.23	3.26	3.28	3.02	2.81	2.77	2.52	2.43
3 Agriculture	4.45	3.93	3.93	3.80	3.49	3.31	3.26	2.98	2.87

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

Table 8.2.33: TSP emissions in the sector Agriculture in kt

WEM=WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
3B	2.73	2.47	2.37	1.70	1.56	1.90	1.83	1.72	1.62
3D	2.73	2.64	2.58	2.60	2.10	2.08	2.10	2.00	1.98
3 Agriculture	5.46	5.11	4.95	4.31	3.66	3.98	3.93	3.72	3.59

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

HCB emissions

Historically, hexachlorobenzene (HCB) was widely used as a seed treatment to prevent fungal growth in crops such as wheat, barley, oats and rye. Emission projections were made using two scenarios, WEM and WAM. In the WAM scenario, the objective of the Farm to Fork strategy was implemented (50% reduction in the use and risk of chemical pesticides and a 50% reduction in the use of more hazardous pesticides). The emission of hexachlorobenzene decreases more in the WAM scenario compared to the WEM scenario. Volume of pesticides containing contamination of hexachlorobenzene decreases continuously; this trend is visible in the WEM scenario.

The decrease of HCB by 2050 in the WEM scenario compared to 1990 is at the level of -94% and then decreases by 83%. HCH TSP emissions by 2050 in the WEM scenario, compared to 1990 is at the level of -97% and then decrease by 91% compared to 2005.

Table 8.2.34: HCB emissions in the Agriculture sector

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
3Df	0.06	0.03	0.05	0.03	0.01	0.06	0.05	0.04	0.03
3 Agriculture	0.06	0.03	0.05	0.03	0.01	0.06	0.05	0.04	0.03

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
3Df	0.06	0.03	0.05	0.03	0.01	0.03	0.03	0.02	0.01
3 Agriculture	0.06	0.03	0.05	0.03	0.01	0.03	0.03	0.02	0.01

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

8.2.9 Emission Projections in the Waste Sector

8.2.9.1 Methodologies and Key Assumptions/Trends

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 NFR categories:

- **5A** Solid Waste Disposal on Land
- **5B** Biological Treatment of Solid Waste
- **5C** Waste Incineration an Open Burning of Waste
- **5D** Wastewater Handling
- **5E** Other Waste

The most common disposal methods are landfill and, to a lesser extent, incineration. When waste from landfills decomposes, non-methane volatile organic compounds (NMVOCs) and methane are released into the air, and particulate emissions are released when waste is handled (PM).

Incineration is the second most common method of waste disposal in the Slovak Republic. In the past, energy from incineration was not often used, and waste was only disposed of. Modern plants now use waste as a fuel in the production of energy or heat, and waste is also recovered in this way. In this case, the emissions from incineration are classified in the energy sector. In our country, waste incineration contributes significantly to the number of dioxins and furans (PCDDs/PCDFs) that are emitted into the air. Since dioxins are virtually unbreakable in nature and can persist for hundreds of years, they are deposited in animal tissues and thus enter the human food chain. Dietary intake, especially of meat, fish, eggs, milk and fats, is the most important route of entry of dioxins into the human body. Incineration of waste also releases high levels of heavy metal emissions into the air. Modern waste incineration plants capture these pollutants efficiently, but this was not common practice in the past. Heavy metals are deposited in the soil and subsequently in organisms, from which they are difficult to break down. Through the food chain, contamination of organisms gradually increases. Animals at the end of the food chain, and therefore humans, are particularly at risk from heavy metals. The risk is particularly higher in coastal areas, where seafood consumption is generally higher.

Recycling is not the only sustainable way to recover waste. Composting any organic waste, such as food and garden waste, is one of them. Organic waste decomposes into mulch in a matter of weeks, which can be used as fertilizer for the soil. Many households practise small-scale composting, and large-scale composting systems are also being developed with the collection of organic waste from parks and urban amenities. Similar types of organic waste can also be treated in biogas plants. Unlike composting, here the waste is decomposed anaerobically (without air access) and biogas is produced, which can be further burned to generate energy that can be used for heating.

This sector also includes cremations of human and animal remains, which are also a source of air pollution through emissions of heavy metals and POPs.

Wastewater treatment also releases pollutants and greenhouse gases (both CH₄ and N₂O). In general, emissions of POPs as well as NMVOCs, CO and NH₃ occur in wastewater treatment plants, but in most cases, these are negligible amounts.

8.2.9.2 Model Description

Projections of emissions were prepared in accordance with the methodology of EMEP GB 2023, which is consistent with the methodology of estimating emissions in the Waste sector. The calculation analysis tool is based on the MS Excel platform, and the calculation includes various policies and measures (in numerical formulation) defined according to the WEM and WAM scenarios. Calculations of emissions projections of individual gases were carried out in consistency with the GHG emission projection from waste activities.

There are several specially developed mathematical models for the preparation of emission projections, but due to the need for complex input data, including economic and energy indicators, it is currently not possible to use them for the purposes of reporting national projections. The small Slovak economy would need its own model developed exactly for our conditions, or at least specifying the specific national parameters that enter the calculations (ideally up to the Tier 3 level). We are currently working partly at the level of Tier 1 and partly already at the level of Tier 2 (national data on production and waste management), as we lack the necessary statistical data specific to Slovakia.

Improving the quality and timely availability of input data, as well as further improvements in the preparation of emissions projections from the Waste sector, should enable the entire calculation process to be automated, which should bring a reduction in calculation time and create space for the creation of a larger number of scenarios and the processing of sensitivity analysis.

Calculating NMVOC emission projections from landfilling is connected with the methane emissions, and it follows that two of the parameters used are of an objective nature - the development of the population over the monitored period as well as the total production of waste. These parameters are influenced by social and economic factors, which we still do not know how to regulate or guide significantly. Their future values for the monitored period are therefore relatively difficult to predict and burdened with a relatively high degree of uncertainty. The other three parameters (proportion of landfilled waste, composition of waste, and capture and use of landfill gas) are more or less subjective in nature and can be influenced by external interventions and state policies. Some of these parameters may (but may not) act synergistically and increase their impact on overall emissions from landfilling. For example, the construction and operation of additional waste-to-energy facilities ("incinerators" = WtE) will, in any case, contribute to a decrease in the amount of landfilled waste, for example, in the data from BSK and KSK. More intensive separated collection of waste components will lead to a decrease in DOC in landfilled waste. The construction and operation of new MBU facilities will combine both of these parameters. However, it should be noted that the residue from MBU facilities (ending

up in landfills) has a higher DOC > 0 than the residue from WtE (DOC < 0). The resulting impact of the measures on these parameters will depend on the capacity of the new facilities and their operational efficiency. However, from a time point of view, it is necessary to think with a horizon of at least 5-10 years, so that these policies are also reflected in the output. Based on knowledge from European countries, where there has already been a shift away from landfilling, it is clear that the production of landfill gas and thus the amount of NMVOC from landfills will subsequently decrease. On the other hand, according to the EEA report from May 2021, Slovakia is among the EU27 countries with the lowest use of landfill gas (only 5%), while the EU average is around 39%. Due to the lack of data, it is not possible to more precisely quantify the total potential of usable methane from landfills and the current efficiency of its capture and processing.

When describing the preparation of emission projections, it should be noted that emissions from landfilling are calculated according to the components of the landfilled waste (food, wood, paper, textiles, sludge...) and not according to the type of landfills in the sense of the Directive on landfills (43)(2018/850 or 1999/31/EC). Considering the different development and production of municipal and industrial waste in Slovakia, as well as the requirement in previous revisions of the national inventory, emission projections were calculated separately with industrial waste = ISW (sk. 01 to 19 EWC) and separately with municipal waste = MSW (sk. 20 EWC). The resulting emission projections from the waste landfill category (5A) are then the sum of both sub-categories.

Table 8.2.35: SWOT analysis of the Waste-model

STRENGTHS	OPPORTUNITIES
Compatibility with emission inventories Detailed data breakdown The database used is compatible with the national data Models are free of charge	Incorporate new technologies into the model Versatile use of time-series
TREATS	WEAKNESS
Bugs can be introduced if data is incorporated manually Lack of input data introduces high uncertainty	Disconnected from macroeconomic models Too many pre-calculations are needed Missing measurable indicators in national policies and strategies Data inconsistencies in the projection estimation process

8.2.9.3 Scenarios, Parameters and PAMs

Two scenarios have been prepared to model the emission projections for categories 5A - Landfills and 5D - Wastewater:

- WEM – scenario with existing measures (realistic)
- WAM – scenario with additional measures (optimistic)

For the modelling of emission projections from categories 5B - Composting of non-biogenic waste and 5C - Incineration of waste without energy recovery, only one scenario was prepared, namely WEM = WAM, due to the lack of relevant PAMs.

The scenario with existing measures (realistic) scenario, or also called BAU = Business as Usual, is based on the expectation that developments in solid waste landfill management will continue as observed in other EU countries undergoing economic transition.

Municipal waste production - the WEM scenario presents a projection of methane emissions from MSW with the continuation of current trends and policies in waste management in Slovakia, without taking into account more significant externalities or radical economic collapses. The production of municipal waste for the years 2023 – 2050 copies the expected development of GDP with annual

growth in the range of 1.48% - 1.03%. At the same time, we assume that the current significant decrease in the share of landfilled waste to the total production of MSW (-3.1% per year or -40 300 t/y) will slow down and stabilise at 1% per year (-20,000 t/y). Methane emissions from landfilling of municipal waste are shown in [Table 8.2.36](#) below.

Table 8.2.36: Trend projections of MSW parameters in WEM scenario up to 2050

YEAR	UNIT	2022	2025	2030	2035	2040	2045	2050
MSW	kilo tonnes	2,597.46	2,592.79	2,750.77	2,943.83	3,137.35	3,196.77	3,524.17
MSW-> SWDS	kilo tonnes	2,597.46	2,592.79	2,750.77	2,943.83	3,137.35	3,196.77	3,524.17

Production of industrial waste - the WEM scenario represents a projection with a continuation of the current trends given by the policies and measures in the waste management in Slovakia, without taking into account more significant externalities or radical economic collapses. The amount of landfilled industrial waste containing biodegradable carbon stabilises at around 92,000 t/year. Methane emissions from landfilling of industrial waste are shown in [Table 8.2.37](#) below.

Table 8.2.37: Trend projections of ISW parameters in WEM scenario up to 2050

YEAR	UNIT	2022	2025	2030	2035	2040	2045	2050
ISW -> SWDS	kilo tonnes	65.90	90.27	89.40	91.14	92.02	93.61	95.07

The WAM scenario presents a projection of the future development of methane emissions from waste landfills in Slovakia when new policies in waste management are introduced and applied without taking into account significant external influences (economic crisis, war, another pandemic, etc.). The scenario with additional measures (optimistic) is based on the expectation that additional supporting measures will be implemented in the waste management sector in Slovakia to increase the rate of waste recovery and reduce the amount of landfilled waste (MBU, WtE, etc.).

Municipal waste production – in the WAM scenario, is expected a decrease of the “FOOD” component in municipal waste due to separate collection of kitchen waste. Similarly, the separate collection of textiles from 1.1.2025 will contribute to the reduction of this component in the MSW landfilled. Further intensification of separate collection, support of composting and aerobic digestion will also bring a decrease in the components of paper and garden waste in landfilled MSW. The deposit system of returnable packaging will probably be reflected in the reduction of the production of mixed packaging, which represents a significant share of landfilled waste. The introduction of mandatory treatment of municipal waste before landfilling and an increase in the share of waste that can be used for energy will also have a significant impact on reducing the amount of landfilled municipal waste. By 2050, there could thus be a substantial decrease in landfilled biodegradable carbon, which also represents an adequate decrease in the DOC value by about 35% and, ultimately, a decrease in methane production from landfills. This scenario assumes a significant decrease in the amount of landfilled municipal waste, i.e. diversion of mixed MSW to other (new) facilities gradually by approx. 80,000 t per year until 2050. In accordance with the goals of the European Commission for waste management, the goal for 2035 is set: landfill less than 10% of MSW and recover more than 60% MSW. The 2030 environmental strategy has a set goal for the year 2030 to landfill max. 25% and evaluate min. 60%. The WAM scenario envisages reaching the landfill goal of max. 25% in 2030 and max. 15% of MSW in 2035, with a gradual reduction of landfilled MSW from 2023 by approx. 42,000 tons per year. Methane emissions from landfilling of municipal waste are shown in the following [Table 8.2.38](#).

Table 8.2.38: Trend and projections of parameters and methane emissions from MSW in the WAM scenario up to 2050

YEAR	UNIT	2022	2025	2030	2035	2040	2045	2050
MSW	kilo tonnes	2,597.46	2,592.79	2,750.77	2,943.83	3,137.35	3,196.77	3,524.17
MSW-> SWDS	kilo tonnes	1,021.58	886.22	684.61	482.99	281.38	206.11	146.97

Production of industrial waste - WAM scenario represents a projection of the future development of methane emissions from landfilling of industrial waste in Slovakia, with a slight decrease in the amount of landfilled ISW. Methane emissions from landfilling of industrial waste are shown in the following **Table 8.2.39**.

Table 8.2.39: Trend and projections of ISW parameters in WAM scenario up to 2050

YEAR	UNIT	2022	2025	2030	2035	2040	2045	2050
ISW -> SWDS	kilo tonnes	65.90	66.55	77.18	72.67	69.66	66.13	62.87

Biological treatment of solid waste (5B) – Category was calculated in the scenario with existing measures (WEM) scenario due to missing strategic documents and mitigation measures after 2021. The WEM scenario with existing measures is based on the expectation that the development of waste composting will continue to increase, as observed in the last decade. This trend was mainly determined by the adopted Strategy for Reducing the Disposal of Biodegradable Waste in Landfills (44), developed in accordance with Article 5(1) of Directive 1999/31/EC (44). The goal of this strategy, as per Article 5(1) of the Waste Landfill Directive, is to limit the amount of biodegradable municipal waste disposed of in landfills and propose measures to achieve the goals set out in Article 5(2), primarily through recycling, composting, biogas production, or the use of waste as a source of secondary raw materials and energy.

In Slovakia, basic legal conditions were established to fulfil this requirement in Section 5(1)(d) of the Ministry of Environment of the Slovak Republic Decree No 283/2001 Coll. (45) This section stipulates that the binding part of the waste management program of the relevant state administration authorities should include measures to reduce the amount of biodegradable municipal waste deposited in landfills. This reduction is expressed in units of weight in the baseline and target years, to achieve a reduction in the disposal of such waste in landfills in the following manner:

- Within 9 years from the effective date of Decree No 283/2001 Coll., the amount of biodegradable municipal waste deposited in landfills will be reduced to 75% (-25%) of the Strategy for Reducing the Disposal of Biodegradable Waste in Landfills Ministry of the Environment of the Slovak Republic 8 total amount (weight) of biodegradable municipal waste generated between 1995-2010.
- Within 12 years from the effective date of Decree No 283/2001 Coll., the amount of biodegradable municipal waste deposited in landfills will be reduced to 50% (-50%) of the total amount of biodegradable municipal waste generated between 1995 and 2013.
- Within 19 years from the effective date of Decree No 283/2001 Coll., the amount of biodegradable municipal waste deposited in landfills will be reduced to 35% (-65%) of the total amount (weight) of biodegradable municipal waste generated between 1995 and 2020.

Table 8.2.40: Projections of activity data on composting in the WEM scenario

YEAR	UNIT	2020	2030	2040	2050
MSW	kilo tonnes of dm	265.15	264.10	310.64	357.18
Other SW	kilo tonnes of dm	315.78	306.70	322.77	338.84

Waste incineration (5C) - Currently, no strategy addresses the construction of new incineration plants for non-municipal waste without energy recovery. According to the Environmental Strategy 2030 (47), the recycling rate of municipal waste, including its preparation for reuse, should increase to 60% in Slovakia by 2030, and the rate of landfilling should decrease to less than 25% by 2035. The Waste Management Program for 2020-2025 does not anticipate the construction of new incineration capacities. Increasing the recycling rate and reducing the amount of waste landfilled will not have a significant impact on the amount of waste incinerated without energy recovery. For modelling emission projections, one scenario was prepared only one scenario based on existing measures (realistic), also known as BAU (Business as Usual), is founded on the expectation that the trend in incinerating industrial waste without energy recovery will continue as observed over the past decade.

Wastewater treatment (5D) – the scenario with existing measures (realistic) or also called BAU = Business as Usual, is based on the expectation that wastewater management developments will continue as observed over the last decade. According to these assumptions, the development of the wastewater sector is characterised by an increase in the share of the population covered by sewerage systems, with the aim of reaching 85% coverage in 2050. This scenario corresponds with the information from the Envirostrategy 2030 (47), as well as with the recently adopted document "Concept of water policy of the Slovak Republic until 2030 with a view to 2050" (48). Similar visions are also declared in the Plan for the Development of Public Sewers for the Slovak Republic (49). This goal is also indirectly stated in the frequent statements that all agglomerations with a population of over 2000 and half of the agglomerations with a population of up to 2000 are planned to be part of the sewage network, which in total gives the value of about 85% of the population connected to the sewage system. This development can be characterised by the continuous development of sewerage systems and the modernisation of wastewater treatment plants to meet the requirements of the EU water sector strategies.

The scenario assumes that the number of inhabitants using storage tanks (cesspools) will decrease (from 26% in 2022 to 12% in 2050) due to the expansion of the sewerage network from 71 to 85% and also by increasing the number of domestic wastewater treatment plants from the current 2 to 3%.

The scenario with additional measures (optimistic) is based on the expectation that developments in the wastewater sector will continue with increased financial support from the Slovak government, as well as EU support under the Recovery Plan for Europe. This development is characterised by an accelerated increase in the share of the population connected to sewerage systems, with a target of 90% connection in 2050. This scenario corresponds to the aspiration to achieve a level of sewerage connection as high as in the developed Western European countries (at least 90% connection to sewers and wastewater treatment plants).

The scenario assumes that the number of inhabitants using septic tanks will decrease (from 26% in 2022 to 7% in 2050) as a result of the intensive expansion of sewerage from 71 to 90% and the construction of decentralised domestic wastewater treatment plants from 2 to 3%. This strategy corresponds to the strict requirement of the European Commission, as stated in procedure No 2016/2191, for non-compliance with certain articles of Council Directive 91/271/EEC (48) of 21 May 1991 concerning urban wastewater treatment. These measures are expected to contribute to a reduction of methane emissions in the municipal sector by almost 70% and in the industrial sector by 76% in 2050 compared to 2005.

8.2.9.4 Emission Projections in the Waste Sector

Emissions from the Waste sector do not have a key impact on overall emissions. Projection emissions are estimated based on new calculations for AP emissions projections in this sector. A significant share of total emissions is for NMVOC and NH₃, emission projections of SO_x, NH₃ and PM_{2.5} are also prepared (*Tables 8.2.41–8.2.41, Figure 8.2.54*).

NO_x emissions

Table 8.2.41: NO_x emissions in the Waste sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
5 Waste	0.427	0.434	0.477	0.383	0.385	0.386	0.387	0.391	0.395

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
5 Waste	0.427	0.434	0.477	0.383	0.385	0.386	0.386	0.390	0.394

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

NMVOC emissions

Table 8.2.42: NMVOC emissions in the Waste sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
5 Waste	1.378	0.823	0.798	0.750	0.718	0.685	0.658	0.650	0.643

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
5 Waste	1.378	0.823	0.798	0.750	0.718	0.663	0.612	0.588	0.566

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

SO_x emissions

Table 8.2.43: SO_x emissions in the Waste sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
5 Waste	0.012	0.012	0.014	0.011	0.012	0.012	0.012	0.012	0.012

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
5 Waste	0.012	0.012	0.014	0.011	0.012	0.011	0.011	0.011	0.011

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

NH₃ emissions

Table 8.2.44: NH₃ emissions in the Waste sector in kt

WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
5 Waste	1.007	0.925	2.548	2.226	2.177	2.162	2.301	2.383	2.394

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
5 Waste	1.007	0.925	2.548	2.226	2.177	2.155	2.287	2.191	2.035

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

PM_{2.5} emissions

Table 8.2.45: PM_{2.5} emissions in the Waste sector in kt

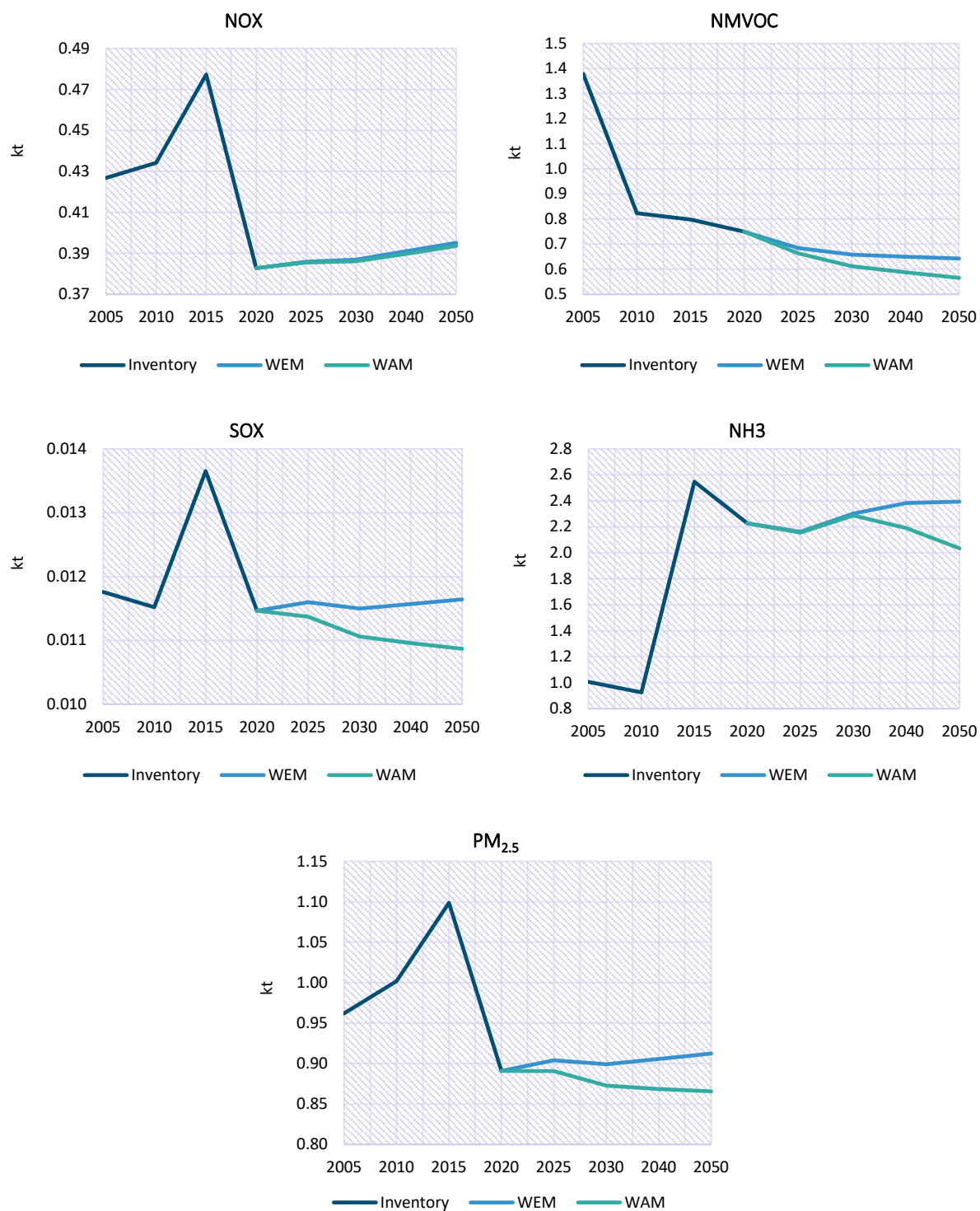
WEM	2005	2010	2015	2020	2022*	2025	2030	2040	2050
5 Waste	0.962	1.002	1.099	0.891	0.898	0.904	0.899	0.906	0.912

WAM	2005	2010	2015	2020	2022*	2025	2030	2040	2050

5 Waste	0.962	1.002	1.099	0.891	0.898	0.891	0.873	0.869	0.866

* Base year 2022; 1990 – 2022 based on the inventory submission 15. 3. 2024

Figure 8.2.54: Air pollutants emissions trends in the Waste sector



8.3 LARGE POINT SOURCES

8.3.1 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". Additional information was added to the IIR after the 2021 review.

All listed LPS are E-PRTR facilities as defined in the EMEP reporting guidelines, and at least one pollutant threshold in Annex II of the E-PRTR Regulation has been exceeded. 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 report.

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, when more activities are carried out (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 total emissions of the facility, and information about stack height is missing; therefore, the source of metadata was NEIS.

NEIS has much more detailed records than the National PRTR. The detailed information about NEIS is described in IIR [Annex IV, Chapter A4.2 SYSTEM CHARACTERISTICS](#).

The allocation of emissions into stack height categories also comes from NEIS.

The data in the National PRTR (as well as E-PRTR) and NEIS are consistent because the data reported to the National PRTR by the operators are usually validated in compliance with NEIS.

Possible discrepancies between LPS (Annex VI) and CLRTAP data (Annex I):

Heavy metals, POPs, PCDD/PCDF

- Annex I: sector-specific calculation methodology for the CLRTAP report in accordance with 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](#).

HCB, PCB

HCB and PCBs are not reported from any LPS facilities, because no emissions were reported into the national PRTR. Operators declare that – following to the permit, they are not obliged to monitor these substances.

Possible discrepancies between LPS (Annex VI) and E-PRTR data:

PM₁₀

- E-PRTR: The emissions of PM₁₀ are not reported in 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.

8.4 NATIONAL GRIDDED DATA

8.4.1 Overview

The 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 five years for the year x-2.

Gridded Emissions

This chapter includes basic information on data reported in the year 2025 for the year 2023.

Data from the years 2015, 2017, and 2021 are available in increased spatial resolution of the EMEP grid 0.1° x 0.1°. The data for previous years 1990, 1995, 2000, 2005, 2010, were reported in the submission in the year 2012.

8.4.2 Methodology and Data Sources for Gridded Emissions

Gridded data were reported in line with the EMEP/EEA GB 2023, part Spatial mapping of emissions in GNFR categories. Emissions from the inventory were spatially distributed using GIS methods. Gridded emissions for 2023 are consistent with reporting in 2025. LPS data were included within the submission of the gridded data. Gridded data were based on the fuel sold methodology.

Table 8.4.1: 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

8.4.3 Description of the methodology based on the division into NFR sectors

Energy and industry

Emissions from the energy and industry sectors were distributed based on available data from the National Emission Information System - NEIS, which contains data on large and medium-sized sources. Based on data on district affiliation and the amount of emissions, amounts were created for each air pollutant.

Transport

Emissions from road transport were spatially distributed based on data on the length of the road network and traffic intensity in individual districts of the Slovak Republic. Data from air quality modellers, who have a distribution of emissions based on traffic intensities prepared for them by the transport research institute - CDV – Brno, were also used as a basis.

Emissions from non-road transport make up a smaller part of emissions from transport and were distributed based on the location of airports, ports, railway junctions, the length of the Danube coast and the length of non-electrified railway routes.

Households

The spatial distribution of emissions from household combustion was calculated based on data on dwellings and fuel consumption in individual districts. Data on solid fuels by district were available from the National Emission Information System – NEIS. Based on historical trends in solid fuel consumption in districts, biomass consumption was estimated in all districts. Subsequently, emissions in individual districts were estimated from fuel data.

The emissions from households sector belong to the GNFR sector C_OtherStationaryComb. Emissions from the national inventory in households sector were spatially distributed based on data from 2021 to inhabited areas from the Corine landcover. Census 2021 was a source of information about fuels which is primary 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 the 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 is significantly higher than in the urban areas. It also depends on the region. Share of natural gas (NG) usage 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 2021 census, but also by data from the 2017, 2019 and 2022 household surveys.

Agriculture

Data on emissions from agriculture were distributed according to detailed information on livestock farming and fertilizer use, divided into districts of the Slovak Republic. For the distribution of NH₃ emissions, the Tier 1 methodology recommended in the EEA/EMEP GB 2023, Chapter 7, spatial mapping. We used data from the Corine land cover for arable land. And based on the area of arable land, we distribute emissions to each cell.

Waste

Emissions from landfilling were distributed based on the statistical yearbook Waste in the Slovak Republic. In the aforementioned yearbook, waste data are divided according to the region in which the waste was generated and individual waste categories according to the waste catalogue. The RISO information system was used to obtain data divided into districts. The share of waste in individual districts of the region was used from IS RISO.

Emissions from composting were divided into districts based on population density.

Emissions from waste incineration, biogas plants and wastewater treatment were divided into districts based on data on their location from the NEIS database.

GNFR sector C_OtherStationaryComb

The most emissions in sector C_OtherStationaryComb come from combustion in households for heating and hot water. Emissions from the national inventory in the households sector were spatially distributed based on data from the 2011 census to inhabited areas from the Corine Landcover. Census

2011 was the source of information about fuels, which are 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 the 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 NH₃ emissions, tier 1 methodology was recommended in the EMEP guidebook chapter 7 spatial mapping. We used data from the Corine Land Cover for arable land. And based on the area of arable land, we distribute emissions to each cell.

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ANNEX I: KEY CATEGORY ANALYSIS

Key categories were calculated on a detailed level for HMs and POPs in the sectors of Energy, Industry and Waste. Uncertainty analysis was also included in the calculation. 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 2024 in % (cumulative total at least 80%)

NOx	1A4cii(17)	1A4cii (20)	1A3biii(13)	1A3bi(12)	3Da1(10)	1A1a(6)	1A2gvii(4)	1A3c(3)	2C1(3)	1A3bii(3)	5C2(2)	1A2f(2)	3Da3(2)	1A4bi(2)
NM VOC	1B2av(28)	1A4bi(24)	2H2(9)	1A3bi(6)	3B1b(3)	1B1a(2)	1B2ai(2)	1A2gviii(2)	1B2b(2)	2D3d(1)	3B1a(1)			
SOx	1B2aiv(35)	1A1a(18)	1A4bi(8)	2C1(7)	1A1b(5)	2B10a(4)	1A2d(3)							
NH₃	3Da2a(37)	3Da1(33)	3B1b(6)	3B3(6)										
PM_{2.5}	1A4bi(53)	5C2(10)	1A3bvi(5)	3Dc(3)	1A3bvii(2)	1A3bi(2)	1B1b(2)	1A1a(2)	3B4h(1)	1A2a(1)				
PM₁₀	1A4bi(30)	3Dc(28)	1A3bvi(6)	5C2(6)	2A5b(3)	1B1b(3)	1A3bvii(2)	1A1a(1)	3B4gi(1)					
TSP	1A4bi(23)	3Dc(17)	5C1bi(7)	2A5b(7)	1A3bvi(5)	3B4gi(5)	1B1b(4)	5C2(4)	1A3bvii(3)	5C1bii(3)	3B4h(2)			
BC	1A4bi(45)	5C2(12)	1A3bi(8)	1A4bii(5)	2C1(5)	1A4cii(5)	1B1b(2)							
CO	1A4bi(42)	1A3bi(9)	1A3biii(8)	1A3bvi(8)	5C2(8)	2G(3)	1A3bii(2)	1A2gvii(2)						
Pb	1A3bvi(52)	1A3bi(19)	1A1a(9)	2C1(3)										
Cd	1A1a(22)	1A4bi(12)	1A1b(12)	1A3bvi(8)	2G(5)	2C7a(4)	1A2a(4)	5C1bii(4)	1A2c(3)	1A2d(3)	5C2(2)	1B1b(2)	2A3(2)	
Hg	1A1a(19)	1A2f(14)	2K(12)	1A2a(12)	5C1bv(9)	1A2d(6)	1A3bi(4)	1A4ai(2)	2C1(2)	5C1biii(2)				
As	1A1a(41)	1A5a(19)	1A3bvi(8)	5C2(4)	1A4bi(3)	2A3(2)	2C1(2)	2C7a(2)						
Cr	1A3bvi(71)	2C7a(5)	1A1b(3)	1A4bi(2)										
Cu	1A3bvi(59)	2C1(9)	1A3biii(8)	1A3bi(6)										
Ni	1A1a(31)	1A3bvi(26)	1A3di(iii)(10)	1A3dii(6)	1B1b(3)	1A2f(3)	1A2a(2)							
Se	2A3(48)	1A1a(13)	1A3bvi(6)	2C1(6)	1A2a(4)	1B1b(4)								
Zn	1A3bvi(50)	2D3i(11)	2C1(11)	1A3biii(3)	1A3bi(3)	1A1b(2)								
PCDD/F	2C7a(32)	1A1a(17)	1B1b(9)	1A1c(7)	1A4bi(6)	1A3bi(4)	5C2(3)	5C1biii(3)						
PAHs	2C1(41)	1B1b(21)	5C2(10)	1A4bi(10)										
HCB	1A1a(52)	1A2d(10)	2C1(7)	3Df(5)	1A4bi(4)	1A4ai(3)								
PCB	1A3c(47)	2C1(14)	1A1a(14)	1A2c(4)	5C1biii(2)									

Note: Different colours used to highlight sectors - 1, 2, 3, 5

Table A1.2: Trend assessment of the key categories analysis with uncertainty of air pollutants in the Slovak Republic in 2024 in % (cumulative total at least 80%)

NO_x	3Da1(26)	1A3bi(12)	3Da2a(8)	3Da3(8)	1A4cii(6)	1A3biii(4)	1A3bii(4)	1A2gvii(3)	1A3c(3)	1A2f(3)	2C1(3)	1A3di(ii)(2)
NM VOC	2H2(16)	1B2b (8)	1A4bi(6)	1B2ai(6)	1A3bv(5)	3B1b(5)	3B1a(4)	2D3d(3)	3B4gii(2)	3De(1)	1A2gviii(1)	2D3a(1)
SO_x	1B2aiv(46)	2C1(12)	1A1b(10)	2B10a(5)	1A2a(3)	5C1bii(3)	1A2f(2)					
NH₃	3Da1(46)	3Da2a(21)	3B1b(7)	3Da3(5)	3B3(5)							
PM_{2.5}	1A4bi(40)	5C2(12)	1A3bvi(6)	3Dc(4)	1A3bi(3)	1A3bvii(3)	1B1b(3)	3B1b(3)	3B1a(2)	3B4h(2)	5E(1)	
PM₁₀	3Dc(33)	1A4bi(17)	5C2(6)	1A3bvi(6)	2A5b(3)	3B4gi(3)	1B1b(3)	1A3bvii(3)	3B3(2)	3B4gii(2)	3B1b(2)	
TSP	3Dc(19)	3B4gi(11)	3B3(10)	1A4bi(9)	2A5b(8)	1A3bvi(5)	1B1b(5)	5C2(4)	1A3bvii(3)	3B1b(3)	3B4gii(3)	3B1a(2)
BC	1A4bi(34)	5C2(20)	2C1(9)	1A2bii(8)	1A3bi(4)	1B1b(4)	1A5gvii(2)					
CO	1A4bi(27)	1A3bi(16)	5C2(10)	1A3bvi(9)	1A4cii(7)	1A3bii(5)	2G(4)	1A2gvii(3)	1B1b(3)			
Pb	1A3bvi(77)	2C1(6)										
Cd	1A2c(21)	1A4bi(12)	1A3bvi(10)	1A1b(10)	2G(6)	1A2a(5)	5C1bii(5)	1B1b(4)	5C2 (3)	2C1(2)	2A3(2)	1A1a(5)
Hg	1A2f(23)	2K(19)	5C1bv(12)	1A2a(10)	1A2d(8)	1A3bi(6)	1A4ai(2)	1B1b(2)				
As	1A3bvi(20)	5C2(14)	2C1(11)	2A3(10)	1A1a(8)	1B1b(5)	1A2c(4)	1A2d(4)	1A2f(4)			
Cr	1A3bvi(78)	2C7a(6)										
Cu	1A3bvi(98)											
Ni	1A1a(28)	1A3bvi(22)	1A3di(ii)(21)	1A3dii(6)	2C1(5)							
Se	2A3(62)	2C1(9)	1A3bvi(7)	1B1b(6)								
Zn	1A3bvi(48)	2D3i(25)	2C1(14)									
PCDD/F	2C7a(39)	1B1b(12)	1A4bi(11)	1A1c(9)	1A3bi(5)	5C2(4)	1A3c(2)					
PAHs	2C1(49)	1B1b(28)	5C2(8)									
HCB	1A1a(54)	1A2d(10)	2C1(8)	5C1bii(3)	1A4ai(3)	3Df(2)						
PCB	2C1(67)	1A3c(9)	1A1a(9)									

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 cell categories are unknown when using the condensable component in emission factors of particulate matter.

Table A2.1: Inclusion/exclusion of the condensable component from the PM₁₀ 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

	SOURCE	PM EMISSIONS: THE CONDENSABLE COMPONENT IS:		EF REFERENCE AND COMMENTS
		INCLUDED	EXCLUDED	
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
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			

	SOURCE	PM EMISSIONS: THE CONDENSABLE COMPONENT IS:		EF REFERENCE AND COMMENTS
		INCLUDED	EXCLUDED	
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]
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			

	SOURCE	PM EMISSIONS: THE CONDENSABLE COMPONENT IS:		EF REFERENCE AND COMMENTS
		INCLUDED	EXCLUDED	
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
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 2024 in TJ

	Anthracite	Coking Coal	Other Bituminous Coal	Brown Coal and Lignite	Hard Coal Coke	Brown Coal Briquettes	Coal Tar	Coke Oven Gas	Blast Furnace Gas	Oxygen Steel Furnace Gas
Primary Production	-	-	-	-	-	-	-	-	-	-
Import	508	68,400	8,188	2,816	4,075	567	-	-	-	-
Export	-	-	-	-	28	-	1,741	-	-	-
Stock Changes	401	-1,120	2,413	866	-2,859	-	-	-	-	-
Gross Inland Consumption	909	67,280	10,601	3,682	1,188	567	-1,741	-	-	-
Statistical difference	-	-	-	-	-	-	-	-	-	-
Transformation Input	428	67,280	3,470	2,284	38,123	-	-	661	1,210	270
Electricity Production - Thermal Equipment	428	-	3,470	2,264	-	-	-	661	1,204	255
of which: Public	428	-	2,196	2,264	-	-	-	-	-	-
Autoproducers	-	-	1,274	-	-	-	-	661	1,204	255
Nuclear Plants	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	54,549	-	-	-	-	-	-	-	-
Blast Furnaces	-	12,731	-	-	38,123	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	20	-	-	-	-	6	15
Transformation Output	-	-	-	-	39,652	-	1,741	9,763	17,691	3,025
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	39,652	-	1,741	9,763	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	17,691	3,025
Refineries	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	-	-	-	-	-	-	-	-	-	-
Product Transferred	-	-	-	-	-	-	-	-	-	-
Backflows from Petrochemical Sector	-	-	-	-	-	-	-	-	-	-
Consumption of the Energy Sector	-	-	-	-	-	-	-	3,133	9,796	-
Distribution Losses	-	-	-	-	-	-	-	146	1,225	480

1st continuation

	Anthracite	Coking Coal	Other Bituminous Coal	Brown Coal and Lignite	Hard Coal Coke	Brown Coal Briquettes	Coal Tar	Coke Oven Gas	Blast Furnace Gas	Oxygen Steel Furnace Gas
Final Consumption	481	-	7,131	1,398	2,717	567	-	5,823	5,460	2,275
Final Non - Energy Consumption	187	-	-	-	1,104	-	-	-	-	-
of which: Chemical Industry	-	-	-	-	-	-	-	-	-	-
Final Energy Consumption	294	-	7,131	1,398	1,613	567	-	5,823	5,460	2,275
Industry	294	-	5,558	768	1,556	-	-	5,823	5,460	2,275
of which: Iron and steel	294	-	5,070	-	509	-	-	5,818	5,460	2,275
Non - ferrous metals	-	-	-	-	85	-	-	-	-	-
Chemical	-	-	-	-	28	-	-	-	-	-
Non - metallic minerals	-	-	488	748	877	-	-	5	-	-
Mining and quarrying	-	-	-	-	-	-	-	-	-	-
Food, beverages and tobacco	-	-	-	-	57	-	-	-	-	-
Textile and leather	-	-	-	-	-	-	-	-	-	-
Pulp, paper and print	-	-	-	-	-	-	-	-	-	-
Mach. and transport equipment	-	-	-	20	-	-	-	-	-	-
Not elsewhere specified	-	-	-	-	-	-	-	-	-	-
Transport	-	-	-	-	-	-	-	-	-	-
Other Sectors	-	-	1,573	630	57	567	-	-	-	-
of which: Households	-	-	217	551	57	504	-	-	-	-
Agriculture	-	-	-	-	-	-	-	-	-	-
Commercial and public services	-	-	1,356	79	-	63	-	-	-	-

2nd continuation

	Natural Gas	Crude Oil and NGL	Refinery Feedstock ^{1/}	Refinery Gas	LPG	Naphta	Gasoline	Kerosene
Primary Production	1,451	84	7,896	-	-	-	-	-
Import	143,336	195,011	-	-	2,254	924	9,622	346
Export	-	42	-	-	1,656	4,928	32,028	2,511
Stock Changes	11,663	1,428	-	-	184	88	835	-43
Gross Inland Consumption	156,450	196,481	7,896	-	782	-3,916	-21,571	-2,208
Statistical difference	1,113	-	-	-	-	-	-	-
Transformation Input	33,633	196,481	29,028	251	-	-	-	-
Electricity Production - Thermal Equipment	26,112	-	-	251	-	-	-	-
of which: Public	24,850	-	-	-	-	-	-	-
Autoproducers	1,262	-	-	251	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-
Refineries	-	196,481	29,028	-	-	-	-	-
Heat Production	7,521	-	-	-	-	-	-	-
Transformation Output	-	-	-	13,392	5,244	17,116	49,908	3,637
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-
Refineries	-	-	-	13,392	5,244	17,116	49,908	3,637
Heat Production	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	-5,841	-	21,132	-	-1,610	-4,928	-	-
Product Transferred	-5,841	-	14,594	-	-	-	-	-
Backflows from Petrochemical Sector	-	-	6,538	-	-1,610	-4,928	-	-
Consumption of the Energy Sector	3,919	-	-	10,407	-	-	-	-
Distribution Losses	2,990	-	-	-	-	-	-	-

3rd continuation

	Natural Gas	Crude Oil and NGL	Refinery Feedstock ^{1/}	Refinery Gas	LPG	Naphta	Gasoline	Kerosene
Final Consumption	108,954	-	-	2,734	4,416	8,272	28,337	1,429
Final Non - Energy Consumption	14,922	-	-	-	2,024	8,272	-	-
of which: Chemical Industry	14,922	-	-	-	2,024	8,272	-	-
Final Energy Consumption	94,032	-	-	2,734	2,392	-	28,337	1,429
Industry	31,460	-	-	2,734	368	-	44	-
of which: Iron and steel	5,504	-	-	-	-	-	-	-
Non - ferrous metals	1,382	-	-	-	-	-	-	-
Chemical	5,125	-	-	2,734	-	-	-	-
Non - metallic minerals	4,047	-	-	-	92	-	-	-
Mining and quarrying	970	-	-	-	-	-	-	-
Food, beverages and tobacco	4,265	-	-	-	46	-	-	-
Textile and leather	279	-	-	-	-	-	-	-
Pulp, paper and print	1,190	-	-	-	-	-	-	-
Mach. and transport equipment	5,221	-	-	-	92	-	44	-
Not elsewhere specified	3,477	-	-	-	138	-	-	-
Transport	347	-	-	-	1,702	-	28,293	1429
Other Sectors	62,225	-	-	-	322	-	-	-
of which: Households	41,647	-	-	-	184	-	-	-
Agriculture	1,112	-	-	-	92	-	-	-
Commercial and public services	19,466	-	-	-	46	-	-	-

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	42,823	1,950	-	2,020	688	2,718	6,697	130	2,657	5,148
Export	66,969	1,097	2,504	9,090	516	502	3,207	-	-	12,786
Stock Changes	-210	-	242	364	-	-	-	-	173	422
Gross Inland Consumption	-24,356	853	-2,262	-6,706	172	2,216	3,490	130	2,830	-7,216
Statistical difference	-	-	-	-	-	-	-	-	-	-
Transformation Input	42	-	-	2,303	-	-	-	-	-	-
Electricity Production - Thermal Equipment	42	-	-	2,303	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-	-	-
Autoproducers	42	-	-	2,303	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	-	-	-	-	-	-	-
Transformation Output	104,408	-	2,262	15,231	-	-	-	-	1,381	9,326
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	-
Refineries	104,408	-	2,262	15,231	-	-	-	-	1,381	9,326
Heat Production	-	-	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	-	-	-	-	-	-	-	-	-	-
Product Transferred	-	-	-	-	-	-	-	-	-	-
Backflows from Petrochemical Sector	-	-	-	-	-	-	-	-	-	-
Consumption of the Energy Sector	-	-	-	-	-	-	-	-	1,381	-
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	80,010	853	-	6,222	172	2,216	3,490	130	2,830	2,110
Final Non - Energy Consumption	-	609	-	-	172	2,216	3,490	130	1,415	2,110
of which: Chemical Industry	-	609	-	-	-	-	-	-	-	2,110
Final Energy Consumption	80,010	244	-	6,222	-	-	-	-	1,415	-
Industry	715	82	-	6,222	-	-	-	-	1,415	-
of which: Iron and steel	-	-	-	-	-	-	-	-	-	-
Non - ferrous metals	-	-	-	-	-	-	-	-	-	-
Chemical	-	-	-	6,222	-	-	-	-	-	-
Non - metallic minerals	84	-	-	-	-	-	-	-	1,415	-
Mining and quarrying	168	-	-	-	-	-	-	-	-	-
Food, beverages and tobacco	42	41	-	-	-	-	-	-	-	-
Textile and leather	-	-	-	-	-	-	-	-	-	-
Pulp, paper and print	-	-	-	-	-	-	-	-	-	-
Mach. and transport equipment	84	-	-	-	-	-	-	-	-	-
Not elsewhere specified	337	41	-	-	-	-	-	-	-	-
Transport	77,234	-	-	-	-	-	-	-	-	-
Other Sectors	2,061	162	-	-	-	-	-	-	-	-
of which: Households	-	-	-	-	-	-	-	-	-	-
Agriculture	2,061	-	-	-	-	-	-	-	-	-
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	190,060	419	332	5,550	-	45,779	2,259	6,026	6,099	18	17,374	2,498	-	7,792	293,637
Import	-	-	-	-	60	155	-	-	475	-	-	-	52,070	5,719	559,357
Export	-	-	-	-	-	339	-	-	-	-	-	-	62,676	4,940	207,560
Stock Changes	-	-	-	-	-	-311	-	-	-19	-	-	-	-	182	14,699
Gross Inland Consumption	190,060	419	332	5,550	60	45,284	2,259	6,026	6,555	18	17,374	2,498	-10,606	8,753	660,133
Statistical difference	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,113
Transformation Input	188,315	-	300	-	-	17,034	2,051	4,891	243	-	-	-	-	-	588,298
Electricity Production - Thermal Equipment	-	-	-	-	-	13,945	2,051	4,831	112	-	-	-	-	-	57,929
of which: Public	-	-	-	-	-	8,349	-	1,117	-	-	-	-	-	-	39,204
Autoproducers	-	-	-	-	-	5,596	2,051	3,714	112	-	-	-	-	-	18,725
Nuclear Plants	188,315	-	-	-	-	-	-	-	-	-	-	-	-	-	188,315
Coke Ovens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54,549
Blast Furnaces	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50,854
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225,509
Heat Production	-	-	300	-	-	3,089	-	60	131	-	-	-	-	-	11,142
Transformation Output	-	-	-	-	22,368	-	-	-	-	-	-	-	86,119	-	402,264
Electricity Production - Thermal Equipment	-	-	-	-	12,728	-	-	-	-	-	-	-	20,484	-	33,212
of which: Public	-	-	-	-	10,890	-	-	-	-	-	-	-	12,636	-	23,526
Autoproducers	-	-	-	-	1,838	-	-	-	-	-	-	-	7,848	-	9,686
Nuclear Plants	-	-	-	-	-	-	-	-	-	-	-	-	65,635	-	65,635
Coke Ovens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51,156
Blast Furnaces	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20,716
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	221,905
Heat Production	-	-	-	-	9,640	-	-	-	-	-	-	-	-	-	9,640
Exchanges and Transfers, Backflows	-1,745	-2	-	-5,550	7,297	-	-	-	-	-18	-17,374	-2,498	19,890	-8,753	0
Product Transferred	-1,745	-2	-	-5,550	7,297	-	-	-	-	-18	-17,374	-2,498	19,890	-8,753	0
Backflows from Petrochemical Sector	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Consumption of the Energy Sector	-	2	-	-	2,605	-	-	-	-	-	-	-	12,826	-	44,069
Distribution Losses	-	-	-	-	2,115	16	-	-	-	-	-	-	5,494	-	12,466

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 Consumption	-	415	32	-	25,005	28,234	208	1,135	6,312	-	-	-	77,083	-	416,451
Final Non - Energy Consumption	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36,651
of which: Chemical Industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27,937
Final Energy Consumption	-	415	32	-	25,005	28,234	208	1,135	6,312	-	-	-	77,083	-	379,800
Industry	-	-	-	-	1,617	12,505	-	88	6,301	-	-	-	32,951	-	118,236
of which: Iron and steel	-	-	-	-	21	-	-	-	-	-	-	-	6,304	-	31,255
Non - ferrous metals	-	-	-	-	61	-	-	-	-	-	-	-	738	-	2,266
Chemical	-	-	-	-	307	63	-	-	492	-	-	-	3,755	-	18,726
Non - metallic minerals	-	-	-	-	154	126	-	-	5,797	-	-	-	2,646	-	16,479
Mining and quarrying	-	-	-	-	1	-	-	-	-	-	-	-	209	-	1,348
Food, beverages and tobacco	-	-	-	-	102	240	-	30	-	-	-	-	2,570	-	7,393
Textile and leather	-	-	-	-	40	-	-	-	-	-	-	-	475	-	794
Pulp, paper and print	-	-	-	-	406	9,634	-	58	-	-	-	-	3,060	-	14,348
Mach. and transport equipment	-	-	-	-	330	147	-	-	12	-	-	-	9,533	-	15,483
Not elsewhere specified	-	-	-	-	195	2,295	-	-	-	-	-	-	3,661	-	10,144
Transport	-	-	-	-	-	-	-	-	-	-	-	-	2,592	-	111,597
Other Sectors	-	415	32	-	23,388	15,729	208	1047	11	-	-	-	41,540	-	149,967
of which: Households	-	374	-	-	16,611	15,396	-	-	-	-	-	-	20,750	-	96,291
Agriculture	-	-	32	-	23	262	-	721	-	-	-	-	749	-	5,052
Commercial and public services	-	41	-	-	6,754	71	208	326	11	-	-	-	20,041	-	48,624

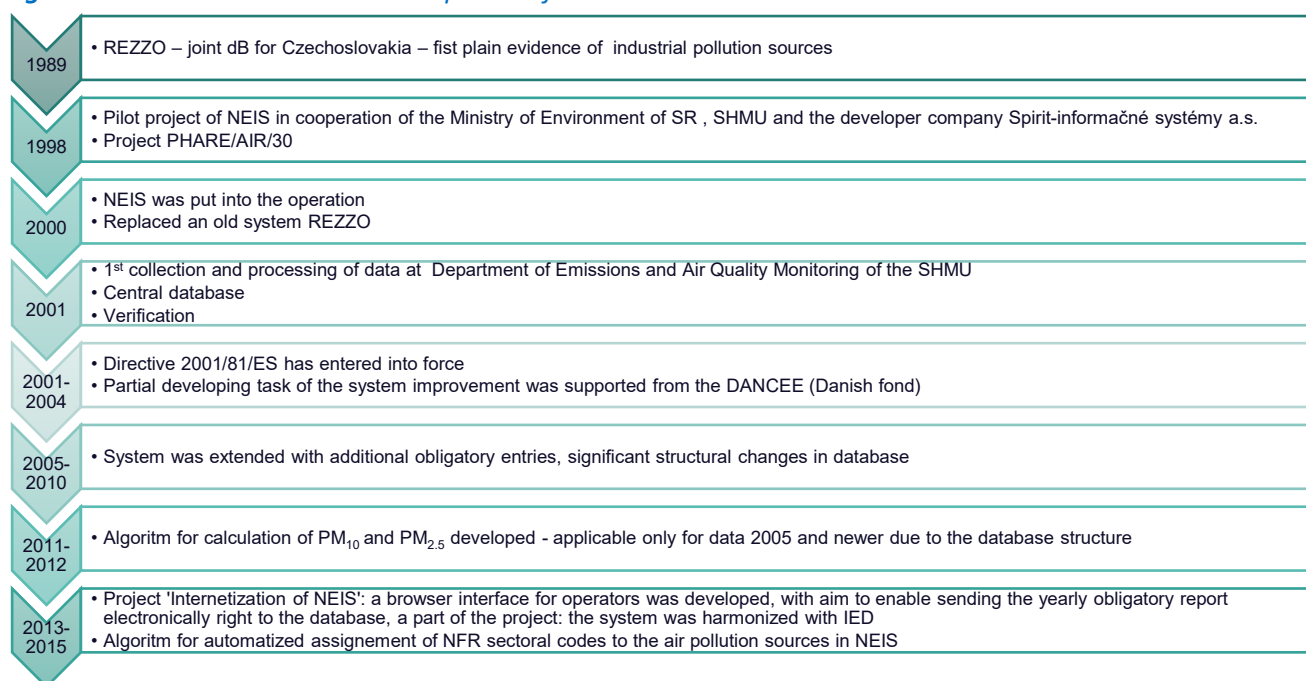
ANNEX IV: ADDITIONAL INFORMATION ON METHODOLOGY

ANNEX IV includes additional information on the methodology used in the NEIS database.

The NEIS database is the National Emission Information System for air pollutants (NO_x, SO_x, NMVOC, NH₃, HM and TSP). Information System NEIS was established in 1998. The database was developed to fulfil the national legislation on air quality and the requirements for pollutant fees decisions (Act No 401/1998 on air pollution charges as amended). Since 2000, when the NEIS was set into operation, emissions have been directly collected consistently and verified on multiple levels. This database replaced the old system REZZO (Emission and Air Pollution Source Inventory). The first collection and processing of data by NEIS was realised 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.

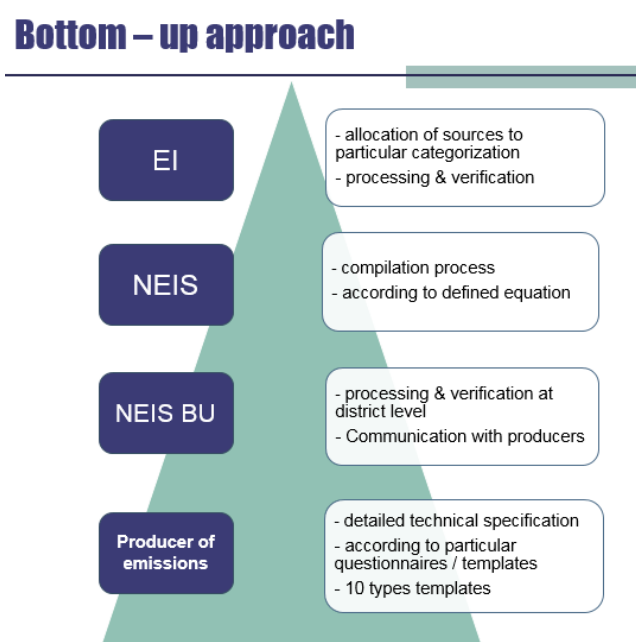
The last changes within the improvement of the NEIS were carried out from December 2013 until August 2015. Within the scope of the recent Project 'Internetisation of NEIS, a browser interface was developed. The aim was to enable sending the yearly obligatory report electronically right to the database NEIS PZ WEB. The module NEIS BU on district offices is connected to this database and data is synchronised.

Figure A4.1: Milestones in the development of the NEIS database



The emissions of air pollutants (NO_x, SO_x, NMVOC, NH₃, TSP, PMs and HM) are recorded and calculated on a yearly basis in the NEIS database. The data collection of air pollutants and emission inventory preparation is performed by a standardised procedure. For the international emission inventory requirements, the bottom-up approach has been introduced for the basic pollutants

Figure A4.2: Scheme of the bottom-up approach built-in database NEIS



A4.1 DATA COLLECTION

Annual data is collected from energy and industry sources following the Act on Air Protection No 137/2010 Coll. (1) 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, the complete list of forms is presented with the name and content of the 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 the 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 categorisation, 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 categorisation for solid, liquid, gaseous fuels, biomass and other fuels. The emissions balances of air pollutants in the range from 2000–2024 were processed in the NEIS CU module in 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 the 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

FORM TYPE	NAME	CONTENT
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
T6	Source of air pollution	Steady data about the source
T7	Location of discharge and release of AP	Base data on stacks, exhausts and a 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 the 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

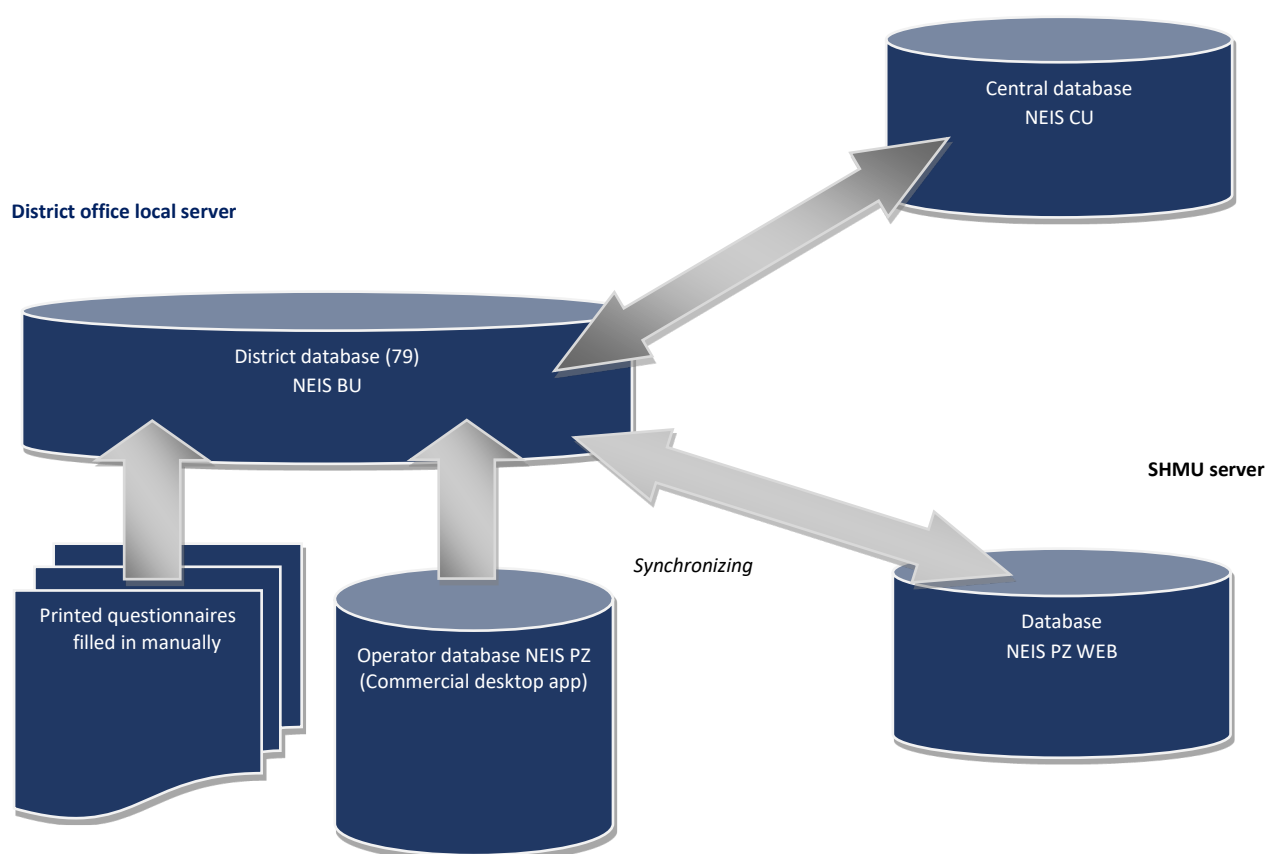
Database NEIS includes about 13,000 sources of air pollution per year. The sources are categorised by activity and projected capacity as large or medium (Decree No 410/2012 Coll. (2)) as follows:

- 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 a 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-sized 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 146/2023 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 as a functional and spatial complexity of all plants and activities. In some cases, this definition overlaps with 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 databases in NEIS



Each source can contain one or more combustion plants and/or one or more technologies. The quantifying of the yearly emissions is executed on the plant/technology level. The applicable methods for quantifying are enacted in Decree No 411/2012 (2) 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 the emission factor evaluated by periodic measurement,
- calculation using mass flow or mass concentration evaluated by periodic measurement,
- general emission-dependence approach,
- default emission factor approach¹,
- 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 organisations,
- other suitable approaches to filling the given requirements,
- combination of previous approaches.

¹ General relations, as well as default EF, are published in Decree of the Ministry of the Environment No 410/2012 Coll. (3)

Possibly, the 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 is expected, along with the development of the methodology for automated re-assignment of sectoral codes to the individual sources. The accessible timeline in NEIS (2000-2024) was revised: emissions from individual air pollution sources were reallocated according to revised sectoral codes.

The methodology for automated re-assignment is based on the following key data:

- Air pollution source category (Decree No 410/2012 Coll. (3))
- SK NACE rev.2 code of the operator

The developed algorithm checks the key data, compares this with the assignment rules and based on 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

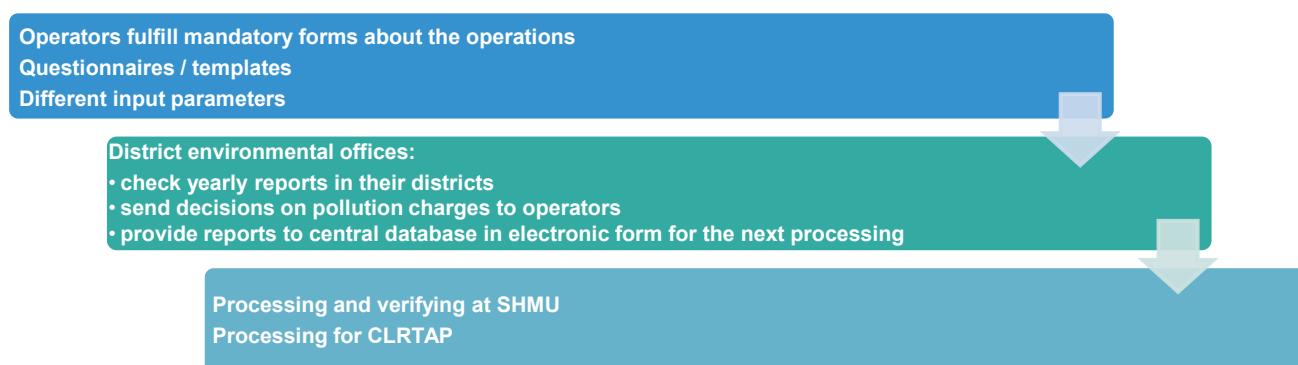
The sources below 0.3 MW (category **1A4bi** – Residential: Stationary plants) are defined as small sources. These are not registered as individual point sources. The emission balance is being processed centrally (NEIS CU - central unit), and it is based on:

- 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 Coll. (4)
- in 2004–2009, according to Decree No 53/2004 Coll. (5)
- since 2010, according to Decree No 362/2010 Coll. (6)
- Consumption of natural gas for the inhabitants and the annual market share of gas sales in SR
- Consumption of electric energy in households
- Annually specified emission factor

A4.3 DATAFLOW AND PROCESSING

According to Act No 137/2010 Coll. (1) as amended by Act No 318/2012 Coll. (7), 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 also contains 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



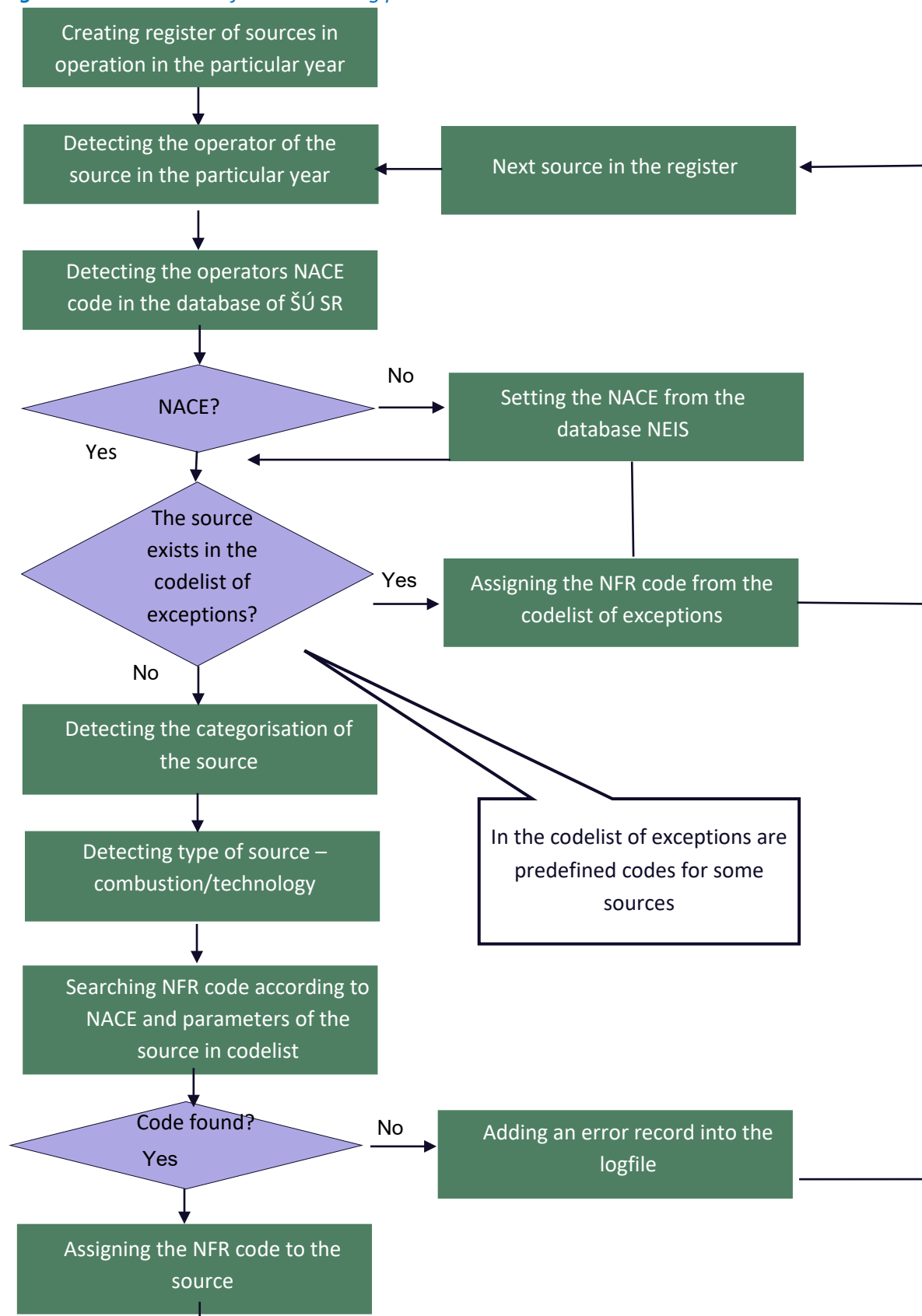
A4.4 VERIFICATION PROCESS OF NEIS DATA

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 automated 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 verification and explanation of their input data.

The second verification level is in a central database in SHMÚ, where the automated verification includes built-in check-up mechanisms for illogical and missing key data, and partly by a specialist for environmental issues. In cases when the data are not clear, the operator or the responsible district offices are contacted, or the operators are contacted directly.

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 gas ³ .	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

$$Em[t] = (1 - \eta/100) \times EF[kg/t] \times AP[\%] \times AD[t] \times 10^{-3}$$

$$Em[t] = (1 - \eta/100) \times EF[kg/mil.m^3] \times AP[\%] \times AD[th.m^3] \times 10^{-6}$$

$$Em [t] = (1 - \eta/100) \times EF [kg/t] \times AP [mg/kg] \times AD [t] \times 10^{-9}$$

$$Em [t] = (1 - \eta/100) \times EF [kg/mil.m^3] \times AP [mg/kg] \times AD [th.m^3] \times 10^{-12}$$

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)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

$$Em [t] = (1 - \eta/100) \times EF [kg/t] \times AP [\% \text{ in dry matter}] \times 1 - W/100 \times AD [t] \times 10^{-3}$$

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

$$Em [t] = (1 - \eta/100) \times EF [kg/GJ] \times NCV [GJ/t] \times AD [t] \times 10^{-3}$$

$$Em [t] = (1 - \eta/100) \times EF [kg/GJ] \times NCV [GJ/th.m^3] \times AD [th.m^3] \times 10^{-3}$$

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 basis of measurements or more precisely by calculation (in compliance with the air protection legislation of the Slovak Republic). The emission inventory of PM₁₀ and PM_{2.5} for the Slovak Republic is elaborated according to the EMEP/EEA GB 2023 and in compliance with the 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 (8).

Automated calculation of emissions PM₁₀ and PM_{2.5} was technically implemented in 2011 (9) in db. NEIS, according to the study (10). Emissions PM₁₀ and PM_{2.5} were processed with certain sectoral default indicators. In respect of that, on the EU level, an emission ceiling for 2020 was established based on the GAINS model (from IIASA), so we adopted the methodology of calculating the inventory of PM₁₀ and PM_{2.5}. The national inventory is based on the modelling of national projections

The NEIS database contains a special program that automatically calculates emissions of PM₁₀ and PM_{2.5}. The outputs from the NEIS database are verified and presented in Excel sheets. The efficiency of the installed separation of fractions is defined, and then emissions of PM₁₀ and PM_{2.5} behind the separator were calculated. After calculations behind the separator, the calculation of total emissions of PM₁₀ and PM_{2.5} is taken to the NFR tables

Emissions are distinguished into three fractions: fine (PM_{2.5}), coarse (PM₁₀ -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 the 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 (11). Updated emission factors are available in ANNEX I (12) and ANNEX II (13) of this study (only in Slovak).

A4.7 ABATEMENT TECHNOLOGIES

Table A4.3: List of 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

TYPE OF SEPARATOR	NAME
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
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

TYPE OF SEPARATOR	NAME
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
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 NO _x , catal.ox.SO ₂
KMB - combine	KMB - combine-DESONOX catalysing 1 chamber, NO _x catalytic reduction, catal.ox.SO ₃
KMB - combine	KMB - combine-AC-dry simultaneous adsorption on moving the activated carbon (coke) to H ₂ SO 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%]*	WHITE 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	DOWANOL
LACQUERS AND VARNISH																		
oil and varnish	XX																	
synthetic airborne	XX		X															
synthetic burning			XX								XX							
epoxid			XX								XX							
polyurethane			XX				XX								XX			
polymerate				XX			XX	XX							XX			
cellulose			XX	XX		XX	XX		XX	XX		XX						XX
asphalt	XX		XX															
estermid			XX											XX		XX		
resole			XX								XX							
PAINTS																		
oil and varnish	XX																	
synthetic airborne	XX		XX															
synthetic burning			XX	XX							XX							
polyurethane 2 K			XX				XX								XX			
polyurethane 1 K			X				XX								XX			
acrylic			XX				XX				XX							
cellulose		XX	XX	XX		XX	XX			XX		XX						
resole			XX			XX	XX				XX							
epoxide			XX								XX							
high solid paints	XX		XX															
chlorine rubber paints			XX				XX											
for print				XX		XX	XX	XX		XX								
THINNERS																		
synthetic	XX		XX															
polyurethane			XX				XX								XX			
cellulose				XX		XX	XX		XX	XX		XX						
other			XX	XX		XX	XX		XX	XX	XX	XX			XX			
solvent adhesives		XX		XX		XX							XX					XX
RESINS																		
unsaturated polyester					XX													
alkyde resins	XX		XX															
akryl resins			XX				XX				XX							
other resins											XX	XX						
COATING REMOVERS																		
old cover removers				XX				XX	XX	XX							XX	

XX-Confidential data

ANNEX V: NECD RECOMMENDATIONS

The Slovak Republic has prioritised its effort to implement the recommendations of the Review of National Air Pollutant Emission Inventory Data 2025 under Directive (EU) 2016/2284, which might have an impact on the emission estimates as far as possible in the 2025 submission. The implementation of the recommendations is shown in [Table A5.1](#).

Table A5.1: Status of implementation of the NECD recommendations

SERIAL NO.	REVIEW REPORT/ CHAPTER/PAGE	PRIORITY CRITERIA TCCCA ¹	PRIORITY CRITERIA KEY CATEGORY	PRIORITY CRITERIA OVER EMISSION 2%	PRIORITY LEVEL (VERY HIGH, HIGH, LOW)	REVIEW RECOMMENDATION
SK-OA-2025-0001	Final Review Report 2025, Chapter VI., p. 14	Transparency	Yes	Yes	High	OA National total - National total for the entire territory: The TERT recommends that Slovakia carefully evaluate all emission factors and other data used from the EMEP/EEA Guidebook and reference the correct and current version in the IIR in their next submission. Implemented in the IIR, various chapters.
SK-1A2f-2025-0002	Final Review Report 2025, Chapter VI., p. 21	Transparency	Yes	Yes	High	1A2f Stationary Combustion in Manufacturing Industries and Construction, PCDD/F, years 2012–2022: The TERT recommends that Slovakia carry out an investigation, report the outcome in the next IIR, and, if necessary, provide revised estimates that consider the level and type of abatement applied to this data. Implemented in Chapter 3.5.7.
SK-1A3bvi-2025-0001	Final Review Report 2025, Chapter VI, p.20	Completeness	No	No	Low	1A3bvi Road Transport: Automobile Tyre and Brake Wear, pollutants Pb and Cd, years 2005 to 2012: The TERT recommends that Slovakia include the revised estimate for Pb and Cd for years 2005-2012 using the COPERT 5 (v5.8) model in the next submission. Implemented in Chapter 3.6.3.
SK-1A3bvi-2025-0002	Final Review Report 2025, Chapter VI, p.21	Completeness	No	No	Low	1A3bvi Road Transport: Automobile Tyre and Brake Wear, pollutant PAHs, years 1990-2023: The TERT recommends that Slovakia provide emission estimates of PAHs for 1A3bvi Road transport: Automobile tyre and brake wear, following the methodology provided in the Q&A comment loop in the next submission. Implemented in Chapter 3.6.3.
SK-1A3c-2025-0001	Final Review Report 2025, Chapter V, p.15	Transparency	Yes	Yes	High	1A3c Railways, pollutant NOX, years 2020-2023: The TERT recommends that Slovakia include information on which Tier of method was used for this key category in the IIR in the next submission. Implemented in Chapter 3.6.4.
SK-1A4cii-2025-0001	Final Review Report 2025, Chapter V, p.14	Accuracy	Yes	Yes	Very high	1A4cii Agriculture/Forestry/Fishing: Off-Road Vehicles and Other Machinery, NOX: The TERT recommends that Slovakia include the revised estimate using the Tier 2 approach for all pollutants in the next submission. Implemented in Chapter 3.7.7.

SERIAL NO.	REVIEW REPORT/ CHAPTER/PAGE	PRIORITY CRITERIA TCCCA ¹	PRIORITY CRITERIA KEY CATEGORY	PRIORITY CRITERIA OVER EMISSION 2%	PRIORITY LEVEL (VERY HIGH, HIGH, LOW)	REVIEW RECOMMENDATION
SK-2A3-2025-0003	Final Review Report 2025, Chapter V., p. 20	Completeness	Yes	Yes	High	2A3 Glass Production, pollutant Pb and Cd, years 1990-2023: The TERT recommends that Slovakia include the revised estimate for Pb and Cd using the Tier 1 approach for water glass and fibre glass production in the next submission. Implemented in Chapter 4.4.4.
SK-2A5c-2025-0001	Final Review Report 2025, Chapter V., p. 15	Transparency	No	No	Low	2A5c Storage, Handling and Transport of Mineral Products, pollutants SO ₂ , NOX, NH ₃ , NMVOC, years 1990-2023: The TERT recommends that Slovakia follow up on the change of notation keys in this category, as suggested for the next submission. Implemented in Chapter 4.4.7.
SK-3-2025-0001	Final Review Report 2025, Chapter V., p. 16	Consistency	No	Yes	Very high	3B Manure management and 3Da2a Animal manure applied to soils, pollutants NH ₃ , years 2006-2023: The TERT recommends that Slovakia explore options to extrapolate penetration rates of mitigation measures backwards from 2006, using expert judgment, if necessary, to improve time series consistency for the next submission. Not Implemented
SK-3B2-2025-0001	Final Review Report 2025, Chapter V., p. 16	Consistency	No	Yes	Very high	3B2 Manure Management - Sheep, pollutant PM ₁₀ , years 2005, 2020-2022: The TERT recommends that in the next submission, Slovakia: i) correct the aggregation error discovered for PM _{2.5} emissions, and ii) update the calculation method for PM emissions by scaling the Tier 1 emission factors to account for the fraction of the year that each livestock category spends in housing. Implemented in Chapter 5.8.5.
SK-3Da1-2025-0001	Final Review Report 2025, Chapter V., p. 13	Accuracy	Yes	Yes	Very high	3Da1 Inorganic N-fertilisers, NH ₃ , across the whole time series: The TERT recommends that Slovakia include a revised estimate using EMEP/EEA GB 2023 Tier 2 EFs in the next submission. Implemented in Chapter 5.9.8.
SK-3Da4-2025-0001	Final Review Report 2025, Chapter V., p. 13	Accuracy	Yes	Yes	Very high	3Da4 Crop Residues Applied to Soils, NH ₃ , for the whole time series: The TERT recommends that Slovakia include a revised estimate with corrected calculation for NH ₃ in the next submission. Implemented in Chapter 5.9.8.

Serial No.	Review report/ Chapter/Page	Priority criteria TCCCA ¹	Priority criteria Key category	Priority criteria over emission 2%	Priority level (Very high, High, Low)	Review Recommendation
SK-3De-2025-0001	Final Review Report 2025, Chapter V., p. 17	Accuracy	No	Yes	High	3De Cultivated Crops, pollutant NMVOC, years 1990-2023: The TERT recommends that Slovakia correct Table 5.51 and related text in the next IIR submission to be consistent with the values used in calculations. Implemented in Chapter 5.10.3.
SK-5B1-2025-0001	Final Review Report 2025, Chapter VI., p. 17	Transparency	Yes	Yes	High	5B1 Biological Treatment of Waste - Composting, pollutant NH ₃ , years 1990-2023: TERT recommends that Slovakia provide a clear description of the activity data used and any aggregations undertaken in the next submission. Implemented in Chapter 6.5.2.
SK-5C-2025-0001	Final Review Report 2025, Chapter V., p. 18	Transparency	Yes	Yes	High	5C Waste incineration, pollutants SO ₂ , NO _x , NMVOC, PM _{2.5} , BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, PM ₁₀ , years 2005-2023: The TERT recommends that Slovakia include a more detailed description of the methodology used for emissions resulting from waste incineration with energy recovery in its next submission. Implemented in Chapters 3.4.2, 3.4.3 and 3.5.4.

ANNEX VI: IMPLEMENTATION OF MITIGATION MEASURES FOR AMMONIA EMISSIONS REDUCTION IN AGRICULTURE

Revision of the provided information was done according to the NECD [Recommendation No A8/SK-3Da2a-2023-0001](#) of the SVK NECD Final Review Report 2025. 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

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 Coll. (14) on Air and Decree of the Ministry of the Environment of the Slovak Republic No 410/2012 Coll. (15) 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 abatements used as well.

The emissions from the NEIS database cannot be fully implemented into the national emission inventories due to the validity of the legislation. In addition, ammonia emissions from goats are missing entirely in the database due to a lack of law. The best practice for the NH₃ estimation is to analyse nitrogen flux in agriculture. Estimation of nitrogen flux is a more complex approach, which was used during NH₃ calculation. During it, nitrogen losses are formed as nitrogen emissions (NH₃, NO, N₂O). Emissions are estimated from each breeding phase. The NEIS calculates only NH₃ emissions. The Slovak Republic shall also report other nitrogen emissions (NO, N₂O). The NH₃ 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 the NH₃ balance annually according to the EMEP/EEA GB 2023 using country-specific parameters and national input data from the ŠU SR. 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. In the 2026 submission, the extrapolation of abatement was not prepared retrospectively; however, it is planned to be included in future submissions.

Table A6.1: Efficiency of abatements

ID	STAGE	FORM	MEASURE	REDUCTION
h1	housing	solid	high-frequency cleaning	50%
h2	housing	liquid	slated floor	20%
h3	housing	solid	biological treatment of litter	60%
h4	housing	solid	manure conveyor forced drying	80%
h5	housing	solid	ventilation with recuperation	70%
h6	housing	not included	other	0%
h7	housing	not included	no abatement	0%
s1	storage	solid	solid lid or roof covering	80%
s2	storage	liquid	surface covered with peat, straw, oil or other material	40%
s3	storage	liquid	surface covered with foil/plastic sheeting	60%
s4	storage	liquid	formation of a natural crust	40%
s5	storage	solid	biotechnological additives	40%
s6	storage	solid	bioreactors	85%
s7	storage	not included	other	0%
s8	storage	solid	solid	100%
s9	storage	not included	no abatement	0%
a1	application	liquid	shallow injection	60%
a2	application	liquid	deep injection	90%
a3	application	solid	incorporation within 4-12 hours	50%
a4	application	solid	incorporation within 24 hours	30%
a5	application	liquid	trailing hose	30%
a6	application	solid	broadcast spreading	40%
a7	application	solid	exported	100%
a8	application	not included	other	0%
a9	application	not included	no abatement	0%

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. **Tables A6.2** and **A6.3** provide a share of the abatements per farm. They were calculated for a better interpretation and usability in the NH₃ calculations. NH₃ emissions from Sector 3 Agriculture are estimated according to the EMEP/EEA GB 2023 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 Refinement 2019 methodology. For the calculation of the tier 3 approach, was accepted the philosophy for ammonia reduction. Ammonia reduction at the various stages of livestock manure production and handling is 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. The 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.

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

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.

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 **all** of these measures aimed at reducing emissions.

Table A6.2: Penetration of storage abatement measure

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
2006										
a1	0.44%	0.39%		0.00%	0.00%	0.00%	0.00%	1.84%	2.20%	0.00%
a2	0.44%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	3.43%	1.79%	0.00%
a3	17.27%	17.37%	6.60%	4.29%	5.11%	40.58%	15.68%	13.54%	14.15%	9.27%
a4	4.13%	4.28%	3.68%	1.04%	0.00%	3.62%	0.00%	2.53%	2.12%	5.50%
a5	1.12%	1.26%	0.00%	0.00%	0.00%	0.00%	0.00%	3.55%	3.01%	0.58%
a6	1.32%	1.51%	0.13%	0.00%	0.00%	0.00%	0.00%	0.39%	0.35%	1.67%
a7	0.52%	0.54%	19.04%	24.19%	24.80%	0.00%	13.57%	1.11%	2.37%	0.00%
a8	4.25%	4.42%	3.52%	2.30%	0.00%	0.00%	0.00%	5.90%	6.23%	0.00%
a9	3.85%	3.52%	0.37%	1.52%	3.42%	5.80%	20.75%	1.04%	1.10%	16.32%
h1	17.20%	16.14%	0.44%	2.38%	6.84%	34.85%	50.00%	11.62%	10.91%	4.97%
h2	0.83%	0.66%	4.66%	3.01%	0.51%	0.00%	0.00%	11.68%	11.72%	5.67%
h3	0.39%	0.40%	0.21%	0.00%	0.00%	0.00%	0.00%	0.25%	0.34%	0.00%
h4	0.31%	0.38%	0.00%	6.54%	17.96%	0.00%	0.00%	0.54%	0.28%	0.00%
h5	0.24%	0.24%	0.08%	0.52%	0.00%	0.00%	0.00%	0.49%	0.22%	0.00%
h6	1.00%	0.53%	11.01%	1.72%	0.00%	0.00%	0.00%	1.05%	0.43%	0.00%
h7	13.37%	14.97%	16.94%	19.15%	8.02%	15.15%	0.00%	7.71%	9.43%	22.69%
s1	6.24%	6.70%	0.28%	0.00%	17.96%	0.00%	0.00%	11.73%	15.81%	0.00%
s2	1.57%	1.30%	0.12%	0.69%	3.25%	0.00%	0.00%	3.24%	2.52%	0.00%
s3	0.42%	0.21%	0.16%	0.00%	0.00%	0.00%	0.00%	0.23%	0.22%	0.00%
s4	8.95%	9.46%	2.16%	2.24%	1.87%	0.00%	0.00%	5.51%	4.19%	0.00%
s5	0.14%	0.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.15%	0.15%	0.00%
s6	0.04%	0.10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.07%	0.00%
s7	2.45%	2.14%	3.94%	2.30%	0.00%	0.00%	0.00%	3.01%	3.28%	0.00%
s8	0.64%	0.59%	22.42%	21.85%	6.84%	0.00%	0.00%	1.20%	1.16%	0.00%
s9	12.88%	12.60%	4.25%	6.24%	3.42%	0.00%	0.00%	8.25%	5.94%	33.33%
2007										

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
a1	0.39%	0.27%	0.00%	0.00%	0.00%	0.00%	0.00%	4.20%	1.28%	0.00%
a2	0.57%	0.10%	0.00%	0.00%	0.00%	0.00%	0.00%	3.63%	3.64%	0.00%
a3	16.16%	16.98%	6.71%	3.29%	10.00%	27.59%	14.78%	11.48%	12.87%	10.14%
a4	5.53%	5.03%	1.69%	1.85%	0.00%	5.17%	0.00%	2.65%	2.58%	6.71%
a5	1.15%	1.22%	0.02%	0.62%	0.00%	0.00%	0.00%	3.41%	3.11%	0.37%
a6	1.16%	1.54%	0.10%	0.00%	0.00%	0.00%	0.00%	0.14%	0.25%	1.82%
a7	0.76%	0.75%	20.55%	25.07%	4.17%	0.00%	3.87%	2.06%	2.69%	1.85%
a8	4.22%	4.03%	1.95%	1.21%	0.00%	0.00%	14.78%	4.72%	5.97%	0.37%
a9	3.39%	3.41%	2.31%	1.29%	19.17%	17.24%	16.57%	1.04%	0.94%	12.08%
h1	16.96%	14.98%	1.25%	2.68%	0.83%	11.54%	35.22%	9.87%	10.61%	4.31%
h2	0.76%	0.77%	0.00%	2.56%	1.67%	0.00%	0.00%	13.22%	11.69%	4.08%
h3	0.59%	0.74%	0.32%	0.10%	0.00%	0.00%	0.00%	0.84%	0.71%	0.00%
h4	0.28%	0.23%	0.05%	13.14%	0.00%	0.00%	0.00%	0.86%	0.10%	0.00%
h5	0.44%	0.42%	0.74%	0.43%	3.33%	0.00%	0.00%	0.17%	0.25%	0.00%
h6	0.85%	0.54%	10.85%	2.36%	0.00%	0.00%	14.78%	0.42%	0.87%	0.00%
h7	13.45%	15.66%	20.12%	12.07%	27.50%	38.46%	0.00%	7.94%	9.09%	24.94%
s1	5.95%	6.62%	1.55%	8.03%	0.00%	0.00%	0.00%	11.59%	13.87%	6.21%
s2	1.38%	1.10%	1.23%	1.41%	1.67%	0.00%	0.00%	2.82%	1.98%	0.00%
s3	0.29%	0.24%	0.00%	0.00%	0.00%	0.00%	0.00%	0.42%	0.34%	0.00%
s4	10.59%	10.36%	1.00%	0.00%	8.33%	0.00%	0.00%	6.35%	6.77%	0.00%
s5	0.13%	0.09%	0.00%	0.00%	0.00%	0.00%	0.00%	0.09%	0.10%	0.00%
s6	0.04%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.07%	0.00%
s7	2.28%	2.27%	1.80%	0.39%	0.00%	0.00%	0.00%	2.43%	2.87%	0.00%
s8	0.74%	0.43%	23.45%	17.31%	4.17%	0.00%	0.00%	1.33%	0.95%	24.47%
s9	11.92%	12.18%	4.30%	6.19%	19.17%	0.00%	0.00%	8.30%	6.38%	2.66%

2008

a1	0.39%	0.21%	0.00%	0.00%	0.00%	0.00%	0.00%	4.70%	5.33%	0.00%
a2	0.57%	0.16%	0.00%	0.00%	0.00%	0.00%	0.00%	5.40%	2.69%	0.00%
a3	17.66%	18.13%	6.44%	2.92%	12.50%	30.36%	0.00%	9.64%	11.49%	8.90%
a4	4.54%	4.42%	1.28%	1.48%	0.00%	1.79%	0.00%	2.80%	1.90%	7.54%
a5	1.17%	1.16%	0.00%	0.24%	0.00%	0.00%	0.00%	2.54%	2.71%	0.59%
a6	0.99%	1.24%	0.21%	0.00%	0.00%	0.00%	0.00%	0.25%	0.30%	3.94%
a7	0.22%	0.52%	20.51%	26.28%	3.29%	0.00%	25.00%	1.51%	2.70%	1.63%
a8	4.33%	3.84%	2.67%	0.95%	0.00%	0.00%	25.00%	4.62%	5.27%	0.45%
a9	3.46%	3.66%	2.22%	1.48%	17.54%	17.86%	0.00%	1.87%	0.95%	10.28%
h1	17.87%	15.05%	1.06%	2.54%	3.29%	12.96%	0.00%	9.97%	10.63%	4.75%
h2	0.77%	0.82%	0.00%	2.22%	2.63%	0.00%	0.00%	12.97%	12.13%	4.26%
h3	0.73%	0.68%	0.53%	0.10%	0.00%	0.00%	0.00%	1.27%	1.23%	1.08%
h4	0.17%	0.24%	0.08%	11.31%	0.00%	0.00%	25.00%	0.59%	0.26%	0.00%
h5	0.45%	0.48%	0.45%	0.41%	0.00%	0.00%	0.00%	0.22%	0.21%	0.00%
h6	0.89%	0.58%	12.02%	4.02%	0.00%	0.00%	25.00%	0.37%	0.43%	0.03%
h7	12.45%	15.48%	19.19%	12.74%	27.41%	37.04%	0.00%	7.93%	8.45%	23.21%
s1	6.04%	6.48%	1.39%	7.30%	0.00%	0.00%	0.00%	12.08%	14.16%	5.80%

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
s2	1.65%	1.75%	0.89%	1.33%	2.63%	0.00%	0.00%	3.56%	2.35%	0.00%
s3	0.28%	0.25%	0.00%	0.00%	0.00%	0.00%	0.00%	0.28%	1.15%	0.00%
s4	11.55%	10.93%	0.79%	1.15%	9.87%	0.00%	0.00%	8.70%	6.74%	0.00%
s5	0.44%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.41%	0.28%	0.00%
s6	0.04%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%	0.00%
s7	2.34%	1.86%	2.58%	1.28%	0.00%	0.00%	0.00%	1.72%	2.58%	0.00%
s8	0.02%	0.13%	23.34%	18.12%	3.29%	0.00%	0.00%	0.00%	1.10%	0.00%
s9	10.97%	11.88%	4.34%	4.14%	17.54%	0.00%	0.00%	6.58%	4.95%	27.53%

2009

a1	0.24%	0.29%	0.00%	0.00%	0.00%	0.00%	0.00%	0.83%	4.46%	0.00%
a2	0.63%	0.23%	0.00%	0.00%	0.00%	0.00%	0.00%	5.06%	4.11%	0.00%
a3	18.13%	18.09%	6.00%	2.98%	3.97%	32.86%	0.00%	13.80%	11.18%	7.21%
a4	4.47%	4.41%	0.59%	1.50%	0.00%	2.86%	0.00%	2.14%	1.41%	6.93%
a5	1.17%	1.13%	0.00%	0.25%	0.00%	0.00%	0.00%	2.29%	2.19%	0.12%
a6	1.03%	1.21%	0.21%	0.00%	0.00%	0.00%	0.00%	3.44%	2.32%	2.22%
a7	0.32%	0.72%	22.90%	26.59%	3.97%	0.00%	25.00%	0.60%	1.71%	1.54%
a8	3.81%	3.46%	2.42%	1.35%	0.00%	0.00%	25.00%	4.81%	5.37%	2.94%
a9	3.54%	3.79%	1.22%	0.65%	25.40%	14.29%	0.00%	0.37%	0.59%	12.36%
h1	18.25%	14.79%	1.73%	2.38%	3.97%	18.18%	0.00%	11.26%	11.47%	4.57%
h2	0.34%	0.57%	0.00%	2.60%	3.97%	0.00%	0.00%	9.51%	10.07%	4.41%
h3	1.04%	1.32%	0.38%	0.09%	0.00%	0.00%	0.00%	4.91%	3.61%	2.00%
h4	0.15%	0.21%	0.14%	10.89%	0.00%	0.00%	25.00%	0.22%	0.10%	0.00%
h5	0.40%	0.50%	0.11%	0.36%	0.00%	0.00%	0.00%	0.22%	0.39%	0.00%
h6	0.59%	0.48%	12.68%	5.19%	0.00%	0.00%	25.00%	0.26%	0.55%	0.00%
h7	12.57%	15.48%	18.29%	11.83%	25.40%	31.82%	0.00%	6.96%	7.14%	22.35%
s1	6.11%	6.43%	0.74%	7.38%	0.00%	0.00%	0.00%	7.08%	11.16%	14.49%
s2	1.76%	1.94%	1.65%	1.31%	3.97%	0.00%	0.00%	3.48%	2.91%	0.00%
s3	0.81%	0.35%	0.00%	0.00%	0.00%	0.00%	0.00%	0.33%	2.04%	0.00%
s4	11.12%	10.69%	0.16%	1.18%	0.00%	0.00%	0.00%	15.09%	10.69%	0.00%
s5	0.39%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.88%	0.85%	0.00%
s6	0.04%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.15%	0.00%
s7	1.87%	1.86%	1.63%	0.73%	0.00%	0.00%	0.00%	1.86%	1.66%	0.00%
s8	0.03%	0.23%	25.29%	18.31%	3.97%	0.00%	0.00%	0.00%	0.24%	0.00%
s9	11.21%	11.79%	3.86%	4.42%	25.40%	0.00%	0.00%	4.61%	3.64%	18.85%

2010

a1	0.30%	0.23%	0.00%	0.00%	0.00%	0.00%	0.00%	2.73%	6.33%	0.00%
a2	0.97%	0.14%	0.00%	0.00%	0.00%	0.00%	0.00%	5.90%	4.21%	0.00%
a3	17.31%	17.63%	4.77%	4.10%	3.74%	31.52%	0.00%	9.93%	9.34%	7.67%
a4	4.74%	4.72%	1.44%	1.88%	2.24%	9.78%	0.00%	4.49%	3.29%	7.84%
a5	1.15%	1.13%	0.43%	0.00%	0.00%	0.00%	0.00%	1.73%	2.07%	0.09%
a6	1.21%	1.35%	0.22%	0.00%	0.00%	0.00%	0.00%	2.61%	2.10%	2.36%
a7	0.70%	0.87%	23.75%	24.57%	3.74%	0.00%	0.00%	1.01%	0.65%	1.17%
a8	3.78%	3.46%	1.98%	2.71%	0.00%	0.00%	0.00%	4.65%	4.93%	3.09%

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
a9	3.17%	3.79%	0.75%	0.07%	23.62%	8.70%	0.00%	0.27%	0.41%	11.12%
h1	18.55%	14.88%	1.16%	3.08%	3.74%	17.44%	0.00%	10.24%	10.32%	3.80%
h2	0.46%	0.46%	0.28%	1.17%	3.74%	0.00%	0.00%	9.68%	11.18%	3.80%
h3	0.91%	1.47%	1.00%	0.33%	2.24%	0.00%	0.00%	6.09%	3.89%	3.15%
h4	0.16%	0.18%	0.10%	11.04%	0.00%	0.00%	0.00%	0.14%	0.06%	0.00%
h5	0.12%	0.39%	0.26%	0.56%	0.00%	0.00%	0.00%	0.22%	0.22%	0.00%
h6	0.58%	0.46%	14.09%	6.70%	0.00%	0.00%	0.00%	0.26%	0.30%	0.11%
h7	12.55%	15.50%	16.44%	10.45%	23.62%	32.56%	0.00%	6.71%	7.36%	22.47%
s1	5.63%	5.56%	0.23%	8.53%	0.00%	0.00%	0.00%	6.02%	11.45%	16.11%
s2	1.81%	1.97%	0.53%	1.44%	3.74%	0.00%	0.00%	3.93%	3.79%	0.00%
s3	0.57%	0.31%	0.00%	0.00%	0.00%	0.00%	0.00%	1.48%	1.57%	0.00%
s4	11.89%	11.53%	1.18%	1.00%	0.00%	0.00%	0.00%	14.83%	10.18%	0.00%
s5	0.40%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.94%	0.53%	0.00%
s6	0.05%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.23%	0.00%
s7	1.93%	1.93%	2.30%	1.49%	2.24%	0.00%	0.00%	1.84%	1.83%	0.00%
s8	0.07%	0.32%	27.38%	17.81%	3.74%	0.00%	0.00%	0.00%	0.14%	0.00%
s9	10.98%	11.62%	1.71%	3.06%	23.62%	0.00%	0.00%	4.29%	3.61%	17.22%

2011

a1	0.28%	0.21%	0.00%	0.00%	0.00%	0.00%	0.00%	3.36%	5.46%	0.00%
a2	1.76%	0.42%	0.00%	0.00%	0.00%	0.00%	0.00%	4.20%	2.98%	0.00%
a3	17.12%	17.44%	4.50%	3.88%	2.62%	34.15%	0.00%	12.78%	9.76%	8.55%
a4	4.92%	4.88%	1.50%	1.09%	0.00%	4.88%	0.00%	2.01%	1.61%	6.35%
a5	1.18%	1.13%	0.00%	0.00%	0.00%	0.00%	0.00%	1.42%	1.79%	0.53%
a6	1.36%	1.26%	0.71%	0.00%	0.56%	0.00%	0.00%	3.20%	2.24%	4.05%
a7	0.77%	0.88%	24.13%	24.19%	25.96%	0.00%	0.00%	4.54%	4.37%	1.24%
a8	3.54%	3.59%	2.21%	3.52%	0.00%	0.00%	0.00%	1.50%	3.96%	3.24%
a9	2.40%	3.52%	0.28%	0.66%	4.20%	10.98%	50.00%	0.33%	1.16%	9.37%
h1	17.91%	14.77%	1.29%	2.83%	3.95%	20.27%	0.00%	9.89%	10.31%	3.96%
h2	0.42%	0.35%	0.36%	3.31%	0.70%	0.00%	0.00%	9.52%	9.95%	3.36%
h3	1.14%	1.32%	0.34%	0.30%	1.64%	0.00%	0.00%	7.00%	4.79%	3.62%
h4	0.16%	0.18%	0.10%	10.06%	0.00%	0.00%	0.00%	0.14%	0.06%	0.00%
h5	0.12%	0.33%	0.30%	0.00%	0.00%	0.00%	0.00%	0.20%	0.20%	0.00%
h6	0.52%	0.57%	14.33%	5.04%	0.00%	0.00%	0.00%	0.19%	0.32%	1.00%
h7	13.06%	15.81%	16.60%	11.79%	27.04%	29.73%	50.00%	6.39%	7.70%	21.39%
s1	5.29%	5.53%	0.46%	7.60%	0.00%	0.00%	0.00%	4.72%	11.67%	0.00%
s2	1.61%	1.77%	0.72%	1.10%	0.70%	0.00%	0.00%	4.31%	3.52%	0.00%
s3	1.32%	0.52%	0.00%	0.00%	0.00%	0.00%	0.00%	1.52%	1.57%	0.00%
s4	12.21%	11.95%	0.98%	1.10%	1.92%	0.00%	0.00%	16.05%	10.44%	10.84%
s5	0.38%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.92%	0.85%	0.00%
s6	0.05%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%
s7	1.82%	1.96%	2.22%	1.99%	0.00%	0.00%	0.00%	1.54%	1.27%	0.00%
s8	0.23%	0.51%	27.35%	18.80%	25.96%	0.00%	0.00%	0.00%	0.12%	0.00%
s9	10.44%	11.00%	1.60%	2.75%	4.76%	0.00%	0.00%	4.27%	3.88%	22.49%

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
2012										
a1	0.28%	0.23%	0.00%	0.00%	0.00%	0.00%	0.00%	3.55%	3.25%	0.00%
a2	1.90%	0.51%	0.00%	0.00%	0.00%	0.00%	0.00%	5.31%	5.34%	0.00%
a3	17.01%	17.50%	2.01%	3.82%	1.18%	30.00%	0.00%	11.81%	8.39%	10.53%
a4	4.55%	4.62%	1.34%	1.71%	0.00%	3.33%	0.00%	1.89%	1.52%	5.54%
a5	1.17%	1.02%	0.00%	0.00%	0.00%	0.00%	0.00%	1.02%	1.52%	0.50%
a6	1.43%	1.44%	0.75%	0.00%	0.09%	10.00%	0.00%	3.49%	2.65%	3.70%
a7	0.79%	0.85%	25.61%	23.74%	30.97%	0.00%	0.00%	5.09%	4.46%	0.60%
a8	3.80%	3.69%	3.23%	3.58%	0.00%	0.00%	0.00%	0.94%	4.68%	2.96%
a9	2.39%	3.47%	0.41%	0.49%	1.09%	6.67%	50.00%	0.25%	1.53%	9.51%
h1	17.95%	14.67%	1.00%	2.44%	1.17%	18.75%	0.00%	8.65%	10.17%	3.96%
h2	0.43%	0.33%	0.31%	3.69%	0.23%	0.00%	0.00%	9.34%	10.43%	3.10%
h3	1.20%	1.35%	0.37%	0.18%	0.34%	0.89%	0.00%	8.64%	4.64%	3.27%
h4	0.15%	0.20%	0.10%	9.90%	0.00%	0.00%	0.00%	0.15%	0.08%	0.00%
h5	0.12%	0.29%	0.29%	0.00%	0.00%	0.00%	0.00%	0.20%	0.29%	0.00%
h6	0.48%	0.51%	13.91%	4.72%	0.04%	0.00%	0.00%	0.19%	0.36%	0.59%
h7	13.01%	15.98%	17.37%	12.40%	31.55%	30.36%	50.00%	6.16%	7.37%	22.41%
s1	5.54%	5.41%	1.18%	6.95%	0.00%	0.00%	0.00%	4.59%	11.24%	0.00%
s2	1.37%	1.71%	0.72%	1.10%	0.23%	0.00%	0.00%	5.66%	3.64%	0.00%
s3	1.56%	0.76%	0.00%	0.00%	0.00%	0.00%	0.00%	1.53%	2.24%	0.00%
s4	12.04%	11.68%	0.94%	1.26%	0.95%	0.00%	0.00%	15.82%	11.31%	10.34%
s5	0.39%	0.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.94%	0.80%	0.00%
s6	0.04%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%
s7	2.02%	1.97%	2.70%	2.07%	0.00%	0.00%	0.00%	0.88%	1.23%	0.00%
s8	0.18%	0.38%	25.18%	19.49%	30.97%	0.00%	0.00%	0.83%	0.18%	0.00%
s9	10.19%	11.33%	2.61%	2.46%	1.18%	0.00%	0.00%	3.09%	2.67%	23.00%
2013										
a1	0.21%	0.22%	0.00%	0.00%	0.00%	0.00%	0.00%	3.49%	3.22%	0.00%
a2	1.83%	0.54%	0.00%	0.00%	0.00%	0.00%	0.00%	6.93%	5.93%	0.00%
a3	17.18%	17.22%	2.04%	4.04%	0.92%	19.58%	0.00%	9.47%	7.21%	9.24%
a4	4.38%	4.83%	1.73%	3.14%	18.07%	4.17%	0.00%	3.27%	1.64%	6.51%
a5	1.36%	1.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.91%	1.45%	0.47%
a6	1.28%	1.47%	1.10%	1.65%	0.06%	5.83%	0.00%	3.46%	3.01%	4.47%
a7	0.81%	0.82%	23.78%	20.47%	13.27%	0.00%	0.00%	3.86%	4.62%	1.24%
a8	3.87%	3.64%	4.27%	3.56%	0.00%	2.08%	0.00%	1.71%	5.02%	2.74%
a9	2.41%	3.56%	0.41%	0.47%	1.03%	1.67%	50.00%	0.24%	1.22%	8.67%
h1	18.27%	14.70%	0.62%	2.10%	18.73%	14.96%	0.00%	7.37%	10.78%	5.59%
h2	0.56%	0.33%	0.00%	2.86%	0.15%	0.00%	0.00%	9.47%	10.90%	2.53%
h3	1.32%	1.65%	0.62%	0.60%	0.38%	0.00%	0.00%	10.84%	5.18%	4.64%
h4	0.15%	0.17%	0.10%	12.19%	0.00%	0.00%	0.00%	0.15%	0.12%	0.00%
h5	0.11%	0.40%	0.25%	0.00%	0.00%	0.00%	0.00%	0.19%	0.32%	0.00%
h6	0.50%	0.52%	13.98%	4.16%	0.01%	2.14%	0.00%	0.19%	0.38%	0.43%
h7	12.42%	15.56%	17.75%	11.42%	14.05%	16.24%	50.00%	5.12%	5.66%	20.13%

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
s1	5.37%	5.00%	1.43%	8.86%	0.00%	0.00%	0.00%	3.17%	10.10%	0.00%
s2	1.34%	1.76%	0.65%	1.12%	0.15%	0.00%	0.00%	7.31%	3.55%	0.00%
s3	1.39%	0.79%	0.45%	0.00%	0.00%	0.00%	0.00%	1.41%	2.46%	0.00%
s4	12.06%	11.86%	0.59%	1.22%	0.76%	33.33%	0.00%	13.60%	11.25%	5.38%
s5	0.52%	0.07%	0.46%	0.27%	18.07%	0.00%	0.00%	0.87%	0.93%	0.00%
s6	0.04%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.83%	0.39%	0.00%
s7	2.07%	1.91%	3.85%	2.24%	0.00%	0.00%	0.00%	0.93%	1.09%	0.00%
s8	0.30%	0.43%	23.22%	15.54%	13.27%	0.00%	0.00%	1.80%	0.44%	0.00%
s9	10.24%	11.47%	2.68%	4.08%	1.08%	0.00%	0.00%	3.40%	3.11%	27.96%

2014

a1	0.21%	0.22%	0.00%	0.00%	0.00%	0.00%	0.00%	3.36%	4.17%	0.00%
a2	1.71%	0.39%	0.00%	0.00%	0.00%	0.00%	0.00%	8.25%	6.57%	0.00%
a3	16.93%	16.68%	1.84%	4.00%	1.60%	28.03%	0.00%	5.95%	7.83%	8.97%
a4	4.82%	5.35%	1.11%	1.40%	0.00%	9.09%	0.00%	3.20%	2.12%	7.70%
a5	1.37%	1.14%	0.25%	0.00%	0.00%	0.00%	0.00%	0.69%	1.48%	0.48%
a6	1.42%	1.50%	0.59%	2.34%	0.03%	9.09%	0.00%	0.33%	0.69%	5.03%
a7	0.96%	0.93%	26.01%	21.99%	29.79%	2.27%	0.00%	10.45%	5.68%	1.63%
a8	3.72%	3.73%	3.32%	3.27%	0.00%	0.00%	0.00%	0.99%	4.35%	1.32%
a9	2.19%	3.40%	0.22%	0.34%	1.91%	1.52%	50.00%	0.12%	0.44%	8.20%
h1	18.46%	15.42%	0.95%	2.31%	1.26%	25.00%	0.00%	6.71%	9.64%	5.88%
h2	0.53%	0.37%	0.18%	2.53%	0.31%	0.00%	0.00%	12.66%	15.29%	5.23%
h3	1.07%	1.60%	0.35%	0.41%	5.55%	0.00%	0.00%	10.59%	4.35%	1.69%
h4	0.15%	0.14%	0.10%	13.01%	0.00%	0.00%	0.00%	0.12%	0.08%	0.00%
h5	0.19%	0.35%	0.14%	0.00%	0.00%	0.00%	0.00%	0.15%	0.24%	0.00%
h6	0.59%	0.46%	13.63%	2.76%	0.04%	0.00%	0.00%	0.15%	0.28%	0.45%
h7	12.34%	14.99%	17.98%	12.31%	26.17%	25.00%	50.00%	2.96%	3.45%	20.08%
s1	5.22%	4.75%	1.78%	8.95%	0.00%	0.00%	0.00%	3.31%	8.66%	0.00%
s2	1.32%	1.78%	0.63%	1.11%	0.31%	0.00%	0.00%	7.55%	3.18%	0.00%
s3	1.33%	0.68%	0.00%	0.00%	0.00%	0.00%	0.00%	4.35%	6.93%	0.00%
s4	12.24%	11.81%	0.33%	0.06%	1.28%	0.00%	0.00%	11.91%	10.12%	0.00%
s5	0.13%	0.07%	0.27%	0.21%	0.00%	0.00%	0.00%	0.81%	0.95%	0.00%
s6	0.13%	0.08%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%
s7	1.87%	2.03%	4.30%	2.68%	0.00%	0.00%	0.00%	0.74%	0.73%	10.36%
s8	0.52%	0.58%	23.82%	16.98%	29.79%	0.00%	0.00%	1.73%	0.28%	0.00%
s9	10.57%	11.56%	2.21%	3.34%	1.95%	0.00%	0.00%	2.93%	2.47%	22.97%

2015

a1	0.22%	0.26%	0.00%	0.00%	0.00%	0.00%	0.00%	3.79%	4.39%	0.00%
a2	1.74%	0.26%	0.00%	0.00%	0.00%	0.00%	0.00%	8.11%	7.90%	0.00%
a3	16.46%	16.65%	1.96%	3.55%	0.71%	16.95%	0.00%	5.25%	5.90%	8.78%
a4	4.88%	5.09%	1.14%	1.07%	0.00%	11.86%	0.00%	3.11%	1.64%	6.64%
a5	1.55%	1.08%	0.00%	0.00%	0.00%	0.00%	0.00%	0.57%	1.44%	0.52%
a6	1.29%	1.71%	0.44%	1.89%	0.03%	2.26%	0.00%	0.23%	0.48%	5.78%
a7	0.63%	0.86%	26.04%	24.44%	30.67%	1.13%	0.00%	11.22%	9.16%	2.73%

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
a8	4.26%	3.89%	3.64%	2.11%	0.00%	0.00%	0.00%	0.94%	1.97%	1.48%
a9	2.31%	3.53%	0.12%	0.27%	1.92%	1.13%	50.00%	0.11%	0.45%	7.41%
h1	18.01%	15.42%	0.89%	1.36%	1.26%	16.95%	0.00%	2.94%	4.23%	8.81%
h2	0.59%	0.39%	0.00%	3.98%	0.37%	0.00%	0.00%	14.27%	15.88%	2.64%
h3	0.99%	1.67%	0.44%	0.61%	4.29%	0.00%	0.00%	12.83%	6.42%	1.88%
h4	0.16%	0.14%	0.16%	14.74%	0.00%	0.00%	0.00%	0.09%	0.05%	0.00%
h5	0.24%	0.33%	0.03%	0.00%	0.00%	0.00%	0.00%	0.10%	0.19%	0.00%
h6	0.58%	0.62%	13.72%	2.21%	0.00%	0.00%	0.00%	0.00%	0.11%	0.44%
h7	12.78%	14.76%	18.10%	10.44%	27.42%	16.38%	50.00%	3.10%	6.45%	19.56%
s1	5.37%	5.03%	1.33%	8.11%	0.00%	0.00%	0.00%	2.99%	8.73%	0.00%
s2	0.99%	1.41%	0.79%	0.98%	0.37%	0.00%	0.00%	8.32%	5.24%	0.00%
s3	1.22%	0.46%	0.00%	0.00%	0.00%	0.00%	0.00%	3.75%	4.87%	0.00%
s4	12.50%	12.09%	0.35%	0.03%	0.34%	33.33%	0.00%	11.72%	9.12%	0.00%
s5	0.10%	0.19%	0.24%	0.18%	0.00%	0.00%	0.00%	0.75%	0.99%	0.00%
s6	0.13%	0.10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%
s7	2.02%	2.01%	4.34%	1.36%	0.00%	0.00%	0.00%	0.73%	0.74%	0.00%
s8	0.28%	0.40%	24.12%	19.99%	30.67%	0.00%	0.00%	1.97%	0.90%	0.00%
s9	10.72%	11.64%	2.16%	2.68%	1.95%	0.00%	0.00%	3.11%	2.72%	33.33%

2016

a1	0.24%	0.28%	0.00%	0.00%	0.00%	0.00%	0.00%	3.77%	2.74%	0.00%
a2	1.90%	0.63%	0.00%	0.00%	0.00%	0.00%	0.00%	7.97%	11.57%	0.00%
a3	15.90%	15.93%	1.36%	3.57%	2.00%	22.08%	0.00%	3.54%	3.21%	8.35%
a4	5.08%	5.30%	1.08%	0.44%	0.00%	6.67%	0.00%	3.34%	1.06%	5.89%
a5	1.55%	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.55%	0.72%	0.51%
a6	1.41%	1.77%	0.38%	1.08%	0.09%	2.50%	0.00%	0.10%	0.11%	6.52%
a7	0.62%	0.94%	25.77%	24.98%	23.25%	0.83%	0.00%	13.06%	12.82%	3.48%
a8	4.29%	3.88%	3.78%	3.01%	0.00%	0.00%	0.00%	0.88%	0.81%	1.56%
a9	2.33%	3.61%	0.97%	0.26%	8.00%	1.25%	50.00%	0.11%	0.30%	7.03%
h1	17.80%	15.31%	0.88%	1.97%	8.90%	21.25%	0.00%	2.03%	3.33%	10.07%
h2	0.66%	0.35%	0.00%	4.07%	1.16%	0.00%	0.00%	16.36%	12.41%	2.51%
h3	1.61%	1.94%	1.11%	0.64%	11.71%	0.83%	0.00%	12.98%	12.60%	1.86%
h4	0.18%	0.16%	0.09%	14.07%	0.00%	0.00%	0.00%	0.07%	0.03%	0.00%
h5	0.20%	0.28%	0.17%	0.00%	0.00%	0.00%	0.00%	0.09%	0.09%	0.00%
h6	0.47%	0.82%	12.87%	2.64%	1.29%	0.00%	0.00%	0.00%	0.16%	0.46%
h7	12.41%	14.48%	18.22%	9.94%	10.27%	11.25%	50.00%	1.80%	4.73%	18.43%
s1	5.24%	5.03%	0.79%	7.86%	0.00%	0.00%	0.00%	2.61%	6.52%	0.00%
s2	0.91%	1.33%	0.61%	0.99%	1.21%	0.00%	0.00%	7.44%	11.70%	0.00%
s3	1.32%	0.85%	0.00%	0.00%	0.00%	0.00%	0.00%	5.43%	4.59%	0.00%
s4	12.62%	11.85%	0.50%	0.03%	0.79%	33.33%	0.00%	12.25%	7.25%	0.00%
s5	0.11%	0.17%	0.20%	0.26%	0.00%	0.00%	0.00%	0.81%	0.58%	0.00%
s6	0.14%	0.10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%
s7	1.97%	1.99%	5.42%	2.34%	1.34%	0.00%	0.00%	0.15%	0.20%	0.00%
s8	0.27%	0.53%	23.47%	19.95%	21.91%	0.00%	0.00%	2.17%	0.65%	0.00%

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
s9	10.75%	11.48%	2.35%	1.90%	8.09%	0.00%	0.00%	2.47%	1.85%	33.33%
2017										
a1	0.23%	0.32%	0.00%	0.00%	0.00%	0.00%	0.00%	3.61%	2.50%	0.00%
a2	1.99%	0.66%	0.00%	0.00%	0.00%	0.00%	0.00%	8.92%	11.10%	0.00%
a3	15.31%	15.34%	1.33%	3.74%	2.43%	17.95%	0.00%	3.73%	3.39%	8.24%
a4	5.55%	5.60%	1.07%	0.47%	0.00%	8.21%	0.00%	2.58%	1.29%	6.43%
a5	1.47%	1.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.51%	0.63%	0.55%
a6	1.39%	1.57%	0.41%	1.22%	0.47%	3.08%	0.00%	0.06%	0.07%	7.35%
a7	0.69%	1.04%	25.69%	24.56%	23.69%	1.03%	0.00%	12.96%	12.22%	2.98%
a8	4.30%	3.96%	3.81%	3.08%	0.00%	2.05%	0.00%	0.85%	0.72%	1.68%
a9	2.42%	3.78%	1.03%	0.26%	6.74%	1.03%	50.00%	0.11%	1.41%	6.11%
h1	18.11%	15.00%	0.92%	1.66%	0.20%	16.92%	0.00%	1.82%	3.18%	10.15%
h2	0.47%	0.26%	0.00%	4.39%	1.32%	0.00%	0.00%	14.60%	14.52%	2.77%
h3	1.37%	2.20%	1.23%	0.97%	15.06%	1.03%	0.00%	14.88%	11.70%	1.85%
h4	0.12%	0.11%	0.10%	13.37%	0.00%	0.00%	0.00%	0.05%	0.02%	0.00%
h5	0.21%	0.29%	0.16%	0.00%	0.00%	0.00%	0.00%	0.03%	0.07%	0.00%
h6	0.51%	0.67%	11.95%	2.52%	3.81%	0.00%	0.00%	0.00%	0.08%	0.51%
h7	12.53%	14.81%	18.96%	10.43%	12.94%	15.38%	50.00%	1.95%	3.75%	18.05%
s1	5.14%	5.01%	0.76%	6.92%	0.00%	0.00%	0.00%	3.12%	6.01%	0.00%
s2	0.91%	1.25%	0.61%	1.00%	1.49%	0.00%	0.00%	8.66%	10.27%	0.00%
s3	1.34%	0.84%	0.00%	0.00%	0.00%	0.00%	0.00%	4.59%	5.80%	0.00%
s4	12.97%	11.92%	0.51%	0.03%	0.95%	33.33%	0.00%	11.18%	7.17%	6.54%
s5	0.00%	0.23%	0.21%	0.25%	0.00%	0.00%	0.00%	0.74%	0.48%	0.00%
s6	0.14%	0.09%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%
s7	1.99%	2.06%	4.24%	2.43%	4.31%	0.00%	0.00%	0.14%	0.15%	0.00%
s8	0.34%	0.56%	24.39%	20.72%	19.38%	0.00%	0.00%	2.45%	1.19%	0.00%
s9	10.50%	11.37%	2.60%	1.98%	7.21%	0.00%	0.00%	2.47%	2.25%	26.80%
2018										
a1	0.12%	0.19%	0.00%	0.00%	0.00%	0.00%	0.00%	1.30%	0.29%	0.00%
a2	2.06%	0.61%	0.00%	0.00%	0.00%	0.00%	0.00%	8.82%	9.30%	0.00%
a3	14.88%	15.01%	1.26%	3.14%	2.11%	19.75%	0.00%	6.38%	3.81%	8.14%
a4	5.69%	6.01%	0.98%	0.42%	0.00%	6.58%	0.00%	2.67%	1.45%	7.24%
a5	1.44%	1.33%	0.00%	0.00%	0.00%	0.00%	0.00%	0.47%	0.52%	0.52%
a6	1.39%	1.67%	0.35%	1.13%	0.37%	2.47%	0.00%	0.08%	0.06%	6.57%
a7	0.62%	0.99%	25.11%	25.93%	26.31%	0.82%	0.00%	13.20%	16.33%	3.59%
a8	4.52%	3.91%	4.34%	2.55%	0.00%	3.29%	0.00%	0.27%	0.71%	2.22%
a9	2.61%	3.61%	1.30%	0.17%	4.54%	0.41%	50.00%	0.14%	0.87%	5.06%
h1	17.79%	15.16%	0.87%	0.77%	0.74%	18.93%	0.00%	1.92%	1.74%	12.08%
h2	0.50%	0.35%	0.00%	3.78%	1.27%	0.00%	0.00%	13.68%	15.55%	3.00%
h3	1.39%	2.19%	1.60%	1.44%	8.26%	2.06%	0.00%	15.24%	8.24%	1.22%
h4	0.11%	0.06%	0.10%	16.32%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%
h5	0.29%	0.30%	0.19%	0.00%	0.00%	0.00%	0.00%	0.06%	0.04%	0.00%
h6	0.64%	0.68%	11.51%	4.81%	4.92%	0.00%	0.00%	1.36%	1.07%	0.55%

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
h7	12.61%	14.59%	19.05%	6.21%	18.15%	12.35%	50.00%	1.07%	6.68%	16.48%
s1	4.92%	5.04%	0.66%	7.74%	0.00%	4.35%	0.00%	3.14%	4.34%	0.00%
s2	0.92%	1.36%	0.63%	0.89%	1.49%	0.00%	0.00%	8.53%	7.56%	0.00%
s3	1.27%	0.86%	0.00%	0.00%	0.00%	0.00%	0.00%	4.29%	7.32%	0.00%
s4	12.73%	12.03%	0.47%	0.04%	0.63%	17.39%	0.00%	11.71%	8.93%	7.65%
s5	0.00%	0.15%	0.18%	0.22%	0.00%	0.00%	0.00%	0.78%	0.64%	0.00%
s6	0.14%	0.09%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%
s7	2.20%	2.04%	4.58%	2.81%	0.00%	0.00%	0.00%	0.00%	0.09%	2.58%
s8	0.37%	0.66%	24.11%	20.17%	26.31%	1.45%	0.00%	2.38%	2.88%	7.67%
s9	10.77%	11.11%	2.71%	1.47%	4.91%	10.14%	0.00%	2.49%	1.57%	15.44%
2019										
a1	0.16%	0.18%	0.00%	0.00%	0.00%	0.00%	0.00%	0.97%	0.32%	0.00%
a2	2.13%	0.64%	0.00%	0.00%	0.00%	0.00%	0.00%	8.70%	10.05%	0.00%
a3	14.70%	14.90%	1.18%	3.20%	3.16%	22.22%	13.94%	6.83%	4.34%	7.79%
a4	5.83%	6.18%	0.95%	0.32%	0.00%	6.28%	0.00%	2.61%	1.91%	7.75%
a5	1.51%	1.37%	0.00%	0.00%	0.00%	0.00%	0.00%	0.19%	0.58%	0.49%
a6	1.39%	1.92%	0.28%	0.21%	0.40%	0.00%	0.00%	0.03%	0.11%	6.38%
a7	0.68%	1.00%	26.90%	26.91%	23.32%	0.48%	0.00%	12.78%	14.16%	3.39%
a8	4.37%	3.89%	3.53%	2.57%	0.00%	3.86%	0.00%	1.13%	1.62%	2.83%
a9	2.58%	3.26%	0.51%	0.12%	6.45%	0.48%	19.39%	0.09%	0.24%	4.71%
h1	18.17%	15.04%	0.84%	0.50%	1.06%	21.26%	13.94%	3.18%	2.84%	11.60%
h2	0.54%	0.38%	0.00%	3.73%	1.78%	0.00%	0.00%	12.65%	11.57%	2.90%
h3	1.54%	2.12%	0.82%	1.20%	2.63%	0.97%	0.00%	15.14%	14.23%	1.42%
h4	0.11%	0.06%	0.00%	15.59%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%
h5	0.27%	0.46%	0.18%	0.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
h6	0.45%	0.72%	11.93%	5.60%	6.44%	0.00%	0.00%	1.46%	2.25%	0.65%
h7	12.26%	14.56%	19.56%	6.60%	21.42%	11.11%	19.39%	0.90%	2.43%	16.77%
s1	5.06%	5.24%	0.70%	7.29%	0.00%	5.80%	0.00%	2.67%	5.20%	3.09%
s2	0.85%	1.28%	0.54%	1.01%	2.20%	0.00%	0.00%	8.04%	11.35%	0.00%
s3	1.33%	0.87%	0.00%	0.00%	0.00%	0.00%	0.00%	4.92%	4.89%	0.00%
s4	13.27%	12.40%	0.45%	0.14%	0.80%	16.67%	33.33%	12.07%	6.73%	5.26%
s5	0.10%	0.08%	0.13%	0.22%	0.00%	0.00%	0.00%	0.49%	0.80%	0.00%
s6	0.14%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%
s7	1.84%	1.95%	3.90%	1.86%	0.00%	0.00%	0.00%	0.00%	0.16%	3.58%
s8	0.51%	0.63%	25.82%	21.49%	23.32%	0.72%	0.00%	2.62%	2.56%	6.48%
s9	10.22%	10.76%	1.80%	1.33%	7.00%	10.14%	0.00%	2.52%	1.64%	14.91%
2020										
a1	0.25%	0.22%	0.00%	0.00%	0.00%	0.00%	0.00%	0.84%	0.58%	0.00%
a2	2.26%	0.53%	0.00%	0.00%	0.00%	0.00%	0.00%	7.84%	9.31%	0.00%
a3	14.49%	14.76%	1.27%	3.91%	7.30%	14.29%	0.13%	4.82%	4.26%	9.14%
a4	5.91%	6.50%	1.12%	0.41%	0.00%	13.49%	0.00%	2.13%	1.61%	6.74%
a5	1.33%	1.27%	0.00%	0.00%	0.00%	0.00%	0.00%	2.27%	2.99%	0.00%
a6	1.59%	2.03%	0.30%	0.20%	0.46%	1.59%	0.00%	0.01%	0.06%	6.36%

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
a7	0.66%	1.08%	28.61%	24.54%	21.86%	0.40%	0.00%	14.33%	12.72%	4.45%
a8	4.38%	3.86%	1.93%	3.99%	0.00%	3.17%	0.00%	0.88%	1.56%	2.53%
a9	2.46%	3.09%	0.10%	0.29%	3.72%	0.40%	33.20%	0.21%	0.25%	4.11%
h1	17.75%	14.87%	1.15%	0.49%	1.46%	19.84%	0.00%	5.90%	2.38%	13.72%
h2	0.52%	0.43%	0.00%	4.62%	2.40%	0.00%	0.00%	10.99%	11.95%	2.60%
h3	2.03%	1.85%	0.68%	1.45%	3.34%	0.79%	0.00%	14.21%	14.56%	1.51%
h4	0.13%	0.07%	0.00%	12.40%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%
h5	0.27%	0.38%	0.16%	0.22%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%
h6	0.43%	0.73%	11.88%	7.22%	5.69%	0.00%	0.00%	1.29%	2.03%	0.72%
h7	12.21%	15.00%	19.47%	6.94%	20.43%	12.70%	33.33%	0.93%	2.40%	14.75%
s1	5.25%	4.99%	0.65%	8.05%	0.00%	5.95%	0.00%	5.58%	4.52%	1.83%
s2	0.93%	1.39%	0.67%	0.94%	2.89%	0.00%	0.00%	7.46%	10.84%	0.00%
s3	1.56%	0.80%	0.00%	0.00%	0.00%	0.00%	0.00%	6.50%	6.99%	0.00%
s4	12.85%	12.44%	0.36%	0.26%	0.94%	16.67%	0.00%	9.07%	5.61%	6.47%
s5	0.00%	0.11%	0.23%	0.21%	0.00%	0.00%	0.00%	0.40%	1.06%	0.00%
s6	0.30%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%
s7	1.91%	2.10%	2.35%	2.21%	0.00%	0.00%	0.00%	0.00%	0.13%	1.69%
s8	0.60%	0.58%	27.75%	20.39%	21.86%	0.60%	0.00%	2.13%	2.43%	8.03%
s9	9.93%	10.80%	1.32%	1.27%	7.64%	10.12%	33.33%	2.19%	1.73%	15.31%

2021

a1	0.23%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.55%	0.45%	0.00%
a2	2.31%	0.50%	0.00%	0.00%	0.00%	0.00%	0.00%	8.37%	9.42%	0.00%
a3	14.60%	14.53%	1.09%	3.85%	8.54%	2.50%	0.13%	5.02%	4.34%	8.46%
a4	5.78%	6.85%	1.01%	0.42%	0.00%	25.83%	0.00%	1.57%	2.69%	7.51%
a5	1.28%	0.98%	0.00%	0.00%	0.00%	0.00%	0.00%	2.23%	3.19%	0.35%
a6	2.01%	2.18%	0.30%	0.19%	0.00%	2.50%	0.00%	0.02%	0.08%	6.62%
a7	0.53%	1.01%	27.69%	24.08%	23.25%	0.83%	0.00%	14.63%	11.97%	3.74%
a8	4.39%	4.29%	2.89%	4.50%	0.00%	1.67%	0.00%	0.78%	0.98%	2.99%
a9	2.20%	2.86%	0.35%	0.30%	1.55%	0.00%	33.21%	0.17%	0.20%	3.66%
h1	17.76%	14.92%	1.48%	0.53%	1.68%	11.67%	0.00%	5.16%	1.89%	12.95%
h2	0.54%	0.55%	0.00%	5.58%	2.91%	0.00%	0.00%	10.14%	10.63%	2.47%
h3	2.21%	1.71%	0.57%	0.86%	2.81%	2.50%	0.00%	14.80%	14.62%	1.23%
h4	0.14%	0.07%	0.00%	11.88%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%
h5	0.48%	0.24%	0.13%	0.22%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
h6	0.42%	0.84%	11.69%	6.81%	6.15%	0.00%	0.00%	2.46%	3.86%	0.70%
h7	11.79%	15.00%	19.47%	7.45%	19.78%	19.17%	33.33%	0.78%	2.32%	15.97%
s1	5.41%	4.81%	0.64%	6.68%	0.00%	5.56%	0.00%	5.24%	3.84%	3.94%
s2	0.95%	1.37%	0.65%	0.98%	3.57%	0.00%	0.00%	8.25%	11.07%	0.00%
s3	1.53%	0.75%	0.00%	0.00%	0.00%	0.00%	0.00%	6.50%	8.68%	0.00%
s4	13.24%	12.39%	0.35%	0.27%	0.02%	1.85%	0.00%	9.42%	5.59%	4.27%
s5	0.11%	0.14%	0.11%	0.20%	0.00%	0.00%	0.00%	0.39%	0.75%	0.00%
s6	0.31%	0.10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%
s7	1.91%	2.39%	3.58%	2.44%	0.00%	0.00%	0.00%	0.00%	0.15%	2.88%

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
s8	0.49%	0.68%	26.84%	21.57%	23.25%	1.85%	0.00%	1.65%	1.52%	6.28%
s9	9.38%	10.71%	1.16%	1.20%	6.49%	24.07%	33.33%	1.87%	1.72%	15.97%
2022										
a1	0.26%	0.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.59%	0.32%	0.00%
a2	2.26%	0.48%	0.00%	0.00%	0.00%	0.00%	0.00%	9.85%	10.80%	0.00%
a3	14.66%	15.05%	1.00%	3.42%	12.61%	11.44%	0.02%	3.55%	3.61%	8.57%
a4	6.15%	6.54%	0.72%	0.42%	0.00%	19.90%	0.00%	0.09%	1.45%	7.22%
a5	1.31%	0.97%	0.00%	0.00%	0.00%	0.00%	0.00%	1.63%	2.52%	0.30%
a6	1.92%	2.03%	0.30%	0.16%	1.00%	0.50%	0.00%	0.02%	0.02%	6.90%
a7	0.43%	1.07%	28.09%	25.26%	16.84%	0.50%	0.00%	17.17%	13.69%	3.81%
a8	4.38%	4.32%	2.88%	3.86%	0.00%	1.00%	0.00%	0.24%	0.82%	2.56%
a9	1.96%	2.77%	0.35%	0.21%	2.89%	0.00%	33.32%	0.20%	0.11%	3.97%
h1	18.16%	14.51%	1.43%	0.41%	3.44%	20.40%	0.00%	6.28%	1.90%	12.94%
h2	0.55%	0.58%	0.00%	5.49%	1.88%	0.00%	0.00%	8.68%	10.42%	2.32%
h3	2.29%	1.94%	1.17%	0.51%	6.28%	2.99%	0.00%	16.51%	17.13%	0.58%
h4	0.15%	0.07%	0.00%	12.84%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
h5	0.50%	0.26%	0.13%	0.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
h6	0.45%	0.74%	11.42%	6.71%	5.01%	0.00%	0.00%	1.06%	2.12%	1.18%
h7	11.23%	15.22%	19.19%	7.15%	16.72%	9.95%	33.33%	0.80%	1.77%	16.31%
s1	5.32%	4.76%	0.60%	7.76%	0.00%	0.78%	0.00%	5.54%	3.31%	1.82%
s2	0.97%	1.47%	0.25%	1.11%	2.21%	0.00%	0.00%	10.63%	13.39%	0.00%
s3	1.60%	0.86%	0.00%	0.00%	0.00%	0.00%	0.00%	7.13%	7.09%	0.00%
s4	13.24%	12.24%	0.34%	0.27%	0.02%	24.03%	0.00%	8.60%	5.80%	7.22%
s5	0.13%	0.13%	0.14%	0.17%	0.00%	0.00%	0.00%	0.50%	0.79%	0.00%
s6	0.31%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%
s7	1.99%	2.37%	3.38%	2.33%	0.00%	0.00%	0.00%	0.00%	0.01%	2.28%
s8	0.44%	0.64%	27.47%	20.59%	16.84%	0.78%	0.00%	0.00%	1.64%	7.58%
s9	9.34%	10.73%	1.15%	1.10%	14.26%	7.75%	33.33%	0.93%	1.29%	14.45%
2023										
a1	0.22%	0.14%	0.00%	0.00%	0.00%	0.00%	0.00%	0.58%	0.30%	0.00%
a2	2.38%	0.45%	0.00%	0.00%	0.00%	0.00%	0.00%	9.94%	10.48%	0.00%
a3	14.75%	15.23%	1.27%	3.72%	13.70%	16.93%	0.00%	3.33%	3.58%	11.56%
a4	5.93%	6.41%	0.72%	0.50%	0.00%	15.34%	0.00%	0.56%	2.85%	4.43%
a5	1.23%	0.99%	0.00%	0.00%	0.00%	0.00%	0.00%	0.90%	2.23%	0.31%
a6	1.79%	2.22%	0.28%	0.18%	0.91%	0.53%	0.00%	0.02%	0.02%	5.59%
a7	0.36%	0.92%	28.29%	24.67%	18.72%	0.53%	0.00%	17.33%	12.74%	4.79%
a8	4.47%	3.95%	2.77%	4.00%	0.00%	0.00%	0.00%	0.48%	1.06%	2.74%
a9	2.21%	3.02%	0.00%	0.26%	0.00%	0.00%	50.00%	0.19%	0.07%	3.92%
h1	18.14%	14.43%	1.41%	0.81%	3.67%	24.34%	0.00%	6.03%	1.63%	10.98%
h2	0.55%	0.65%	0.20%	5.20%	0.00%	0.00%	0.00%	7.51%	10.11%	2.15%
h3	2.63%	1.89%	1.10%	0.77%	6.06%	1.06%	0.00%	17.00%	15.57%	1.08%
h4	0.13%	0.04%	0.04%	13.81%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
h5	0.49%	0.36%	0.39%	0.40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%

ABATEMENT	DAIRY CATTLE	NON-DAIRY CATTLE	BROILERS	HENCE	OTHER POULTRY	HORSES	FURS ANIMALS	BREEDING SWINE	MARKET SWINE	SHEEP
h6	0.44%	0.88%	11.24%	5.48%	5.40%	0.00%	0.00%	2.09%	4.32%	1.09%
h7	10.96%	15.09%	18.95%	6.85%	18.21%	7.94%	50.00%	0.70%	1.70%	18.02%
s1	5.74%	4.70%	0.88%	8.24%	0.00%	0.69%	0.00%	5.90%	3.26%	1.49%
s2	0.97%	1.48%	0.29%	1.01%	0.00%	0.00%	0.00%	10.60%	12.27%	0.00%
s3	1.89%	0.81%	0.00%	0.00%	0.00%	0.00%	0.00%	6.04%	8.86%	0.00%
s4	12.15%	12.09%	0.37%	0.46%	0.02%	21.53%	0.00%	8.21%	5.23%	8.13%
s5	0.12%	0.26%	0.11%	0.19%	0.00%	0.00%	0.00%	0.53%	0.84%	1.86%
s6	0.52%	0.15%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%
s7	2.00%	2.31%	3.51%	2.28%	0.00%	0.00%	0.00%	0.01%	0.07%	2.77%
s8	0.42%	0.67%	26.79%	19.79%	18.72%	0.69%	0.00%	0.61%	1.82%	7.10%
s9	9.53%	10.87%	1.39%	1.36%	14.59%	10.42%	0.00%	1.44%	0.97%	11.98%

2024

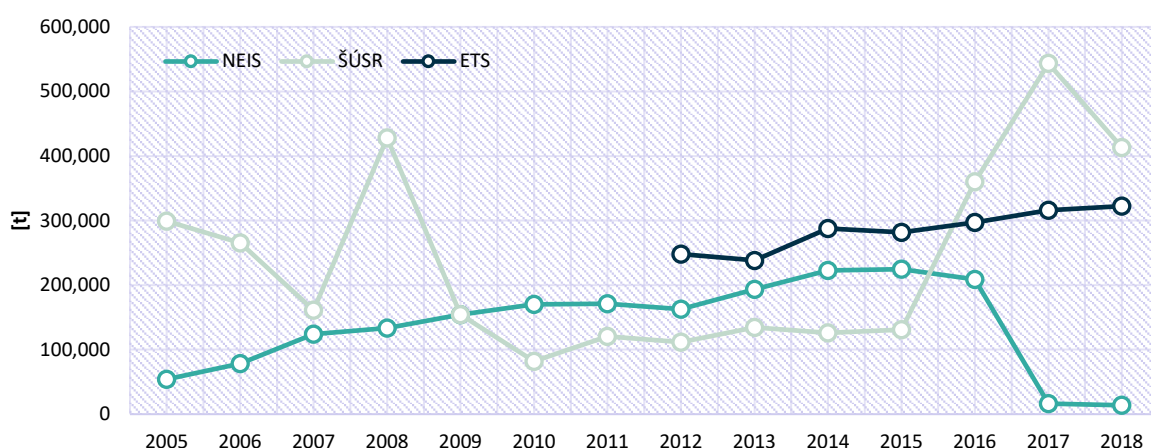
a1	0.26%	0.15%	0.00%	0.00%	0.00%	0.00%	0.00%	0.65%	0.39%	0.00%
a2	2.38%	0.58%	0.00%	0.00%	0.00%	0.00%	0.00%	2.94%	9.47%	0.00%
a3	14.94%	15.19%	1.13%	3.80%	11.13%	18.58%	0.00%	4.06%	7.00%	9.08%
a4	5.81%	6.16%	0.70%	0.52%	0.00%	5.46%	0.00%	2.15%	0.19%	3.65%
a5	1.13%	1.01%	0.00%	0.00%	0.00%	0.00%	0.00%	2.89%	5.12%	0.20%
a6	1.73%	2.25%	0.27%	0.17%	0.76%	8.74%	0.00%	0.04%	0.03%	7.81%
a7	0.38%	1.02%	28.49%	25.36%	21.45%	0.55%	0.00%	19.82%	9.54%	5.81%
a8	4.50%	4.02%	2.74%	3.20%	0.00%	0.00%	0.00%	0.56%	1.47%	2.94%
a9	2.20%	2.95%	0.00%	0.29%	0.00%	0.00%	33.33%	0.22%	0.13%	3.85%
h1	18.09%	14.54%	1.53%	3.63%	3.82%	26.23%	0.00%	5.74%	2.31%	10.55%
h2	0.56%	0.63%	0.20%	5.37%	0.00%	0.00%	0.00%	9.62%	16.47%	2.23%
h3	2.43%	1.85%	0.98%	0.96%	5.43%	1.09%	0.00%	5.76%	1.19%	0.99%
h4	0.16%	0.04%	0.04%	12.62%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
h5	0.55%	0.33%	0.15%	0.57%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
h6	0.50%	0.99%	11.00%	4.09%	7.03%	0.00%	0.00%	11.54%	10.04%	0.60%
h7	11.06%	14.95%	19.44%	6.10%	17.05%	6.01%	33.33%	0.68%	3.32%	18.94%
s1	5.78%	4.73%	0.75%	9.37%	0.00%	0.00%	0.00%	5.06%	5.83%	1.46%
s2	0.98%	1.45%	0.29%	1.03%	0.00%	0.00%	0.00%	8.88%	4.30%	0.00%
s3	1.84%	0.84%	0.00%	0.00%	0.00%	0.00%	0.00%	7.04%	10.04%	0.00%
s4	11.95%	12.05%	0.37%	0.68%	0.00%	21.57%	0.00%	7.55%	7.86%	9.95%
s5	0.12%	0.30%	0.11%	0.18%	0.00%	0.00%	0.00%	0.43%	0.90%	1.78%
s6	0.53%	0.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%
s7	2.03%	2.51%	3.41%	1.27%	0.00%	0.00%	0.00%	0.00%	0.08%	2.74%
s8	0.43%	0.53%	27.20%	19.49%	21.45%	0.65%	0.00%	1.95%	2.96%	8.14%
s9	9.68%	10.76%	1.20%	1.31%	11.89%	11.11%	33.33%	2.42%	1.34%	9.26%

ANNEX VII: JUSTIFICATION OF THE ACTIVITY DATA SOURCE FOR WASTE INCINERATION

In the submissions before 2022, 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.

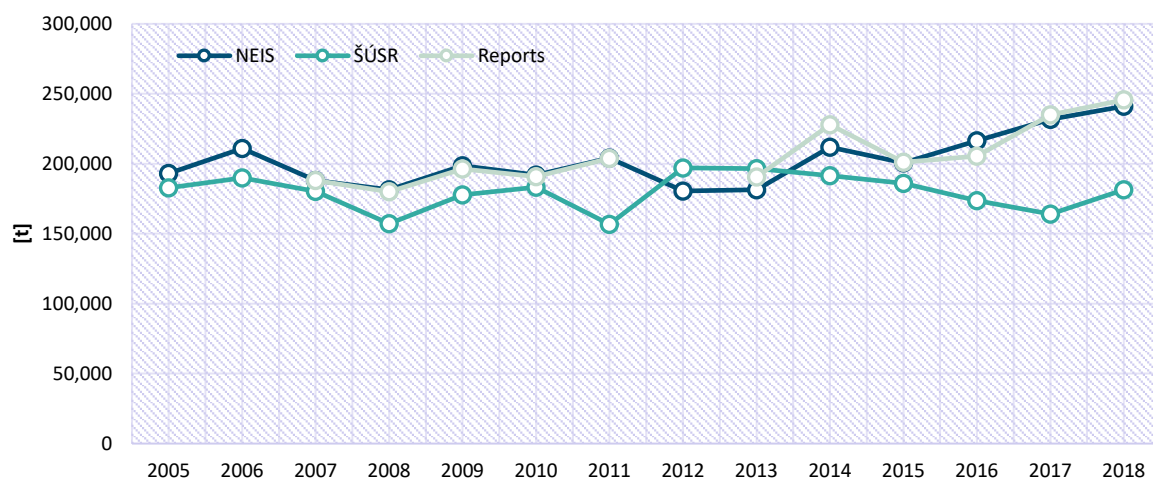
Operators of waste incineration and waste co-incineration plants are also obligated to provide information on the waste burned to the NEIS database as part of reporting for air pollution taxes. Detailed information on the type of waste incinerated is available in the database from the year 2005. By comparison 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 on industrial waste incinerated (with energy recovery) from the 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 on municipal waste incinerated (with energy recovery) from the 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 the amounts of incinerated clinical and industrial waste. For clinical waste, in national statistics, veterinary waste is also included.

Figure A8.3: Comparison of data on industrial waste incinerated (without energy recovery) from the ŠÚ SR and NEIS database

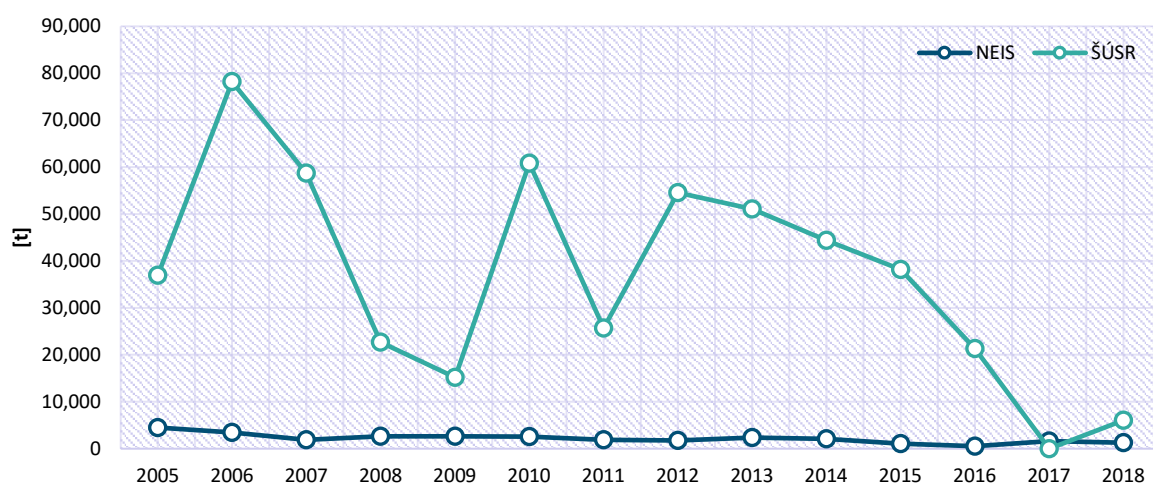
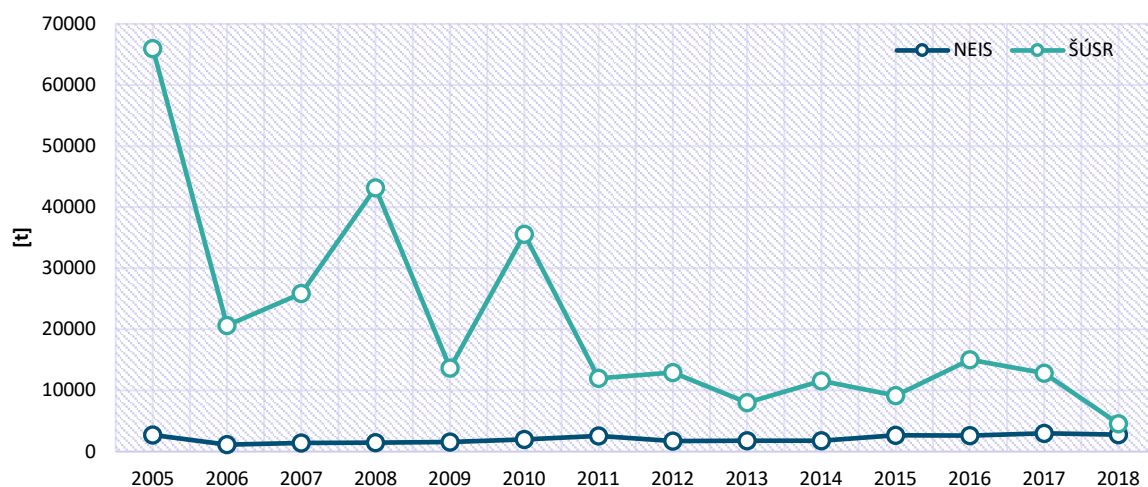


Figure A8.4: Comparison of data on clinical waste incinerated (without energy recovery) from the ŠÚ SR and NEIS database



For the sake of consistency in 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 and are regularly checked.

ANNEX VIII: 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 the 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 2023 were used.

A9.2 UNCERTAINTY OF EMISSION FACTORS

For the analysis of the uncertainty of emission factors, data from the CEIP's Uncertainty analysis tool were used for the sectors of energy, industry, solvents, and waste.

For the sectors transport and agriculture, the arithmetic mean values of the proposed upper and lower emission factor uncertainty from Table 2-2 in the Chapter Uncertainty analysis of EMEP/EEA GB 2023 were calculated and used.

For the residential heating sector, the value of uncertainty was obtained from the VEC VŠB (16).

Emission factors and measurement uncertainties for emissions from the NEIS database (main pollutants) were established by Decree 410/2012 Coll. (3).

The table below represents an example of the uncertainty analysis calculation.

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	1.23	4	20	20.30	0.24	-0.04	0.01	-0.90	0.04	0.81
1A1b	NOx	NEIS	NA	3.80	1.93	5	20	20.62	0.61	0.00	0.01	0.08	0.10	0.02
1A1c	NOx	NEIS	NA	0.43	0.72	5	20	20.62	0.09	0.00	0.01	0.08	0.04	0.01
1A2a	NOx	NEIS	NA	5.13	1.02	4	20	20.43	0.17	-0.01	0.01	-0.12	0.04	0.02
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	0.18	4	20	20.42	0.01	0.00	0.00	-0.01	0.01	0.00
1A2d	NOx	NEIS	NA	3.30	1.22	4	20	20.37	0.24	0.00	0.01	0.00	0.05	0.00
1A2e	NOx	NEIS	NA	0.78	0.25	4	20	20.37	0.01	0.00	0.00	0.00	0.01	0.00
1A2f	NOx	NEIS	NA	5.67	4.31	2	20	20.10	2.90	0.02	0.03	0.32	0.09	0.11
1A2gvii	NOx	NA	NA	0.50	0.56	5	200	200.06	4.89	0.00	0.00	0.54	0.03	0.29
1A2gviii	NOx	NEIS	NA	2.58	0.82	3	20	20.26	0.11	0.00	0.01	-0.02	0.03	0.00
1A3ai(i)	NOx	Please Select	Jet Gasoline and Aviation Gasoline	0.10	0.10	1	40	40.01	0.01	0.00	0.00	0.02	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	10.24	1	40	40.01	64.95	0.04	0.07	1.78	0.10	3.18
1A3bii	NOx	Light commercial vehicles	Diesel	4.45	3.02	1	40	40.01	5.65	0.01	0.02	0.40	0.03	0.16
1A3biii	NOx	Please Select	Please Select	28.26	3.44	1	40	40.01	7.33	-0.05	0.02	-1.93	0.03	3.71
1A3biv	NOx	Please Select	Please Select	0.09	0.02	1	40	40.01	0.00	0.00	0.00	0.00	0.00	0.00
1A3c	NOx	Rail Cars	Gas Oil/Diesel	1.96	0.42	1	89	88.75	0.53	0.00	0.00	-0.19	0.00	0.03
1A3c	NOx	Line-haul locomotives	Gas Oil/Diesel	4.23	0.90	1	98	97.75	2.98	0.00	0.01	-0.44	0.01	0.19
1A3di(ii)	NOx	NA	Marine diesel oil/marine gas oil (MDO/MGO)	1.42	0.39	1	200	200.00	2.33	0.00	0.00	-0.18	0.00	0.03
1A3dii	NOx	Please Select	Please Select	0.00	0.12	1	200	200.00	0.23	0.00	0.00	0.17	0.00	0.03
1A3ei	NOx	NEIS	NA	3.11	0.01	1	20	20.02	0.00	-0.01	0.00	-0.16	0.00	0.03
1A4ai	NOx	NEIS	NA	2.75	2.25	4	20	20.36	0.81	0.01	0.02	0.18	0.09	0.04
1A4aii	NOx	Please Select	Please Select	0.11	0.07	5	200	200.06	0.07	0.00	0.00	0.03	0.00	0.00
1A4bi	NOx	Overfire boilers-low heat input	biomass dry	0.08	0.19	3	30	30.15	0.01	0.00	0.00	0.03	0.01	0.00

A	B	TECHNOLOGY	FUEL/IDEN.	C	D	E	F	G	H	I	J	K	L	M
				kt	kt	%	%	%	%	%	%	%	%	%
1A4bi	NOx	Overfire boilers-normal heat input	biomass dry	0.02	0.09	3	30	30.15	0.00	0.00	0.00	0.02	0.00	0.00
1A4bi	NOx	Overfire boilers-low heat input	biomass wet	0.02	0.04	3	30	30.15	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Overfire boilers-normal 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	Overfire 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	Overfire 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	Overfire boilers-low heat input	hard coal	0.12	0.01	3	30	30.15	0.00	0.00	0.00	-0.01	0.00	0.00
1A4bi	NOx	Overfire boilers-normal heat input	hard coal	0.03	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	brown coal	1.39	0.01	3	30	30.15	0.00	0.00	0.00	-0.10	0.00	0.01
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	0.02	3	30	30.15	0.00	0.00	0.00	0.00	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	-0.01	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	0.05	3	30	30.15	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Underrfire boilers-normal heat input	biomass dry	0.01	0.03	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	0.01	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underrfire 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	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underrfire 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	0.00	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Underrfire boilers-normal heat input	hard coal	0.01	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	brown coal	0.83	0.01	3	30	30.15	0.00	0.00	0.00	-0.06	0.00	0.00
1A4bi	NOx	Underrfire boilers-normal heat input	brown coal	0.19	0.00	3	30	30.15	0.00	0.00	0.00	-0.01	0.00	0.00
1A4bi	NOx	Underfire 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	Underrfire 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	Underrfire 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

A	B	TECHNOLOGY	FUEL/IDEN.	C	D	E	F	G	H	I	J	K	L	M
				kt	kt	%	%	%	%	%	%	%	%	%
1A4bi	NOx	Gasification boilers-low heat input	biomass dry	0.00	0.03	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	0.02	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Gasification 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	Gasification 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	Gasification boilers-low 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	Gasification 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	Gasification boilers-low 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-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	0.02	3	30	30.15	0.00	0.00	0.00	0.00	0.00	0.00
1A4bi	NOx	Automatic boilers-normal heat input	biomass dry	0.00	0.01	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	0.00	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	0.02	3	30	30.15	0.00	0.00	0.00	0.00	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
1A4bi	NOx	Automatic boilers-low 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-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

A	B	TECHNOLOGY	FUEL/IDEN.	C	D	E	F	G	H	I	J	K	L	M
				kt	kt	%	%	%	%	%	%	%	%	%
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	0.12	3	150	150.03	0.13	0.00	0.00	0.11	0.00	0.01
1A4bi	NOx	Fireplaces-normal heat input	biomass dry	0.01	0.05	3	150	150.03	0.02	0.00	0.00	0.04	0.00	0.00
1A4bi	NOx	Fireplaces-low heat input	biomass wet	0.01	0.03	3	150	150.03	0.01	0.00	0.00	0.03	0.00	0.00
1A4bi	NOx	Fireplaces-normal heat input	biomass wet	0.00	0.01	3	150	150.03	0.00	0.00	0.00	0.01	0.00	0.00
1A4bi	NOx	Fireplaces-low 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-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	0.00	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	-0.04	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	0.00	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	0.02	3	125	125.04	0.00	0.00	0.00	0.02	0.00	0.00
1A4bi	NOx	Modern stoves-normal heat input	biomass dry	0.00	0.01	3	125	125.04	0.00	0.00	0.00	0.01	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	0.00	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	Automatic boilers-low heat input	Natural Gas	1.09	1.59	3	30	30.15	0.89	0.01	0.01	0.26	0.05	0.07
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	0.15	5	200	200.06	0.36	0.00	0.00	0.19	0.01	0.04
1A4ci	NOx	NEIS	NA	0.11	0.19	4	20	20.36	0.01	0.00	0.00	0.02	0.01	0.00
1A4cii	NOx	Please Select	Please Select	8.55	0.96	5	200	200.06	14.12	-0.02	0.01	-3.04	0.05	9.25
1A5a	NOx	NEIS	NA	0.19	0.37	5	20	20.52	0.02	0.00	0.00	0.04	0.02	0.00

A	B	TECHNOLOGY	FUEL>IDEN.	C	D	E	F	G	H	I	J	K	L	M
				kt	kt	%	%	%	%	%	%	%	%	%
1A5b	NOx	NA	Please Select	0.32	0.02	5	200	200.06	0.01	0.00	0.00	-0.13	0.00	0.02
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	0.02	2	20	20.10	0.00	0.00	0.00	0.00	0.00	0.00
2A6	NOx	NA	NA	0.34	0.26	2	20	20.10	0.01	0.00	0.00	0.02	0.01	0.00
2B1	NOx	NA	NA	0.21	0.08	2	20	20.10	0.00	0.00	0.00	0.00	0.00	0.00
2B2	NOx	Please Select	NA	0.17	0.10	2	20	20.10	0.00	0.00	0.00	0.01	0.00	0.00
2B5	NOx	Please Select	NA	0.00	0.05	2	20	20.10	0.00	0.00	0.00	0.01	0.00	0.00
2B10a	NOx	NA	NA	0.70	0.34	2	20	20.10	0.02	0.00	0.00	0.01	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	3.87	7	20	21.36	2.64	0.02	0.03	0.38	0.29	0.23
2C2	NOx	NA	NA	0.43	0.00	3	20	20.22	0.00	0.00	0.00	-0.02	0.00	0.00
2C3	NOx	NEIS	NA	0.23	0.04	2	20	20.10	0.00	0.00	0.00	-0.01	0.00	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	0.02	2	20	20.10	0.00	0.00	0.00	0.00	0.00	0.00
2C7c	NOx	0	NA	1.41	0.65	2	20	20.10	0.07	0.00	0.00	0.02	0.01	0.00
2G	NOx	Other, Tobacco combustion	NA	0.00	0.01	2	53	52.82	0.00	0.00	0.00	0.00	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	0.23	2	20	20.10	0.01	0.00	0.00	0.02	0.00	0.00
3B1a	NOx	Dairy cattle	Slurry	0.05	0.03	25	200	201.56	0.01	0.00	0.00	0.01	0.01	0.00
3B1b	NOx	Please Select	Please Select	0.36	0.05	25	200	201.56	0.04	0.00	0.00	-0.11	0.01	0.01
3B2	NOx	Sheep	Please Select	0.02	0.01	25	200	201.56	0.00	0.00	0.00	0.01	0.00	0.00
3B3	NOx	Please Select	Please Select	0.02	0.00	25	200	201.56	0.00	0.00	0.00	0.00	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	0.04	0.02	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	%	%	%	%	%	%	%	%	%
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
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	4.28	25	200	201.56	287.71	0.01	0.03	1.51	1.08	3.44
3Da2a	NOx	Please Select	Please Select	3.75	1.35	25	200	201.56	28.54	0.00	0.01	-0.01	0.34	0.12
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	0.02	0.13	25	200	201.56	0.28	0.00	0.00	0.18	0.03	0.03
3Da3	NOx	Please Select	Please Select	4.05	1.24	25	200	201.56	24.20	0.00	0.01	-0.32	0.31	0.20
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	0.01	5	500	500.02	0.00	0.00	0.00	0.02	0.00	0.00
5C1biii	NOx	Controlled air incineration	NA	0.01	0.00	5	58	58.55	0.00	0.00	0.00	0.00	0.00	0.00
5C1bv	NOx	NA	NA	0.00	0.02	5	500	500.02	0.03	0.00	0.00	0.06	0.00	0.00
5C2	NOx	Please Select	NA	0.19	0.38	2	150	149.65	1.23	0.00	0.00	0.33	0.01	0.11
5D1	NOx	NEIS	NA	NA	NA	4	20	20.49		0.00	0.00	0.00	0.00	0.00
5D2	NOx	NEIS	NA	NA	NA	4	20	20.49		0.00	0.00	0.00	0.00	0.00
		Total	140.54	50.85					454.76					22.23
		Total Uncertainties		-63.82	Uncertainty in total inventory %:				21.33	Trend uncertainty %:				4.71

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 IX: 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 the sectors energy, residential heating, 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	Continuously	To be implemented
Uncertainty analysis with detailed data for the sectors agriculture and transport	Uncertainty analysis on tier 1	Submission 2027/2028	To be implemented
Improvement of priority categories to Tier 2	Emissions of priority key categories are reported using Tier 2	Continuously	To be implemented
Further analysis of available sources of methodology/Activity data	Emissions of non-priority key categories using Tier 2	Continuously	To be implemented

ANNEX X: COUNTRY-SPECIFIC EMISSION FACTORS AND BC METHODOLOGY USED IN 1A1, 1A2, 1A4 AND 1A5

A10.1 COUNTRY-SPECIFIC EMISSION FACTORS IN 1A1, 1A2, 1A4 AND 1A5

In general, the methodology used to calculate emissions of HMs and POPs in the energy sector complies with the newest EMEP/EEA GB, except for categories **1A1a**, **1A2a**, **1A2d**, **1A2gviii**, **1A4ai** and **1A4ci**, where the country-specific methodology was used.

Emission factors used in this methodology are a combination of the results of the Czech State project VaV/520/1/97 (17), publication by Modlík, M., 2017 (18), EMEP/EEA GB 2016 and expert judgment.

Methodology divides the sources according to the type of combustion technology into six groups: fixed bed boilers, pulverized coal-fired boilers, fluidized bed boilers, all types of boilers, gas turbines, and stationary engines. Each technology is subsequently divided according to the type of fuel (Hard coal, Brown coal, Biomass, Liquid fuels and Gaseous fuels. Then, according to their thermal capacity, they are divided into four groups: <5 MW, 5-50 MW, 50-100 MW, and >100 MW.

Emission factors used in the calculations are listed in the following **Table A10.1**.

Table A10.1: Summary of HMs emission factors for boilers in category 1A1a, 1A2a, 1A2d, 1A2gviii, 1A4ai and 1A4ci

TYPE OF BOILER	FUEL TYPE	THERMAL CAPACITY	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
		MW	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹
Fixed bed boiler	Brown Coal	<5	59.471	1.294	2.382	60.967	38.383	69.545	62.104	5.192	30.756
		5-50	6.67	0.495	1.924	2.102	9.1	1	27.67	45	8.8
		50-100	6.67	0.495	1.924	2.102	9.1	1	27.67	45	8.8
		>100	6.67	0.495	1.924	2.102	9.1	1	27.67	45	8.8
Fixed bed boiler	Hard Coal	<5	13.687	2.456	9.051	9.402	15	10	10	2	150
		5-50	2.656	0.823	1.744	0.243	4.5	7.8	4.9	23	19
		50-100	2.656	0.823	1.744	0.243	4.5	7.8	4.9	23	19
		>100	2.656	0.823	1.744	0.243	4.5	7.8	4.9	23	19
Fixed bed boiler	Biomass	<5	27	13	0.56	0.19	23	6	2	0.5	512
		5-50	1.606	0.169	1.268	0.871	0.027	0.106	0.085	0.211	1.991
		50-100	1.606	0.169	1.268	0.871	0.027	0.106	0.085	0.211	1.991
		>100	1.606	0.169	1.268	0.871	0.027	0.106	0.085	0.211	1.991
Pulverized coal-fired boilers	Brown Coal	<5	1.653	0.125	2.24	0.829	9.1	1	9.7	45	8.8
		5-50	1.653	0.125	2.24	0.829	9.1	1	9.7	45	8.8
		50-100	1.653	0.125	2.24	0.829	9.1	1	9.7	45	8.8
		>100	4.071	0.292	2.965	0.76	9.1	1	3.374	45	8.8
Pulverized coal-fired boilers	Hard Coal	<5	0.515	0.048	0.476	0.122	4.5	7.8	3.399	23	19
		5-50	0.515	0.048	0.476	0.122	4.5	7.8	3.399	23	19
		50-100	0.515	0.048	0.476	0.122	4.5	7.8	3.399	23	19
		>100	2.722	0.268	0.668	0.339	4.5	7.8	4.537	23	19
Pulverized coal-fired boilers	Biomass	<5	1.606	0.169	1.268	0.871	0.027	0.106	0.085	0.211	1.991
		5-50	1.606	0.169	1.268	0.871	0.027	0.106	0.085	0.211	1.991
		50-100	1.606	0.169	1.268	0.871	0.027	0.106	0.085	0.211	1.991
		>100	1.606	0.169	1.268	0.871	0.027	0.106	0.085	0.211	1.991
		<5	2.037	0.282	1.5	0.922	9.1	1	4.803	45	8.8

TYPE OF BOILER	FUEL TYPE	THERMAL CAPACITY	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
		MW	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹	mg.GJ ⁻¹
Fluidized bed boiler	Brown Coal	5-50	2.037	0.282	1.5	0.922	9.1	1	4.803	45	8.8
		50-100	2.037	0.282	1.5	0.922	9.1	1	4.803	45	8.8
		>100	2.037	0.282	1.5	0.922	9.1	1	4.803	45	8.8
Fluidized bed boiler	Hard Coal	<5	0.515	0.048	0.476	0.122	4.5	9	3.399	23	90
		5-50	0.515	0.048	0.476	0.122	4.5	9	3.399	23	90
		50-100	0.515	0.048	0.476	0.122	4.5	9	3.399	23	90
		>100	0.515	0.048	0.476	0.122	4.5	9	3.399	23	90
Fluidized bed boiler	Biomass	<5	1.606	0.169	1.268	0.871	0.027	0.106	0.085	0.211	1.991
		5-50	1.606	0.169	1.268	0.871	0.027	0.106	0.085	0.211	1.991
		50-100	1.606	0.169	1.268	0.871	0.027	0.106	0.085	0.211	1.991
		>100	1.606	0.169	1.268	0.871	0.027	0.106	0.085	0.211	1.991
All type of boilers	Liquid fuels	<5	4.56	1.2	0.341	3.98	2.55	5.31	255	2.06	87.8
		5-50	4.56	1.2	0.341	3.98	2.55	5.31	255	2.06	87.8
		50-100	4.56	1.2	0.341	3.98	2.55	5.31	255	2.06	87.8
		>100	4.56	1.2	0.341	3.98	2.55	5.31	255	2.06	87.8
All type of boilers	Gaseous fuels	<5	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.0112	0.0015
		5-50	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.0112	0.0015
		50-100	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.0112	0.0015
		>100	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.0112	0.0015
Gas turbines	Gaseous fuels	-	0.0015	0.00025	0.1	0.12	0.00076	0.000076	0.00051	0.0112	0.0015
Stationary engines	Gaseous fuels	-	0.04	0.003	0.1	0.05	0.05	0.01	0.05	0.2	2.91
Stationary engines	Liquid fuels	-	4.07	1.36	1.36	1.81	1.36	2.72	1.36	6.79	1.81

Table A10.2: Summary of POPs emission factors for boilers in category 1A1a, 1A2a, 1A2d, 1A2gviii, 1A4ai and 1A4ci

TYPE OF BOILER	FUEL TYPE	THERMAL CAPACITY	PCDD_F	BaP	BbF	BkF	InP	PAH	HCB	PCBs
		MW	ng.GJ-1	µg.GJ-1	µg.GJ-1	µg.GJ-1	µg.GJ-1	µg.GJ-1	µg.GJ-1	µg.GJ-1
Fixed bed boiler	Brown Coal	<5	4.986	320.061	518.482	518.482	400.322	1757.347	6.7	5.059
		5-50	7.68	3.147	7.973	4.047	4.203	19.37	6.7	0.757
		50-100	7.68	3.147	7.973	4.047	4.203	19.37	6.7	0.757
		>100	7.68	3.147	7.973	4.047	4.203	19.37	6.7	0.757
Fixed bed boiler	Hard Coal	<5	14.657	10.975	18.54	10.966	5.956	46.437	6.7	8.073
		5-50	2.299	2.4	4.768	3.085	2.08	12.33	6.7	0.395
		50-100	2.299	2.4	4.768	3.085	2.08	12.33	6.7	0.395
		>100	2.299	2.4	4.768	3.085	2.08	12.33	6.7	0.395
Fixed bed boiler	Biomass	<5	100	10000	16000	5000	4000	35000	5	0.007
		5-50	11.348	46.462	144.329	67.897	33.073	291.761	5	2.233
		50-100	11.348	46.462	144.329	67.897	33.073	291.761	5	2.233
		>100	11.348	46.462	144.329	67.897	33.073	291.761	5	2.233
Pulverized coal-fired boilers	Brown Coal	<5	6.525	1.971	2.731	2.324	2.095	9.121	6.7	1.066
		5-50	6.525	1.971	2.731	2.324	2.095	9.121	6.7	1.066
		50-100	6.525	1.971	2.731	2.324	2.095	9.121	6.7	1.066

TYPE OF BOILER	FUEL TYPE	THERMAL CAPACITY	PCDD_F	BaP	BbF	BkF	InP	PAH	HCB	PCBs
		MW	ng.GJ-1	µg.GJ-1	µg.GJ-1	µg.GJ-1	µg.GJ-1	µg.GJ-1	µg.GJ-1	µg.GJ-1
		>100	1.925	4.653	6.187	4.915	5.664	21.419	6.7	0.547
Pulverized coal-fired boilers	Hard Coal	<5	2.055	2.271	5.066	2.64	2.232	12.209	6.7	0.244
		5-50	2.055	2.271	5.066	2.64	2.232	12.209	6.7	0.244
		50-100	2.055	2.271	5.066	2.64	2.232	12.209	6.7	0.244
		>100	1.314	2.844	5.433	3.786	3.662	15.725	6.7	1.176
Pulverized coal-fired boilers	Biomass	<5	11.348	46.462	144.329	67.897	33.073	291.761	5	2.233
		5-50	11.348	46.462	144.329	67.897	33.073	291.761	5	2.233
		50-100	11.348	46.462	144.329	67.897	33.073	291.761	5	2.233
		>100	11.348	46.462	144.329	67.897	33.073	291.761	5	2.233
Fluidized bed boiler	Brown Coal	<5	2.778	5.148	7.621	5.321	5.559	23.649	6.7	1.449
		5-50	2.778	5.148	7.621	5.321	5.559	23.649	6.7	1.449
		50-100	2.778	5.148	7.621	5.321	5.559	23.649	6.7	1.449
		>100	2.778	5.148	7.621	5.321	5.559	23.649	6.7	1.449
Fluidized bed boiler	Hard Coal	<5	2.055	2.271	5.066	2.64	2.232	12.209	6.7	0.244
		5-50	2.055	2.271	5.066	2.64	2.232	12.209	6.7	0.244
		50-100	2.055	2.271	5.066	2.64	2.232	12.209	6.7	0.244
		>100	2.055	2.271	5.066	2.64	2.232	12.209	6.7	0.244
Fluidized bed boiler	Biomass	<5	11.348	46.462	144.329	67.897	33.073	291.761	5	2.233
		5-50	11.348	46.462	144.329	67.897	33.073	291.761	5	2.233
		50-100	11.348	46.462	144.329	67.897	33.073	291.761	5	2.233
		>100	11.348	46.462	144.329	67.897	33.073	291.761	5	2.233
All type of boilers	Liquid fuels	<5	2.5	3.678	12.673	3.968	6.484	26.803	-	3.334
		5-50	2.5	3.678	12.673	3.968	6.484	26.803	-	3.334
		50-100	2.5	3.678	12.673	3.968	6.484	26.803	-	3.334
		>100	2.5	3.678	12.673	3.968	6.484	26.803	-	3.334
All type of boilers	Gaseous fuels	<5	0.5	0.56	0.84	0.84	0.84	3.08	0.00308	-
		5-50	0.5	0.56	0.84	0.84	0.84	3.08	0.00308	-
		50-100	0.5	0.56	0.84	0.84	0.84	3.08	0.00308	-
		>100	0.5	0.56	0.84	0.84	0.84	3.08	0.00308	-
Gas turbines	Gaseous fuels	-	0.5	0.56	0.84	0.84	0.84	3.08	0.00308	-
Stationary engines	Gaseous fuels	-	0.57	1.2	9	1.7	1.8	13.7	-	-
Stationary engines	Liquid fuels	-	0.99	116	502	98.7	187	903.7	0.22	0.00013

projekt VaV520/1/97

EMEP/EEA air pollutant emission inventory guidebook 2016, Tier 2

national emission factors [citace]

expert estimation

A10.2 BC METHODOLOGY USED IN 1A1, 1A2, 1A4 AND 1A5

Following **Recommendation No SK-1A2a-2021-0001**, Slovakia started to calculate emissions of BC, using the methodology proposed by the TERT. BC emissions were not estimated before, because Slovakia cannot distinguish which emissions are emitted from which fuel type. The proposed methodology utilises the calculation of TSP, PMs, and BC, as outlined in EMEP/EEA GB 2023, as a supporting calculation to determine the share of BC in PM_{2.5} emissions. This share is then used to calculate BC emissions from measured emissions, which are used in compiling the Slovak emission inventory for the energy and industry sector.

The following **Table A10.3** shows the share of BC in all affected categories.

Table A10.3: Share of BC in PM_{2.5} emissions in 1A1, 1A2, 1A4 and 1A5

YEAR/CATEGORY	1A1a	1A2a	1A2b	1A2c	1A2d	1A2e	1A2f	1A2gviii	1A3ei	1A4ai	1A4ci	1A5a
1990	3%	6%	4%	7%	20%	14%	8%	15%	4%	9%	14%	7%
1991	3%	6%	4%	7%	20%	14%	8%	15%	4%	9%	14%	7%
1992	3%	6%	4%	7%	20%	14%	8%	15%	4%	9%	14%	7%
1993	3%	6%	4%	7%	20%	14%	8%	15%	4%	9%	14%	7%
1994	3%	6%	4%	7%	21%	14%	8%	15%	4%	9%	14%	7%
1995	3%	6%	4%	7%	21%	15%	8%	15%	4%	8%	15%	7%
1996	3%	6%	4%	7%	21%	15%	8%	16%	4%	9%	14%	7%
1997	2%	6%	4%	8%	21%	15%	8%	16%	4%	9%	15%	7%
1998	2%	6%	4%	8%	21%	15%	8%	16%	4%	8%	15%	7%
1999	2%	6%	4%	8%	21%	15%	7%	16%	4%	8%	16%	7%
2000	2%	6%	4%	8%	22%	15%	8%	18%	4%	9%	14%	7%
2001	2%	6%	4%	33%	23%	16%	7%	17%	4%	8%	19%	7%
2002	2%	6%	4%	40%	23%	18%	9%	19%	4%	8%	18%	7%
2003	2%	6%	5%	42%	23%	18%	8%	21%	4%	9%	20%	7%
2004	2%	6%	5%	43%	26%	22%	9%	23%	4%	9%	21%	8%
2005	2%	6%	5%	41%	25%	19%	8%	24%	4%	12%	21%	9%
2006	2%	6%	5%	19%	25%	19%	9%	27%	4%	15%	25%	9%
2007	2%	6%	5%	4%	25%	10%	9%	27%	4%	17%	20%	11%
2008	2%	6%	4%	21%	25%	6%	9%	27%	4%	20%	19%	15%
2009	2%	6%	4%	14%	25%	9%	9%	27%	4%	20%	20%	15%
2010	3%	6%	4%	7%	28%	9%	9%	27%	4%	23%	20%	13%
2011	3%	6%	4%	7%	28%	7%	9%	26%	4%	25%	24%	15%
2012	3%	6%	4%	7%	28%	7%	9%	27%	4%	26%	24%	27%
2013	3%	6%	4%	8%	28%	7%	11%	27%	4%	26%	24%	27%
2014	3%	6%	4%	7%	28%	7%	11%	27%	4%	27%	26%	28%
2015	3%	6%	4%	6%	28%	7%	12%	27%	4%	27%	24%	28%
2016	3%	6%	4%	9%	28%	7%	13%	27%	4%	27%	23%	28%
2017	3%	6%	4%	8%	28%	7%	13%	23%	4%	27%	23%	28%
2018	3%	6%	4%	7%	28%	7%	13%	27%	4%	27%	26%	27%
2019	3%	6%	4%	5%	28%	12%	14%	27%	4%	27%	25%	27%
2020	3%	6%	4%	14%	28%	13%	12%	27%	4%	27%	25%	17%
2021	3%	6%	4%	6%	28%	21%	13%	27%	4%	27%	26%	18%

YEAR/CATEGORY	1A1a	1A2a	1A2b	1A2c	1A2d	1A2e	1A2f	1A2gviii	1A3ei	1A4ai	1A4ci	1A5a
2022	3%	6%	4%	7%	28%	25%	16%	27%	6%	27%	26%	18%
2023	3%	6%	4%	6%	28%	28%	15%	27%	7%	28%	26%	18%
2024	3%	6%	4%	6%	28%	26%	14%	27%	5%	28%	26%	18%

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