SLOVAK REPUBLIC

INFORMATIVE INVENTORY REPORT 2021

Submission under the LRTAP Convention and the NEC Directive

Slovak Hydrometeorological Institute

Ministry of Environment of the Slovak Republic

Bratislava, March 15, 2021

PREFACE

TITLE OF REPORT	INFORMATIVE INVENTORY REPORT 2021 SLOVAK REPUBLIC. AIR POLLUTANT EMISSIONS 1990-2019.
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VERSION	**1**
DATE OF SUBMISSION	March 15th, 2021 – FIRST VERSION

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 represents also the official document as required in the new NEC Directive.

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

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

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

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

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
ETS	Emission trading system
GHGs	Greenhouse gases
HMs	Heavy metals
IED	Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control)
IPCC	Intergovernmental Panel on Climate Change
IPCC 2006 GL	2006 IPCC Guidelines for National Greenhouse Gas Inventories
ISW	Industrial solid waste
IW	Industrial waste
LCP	Large Combustion Plant
LRTAP Convention	Convention on Long-Range Transboundary Air Pollution
MPaRV	Ministerstvo pôdohospodárstva a rozvoja vidieka The Ministry of Agriculture and Rural Development
MSW	Municipal solid waste
MW	Municipal waste
MŽP SR	Ministerstvo životného prostredia Slovenskej republiky The Ministry of Environment of the Slovak Republic
NECD	National Emission Ceilings Directive
NEC Directive	National Emission Ceiling Directive
NIS SR	National Inventory System of the Slovak Republic
NPPC	Národné poľnohospodárske a potravinárske centrum National Agriculture and Food Centre
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)
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
VÚVZ	Výskumný ústav výživy zvierat Research Institute for Animal Production
WI	Waste incineration

EXECUTIVE SUMMARY

Last update: 15.3.2021

ES.1 BACKGROUND INFORMATION ON INVENTORY OF AIR POLLUTANTS

Informative Inventory Report of the Slovak Republic (IIR SR) and the complete set of NFR tables represent official submission under the United Nations Economic Commission for Europe (UNECE) Convention on Long-rage Transboundary Air Pollution (LRTAP Convention) and under Directive 2016/2284/EU (NEC Directive).

The SHMÚ, as a single national entity regarding emission inventories, compiles annual delivery of the Slovak Republic and submits it officially to the Executive Secretary of UNECE as well as to the European Commission. As a party to the UNECE/LRTAP Convention and under the NEC Directive, the Slovak Republic is required to annually report data on emissions of air pollutants covered in the Convention and its Protocols:

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

The IIR SR contains information on the inventory of air pollutants of the Slovak Republic for all years from 1990 to 2018, all requested air pollutants in NFR14 reporting format and detailed descriptions of methods, data sources, information on quality assurance and quality control (QA/QC) activities analysis of emission trends.

ES.2 MAJOR GENERAL CHANGES

All changes were done to achieve improvement in the data quality, data completeness and transparency of the results, in line with the legal requirements and with the SK Review 2020 Recommendations.

In the sector of energy, Tier 2 methodology was used for the calculation of heavy metals and POPs for the categories **1A1a** and **1A4ai**. Methodology for the calculation of emissions in the category **1A4bi** was recalculated using new data obtained during the statistical survey among the households with independent heating source and using solid fuels including biomass. Historical data was recalculated for most of the categories using the same methodology as used in the industry sector.

In the transport sector, a new methodology for the category **1A3c** on the Tier 2 level was applied. Also, category **1A2gvii** was recalculated due to a change of methodology. Emissions from the vehicles from this category was redistributed among categories **1A2gvii**, **1A4aii** and **1A4bii** for the year 2019 according to national fuel statistics.

Recalculations were made in the industry sector for the emissions of air pollutants. Emissions from category **2C7c** were reallocated. Emissions from copper production were included in the category **2C7a** and emission from aluminium production into the category **2C3**. Emissions of heavy metals and POPs were recalculated using Tier 2 methodology for categories **2C1**, **2C3** and **2C7a**. Emissions of PMs from

Sugar production (**1A2e**) were allocated in the category **2H2** as these originated from the processes. Emissions of NMVOC were calculated for the first time for this category. In the subsector **2D**, database error was eliminated and emissions from the category **2D3a** were recalculated using Tier 2 methodology.

Sectoral emissions in Agriculture was recalculated in line with EMEP/EEA GB2019 and due to methodological changes related to shifting in the higher tier.

The revisions of time-series are visible in the **3B**, **3Da2a**, **3Da3**, **3Dc** emission categories. More details are available in related **Chapter 3 Agriculture**.

Besides, recalculated data on pollutants is provided in the categories **5C**, **5D** and **5A**. In category **5A** the emissions of NMVOC were recalculated following the recommendation from the NECD review 2020. Emissions from wastewater handling (**5D**) were recalculated due to the inclusion of residual gases burning and change of activity data for domestic wastewater handling to comply with the data from GHG inventory. In category **5C**, category **5Cbii** was calculated for the first time. Non-municipal waste incinerated was redistributed among three categories **5C1bi**, **5C1bii** and **5C1biii**. Category **5Cbv** – Cremation was recalculated due to improvement of the activity data.

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

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

ES.3 STRUCTURAL CHANGES IN INSTITUTIONAL COOPERATION

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

Since submission 2018, emission estimations in sector waste are calculated using EMEP/EEA Guidebook (EMEP/EEA GB) methodology, instead of using emissions value reported to the NEIS database by operators.

ES.4 OVERVIEW OF THE EMISSION TRENDS

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

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

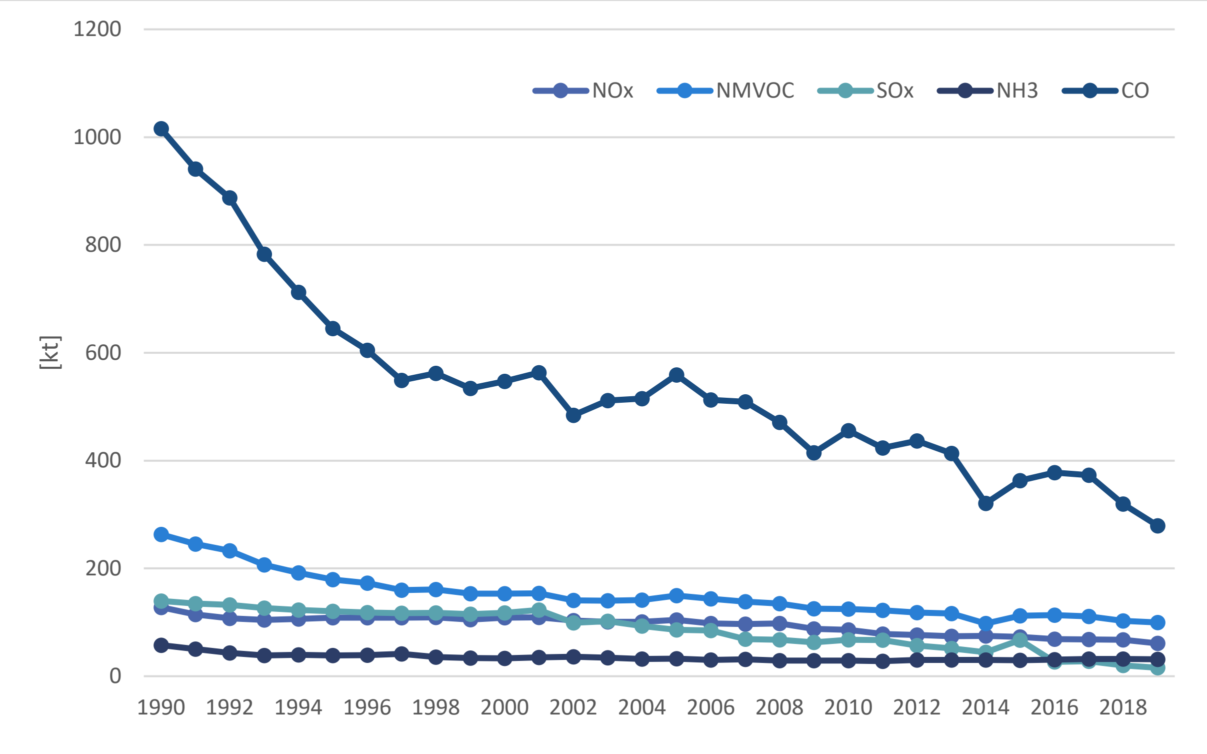


Figure ES.2: *Overall emission trends of the Particulate matter*

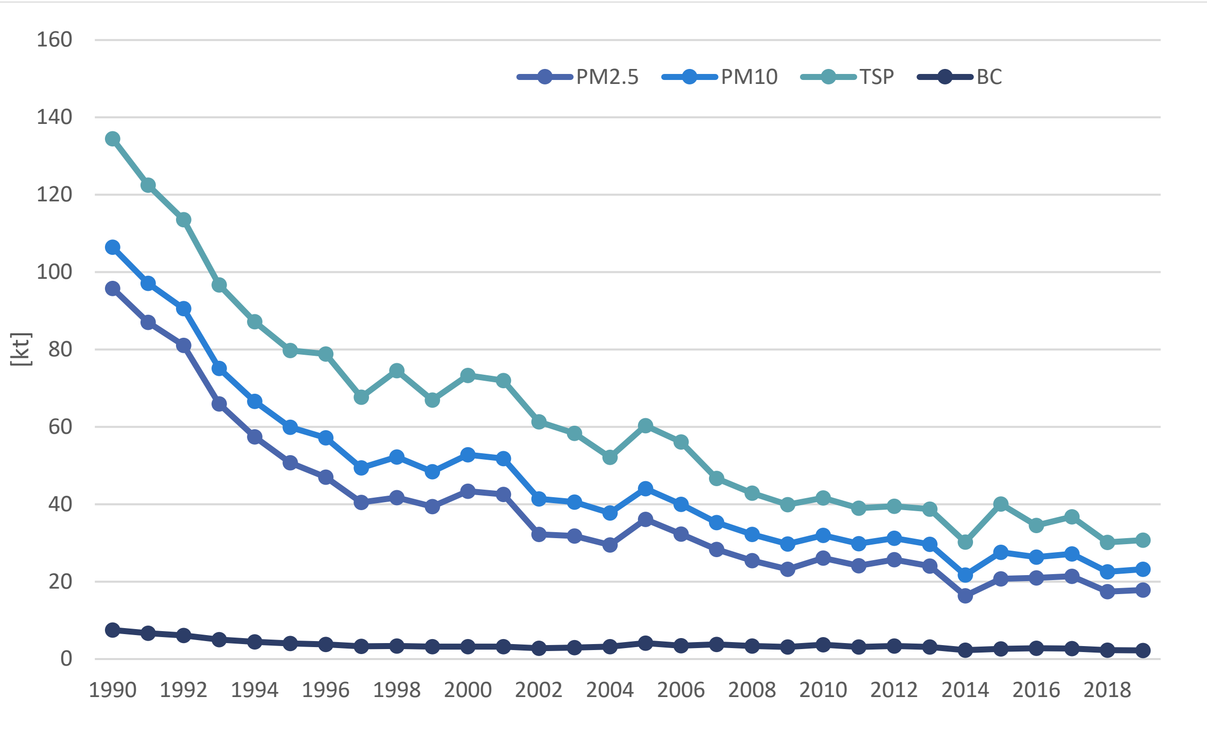


Table ES.3: *Overall emission trends of the Priority heavy metals*

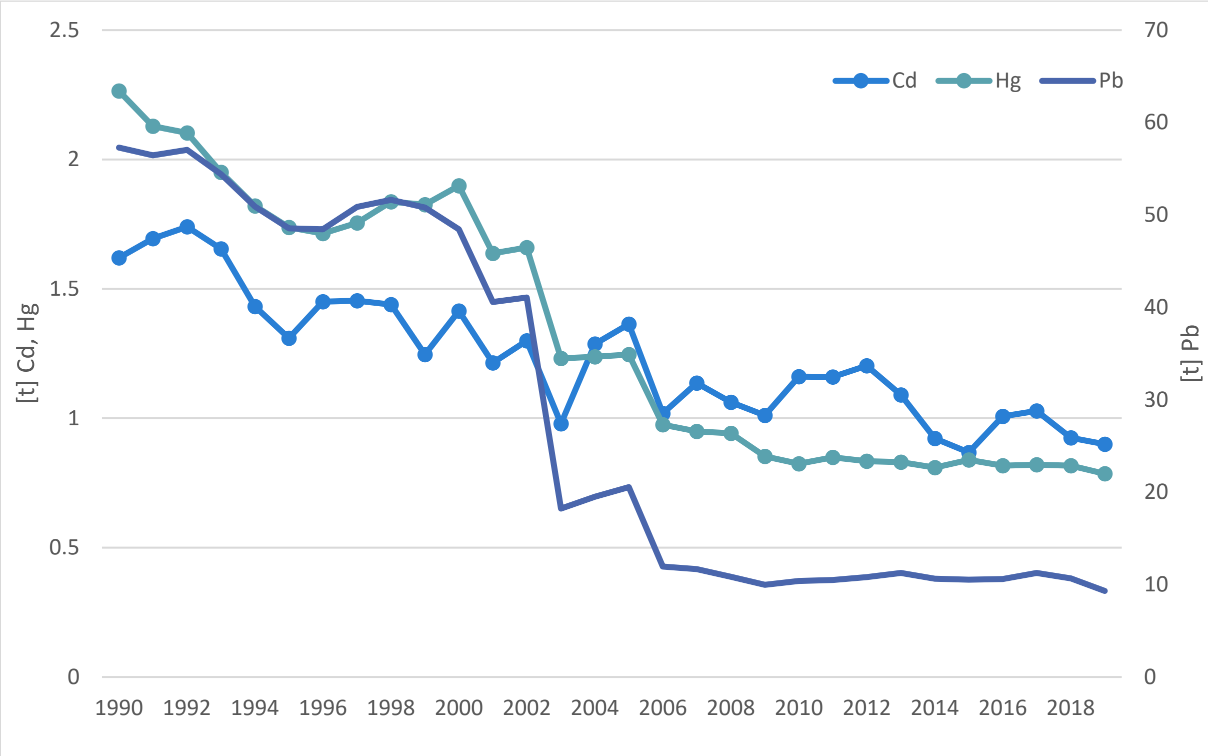
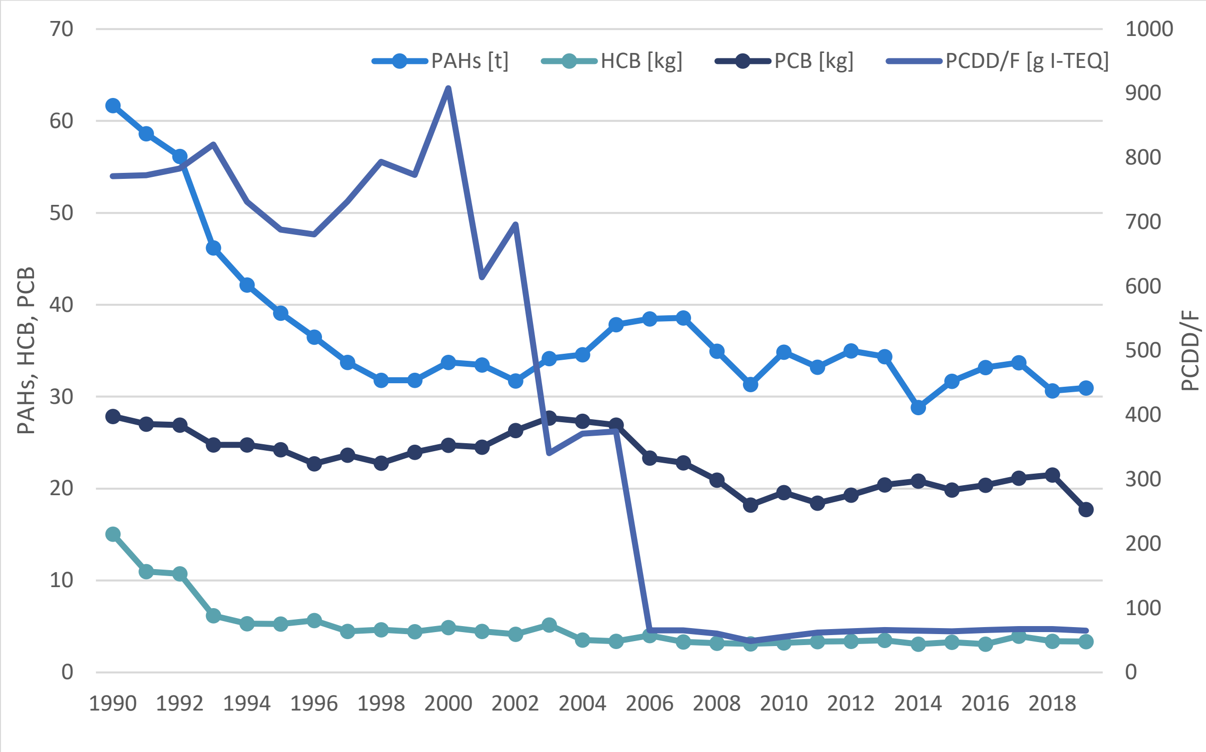


Table ES.4: *Overall emission trend of the Persistent organic pollutants*



ES.5 OVERVIEW OF RECALCULATIONS

Most of the recalculations realized in the 2021 submission were connected with the improvement of the methodology for heavy metals and POPs. Historical years in sectors energy and industry were recalculated using a weighted average of implied emission factors from the period 2000-2004.

Several recalculations were made in Agriculture and Transport sector according to the follow-up recommendations from the previous review process 2020.

Table ES.1 provide an overview of recalculations in the 2021 submission. More detailed data can be found in the particular chapters of this report.

Table *ES.1:* *Main recalculations and their explanation, % difference for the year 2018, 2015, 2010, 2005, 2000 and 1990 between the 2020 and 2021 Final Submissions*

POLLUTANT	CHANGE FOR 1990 VALUES	CHANGE FOR 2000 VALUES	CHANGE FOR 2005 VALUES	CHANGE FOR 2010 VALUES	CHANGE FOR 2015 VALUES	CHANGE FOR 2017 VALUES	UNITS	COMMENT/EXPLANATION
NOx (as NO_2)	-5%	0%	0%	0%	1%	1%	kt	Historical data were recalculated using a weighted average of implied emission factors from the period 2000-2004.
NMVOC	-15%	-13%	-6%	-11%	10%	19%	kt	Recalculations were made due to the improvement of methodology in the category 2D3a and the removal of the database error for other Solvents categories. The emission factor for the category 1A4bi was changed because the EF used in the submission 2020 was TOC, not VOC.
SOx (as SO_2)	-6%	1%	0%	0%	0%	0%	kt	Historical data were recalculated using a weighted average of implied emission factors from the period 2000-2004.
NH_3	-11%	-10%	-10%	-10%	-9%	7%	kt	Emissions on the Agriculture sector were recalculated using EMEP/EEA GB_{2019}.
$PM_{2.5}$	2%	3%	5%	6%	12%	15%	kt	Emissions were recalculated in the category 1A4bi due to new data obtained during the second statistical survey among households from 2019.
PM_{10}	3%	4%	9%	10%	20%	15%	kt	Emissions were recalculated in the category 1A4bi due to new data obtained during the second statistical survey among households from 2019.
TSP	2%	3%	10%	11%	27%	10%	kt	Emissions were recalculated in the category 1A4bi due to new data obtained during the second statistical survey among households from 2019.
BC	2%	4%	4%	4%	8%	11%	kt	Emissions were recalculated in the category 1A4bi due to new data obtained during the second statistical survey among households from 2019.
CO	-2%	0%	0%	1%	3%	6%	kt	Historical data were recalculated using a weighted average of implied emission factors from the period 2000-2004. Emissions were recalculated in the category 1A4bi due to new data obtained during the second statistical survey among households from 2019.

POLLUTANT	CHANGE FOR 1990 VALUES	CHANGE FOR 2000 VALUES	CHANGE FOR 2005 VALUES	CHANGE FOR 2010 VALUES	CHANGE FOR 2015 VALUES	CHANGE FOR 2017 VALUES	UNITS	COMMENT/EXPLANATION
Pb	6%	1%	-46%	-65%	-64%	-66%	t	Emissions were recalculated due to the improvement of the methodology for key categories.
Cd	6%	5%	-9%	-33%	-42%	-45%	t	Emissions were recalculated due to the improvement of the methodology for key categories.
Hg	-5%	-10%	-29%	-39%	-32%	-33%	t	Emissions were recalculated due to the improvement of the methodology for key categories.
PCDD/PCDF	-20%	-3%	-1%	5%	37%	1%	g I-TEQ	Emissions were recalculated due to the improvement of the methodology for key categories.
PAHs	42%	40%	30%	28%	39%	47%	t	Emissions were recalculated due to the improvement of the methodology for key categories.
HCB	17%	10%	7%	4%	5%	3%	kg	Emissions were recalculated due to the improvement of the methodology for key categories.
PCBs	54%	46%	44%	14%	21%	24%	kg	Emissions were recalculated due to the improvement of the methodology for key categories.

ES.6 IMPROVEMENT AND PRIORITIES

General and sectoral uncertainty analysis is one of our main future goals. Due to the necessity of total approach change in most of the categories in sectors energy and industry, this cannot be done in the short-term. Mentioned approach change is very difficult to provide and must be also approved by competent executives in the MŽP SR. Currently, the approach change is at the stage of analysing the available options. In the short-term, it will be possible to manage several sectoral uncertainty analyses. With this improvement is connected possibility to move on of the key category analysis from current Tier 1 to Tier 2 methodology.

The next important improvement planned for the next period is to develop a new methodology for heavy metals and POPs, with priority to key categories.

A categorisation of operators is not in comply with GHG inventory at this moment. Several sources from ETS are still allocated in different categories. Tight cooperation with the GHG inventory experts was initiated, but due to lack of capacity, a complex solution was not yet achieved.

Next of the key priorities is to include independent experts assigned by the MŽP SR to improve quality assessment of the inventory and the IIR.

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

This section was added to IIR for the first time in this submission. In sector Industry and subsector Energy production, emissions are mostly measured on stacks, therefore the condensable component is not included. There are three categories in sector Transport, which include the condensable component into PMs emission factors: Aviation (**1A3a**), Off-road vehicles and other machinery (**1A4cii**) and Other mobile sources (**1A5b**), other categories are estimated using model COPERT and inclusion of condensable compound in EF is unknown. In the sector Agriculture and Waste, estimations were provided using EEA/EMEP GB_{2019} emission factors, which do not include the condensable component. Detailed information about the methodology used to estimate emissions and inclusion/exclusion of condensable component in PM emission factors of individual categories is described in **ANNEX II** of this report.

CHAPTER 1: INTRODUCTION

Last update: 15.3.2021

1.1 NATIONAL INVENTORY BACKGROUND

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

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

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

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

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

[2] https://www.unece.org/env/lrtap/emep_h1.html
[3] http://www.unece.org/env/lrtap/status/lrtap_s.html

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

This Directive sets national reduction commitments for each country for the five pollutants that cause acidification, eutrophication and ground-level ozone pollution. The new Directive repeals and replaces NEC Directive 2001/81/EC, the National Emission Ceilings Directive (***Table 1.1***).

In line with the objective of the Union's air policy to achieve levels of air quality that do not give rise to significant negative impacts on, and risks to, human health and the environment, the new Directive 2016/2284 sets emission reduction commitments for:

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

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

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

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

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

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

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

UNFCCC - UN Framework Convention on Climate Change was adopted in 1992 as an instrument to tackle climate change. The objective of the Convention was to stabilize atmospheric concentrations of greenhouse gases at a safe level that enables the adaptation of ecosystems. The UNFCCC covered 195 countries or international communities, including the Slovak Republic, and the EU, which was also the Party to the Convention. The Convention required the adoption of mitigation measures to reduce GHG emissions in developed countries by 25-40% by 2020 compared to 1990. In the Slovak Republic, the Convention came into force on 23rd November 1994. The Slovak Republic accepted all the commitments of the Convention, including the reduction of GHG emissions by 2000 to the 1990 level. In response to the significant increase of GHG emissions since 1992, an urgent need to adopt an additional and efficient instrument that would stimulate mitigation effort has occurred. 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 31th 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 15th April each year.

[4] http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1491821672988&uri=CELEX:32016L2284
[5] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32001L0081&from=EN

After joining the EU (1st May 2004), a set of new environmental legislative requirements has been adopted including climate change and air protection. The EU considers climate change as one of the four environmental priorities. According to Regulation (EU) No 525/2013 (the MMR) repealing Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community GHG emissions and for implementing the Kyoto Protocol and Doha Amendment, the Slovak Republic shall submit the preliminary data on GHG emission inventory for the year X-2 in required scope by January 15th each year (Annual Report) and National Inventory report submits by 15th March each year.

The Paris Agreement (PA) was adopted on December 12, 2015, as a result of the international effort of the 196 parties of the UNFCCC. The Paris Agreement 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. The Paris Agreement entered into force on November 4, 2016, as the world's first-ever climate change agreement. The EU, together with the Heads of State, including the Slovak Republic, signed the Paris Agreement together at the ceremony held on April 22, 2016, in New York. The proposal for the adoption of the Paris Agreement was negotiated by the Government of the Slovak Republic on September 14, 2016, and approved by Resolution No 387/2016.[14] Subsequently, the proposal was submitted by the National Council of the Slovak Republic, which approved the Paris Agreement by Resolution No 215/2016 on September 21, 2016. The SR completed its ratification process on September 28, 2016, signed by the President of the Slovak Republic.

More information on UNFCCC GHG inventory of The Slovak Republic and National Inventory report 2020 is available at http://ghg-inventory.shmu.sk/documents.php and UNFCCC website.

1.1.1 HISTORICAL BACKGROUND AND CIRCUMSTANCES

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

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

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

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

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

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

- Act No 478/2002 Coll. on air protection[10]
- Decree of the Ministry of Environment of the Slovak Republic No 408/2003 Coll. on monitoring of emissions and air quality monitoring[11]
- Decree No 409/2003 Coll. on emission limits, technical requirements and general operating conditions of certain activities and installations, which use organic solvents[12]
- Decree No 706/2002 Coll. on air pollution sources, on emission limits, on technical requirements and general operational conditions, on the list of pollutants, on the categorization of air pollution sources and on requirements of emission's dispersion as amended[13]

[10] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2002/478/vyhlasene_znenie.html
[11] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2003/408/vyhlasene_znenie.html
[12] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2003/409/vyhlasene_znenie.html
[13] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2002/706/vyhlasene_znenie.html

- Decree No 705/2002 Coll. on air quality[14]
- Decree No 704/2002 Coll. on the control of volatile organic compounds emissions resulting from the storage of petrol and its distribution from terminals to service stations[15]
- Decree No60/2003 Coll. on the Specification of a maximum volume of discharged pollutants (emission quotas)[16]
- Decree No 144/2000 Coll. on the Requirements for the quality of fuels[17]

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

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

The National Inventory System of the Slovak Republic (http://ghg-inventory.shmu.sk/) has been established and officially announced by Decision of the Ministry of Environment of the Slovak Republic on 1st January 2007 in the official bulletin: Vestnik, Ministry of Environment, XV, 3, 2007[19]. In agreement with paragraph 30(f) of Annex to Decision 19/CMP.1, which gives the definitions of all qualitative parameters for the national inventory systems, the description of quality assurance and quality control plan according to Article 5, paragraph 1 is also required. The revised report of the National Inventory System dated in 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.

[14] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2002/705/vyhlasene_znenie.html
[15] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2002/704/vyhlasene_znenie.html
[16] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2003/60/vyhlasene_znenie.html
[17] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2000/144/20000601.html
[18] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2010/137/20160101
[19] Vestnik" (Official Journal of the Ministry of Environment), XV, 3, 2007, page 19: National inventory system of the Slovak Republic for the GHG emissions and sinks under the Article 5, of the Kyoto Protocol

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 within the preparation process and participate in compilations. The list of internal experts of the Slovak Hydrometeorological Institute and designated external experts involved in the inventory of emissions are in the following ***Table 1.3***.

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

SECTOR/SUBSECTOR	CONTRIBUTOR	INSTITUTION	E-MAIL
CLRTAP coordinator	Zuzana Jonáček	SHMÚ	zuzana.jonacek@shmu.sk
Energy	Monika Jalšovská	SHMÚ	monika.jalsovska@shmu.sk
	Michaela Câmpian	SHMÚ	michaela.campian@shmu.sk
Transport	Ján Horváth	SHMÚ	jan.horvath@shmu.sk
IPPU	Zuzana Jonáček	SHMÚ	zuzana.jonacek@shmu.sk
	Róbert Kovács	VUIS - CESTY	
	Vladimír Danielik	STU BA	
Agriculture	Kristína Tonhauzer	SHMÚ	kristina.tonhauzer@shmu.sk
	Zuzana Palkovičová	NPPC	
	Vojtech Brestenský	NPPC	
Waste	Zuzana Jonáček	SHMÚ	zuzana.jonacek@shmu.sk
Projections	Marcel Zemko Kristína Tonhauzer	SHMÚ SHMÚ	marcel.zemko@shmu.sk kristina.tonhauzer@shmu.sk
	Ján Horváth Jiří Balajka	SHMÚ Senior consultant	jan.horvath@shmu.sk
QA/QC	Lenka Zetochová	SHMÚ	lenka.zetochova@shmu.sk

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

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

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

1.3 INVENTORY PREPARATION PROCESS

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

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

- ensure the cooperation with institutions, experts and necessary background studies or papers
- ensure the processing and verification of data in the NEIS database

[20] Note: Slovak Hydrometeorological Institute is the allowance institution to the Ministry of Environment and thus the Contract is formally between Statistical Office of the Slovak Republic and the Ministry of Environment
[21] http://www.mpsr.sk/
[22] http://www.nppc.sk/index.php/sk/

- ensure the technical preparation and compilation of data
- ensure the processing of data from the Statistical Office
- preparation of the LRTAP Convention reporting template
- annual update of the SK IIR
- submission of LRTAP Convention reporting template and SK IIR
- cooperation during the review procedure for national emission inventories
- providing data to the Slovak Environmental Agency (Slovenská agentúra životného prostredia – SAŽP)
- providing processed emission data to the ŠÚ SR

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

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

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

b) for verification of E-PRTR

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

The National Emissions Inventory is being prepared following the updated EMEP/EEA GB_{2019} and implements the NFR (reporting nomenclature) and the category. Data are provided between 1990 and 2019[24]. 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. Basic principles of the NEIS are shown in ***Figure 1.1***.

Activity data from the ŠÚ SR are provided to the SHMÚ based on the long-term cooperation in the field of data exchange through 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 FTP server to qualified and authorized persons with direct access.

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

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

All annual sets of input data involving fuel amounts (according to the types, and quality marks) necessary for the emission balance are obtained from the district offices by means of the NEIS BU module. Activity data collected in the NEIS central database are allocated according to the NFR categorization for solid,

[23] under the Regulation (EU) No 691/2011 of the EP and of the Council on European environmental economic accounts
[24]https://www.eea.europa.eu//publications/emep-eea-guidebook-2019

liquid, gaseous fuels, biomass and other fuels. The emissions balances of air pollutants in the range from 2000–2019 were processed in the NEIS CU module by the same way of calculation.

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

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

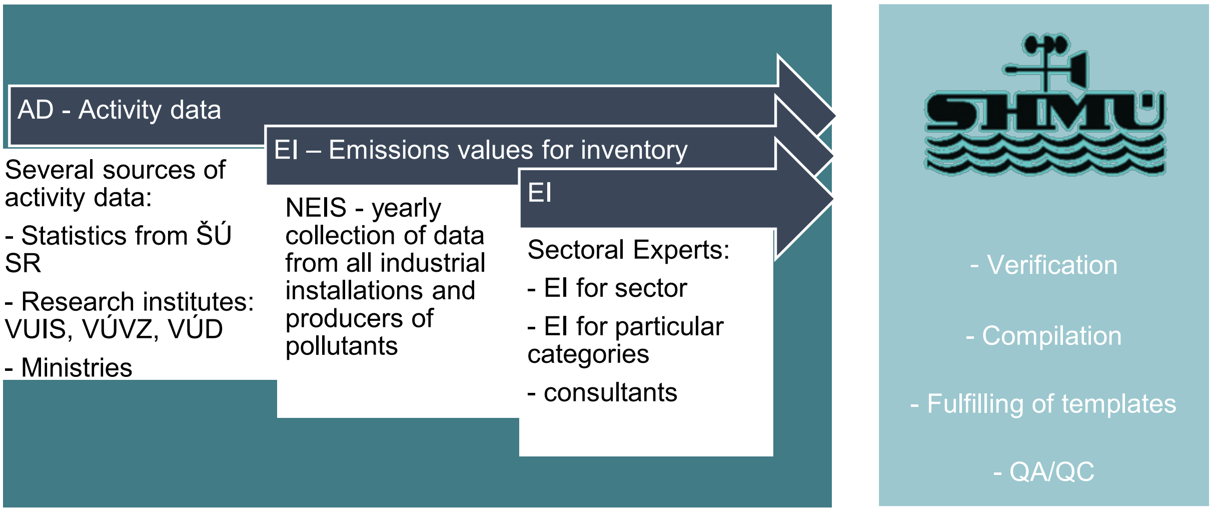
The MŽP SR has mandated the SHMÚ to ensure communication with the producers to collect the necessary data, which they are not obliged to provide to the NEIS.

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

Data on the quantity of emitted total suspended particulate matter (TSP) were provided directly by operators of individual large and medium sources based on measurements or calculations (under the Slovak Air Protection Act). The PM_{10} and $PM_{2.5}$ emission inventory for the Slovak Republic was compiled according to the EMEP/EEA GB_{2019}, following the requirements of the relevant UNECE Working Group on Inventory of Emissions and the methodology based on the IIASA report[25].

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

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



1.5 KEY CATEGORIES

The identification of key categories is described in the EMEP/EEA GB_{2019}. It stipulates that a key category is one that is prioritised within the national inventory system because it is significantly important for one or a number of air pollutants in a country's national inventory of air pollutants in terms of the absolute level, the trend, or the uncertainty in emissions.

It is good practice for each country to use key category analysis systematically and objectively as a basis for choosing methods of emission calculation. Such a process will lead to improved inventory

[25] hhttp://www.iiasa.ac.at/web/home/research/researchPrograms/air/ir-02-076.pdf

quality as well as greater confidence in the resulting estimates. This can be achieved by performing a quantitative analysis of the relationship between the magnitude of emissions in any one year (i.e. level) and the change in emissions year to year (i.e. trend) for each category's emissions compared to the total national emissions. The identification includes all NFR categories and all mandatory gases.

Purpose of key category analysis:

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

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

- **Level**: the absolute level the source category contributes to the total pollutant emissions for a particular year of interest.
- **Trend**: the change of emissions for the source category across a time series. This is particularly important for categories with increasing or decreasing emissions trends over time.
- **Uncertainty**: if the contribution of a source category's uncertainty to total inventory uncertainty in a particular year, or the trend uncertainty is high, then the category should be identified as key.

In addition to making a quantitative determination of *key categories*, it is *good practice* to consider qualitative criteria for identifying categories that are likely to need prioritised attention (e.g. where significant changes in trends are expected, categories not presently estimated or having a suspected high uncertainty)

The identification includes all NFR categories and all mandatory gases

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

<u>Methodology used for identification of key categories: Approach 1</u>

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 calculated according to ***Equation 1.1***.

Equation 1.1: *Level assessment*

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

Where:

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

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

$\Sigma \boldsymbol{E_t}$ = total contribution, which is the sum of the emissions in year *t*, calculated using the aggregation level chosen by the country for key category analysis.

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

Equation 1.2: *Trend assessment*

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

Where:

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

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

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

The presented key category analysis was performed with data for air emissions of the submission 2020 to the UNECE/LRTAP. For all gases a level assessment for all years 1990 (base year) and 2018 (last year), was prepared.

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

As the analysis was made for all mandatory pollutants reported to the UNECE and as these pollutants differ in their way of formation, most of the identified categories are key for more than one pollutant (***Table 1.4***).

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

NFR	NOx		SOx		NH_3		NMVOC		$PM_{2.5}$		PM_{10}		TSP		CO		BC		Pb		Cd		Hg		PCDD/F		PAHs		HCB		PCB		Sum of KC
	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	
1A1a	6	23	15	46								7		7					5	39	6	48	11	47		86			21				367
1A1b	2	3	12	8																													25
1A1c															5								21										26
1A2a		6	4																12				9								8		39
1A2c																																7	7
1A2d		3		10															5		23	6										10	57
1A2f	7																						18		12								37
1A2gviii	2						6	3													9												20
1A3bi	17							8		80						20	10			15													150
1A3bii	6																																6
1A3biii	13	27															4	8															52
1A3bvi									2		3		3						10														18
1A3bvii													3																				3
1A3c	3	6																														8	17
1A3ei		4																															4
1A4ai	4																				11											6	21
1A4aii																												8					8
1A4bi	5	3	8	22	5		32	56	79		62	76	50	68	55	70	63	75			25	10	8	19	10		36	64	70	92		5	1068
1A4cii	3																																3
1A5a																																4	4
1B1a							4				2		3																				9
1B1b								3											5						6		15	10					39
1B2av							5																										5
1B2b							8																										8

NFR	Nox		Sox		NH3		NMVOC		PM2.5		PM10		TSP		CO		BC		Pb		Cd		Hg		PCDD/F		PAHs		HCB		PCB		Sum of KC
	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	
2A5b											4		10																				14
2B10a			8																														8
2C1	4		19										2	6	19				36	32	7		5	11	46		30				77	49	343
2C3			13												6																		19
2C7a																						21			6								27
2C7c			4																														4
2D3a							6																										6
2D3d							9																										9
2D3e							4	3																									7
2G																	5		8														13
2H2							3																										3
2K																							7										7
3B1a							3	3																									6
3B1b					4	10	3	4																									21
3B3					4	16																											20
3B4gi													4																				4
3B4gii					4																												4
3Da1	8	5			29	4																											46
3Da2a					36	51																											87
3Da2b		2																															2
3Dc											10		8																				18
5C1biii																								6									6
5C1bv																							4										4

1.6 QA/QC AND VERIFICATION METHODS

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

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

Sectoral experts apply the QA/QC methodology according to EEA/EMEP GB_{2016}, collect data from providers and process emission inventory for a given sector – they provide partial reports with information on 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

In November 2019, Bilateral QAQC meeting between Slovak and Czech inventory compilers took place. The meeting was focused on the methodology for the households heating, model COPERT and exchange of knowledge and experience in the other sectors. These meetings are planned to take place regularly to ensure close cooperation and improvement of our inventories as both countries have a common history and political and socio-economical settings. The next meeting is planned for March 2021.

1.6.1 QA/QC PLAN

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

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

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

- ➢ Timeliness
- ➢ Completeness
- ➢ Consistency
- ➢ Comparability
- ➢ Accuracy
- ➢ Transparency
- ➢ Improvement
- ➢ Quality Control Procedures (DO)

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 the spreadsheets to minimise emission calculation errors. Checks ensure compliance with the established procedures as well as allow detecting the remaining errors. Parameters, emission units and conversion factors used for the calculations must be clearly singled out and specified.

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

1.6.2 QUALITY ASSURANCE (CHECK)

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

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

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

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

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

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

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

1.6.3 VERIFICATION ACTIVITIES

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

1.6.4 INVENTORY IMPROVEMENT (ACT)

The main aim of the QA/QC process is 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 this 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 recommendation raised during reviews and expert's consultations. Results of prioritisation are included in the improvement plans. Detailed recommendation list and improvement plan are prepared by sectors and delivered to the sectoral experts for consideration and prioritisation of planned activities for the next inventory cycle.

During the last years, the prioritisation of the improvement plan was focused on the Energy and Industry sector. In this submission, several emissions sources were reallocated and the methodology for calculation of heavy metals and POPs in these sectors was changed to comply with EMEP/EEA GB_{2019}, however, a methodology for these pollutants needs further development as it is ion a sufficient level.

1.7 GENERAL UNCERTAINTY EVALUATION

Uncertainty analysis was not provided in the past due to insufficient capacities and unavailable data. Nevertheless, this important issue was involved in the improvement plan as an item with high importance.

1.8 ARCHIVING, DOCUMENTATION AND REPORTING

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

Collected input data are compared and checked with the 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 COPERT model).

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

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

The data from the ŠÚ SR are, except the arranged FTP server, archived electronically at SHMÚ as well as the Statistical yearbook published annually by the ŠÚ SR are stored in paper form.

All documents and background materials of the internal expert of SHMÚ and external are archived, too. Printed documents are archived in the central archive of the SHMÚ and at the OEaB. The electronic archive has been created for all electronic documents relates to the emission inventories.

1.9 GENERAL ASSESSMENT OF COMPLETENESS

Assessment of completeness is one of the elements of quality control procedure in the inventory preparation on the general and sectoral level. 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 is performed and the estimation is completed in recent inventory submission (2021). The list of categories reported by the notation keys NE and IE is provided in ***Table 1.5.***

Several categories are reported as not occurring (NO) due to the not existence of the emission source or the source is out of threshold and measurement range. If the methodology does not exist in the EMEP/EEA GB_{2019}, the notation key not applicable (NA) was used. The lists of notation keys NA and NO are available in ***Table 1.6***.

Several NE key categories have been reported in 2021 submission for 1990–2019.

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

NFR	NOT ESTIMATED	YEARS	INCLUDED ELSEWHERE	YEARS
1A1a	BC	1990-2019		
1A1b	B(a)P, B(b)F, B(k)F, I()P	1990-2019	Cr, Cu, Se, Zn	1990-2019
1A2a	BC	1990-2019		
1A2b	BC	1990-2019		
	HCB, PCBs	1990-2002, 2008-2018		
1A2c	BC	1990-2019		
1A2d	BC	1990-2019		
1A2e	BC	1990-2019		
1A2f	BC	1990-2019		
1A2gvii	Pb, PCDD/F, B(k)F, I()P, HCB, PCBs	2014-2019	MPs, PMs, Pb, Cd, Cr, Cu, Ni, Se, POPs	1990-2013
1A2gviii	BC	1990-2019		
1A3ai(i)	Pb	1990-2018		
	NH_3, Hg, Cd, AHMs, PCDD/F, PAHs	1990-2019		
1A3aii(i)	Pb	1990-2018		
	NH_3, Hg, Cd, AHMs, PCDD/F, PAHs	1990-2019		
1A3bv	Zn, PCDD/F, B(a)P, B(b)F, B(k)F, PAHs, PCB	1990-2019		
1A3bvi	CO, PCDD/F, PAHs, PCB	1990-2019		
1A3bvii	CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, PCDD/F, PAHs, PCB	1990-2019		
1A3c	Pb, Hg, As	1990-2019		
1A3di(ii)			MPs, Cd, Cr, Cu, Ni, Se, Zn, POPs	1990-2015
			Pb	1990-2000
1A3ei	BC	1990-2019		
1A4ai	BC	1990-2019		
1A4aii	Pb, PCDD/F, B(k)F, I()P, HCB, PCB	2019	All pollutants	1990-2018
1A4bii	Pb, PCDD/F, B(k)F, I()P, HCB, PCB	2019	All pollutants	1990-2018
1A4ci	NH_3, BC	1990-2019		

NFR	NOT ESTIMATED	YEARS	INCLUDED ELSEWHERE	YEARS
1A4cii	Pb, PCDD/F, B(k)F, I()P, HCB, PCB	1990-2019		
	PAHs	1990-2013		
1A5a	BC	1990-2019		
1A5b	Cd, Hg, AHMs, POPs	1990-2019	All pollutants	1990-2014
1B1a	BC, HMs	1990-2019		
1B1b	HCB, PCB	1990-2019		
1B2ai	SOx, PCDD/F	1990-2019		
1B2aiv			MPs, $PM_{2.5}$, PM_{10}, TSP	1990-2019
1B2av	SOx, PCDD/F	1990-2019		
1B2b	SOx, PCDD/F	1990-2019		
1B2c	BC, CO, HMs, POPs	1990-2019	MPs, $PM_{2.5}$, PM_{10}, TSP	1990-2019
2A1			MPs, HMs, POPs	
2A2	PHMs	1990-2019	MPs	1990-2019
2A3	PCDD/F, PAHs, HCB	1990-2019	MPs	1990-2019
2A5c			$PM_{2.5}$, PM_{10}, TSP	1990-2019
2A6	BC	1990-2019		
2B5	BC, HMs, PCDD/F, PAHs, HCB	1992-2019		
2B6				
2B7				
2B10a	HMs, POPs	1990-2019		
2B10b	BC	1990-2019		
2C1	B(a)P, B(b)F, B(k)F, I()P	1990-2019		
2C2	HMs, PCDD/F, PAHS	1990-2019		
2C3	NH_3, HMs, PCDD/F, HCB	1990-2019		
2C4	BC, HMs, POPs	1990-2019		
2C5	NH_3, BC, Cr, Cu, Ni, Se, , B(a)P, B(b)F, B(k)F, I()P, HCB	2011-2019		
2C6	NOx, NMVOC, NH_3, BC, CO, Cr, Cu, Ni, Se, PAHs, HCB	1990-2019		
2C7a	NH_3, Se, Zn, PAHs, HCB	1990-2019		
2C7c	BC, HMs, POPs	1990-2019		
2C7d			All Pollutants	1990-2019
2D3a	$PM_{2.5}$	1990-2019		
2D3b	NOx, SOx, CO, PAHs, HCB	1990-2019		
2D3c	NOx, CO, PHMs, PCDD/F, PAHs, HCB	1990-2019		
2D3e	$PM_{2.5}$	1990-2019		
2D3f	$PM_{2.5}$	1990-2019		
2D3g	NOx, SOx, NH_3, PMs, CO, Pb, Hg, Cu, Zn, B(a)P, B(b)F, B(k)F, I()P, HCB, PCB	1990-2019		
	Cd, As, Cr, Ni, Se, PAHs	2015-2019		
2D3h	$PM_{2.5}$, BC	1990-2019		
2G	Se, HCB, PCBs	1990-2019		
2H1	NH_3, PAHs, HCB	1990-2019	NOx, NMVOC, SOx, CO	1990-2019
2H2	BC	1990-2019		
2H3	BC	1990-2019		
2I	BC, As, Cu	1990-2019		
2K	Pb, Cd, AHMs, HCB	1990-2019		
3Da4	NH_3	1990-2019		
5A	NH_3, CO, Hg	1990-2019		
5B1	NOx, NMVOC, SOx, PMs, CO	1990-2019		
5B2	NOx, NMVOC, SOx, PMs, CO, PHMs, Cr, Zn, POPs	2001-2019		
5C1bi	NH_3, Cr, Cu, Se, Zn, B(a)P, B(b)F, B(k)F, I()P	1990-2006		
5C1bii	NH_3, Cr, Cu, Se, Zn, B(a)P, B(b)F, B(k)F, I()P	1990-2019		

NFR	NOT ESTIMATED	YEARS	INCLUDED ELSEWHERE	YEARS
5C1biii	NH_3, $PM_{2.5}$, PM_{10}, TSP, Se, Zn, PAHs	1990-2019		
5C1bv	BC	1990-2019		
5D1	BC, HMS	1990-2019		
5D2	BC, HMS	1990-2019		
5E	NOx, NMVOC, SOx, BC, CO, Ni, Se, Zn, PAHs, HCB, PCB	1990-2019		

Main Pollutants: MPs - NOx, NMVOC, SOx, NH_3, CO

Particulate Matter: PMs - $PM_{2.5}$, PM_{10}, TSP, BC

Heavy metals: HMs –**Priority Heavy Metals**: **PHMs** - Pb, Cd, Hg; **Additional Heavy metals: AHMs** - As, Cr, Cu, Ni, Se, Zn

Persistent Organic Pollutants: POPs - PCDD/F; **Polycyclic Aromatic Hydrocarbons**: **PAHs** - B(a)P, B(b)F, B(k)F, I()P; HCB, PCBs

Table 1.6: *List of NFR categories with notation key NA and NO*

NFR	NOT APPLICABLE	YEARS	NOT OCCURRING	YEARS
1A1a			NH_3	1990-2014,2018
1A1c	HCB, PCBs	1990-2019		
1A2a			NH_3	1990-2015,2017-2019
1A2b			NH_3	1990-2019
1A2c			NH_3	1990-2019
1A2d			NH_3	1990-2006
1A2f			NH_3	1990-1999,20006-2011
1A2gvii	Hg, As	1990-2019		
1A3ai(i)	HCB, PCBs	1990-2019		
1A3aii(i)	HCB, PCBs	1990-2019		
1A3bv	NOx, SOx, NH_3, PMs, CO, PHMs, As, Cr, Cu, Ni, Se, PCDD/F,B(a)P, B(b)F, B(k)F, HCB	1990-2019		
1A3bvi	NOx, NMVOC, SOx, NH_3, BC	1990-2019		
1A3bvii	NOx NMVOC, SOx, NH_3, BC, Zn, HCB	1990-2019		
1A3di(ii)	Pb	2001-2019		
	Hg, As	1990-2019		
1A3ei	NH_3, HMs, POPs	1990-2019		
1A3eii			All pollutants	1990-2019
1A4ai			NH_3	1990-2013
1A4aii	Hg, As	1990-2019		
1A4bii	Hg, As	2019		
1A4cii	Hg, As	1990-2019		
1A4ciii			All pollutants	1990-2019
1B1a	NOx, SOx, NH_3, CO, POPs	1990-2019		
1B1c			All pollutants	1990-2019
1B2ai	NOx, NH_3, CO, HMs, PAHs, HCB, PCB	1990-2019		
1B2aiv	BC, PAHs, HCB, PCB	1990-2019		
1B2av	NOx, NH_3, CO, HMs, PAHs, HCB, PCB	1990-2019		
1B2b	NOx, NH_3, CO, HMs, PAHs, HCB, PCB	1990-2019		
1B2d			All pollutants	1990-2019
2A2	AHMs, POPs	1990-2019		
2A3	PCB	1990-2019		
2A5a	NH_3, BC, HMs, POPs	1990-2019		
2A5b	MPs, BC, HMs, POPs	1990-2019		
2A5c	MPs, BC, HMs, POPs	1990-2019		

NFR	NOT APPLICABLE	YEARS	NOT OCCURRING	YEARS
2A6	HMs, POPs	1990-2019		
2B1	BC, HMs, POPs	1990-2019		
2B2	NMVOC, SOx, PMs, HMs, POPs	1990-2019		
2B3			All pollutants	1990-2019
2B5	NH_3, PCB	1992-2019	All pollutants	1990-1991
2B6			All pollutants	1990-2019
2B7			All pollutants	1990-2019
2B10b	HMs, POPs	1990-2019	NH_3	2006-2019
2C2	HCB, PCBs	1990-2019	NH_3	2004-2009
2C3	PCBs	1990-2019		
2C5			All Pollutants	1990-2010
2C7b			All Pollutants	1990-2019
2D3a	NOx, SOx, NH_3, PM_{10}, TSP, BC, CO, Pb, Cd, AHMs, POPs	1990-2019		
2D3b	NH_3, HMs, PCBs	1990-2019		
2D3c	Sox, NH_3, AHMs, PCBs	1990-2019		
2D3d	NOx, SOx, NH_3, PMs, CO, HMs, POPs	1990-2019		
2D3e	NOx, SOx, NH_3, PM_{10}, TSP, BC, CO, HMs, POPs	1990-2019		
2D3f	NOx, SOx, NH_3, PM_{10}, TSP, BC, CO, HMs, POPs	1990-2019		
2D3h	NOx, SOx, NH_3, PM_{10}, TSP, CO, HMs, POPs	1990-2019		
2D3i	NOx, NH_3, PMs, CO, POPs	1990-2019		
2H1	HMs, PCDD/F, PCBs	1990-2019		
2H2	NOx, SOx, NH_3, HMs, POPs	1990-2019		
2H3	HMs, POPs	1990-2019	NH_3	2017-2019
2I	PHMs, Cr, Ni, Se, Zn, POPs	1990-2019	NH_3	2011-2013
2J			All Pollutants	1990-2019
2K	MPs, PMs, PCDD/F, PAHs	1990-2019		
2L			All Pollutants	1990-2019
3B1a	SOx, BC, CO, HMs, POPs	1990-2019		
3B1b	SOx, BC, CO, HMs, POPs	1990-2019		
3B2	SOx, BC, CO, HMs, POPs	1990-2019		
3B3	SOx, BC, CO, HMs, POPs	1990-2019		
3B4a			All Pollutants	1990-2019
3B4d	SOx, BC, CO, HMs, POPs	1990-2019		
3B4e	SOx, BC, CO, HMs, POPs	1990-2019		
3B4f			All Pollutants	1990-2019
3B4gi	SOx, BC, CO, HMs, POPs	1990-2019		
3B4gii	SOx, BC, CO, HMs, POPs	1990-2019		
3B4giii	SOx, BC, CO, HMs, POPs	1990-2019		
3B4giv	SOx, BC, CO, HMs, POPs	1990-2019		
3B4h	All Pollutants	1990-2019		
3Da1	NMVOC, SOx, TSP, BC, CO, HMs, POPs	1990-2019	$PM_{2.5}$, PM_{10}	1990-2019
3Da2a	SOx, PMs, HMs, POPs	1990-2019		
3Da2b	NMVOC, SOx, TSP, BC, CO, HMs, POPs	1990-2019	NOx, NH_3	2015-2019
3Da2c	NMVOC, SOx, TSP, BC, CO, HMs, POPs	1990-2019		
3Da3	SOx, TSP, BC, CO, HMs, POPs	1990-2019		
3Da4	NOx, NMVOC, SOx, PMs, HMs, POPs	1990-2019		
3Db	NOx, NMVOC, SOx, PMs, HMs, POPs	1990-2019	NH_3	1990-2019
3Dc	MPs, BC, HMs, POPs	1990-2019		
3Dd	All Pollutants	1990-2019		
3De	NOx, SOx, PMs, HMs, POPs	1990-2019	NH_3	1990-2019

NFR	NOT APPLICABLE	YEARS	NOT OCCURRING	YEARS
3Df	MPs, PMs, HMs, PCDD/F, PAHs, PCBs	1990-2019		
3F			All Pollutants	1990-2019
3I	All Pollutants	1990-2019		
5A	NOx, SOx, BC, Pb, Cd, AHMs, POPs	1990-2019		
5B1	HMs, POPs	1990-2019		
5B2	As, Cu, Ni, Se	2001-2019	All Pollutants	1990-2000
5C1a			All Pollutants	1990-2019
5C1bi	PCBs	1990-2006	All Pollutants	2007-2019
5C1bii	PCBs	1990-2019		
5C1biii			Pb	2006-2019
5C1biv			All Pollutants	1990-2019
5C1bv	NH_3	1990-2019		
5C1bvi			All Pollutants	1990-2019
5C2			All Pollutants	1990-2019
5D1	POPs	1990-2019		
5D2	POPs	1990-2019		
5D3			All Pollutants	1990-2019
5E	NH_3	1990-2019		
6A			All Pollutants	1990-2019

Main Pollutants: MPs - NOx, NMVOC, SOx, NH_3, CO

Particulate Matter: PMs - $PM_{2.5}$, PM_{10}, TSP, BC

Heavy metals: HMs –**Priority Heavy Metals**: **PHMs** - Pb, Cd, Hg; **Additional Heavy metals: AHMs** - As, Cr, Cu, Ni, Se, Zn

Persistent Organic Pollutants: POPs - PCDD/F; **Polycyclic Aromatic Hydrocarbons**: **PAHs** - B(a)P, B(b)F, B(k)F, I()P; HCB, PCBs

CHAPTER 2: KEY TRENDS

Last update: 15.3.2021

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

• 2.1 TRENDS IN EMISSIONS OF NECD POLLUTANTS

In Europe, regional air pollution is regulated by a number of protocols under the CLRTAP (Convention on Long Range Transboundary Air Pollution) under the UNECE (United Nations Economic Commission for Europe). Additionally, there is EU legislation that mostly mirrors the obligations under the CLRTAP.

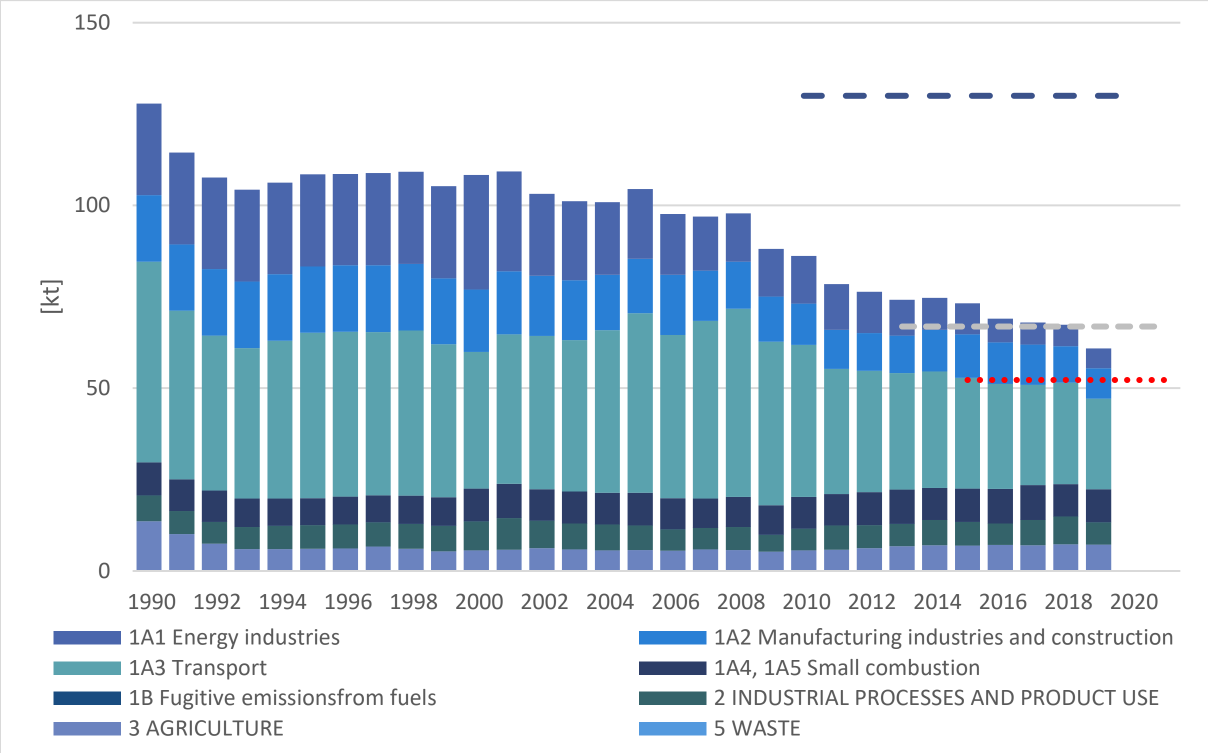
The Directive 2001/81/EC on National emissions ceilings (NEC Directive) sets limit values of emissions of **sulphur dioxide** (SO_2), **nitrogen oxides** (NOx), **volatile organic compounds** (VOCs) and **ammonia** (NH_3).

This Directive was replaced by The **New NEC Directive** 2284/2016, which sets national emission reduction commitments for the Member States and the EU for five important air pollutants: NOx, NMVOCs, SO_2, NH_3 and for the first time for fine **particulate matter** ($PM_{2.5}$).

2.1.1 TRENDS IN EMISSIONS OF NOx

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

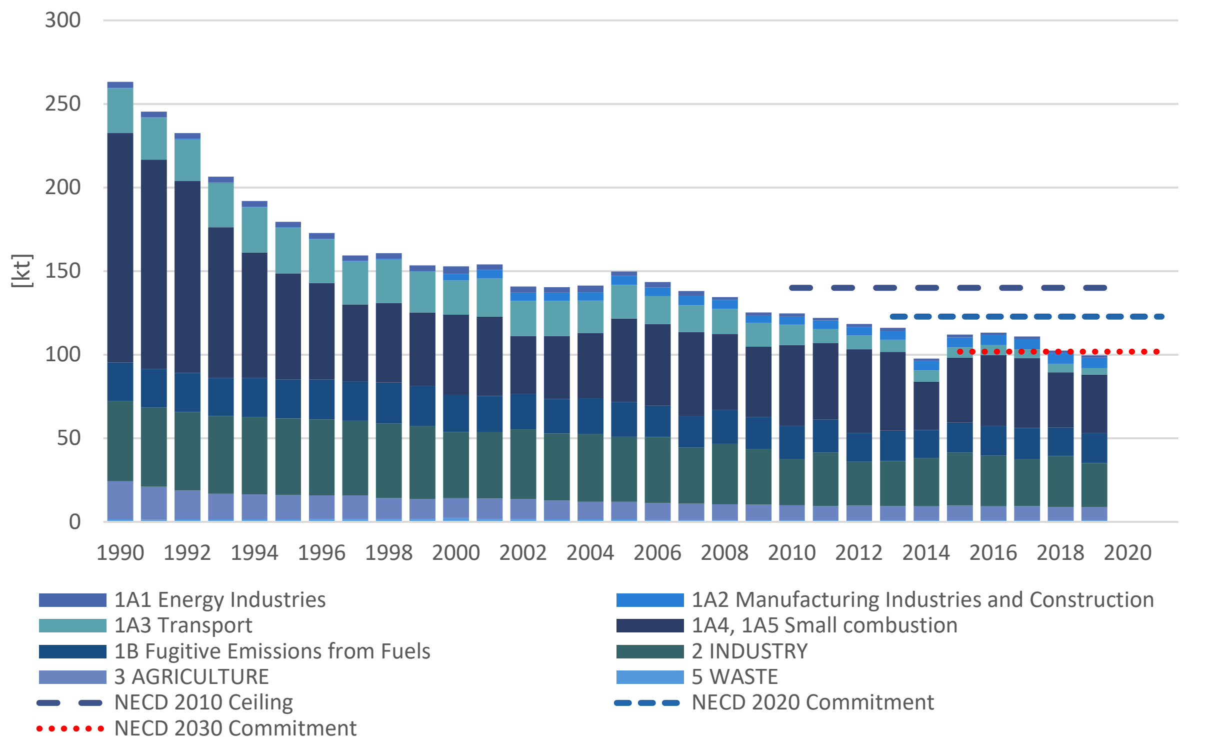
Figure 2.1: *Total NOx Emissions by Sectors*



2.1.2 TRENDS IN EMISSIONS OF NMVOC

Emissions of NMVOC have a decreasing trend in the whole time-series although the most significant decrease occurred in the period 1990-2000. The main source of NMVOCs in the Slovak Republic is residential heating sources, which produced 37% of total NMVOCs emission in 2019. The decrease in the period 1990-2000 was caused primarily by a decrease in energy demand in the households, which reconstructed their houses and also an increase in energy effectiveness of boilers. National Emission 2010 Ceiling set by **NEC Directive 2001/81/EC**, as well as Commitment set by new **NEC Directive 2016/2284/EU** for the period 2020-2029, were not exceeded (***Figure 2.2***). **Geneva protocol** of CLRTAP concerning the control of emissions of volatile organic compounds or their transboundary fluxes, which requires a decrease of VOCs by at least 30 per cent by the year 1999, using 1990 levels as a basis was also fulfilled.

Figure 2.2: *Total NMVOC Emissions by Sectors*



2.1.3 TRENDS IN EMISSIONS OF SOx

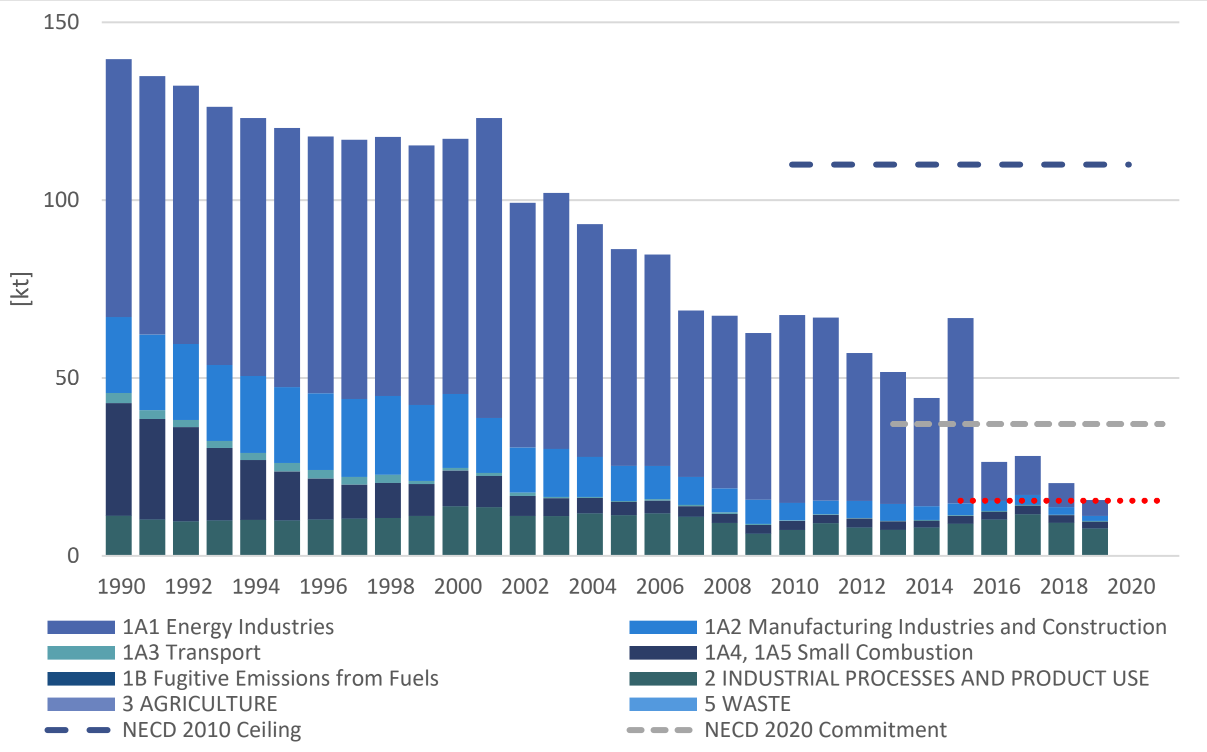
The trends of SOx emission decrease until 2014 continually. Since 1990 SOx emissions have noticed a significant decrease due to strict air protective legislative. The downward trend relates also to the composition of the fuel used in all sectors and related legislative limitations.

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

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

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

Figure 2.3: *Total SOx Emissions by Sectors*



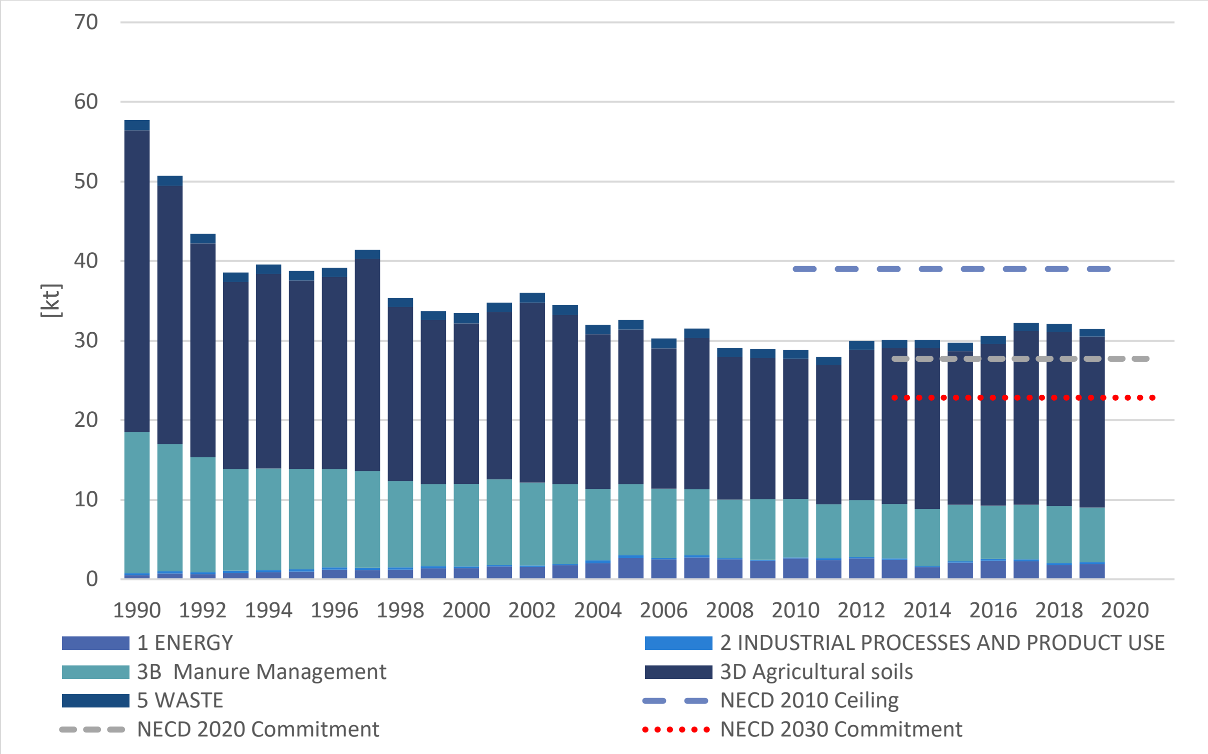
2.1.4 TRENDS IN EMISSIONS OF NH_3

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

Animal manure applied to soils is the key category, which emitted more than 68% of all ammonia in the Slovak republic in the year 2019. This category is the main polluter in the whole time-series.

As shown in ***Figure 2.4***, the Slovak Republic fulfills both the 2010 emission ceiling set by **2001/81/EC Directive** and national commitment on emission reduction set by **2016/2284/EU Directive.**

Figure 2.4: *Total NH_3 Emissions by Sectors*



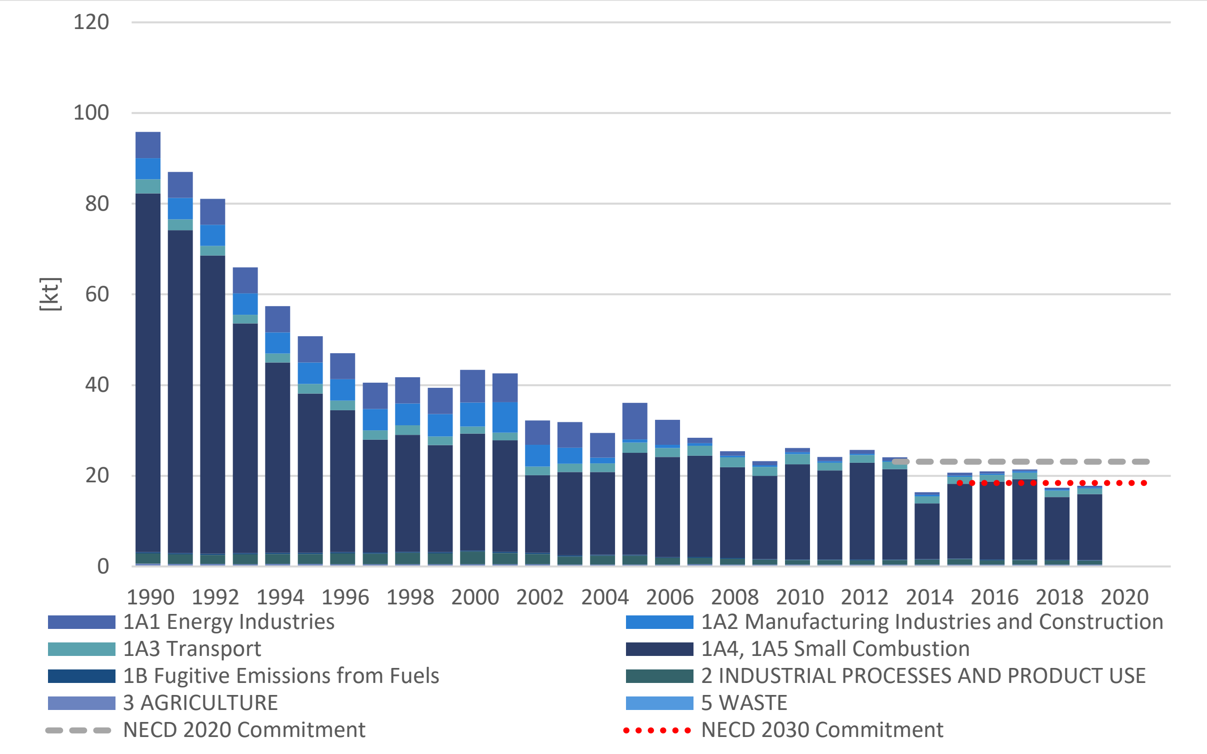
2.1.5 TRENDS IN EMISSIONS OF $PM_{2.5}$

The emission trend of $PM_{2.5}$ is significantly affected by the emission trend of the category Residential heating. This category produced more than 82% of total $PM_{2.5}$ emission in the Slovak Republic in the year 2019. Emissions in this category are connected to the energy demand of households, which is influenced by several conditions, such as climate factor, reconstruction status of buildings etc.

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

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

Figure 2.5: *Total $PM_{2.5}$ Emissions by Sectors*



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

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

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

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

Figure 2.6: *Total PM_{10} Emissions by Sectors*

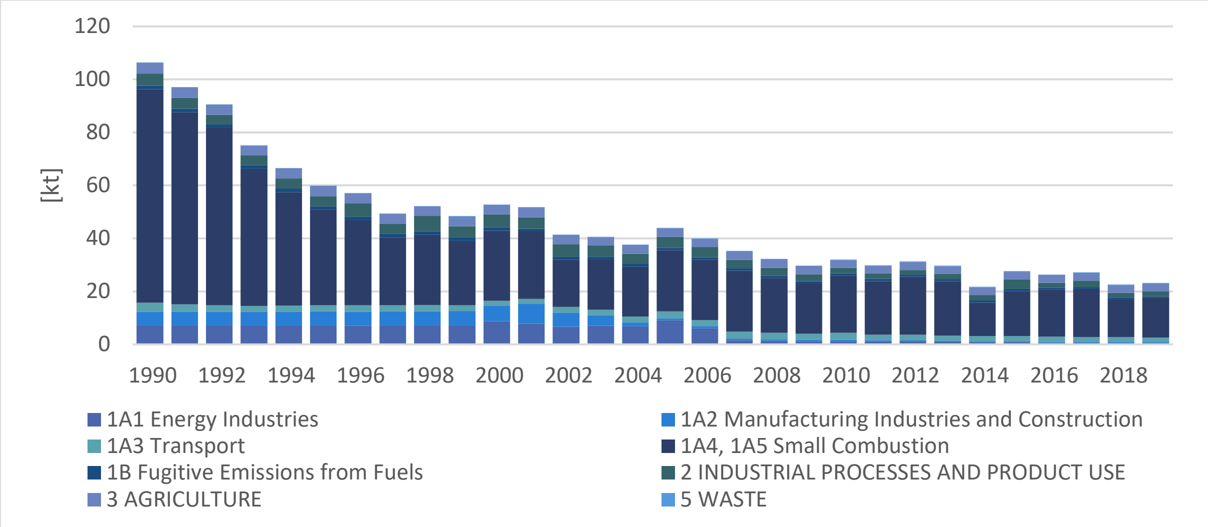


Figure 2.7: *Total BC Emissions by Sectors*

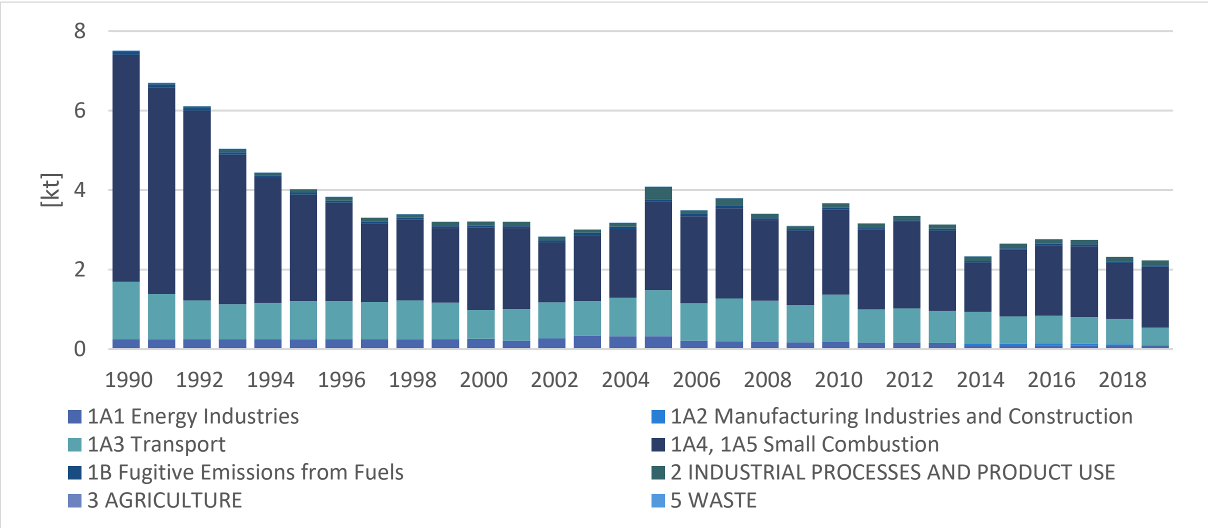
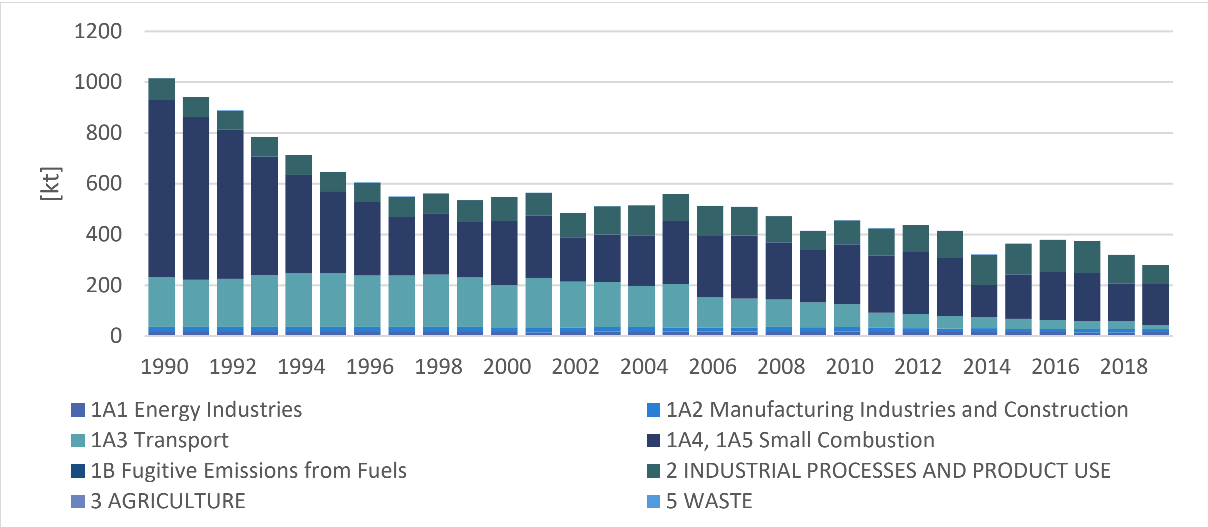


Figure 2.8: *Total CO Emissions by Sectors*



2.3 TRENDS IN EMISSIONS OF HEAVY METALS

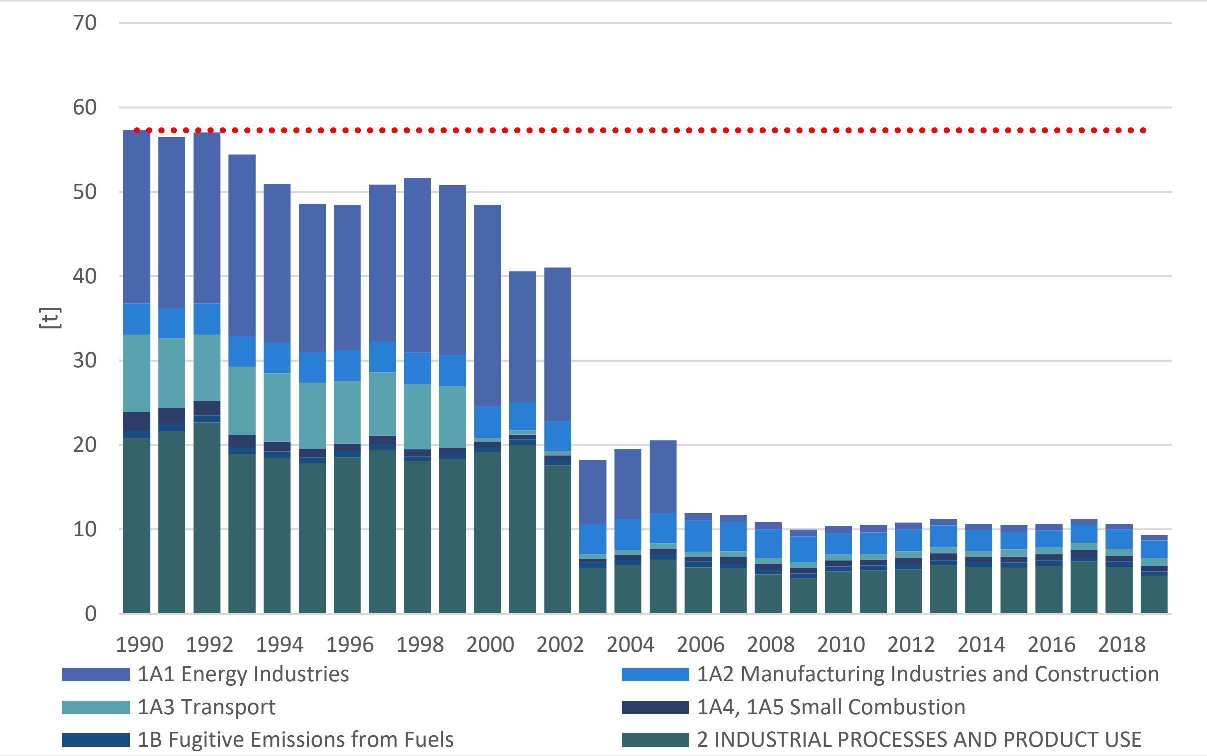
2.3.1 TRENDS IN EMISSIONS OF Pb

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

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

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

Figure 2.9: *Total Pb Emissions by Sectors*

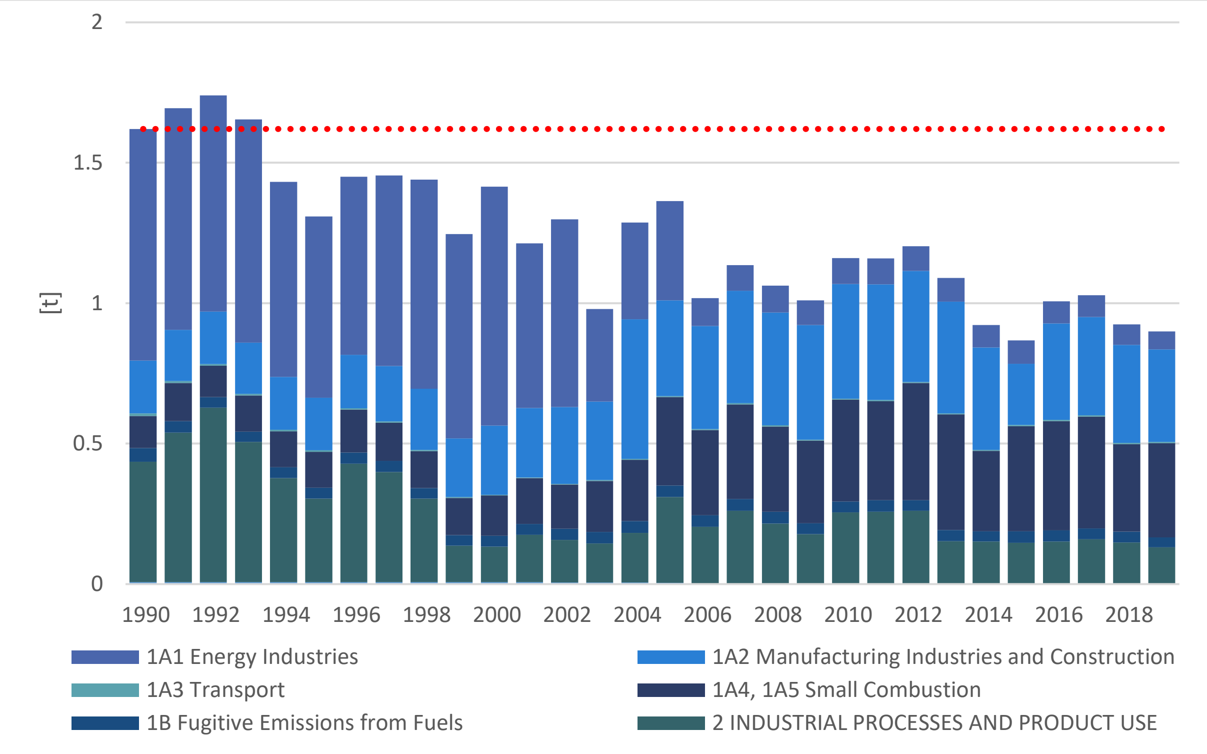


2.3.2 TRENDS IN EMISSIONS OF Cd

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

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

Figure 2.10: *Total Cd Emissions by Sources*



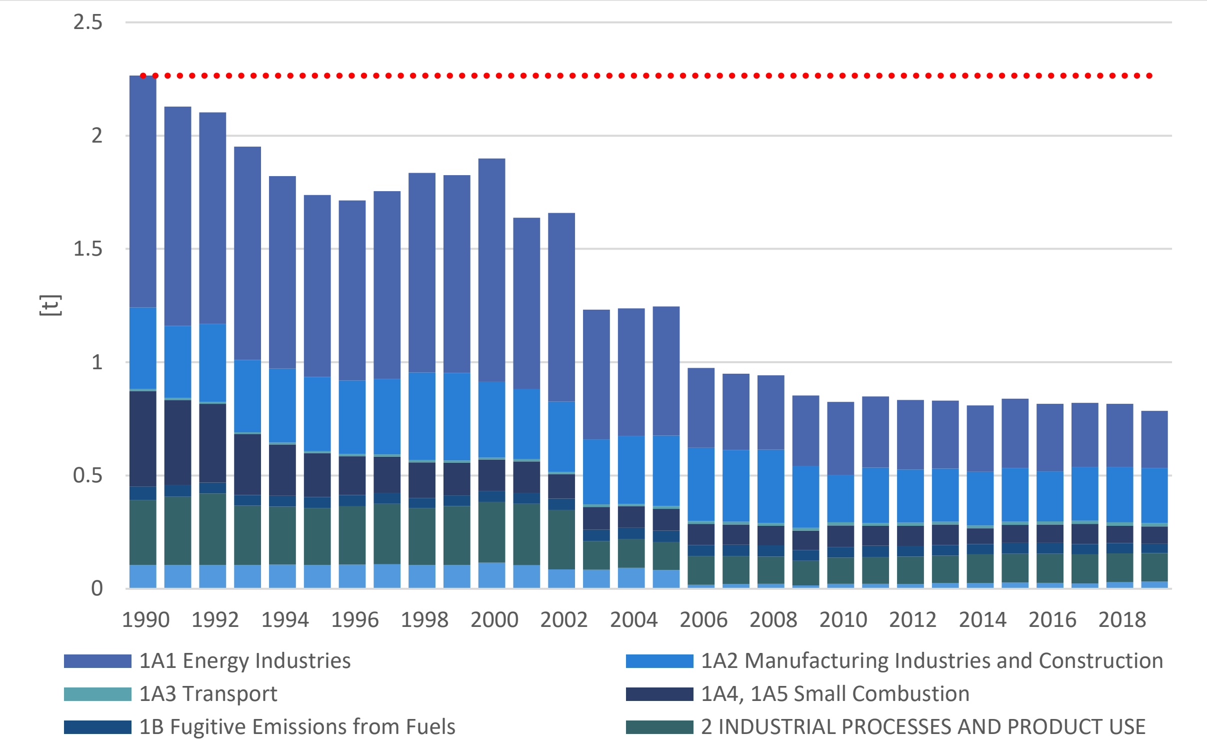
2.3.3 TRENDS IN EMISSIONS OF Hg

The emissions trend of Hg is decreasing in general (***Figure 2.11***). Since 2009, the emission trend remains 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 Aarhus protocol were recorded.

Figure 2.11: *Total Hg Emissions by Sources*



2.4 TREND IN EMISSION OF POPS

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

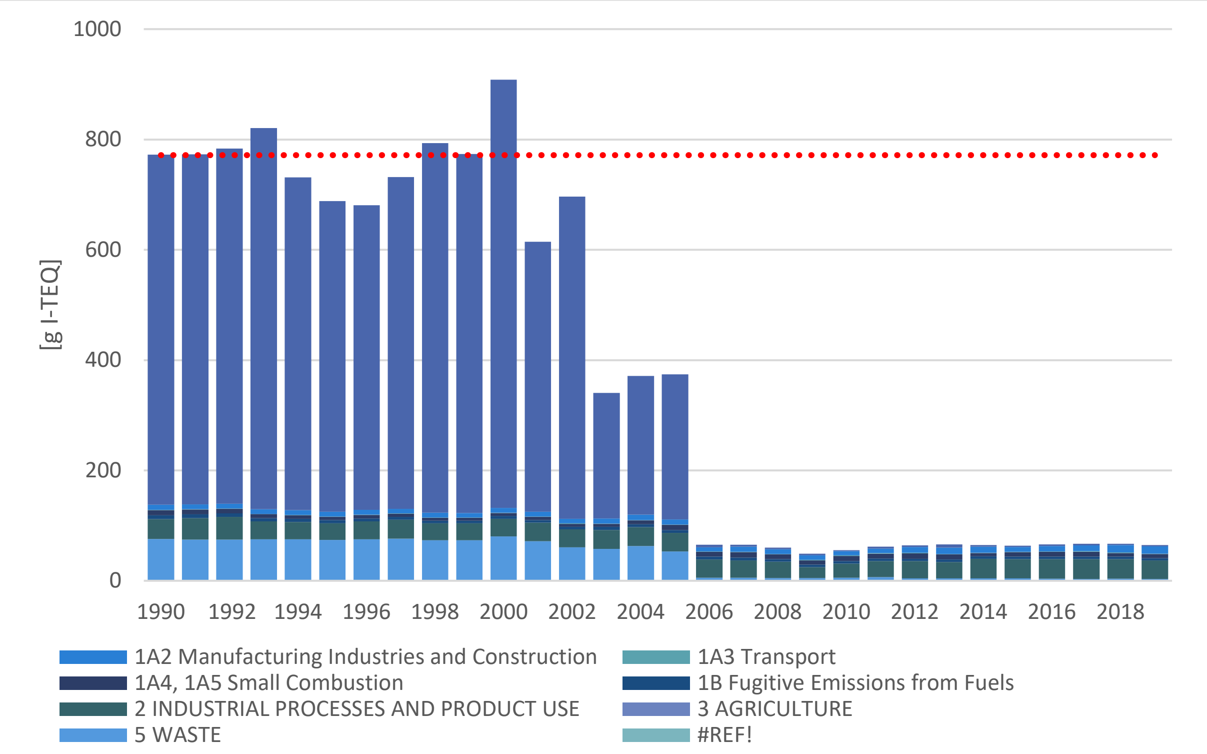
2.4.1 TRENDS IN EMISSIONS OF PCDD/PCDF

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

The main contributors are energy production (includes incineration of municipal waste with energy recovery) and waste incineration without energy recovery, which includes incineration of industrial and clinical waste.

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

Figure 2.12: *Total PCDD/PCDF Emissions by Sectors*



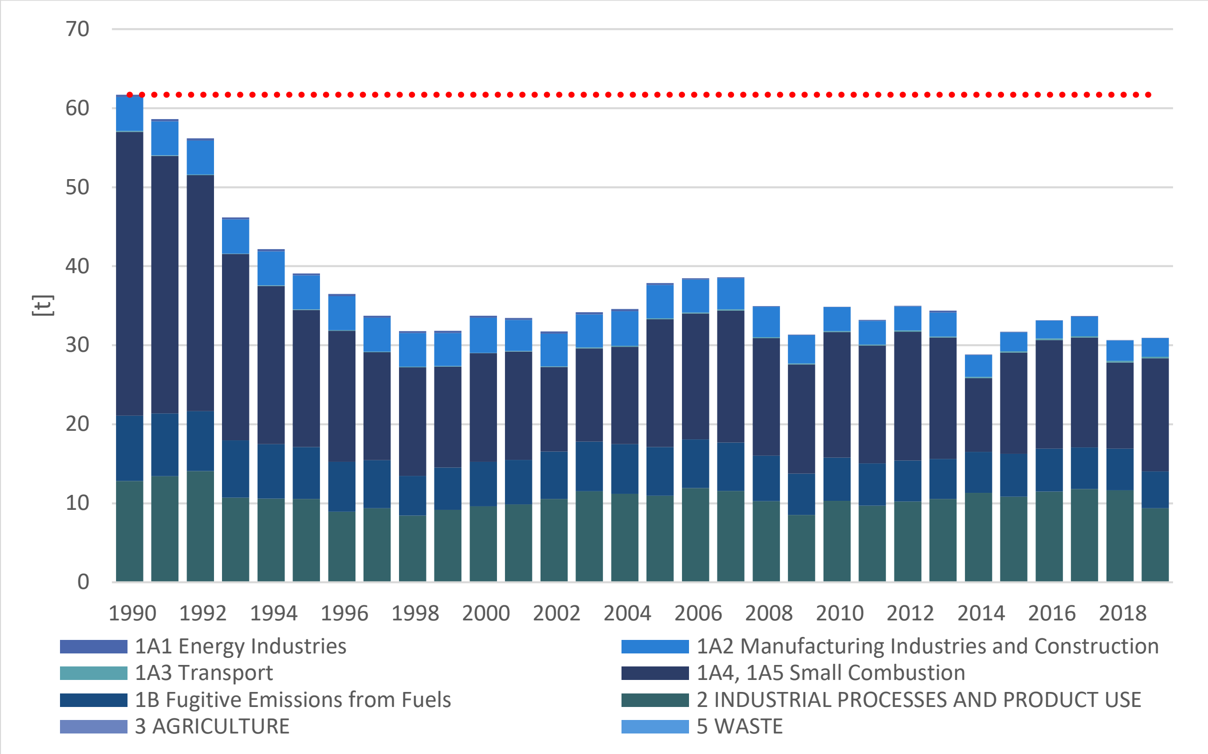
2.4.2 TRENDS IN EMISSIONS OF PAHS

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

The emission of PAHs originated in the sector of households (36%) and metal production (60%) in 2019.

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

Figure 2.13: *Total PAHs Emissions by Sectors*

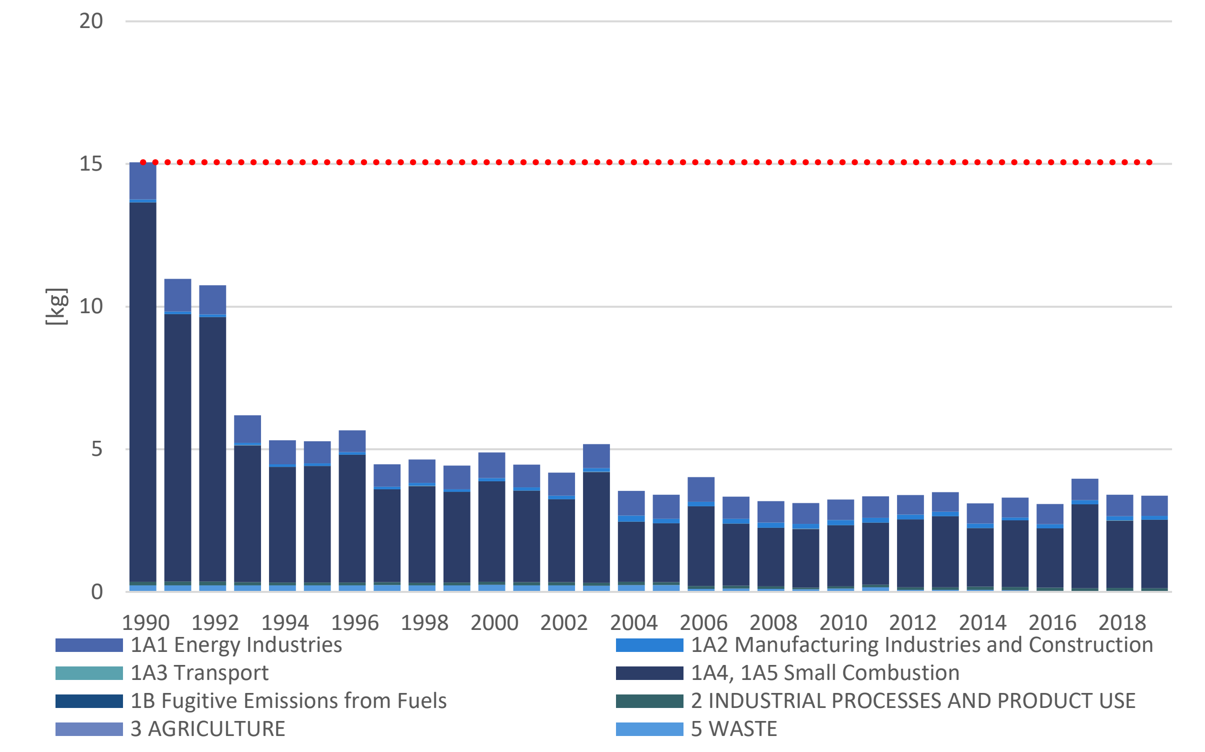


2.4.3 TRENDS IN HCB EMISSIONS

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

No exceedances of Aarhus protocol were recorded.

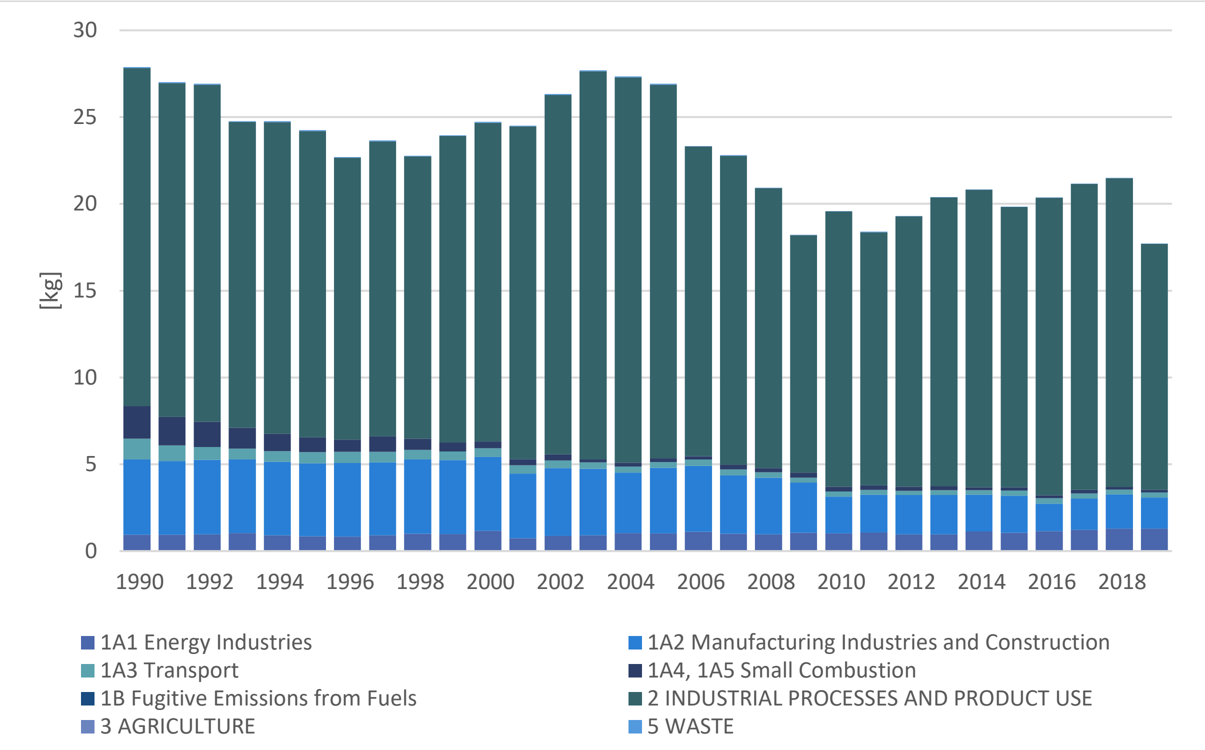
Figure 2.14: *Total HCB Emissions by Sectors*



2.4.4 TRENDS IN PCBs EMISSIONS

Emissions of PCB have fluctuating trend due to fluctuations 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 2019 was 77%. (***Figure 2.15***).

Figure 2.15: *Total PCBs Emissions by Sectors*



CHAPTER 3: ENERGY (NFR 1)

Last update: 15.3.2021

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 (NOx), non-methane volatile organic compounds (NMVOC) sulphur oxides (SOx), ammonia (NH_3), total suspended particles (TSP, PM_{10} and $PM_{2.5}$ are consequently compiled) and carbon monoxide (CO). All data that comes from the database is considered as T3 methodology. In the year 2019, the system contained 13 879 large and medium sources.

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

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

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

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

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

NFR	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	NK	T2	T2
1A1b	Petroleum refining	T3	T3	T3	T1	T1, NK	T1, NK
1A1c	Manufacture of solid fuels and other energy industries	T3	T3	T3	T1	T1	T1, NK
STATIONARY COMBUSTION IN MANUFACTURING AND CONSTRUCTION							
1A2a	Iron and steel	T3	T3, NK	T3	NK	T1	T1
1A2b	Non-ferrous metals	T3	NK	T3	NK	T1	T1, NK
1A2c	Chemicals	T3	NK	T3	NK	T1	T1

NFR		METHODOLOGY/TIER					
	LONGNAME OF CATEGORY	NOx, NMVOC, SOx, CO	NH_3	$PM_{2.5}$, PM_{10}, TSP	BC	HM	POPS
1A2d	Pulp, Paper and Print	T3	T3, NK	T3	NK	T1	T1
1A2e	Food processing, beverages and tobacco	T3	T3	T3	NK	T1	T1
1A2f	Non-metallic minerals	T3	T3, NK	T3	NK	T2	T2
1A2gvii	Mobile Combustion	NK	NK	NK	NK	NK	NK
1A2gviii	Other	T3	T3	T3	NK	T1	T1
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)	T2	T2	T2	T2	T2	T2
1A3ei	Pipeline transport	T3	NK	T3	NK	NK	NK
1A3eii	Other	NK	NK	NK	NK	NK	NK
SMALL COMBUSTION							
1A4ai	Commercial/institutional: Stationary	T3	T3, NK	T3	NK	T2	T2
1A4aii	Commercial/institutional: Mobile	NK	NK	NK	NK	NK	NK
1A4bi	Residential: Stationary	T1, T2	T1, T2	T1, T2	T1, T2	T1, T2	T1, T2
1A4bii	Residential: Household and gardening	NK	NK	NK	NK	NK	NK
1A4ci	Agri./Forest./Fish.: Stationary	T3	NK	T3	NK	T2	T2
1A4cii	Agri./Forest./Fish.: Off-road vehicles and other machinery	T3	T3	T3	T3	T3, NK	T3, NK
1A4ciii	Agri./Forest./Fish.: National fishing	NK	NK	NK	NK	NK	NK
NON-ROAD MOBILE MACHINERY							
1A5a	Other stationary (including military)	T3	T3	T3	NK	T2	T2
1A5b	Other, Mobile	T2, NK	T2, NK	T2, NK	NK	T2, NK	NK
FUGITIVE EMISSIONS							
1B1a	from solid fuels: Coal mining and handling	T1, T2, NK	NK	T2	NK	NK	NK
1B1b	from solid fuels: Solid fuel transformation	T1	T1	T1	T1	T1	T1, NK
1B1c	Other fugitive emissions from solid fuels	NK	NK	NK	NK	NK	NK
1B2ai	from oil: Exploration, production, transport	T1, NK	NK	NK	NK	NK	NK
1B2aiv	from oil: Refining / storage	NK	NK	NK	NK	T1	T1, NK
1B2av	Distribution of oil products	T3, NK	NK	NK	NK	NK	NK
1B2b	from natural gas	T2, NK	NK	NK	NK	NK	NK
1B2c	Venting and flaring	NK	NK	NK	NK	NK	NK
1B2d	Other fugitive emissions from energy production	NK	NK	NK	NK	NK	NK

3.2 TRENDS IN THE SECTOR ENERGY

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

The categories of the energy sector are key categories for most of the main pollutants, heavy metals and POPs. The most significant categories are 1A1a, which is the key category for NOx, SOx, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Ni, Se, PCDD/F, HCB and 1A4bi is the key category for NOx, SOx, NMVOC, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Cd, Hg, As, Cr, Ni, Zn, PCDD/F, PAHs, HCB and PCBs.

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

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	107.1693	190.8699	128.3083	0.5122	92.9148	97.6055	111.4372	7.4704	930.8099
1995	95.9951	117.7871	110.3438	0.9604	48.0074	52.0575	61.2891	3.9389	571.1703
2000	94.7335	99.0860	103.3788	1.4105	40.0601	44.1839	52.8485	3.1019	453.4644
2005	92.0598	98.8020	74.7579	2.6937	33.6964	36.5197	44.7113	3.7706	453.5752
2010	74.5749	86.9281	60.3782	2.6200	24.7058	26.7761	30.3696	3.5528	361.4612
2011	66.0212	80.4481	57.8089	2.4217	22.7246	24.7217	28.1548	3.0481	316.1818
2012	63.8072	82.2726	48.9461	2.6103	24.3405	26.3937	29.8871	3.2386	331.0514
2013	61.3006	79.7455	44.3612	2.4367	22.6519	24.6416	28.0593	3.0273	308.2542
2014	60.7937	59.7084	36.4014	1.5167	14.9043	16.5825	19.3792	2.2163	200.7531
2015	59.7740	70.4649	57.7002	2.0902	19.0824	20.8773	23.9146	2.5399	242.8853
2016	55.9848	73.7212	16.1362	2.3434	19.6013	21.3452	24.2641	2.6535	256.0225
2017	54.0798	73.1725	16.3233	2.2626	19.9810	21.6860	24.6284	2.6321	248.7981
2018	52.4764	63.0918	10.9799	1.8277	16.0888	17.6300	20.2381	2.2083	207.8075
2019	47.5471	64.3599	7.9753	1.9489	16.5858	18.1214	20.7248	2.1117	205.8881
1990/2019	**-56%**	**-66%**	**-94%**	**281%**	**-82%**	**-81%**	**-81%**	**-72%**	**-78%**
2018/2019	**-9%**	**2%**	**-27%**	**7%**	**3%**	**3%**	**2%**	**-4%**	**-1%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	36.4523	1.1843	1.8724	2.9162	4.9674	8.8049	6.0788	5.1512	25.4666
1995	30.7642	1.0049	1.3812	1.6239	2.9359	6.1377	2.8555	2.4900	19.3155
2000	29.3173	1.2824	1.5152	1.6405	2.6596	5.2021	1.6202	2.4799	20.2940
2005	14.1580	1.0537	1.0390	1.2257	3.0083	7.1828	1.6321	2.4632	26.9215
2010	5.4217	0.9053	0.6863	0.9095	2.9922	7.3756	1.6917	2.0687	30.2101
2011	5.3867	0.9017	0.7074	0.9172	2.9497	7.0463	1.6575	2.0513	30.3702
2012	5.5384	0.9412	0.6910	0.8790	3.0525	7.4214	1.4758	1.9243	31.9512
2013	5.4920	0.9376	0.6840	0.8499	2.9914	7.2546	1.4631	1.8177	32.2625
2014	5.0720	0.7705	0.6565	0.7831	2.5280	7.3076	1.3677	1.6448	28.6436
2015	5.0775	0.7210	0.6847	0.8394	2.5995	8.0788	1.5210	1.7615	25.1540
2016	4.9077	0.8556	0.6625	0.7855	2.8188	8.2272	1.4526	1.6538	29.5580
2017	5.1062	0.8689	0.6684	0.7936	2.8714	8.3701	1.4259	1.6669	30.5815
2018	5.0723	0.7765	0.6607	0.7493	2.6353	8.5548	1.3830	1.5310	28.4637
2019	4.8355	0.7685	0.6283	0.6768	2.5949	8.9411	1.2686	1.3318	28.1353
1990/2019	**-87%**	**-35%**	**-66%**	**-77%**	**-48%**	**2%**	**-79%**	**-74%**	**10%**
2018/2019	**-5%**	**-1%**	**-5%**	**-10%**	**-2%**	**5%**	**-8%**	**-13%**	**-1%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	660.5441	15.0483	11.9430	6.6288	7.7936	48.8693	1.4356	7.6992
1995	583.8043	8.0375	6.7807	3.6280	4.1055	28.5355	0.8792	6.2839
2000	795.6201	6.6794	5.8560	2.9952	3.3912	24.1054	1.0211	6.1246
2005	287.3540	7.6002	6.5176	3.3063	3.8708	26.8978	1.0069	5.2131
2010	24.6638	7.0626	5.9983	3.0400	3.6380	24.5486	0.9181	3.6154
2011	25.9842	6.6639	5.7312	2.8761	3.4382	23.5079	0.9494	3.6889
2012	28.5410	7.2021	6.1701	3.0961	3.7243	24.7745	0.8897	3.6073
2013	31.8753	6.7958	5.9259	2.9332	3.5208	23.8384	0.8988	3.6436
2014	24.9906	4.4416	4.2013	1.9932	2.2943	17.4933	0.9052	3.6007
2015	24.3694	5.6417	5.0095	2.4748	2.9601	20.8388	0.8435	3.5808
2016	26.7253	5.9471	5.2363	2.6100	3.1410	21.7140	0.9021	3.1169
2017	27.8419	5.9918	5.4019	2.6246	3.2058	21.8782	0.9493	3.4150
2018	28.1961	4.9197	4.6132	2.2062	2.6389	19.0245	0.9437	3.6167
2019	27.5131	6.1037	6.3963	2.2526	2.7454	21.5877	0.8848	3.4338
1990/2019	**-96%**	**-59%**	**-46%**	**-66%**	**-65%**	**-56%**	**-38%**	**-55%**
2018/2019	**-2%**	**24%**	**39%**	**2%**	**4%**	**13%**	**-6.2%**	**-5%**

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

Transport categories are the main contributor to NOx emissions, especially category 1A3bi (Passenger cars) with a share of 22% and 1A3biii (Heavy-duty vehicles and buses) with share almost 17% of emissions in the energy sector in 2019 (***Figure 3.1***). Emissions in these categories decrease slowly.

Emissions of NMVOC are emitted mostly by the category 1A4bi (Residential: Stationary). In 2019, it was 49% of all NMVOC emissions in the energy sector and about 32% of the total emissions of this pollutant (***Figure 3.1***). Emission is relatively stable, with only slight fluctuation since 2005.

SOx emissions are mainly emitted by category 1A1a (almost 30% in 2019) in the energy sector (***Figure 3.1***). This category shows an overall decreasing trend except for the year 2015. The increase in 2015 and drop in 2016 was caused by the one source of Slovak power plants (***Table 3.2***). This increase was in ENO A K1, K2 – granulated boiler: higher deployment of not abated ENO B3.4 blocks during the extensive reconstruction of ENO B1.2 blocks (from the SE annual report). The source according to the NEIS database burned double the amount of brown coal as in the previous year 2014.

Residential heating is the main contributor to emissions of $PM_{2.5}$, PM_{10} and TSP. From ***Table 3.2*** is clear that emissions of $PM_{2.5}$ (the trend for PM_{10} and TSP is very similar) show a decreasing trend since 1990 although since 2005 emissions in this category are relatively stable. In 2019 this category contributed by almost 79% of total emissions of $PM_{2.5}$ (***Figure 3.1***).

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

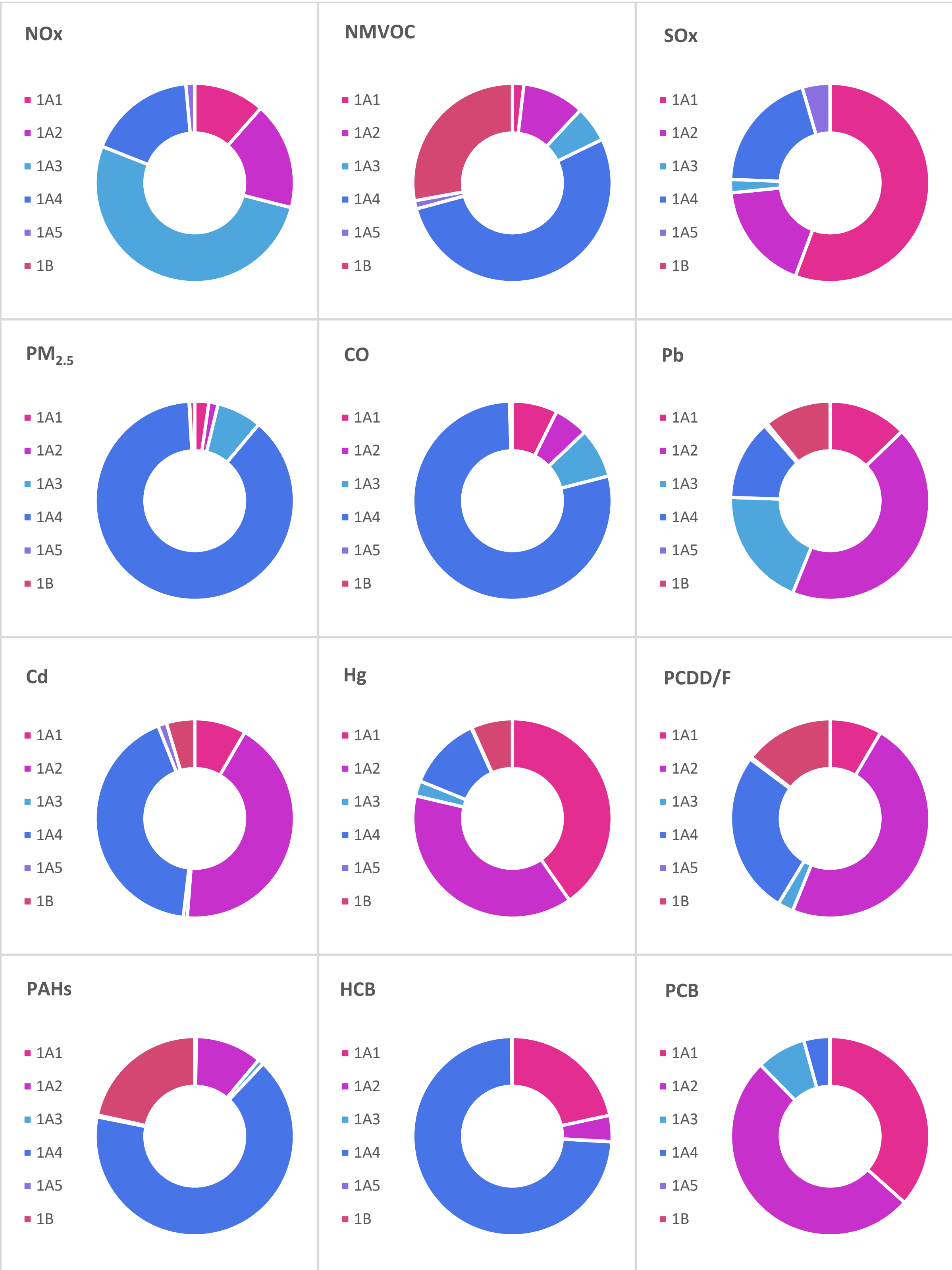
Until 2005, the main contributor to emissions of Pb was the incineration of municipal waste with energy recovery allocated in category 1A1a. Reconstruction of both MSW incineration plants led to a significant decrease in emissions. The decrease of Pb emission from road transport in 2000 was caused by the ban of lead addition to fuels. Since 2006 the main contributor to these emissions is category 1A2a. Emissions of Cd decreased only slightly in this sector since 1990. Similar to Pb emissions, MSW incineration plants contributed significantly to its emissions until 2005 (***Table 3.2***). Since then, combustion activities in iron and steel production and households heating have become important.

The amount of emissions of PCDD/F emitted into the air in the Slovak Republic is affected mostly by MSW incineration plants. Since reconstruction, both plants reduced emissions of this pollutant significantly. The category 1A2a is the main contributor to emissions of PCBs in the whole time-series

(***Figure 3.1***). In 2019, almost 38% of emissions of PCB was emitted by this category in the energy sector.

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

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



3.3 RECALCULATIONS, IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

The energy sector undertakes continuing improvements. One of these further improvement re-categorisation of fuels in compliance with GHG inventory and the change of the methodological approach for calculations of emissions of heavy metals and POPs.

The methodology used in the submission 2019 was assumed as outdated and impossible to further improvements. Therefore, all categories were recalculated using EMEP/EEA GB_{2019} emission factors for HMs and POPs on Tier 1 level in submission 2020. This step was followed by an improvement of the methodology of all key categories to a higher level in 2021 submission. Further improvements are planned in the following years.

The detailed analysis of the allocation of sources to the NFR categories across the whole NEIS database is planned in the next period, as it was identified that some sources might be allocated incorrectly within the database.

For most of the categories, the historical years were recalculated consistently using the same methodology.

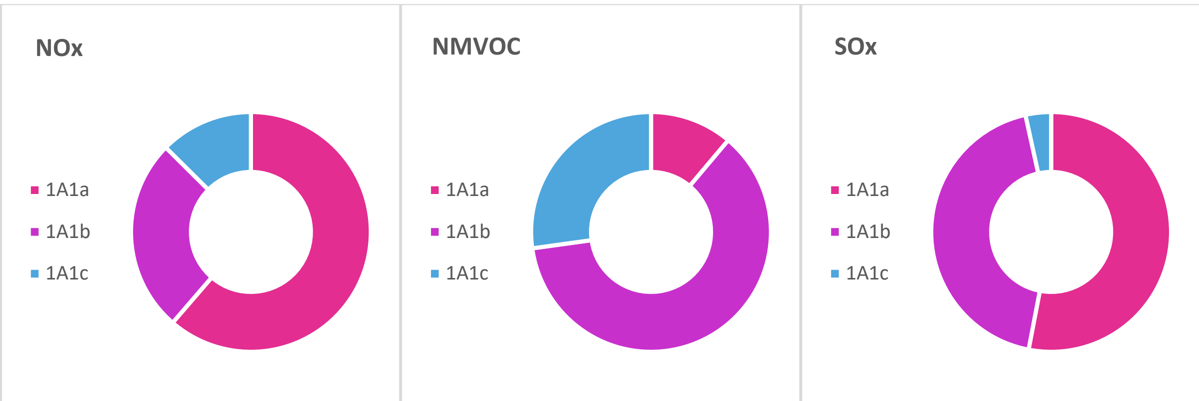
3.4 ENERGY INDUSTRIES (NFR 1A1)

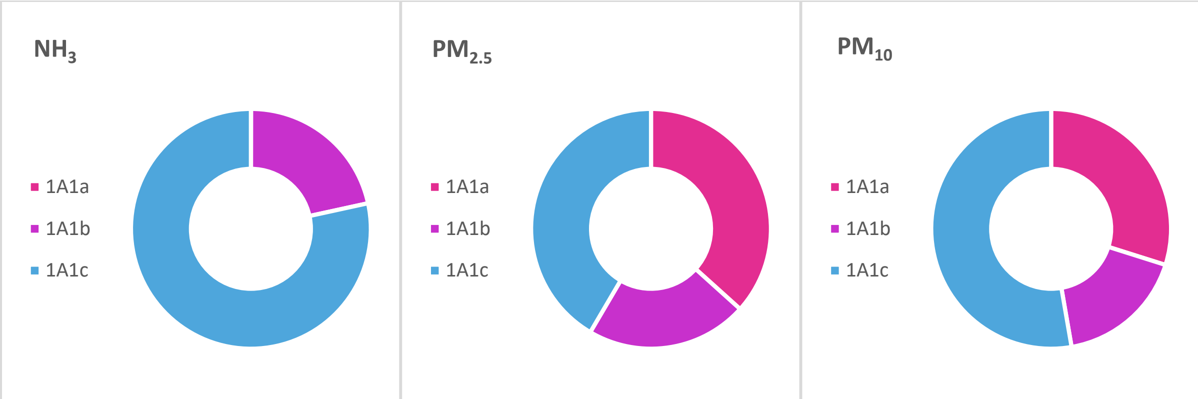
3.4.1 OVERVIEW

The category energy industries 1A1 covers the following subcategories: Public Electricity and Heat Production (1A1a), Petroleum Refining (1A1b) and Manufacture of Solid Fuels and Other Energy Industries (1A1c). These subcategories are further described in the following chapters.

Energy industries are a substantial contributor to most of the air pollutants. The category 1A1a, which includes also municipal waste incineration with energy utilization contributes to most main pollutants, heavy metals and POPs. Shares of emissions of main pollutants in particular subcategories are shown in ***Figure 3.2***.

Figure 3.2: *Share of emissions of the main pollutants in 1A1 in 2019*





3.4.2. PUBLIC ELECTRICITY AND HEAT PRODUCTION (NFR 1A1A)

3.4.2.1 Overview

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

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

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

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

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

The source took advantage of the last year of the special survival regime (maximum 20 000 hours of operation from 1.1.2008 to 31.12.2015) during which they did not apply any Emission Limits. From 1.1.2016, such devices can only be operated if they are applied to new equipment to comply with national legislation, so the expected significant reduction in SO_X emissions was visible in 2016 emissions. The decline was continuing during 2019.

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

The emission data of air pollutants is presented in ***Table 3.4***. The emissions originating from MSW incineration with energy utilisation are described in ***Chapter 6.7.1***.

Table 3.4: Overview of emissions in the category 1A1a

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	20.8652	0.1699	60.6572	NO	5.0981	6.1196	8.1175	2.6616
1995	20.9769	0.1708	60.9819	NO	5.1254	6.1524	8.1609	2.6759
2000	26.3778	0.1559	58.8624	NO	6.3197	7.5860	10.0625	2.6729
2005	15.2963	0.1529	51.9931	NO	7.2630	7.8104	11.7351	2.3064
2010	9.5278	0.1612	43.1548	NO	0.4317	0.5171	0.6571	1.6932
2011	9.7997	0.1676	45.1935	NO	0.5053	0.5963	0.7224	1.6207
2012	8.9735	0.1799	39.3491	NO	0.4601	0.5735	0.7016	1.7577
2013	7.8687	0.1766	36.1728	NO	0.3722	0.4683	0.6452	1.8626
2014	7.0565	0.1678	29.2536	NO	0.3507	0.4282	0.5545	1.6862
2015	6.5387	0.1702	50.8989	0.0148	0.4611	0.5645	0.7051	1.6742
2016	4.2010	0.1530	9.2366	0.0202	0.2072	0.2494	0.3018	2.1715
2017	3.8701	0.1504	8.6485	0.0194	0.1494	0.1796	0.2277	1.7777
2018	3.6499	0.1438	4.4968	NO	0.1168	0.1363	0.1675	1.5783
2019	3.3581	0.1324	2.3546	0.0000	0.1388	0.1499	0.1774	1.4240
1990/2019	**-84%**	**-22%**	**-96%**	**-**	**-97%**	**-98%**	**-98%**	**-46%**
2018/2019	**-8%**	**-8%**	**-48%**	**-**	**19%**	**10%**	**6%**	**-10%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	20.2835	0.8118	0.8087	1.9219	1.0090	0.6752	3.9638	4.7628	3.6076
1995	17.3118	0.6330	0.5903	1.0531	0.4800	0.3101	1.2346	2.2255	1.5409
2000	23.6358	0.8378	0.7612	1.1790	0.4880	0.3140	0.6988	2.2341	1.4374
2005	8.3952	0.3409	0.3522	0.8601	0.4595	0.3152	0.6841	2.2145	1.2438
2010	0.6702	0.0816	0.1289	0.6125	0.3976	0.2058	0.6001	1.8528	1.1592
2011	0.6692	0.0812	0.1283	0.6066	0.3950	0.2049	0.5858	1.8178	1.2050
2012	0.6475	0.0777	0.1211	0.5767	0.3788	0.2268	0.5974	1.6965	1.3657
2013	0.6226	0.0742	0.1154	0.5477	0.3617	0.2248	0.5321	1.5891	1.4059
2014	0.5776	0.0689	0.1052	0.4991	0.3332	0.2222	0.4683	1.4336	1.4106
2015	0.6194	0.0734	0.1122	0.5353	0.3571	0.2201	0.4935	1.5351	1.4757
2016	0.5669	0.0680	0.1042	0.4928	0.3280	0.2087	0.4792	1.4238	1.3365
2017	0.5627	0.0678	0.1045	0.4917	0.3267	0.2147	0.4426	1.4325	1.2882
2018	0.5252	0.0633	0.0973	0.4538	0.3032	0.2196	0.4154	1.3062	1.3095
2019	0.4583	0.0553	0.0854	0.3917	0.2628	0.1753	0.3565	1.1088	1.1695
1990/2019	**-98%**	**-93%**	**-89%**	**-80%**	**-74%**	**-74%**	**-91%**	**-77%**	**-68%**
2018/2019	**-13%**	**-13%**	**-12%**	**-14%**	**-13%**	**-20%**	**-14%**	**-15%**	**-11%**

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	630.0360	0.0009	0.0058	0.0046	0.0004	0.0117	1.2829	0.9524
1995	558.3656	0.0008	0.0029	0.0024	0.0002	0.0063	0.7511	0.8447
2000	771.4122	0.0010	0.0032	0.0026	0.0002	0.0070	0.8789	1.1673
2005	258.9175	0.0009	0.0031	0.0025	0.0002	0.0067	0.8285	1.0241
2010	1.2779	0.0009	0.0024	0.0020	0.0002	0.0055	0.7184	1.0174
2011	1.3320	0.0009	0.0024	0.0020	0.0002	0.0056	0.7353	1.0821
2012	1.2727	0.0008	0.0022	0.0019	0.0002	0.0051	0.6767	0.9571
2013	1.2743	0.0008	0.0021	0.0018	0.0002	0.0050	0.6607	0.9622
2014	1.3533	0.0009	0.0021	0.0018	0.0001	0.0049	0.6973	1.1232
2015	1.3482	0.0009	0.0021	0.0018	0.0001	0.0049	0.6866	1.0641
2016	1.3439	0.0010	0.0021	0.0018	0.0001	0.0049	0.7008	1.1478
2017	1.3916	0.0010	0.0022	0.0018	0.0001	0.0051	0.7370	1.2292
2018	1.4248	0.0011	0.0021	0.0018	0.0001	0.0051	0.7479	1.3019

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	1.3438	0.0011	0.0019	0.0016	0.0001	0.0046	0.6961	1.2882
1990/2019	**-100%**	**18%**	**-68%**	**-65%**	**-65%**	**-60%**	**-46%**	**35%**
2018/2019	**-6%**	**-1%**	**-12%**	**-11%**	**-6%**	**-9%**	**-7%**	**-1%**

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

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

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [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	5.59	1 091.31
2005	393.28	65 937.71	25 852.54	77.70	1 700.25
2010	471.08	48 138.63	20 379.21	2 391.39	1 687.34
2011	430.75	46 672.38	25 678.60	2 873.84	1 829.41
2012	522.43	44 238.33	23 100.57	3 844.97	1 616.04
2013	343.39	41 156.77	19 585.56	4 392.44	1 896.34
2014	210.28	37 326.16	12 489.39	4 688.75	2 122.12
2015	225.52	38 769.06	13 854.96	5 064.15	2 028.41
2016	291.55	36 753.64	13 274.23	4 283.51	2 232.70
2017	132.43	37 815.53	13 707.43	3 973.30	2 293.47
2018	112.58	35 175.81	14 575.87	4 192.06	2 451.39
2019	114.58	28 330.00	21 959.76	4 050.06	2 265.37
1990/2019	**-70%**	**-58%**	**-40%**	**-**	**-**
2018/2019	**2%**	**-19%**	**51%**	**-3%**	**-8%**

3.4.2.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

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

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

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

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

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

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

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

Where:

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

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

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

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

T2	UNIT	HEAVY FUEL OIL	LIGHT FUEL OIL		HARD COAL		
		Dry bottom boiler	Gas turbines	Stationary engines	Dry bottom boiler	Wet bottom boiler	Fluid bed boiler
Pb	[mg/GJ]	4.56	0.0069	4.07	7.3	7.3	7.3
Cd	[mg/GJ]	1.2	0.0012	1.36	0.9	0.9	0.9
Hg	[mg/GJ]	0.341	0.053	1.36	1.4	1.4	1.4
As	[mg/GJ]	3.98	0.0023	1.81	7.1	7.1	7.1
Cr	[mg/GJ]	2.55	0.28	1.36	4.5	4.5	4.5
Cu	[mg/GJ]	5.31	0.17	2.72	7.8	9	9
Ni	[mg/GJ]	255	0.0023	1.36	7.9	4.9	4.9
Se	[mg/GJ]	2.06	0.0023	6.79	23	23	23
Zn	[mg/GJ]	87.8	0.44	1.81	19	90	90
PCDD/F	[ng I-TEQ/GJ]	2.5	NE	0.99	10	10	10
B(a)P	[µg/GJ]	NE	NE	0.116	0.7	0.7	0.7
B(b)F	[µg/GJ]	4.5	NE	0.502	37	37	37
B(k)F	[µg/GJ]	4.5	NE	0.0987	29	29	29
I()P	[µg/GJ]	6.92	NE	0.187	1.1	1.1	1.1
PAHs	[µg/GJ]	15.92	NE	0.9037	67.8	67.8	67.8
HCB	[µg/GJ]	NE	NE	0.22	6.7	6.7	6.7
PCBs	[ng/GJ]	NE	NE	0.13	3.3	3.3	3.3

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

3.4.2.3 Completeness

Emissions are well covered.

3.4.2.4 Source-specific recalculations

Recalculations of the main pollutants in this submission were done due to a change of categorisation of fuels with the aim to improve data quality and transparency.

The detailed information compiled in the NEIS database allowed to use of Tier 2 emission factors EMEP/EEA GB_{2019} for the calculation of emissions of HMs and POPs with the aim to improve the methodology for this category. Recalculations are shown in ***Table 3.8***.

Table 3.8: *Previous and refined emissions in the category 1A1a*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	22.2039	20.8652	-6%	0.1808	0.1699	-6%	64.5489	60.6572	-6%
1991	22.2174	20.8978	-6%	0.1809	0.1702	-6%	64.5881	60.7521	-6%
1992	22.1838	20.8695	-6%	0.1807	0.1700	-6%	64.4906	60.6698	-6%
1993	22.1878	20.8703	-6%	0.1807	0.1700	-6%	64.5020	60.6722	-6%
1994	22.1779	20.8662	-6%	0.1806	0.1699	-6%	64.4734	60.6602	-6%
1995	22.1882	20.9769	-5%	0.1807	0.1708	-5%	64.5032	60.9819	-5%
1996	22.0180	20.7263	-6%	0.1793	0.1688	-6%	64.0086	60.2535	-6%
1997	22.1882	20.9728	-5%	0.1807	0.1708	-5%	64.5032	60.9700	-5%
1998	21.9893	20.9271	-5%	0.1791	0.1704	-5%	63.9251	60.8370	-5%
1999	21.8991	21.0250	-4%	0.1783	0.1712	-4%	63.6629	61.1219	-4%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	5.4252	5.0981	-6%	6.5123	6.1196	-6%	8.6383	8.1175	-6%	2.8324	2.6616	-6%
1991	5.4285	5.1061	-6%	6.5162	6.1292	-6%	8.6435	8.1302	-6%	2.8341	2.6658	-6%
1992	5.4203	5.0992	-6%	6.5064	6.1209	-6%	8.6305	8.1192	-6%	2.8298	2.6622	-6%
1993	5.4213	5.0994	-6%	6.5075	6.1212	-6%	8.6320	8.1195	-6%	2.8303	2.6623	-6%
1994	5.4189	5.0984	-6%	6.5047	6.1199	-6%	8.6282	8.1179	-6%	2.8291	2.6617	-6%
1995	5.4214	5.1254	-5%	6.5077	6.1524	-5%	8.6322	8.1609	-5%	2.8304	2.6759	-5%
1996	5.3798	5.0642	-6%	6.4578	6.0789	-6%	8.5660	8.0634	-6%	2.8087	2.6439	-6%
1997	5.4214	5.1244	-5%	6.5077	6.1512	-5%	8.6322	8.1593	-5%	2.8304	2.6753	-5%
1998	5.3728	5.1132	-5%	6.4493	6.1378	-5%	8.5548	8.1415	-5%	2.8050	2.6695	-5%
1999	5.3508	5.1372	-4%	6.4229	6.1665	-4%	8.5197	8.1797	-4%	2.7935	2.6820	-4%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	19.5124	20.2835	4%	0.7117	0.8118	14%	0.6673	0.8087	21%	1.1878	1.9219	62%
1991	19.5132	19.9981	2%	0.7118	0.7758	9%	0.6674	0.7548	13%	1.1885	1.6488	39%
1992	19.7868	20.0505	1%	0.7206	0.7566	5%	0.6747	0.7206	7%	1.1932	1.4424	21%
1993	21.1884	21.2867	0%	0.7664	0.7813	2%	0.7123	0.7274	2%	1.2217	1.3129	7%
1994	18.5998	18.5819	0%	0.6817	0.6818	0%	0.6425	0.6359	-1%	1.1679	1.1482	-2%
1995	17.4069	17.3118	-1%	0.6430	0.6330	-2%	0.6109	0.5903	-3%	1.1462	1.0531	-8%
1996	17.0819	16.9827	-1%	0.6316	0.6205	-2%	0.6006	0.5798	-3%	1.1309	1.0344	-9%
1997	18.5443	18.4164	-1%	0.6799	0.6650	-2%	0.6410	0.6150	-4%	1.1664	1.0428	-11%
1998	20.5913	20.4614	-1%	0.7467	0.7314	-2%	0.6959	0.6699	-4%	1.2078	1.0826	-10%
1999	19.9973	19.8997	0%	0.7267	0.7151	-2%	0.6788	0.6591	-3%	1.1893	1.0948	-8%
2000	23.7036	23.6358	0%	0.8460	0.8378	-1%	0.7746	0.7612	-2%	1.2440	1.1790	-5%
2001	15.2542	15.2603	0%	0.5741	0.5746	0%	0.5558	0.5562	0%	1.1181	1.1208	0%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	C	P	R	C	P	R	C	P	R	C
2002	17.9653	17.9716	0%	0.6554	0.6559	0%	0.6147	0.6151	0%	1.0960	1.0988	0%
2003	7.4008	7.4008	-	0.3150	0.3150	-	0.3386	0.3385	0%	0.9124	0.9123	0%
2004	8.0494	8.0494	-	0.3319	0.3319	-	0.3479	0.3479	-	0.8778	0.8778	-
2005	8.3952	8.3952	-	0.3409	0.3409	-	0.3522	0.3522	-	0.8601	0.8601	-
2006	0.7048	0.7050	0%	0.0880	0.0880	0%	0.1413	0.1415	0%	0.6702	0.6705	0%
2007	0.6435	0.6437	0%	0.0800	0.0800	0%	0.1284	0.1284	0%	0.6095	0.6096	0%
2008	0.6853	0.6855	0%	0.0845	0.0846	0%	0.1352	0.1351	0%	0.6444	0.6444	-
2009	0.6258	0.6267	0%	0.0773	0.0774	0%	0.1238	0.1235	0%	0.5840	0.5840	-
2010	0.6701	0.6702	0%	0.0816	0.0816	0%	0.1290	0.1289	0%	0.6125	0.6125	-
2011	0.6691	0.6692	0%	0.0812	0.0812	0%	0.1284	0.1283	0%	0.6067	0.6066	0%
2012	0.6475	0.6475	0%	0.0777	0.0777	0%	0.1210	0.1211	0%	0.5767	0.5767	-
2013	0.6225	0.6226	0%	0.0742	0.0742	0%	0.1146	0.1154	1%	0.5468	0.5477	0%
2014	0.5752	0.5776	0%	0.0687	0.0689	0%	0.1050	0.1052	0%	0.4980	0.4991	0%
2015	0.6180	0.6194	0%	0.0733	0.0734	0%	0.1122	0.1122	-	0.5347	0.5353	0%
2016	0.5667	0.5669	0%	0.0680	0.0680	0%	0.1043	0.1042	0%	0.4927	0.4928	0%
2017	0.5607	0.5627	0%	0.0677	0.0678	0%	0.1045	0.1045	-	0.4910	0.4917	0%
2018	0.5241	0.5252	0%	0.0633	0.0633	0%	0.0972	0.0973	0%	0.4533	0.4538	0%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.5410	1.0090	87%	0.3090	0.6752	118%	0.6567	3.9638	504%
1991	0.5415	0.8355	54%	0.3090	0.5567	80%	0.6565	3.1650	382%
1992	0.5414	0.7010	29%	0.3093	0.4642	50%	0.6556	2.5063	282%
1993	0.5436	0.6027	11%	0.3105	0.3956	27%	0.6585	1.9756	200%
1994	0.5387	0.5272	-2%	0.3079	0.3436	12%	0.6549	1.5539	137%
1995	0.5384	0.4800	-11%	0.3075	0.3101	1%	0.6512	1.2346	90%
1996	0.5322	0.4716	-11%	0.3060	0.3018	-1%	0.6490	1.0235	58%
1997	0.5384	0.4604	-14%	0.3079	0.2923	-5%	0.6573	0.8599	31%
1998	0.5415	0.4624	-15%	0.3111	0.2916	-6%	0.6467	0.7574	17%
1999	0.5365	0.4770	-11%	0.3057	0.3009	-2%	0.6411	0.7111	11%
2000	0.5292	0.4880	-8%	0.3135	0.3140	0%	0.6577	0.6988	6%
2001	0.5451	0.5478	0%	0.3078	0.3168	3%	0.6432	0.7377	15%
2002	0.4998	0.5026	1%	0.2907	0.2994	3%	0.5668	0.6571	16%
2003	0.5040	0.5040	-	0.3198	0.3228	1%	0.6574	0.7548	15%
2004	0.4745	0.4745	-	0.3061	0.3089	1%	0.6089	0.7021	15%
2005	0.4595	0.4595	-	0.3124	0.3152	1%	0.5880	0.6841	16%
2006	0.4275	0.4275	-	0.3140	0.3170	1%	0.5657	0.6639	17%
2007	0.3894	0.3895	0%	0.2659	0.2691	1%	0.4910	0.5695	16%
2008	0.4130	0.4131	0%	0.2561	0.2584	1%	0.5200	0.5921	14%
2009	0.3755	0.3759	0%	0.1937	0.1962	1%	0.5003	0.5484	10%
2010	0.3975	0.3976	0%	0.2046	0.2058	1%	0.5590	0.6001	7%
2011	0.3950	0.3950	-	0.2040	0.2049	0%	0.5482	0.5858	7%
2012	0.3787	0.3788	0%	0.2260	0.2268	0%	0.5580	0.5974	7%
2013	0.3617	0.3617	-	0.2240	0.2248	0%	0.4969	0.5321	7%
2014	0.3321	0.3332	0%	0.2190	0.2222	1%	0.4335	0.4683	8%
2015	0.3565	0.3571	0%	0.2180	0.2201	1%	0.4645	0.4935	6%
2016	0.3279	0.3280	0%	0.2078	0.2087	0%	0.4483	0.4792	7%
2017	0.3258	0.3267	0%	0.2121	0.2147	1%	0.4048	0.4426	9%
2018	0.3027	0.3032	0%	0.2179	0.2196	1%	0.3772	0.4154	10%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	2.5336	4.7628	88%	1.1540	3.6076	213%
1991	2.5359	3.9202	55%	1.1541	2.9636	157%
1992	2.5331	3.2665	29%	1.1559	2.4529	112%
1993	2.5319	2.7802	10%	1.1682	2.0691	77%
1994	2.5299	2.4399	-4%	1.1450	1.7537	53%
1995	2.5391	2.2255	-12%	1.1361	1.5409	36%
1996	2.5113	2.1948	-13%	1.1279	1.4520	29%
1997	2.5289	2.1319	-16%	1.1451	1.3818	21%
1998	2.5273	2.1292	-16%	1.1616	1.3604	17%
1999	2.5070	2.2077	-12%	1.1436	1.3834	21%
2000	2.4379	2.2341	-8%	1.1824	1.4374	22%
2001	2.5923	2.5926	0%	1.1247	1.3402	19%
2002	2.3433	2.3437	0%	1.0642	1.2513	18%
2003	2.4480	2.4480	-	1.1136	1.2943	16%
2004	2.2920	2.2920	-	1.0735	1.2372	15%
2005	2.2145	2.2145	-	1.0779	1.2438	15%
2006	2.1104	2.1104	-	1.0489	1.2208	16%
2007	1.9130	1.9130	-	0.9327	1.1187	20%
2008	2.0082	2.0082	-	0.9905	1.1206	13%
2009	1.8044	1.8044	-	0.8747	0.9751	11%
2010	1.8528	1.8528	-	1.0968	1.1592	6%
2011	1.8179	1.8178	0%	1.1573	1.2050	4%
2012	1.6965	1.6965	-	1.3192	1.3657	4%
2013	1.5890	1.5891	0%	1.3614	1.4059	3%
2014	1.4335	1.4336	0%	1.3489	1.4106	5%
2015	1.5350	1.5351	0%	1.4206	1.4757	4%
2016	1.4238	1.4238	-	1.2913	1.3365	4%
2017	1.4324	1.4325	0%	1.2368	1.2882	4%
2018	1.3061	1.3062	0%	1.2670	1.3095	3%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	629.3619	630.0360	0%	0.0070	0.0117	68%	0.8412	1.2829	53%	0.9522	0.9524	0%
1991	629.3624	629.7862	0%	0.0070	0.0099	43%	0.8415	1.1196	33%	0.9522	0.9523	0%
1992	638.6025	638.8337	0%	0.0070	0.0087	24%	0.8464	0.9982	18%	0.9661	0.9662	0%
1993	685.7866	685.8741	0%	0.0071	0.0078	10%	0.8732	0.9310	7%	1.0376	1.0376	0%
1994	598.6860	598.6723	0%	0.0069	0.0069	0%	0.8230	0.8155	-1%	0.9057	0.9057	0%
1995	558.4448	558.3656	0%	0.0068	0.0063	-6%	0.8017	0.7511	-6%	0.8448	0.8447	0%
1996	547.8076	547.7249	0%	0.0067	0.0062	-7%	0.7911	0.7394	-7%	0.8287	0.8286	0%
1997	596.8294	596.7239	0%	0.0068	0.0062	-9%	0.8218	0.7553	-8%	0.9029	0.9029	0%
1998	665.7495	665.6414	0%	0.0071	0.0064	-9%	0.8617	0.7943	-8%	1.0073	1.0072	0%
1999	645.9715	645.8961	0%	0.0069	0.0065	-6%	0.8454	0.7988	-6%	0.9773	0.9773	0%
2000	771.4643	771.4122	0%	0.0072	0.0070	-3%	0.9092	0.8789	-3%	1.1674	1.1673	0%
2001	485.4207	485.4288	0%	0.0066	0.0067	2%	0.7685	0.7700	0%	0.7342	0.7342	0%
2002	579.3787	579.3874	0%	0.0064	0.0065	2%	0.7791	0.7806	0%	0.8765	0.8765	0%
2003	222.9209	222.9144	0%	0.0068	0.0069	2%	0.8220	0.8220	0%	0.9102	0.9102	0%
2004	246.4400	246.4338	0%	0.0068	0.0069	2%	0.8393	0.8393	0%	1.0311	1.0311	0%
2005	258.9232	258.9175	0%	0.0066	0.0067	2%	0.8285	0.8285	0%	1.0241	1.0241	0%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	C	P	R	C	P	R	C	P	R	C
2006	1.3996	1.3954	0%	0.0067	0.0068	1%	0.8515	0.8515	0%	1.1184	1.1184	0%
2007	1.2516	1.2475	0%	0.0059	0.0060	1%	0.7565	0.7565	0%	0.9971	0.9971	0%
2008	1.2571	1.2532	0%	0.0059	0.0060	1%	0.7497	0.7498	0%	0.9614	0.9614	0%
2009	1.2413	1.2376	0%	0.0055	0.0055	1%	0.7263	0.7265	0%	1.0523	1.0523	0%
2010	1.2838	1.2779	0%	0.0054	0.0055	2%	0.7183	0.7184	0%	1.0174	1.0174	0%
2011	1.3386	1.3320	0%	0.0055	0.0056	2%	0.7353	0.7353	0%	1.0821	1.0821	0%
2012	1.2792	1.2727	-1%	0.0050	0.0051	2%	0.6767	0.6767	0%	0.9571	0.9571	0%
2013	1.2770	1.2743	0%	0.0048	0.0050	3%	0.6607	0.6607	0%	0.9622	0.9622	0%
2014	1.3500	1.3533	0%	0.0048	0.0049	1%	0.6967	0.6973	0%	1.1232	1.1232	0%
2015	1.3476	1.3482	0%	0.0048	0.0049	1%	0.6862	0.6866	0%	1.0641	1.0641	0%
2016	1.3464	1.3439	0%	0.0049	0.0049	1%	0.7007	0.7008	0%	1.1478	1.1478	0%
2017	1.3907	1.3916	0%	0.0051	0.0051	1%	0.7365	0.7370	0%	1.2292	1.2292	0%
2018	1.4259	1.4248	0%	0.0047	0.0051	8%	0.6866	0.7479	9%	1.1404	1.3019	14%

P – Previous, R – Refined, C – Changed

3.4.3 PETROLEUM REFINING (NFR 1A1b)

3.4.3.1 Overview

The emissions from the refineries are allocated in category 1A1b. Refineries process crude oil into a variety of hydrocarbon products. The biggest refinery SLOVNAFT Plc is the only petroleum refining company operating in Slovakia, processing approximately 5.7 million tons of crude oil a year. The company is the most important supplier of petrol and diesel fuels in Slovakia. Emissions from petroleum refining, classified by code 1A1b, concern all combustion activities required to support the refining of petroleum products. Decrease in emissions of SOx after 2010 was caused by the economic situation of Slovak biggest refinery Slovnaft. This activity covers emissions released from production and combustion processes within a refinery.

The combustion processes include the heating of crude and petroleum products without contact between flame and products and also the industrial waste incineration. Activities listed within this category are shown in ***Table 3.9***.

Table 3.9: *Activities according to national categorization included in 1A1b*

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

Overview of emissions in this category is shown in ***Table 3.10***.

Table 3.10: *Overview of emissions in the category 1A1b*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	3.7968	1.9928	11.2358	0.0231	0.2306	0.2518	0.2529	0.0424	0.4963
1995	3.8022	1.9956	11.2517	0.0232	0.2309	0.2522	0.2532	0.0425	0.4970
2000	4.6652	2.5278	12.2614	0.0245	0.5848	0.6387	0.6414	0.1076	0.7964
2005	3.1916	1.5070	8.1885	0.0127	0.2439	0.2629	0.2911	0.0449	0.2913
2010	2.8144	1.3846	9.0583	0.0013	0.1499	0.1595	0.1600	0.0276	0.1756
2011	2.0950	1.1533	6.0985	0.0028	0.1043	0.1104	0.1107	0.0192	0.1797
2012	1.7081	1.1991	1.9754	0.0006	0.0814	0.0882	0.0886	0.0150	0.1053
2013	1.3770	1.2277	0.6966	0.0053	0.0834	0.0907	0.0912	0.0153	0.1104
2014	1.1687	1.0975	1.0279	0.0023	0.0456	0.0494	0.0497	0.0084	0.1074

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
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
1990/2019	**-62%**	**-63%**	**-83%**	**-70%**	**-64%**	**-65%**	**-65%**	**-64%**	**-90%**
2018/2019	**-12%**	**-23%**	**-3%**	**445%**	**-10%**	**-11%**	**-11%**	**-10%**	**-8%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0169	0.0013	0.0007	0.0002	IE	IE	0.0018	IE	IE
1995	0.0169	0.0013	0.0007	0.0002	IE	IE	0.0018	IE	IE
2000	0.0169	0.0013	0.0007	0.0002	IE	IE	0.0018	IE	IE
2005	0.0156	0.0012	0.0007	0.0002	IE	IE	0.0017	IE	IE
2010	0.0019	0.0001	0.0001	0.0000	IE	IE	0.0002	IE	IE
2011	0.0070	0.0005	0.0003	0.0001	IE	IE	0.0008	IE	IE
2012	0.0043	0.0003	0.0002	0.0001	IE	IE	0.0005	IE	IE
2013	0.0163	0.0013	0.0007	0.0002	IE	IE	0.0018	IE	IE
2014	0.0049	0.0004	0.0002	0.0001	IE	IE	0.0005	IE	IE
2015	0.0046	0.0004	0.0002	0.0001	IE	IE	0.0005	IE	IE
2016	0.0042	0.0003	0.0002	0.0001	IE	IE	0.0005	IE	IE
2017	0.0050	0.0004	0.0002	0.0001	IE	IE	0.0005	IE	IE
2018	0.0028	0.0002	0.0001	0.0000	IE	IE	0.0003	IE	IE
2019	0.0031	0.0002	0.0001	0.0000	IE	IE	0.0003	IE	IE
1990/2019	**-82%**	**-82%**	**-82%**	**-82%**	**-**	**-**	**-82%**	**-**	**-**
2018/2019	**10%**	**10%**	**10%**	**10%**	**-**	**-**	**10%**	**-**	**-**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [g]	PCBs [kg]
1990	4.5512	NE	NE	NE	NE	0.2601	0.0260	NA
1995	4.5586	NE	NE	NE	NE	0.2605	0.0260	NA
2000	4.5539	NE	NE	NE	NE	0.2602	0.0260	NA
2005	4.1941	NE	NE	NE	NE	0.2397	0.0240	NA
2010	0.5162	NE	NE	NE	NE	0.0295	0.0029	NA
2011	1.8872	NE	NE	NE	NE	0.1078	0.0108	NA
2012	1.1660	NE	NE	NE	NE	0.0666	0.0067	NA
2013	4.3792	NE	NE	NE	NE	0.2502	0.0250	NA
2014	1.3067	NE	NE	NE	NE	0.0747	0.0075	NA
2015	1.2415	NE	NE	NE	NE	0.0709	0.0071	NA
2016	1.1373	NE	NE	NE	NE	0.0650	0.0065	NA
2017	1.3429	NE	NE	NE	NE	0.0767	0.0077	NA
2018	0.7577	NE	NE	NE	NE	0.0433	0.0043	NA
2019	0.8372	NE	NE	NE	NE	0.0478	0.0048	NA
1990/2019	**-82%**	**-**	**-**	**-**	**-**	**-82%**	**-82%**	**-**
2018/2019	**10%**	**-**	**-**	**-**	**-**	**10%**	**10%**	**-**

An overview of activity data (energy consumption) for this source category is in ***Table 3.11*** below.

Table 3.11: Overview of activity data in the category 1A1b

YEAR	WASTE INCINERATED [KT]	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	13.00	29694.17	1069.06	10467.17	NO	NO
1995	13.02	29952.97	1106.24	10229.82	NO	NO
2000	13.01	30828.03	1197.97	8842.78	87.50	96.33
2005	11.98	29601.35	1958.62	6438.24	37.84	65.59
2010	1.47	31575.66	1282.94	5749.07	NO	4.42
2011	5.39	25653.21	1551.69	4321.68	10.22	10.05
2012	3.33	23398.09	1483.57	4198.31	NO	14.40
2013	12.51	19474.46	1833.24	5752.59	NO	54.35
2014	3.73	15698.77	1278.42	5209.24	NO	13.88
2015	3.55	19621.47	1893.66	5005.96	NO	13.19
2016	3.25	20417.54	1727.90	4960.58	NO	13.77
2017	3.84	19465.74	1925.76	5171.72	NO	16.15
2018	2.16	19948.10	1776.06	4606.00	NO	9.55
2019	2.39	18868.78	1225.26	4425.81	0.00	10.50
1990/2019	**-82%**	**-36%**	**15%**	**-58%**	**-**	**-**
2018/2019	**10%**	**-5%**	**-31%**	**-4%**	**-**	**10%**

3.4.3.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.12***).

Table 3.12: Emission factors for calculation of historical years

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	NH_3 [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/tGJ]
EF	92.09	48.33	272.51	0.56	6.13	91.2%	99.6%	18.40%	12.04

*T1 EMEP/EEA GB_{2019} EF

HMs and POPs emissions from the category 1A1b were allocated in the category 1B2aiv because if using of Tier 1 approach adopted for the process emissions, the combustion emissions are already covered and should not be reported again in Chapter 1A1b since this would lead to double counting. Only industrial waste incineration emissions for HMs and POPs are allocated in this category and were calculated using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.13***).

Table 3.13: Emission factors for HMs and POPs in 1A1b

T1	UNIT	EF
Pb	[g/t]	1.3
Cd	[g/t]	0.1
Hg	[g/t]	0.056
As	[g/t]	0.016
Ni	[g/t]	0.14
PCDD/F	[µg/t I-TEQ]	350
PAHs	[g/t]	0.02
HCB	[g/t]	0.002

3.4.3.3 Completeness

Emissions are well covered.

3.4.3.4 Source-specific recalculations

Recalculations in this submission were done due to a change of categorisation of fuels with the aim to improve data quality and transparency. Following the instruction of EMEP/EEA GB_{2019} (Part: Energy industries), the combustion emissions were excluded from category 1A1b since this would lead to double counting (***Table 3.14***).

Table 3.14: *Previous and refined emissions in the category 1A1b*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	3.7392	3.7968	2%	1.9625	1.9928	2%	11.0653	11.2358	2%	0.0228	0.0231	2%
1991	3.7426	3.8001	2%	1.9643	1.9945	2%	11.0753	11.2453	2%	0.0228	0.0231	2%
1992	3.7380	3.7956	2%	1.9619	1.9921	2%	11.0617	11.2320	2%	0.0228	0.0231	2%
1993	3.7377	3.7951	2%	1.9617	1.9918	2%	11.0607	11.2306	2%	0.0228	0.0231	2%
1994	3.7474	3.8019	1%	1.9668	1.9954	1%	11.0895	11.2506	1%	0.0228	0.0232	1%
1995	3.7454	3.8022	2%	1.9657	1.9956	2%	11.0834	11.2517	2%	0.0228	0.0232	2%
1996	3.7238	3.7784	1%	1.9544	1.9831	1%	11.0197	11.1811	1%	0.0227	0.0230	1%
1997	3.7632	3.8133	1%	1.9751	2.0014	1%	11.1361	11.2846	1%	0.0229	0.0232	1%
1998	3.7683	3.8130	1%	1.9778	2.0012	1%	11.1512	11.2835	1%	0.0230	0.0232	1%
1999	3.7098	3.7675	2%	1.9471	1.9774	2%	10.9783	11.1490	2%	0.0226	0.0229	2%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.2271	0.2306	2%	0.2480	0.2518	2%	0.2491	0.2529	2%
1991	0.2273	0.2308	2%	0.2482	0.2520	2%	0.2493	0.2531	2%
1992	0.2270	0.2305	2%	0.2479	0.2517	2%	0.2490	0.2528	2%
1993	0.2270	0.2305	2%	0.2479	0.2517	2%	0.2489	0.2528	2%
1994	0.2276	0.2309	1%	0.2485	0.2522	1%	0.2496	0.2532	1%
1995	0.2274	0.2309	2%	0.2484	0.2522	2%	0.2495	0.2532	2%
1996	0.2261	0.2294	1%	0.2470	0.2506	1%	0.2480	0.2517	1%
1997	0.2285	0.2316	1%	0.2496	0.2529	1%	0.2506	0.2540	1%
1998	0.2288	0.2315	1%	0.2499	0.2529	1%	0.2510	0.2540	1%
1999	0.2253	0.2288	2%	0.2461	0.2499	2%	0.2471	0.2509	2%

YEAR	BC [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0418	0.0424	2%	0.4888	0.4963	2%
1991	0.0418	0.0425	2%	0.4892	0.4967	2%
1992	0.0418	0.0424	2%	0.4886	0.4961	2%
1993	0.0418	0.0424	2%	0.4886	0.4961	2%
1994	0.0419	0.0425	1%	0.4898	0.4970	1%
1995	0.0418	0.0425	2%	0.4896	0.4970	2%
1996	0.0416	0.0422	1%	0.4868	0.4939	1%
1997	0.0420	0.0426	1%	0.4919	0.4985	1%
1998	0.0421	0.0426	1%	0.4926	0.4984	1%
1999	0.0415	0.0421	2%	0.4849	0.4925	2%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]			Ni [t]		
	P	R	C	P	R	C	P	R	C	P	R	C	P	R	C
1990	IE	0.0169	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]			Ni [t]		
	P	R	C	P	R	C	P	R	C	P	R	C	P	R	C
1991	IE	0.0169	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-
1992	IE	0.0169	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-
1993	IE	0.0169	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-
1994	IE	0.0169	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-
1995	IE	0.0169	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-
1996	IE	0.0168	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-
1997	IE	0.0170	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-
1998	IE	0.0170	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-
1999	IE	0.0168	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-
2000	IE	0.0169	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-
2001	IE	0.0146	-	IE	0.0011	-	IE	0.0006	-	IE	2E-04	-	IE	0.0016	-
2002	IE	0.0158	-	IE	0.0012	-	IE	0.0007	-	IE	2E-04	-	IE	0.0017	-
2003	IE	0.0178	-	IE	0.0014	-	IE	0.0008	-	IE	2E-04	-	IE	0.0019	-
2004	IE	0.0182	-	IE	0.0014	-	IE	0.0008	-	IE	2E-04	-	IE	0.0020	-
2005	IE	0.0156	-	IE	0.0012	-	IE	0.0007	-	IE	2E-04	-	IE	0.0017	-
2006	IE	0.0111	-	IE	0.0009	-	IE	0.0005	-	IE	1E-04	-	IE	0.0012	-
2007	IE	0.0078	-	IE	0.0006	-	IE	0.0003	-	IE	1E-04	-	IE	0.0008	-
2008	IE	0.0051	-	IE	0.0004	-	IE	0.0002	-	IE	6E-05	-	IE	0.0005	-
2009	IE	0.0052	-	IE	0.0004	-	IE	0.0002	-	IE	6E-05	-	IE	0.0006	-
2010	IE	0.0019	-	IE	0.0001	-	IE	0.0001	-	IE	2E-05	-	IE	0.0002	-
2011	IE	0.0070	-	IE	0.0005	-	IE	0.0003	-	IE	9E-05	-	IE	0.0008	-
2012	IE	0.0043	-	IE	0.0003	-	IE	0.0002	-	IE	5E-05	-	IE	0.0005	-
2013	IE	0.0163	-	IE	0.0013	-	IE	0.0007	-	IE	2E-04	-	IE	0.0018	-
2014	IE	0.0049	-	IE	0.0004	-	IE	0.0002	-	IE	6E-05	-	IE	0.0005	-
2015	IE	0.0046	-	IE	0.0004	-	IE	0.0002	-	IE	6E-05	-	IE	0.0005	-
2016	IE	0.0042	-	IE	0.0003	-	IE	0.0002	-	IE	5E-05	-	IE	0.0005	-
2017	IE	0.0050	-	IE	0.0004	-	IE	0.0002	-	IE	6E-05	-	IE	0.0005	-
2018	IE	0.0028	-	IE	0.0002	-	IE	0.0001	-	IE	3E-05	-	IE	0.0003	-

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	IE	4.5512	-	4E-04	0.2601	73493%	7E-06	0.0260	362985%	4E-06	NA	-
1991	IE	4.5553	-	4E-04	0.2603	73580%	7E-06	0.0260	362088%	4E-06	NA	-
1992	IE	4.5497	-	4E-04	0.2600	73480%	7E-06	0.0260	359930%	4E-06	NA	-
1993	IE	4.5493	-	4E-04	0.2600	73447%	7E-06	0.0260	359840%	4E-06	NA	-
1994	IE	4.5611	-	4E-04	0.2606	73608%	7E-06	0.0261	359471%	4E-06	NA	-
1995	IE	4.5586	-	4E-04	0.2605	73682%	7E-06	0.0260	351358%	4E-06	NA	-
1996	IE	4.5324	-	4E-04	0.2590	73045%	7E-06	0.0259	348858%	4E-06	NA	-
1997	IE	4.5803	-	4E-04	0.2617	73840%	7E-06	0.0262	350276%	4E-06	NA	-
1998	IE	4.5865	-	4E-04	0.2621	73994%	8E-06	0.0262	332519%	4E-06	NA	-
1999	IE	4.5154	-	4E-04	0.2580	72931%	8E-06	0.0258	310519%	4E-06	NA	-
2000	IE	4.5539	-	4E-04	0.2602	72459%	8E-06	0.0260	324105%	4E-06	NA	-
2001	IE	3.9221	-	4E-04	0.2241	63525%	9E-06	0.0224	239193%	5E-06	NA	-
2002	IE	4.2473	-	4E-04	0.2427	67976%	1E-05	0.0243	221985%	5E-06	NA	-
2003	IE	4.8026	-	4E-04	0.2744	75956%	1E-05	0.0274	250722%	5E-06	NA	-
2004	IE	4.8927	-	4E-04	0.2796	75384%	1E-05	0.0280	228956%	6E-06	NA	-
2005	IE	4.1941	-	4E-04	0.2397	63486%	1E-05	0.0240	182529%	6E-06	NA	-
2006	IE	2.9797	-	4E-04	0.1703	46950%	1E-05	0.0170	145789%	6E-06	NA	-
2007	IE	2.0903	-	4E-04	0.1194	31765%	1E-05	0.0119	82171%	7E-06	NA	-

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	C	P	R	C	P	R	C	P	R	C
2008	IE	1.3610	-	3E-04	0.0778	24107%	1E-05	0.0078	77576%	5E-06	NA	-
2009	IE	1.4064	-	3E-04	0.0804	25011%	1E-05	0.0080	78638%	5E-06	NA	-
2010	IE	0.5162	-	3E-04	0.0295	10066%	9E-06	0.0029	34219%	4E-06	NA	-
2011	IE	1.8872	-	3E-04	0.1078	37252%	1E-05	0.0108	103628%	5E-06	NA	-
2012	IE	1.1660	-	3E-04	0.0666	24721%	1E-05	0.0067	66930%	5E-06	NA	-
2013	IE	4.3792	-	3E-04	0.2502	89540%	1E-05	0.0250	203632%	6E-06	NA	-
2014	IE	1.3067	-	2E-04	0.0747	36717%	9E-06	0.0075	87073%	4E-06	NA	-
2015	IE	1.2415	-	3E-04	0.0709	26050%	1E-05	0.0071	55816%	6E-06	NA	-
2016	IE	1.1373	-	3E-04	0.0650	23094%	1E-05	0.0065	56034%	6E-06	NA	-
2017	IE	1.3429	-	3E-04	0.0767	26886%	1E-05	0.0077	59373%	6E-06	NA	-
2018	IE	0.7577	-	3E-04	0.0433	15342%	1E-05	0.0043	36287%	6E-06	NA	-

P – Previous, R – Refined, C – Changed

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 3.15***.

Table 3.15: *Activities according to national categorization included in 1A1c*

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

An overview of emissions in this category is shown in ***Table 3.16***.

Table 3.16: *Overview of emissions in the category 1A1c*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.4307	1.2510	0.6901	0.0887	0.4264	0.7176	1.0773	0.2047	12.2804
1995	0.4279	1.2428	0.6855	0.0881	0.4236	0.7129	1.0702	0.2033	12.1997
2000	0.3519	1.8925	0.6866	0.1067	0.3097	0.5213	0.7825	0.1487	12.3868
2005	0.6081	1.0227	0.6376	0.0645	0.5719	0.9610	1.4396	0.2745	15.2868
2010	0.6990	0.3721	0.5342	0.0310	0.3124	0.5255	0.7884	0.1500	15.4326
2011	0.6540	0.3178	0.1996	0.0325	0.2953	0.4965	0.7443	0.1418	15.0236
2012	0.5827	0.2740	0.2144	0.0270	0.3002	0.5047	0.7567	0.1441	14.9857
2013	0.5846	0.3343	0.3310	0.0314	0.2936	0.4940	0.7413	0.1409	14.0761
2014	0.5514	0.3273	0.2054	0.0312	0.1703	0.2875	0.4331	0.0818	14.5471
2015	0.6271	0.3609	0.2393	0.0311	0.1623	0.2739	0.4126	0.0779	14.4584
2016	0.5759	0.4290	0.2129	0.0323	0.1754	0.2957	0.4449	0.0842	13.2027
2017	0.5214	0.4100	0.1786	0.0308	0.1450	0.2446	0.3681	0.0696	12.6232
2018	0.6125	0.3708	0.2032	0.0296	0.1484	0.2499	0.3755	0.0712	12.9564
2019	0.6880	0.3231	0.1529	0.0256	0.1572	0.2646	0.3974	0.0755	13.6313
1990/2019	**60%**	**-74%**	**-78%**	**-71%**	**-63%**	**-63%**	**-63%**	**-63%**	**11%**
2018/2019	**12%**	**-13%**	**-25%**	**-13%**	**6%**	**6%**	**6%**	**6%**	**5%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.1988	0.0114	0.2130	0.0781	0.0405	0.1775	0.0369	0.0206	0.3265
1995	0.1975	0.0113	0.2116	0.0776	0.0402	0.1763	0.0367	0.0205	0.3244
2000	0.2081	0.0119	0.2230	0.0818	0.0424	0.1858	0.0387	0.0216	0.3419
2005	0.2025	0.0116	0.2170	0.0796	0.0412	0.1808	0.0376	0.0210	0.3327

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2010	0.1818	0.0104	0.1948	0.0714	0.0370	0.1624	0.0338	0.0188	0.2988
2011	0.1733	0.0099	0.1857	0.0681	0.0353	0.1547	0.0322	0.0179	0.2847
2012	0.1740	0.0099	0.1864	0.0684	0.0354	0.1554	0.0323	0.0180	0.2859
2013	0.1717	0.0098	0.1840	0.0675	0.0350	0.1533	0.0319	0.0178	0.2821
2014	0.1739	0.0099	0.1863	0.0683	0.0354	0.1553	0.0323	0.0180	0.2857
2015	0.1808	0.0103	0.1937	0.0710	0.0368	0.1615	0.0336	0.0187	0.2971
2016	0.1812	0.0104	0.1942	0.0712	0.0369	0.1618	0.0337	0.0188	0.2978
2017	0.1664	0.0095	0.1783	0.0654	0.0339	0.1485	0.0309	0.0172	0.2733
2018	0.1706	0.0098	0.1828	0.0670	0.0347	0.1524	0.0317	0.0177	0.2803
2019	0.1566	0.0089	0.1678	0.0615	0.0319	0.1398	0.0291	0.0162	0.2572
1990/2019	**-21%**	**-21%**	**-21%**	**-21%**	**-21%**	**-21%**	**-21%**	**-21%**	**-21%**
2018/2019	**-8%**	**-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	0.1846	0.0021	2E-05	7E-06	7E-06	0.0021
1995	0.1833	0.0020	2E-05	7E-06	7E-06	0.0021
2000	0.1933	0.0022	2E-05	7E-06	7E-06	0.0022
2005	0.1881	0.0021	2E-05	7E-06	7E-06	0.0021
2010	0.1689	0.0019	2E-05	6E-06	6E-06	0.0019
2011	0.1609	0.0018	2E-05	6E-06	6E-06	0.0018
2012	0.1616	0.0018	2E-05	6E-06	6E-06	0.0018
2013	0.1595	0.0018	2E-05	6E-06	6E-06	0.0018
2014	0.1615	0.0018	2E-05	6E-06	6E-06	0.0018
2015	0.1679	0.0019	2E-05	6E-06	6E-06	0.0019
2016	0.1683	0.0019	2E-05	6E-06	6E-06	0.0019
2017	0.1545	0.0017	2E-05	6E-06	6E-06	0.0018
2018	0.1584	0.0018	2E-05	6E-06	6E-06	0.0018
2019	0.1454	0.0016	2E-05	6E-06	6E-06	0.0016
1990/2019	**-21%**	**-21%**	**-21%**	**-21%**	**-21%**	**-21%**
2018/2019	**-8%**	**-8%**	**-8%**	**-8%**	**-8%**	**-8%**

Overview of activity data (energy consumption) for this source category is in ***Table 3.17*** below.

Table 3.17: *Overview of activity data in the category 1A1c*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	NO	7 109.30	NO	NO	NO
1995	NO	7 061.99	NO	NO	NO
2000	NO	7 431.88	0.93	NO	NO
2005	NO	7 231.65	1.85	NO	NO
2010	0.09	6 491.11	3.43	NO	NO
2011	0.08	6 187.55	1.76	NO	NO
2012	0.10	6 211.97	2.46	NO	NO
2013	0.07	6 130.61	2.48	NO	NO
2014	0.09	6 209.12	1.29	NO	NO
2015	0.10	6 456.99	1.23	NO	NO
2016	0.13	6 471.44	1.33	NO	NO
2017	0.05	5 934.80	6.83	NO	NO
2018	0.10	6 087.14	6.83	NO	NO
2019	0.08	5 585.03	7.02	NO	NO

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990/2019	-	-21%	-	-	-
2018/2019	-26%	-8%	3%	-	-

3.4.4.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.18***).

Table 3.18: *Emission factors for calculation of historical years*

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

*T1 EMEP/EEA GB_{2019} EF

HMs and POPs emissions were calculated using of Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.19***).

Table 3.19: *Emission factors for heavy metals and POPs in the category 1A1c*

T1	UNIT	COAL
Pb	[mg/GJ]	28
Cd	[mg/GJ]	1.6
Hg	[mg/GJ]	20
As	[mg/GJ]	11
Cr	[mg/GJ]	5.7
Cu	[mg/GJ]	25
Ni	[mg/GJ]	5.2
Se	[mg/GJ]	2.9
Zn	[mg/GJ]	46
PCDD/F	[ng I-TEQ/GJ]	26
B(a)P	[µg/GJ]	0.29
B(b)F	[µg/GJ]	0.003
B(k)F	[µg/GJ]	0.001
I()P	[µg/GJ]	0.001
PAHs	[µg/GJ]	0.295

3.4.4.3 Completeness

Emissions are well covered.

3.4.4.3 Source-specific recalculations

Recalculations in this submission were done due to a change of categorisation of fuels with the aim to improve data quality and transparency. This caused recalculations of data for the period 1990-1999, as these data do not originate from the NEIS database but are calculated according to activity data (***Table 3.20***).

***Table 3.20:** Previous and refined emissions in the category 1A1c*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	0.4314	0.4307	0%	1.2529	1.2510	0%	0.6911	0.6901	0%	0.0888	0.0887	0%
1991	0.4305	0.4298	0%	1.2503	1.2484	0%	0.6897	0.6886	0%	0.0886	0.0885	0%
1992	0.4310	0.4304	0%	1.2519	1.2500	0%	0.6906	0.6895	0%	0.0888	0.0886	0%
1993	0.4318	0.4312	0%	1.2543	1.2525	0%	0.6919	0.6909	0%	0.0889	0.0888	0%
1994	0.4310	0.4303	0%	1.2517	1.2499	0%	0.6905	0.6895	0%	0.0887	0.0886	0%
1995	0.4285	0.4279	0%	1.2445	1.2428	0%	0.6865	0.6855	0%	0.0882	0.0881	0%
1996	0.4353	0.4347	0%	1.2642	1.2627	0%	0.6974	0.6965	0%	0.0896	0.0895	0%
1997	0.4308	0.4304	0%	1.2513	1.2501	0%	0.6903	0.6896	0%	0.0887	0.0886	0%
1998	0.4259	0.4254	0%	1.2371	1.2354	0%	0.6824	0.6815	0%	0.0877	0.0876	0%
1999	0.4321	0.4319	0%	1.2550	1.2544	0%	0.6923	0.6920	0%	0.0890	0.0889	0%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.4271	0.4264	0%	0.7187	0.7176	0%	1.0789	1.0773	0%
1991	0.4262	0.4255	0%	0.7173	0.7162	0%	1.0767	1.0751	0%
1992	0.4267	0.4261	0%	0.7182	0.7171	0%	1.0781	1.0764	0%
1993	0.4275	0.4269	0%	0.7195	0.7185	0%	1.0801	1.0786	0%
1994	0.4267	0.4260	0%	0.7180	0.7170	0%	1.0779	1.0763	0%
1995	0.4242	0.4236	0%	0.7140	0.7129	0%	1.0717	1.0702	0%
1996	0.4309	0.4304	0%	0.7252	0.7244	0%	1.0887	1.0874	0%
1997	0.4265	0.4261	0%	0.7179	0.7171	0%	1.0776	1.0765	0%
1998	0.4217	0.4211	0%	0.7097	0.7087	0%	1.0653	1.0639	0%
1999	0.4278	0.4276	0%	0.7200	0.7196	0%	1.0808	1.0802	0%

YEAR	BC [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE
1990	0.2050	0.2047	0%	12.2991	12.2804	0%
1991	0.2046	0.2043	0%	12.2739	12.2552	0%
1992	0.2048	0.2045	0%	12.2892	12.2705	0%
1993	0.2052	0.2049	0%	12.3127	12.2952	0%
1994	0.2048	0.2045	0%	12.2874	12.2695	0%
1995	0.2036	0.2033	0%	12.2173	12.1997	0%
1996	0.2068	0.2066	0%	12.4105	12.3953	0%
1997	0.2047	0.2045	0%	12.2841	12.2720	0%
1998	0.2024	0.2021	0%	12.1439	12.1276	0%
1999	0.2053	0.2052	0%	12.3202	12.3142	0%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.1991	0.1988	0%	0.0114	0.0114	0%	0.2133	0.2130	0%	0.0782	0.0781	0%
1991	0.1987	0.1983	0%	0.0114	0.0113	0%	0.2128	0.2125	0%	0.0780	0.0779	0%
1992	0.1989	0.1986	0%	0.0114	0.0113	0%	0.2131	0.2128	0%	0.0781	0.0780	0%
1993	0.1993	0.1990	0%	0.0114	0.0114	-	0.2135	0.2132	0%	0.0783	0.0782	0%
1994	0.1989	0.1986	0%	0.0114	0.0113	0%	0.2131	0.2128	0%	0.0781	0.0780	0%
1995	0.1977	0.1975	0%	0.0113	0.0113	-	0.2119	0.2116	0%	0.0777	0.0776	0%
1996	0.2009	0.2006	0%	0.0115	0.0115	-	0.2152	0.2149	0%	0.0789	0.0788	0%
1997	0.1988	0.1986	0%	0.0114	0.0113	0%	0.2130	0.2128	0%	0.0781	0.0780	0%
1998	0.1965	0.1963	0%	0.0112	0.0112	-	0.2106	0.2103	0%	0.0772	0.0771	0%
1999	0.1994	0.1993	0%	0.0114	0.0114	-	0.2136	0.2135	0%	0.0783	0.0783	-

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0405	0.0405	-	0.1777	0.1775	0%	0.0370	0.0369	0%
1991	0.0404	0.0404	-	0.1774	0.1771	0%	0.0369	0.0368	0%
1992	0.0405	0.0404	0%	0.1776	0.1773	0%	0.0369	0.0369	-
1993	0.0406	0.0405	0%	0.1779	0.1777	0%	0.0370	0.0370	-
1994	0.0405	0.0404	0%	0.1776	0.1773	0%	0.0369	0.0369	-
1995	0.0403	0.0402	0%	0.1765	0.1763	0%	0.0367	0.0367	-
1996	0.0409	0.0408	0%	0.1793	0.1791	0%	0.0373	0.0373	-
1997	0.0405	0.0404	0%	0.1775	0.1773	0%	0.0369	0.0369	-
1998	0.0400	0.0400	-	0.1755	0.1753	0%	0.0365	0.0365	-
1999	0.0406	0.0406	-	0.1780	0.1780	-	0.0370	0.0370	-

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0206	0.0206	-	0.3270	0.3265	0%
1991	0.0206	0.0205	-	0.3264	0.3259	0%
1992	0.0206	0.0206	-	0.3268	0.3263	0%
1993	0.0206	0.0206	-	0.3274	0.3269	0%
1994	0.0206	0.0206	-	0.3267	0.3262	0%
1995	0.0205	0.0205	-	0.3249	0.3244	0%
1996	0.0208	0.0208	-	0.3300	0.3296	0%
1997	0.0206	0.0206	-	0.3266	0.3263	0%
1998	0.0204	0.0203	0%	0.3229	0.3225	0%
1999	0.0207	0.0206	0%	0.3276	0.3274	0%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.1848	0.1846	0%	0.0021	0.0021	0%
1991	0.1845	0.1842	0%	0.0021	0.0021	0%
1992	0.1847	0.1844	0%	0.0021	0.0021	0%
1993	0.1850	0.1848	0%	0.0021	0.0021	0%
1994	0.1847	0.1844	0%	0.0021	0.0021	0%
1995	0.1836	0.1833	0%	0.0021	0.0021	0%
1996	0.1865	0.1863	0%	0.0021	0.0021	0%
1997	0.1846	0.1844	0%	0.0021	0.0021	0%
1998	0.1825	0.1823	0%	0.0021	0.0021	0%
1999	0.1852	0.1851	0%	0.0021	0.0021	0%

P – Previous, R – Refined, C – Change

3.5 MANUFACTURING INDUSTRIES AND CONSTRUCTION (NFR 1A2)

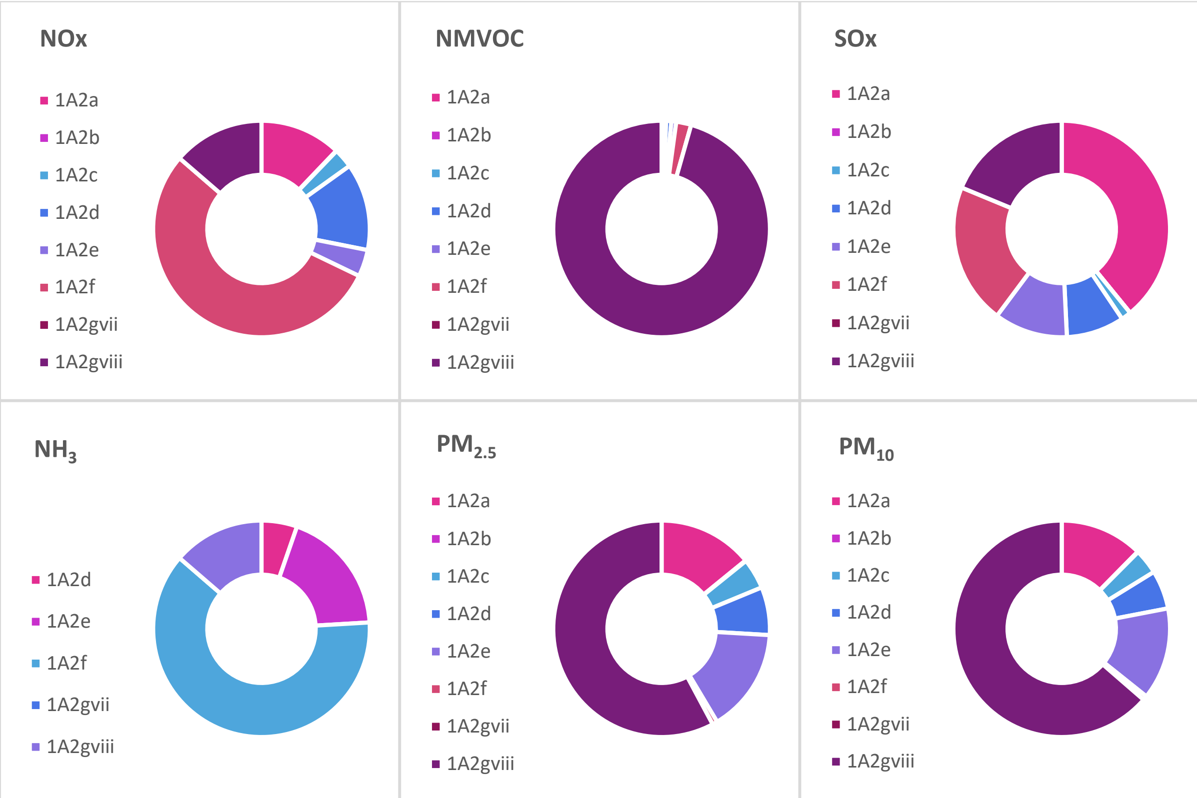
3.5.1 OVERVIEW

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

The emissions depend on fuel and process activity. Relevant pollutants are generally as described for combustion: SO_2, NOx, CO, NMVOC, particulate matter (TSP, PM_{10}, $PM_{2.5}$), black carbon (BC), heavy metals (HM), polycyclic aromatic hydrocarbons (PAH), polychlorinated dibenzo-dioxin and polychlorinated dibenzo-furans (PCDD/F) and, for some activities, polychlorinated biphenyls (PCB) and hexachlorobenzene (HCB).

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

Figure 3.3: *Share of emissions of the main pollutants in 1A2 in 2019*



3.5.2 STATIONARY COMBUSTION IN MANUFACTURING INDUSTRIES AND CONSTRUCTION: IRON AND STEEL (NFR 1A2a)

3.5.2.1 Overview

The iron and steel industry is one of the most energy-intensive industrial branches in the Slovak Republic and it is represented by one biggest iron and steel company in the Slovak Republic (U.S. Steel). The total volume of fuels allocated in 1A2a expressed in energy units represented 19 470.4 TJ in 2019. Emissions of main pollutants are calculated using Tier 3 method – facility data from the operator. Emissions have an overall decreasing trend except for SOx in 2000 when a single operator used to duel with a higher share of sulphur. A slight increase in 2018 was caused by a temporal increase in production.

Activities listed within this category are shown in ***Table 3.21***.

Table 3.21: *Activities according to national categorization included in 1A2a*

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

Overview of emissions in this category is shown in ***Table 3.22***.

***Table 3.22:** Overview of emissions in the category 1A2a*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	5.1282	0.0362	4.3832	NO	3.6566	3.9214	4.5386	0.4202
1995	5.2063	0.0368	4.4499	NO	3.7123	3.9811	4.6077	0.4266
2000	6.0894	0.0367	9.7871	NO	4.5250	4.8526	5.6164	0.7581
2005	5.7510	0.0287	4.8804	NO	0.2555	0.2589	0.2870	0.4317
2010	3.8203	0.0509	3.9807	NO	0.1790	0.1836	0.2007	0.6545
2011	2.8316	0.0487	2.8248	NO	0.1209	0.1235	0.1360	0.5703
2012	3.3872	0.0570	3.8774	NO	0.0642	0.0784	0.0979	0.7353
2013	3.2981	0.0560	3.6654	NO	0.0503	0.0595	0.0746	0.8143
2014	3.0680	0.0612	2.7901	NO	0.0616	0.0725	0.0890	0.5220
2015	3.0669	0.0424	2.3135	NO	0.0418	0.0517	0.0728	0.5840
2016	2.5749	0.0381	1.9776	1E-05	0.0377	0.0448	0.0539	0.3735
2017	2.1911	0.0339	1.5720	NO	0.0299	0.0360	0.0481	0.3239
2018	2.5348	0.0474	1.3473	NO	0.0347	0.0401	0.0545	0.3129
2019	0.9780	0.0373	0.5527	NO	0.0328	0.0362	0.0387	0.1024
1990/2019	**-81%**	**3%**	**-87%**	**-**	**-99%**	**-99%**	**-99%**	**-76%**
2018/2019	**-61%**	**-21%**	**-59%**	**-**	**-5%**	**-10%**	**-29%**	**-67%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	1.3784	0.0185	0.0865	0.0421	0.1390	0.1800	0.1338	0.0191	2.0645
1995	1.4138	0.0190	0.0887	0.0432	0.1426	0.1847	0.1373	0.0196	2.1174
2000	1.4598	0.0196	0.0918	0.0446	0.1472	0.1907	0.1418	0.0202	2.1866
2005	2.0879	0.0281	0.1300	0.0636	0.2105	0.2727	0.2027	0.0288	3.1254
2010	1.3909	0.0187	0.0905	0.0431	0.1403	0.1817	0.1351	0.0196	2.0873
2011	1.3991	0.0188	0.0909	0.0433	0.1411	0.1827	0.1359	0.0197	2.0994
2012	1.5420	0.0207	0.0989	0.0475	0.1555	0.2014	0.1498	0.0216	2.3126
2013	1.5241	0.0205	0.0977	0.0469	0.1537	0.1991	0.1480	0.0213	2.2852
2014	1.3749	0.0185	0.0894	0.0426	0.1387	0.1796	0.1336	0.0194	2.0631
2015	1.3567	0.0182	0.0880	0.0420	0.1369	0.1772	0.1318	0.0191	2.0356
2016	0.9528	0.0128	0.0642	0.0299	0.0962	0.1244	0.0926	0.0137	1.4327
2017	0.9693	0.0130	0.0650	0.0304	0.0978	0.1266	0.0942	0.0139	1.4571
2018	1.2367	0.0166	0.0817	0.0385	0.1248	0.1615	0.1202	0.0176	1.8574
2019	1.1012	0.0148	0.0710	0.0340	0.1111	0.1438	0.1070	0.0154	1.6520
1990/2019	**-20%**	**-20%**	**-18%**	**-19%**	**-20%**	**-20%**	**-20%**	**-19%**	**-20%**
2018/2019	**-11%**	**-11%**	**-13%**	**-12%**	**-11%**	**-11%**	**-11%**	**-12%**	**-11%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	2.0931	0.4751	0.6343	0.2546	0.2009	1.5648	0.0064	1.7486
1995	2.1468	0.4871	0.6500	0.2609	0.2058	1.6038	0.0065	1.7935
2000	2.2169	0.5033	0.6727	0.2699	0.2131	1.6590	0.0068	1.8518
2005	3.1694	0.7181	0.9549	0.3834	0.3021	2.3584	0.0097	2.6486
2010	2.1151	0.4836	0.6570	0.2633	0.2090	1.6130	0.0064	1.7644
2011	2.1274	0.4863	0.6603	0.2646	0.2100	1.6212	0.0065	1.7747
2012	2.3435	0.5343	0.7212	0.2891	0.2290	1.7736	0.0071	1.9560
2013	2.3162	0.5279	0.7119	0.2855	0.2261	1.7513	0.0071	1.9334
2014	2.0906	0.4779	0.6490	0.2601	0.2065	1.5935	0.0064	1.7441
2015	2.0628	0.4714	0.6396	0.2563	0.2034	1.5707	0.0063	1.7210
2016	1.4509	0.3342	0.4619	0.1849	0.1476	1.1285	0.0044	1.2085

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2017	1.4757	0.3395	0.4681	0.1874	0.1495	1.1444	0.0045	1.2295
2018	1.8816	0.4316	0.5907	0.2366	0.1883	1.4472	0.0057	1.5687
2019	1.6739	0.3820	0.5168	0.2071	0.1642	1.2701	0.0051	1.3969
1990/2019	**-20%**	**-20%**	**-19%**	**-19%**	**-18%**	**-19%**	**-20%**	**-20%**
2018/2019	**-11%**	**-11%**	**-13%**	**-12%**	**-13%**	**-12%**	**-11%**	**-11%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.23*** below.

Table 3.23: *Overview of activity data in the category 1A2a*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	5.93	18 622.60	1 451.96	NO	NO
1995	5.97	18 979.64	1 400.55	NO	NO
2000	5.50	20 111.83	1 465.23	NO	NO
2005	NO	27 089.95	1 319.92	NO	NO
2010	0.35	24 392.52	1 756.07	NO	NO
2011	2.82	23 921.25	2 160.77	NO	NO
2012	17.10	24 668.61	1 740.10	NO	NO
2013	2.23	23 780.86	2 085.08	NO	NO
2014	1.36	23 837.29	1 849.90	NO	NO
2015	0.60	23 489.52	1 561.83	NO	NO
2016	1.30	20 577.44	1 413.57	NO	NO
2017	4.64	20 294.87	1 446.04	NO	NO
2018	2.89	24 210.47	1 290.38	NO	NO
2019	14.44	18 054.40	1 401.57	NO	NO
1990/2019	**144%**	**-3%**	**-3%**	**-**	**-**
2018/2019	**400%**	**-25%**	**9%**	**-**	**-**

3.5.2.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.24***).

Table 3.24: *Emission factors for calculation of historical years*

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

HMs and POPs emissions were calculated using of Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.25***).

Table 3.25: *Emission factors for heavy metals and POPs in the category 1A2a*

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	0.8	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

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
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

3.5.2.3 Completeness

Emissions are well covered.

3.5.2.4 Source-specific recalculations

No recalculations in this submission.

3.5.3 STATIONARY COMBUSTION IN MANUFACTURING INDUSTRIES AND CONSTRUCTION: NON-FERROUS METALS (NFR 1A2b)

3.5.3.1 Overview

The category is focused on combustion processes in the production of non-ferrous metals. Activities listed within this category are shown in ***Table 3.26***.

Table 3.26: *Activities according to national categorization included in 1A2b*

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

An overview of emissions in this category is shown in ***Table 3.27***.

Table 3.27: *Overview of emissions in the category 1A2b*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.0040	0.0001	2E-04	0.0002	0.0002	0.0003	0.0014
1995	0.0044	0.0001	2E-04	0.0002	0.0003	0.0003	0.0016
2000	0.0011	0.0001	7E-06	0.0000	0.0000	0.0001	0.0004
2005	0.0036	0.0001	4E-04	0.0002	0.0002	0.0006	0.0015
2010	0.0033	0.0002	2E-05	0.0002	0.0002	0.0002	0.0013
2011	0.0035	0.0002	3E-05	0.0001	0.0002	0.0002	0.0016
2012	0.0036	0.0002	2E-05	0.0002	0.0002	0.0002	0.0014
2013	0.0035	0.0002	2E-05	0.0002	0.0002	0.0002	0.0014
2014	0.0039	0.0002	2E-05	0.0002	0.0002	0.0002	0.0016

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2015	0.0041	0.0002	3E-05	0.0002	0.0002	0.0002	0.0017
2016	0.0042	0.0003	3E-05	0.0002	0.0002	0.0002	0.0017
2017	0.0050	0.0003	3E-05	0.0002	0.0002	0.0003	0.0020
2018	0.0053	0.0003	3E-05	0.0002	0.0003	0.0003	0.0021
2019	0.0050	0.0003	3E-05	0.0002	0.0002	0.0003	0.0020
1990/2019	**26%**	**317%**	**-81%**	**0%**	**2%**	**-9%**	**45%**
2018/2019	**-5%**	**-3%**	**-5%**	**-7%**	**-6%**	**-5%**	**-5%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	9E-07	7E-08	4E-05	8E-06	1E-06	2E-07	1E-06	5E-06	6E-05
1995	1E-06	8E-08	5E-05	9E-06	1E-06	2E-07	1E-06	5E-06	7E-05
2000	6E-07	5E-08	3E-05	5E-06	7E-07	1E-07	7E-07	3E-06	4E-05
2005	7E-05	9E-07	4E-05	9E-06	8E-06	9E-06	7E-06	5E-06	2E-04
2010	8E-07	7E-08	4E-05	8E-06	1E-06	2E-07	1E-06	4E-06	6E-05
2011	9E-07	7E-08	4E-05	8E-06	1E-06	2E-07	1E-06	5E-06	6E-05
2012	9E-07	7E-08	4E-05	8E-06	1E-06	2E-07	1E-06	5E-06	6E-05
2013	1E-06	9E-08	6E-05	1E-05	1E-06	3E-07	1E-06	6E-06	7E-05
2014	7E-07	6E-08	3E-05	6E-06	8E-07	2E-07	8E-07	4E-06	5E-05
2015	1E-06	9E-08	5E-05	1E-05	1E-06	3E-07	1E-06	6E-06	7E-05
2016	1E-06	9E-08	5E-05	1E-05	1E-06	3E-07	1E-06	6E-06	7E-05
2017	1E-06	1E-07	6E-05	1E-05	2E-06	3E-07	2E-06	7E-06	9E-05
2018	1E-06	1E-07	7E-05	1E-05	2E-06	3E-07	2E-06	7E-06	9E-05
2019	1E-06	1E-07	6E-05	1E-05	2E-06	3E-07	2E-06	7E-06	9E-05
1990/2019	**43%**	**43%**	**43%**	**43%**	**43%**	**43%**	**43%**	**43%**	**43%**
2018/2019	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	4E-05	6E-05	2E-04	9E-05	9E-05	5E-04	NE	NE
1995	5E-05	7E-05	3E-04	1E-04	1E-04	5E-04	NE	NE
2000	3E-05	4E-05	1E-04	6E-05	5E-05	3E-04	NE	NE
2005	1E-04	8E-05	2E-04	9E-05	9E-05	5E-04	3E-07	8E-05
2010	4E-05	6E-05	2E-04	8E-05	8E-05	4E-04	NE	NE
2011	4E-05	6E-05	2E-04	9E-05	9E-05	5E-04	NE	NE
2012	4E-05	6E-05	2E-04	9E-05	9E-05	5E-04	NE	NE
2013	5E-05	7E-05	3E-04	1E-04	1E-04	6E-04	NE	NE
2014	3E-05	4E-05	2E-04	7E-05	7E-05	4E-04	NE	NE
2015	5E-05	7E-05	3E-04	1E-04	1E-04	6E-04	NE	NE
2016	5E-05	7E-05	3E-04	1E-04	1E-04	6E-04	NE	NE
2017	6E-05	8E-05	3E-04	1E-04	1E-04	7E-04	NE	NE
2018	6E-05	9E-05	4E-04	1E-04	1E-04	7E-04	NE	NE
2019	6E-05	8E-05	3E-04	1E-04	1E-04	7E-04	NE	NE
1990/2019	**43%**	**43%**	**43%**	**43%**	**43%**	**43%**	**-**	**-**
2018/2019	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-**	**-**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.28*** below.

Table 3.28: *Overview of activity data in the category 1A2b*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	NO	NO	82.27	NO	NO

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1995	NO	NO	92.15	NO	NO
2000	0.00	NO	50.36	NO	NO
2005	0.00	0.48	74.88	NO	NO
2010	0.00	0.00	76.40	0.00	NO
2011	0.00	0.00	81.65	0.00	NO
2012	0.00	0.00	83.09	0.00	NO
2013	0.01	0.00	102.13	0.00	NO
2014	0.01	0.00	61.46	0.00	NO
2015	0.01	0.00	97.30	0.00	NO
2016	0.01	0.00	99.67	0.00	NO
2017	0.01	0.00	116.37	0.00	NO
2018	0.01	0.00	122.78	0.00	NO
2019	0.01	NO	117.47	NO	NO
1990/2019	**-**	**-**	**43%**	**-**	**-**
2018/2019	**-4%**	**-**	**-4%**	**-**	**-**

3.5.3.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.29***).

Table 3.29: *Emission factors for calculation of historical years*

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

HMs and POPs emissions were calculated using of Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.30***).

Table 3.30: *Emission factors for heavy metals and POPs in the category 1A2b*

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	0.8	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

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
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

3.5.3.3 Completeness

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

3.5.3.4 Source-specific recalculations

No recalculations in this submission.

3.5.4 STATIONARY COMBUSTION IN MANUFACTURING INDUSTRIES AND CONSTRUCTION: CHEMICALS (NFR 1A2c)

3.5.4.1 Overview

Combustion in the chemicals sector ranges from conventional fuels in boiler plant 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 3.31***. The emissions from the combustion of industrial waste are included in this category because of the energy recovery from the combustion process.

Table 3.31: *Activities according to national categorization included in 1A2c*

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

Overview of emissions in this category is shown in ***Table 3.32***.

Table 3.32: *Overview of emissions in the category 1A2c*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.7208	0.0375	0.4394	0.0311	0.0462	0.0687	0.1880
1995	0.6853	0.0357	0.4178	0.0296	0.0439	0.0653	0.1787
2000	0.3992	0.0207	0.2715	0.0232	0.0345	0.0513	0.1221
2005	0.2958	0.0057	0.0595	0.0165	0.0169	0.0206	0.0472
2010	0.2064	0.0050	0.0092	0.0108	0.0120	0.0153	0.0606
2011	0.2299	0.0056	0.0128	0.0119	0.0128	0.0162	0.0649
2012	0.2375	0.0050	0.0119	0.0120	0.0130	0.0162	0.0667
2013	0.2275	0.0059	0.0120	0.0116	0.0125	0.0151	0.0655
2014	0.2301	0.0054	0.0125	0.0100	0.0104	0.0107	0.0651
2015	0.2402	0.0060	0.0145	0.0107	0.0109	0.0112	0.0807
2016	0.2368	0.0059	0.0150	0.0117	0.0122	0.0127	0.0787
2017	0.2372	0.0058	0.0274	0.0121	0.0127	0.0133	0.0741
2018	0.2534	0.0057	0.0197	0.0113	0.0117	0.0121	0.0708
2019	0.2343	0.0057	0.0209	0.0106	0.0109	0.0116	0.0685
1990/2019	**-67%**	**-85%**	**-95%**	**-66%**	**-76%**	**-83%**	**-64%**

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2018/2019	**-8%**	**0%**	**6%**	**-6%**	**-6%**	**-4%**	**-3%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.6213	0.0091	0.0408	0.0192	0.0616	0.0798	0.0605	0.0087	0.9311
1995	0.5526	0.0081	0.0367	0.0171	0.0548	0.0709	0.0538	0.0078	0.8296
2000	0.6305	0.0143	0.0406	0.0191	0.0712	0.0823	0.0611	0.0089	1.1464
2005	0.0102	0.0008	0.0026	0.0005	0.0002	0.0002	0.0011	0.0003	0.0155
2010	0.0096	0.0007	0.0025	0.0005	0.0002	0.0001	0.0011	0.0002	0.0060
2011	0.0095	0.0007	0.0027	0.0006	0.0002	0.0001	0.0011	0.0003	0.0060
2012	0.0093	0.0013	0.0028	0.0006	0.0014	0.0004	0.0010	0.0003	0.0331
2013	0.0069	0.0006	0.0027	0.0005	0.0002	0.0001	0.0008	0.0003	0.0063
2014	0.0058	0.0007	0.0027	0.0005	0.0007	0.0002	0.0007	0.0003	0.0165
2015	0.0062	0.0005	0.0030	0.0006	0.0002	0.0001	0.0007	0.0003	0.0068
2016	0.0068	0.0008	0.0029	0.0006	0.0006	0.0002	0.0008	0.0003	0.0163
2017	0.0072	0.0006	0.0029	0.0006	0.0002	0.0001	0.0008	0.0003	0.0072
2018	0.0069	0.0006	0.0029	0.0006	0.0002	0.0001	0.0008	0.0003	0.0068
2019	0.0055	0.0005	0.0041	0.0008	0.0002	0.0000	0.0007	0.0004	0.0073
1990/2019	**-99%**	**-95%**	**-90%**	**-96%**	**-100%**	**-100%**	**-99%**	**-95%**	**-99%**
2018/2019	**-20%**	**-22%**	**41%**	**38%**	**-11%**	**-17%**	**-15%**	**47%**	**8%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	4.0019	0.2138	0.2989	0.1175	0.0935	0.8992	0.0204	0.7736
1995	3.6495	0.1906	0.2686	0.1053	0.0840	0.8099	0.0186	0.6876
2000	3.3992	0.2177	0.3051	0.1190	0.0946	0.8753	0.0188	0.7741
2005	2.5939	0.0037	0.0175	0.0050	0.0048	0.1791	0.0148	0.0007
2010	2.3575	0.0031	0.0117	0.0045	0.0043	0.1581	0.0135	0.0009
2011	2.3660	0.0033	0.0128	0.0048	0.0047	0.1607	0.0135	0.0008
2012	1.9263	0.0039	0.0139	0.0052	0.0051	0.1377	0.0112	0.0007
2013	1.6988	0.0034	0.0133	0.0050	0.0049	0.1236	0.0097	0.0006
2014	1.3532	0.0035	0.0136	0.0051	0.0050	0.1043	0.0078	0.0001
2015	1.5921	0.0037	0.0147	0.0056	0.0055	0.1202	0.0091	0.0000
2016	1.6402	0.0038	0.0147	0.0056	0.0054	0.1230	0.0095	0.0000
2017	1.8719	0.0036	0.0142	0.0054	0.0053	0.1352	0.0107	0.0001
2018	1.7882	0.0035	0.0141	0.0053	0.0052	0.1301	0.0102	0.0000
2019	1.4286	0.0052	0.0207	0.0079	0.0077	0.1229	0.0082	0.0000
1990/2019	**-64%**	**-98%**	**-93%**	**-93%**	**-92%**	**-86%**	**-60%**	**-100%**
2018/2019	**-20%**	**47%**	**47%**	**48%**	**48%**	**-6%**	**-20%**	**-58%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.33*** below.

***Table 3.33:** Overview of activity data in the category 1A2c*

YEAR	WASTE INCINERATED [KT]	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	8.78	522.62	4 550.61	7 926.22	NO	NO
1995	8.07	516.75	4 044.80	7 796.65	NO	NO
2000	6.94	617.35	4 553.46	7 244.47	415.16	149.61
2005	7.40	413.42	4.01	3 821.97	4.70	192.44
2010	6.73	1.20	5.58	3 887.23	23.81	161.41
2011	6.75	1.16	4.55	4 269.22	21.95	162.00
2012	5.48	14.03	4.30	4 372.33	74.13	78.44

YEAR	WASTE INCINERATED [KT]	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
2013	4.84	13.99	3.53	4 372.89	111.40	115.27
2014	3.85	14.45	0.58	4 295.01	241.65	68.99
2015	4.54	7.26	0.28	4 750.59	267.85	104.99
2016	4.67	3.18	0.24	4 625.45	337.40	91.27
2017	5.34	0.98	0.42	4 535.95	313.73	125.05
2018	5.10	3.48	0.17	4 529.39	275.12	119.05
2019	4.07	3.40	0.07	6 874.85	246.90	105.64
1990/2019	**-54%**	**-99%**	**-100%**	**-13%**	**-**	**-**
2018/2019	**-20%**	**-2%**	**-59%**	**52%**	**-10%**	**-11%**

3.5.4.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.34***).

Table 3.34: *Emission factors for calculation of historical years*

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

HMs and POPs emissions were calculated using of Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.35***).

Table 3.35: *Emission factors for heavy metals and POPs in the category 1A2c*

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	0.8	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

3.5.4.3 Completeness

Emissions are well covered.

3.5.4.4 Source-specific recalculations

Recalculations in this submission were done due to a change of categorisation of fuels and also the emissions from the combustion of industrial waste were reallocated in this category with the aim to improve data quality and transparency (***Table 3.36***).

Table 3.36: *Previous and refined emissions in the category 1A2c*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.3467	0.7208	108%	0.0180	0.0375	108%	0.2114	0.4394	108%
1991	0.3468	0.7156	106%	0.0181	0.0373	106%	0.2114	0.4362	106%
1992	0.3466	0.7140	106%	0.0180	0.0372	106%	0.2113	0.4353	106%
1993	0.3462	0.7145	106%	0.0180	0.0372	106%	0.2111	0.4355	106%
1994	0.3450	0.7116	106%	0.0180	0.0370	106%	0.2103	0.4338	106%
1995	0.3463	0.6853	98%	0.0180	0.0357	98%	0.2111	0.4178	98%
1996	0.3431	0.7045	105%	0.0179	0.0367	105%	0.2092	0.4294	105%
1997	0.3420	0.6820	99%	0.0178	0.0355	99%	0.2085	0.4157	99%
1998	0.3397	0.6376	88%	0.0177	0.0332	88%	0.2071	0.3887	88%
1999	0.3423	0.5886	72%	0.0178	0.0306	72%	0.2086	0.3588	72%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	0.0150	0.0311	108%	0.0222	0.0462	108%	0.0330	0.0687	108%	0.0904	0.1880	108%
1991	0.0150	0.0309	106%	0.0222	0.0459	106%	0.0331	0.0682	106%	0.0904	0.1866	106%
1992	0.0150	0.0308	106%	0.0222	0.0458	106%	0.0330	0.0681	106%	0.0904	0.1862	106%
1993	0.0149	0.0308	106%	0.0222	0.0458	106%	0.0330	0.0681	106%	0.0903	0.1863	106%
1994	0.0149	0.0307	106%	0.0221	0.0456	106%	0.0329	0.0678	106%	0.0900	0.1856	106%
1995	0.0149	0.0296	98%	0.0222	0.0439	98%	0.0330	0.0653	98%	0.0903	0.1787	98%
1996	0.0148	0.0304	105%	0.0220	0.0452	105%	0.0327	0.0671	105%	0.0895	0.1837	105%
1997	0.0148	0.0294	99%	0.0219	0.0437	99%	0.0326	0.0650	99%	0.0892	0.1779	99%
1998	0.0147	0.0275	88%	0.0218	0.0409	88%	0.0324	0.0608	88%	0.0886	0.1663	88%
1999	0.0148	0.0254	72%	0.0219	0.0377	72%	0.0326	0.0561	72%	0.0893	0.1535	72%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0038	0.6213	16204%	0.0001	0.0091	15539%	0.0034	0.0408	1114%	0.0007	0.0192	2650%
1991	0.0038	0.6108	16013%	0.0001	0.0089	15350%	0.0034	0.0402	1095%	0.0007	0.0188	2605%
1992	0.0038	0.6079	16043%	0.0001	0.0089	15349%	0.0034	0.0400	1091%	0.0007	0.0188	2599%
1993	0.0038	0.6100	16056%	0.0001	0.0089	15340%	0.0034	0.0401	1096%	0.0007	0.0188	2610%
1994	0.0038	0.6069	16038%	0.0001	0.0088	15310%	0.0033	0.0399	1095%	0.0007	0.0187	2606%
1995	0.0036	0.5526	15143%	0.0001	0.0081	14481%	0.0033	0.0367	995%	0.0007	0.0171	2376%
1996	0.0037	0.5975	16246%	0.0001	0.0087	15413%	0.0033	0.0393	1089%	0.0007	0.0184	2597%
1997	0.0036	0.5575	15205%	0.0001	0.0081	14501%	0.0033	0.0369	1017%	0.0007	0.0172	2425%
1998	0.0033	0.4745	14231%	0.0001	0.0070	13592%	0.0033	0.0319	877%	0.0007	0.0148	2102%
1999	0.0030	0.3769	12351%	0.0000	0.0057	11854%	0.0033	0.0261	700%	0.0007	0.0118	1682%
2000	0.0034	0.6305	18258%	0.0001	0.0143	26848%	0.0031	0.0406	1228%	0.0006	0.0191	2922%
2001	0.0023	0.0124	438%	0.0000	0.0008	2084%	0.0032	0.0041	31%	0.0006	0.0009	35%
2002	0.0012	0.0106	779%	0.0000	0.0007	3128%	0.0029	0.0038	32%	0.0006	0.0008	38%
2003	0.0017	0.0117	588%	0.0000	0.0008	2552%	0.0027	0.0035	30%	0.0005	0.0007	36%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2004	0.0010	0.0102	949%	0.0000	0.0007	3793%	0.0021	0.0028	35%	0.0004	0.0006	43%
2005	0.0006	0.0102	1587%	0.0000	0.0008	5861%	0.0018	0.0026	39%	0.0004	0.0005	49%
2006	0.0005	0.0041	738%	0.0000	0.0003	3109%	0.0015	0.0019	26%	0.0003	0.0004	31%
2007	0.0005	0.0102	2107%	0.0000	0.0008	9387%	0.0013	0.0020	51%	0.0002	0.0004	66%
2008	0.0006	0.0097	1636%	0.0000	0.0007	1491%	0.0015	0.0021	39%	0.0003	0.0004	51%
2009	0.0008	0.0089	957%	0.0001	0.0007	979%	0.0019	0.0026	38%	0.0004	0.0005	46%
2010	0.0009	0.0096	979%	0.0001	0.0007	1050%	0.0020	0.0025	24%	0.0004	0.0005	33%
2011	0.0008	0.0095	1160%	0.0001	0.0007	1083%	0.0021	0.0027	32%	0.0004	0.0006	40%
2012	0.0007	0.0093	1189%	0.0001	0.0013	2074%	0.0021	0.0028	30%	0.0004	0.0006	38%
2013	0.0006	0.0069	1037%	0.0001	0.0006	900%	0.0021	0.0027	27%	0.0004	0.0005	33%
2014	0.0002	0.0058	3125%	0.0000	0.0007	2099%	0.0022	0.0027	23%	0.0004	0.0005	29%
2015	0.0001	0.0062	4257%	0.0000	0.0005	1634%	0.0024	0.0030	24%	0.0004	0.0006	30%
2016	0.0002	0.0068	3604%	0.0001	0.0008	1347%	0.0023	0.0029	26%	0.0004	0.0006	32%
2017	0.0002	0.0072	3334%	0.0001	0.0006	1018%	0.0023	0.0029	27%	0.0004	0.0006	34%
2018	0.0001	0.0069	4639%	0.0000	0.0006	1349%	0.0022	0.0029	28%	0.0004	0.0006	35%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0006	0.0616	11064%	0.0006	0.0798	12893%	0.0004	0.0605	13715%
1991	0.0005	0.0606	10926%	0.0006	0.0784	12742%	0.0004	0.0595	13541%
1992	0.0005	0.0603	10917%	0.0006	0.0781	12739%	0.0004	0.0592	13554%
1993	0.0005	0.0606	10929%	0.0006	0.0784	12747%	0.0004	0.0594	13574%
1994	0.0005	0.0603	10923%	0.0006	0.0780	12741%	0.0004	0.0591	13557%
1995	0.0005	0.0548	10197%	0.0006	0.0709	11952%	0.0004	0.0538	12717%
1996	0.0005	0.0594	10900%	0.0006	0.0768	12743%	0.0004	0.0582	13692%
1997	0.0005	0.0553	10248%	0.0006	0.0716	11984%	0.0004	0.0543	12809%
1998	0.0005	0.0470	9318%	0.0005	0.0608	11015%	0.0004	0.0462	11815%
1999	0.0005	0.0372	7684%	0.0005	0.0481	9185%	0.0004	0.0368	10093%
2000	0.0005	0.0712	13448%	0.0006	0.0823	14000%	0.0004	0.0611	15372%
2001	0.0004	0.0004	3%	0.0004	0.0004	1%	0.0003	0.0014	379%
2002	0.0003	0.0003	4%	0.0003	0.0003	1%	0.0002	0.0012	578%
2003	0.0004	0.0004	2%	0.0004	0.0004	0%	0.0002	0.0013	490%
2004	0.0003	0.0003	3%	0.0003	0.0003	1%	0.0001	0.0011	730%
2005	0.0002	0.0002	4%	0.0002	0.0002	1%	0.0001	0.0011	1065%
2006	0.0001	0.0001	6%	0.0001	0.0001	1%	0.0001	0.0005	491%
2007	0.0001	0.0001	8%	0.0001	0.0001	2%	0.0001	0.0011	1445%
2008	0.0002	0.0002	3%	0.0001	0.0001	1%	0.0001	0.0011	1151%
2009	0.0002	0.0002	4%	0.0001	0.0001	1%	0.0001	0.0010	730%
2010	0.0002	0.0002	1%	0.0001	0.0001	0%	0.0001	0.0011	736%
2011	0.0002	0.0002	3%	0.0001	0.0001	1%	0.0001	0.0011	820%
2012	0.0002	0.0014	633%	0.0001	0.0004	297%	0.0001	0.0010	777%
2013	0.0002	0.0002	17%	0.0001	0.0001	8%	0.0001	0.0008	663%
2014	0.0001	0.0007	497%	0.0000	0.0002	422%	0.0001	0.0007	927%
2015	0.0001	0.0002	91%	0.0000	0.0001	88%	0.0001	0.0007	996%
2016	0.0001	0.0006	327%	0.0000	0.0002	327%	0.0001	0.0008	1046%
2017	0.0002	0.0002	52%	0.0000	0.0001	47%	0.0001	0.0008	1111%
2018	0.0001	0.0002	70%	0.0000	0.0001	70%	0.0001	0.0008	1179%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0004	0.0087	1888%	0.0249	0.9311	3645%
1991	0.0004	0.0086	1858%	0.0247	0.9156	3600%
1992	0.0004	0.0085	1851%	0.0248	0.9116	3577%
1993	0.0004	0.0086	1858%	0.0249	0.9150	3575%
1994	0.0004	0.0085	1856%	0.0248	0.9106	3578%
1995	0.0004	0.0078	1691%	0.0244	0.8296	3298%
1996	0.0004	0.0084	1838%	0.0252	0.8977	3463%
1997	0.0004	0.0079	1722%	0.0246	0.8377	3299%
1998	0.0004	0.0067	1488%	0.0238	0.7136	2896%
1999	0.0004	0.0054	1175%	0.0245	0.5692	2225%
2000	0.0004	0.0089	2060%	0.0266	1.1464	4204%
2001	0.0004	0.0005	14%	0.0201	0.0208	4%
2002	0.0004	0.0004	15%	0.0238	0.0245	3%
2003	0.0004	0.0004	11%	0.0277	0.0282	2%
2004	0.0003	0.0003	12%	0.0214	0.0219	2%
2005	0.0002	0.0003	13%	0.0151	0.0155	3%
2006	0.0002	0.0002	15%	0.0044	0.0047	7%
2007	0.0001	0.0002	18%	0.0024	0.0027	14%
2008	0.0002	0.0002	12%	0.0060	0.0063	5%
2009	0.0002	0.0003	18%	0.0065	0.0070	8%
2010	0.0002	0.0002	6%	0.0058	0.0060	3%
2011	0.0002	0.0003	13%	0.0057	0.0060	7%
2012	0.0002	0.0003	26%	0.0056	0.0331	495%
2013	0.0002	0.0003	15%	0.0054	0.0063	17%
2014	0.0002	0.0003	18%	0.0042	0.0165	298%
2015	0.0003	0.0003	14%	0.0043	0.0068	57%
2016	0.0003	0.0003	18%	0.0052	0.0163	214%
2017	0.0002	0.0003	15%	0.0052	0.0072	39%
2018	0.0002	0.0003	16%	0.0046	0.0068	48%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0093	4.0019	42875%	0.0476	0.8992	1788%	2E-05	0.0204	118758%	0.0047	0.7736	16352%
1991	0.0093	3.9363	42316%	0.0476	0.8849	1760%	2E-05	0.0200	117447%	0.0047	0.7605	16161%
1992	0.0092	3.8823	41902%	0.0476	0.8791	1748%	2E-05	0.0198	116491%	0.0046	0.7571	16198%
1993	0.0093	3.8357	41338%	0.0476	0.8787	1746%	2E-05	0.0195	114577%	0.0047	0.7599	16218%
1994	0.0092	3.7814	40912%	0.0474	0.8724	1740%	2E-05	0.0192	113264%	0.0046	0.7562	16203%
1995	0.0090	3.6495	40343%	0.0473	0.8099	1612%	2E-05	0.0186	114322%	0.0045	0.6876	15292%
1996	0.0091	3.6679	40378%	0.0474	0.8568	1707%	2E-05	0.0186	112931%	0.0045	0.7448	16437%
1997	0.0090	3.5575	39350%	0.0470	0.8095	1622%	2E-05	0.0181	110425%	0.0045	0.6943	15365%
1998	0.0085	3.3820	39751%	0.0463	0.7148	1445%	1E-05	0.0174	117316%	0.0041	0.5892	14377%
1999	0.0081	3.1845	39164%	0.0468	0.6051	1193%	1E-05	0.0167	123395%	0.0037	0.4656	12464%
2000	0.0086	3.3992	39482%	0.0460	0.8753	1805%	2E-05	0.0188	121826%	0.0042	0.7741	18232%
2001	0.0068	2.7180	39692%	0.0433	0.2040	371%	1E-05	0.0155	151968%	0.0028	0.0028	-
2002	0.0052	2.5372	48889%	0.0432	0.1935	348%	5E-06	0.0145	283908%	0.0014	0.0014	-
2003	0.0059	2.6876	45419%	0.0442	0.2015	356%	7E-06	0.0153	209052%	0.0020	0.0020	-
2004	0.0041	2.4928	61419%	0.0339	0.1795	430%	4E-06	0.0142	346640%	0.0011	0.0011	-
2005	0.0031	2.5939	83789%	0.0278	0.1791	543%	2E-06	0.0148	594831%	0.0007	0.0007	-
2006	0.0022	0.9626	44103%	0.0174	0.0749	329%	2E-06	0.0055	263843%	0.0006	0.0006	-

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2007	0.0019	2.6321	139000%	0.0142	0.1671	1078%	2E-06	0.0150	741732%	0.0006	0.0006	-
2008	0.0025	2.4575	97892%	0.0181	0.1605	788%	2E-05	0.0140	83759%	0.0006	0.0006	-
2009	0.0033	2.1673	66397%	0.0213	0.1488	598%	2E-05	0.0124	54519%	0.0009	0.0009	-
2010	0.0034	2.3575	68445%	0.0223	0.1581	608%	2E-05	0.0135	58588%	0.0009	0.0009	-
2011	0.0033	2.3660	72082%	0.0227	0.1607	608%	2E-05	0.0135	60414%	0.0008	0.0008	-
2012	0.0032	1.9263	59316%	0.0230	0.1377	498%	2E-05	0.0112	52633%	0.0007	0.0007	-
2013	0.0031	1.6988	54688%	0.0233	0.1236	430%	2E-05	0.0097	49340%	0.0006	0.0006	-
2014	0.0024	1.3532	55848%	0.0234	0.1043	346%	1E-05	0.0078	69663%	0.0001	0.0001	1%
2015	0.0026	1.5921	61937%	0.0258	0.1202	365%	1E-05	0.0091	87912%	0.0000	0.0000	-
2016	0.0027	1.6402	60816%	0.0253	0.1230	385%	2E-05	0.0095	48279%	0.0000	0.0000	3%
2017	0.0027	1.8719	69520%	0.0248	0.1352	445%	2E-05	0.0107	52935%	0.0001	0.0001	-
2018	0.0025	1.7882	71992%	0.0242	0.1301	437%	1E-05	0.0102	71237%	0.0000	0.0000	1%

P – Previous, R – Refined, C – Changed

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 3.37***.

Table 3.37: *Activities according to national categorization included in 1A2d*

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

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

An overview of the emissions is shown in ***Table 3.38***. Emissions in this category show an overall increasing trend due to an increase of activity within this category.

Table 3.38: *Overview of emissions in the category 1A2d*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	3.3048	0.0321	12.6102	NO	0.1983	0.2240	0.2985	NE
1995	3.3055	0.0321	12.6132	NO	0.1983	0.2240	0.2986	NE
2000	1.9772	0.1984	7.3805	NO	0.1261	0.1425	0.1899	NE
2005	2.1433	0.1611	3.3816	NO	0.0748	0.0887	0.1205	NE
2010	1.2829	0.0725	0.2672	0.0039	0.0245	0.0279	0.0424	NE
2011	1.2395	0.0679	0.2202	0.0038	0.0281	0.0315	0.0472	NE
2012	1.1296	0.0707	0.1503	0.0029	0.0253	0.0292	0.0487	NE
2013	1.0277	0.0253	0.1800	0.0029	0.0220	0.0254	0.0411	NE

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2014	0.9283	0.0264	0.2292	0.0026	0.0164	0.0164	0.0164	NE
2015	1.0847	0.0364	0.1637	0.0002	0.0127	0.0134	0.0148	NE
2016	1.1150	0.0462	0.0969	0.0031	0.0181	0.0181	0.0181	NE
2017	1.0995	0.0749	0.2004	0.0072	0.0120	0.0121	0.0122	NE
2018	0.9907	0.0763	0.0596	0.0079	0.0142	0.0142	0.0142	NE
2019	1.0505	0.0494	0.1221	0.0033	0.0167	0.0169	0.0170	NE
1990/2019	**-68%**	**54%**	**-99%**	**-**	**-92%**	**-92%**	**-94%**	**-**
2018/2019	**6%**	**-35%**	**105%**	**-58%**	**18%**	**19%**	**20%**	**-**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	1.0410	0.1184	0.0549	0.0264	0.2726	0.1565	0.0959	0.0154	5.4669
1995	1.0367	0.1215	0.0543	0.0261	0.2771	0.1565	0.0953	0.0153	5.5756
2000	1.1330	0.1709	0.0561	0.0266	0.3641	0.1785	0.1023	0.0172	7.5152
2005	1.0588	0.2573	0.0436	0.0199	0.4967	0.1859	0.0908	0.0170	10.6547
2010	0.6811	0.2971	0.0187	0.0067	0.5307	0.1453	0.0520	0.0125	11.7659
2011	0.5968	0.2867	0.0144	0.0046	0.5074	0.1325	0.0443	0.0113	11.2967
2012	0.5640	0.2707	0.0135	0.0043	0.4790	0.1252	0.0419	0.0106	10.6638
2013	0.5899	0.2833	0.0132	0.0044	0.5014	0.1310	0.0437	0.0110	11.1612
2014	0.5290	0.2547	0.0119	0.0039	0.4506	0.1176	0.0392	0.0099	10.0323
2015	0.2200	0.1059	0.0061	0.0018	0.1874	0.0489	0.0163	0.0042	4.1739
2016	0.4921	0.2369	0.0112	0.0036	0.4192	0.1094	0.0365	0.0092	9.3329
2017	0.4833	0.2327	0.0108	0.0036	0.4117	0.1074	0.0358	0.0090	9.1658
2018	0.4718	0.2271	0.0107	0.0035	0.4019	0.1048	0.0350	0.0088	8.9469
2019	0.4300	0.2070	0.0100	0.0032	0.3663	0.0956	0.0319	0.0081	8.1555
1990/2019	**-59%**	**75%**	**-82%**	**-88%**	**34%**	**-39%**	**-67%**	**-47%**	**49%**
2018/2019	**-9%**	**-9%**	**-6%**	**-7%**	**-9%**	**-9%**	**-9%**	**-9%**	**-9%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	2.0679	0.3639	0.5090	0.1908	0.1507	1.2143	0.0451	1.0380
1995	2.0757	0.3625	0.5076	0.1899	0.1500	1.2100	0.0463	1.0242
2000	2.4468	0.3983	0.5652	0.2078	0.1643	1.3357	0.0653	1.0161
2005	2.7415	0.3769	0.5509	0.1937	0.1534	1.2749	0.0987	0.6856
2010	2.3801	0.2530	0.4046	0.1298	0.1043	0.8916	0.1142	0.0850
2011	2.2093	0.2236	0.3641	0.1145	0.0924	0.7946	0.1103	0.0029
2012	2.0863	0.2112	0.3434	0.1080	0.0871	0.7497	0.1041	0.0036
2013	2.1824	0.2197	0.3543	0.1111	0.0892	0.7743	0.1090	0.0032
2014	1.9600	0.1971	0.3182	0.0998	0.0801	0.6952	0.0980	0.0012
2015	0.8163	0.0835	0.1385	0.0438	0.0356	0.3014	0.0407	0.0005
2016	1.8235	0.1836	0.2969	0.0931	0.0749	0.6484	0.0911	0.0011
2017	1.7908	0.1801	0.2908	0.0912	0.0732	0.6353	0.0895	0.0011
2018	1.7481	0.1759	0.2843	0.0892	0.0717	0.6210	0.0874	0.0010
2019	1.5936	0.1607	0.2607	0.0819	0.0659	0.5691	0.0796	0.0010
1990/2019	**-23%**	**-56%**	**-49%**	**-57%**	**-56%**	**-53%**	**77%**	**-100%**
2018/2019	**-9%**	**-9%**	**-8%**	**-8%**	**-8%**	**-8%**	**-9%**	**-9%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.39*** below.

Table 3.39: *Overview of activity data in the category 1A2d*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [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

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
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	0.58	491.85	3 811.88	22 783.06	NO
2011	0.02	9.27	3 677.97	22 055.32	NO
2012	0.10	14.06	3 274.23	20 817.75	NO
2013	NO	10.93	1 720.44	21 792.68	NO
2014	NO	NO	1 630.09	19 592.17	NO
2015	NO	NO	2 800.74	8 148.13	NO
2016	NO	NO	1 818.05	18 226.09	NO
2017	0.03	NO	1 513.20	17 900.05	NO
2018	1.45	NO	1 631.93	17 472.21	NO
2019	0.33	NO	2 020.11	15 925.89	NO
1990/2019	**-100%**	**-**	**-46%**	**93%**	**-**
2018/2019	**-78%**	**-**	**24%**	**-9%**	**-**

3.5.5.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.40***).

Table 3.40: *Emission factors for calculation of historical years*

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

HMs and POPs emissions were calculated using of Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.41***).

Table 3.41: *Emission factors for heavy metals and POPs in the category 1A2d*

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	0.8	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

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
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

3.5.5.3 Completeness

Emissions are well covered.

3.5.5.4 Source-specific recalculations

No recalculations 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. Emission from activities of the food industry was clearly identified as combustion emissions. Therefore the industrial categories of national classification according to the following ***Table 3.42*** were included here.

Table 3.42: *Activities according to national categorization included in 1A2e*

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

An overview of the emissions is shown in ***Table 3.43***. Emissions of main pollutants in this category show an overall decreasing trend due to stricter emission limits for these pollutants. Emissions of HMs and POPs are increasing due to the increase of using solid fuels within this category.

Table 3.43: *Overview of emissions in the category 1A2e*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.7790	0.0520	0.8731	0.0075	0.0651	0.1039	0.1734	0.4200
1995	0.7739	0.0516	0.8674	0.0075	0.0646	0.1032	0.1723	0.4173
2000	0.7063	0.0230	0.9341	0.0001	0.0649	0.1036	0.1729	0.3813
2005	0.5258	0.0259	0.5047	0.0075	0.0755	0.0829	0.0958	0.2446
2010	0.3418	0.0600	0.1481	0.0094	0.0154	0.0244	0.0406	0.3559
2011	0.3358	0.0602	0.1785	0.0037	0.0138	0.0227	0.0385	0.3644
2012	0.2992	0.0572	0.1815	0.0039	0.0127	0.0208	0.0355	0.2884
2013	0.2949	0.0605	0.2061	0.0040	0.0152	0.0257	0.0414	0.2416
2014	0.2987	0.0577	0.2037	0.0040	0.0155	0.0270	0.0434	0.2626
2015	0.3406	0.0596	0.2015	0.0040	0.0182	0.0309	0.0472	0.2730
2016	0.2989	0.0407	0.1783	0.0039	0.0353	0.0445	0.0569	0.2577
2017	0.3289	0.0425	0.2551	0.0096	0.0362	0.0462	0.0597	0.2766
2018	0.3095	0.0414	0.1979	0.0117	0.0371	0.0472	0.0601	0.2651
2019	0.3240	0.0464	0.1549	0.0115	0.0361	0.0403	0.0639	0.2486
1990/2019	**-58%**	**-11%**	**-82%**	**54%**	**-45%**	**-61%**	**-63%**	**-41%**
2018/2019	**5%**	**12%**	**-22%**	**-2%**	**-3%**	**-15%**	**6%**	**-6%**

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
1990/2019	**19%**	**147%**	**-31%**	**-12%**	**52%**	**21%**	**16%**	**-16%**	**48%**
2018/2019	**-8%**	**173%**	**-10%**	**-11%**	**31%**	**-4%**	**-9%**	**-6%**	**52%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.0996	0.0283	0.0610	0.0218	0.0191	0.1302	0.0004	0.0762
1995	0.0993	0.0282	0.0609	0.0217	0.0191	0.1298	0.0004	0.0760
2000	0.0865	0.0251	0.0559	0.0198	0.0175	0.1182	0.0004	0.0655
2005	0.0747	0.0207	0.0465	0.0156	0.0137	0.0966	0.0005	0.0549
2010	0.1005	0.0244	0.0397	0.0156	0.0131	0.0928	0.0005	0.0782
2011	0.1035	0.0255	0.0410	0.0162	0.0136	0.0964	0.0003	0.0843
2012	0.0865	0.0216	0.0355	0.0140	0.0117	0.0828	0.0003	0.0706
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	0.0148	0.1076	0.0004	0.1004

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2019	0.1214	0.0272	0.0423	0.0166	0.0137	0.0998	0.0011	0.0868
1990/2019	**22%**	**-4%**	**-31%**	**-24%**	**-29%**	**-23%**	**159%**	**14%**
2018/2019	**0%**	**-8%**	**-7%**	**-8%**	**-7%**	**-7%**	**195%**	**-13%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.44*** below.

Table 3.44: *Overview of activity data in the category 1A2e*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	486.58	448.38	9 248.51	40.84	NO
1995	498.01	447.23	9 171.20	40.84	NO
2000	488.85	385.14	8 774.43	40.84	NO
2005	604.59	323.08	6 093.54	53.97	NO
2010	0.80	459.72	4 066.54	68.66	NO
2011	1.23	496.14	4 024.59	18.37	NO
2012	12.95	415.15	3 717.15	17.44	NO
2013	29.59	459.88	3 343.55	20.63	NO
2014	6.00	547.16	3 517.81	21.56	NO
2015	11.92	720.47	3 570.57	31.39	NO
2016	27.23	550.43	3 520.30	25.33	NO
2017	30.26	657.52	3 547.82	51.78	NO
2018	42.21	590.46	3 400.91	97.01	NO
2019	13.97	510.69	3 281.77	189.35	NO
1990/2019	**-97%**	**14%**	**-65%**	**364%**	**-**
2018/2019	**-67%**	**-14%**	**-4%**	**95%**	**-**

3.5.6.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.45***).

Table 3.45: *Emission factors for calculation of historical years*

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

HMs and POPs emissions were calculated using of Tier 1emission factors from EMEP/EEA GB_{2019} (***Table 3.46***).

Table 3.46: *Emission factors for heavy metals and POPs in the category 1A2e*

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	0.8	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

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
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

3.5.6.3 Completeness

Emissions are well covered.

3.5.6.4 Source-specific recalculations

No recalculations in this submission.

3.5.7 STATIONARY COMBUSTION IN MANUFACTURING INDUSTRIES AND CONSTRUCTION: NON-METALLIC MINERALS (NFR 1A2f)

3.5.7.1 Overview

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

Sources within this category are a combination of combustion and process sources, therefore, emissions of particulate matter from the cement, lime and glass production are reported under particular IPPU category and combustion emissions from those categories are reported in 1A2f. Particular matter emissions included in this category originate only from sources allocated by national law to category 1.1 and NACE division 23. Activities listed within this category are shown in ***Table 3.47***.

Table 3.47*: Activities according to national categorization included in 1A2f*

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

An overview of the emissions is shown in ***Table 3.48***.

Table 3.8: *Overview of emissions in the category 1A2f*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	5.6738	0.0741	0.6594	NO	0.0245	0.0345	0.0386	11.3766

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1995	5.6543	0.0739	0.6571	NO	0.0244	0.0344	0.0385	11.3375
2000	5.3727	0.0741	0.7341	0.0031	0.0285	0.0401	0.0449	9.0429
2005	5.0294	0.0662	0.4997	0.0000	0.0044	0.0063	0.0162	10.2890
2010	4.5594	0.1898	0.3220	NO	0.0029	0.0045	0.0124	12.8343
2011	4.8866	0.2473	0.3462	NO	0.0022	0.0033	0.0088	11.3292
2012	4.2019	0.1520	0.4290	0.0000	0.0030	0.0040	0.0074	9.3928
2013	4.3940	0.1198	0.3624	0.0006	0.0027	0.0036	0.0074	7.9731
2014	4.4765	0.1498	0.3841	0.0006	0.0024	0.0032	0.0067	9.7134
2015	4.6022	0.1757	0.3421	0.0240	0.0024	0.0031	0.0059	7.6889
2016	4.4955	0.1665	0.3008	0.0428	0.0023	0.0026	0.0031	7.8489
2017	4.3187	0.1655	0.2779	0.0439	0.0018	0.0019	0.0020	8.8505
2018	3.7363	0.1677	0.2133	0.0384	0.0017	0.0019	0.0022	10.9896
2019	4.3699	0.1439	0.2975	0.0383	0.0017	0.0019	0.0022	9.3890
1990/2019	**-23%**	**94%**	**-55%**		**-93%**	**-95%**	**-94%**	**-17%**
2018/2019	**17%**	**-14%**	**39%**	**0%**	**2%**	**1%**	**-4%**	**-15%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.2779	0.0227	0.1390	0.0751	0.1163	0.1835	0.1390	0.0717	1.2024
1995	0.2191	0.0179	0.1096	0.0592	0.0917	0.1447	0.1096	0.0566	0.9480
2000	0.2267	0.0185	0.1134	0.0613	0.0949	0.1497	0.1134	0.0585	0.9810
2005	0.2306	0.0188	0.1153	0.0623	0.0965	0.1522	0.1153	0.0595	0.9975
2010	0.1621	0.0132	0.0810	0.0438	0.0678	0.1070	0.0810	0.0418	0.7011
2011	0.2414	0.0197	0.1194	0.0645	0.0998	0.1575	0.1196	0.0616	1.0320
2012	0.2219	0.0180	0.1048	0.0565	0.0872	0.1376	0.1056	0.0538	0.9015
2013	0.2290	0.0186	0.1066	0.0575	0.0886	0.1398	0.1078	0.0547	0.9164
2014	0.2550	0.0207	0.1191	0.0642	0.0990	0.1563	0.1203	0.0611	1.0241
2015	0.2566	0.0209	0.1233	0.0665	0.1028	0.1621	0.1240	0.0634	1.0626
2016	0.2712	0.0221	0.1281	0.0691	0.1066	0.1682	0.1291	0.0658	1.1021
2017	0.2823	0.0230	0.1330	0.0717	0.1107	0.1746	0.1342	0.0683	1.1443
2018	0.2917	0.0237	0.1333	0.0718	0.1105	0.1744	0.1351	0.0682	1.1430
2019	0.3082	0.0250	0.1411	0.0760	0.1170	0.1847	0.1429	0.0722	1.2104
1990/2019	**11%**	**10%**	**2%**	**1%**	**1%**	**1%**	**3%**	**1%**	**1%**
2018/2019	**6%**	**6%**	**6%**	**6%**	**6%**	**6%**	**6%**	**6%**	**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]	PCB [kg]
1990	0.0116	0.0000	0.0008	0.0002	0.0001	0.0012	0.0130	0.2921
1995	0.0092	0.0000	0.0006	0.0002	0.0001	0.0009	0.0103	0.2303
2000	0.0095	0.0000	0.0006	0.0002	0.0001	0.0009	0.0106	0.2383
2005	0.0096	0.0000	0.0007	0.0002	0.0001	0.0010	0.0108	0.2423
2010	0.0068	0.0000	0.0005	0.0001	0.0001	0.0007	0.0076	0.1703
2011	0.7947	0.0000	0.0007	0.0002	0.0001	0.0010	0.0112	0.2507
2012	3.6462	0.0000	0.0006	0.0002	0.0001	0.0011	0.0098	0.2190
2013	4.6272	0.0000	0.0006	0.0002	0.0001	0.0011	0.0100	0.2226
2014	4.9267	0.0000	0.0007	0.0002	0.0001	0.0013	0.0111	0.2488
2015	2.9831	0.0000	0.0007	0.0002	0.0001	0.0012	0.0115	0.2581
2016	4.4538	0.0000	0.0007	0.0002	0.0001	0.0013	0.0120	0.2677
2017	4.8012	0.0000	0.0008	0.0002	0.0001	0.0014	0.0124	0.2780
2018	7.4282	0.0000	0.0008	0.0002	0.0001	0.0015	0.0124	0.2777
2019	7.6730	0.0000	0.0008	0.0002	0.0001	0.0016	0.0132	0.2940
1990/2019	**65895%**	**1%**	**1%**	**1%**	**1%**	**39%**	**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]	PCB [kg]
2018/2019	**3%**	**6%**	**6%**	**6%**	**6%**	**5%**	**6%**	**6%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.49*** below.

Table 3.49: *Overview of activity data in the category 1A2f*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	582.03	6 388.61	10 817.05	95.99	17.10
1995	520.34	6 454.60	10 751.21	95.99	17.11
2000	638.78	6 842.71	9 544.20	95.99	20.25
2005	259.17	10 026.78	7 170.93	585.41	713.38
2010	276.51	6 590.37	4 520.81	865.59	3 229.32
2011	296.85	6 565.93	4 512.34	1 329.85	2 706.82
2012	88.98	6 057.41	3 663.32	1 581.28	2 711.15
2013	1 332.87	4 158.81	4 246.25	1 708.49	3 003.70
2014	1 450.24	4 264.56	4 048.12	1 757.66	3 741.30
2015	2 361.15	4 444.44	3 776.08	1 607.58	3 683.55
2016	2 407.44	4 115.03	4 661.18	2 450.55	3 256.58
2017	2 462.64	4 390.73	4 841.37	7 306.36	178.48
2018	2 219.04	4 159.07	4 699.34	5 771.54	229.49
2019	2 358.09	3 635.78	4 720.09	6 220.98	337.60
1990/2019	**305%**	**-43%**	**-56%**	**6381%**	**1875%**
2018/2019	**6%**	**-13%**	**0%**	**8%**	**47%**

3.5.7.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.50***).

Table 3.50: *Emission factors for calculation of historical years*

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

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

Tier 2 EMEP/EEA GB_{2019} emission factors for the manufacture of cement (2A1) and Tier 1 EMEP/EEA GB_{2019} emission factors for industrial waste incineration (2A2) were used for the calculation of HMs and POPs emissions. (***Table 3.51***).

Table 3.51: *Emission factors for heavy metals and POPs in the category 1A2f*

T2/T1	UNIT	MANUFACTURE OF CEMENT	INDUSTRIAL WASTE INCINERATION
Pb	[mg/GJ]	0.098	1.3
Cd	[mg/GJ]	0.008	0.1
Hg	[mg/GJ]	0.049	0.056

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

3.5.7.3 Completeness

Emissions are well covered. Emissions of BC are not estimated within this category.

3.5.7.4 Source-specific recalculations

No recalculations in this submission for the main pollutants.

HMs and POPs emissions from the category 2A1 (Cement production), 2A2 (Lime production) and 2A3 (Glass production were) were allocated in this category because most of these emissions originate during the combustion processes. Recalculations are shown in ***Table 3.52***.

Table 3.52: *Previous and refined emissions in the category 1A2f*

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.7140	0.2779	-61%	0.0108	0.0227	110%	0.0485	0.1390	187%	0.0225	0.0751	235%
1991	0.7161	0.1970	-72%	0.0108	0.0161	48%	0.0486	0.0985	103%	0.0225	0.0533	137%
1992	0.7125	0.2480	-65%	0.0108	0.0202	88%	0.0484	0.1240	156%	0.0224	0.0671	199%
1993	0.7180	0.1952	-73%	0.0109	0.0159	47%	0.0487	0.0976	100%	0.0226	0.0528	134%
1994	0.7198	0.2116	-71%	0.0109	0.0173	59%	0.0488	0.1058	117%	0.0226	0.0572	153%
1995	0.7210	0.2191	-70%	0.0109	0.0179	64%	0.0489	0.1096	124%	0.0227	0.0592	161%
1996	0.7130	0.2088	-71%	0.0108	0.0170	58%	0.0483	0.1044	116%	0.0224	0.0565	152%
1997	0.7524	0.2305	-69%	0.0113	0.0188	66%	0.0506	0.1152	128%	0.0236	0.0623	164%
1998	0.7243	0.3458	-52%	0.0110	0.0282	158%	0.0489	0.1729	253%	0.0227	0.0935	311%
1999	0.7422	0.3468	-53%	0.0112	0.0283	153%	0.0498	0.1734	248%	0.0232	0.0938	304%
2000	0.7632	0.2267	-70%	0.0115	0.0185	61%	0.0507	0.1134	123%	0.0238	0.0613	158%
2001	0.8827	0.2320	-74%	0.0131	0.0189	45%	0.0580	0.1160	100%	0.0274	0.0627	129%
2002	0.6681	0.2215	-67%	0.0147	0.0181	23%	0.0444	0.1107	150%	0.0207	0.0599	190%
2003	1.0270	0.1720	-83%	0.0210	0.0140	-33%	0.0644	0.0860	33%	0.0311	0.0465	49%
2004	1.0155	0.2226	-78%	0.0208	0.0182	-13%	0.0637	0.1113	75%	0.0308	0.0602	96%
2005	1.0977	0.2306	-79%	0.0212	0.0188	-11%	0.0691	0.1153	67%	0.0334	0.0623	87%
2006	0.9623	0.2537	-74%	0.0210	0.0207	-1%	0.0610	0.1269	108%	0.0292	0.0686	135%
2007	0.9627	0.2769	-71%	0.0216	0.0226	5%	0.0607	0.1384	128%	0.0292	0.0749	157%
2008	1.1686	0.2984	-74%	0.0254	0.0244	-4%	0.0720	0.1492	107%	0.0351	0.0807	130%
2009	0.9670	0.2301	-76%	0.0207	0.0188	-9%	0.0590	0.1151	95%	0.0290	0.0622	115%
2010	0.9009	0.1621	-82%	0.0204	0.0132	-35%	0.0549	0.0810	48%	0.0269	0.0438	63%
2011	0.8977	0.2414	-73%	0.0204	0.0197	-3%	0.0547	0.1194	118%	0.0268	0.0645	140%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2012	0.8284	0.2219	-73%	0.0189	0.0180	-5%	0.0502	0.1048	109%	0.0247	0.0565	129%
2013	0.5681	0.2290	-60%	0.0126	0.0186	47%	0.0355	0.1066	200%	0.0172	0.0575	235%
2014	0.5791	0.2550	-56%	0.0113	0.0207	84%	0.0362	0.1191	229%	0.0176	0.0642	266%
2015	0.6041	0.2566	-58%	0.0120	0.0209	74%	0.0376	0.1233	228%	0.0183	0.0665	264%
2016	0.5647	0.2712	-52%	0.0137	0.0221	61%	0.0356	0.1281	260%	0.0171	0.0691	304%
2017	0.6016	0.2823	-53%	0.0142	0.0230	62%	0.0379	0.1330	251%	0.0182	0.0717	294%
2018	0.5744	0.2917	-49%	0.0156	0.0237	52%	0.0360	0.1333	270%	0.0173	0.0718	315%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	2E-03	0.0741	3458%	3E-03	0.0936	3438%	2E-03	0.0694	3423%
1991	2E-03	0.0743	4698%	2E-03	0.0939	4704%	1E-03	0.0696	4676%
1992	1E-03	0.0740	6532%	1E-03	0.0934	6611%	1E-03	0.0692	6554%
1993	8E-04	0.0745	9548%	9E-04	0.0941	9834%	7E-04	0.0697	9704%
1994	5E-04	0.0747	14527%	6E-04	0.0944	15414%	5E-04	0.0699	15079%
1995	5E-04	0.0748	14475%	6E-04	0.0945	15359%	5E-04	0.0700	14986%
1996	5E-04	0.0740	15308%	6E-04	0.0935	16346%	4E-04	0.0693	15877%
1997	4E-04	0.0780	19284%	5E-04	0.0986	21028%	4E-04	0.0731	20260%
1998	3E-04	0.0751	27866%	3E-04	0.0949	32280%	2E-04	0.0703	30376%
1999	0.0741	0.1163	57%	0.0936	0.1835	96%	0.0694	0.1390	100%
2000	0.0743	0.0824	11%	0.0939	0.1300	39%	0.0696	0.0985	42%
2001	0.0740	0.1038	40%	0.0934	0.1637	75%	0.0692	0.1240	79%
2002	0.0745	0.0817	10%	0.0941	0.1289	37%	0.0697	0.0976	40%
2003	0.0747	0.0885	18%	0.0944	0.1397	48%	0.0699	0.1058	51%
2004	0.0748	0.0917	23%	0.0945	0.1447	53%	0.0700	0.1096	56%
2005	0.0740	0.0874	18%	0.0935	0.1379	47%	0.0693	0.1044	51%
2006	0.0780	0.0964	24%	0.0986	0.1522	54%	0.0731	0.1152	58%
2007	0.0751	0.1447	93%	0.0949	0.2283	140%	0.0703	0.1729	146%
2008	0.0769	0.1451	89%	0.0973	0.2289	135%	0.0721	0.1734	141%
2009	0.0791	0.0949	20%	0.1001	0.1497	50%	0.0741	0.1134	53%
2010	0.0910	0.0971	7%	0.1155	0.1532	33%	0.0857	0.1160	35%
2011	0.0766	0.0927	21%	0.0884	0.1462	65%	0.0647	0.1107	71%
2012	0.1151	0.0719	-37%	0.1356	0.1135	-16%	0.0994	0.0860	-13%
2013	0.1139	0.0931	-18%	0.1341	0.1469	10%	0.0983	0.1113	13%
2014	0.1210	0.0965	-20%	0.1447	0.1522	5%	0.1063	0.1153	8%
2015	0.1100	0.1062	-4%	0.1273	0.1675	32%	0.0931	0.1269	36%
2016	0.1110	0.1158	4%	0.1275	0.1828	43%	0.0931	0.1384	49%
2017	0.1335	0.1249	-6%	0.1546	0.1970	27%	0.1130	0.1492	32%
2018	0.1099	0.0963	-12%	0.1279	0.1519	19%	0.0935	0.1151	23%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0104	0.0717	593%	1.1363	1.2024	6%
1991	0.0104	0.0509	390%	1.1391	0.8522	-25%
1992	0.0103	0.0640	520%	1.1336	1.0729	-5%
1993	0.0104	0.0504	384%	1.1420	0.8446	-26%
1994	0.0104	0.0546	424%	1.1447	0.9155	-20%
1995	0.0104	0.0566	442%	1.1448	0.9480	-17%
1996	0.0103	0.0539	422%	1.1342	0.9034	-20%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1997	0.0109	0.0595	448%	1.1921	0.9972	-16%
1998	0.0105	0.0893	753%	1.1479	1.4962	30%
1999	0.0107	0.0895	739%	1.1717	1.5003	28%
2000	0.0110	0.0585	434%	1.2105	0.9810	-19%
2001	0.0125	0.0599	378%	1.3728	1.0037	-27%
2002	0.0096	0.0572	494%	1.2182	0.9581	-21%
2003	0.0144	0.0444	209%	1.8109	0.7440	-59%
2004	0.0142	0.0575	304%	1.7959	0.9630	-46%
2005	0.0154	0.0595	287%	1.8914	0.9975	-47%
2006	0.0136	0.0655	383%	1.7502	1.0978	-37%
2007	0.0135	0.0715	428%	1.7728	1.1979	-32%
2008	0.0162	0.0770	374%	2.1196	1.2912	-39%
2009	0.0134	0.0594	344%	1.7424	0.9956	-43%
2010	0.0125	0.0418	235%	1.6647	0.7011	-58%
2011	0.0124	0.0616	395%	1.6622	1.0320	-38%
2012	0.0114	0.0538	370%	1.5328	0.9015	-41%
2013	0.0081	0.0547	577%	1.0761	0.9164	-15%
2014	0.0082	0.0611	644%	1.0398	1.0241	-2%
2015	0.0086	0.0634	634%	1.1181	1.0626	-5%
2016	0.0082	0.0658	704%	1.1436	1.1021	-4%
2017	0.0087	0.0683	685%	1.1997	1.1443	-5%
2018	0.0083	0.0682	720%	1.2186	1.1430	-6%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	1.0941	0.0116	-99%	0.8622	0.0012	-100%	0.0038	0.0130	246%	0.9024	0.2921	-68%
1991	1.0972	0.0082	-99%	0.8643	0.0008	-100%	0.0038	0.0092	145%	0.9049	0.2070	-77%
1992	1.0917	0.0104	-99%	0.8602	0.0010	-100%	0.0038	0.0116	209%	0.9004	0.2606	-71%
1993	1.1001	0.0082	-99%	0.8661	0.0008	-100%	0.0038	0.0092	142%	0.9074	0.2052	-77%
1994	1.1029	0.0089	-99%	0.8681	0.0009	-100%	0.0038	0.0099	162%	0.9097	0.2224	-76%
1995	1.1045	0.0092	-99%	0.8683	0.0009	-100%	0.0038	0.0103	170%	0.9112	0.2303	-75%
1996	1.0925	0.0087	-99%	0.8595	0.0009	-100%	0.0038	0.0098	160%	0.9011	0.2195	-76%
1997	1.1520	0.0096	-99%	0.9018	0.0010	-100%	0.0039	0.0108	174%	0.9510	0.2423	-75%
1998	1.1093	0.0145	-99%	0.8695	0.0014	-100%	0.0038	0.0162	325%	0.9154	0.3635	-60%
1999	1.1362	0.0145	-99%	0.8852	0.0014	-100%	0.0039	0.0163	317%	0.9381	0.3645	-61%
2000	1.1681	0.0095	-99%	0.9103	0.0009	-100%	0.0040	0.0106	166%	0.9648	0.2383	-75%
2001	1.3486	0.0097	-99%	1.0325	0.0010	-100%	0.0046	0.0109	139%	1.1164	0.2438	-78%
2002	1.0438	0.0093	-99%	0.7926	0.0009	-100%	0.0053	0.0104	97%	0.8320	0.2328	-72%
2003	1.5938	0.0072	-100%	1.1776	0.0007	-100%	0.0075	0.0081	7%	1.2834	0.1807	-86%
2004	1.5762	0.0093	-99%	1.1664	0.0009	-100%	0.0075	0.0104	40%	1.2688	0.2339	-82%
2005	1.6978	0.0096	-99%	1.2616	0.0010	-100%	0.0075	0.0108	43%	1.3752	0.2423	-82%
2006	1.5002	0.0106	-99%	1.1132	0.0011	-100%	0.0076	0.0119	58%	1.1989	0.2667	-78%
2007	1.5035	0.0116	-99%	1.1115	0.0011	-100%	0.0078	0.0130	67%	1.1977	0.2910	-76%
2008	1.8197	0.0125	-99%	1.3292	0.0012	-100%	0.0092	0.0140	53%	1.4562	0.3137	-78%
2009	1.5038	0.0096	-99%	1.0934	0.0010	-100%	0.0075	0.0108	45%	1.2057	0.2419	-80%
2010	1.4061	0.0068	-100%	1.0208	0.0007	-100%	0.0074	0.0076	3%	1.1204	0.1703	-85%
2011	1.4015	0.7947	-43%	1.0177	0.0010	-100%	0.0074	0.0112	52%	1.1162	0.2507	-78%
2012	1.2934	3.6462	182%	0.9326	0.0011	-100%	0.0068	0.0098	43%	1.0298	0.2190	-79%
2013	0.8879	4.6272	421%	0.6749	0.0011	-100%	0.0046	0.0100	119%	0.7070	0.2226	-69%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	C	P	R	C	P	R	C	P	R	C
2014	0.8976	4.9267	449%	0.6875	0.0013	-100%	0.0040	0.0111	176%	0.7250	0.2488	-66%
2015	0.9384	2.9831	218%	0.7317	0.0012	-100%	0.0043	0.0115	169%	0.7556	0.2581	-66%
2016	0.8895	4.4538	401%	0.6956	0.0013	-100%	0.0050	0.0120	141%	0.6996	0.2677	-62%
2017	0.9455	4.8012	408%	0.7381	0.0014	-100%	0.0051	0.0124	142%	0.7465	0.2780	-63%
2018	0.9121	7.4282	714%	0.7032	0.0015	-100%	0.0057	0.0124	119%	0.7071	0.2777	-61%

P – Previous, R – Refined, C – Changed

3.5.8 MOBILE COMBUSTION IN MANUFACTURING INDUSTRIES AND CONSTRUCTION (NFR 1A2gvii)

3.5.8.1 Overview

According to recommendations ***SK-1A4cii-2018-0001*** Slovakia in this category reported also categories 1A4aii and 1A4bii. After obtaining data from the Statistical Office of the Slovak Republic it was possible to separate all the categories for 2019. Results of the separation are shown in ***Table 3.53***. The data collected by questionnaires in households in the frame of the project “Improve of the quality of air emission accounts and expansion of the time-series provided” were used for estimation of emissions from residential machinery (1A4bii). These data are applicable from year 2017 and were used for estimation of emissions from residential machinery for the first time in 2019 inventory.

Table 3.53: *Overview of emissions in the category 1A2gvii*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2014	1.4483	0.1489	0.0008	0.0003	0.0804	0.0804	0.0804	0.0467	0.4821
2015	1.4483	0.1489	0.0008	0.0003	0.0804	0.0804	0.0804	0.0467	0.4821
2016	1.4550	0.1496	0.0008	0.0003	0.0808	0.0808	0.0808	0.0469	0.4843
2017	1.4610	0.1502	0.0008	0.0003	0.0811	0.0811	0.0811	0.0471	0.4863
2018	0.9292	0.0955	0.0005	0.0002	0.0516	0.0516	0.0516	0.0300	0.3093
2019	0.2482	0.0762	0.0002	0.0001	0.0152	0.0152	0.0152	0.0092	0.1073
2014/2019	**-83%**	**-49%**	**-77%**	**-80%**	**-81%**	**-81%**	**-81%**	**-80%**	**-78%**
2018/2019	**-73%**	**-20%**	**-64%**	**-69%**	**-71%**	**-71%**	**-71%**	**-69%**	**-65%**

YEAR	Cd [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	PAHs [t]
2014	0.0004	0.0021	0.0715	0.0029	0.0004	0.0420	0.0003
2015	0.0004	0.0021	0.0715	0.0029	0.0004	0.0420	0.0003
2016	0.0004	0.0021	0.0718	0.0030	0.0004	0.0422	0.0003
2017	0.0004	0.0021	0.0721	0.0030	0.0004	0.0424	0.0003
2018	0.0003	0.0013	0.0458	0.0019	0.0003	0.0270	0.0002
2019	0.0001	0.0005	0.0166	0.0007	0.0001	0.0098	0.0008
2014/2019	**-77%**	**-77%**	**-77%**	**-77%**	**-77%**	**-77%**	**133%**
2018/2019	**-64%**	**-64%**	**-64%**	**-64%**	**-64%**	**-64%**	**263%**

3.5.9 STATIONARY COMBUSTION IN MANUFACTURING INDUSTRIES AND CONSTRUCTION: OTHER (NFR 1A2gviii)

3.5.9.1 Overview

The category covers the sources that cannot be clearly identified to particular activity but generally it is the combustion process. Activities listed within this category are shown in ***Table 3.54***.

Table 3.54: *Activities according to national categorization included in 1A2gviii*

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

An overview of the emissions is shown in ***Table 3.55***. 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. Significant increase in 2005 was caused by the fact that operators of obsolete plants used the last year before the introduction of stricter emission limits associated with the accession of the Slovak Republic to the EU and burned three times higher amount of waste than in the previous year. Subsequently, in 2006 non-compliance plants ceased their activities. The increase of HMs and PAHs in 2016 correlate with the consumption of solid fuels. The overall trend of these emissions is connected with the trend of biomass fuels used.

Table 3.55: *Overview of emissions in the category 1A2gviii*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	2.5797	0.1227	2.3689	0.0270	0.7010	0.9572	1.4711	3.7165
1995	2.5338	0.1205	2.3268	0.0266	0.6885	0.9402	1.4450	3.6505
2000	2.4824	3.5369	1.6422	0.0080	0.5623	0.7679	1.1802	3.0044
2005	1.1298	4.9561	0.6837	0.0076	0.2662	0.3538	0.6150	2.1215
2010	1.0966	4.4405	0.2108	0.0051	0.1490	0.2055	0.3073	1.8493
2011	1.1755	4.6571	0.2331	0.0072	0.1360	0.1876	0.2795	2.0261
2012	1.1063	4.8403	0.2118	0.0074	0.1529	0.2006	0.2837	1.7745
2013	0.9920	5.0664	0.2472	0.0062	0.1183	0.1648	0.2453	1.8270
2014	0.9397	5.1977	0.2377	0.0064	0.1141	0.1695	0.2670	1.6509
2015	1.1158	5.3408	0.2587	0.0066	0.1190	0.1806	0.2909	1.7669
2016	1.1770	5.5870	0.2670	0.0067	0.1271	0.1757	0.2565	1.1496
2017	1.4359	5.9146	0.4311	0.0081	0.1362	0.1866	0.2713	1.2729
2018	1.1863	6.0538	0.2591	0.0087	0.1310	0.1837	0.2716	1.2487
2019	1.1007	6.1370	0.2649	0.0084	0.1345	0.1863	0.2781	1.1994
1990/2019	**-57%**	**4902%**	**-89%**	**-69%**	**-81%**	**-81%**	**-81%**	**-68%**
2018/2019	**-7%**	**1%**	**2%**	**-3%**	**3%**	**1%**	**2%**	**-4%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.3436	0.0188	0.0300	0.0116	0.0576	0.0478	0.0329	0.0060	1.0674
1995	0.3485	0.0195	0.0300	0.0117	0.0592	0.0485	0.0333	0.0060	1.0992
2000	0.2875	0.0217	0.0250	0.0095	0.0579	0.0412	0.0272	0.0051	1.1227
2005	0.1835	0.0346	0.0136	0.0049	0.0702	0.0303	0.0163	0.0034	1.4909
2010	0.1829	0.0768	0.0087	0.0026	0.1379	0.0385	0.0142	0.0037	3.0579
2011	0.2234	0.0852	0.0105	0.0034	0.1545	0.0453	0.0177	0.0043	3.4087
2012	0.1950	0.0832	0.0091	0.0027	0.1490	0.0413	0.0151	0.0040	3.3069
2013	0.1752	0.0738	0.0087	0.0025	0.1324	0.0369	0.0136	0.0036	2.9357
2014	0.1682	0.0690	0.0082	0.0025	0.1241	0.0350	0.0131	0.0034	2.7475
2015	0.1689	0.0702	0.0086	0.0025	0.1262	0.0354	0.0131	0.0035	2.7981

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2016	0.1584	0.0697	0.0083	0.0023	0.1245	0.0340	0.0122	0.0034	2.7680
2017	0.3064	0.0788	0.0172	0.0065	0.1508	0.0547	0.0262	0.0055	3.2546
2018	0.1783	0.0792	0.0087	0.0024	0.1414	0.0384	0.0136	0.0037	3.1425
2019	0.1785	0.0787	0.0087	0.0024	0.1405	0.0383	0.0137	0.0037	3.1220
1990/2019	**-48%**	**319%**	**-71%**	**-79%**	**144%**	**-20%**	**-58%**	**-38%**	**192%**
2018/2019	**0%**	**-1%**	**0%**	**1%**	**-1%**	**0%**	**0%**	**0%**	**-1%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.5974	0.1329	0.2207	0.0839	0.0702	0.5077	0.0070	0.3974
1995	0.6077	0.1342	0.2214	0.0843	0.0703	0.5102	0.0073	0.4018
2000	0.5286	0.1122	0.1901	0.0712	0.0597	0.4332	0.0082	0.3161
2005	0.4336	0.0722	0.1256	0.0445	0.0372	0.2795	0.0132	0.1457
2010	0.6288	0.0726	0.1282	0.0420	0.0350	0.2778	0.0295	0.0307
2011	0.7266	0.0869	0.1484	0.0494	0.0409	0.3256	0.0327	0.0610
2012	0.6762	0.0772	0.1359	0.0445	0.0371	0.2948	0.0320	0.0293
2013	0.6034	0.0698	0.1237	0.0408	0.0341	0.2685	0.0284	0.0288
2014	0.5703	0.0666	0.1168	0.0386	0.0322	0.2542	0.0265	0.0328
2015	0.5777	0.0676	0.1205	0.0397	0.0333	0.2611	0.0270	0.0302
2016	0.5603	0.0644	0.1175	0.0385	0.0325	0.2529	0.0268	0.0180
2017	0.8183	0.1162	0.1893	0.0664	0.0546	0.4264	0.0302	0.1866
2018	0.6336	0.0717	0.1288	0.0421	0.0353	0.2778	0.0305	0.0182
2019	0.6313	0.0717	0.1287	0.0421	0.0353	0.2778	0.0302	0.0200
1990/2019	**6%**	**-46%**	**-42%**	**-50%**	**-50%**	**-45%**	**330%**	**-95%**
2018/2019	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**-1%**	**10%**

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

***Table 3.56:** Overview of activity data in the category 1A2gviii*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	422.68	2318.63	20227.45	1119.73	NO
1995	410.23	2345.02	19731.99	1173.23	NO
2000	489.74	1859.07	17487.13	1415.42	NO
2005	420.07	927.89	9748.14	2541.02	11.66
2010	217.29	242.57	7253.84	5884.32	9.91
2011	194.93	423.59	7378.02	6501.87	NO
2012	225.84	250.28	7462.88	6396.84	NO
2013	158.32	252.31	7496.96	5686.90	NO
2014	164.43	276.46	6432.57	5570.03	NO
2015	246.65	256.39	7219.92	5655.68	NO
2016	228.47	175.15	7831.62	5634.13	NO
2017	264.64	2363.12	8008.58	6199.95	NO
2018	218.98	173.66	7819.99	6292.75	NO
2019	238.41	172.50	7779.31	6247.07	NO
1990/2019	**-44%**	**-93%**	**-62%**	**458%**	**-**
2018/2019	**9%**	**-1%**	**-1%**	**-1%**	**-**

3.5.9.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from

TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

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

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

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

HMs and POPs emissions were calculated using of Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.58***).

Table 3.58: *Emission factors for heavy metals and POPs in the category 1A2gviii*

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	0.8	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

3.5.9.3 Completeness

Emissions are well covered. Emissions of BC are reported as NE.

3.5.9.4 Source-specific recalculations

Recalculations in this submission were done due to a change of categorisation of fuels with the aim to improve data quality and transparency. Recalculations are shown in ***Table 3.59***.

Table 3.59: *Previous and refined emissions in the category 1A2gviii*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	2.5765	2.5797	0%	0.2076	0.1227	-41%	2.3573	2.3689	0%	0.0269	0.0270	1%
1991	2.5756	2.5789	0%	0.2070	0.1227	-41%	2.3566	2.3682	0%	0.0269	0.0270	1%
1992	2.5615	2.5648	0%	0.2060	0.1220	-41%	2.3437	2.3553	0%	0.0267	0.0269	1%
1993	2.5640	2.5660	0%	0.2065	0.1221	-41%	2.3459	2.3564	0%	0.0268	0.0269	0%
1994	2.5568	2.5603	0%	0.2024	0.1218	-40%	2.3397	2.3511	0%	0.0267	0.0268	1%
1995	2.5312	2.5338	0%	0.2005	0.1205	-40%	2.3162	2.3268	0%	0.0264	0.0266	0%
1996	2.4914	2.4923	0%	0.1983	0.1185	-40%	2.2798	2.2887	0%	0.0260	0.0261	0%
1997	2.5300	2.5287	0%	0.1998	0.1203	-40%	2.3152	2.3222	0%	0.0264	0.0265	0%

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1998	2.4065	2.4106	0%	0.1935	0.1147	-41%	2.2018	2.2137	1%	0.0251	0.0253	1%
1999	2.3224	2.3133	0%	0.1875	0.1100	-41%	2.1249	2.1244	0%	0.0242	0.0242	0%
2000	2.4920	2.4824	0%	0.2139	3.5369	1554%	1.6427	1.6422	0%	0.0080	0.0080	0%
2001	2.6533	2.6442	0%	0.1959	4.6172	2257%	2.1337	2.1332	0%	0.0367	0.0367	0%
2002	1.3849	1.3760	-1%	0.1381	4.6813	3290%	1.6341	1.6336	0%	0.0222	0.0222	0%
2003	1.3810	1.3721	-1%	0.1370	4.4899	3178%	1.8229	1.8225	0%	0.0157	0.0157	0%
2004	1.1692	1.1605	-1%	0.1252	4.6316	3598%	0.8710	0.8706	0%	0.0144	0.0144	0%
2005	1.1467	1.1298	-1%	0.2087	4.9561	2275%	0.6846	0.6837	0%	0.0076	0.0076	0%
2006	1.0306	1.0208	-1%	0.1726	4.9541	2770%	0.3430	0.3425	0%	0.0099	0.0099	0%
2007	1.2468	1.2351	-1%	0.1769	5.1931	2836%	0.2622	0.2615	0%	0.0062	0.0062	0%
2008	1.3544	1.3444	-1%	0.1706	4.9574	2806%	0.2081	0.2076	0%	0.0080	0.0080	0%
2009	0.8852	0.8764	-1%	0.1332	4.0604	2948%	0.1563	0.1558	0%	0.0079	0.0079	0%
2010	1.1055	1.0966	-1%	0.1514	4.4405	2833%	0.2113	0.2108	0%	0.0051	0.0051	0%
2011	1.1843	1.1755	-1%	0.1699	4.6571	2641%	0.2336	0.2331	0%	0.0072	0.0072	0%
2012	1.1140	1.1063	-1%	0.1591	4.8403	2942%	0.2122	0.2118	0%	0.0074	0.0074	0%
2013	0.9983	0.9920	-1%	0.1637	5.0664	2996%	0.2475	0.2472	0%	0.0062	0.0062	0%
2014	0.9452	0.9397	-1%	0.1796	5.1977	2794%	0.2380	0.2377	0%	0.0064	0.0064	0%
2015	1.1224	1.1158	-1%	0.1948	5.3408	2641%	0.2591	0.2587	0%	0.0066	0.0066	0%
2016	1.1837	1.1770	-1%	0.2134	5.5870	2518%	0.2673	0.2670	0%	0.0067	0.0067	0%
2017	1.4433	1.4359	-1%	0.2387	5.9146	2378%	0.4315	0.4311	0%	0.0081	0.0081	0%
2018	1.1925	1.1863	-1%	0.2000	6.0538	2927%	0.2594	0.2591	0%	0.0087	0.0087	0%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.6974	0.7010	1%	0.9523	0.9572	1%	1.4637	1.4711	1%	3.6983	3.7165	0%
1991	0.6972	0.7007	1%	0.9520	0.9569	1%	1.4632	1.4707	1%	3.6971	3.7154	0%
1992	0.6934	0.6969	1%	0.9468	0.9516	1%	1.4552	1.4626	1%	3.6768	3.6951	0%
1993	0.6940	0.6972	0%	0.9477	0.9521	0%	1.4566	1.4634	0%	3.6804	3.6969	0%
1994	0.6922	0.6957	1%	0.9452	0.9500	1%	1.4528	1.4601	1%	3.6706	3.6886	0%
1995	0.6853	0.6885	0%	0.9357	0.9402	0%	1.4382	1.4450	0%	3.6338	3.6505	0%
1996	0.6745	0.6772	0%	0.9210	0.9248	0%	1.4155	1.4213	0%	3.5766	3.5907	0%
1997	0.6850	0.6871	0%	0.9353	0.9383	0%	1.4376	1.4421	0%	3.6322	3.6431	0%
1998	0.6514	0.6550	1%	0.8895	0.8945	1%	1.3671	1.3747	1%	3.4543	3.4730	1%
1999	0.6286	0.6286	-	0.8584	0.8583	0%	1.3194	1.3192	0%	3.3336	3.3328	0%
2000	0.5624	0.5623	0%	0.7680	0.7679	0%	1.1803	1.1802	0%	3.0051	3.0044	0%
2001	0.6634	0.6634	-	0.9059	0.9059	-	1.3924	1.3923	0%	3.4388	3.4381	0%
2002	0.4845	0.4844	0%	0.6616	0.6615	0%	1.0168	1.0167	0%	2.6823	2.6816	0%
2003	0.4296	0.4296	-	0.5867	0.5866	0%	0.9017	0.9016	0%	2.2219	2.2212	0%
2004	0.3480	0.3479	0%	0.4751	0.4751	-	0.7303	0.7302	0%	2.5736	2.5730	0%
2005	0.2663	0.2662	0%	0.3539	0.3538	0%	0.6152	0.6150	0%	2.1227	2.1215	0%
2006	0.2531	0.2530	0%	0.3405	0.3404	0%	0.5741	0.5740	0%	2.2073	2.2066	0%
2007	0.2775	0.2774	-	0.3719	0.3718	0%	0.5941	0.5940	0%	2.2212	2.2203	0%
2008	0.2047	0.2047	-	0.2648	0.2647	0%	0.3731	0.3730	0%	1.6872	1.6865	0%
2009	0.1442	0.1441	0%	0.1872	0.1872	-	0.2758	0.2757	0%	1.3894	1.3888	0%
2010	0.1490	0.1490	-	0.2055	0.2055	-	0.3074	0.3073	0%	1.8498	1.8493	0%
2011	0.1360	0.1360	-	0.1876	0.1876	-	0.2796	0.2795	0%	2.0268	2.0261	0%
2012	0.1529	0.1529	-	0.2007	0.2006	0%	0.2838	0.2837	0%	1.7751	1.7745	0%
2013	0.1183	0.1183	-	0.1649	0.1648	0%	0.2454	0.2453	0%	1.8274	1.8270	0%
2014	0.1142	0.1141	0%	0.1695	0.1695	-	0.2671	0.2670	0%	1.6512	1.6509	0%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2015	0.1190	0.1190	-	0.1807	0.1806	0%	0.2909	0.2909	-	1.7673	1.7669	0%
2016	0.1271	0.1271	-	0.1758	0.1757	0%	0.2566	0.2565	0%	1.1501	1.1496	0%
2017	0.1362	0.1362	-	0.1866	0.1866	-	0.2713	0.2713	-	1.2735	1.2729	0%
2018	0.1310	0.1310	-	0.1838	0.1837	0%	0.2717	0.2716	0%	1.2491	1.2487	0%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.3562	0.3436	-4%	0.0199	0.0188	-6%	0.0305	0.0300	-2%	0.0117	0.0116	-1%
1991	0.3575	0.3450	-3%	0.0199	0.0188	-6%	0.0306	0.0301	-2%	0.0117	0.0116	-1%
1992	0.3568	0.3444	-3%	0.0200	0.0189	-6%	0.0305	0.0300	-2%	0.0117	0.0116	-1%
1993	0.3552	0.3427	-4%	0.0201	0.0190	-6%	0.0304	0.0299	-2%	0.0117	0.0115	-1%
1994	0.3541	0.3421	-3%	0.0201	0.0190	-5%	0.0303	0.0298	-2%	0.0116	0.0115	-1%
1995	0.3603	0.3485	-3%	0.0206	0.0195	-5%	0.0305	0.0300	-2%	0.0118	0.0117	-1%
1996	0.3475	0.3356	-3%	0.0207	0.0196	-5%	0.0295	0.0291	-2%	0.0113	0.0112	-1%
1997	0.3511	0.3390	-3%	0.0209	0.0199	-5%	0.0299	0.0294	-2%	0.0115	0.0113	-1%
1998	0.3578	0.3454	-3%	0.0218	0.0207	-5%	0.0296	0.0291	-2%	0.0115	0.0114	-1%
1999	0.3564	0.3453	-3%	0.0236	0.0225	-4%	0.0288	0.0284	-2%	0.0113	0.0112	-1%
2000	0.3019	0.2875	-5%	0.0229	0.0217	-5%	0.0256	0.0250	-2%	0.0096	0.0095	-2%
2001	0.3885	0.3749	-4%	0.0267	0.0256	-4%	0.0300	0.0294	-2%	0.0120	0.0119	-1%
2002	0.3326	0.3193	-4%	0.0305	0.0295	-3%	0.0226	0.0220	-3%	0.0094	0.0093	-2%
2003	0.2720	0.2587	-5%	0.0343	0.0333	-3%	0.0198	0.0192	-3%	0.0076	0.0074	-2%
2004	0.2310	0.2054	-11%	0.0345	0.0333	-3%	0.0152	0.0139	-8%	0.0060	0.0054	-9%
2005	0.2183	0.1835	-16%	0.0367	0.0346	-6%	0.0152	0.0136	-11%	0.0055	0.0049	-11%
2006	0.1217	0.0974	-20%	0.0339	0.0326	-4%	0.0102	0.0091	-11%	0.0029	0.0025	-16%
2007	0.1566	0.1286	-18%	0.0515	0.0500	-3%	0.0110	0.0097	-12%	0.0031	0.0026	-17%
2008	0.1475	0.1245	-16%	0.0501	0.0488	-3%	0.0131	0.0120	-8%	0.0034	0.0030	-12%
2009	0.1446	0.1296	-10%	0.0520	0.0509	-2%	0.0079	0.0072	-8%	0.0023	0.0021	-9%
2010	0.2048	0.1829	-11%	0.0780	0.0768	-1%	0.0098	0.0087	-11%	0.0030	0.0026	-14%
2011	0.2455	0.2234	-9%	0.0863	0.0852	-1%	0.0116	0.0105	-9%	0.0038	0.0034	-11%
2012	0.2172	0.1950	-10%	0.0842	0.0832	-1%	0.0102	0.0091	-11%	0.0031	0.0027	-15%
2013	0.1959	0.1752	-11%	0.0747	0.0738	-1%	0.0097	0.0087	-11%	0.0030	0.0025	-15%
2014	0.1879	0.1682	-10%	0.0698	0.0690	-1%	0.0092	0.0082	-11%	0.0029	0.0025	-15%
2015	0.1895	0.1689	-11%	0.0711	0.0702	-1%	0.0096	0.0086	-11%	0.0029	0.0025	-15%
2016	0.1778	0.1584	-11%	0.0706	0.0697	-1%	0.0093	0.0083	-10%	0.0027	0.0023	-15%
2017	0.4874	0.3064	-37%	0.0819	0.0788	-4%	0.0270	0.0172	-36%	0.0116	0.0065	-44%
2018	0.1967	0.1783	-9%	0.0801	0.0792	-1%	0.0096	0.0087	-9%	0.0028	0.0024	-14%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0573	0.0576	0%	0.0474	0.0478	1%	0.0343	0.0329	-4%
1991	0.0576	0.0578	0%	0.0476	0.0479	1%	0.0344	0.0330	-4%
1992	0.0577	0.0579	0%	0.0475	0.0479	1%	0.0343	0.0330	-4%
1993	0.0576	0.0579	0%	0.0473	0.0477	1%	0.0342	0.0328	-4%
1994	0.0576	0.0579	0%	0.0473	0.0476	1%	0.0340	0.0327	-4%
1995	0.0589	0.0592	0%	0.0482	0.0485	1%	0.0346	0.0333	-4%
1996	0.0581	0.0583	0%	0.0466	0.0469	1%	0.0334	0.0321	-4%
1997	0.0589	0.0591	0%	0.0471	0.0474	1%	0.0337	0.0324	-4%
1998	0.0607	0.0609	0%	0.0481	0.0484	0%	0.0343	0.0329	-4%
1999	0.0635	0.0638	0%	0.0484	0.0487	1%	0.0341	0.0328	-4%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2000	0.0579	0.0579	-	0.0412	0.0412	-	0.0288	0.0272	-5%
2001	0.0711	0.0711	-	0.0531	0.0531	-	0.0370	0.0356	-4%
2002	0.0728	0.0728	-	0.0467	0.0467	-	0.0313	0.0299	-5%
2003	0.0742	0.0741	0%	0.0398	0.0397	0%	0.0252	0.0238	-6%
2004	0.0711	0.0699	-2%	0.0346	0.0329	-5%	0.0211	0.0185	-12%
2005	0.0712	0.0702	-1%	0.0316	0.0303	-4%	0.0200	0.0163	-18%
2006	0.0612	0.0603	-2%	0.0202	0.0189	-6%	0.0106	0.0080	-24%
2007	0.0917	0.0907	-1%	0.0277	0.0263	-5%	0.0131	0.0102	-22%
2008	0.0892	0.0884	-1%	0.0266	0.0255	-4%	0.0123	0.0100	-19%
2009	0.0923	0.0921	0%	0.0268	0.0266	-1%	0.0118	0.0102	-13%
2010	0.1387	0.1379	-1%	0.0396	0.0385	-3%	0.0165	0.0142	-14%
2011	0.1554	0.1545	-1%	0.0465	0.0453	-3%	0.0200	0.0177	-11%
2012	0.1501	0.1490	-1%	0.0427	0.0413	-3%	0.0173	0.0151	-13%
2013	0.1335	0.1324	-1%	0.0384	0.0369	-4%	0.0157	0.0136	-13%
2014	0.1252	0.1241	-1%	0.0365	0.0350	-4%	0.0151	0.0131	-13%
2015	0.1273	0.1262	-1%	0.0368	0.0354	-4%	0.0152	0.0131	-14%
2016	0.1255	0.1245	-1%	0.0352	0.0340	-4%	0.0141	0.0122	-14%
2017	0.1679	0.1508	-10%	0.0768	0.0547	-29%	0.0438	0.0262	-40%
2018	0.1423	0.1414	-1%	0.0396	0.0384	-3%	0.0155	0.0136	-12%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0059	0.0060	1%	1.0601	1.0674	1%
1991	0.0060	0.0060	1%	1.0640	1.0712	1%
1992	0.0059	0.0060	1%	1.0666	1.0738	1%
1993	0.0059	0.0060	1%	1.0679	1.0748	1%
1994	0.0059	0.0060	1%	1.0683	1.0751	1%
1995	0.0060	0.0060	1%	1.0923	1.0992	1%
1996	0.0058	0.0058	1%	1.0837	1.0898	1%
1997	0.0059	0.0059	1%	1.0996	1.1046	0%
1998	0.0059	0.0059	1%	1.1338	1.1397	1%
1999	0.0059	0.0059	1%	1.2025	1.2062	0%
2000	0.0051	0.0051	-	1.1227	1.1227	-
2001	0.0063	0.0063	-	1.3503	1.3503	-
2002	0.0052	0.0052	-	1.4309	1.4309	-
2003	0.0046	0.0045	-2%	1.5344	1.5161	-1%
2004	0.0038	0.0036	-4%	1.4870	1.4683	-1%
2005	0.0036	0.0034	-4%	1.5051	1.4909	-1%
2006	0.0024	0.0023	-5%	1.3477	1.3334	-1%
2007	0.0031	0.0029	-4%	2.0258	2.0102	-1%
2008	0.0032	0.0031	-3%	1.9737	1.9618	-1%
2009	0.0027	0.0027	-1%	2.0394	2.0368	0%
2010	0.0038	0.0037	-3%	3.0707	3.0579	0%
2011	0.0045	0.0043	-3%	3.4221	3.4087	0%
2012	0.0041	0.0040	-3%	3.3228	3.3069	0%
2013	0.0037	0.0036	-4%	2.9526	2.9357	-1%
2014	0.0035	0.0034	-4%	2.7645	2.7475	-1%
2015	0.0036	0.0035	-4%	2.8141	2.7981	-1%
2016	0.0035	0.0034	-4%	2.7821	2.7680	-1%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
2017	0.0077	0.0055	-29%	3.5072	3.2546	-7%
2018	0.0038	0.0037	-3%	3.1562	3.1425	0%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	4.6383	0.5974	-87%	0.5029	0.5077	1%	0.0301	0.0070	-77%	0.3942	0.3974	1%
1991	4.6144	0.5997	-87%	0.5043	0.5091	1%	0.0300	0.0071	-76%	0.3959	0.3990	1%
1992	4.5975	0.5991	-87%	0.5028	0.5077	1%	0.0300	0.0071	-76%	0.3948	0.3980	1%
1993	4.6160	0.5971	-87%	0.5014	0.5060	1%	0.0301	0.0071	-76%	0.3925	0.3956	1%
1994	4.4358	0.5962	-87%	0.5006	0.5051	1%	0.0291	0.0071	-75%	0.3919	0.3947	1%
1995	4.4149	0.6077	-86%	0.5056	0.5102	1%	0.0291	0.0073	-75%	0.3987	0.4018	1%
1996	4.3826	0.5892	-87%	0.4904	0.4945	1%	0.0291	0.0074	-75%	0.3818	0.3847	1%
1997	4.3737	0.5956	-86%	0.4969	0.5002	1%	0.0291	0.0075	-74%	0.3858	0.3883	1%
1998	4.3638	0.6081	-86%	0.4963	0.5002	1%	0.0293	0.0078	-73%	0.3926	0.3945	0%
1999	4.2776	0.6160	-86%	0.4918	0.4942	0%	0.0294	0.0085	-71%	0.3861	0.3893	1%
2000	4.3944	0.5286	-88%	0.4334	0.4332	0%	0.0303	0.0082	-73%	0.3161	0.3161	-
2001	4.3390	0.6731	-84%	0.5227	0.5225	0%	0.0306	0.0097	-68%	0.4196	0.4196	-
2002	4.1819	0.6068	-85%	0.4214	0.4212	0%	0.0316	0.0112	-65%	0.3368	0.3368	-
2003	4.1066	0.5375	-87%	0.3836	0.3707	-3%	0.0331	0.0127	-62%	0.2475	0.2475	-
2004	3.9880	0.4587	-88%	0.3083	0.2949	-4%	0.0328	0.0127	-61%	0.1938	0.1779	-8%
2005	7.2439	0.4336	-94%	0.2900	0.2795	-4%	0.0521	0.0132	-75%	0.1579	0.1457	-8%
2006	4.2544	0.2999	-93%	0.2014	0.1910	-5%	0.0351	0.0125	-64%	0.0509	0.0387	-24%
2007	5.1628	0.4266	-92%	0.2423	0.2311	-5%	0.0463	0.0192	-58%	0.0455	0.0322	-29%
2008	4.4580	0.4172	-91%	0.2601	0.2515	-3%	0.0418	0.0188	-55%	0.0403	0.0302	-25%
2009	4.0026	0.4298	-89%	0.2053	0.2032	-1%	0.0400	0.0196	-51%	0.0335	0.0313	-7%
2010	4.2269	0.6288	-85%	0.2870	0.2778	-3%	0.0501	0.0295	-41%	0.0416	0.0307	-26%
2011	4.2747	0.7266	-83%	0.3353	0.3256	-3%	0.0530	0.0327	-38%	0.0724	0.0610	-16%
2012	3.7759	0.6762	-82%	0.3062	0.2948	-4%	0.0497	0.0320	-36%	0.0429	0.0293	-32%
2013	3.1437	0.6034	-81%	0.2806	0.2685	-4%	0.0428	0.0284	-34%	0.0432	0.0288	-33%
2014	2.8083	0.5703	-80%	0.2663	0.2542	-5%	0.0393	0.0265	-32%	0.0473	0.0328	-31%
2015	3.2372	0.5777	-82%	0.2726	0.2611	-4%	0.0422	0.0270	-36%	0.0439	0.0302	-31%
2016	3.2335	0.5603	-83%	0.2630	0.2529	-4%	0.0420	0.0268	-36%	0.0301	0.0180	-40%
2017	4.0750	0.8183	-80%	0.6051	0.4264	-30%	0.0481	0.0302	-37%	0.4021	0.1866	-54%
2018	3.1306	0.6336	-80%	0.2873	0.2778	-3%	0.0447	0.0305	-32%	0.0299	0.0182	-39%

P – Previous, R – Refined, C – Changed

3.6 TRANSPORT (NFR 1A3)

3.6.1 CATEGORY DESCRIPTION AND TRENDS

The emissions from the category 1A3 Transport include subcategories Domestic aviation (1A3a), Road transportation (1A3b), Railways (1A3c), Domestic navigation (1A3d) and Pipeline transport (1A3ei). During recent years, the shift from public transportation to individual passenger cars has been observed. The level of transit transport (HDV) has increased at the same time. The consumption of fuels in railways is slightly increasing in recent year and the consumption of fuels in road transportation is sharply increasing. Total aggregated pollutants in transport decreased against the base year in the range of 57.01% (NOx) and 94.05% (SOx), although emission of ammonia has increased by 1 242%, in comparison with the base year. More information can be found below in ***Table 3.60***. Ammonia mostly comes from road transportation, exactly 99.90% of it and the rest is railways and navigation (0.09%). The emissions from road and non-road transport were calculated by using models, default methodologies and the consistent data series from 1990-2019.

Table 3.60: *Overview of the main pollutants and change to the year 1990 in sector transport in years 1990-2019*

YEAR	EMISSIONS					
	kt					
	NOx		NMVOC		SOx	
1990	54.92	0.00%	26.79	0.00%	2.88	0.00%
1995	45.22	-17.66%	27.09	1.09%	2.30	-20.14%
2000	37.41	-31.88%	20.50	-23.50%	0.73	-74.57%
2005	49.09	-10.61%	20.23	-24.52%	0.21	-92.88%
2010	41.55	-24.34%	12.14	-54.68%	0.25	-91.34%
2011	34.21	-37.71%	8.50	-68.27%	0.23	-91.87%
2012	33.15	-39.65%	8.24	-69.23%	0.10	-96.56%
2013	31.89	-41.93%	7.43	-72.28%	0.14	-95.29%
2014	31.83	-42.04%	6.63	-75.27%	0.15	-94.70%
2015	30.25	-44.92%	6.13	-77.12%	0.22	-92.47%
2016	28.79	-47.58%	5.89	-78.03%	0.19	-93.45%
2017	27.37	-50.16%	5.40	-79.84%	0.19	-93.45%
2018	27.76	-49.46%	5.16	-80.74%	0.19	-93.43%
2019	24.72	-55.00%	3.79	-85.87%	0.17	-94.05%
2005-2019	**-**	**-49.65%**	**-**	**-81.28%**	**-**	**-16.42%**

YEAR	EMISSIONS					
	kt					
	NH_3		$PM_{2.5}$		CO	
1990	0.03	0%	3.08	0.00%	194.88	0.00%
1995	0.09	240%	2.12	-31.37%	210.47	8.00%
2000	0.35	1249%	1.51	-50.99%	169.32	-13.12%
2005	0.53	1932%	2.29	-25.79%	170.92	-12.30%
2010	0.47	1716%	2.28	-26.21%	89.84	-53.90%
2011	0.41	1488%	1.70	-45.03%	59.07	-69.69%
2012	0.42	1514%	1.71	-44.45%	56.71	-70.90%
2013	0.39	1418%	1.62	-47.64%	50.53	-74.07%
2014	0.36	1296%	1.60	-47.98%	43.43	-77.71%
2015	0.37	1331%	1.51	-50.90%	40.09	-79.43%
2016	0.38	1364%	1.49	-51.31%	36.22	-81.42%
2017	0.36	1288%	1.49	-52.13%	33.26	-82.93%
2018	0.35	1236%	1.45	-52.72%	30.42	-84.39%
2019	0.35	1242%	1.22	-60.56%	16.66	-91.45%
2005-2019	**-**	**-33.99%**	**-**	**-46.84%**	**-**	**-90.25%**

YEAR	EMISSIONS					
	kt		t			
	BC		Priority HMs		PAHs	
1990	1.45	0.00%	9.16	0.00%	0.10	0.00%
1995	0.96	-33.41%	7.86	-14.11%	0.08	-20.42%
2000	0.72	-49.89%	0.45	-95.14%	0.07	-25.21%
2005	1.16	-19.73%	0.69	-92.50%	0.11	18.18%

YEAR	EMISSIONS					
	kt		t			
	BC		Priority HMs		PAHs	
2010	1.19	-17.47%	0.75	-91.81%	0.15	50.11%
2011	0.84	-41.74%	0.70	-92.30%	0.14	45.64%
2012	0.86	-40.35%	0.75	-91.84%	0.15	56.57%
2013	0.80	-44.36%	0.73	-92.07%	0.15	53.62%
2014	0.79	-45.03%	0.74	-91.89%	0.16	60.62%
2015	0.69	-52.49%	0.84	-90.84%	0.18	81.71%
2016	0.70	-51.92%	0.86	-90.66%	0.18	88.01%
2017	0.67	-53.53%	0.87	-90.48%	0.19	92.45%
2018	0.64	-55.61%	0.90	-90.14%	0.20	100.84%
2019	0.44	-69.40%	0.95	-89.57%	0.20	110.94%
2005-2019	**-**	**-91.43%**	**-**	**39.11%**	**-**	**-65.69%**

3.6.2 CATEGORY-SPECIFIC QA/QC AND VERIFICATION PROCESS

Category-specific QA/QC plan is based on the general QA/QC plan described in ***Chapter 1.6.1*** of this report. The emissions inventory in the transport categories were prepared by the sectoral experts. Slovakia has been dealing with data inconsistency from several statistical sources in the last years regarding fuel consumption in transport. Therefore, in agreement with our QA/QC Plan, the extensive analyses of the available statistical information in liquid fuels in transport begun in 2017. The results were published in the statistical journal[1] in Slovak.

3.6.2.1 Source-specific comparison of fuel statistics

QA/QC procedures for the transport sector follow basic rules and activities of QA/QC as defined in the EMEP/EEA GB_{2019}. The QC checks were done during the NFR and IIR compilation, general QC questionnaire was filled in and is archived.

Due to frequent questions for data consistency between the IEA statistics and the national inventory, the data sources were investigated. Comparison of activity data and their sources is also crucial for the evaluation of consistency in reporting. Gasoline, diesel oil and biofuels 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 2014-2019:

- 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).

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 import/export and production data, the FR SR used data from taxes on sales of products of crude oil and taxes on sales of biofuels (***Figure 3.4***).[2,3]

[1] Slovak Statistics and Demography: https://slovak.statistics.sk/wps/wcm/connect/fcafaa22-6de1-44ce-bd6b-83fb377d84fc/Slovenska_statistika_a_demografia_1_2021.pdf?MOD=AJPERES&CVID=nvIXiB0
[2] Council Directive (EU) 2015/652 laying down calculation methods and reporting requirements pursuant to Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels
[3] Act 309/2009 Coll. on the Promotion of renewable energy sources and high-efficiency cogeneration and on amendments to certain acts as amended, http://www.minzp.sk/en/areas/renewable-energy-sources/biofuels-bioliquids/

Table 3.61: Crude oil and crude oil products data flow and utilisation (final user is the SHMÚ)

ORIGIN OF DATA	PRIMARY USER	SECONDARY USER
Import-export data (ŠÚ SR - Depart. of Foreign Trade)	Statistical Office of Slovak Republic (Depart. 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[4]
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 on gas stations (NEIS)	Ministry of Environment (according to art.8 of Directive 98/70/EC)	European Environmental Agency

As shown in ***Table 3.62*** and in ***Figure 3.4***, discrepancies occurred between major data sources – providers. During discussions with the main authorities, information was collected by the sectoral experts, which were further analysed:

- Each authority report different data in different forms for different institutions or requirements (***Table 3.62*** and **ANNEX VII**);
- The conversion factors (e.g. density) differ throughout all data suppliers not only between authorities and companies but also for each delivered supply has its own characteristics;
- Dates of collection for tax reports and reports to the ŠÚ SR differ.

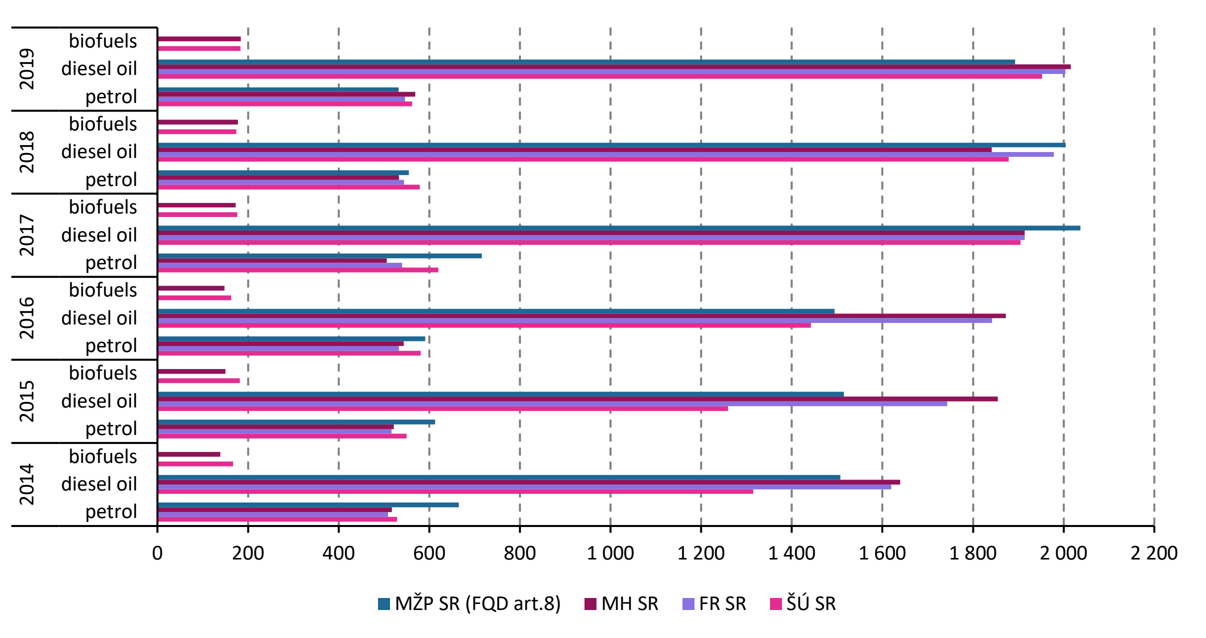
Table 3.62: Results of fuels consumption comparison according to different sources (kt)

DATA SOURCE	2014			2015		
	PETROL	DIESEL OIL	BIOFUELS	PETROL	DIESEL OIL	BIOFUELS
	kt					
ŠÚ SR	529.0	1 315.0	167.0	550.0	1 259.0	182.0
FR SR	508.6	1 619.7	-	516.6	1 743.0	-
MH SR	517.2	1 639.0	138.9	521.5	1 854.8	149.9
MŽP SR (FQD art.8)	664.9	1 507.4	-	613.1	1 514.8	-
DATA SOURCE	**2016**			**2017**		
	PETROL	**DIESEL OIL**	**BIOFUELS**	**PETROL**	**DIESEL OIL**	**BIOFUELS**
	kt					
ŠÚ SR	581.0	1 442.0	163.0	620.0	1 905.0	176.0
FR SR	533.3	1 841.7	-	540.0	1 914.0	-
MH SR	543.8	1 872.3	147.9	506.0	1 914.0	173.0
MŽP SR (FQD art.8)	591.0	1 494.6	-	715.7	2 037.0	-
DATA SOURCE	**2018**			**2019**		
	PETROL	**DIESEL OIL**	**BIOFUELS**	**PETROL**	**DIESEL OIL**	**BIOFUELS**
	kt			*kt*		
ŠÚ SR	579.0	1 879.0	174.0	562.0	1 952.0	183.0
FR SR	544.6	1 978.2	-	546.4	2 003.6	-
MH SR	532.7	1 841.6	178.0	569.0	2 016.0	184.0
MŽP SR (FQD art.8)	555.0	2 004.6	-	532.0	1 893.0	-

[4] SK-BIO is the national register for biofuels and bioliquids (http://www.shmu.sk/en/?page=1684)

The main outcomes of this analysis are harmonisation of fuels consumption in the country on the most possible level and lowering the differences in reporting by different subjects to 0.5% for fossil fuels and 2% for biofuels in 2018. 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.).[5] Data from the MŽP SR according to Article 8 of Directive 98/70/EC (FQD) is differing from other sources, as data collection is governed by focusing on fuel quality (not quantity). Outcomes showed that the most consistent and reliable data source is from the MH SR. Thus, data from the MH SR was used for the years 2014-2019.

Figure 3.4: *Results of fuels consumption comparison according to different sources (kt)*



3.6.3 DOMESTIC AVIATION LTO (NFR 1A3ai(i)) AND INTERNATIONAL AVIATION LTO (NFR 1A3aii(i))

These categories are not the key categories. In the absence of national data on the exact numbers of domestic and international LTO cycles (only total numbers of LTO cycles is available), summary information from the EUROCONTROL database was used. The Slovak Management of Airports manages Slovak airports, except for the airport in Žilina, where exercises with light aircrafts of the Žilina University predominate. Other smaller civil airports (Nitra, Prievidza, Ružomberok and Lučenec) are operated by aero-clubs with a predomination of sport 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 1990-2004. For the time series 2005-2019 EUROCONTROL data on the number of flights, fuel consumption and share of domestic and international flights were used. The emissions of NOx, SOx, PMs and CO were taken from EUROCONTROL file for LTO and Cruise separately (in line with NECD review 2017 recommendation ***SK-1A3aii(ii)-0002***) and reported in Domestic and International Aviation LTO cycles (***Table 3.63***). The fuel consumption in category 1A3aii(i) decreased compared to the base year 1990 by 51.25%. The total consumption of jet kerosene was 7.15 TJ and the consumption of aviation gasoline was 0.06 TJ in the domestic aviation LTO cycle in 2019. Since 2005, domestic aviation emissions are decreasing. This decrease and the whole category is influenced by the fact, that the Slovak Republic

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

has no official national airlines as the Slovak Airlines are out of business since 2007, SkyEurope since 2009 and close distance of other big international airports in Vienna and Budapest. The fuel consumption in category 1A3ai(i) increased compared to the base year 1990 by 182.97%. The total consumption of jet kerosene was 354.56 TJ and the consumption of aviation gasoline was 0.19 TJ allocated in the domestic aviation LTO cycle in 2019. Since 2005, international aviation emissions are slightly increasing. The increase in fuel consumption and emissions is influenced by the arrival of low-cost airlines (Ryanair – based in Bratislava, WizzAir – based in Košice) and charter flights.

Table 3.63: *Overview of emissions from domestic and international aviation (1990-2019)*

YEAR	EMISSIONS – DOMESTIC AVIATION LTO (kt)				
	NOx	NMVOC	SOx	$PM_{2.5}$	CO
1990	0.081	0.0007	0.0226	0.0004	0.020
1995	0.054	0.0004	0.0150	0.0003	0.013
2000	0.061	0.0005	0.0172	0.0003	0.015
2005	0.008	0.0001	0.0006	0.0002	0.011
2010	0.004	0.0002	0.0004	0.0002	0.012
2011	0.003	0.0002	0.0003	0.0002	0.011
2012	0.003	0.0002	0.0003	0.0002	0.013
2013	0.003	0.0001	0.0002	0.0002	0.011
2014	0.003	0.0001	0.0003	0.0002	0.009
2015	0.003	0.0002	0.0003	0.0002	0.012
2016	0.003	0.0002	0.0003	0.0002	0.009
2017	0.003	0.0001	0.0003	0.0001	0.010
2018	0.003	0.0012	0.00021	0.00007	0.00855
2019	0.002	0.0009	0.000139904	0.00006	0.004418891
2005-2019	**-78.62%**	**835%**	**-65.60%**	**-63.61%**	**-20.52%**
1990-2019	**-97.91%**	**37%**	**-99.06%**	**-85.43%**	**-56.91%**

YEAR	EMISSIONS – INTERNATIONAL AVIATION LTO (kt)				
	NOx	NMVOC	SOx	$PM_{2.5}$	CO
1990	0.102	0.0012	0.027	0.0007	0.068
1995	0.068	0.0008	0.018	0.0005	0.046
2000	0.078	0.0009	0.020	0.0005	0.051
2005	0.070	0.0008	0.005	0.0011	0.063
2010	0.077	0.0011	0.005	0.0008	0.054
2011	0.078	0.0010	0.005	0.0008	0.056
2012	0.072	0.0010	0.005	0.0007	0.056
2013	0.069	0.0011	0.004	0.0008	0.056
2014	0.070	0.0012	0.004	0.0008	0.053
2015	0.083	0.0012	0.005	0.0009	0.061
2016	0.092	0.0016	0.006	0.0010	0.069
2017	0.100	0.0015	0.006	0.0009	0.068
2018	0.111	0.0015	0.007	0.0011	0.0747
2019	0.113	0.0129	0.007	0.0011	0.0747
2005-2019	**61.56%**	**15.92%**	**34.39%**	**-1.24%**	**18.33%**
1990-2019	**10.50%**	**10.06%**	**-74.56%**	**56.13%**	**9.87%**

3.6.3.1 Methodological issues

The airport traffic in Slovakia is determined only by the origin of airlines. It means, that there is no direct information about the number of domestic and international flights in statistics. Tier 1 methodology for emission estimation in aviation, both for aviation gasoline and jet kerosene was used for time series 1990-2004. Tier 1 methodology is based on fuel sold in the airports. For this period, the only total number of LTO cycles is known, therefore the average disaggregation of activities between national and international aviation was revised. The share for national and international aviation activities for the period 1990-2004 was improved based on the real data used for time series 2005-2017. The share is a constant value. The real share of national and international activities for the period 2005-2019 was taken from the EUROCONTROL database directly. More data and revision is provided in ***Table 3.64***. Also, data regarding disaggregation to LTO and cruise phase is taken from EUROCONTROL and for the period 1990-2004 was used the share based on the real data used for time series 2005-2017 (in line with observation and recommendation ***SK-1A3aii(ii)-2017-0002***).

Table 3.64: *The share of fuel consumption in domestic and international aviation for the period 1990-2004*

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

The implied emission factors for jet kerosene applied in these submissions for the years 1990-2004 were calculated as average EFs from available EUROCONTROL data for 2005-2017. These average emission factors (***Table 3.65***) for all pollutants were used for the years 1990-2004 in national and international aviation. Emission factors applied for aviation gasoline, for the period 1990-2004, were from EMEP/EEA GB_{2019}.

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

From the year 2005 onwards, Slovakia decided to use the EUROCONTROL data. The decision is based on the analysis of the national data and the data obtained from the EUROCONTROL. Results showed that the EUROCONTROL data are more consistent and accurate in line with the QA/QC rules. The Ministry of Transport of the Slovak Republic thereafter approved these results. EUROCONTROL data used tier 3 methodology applying the Advanced Emissions Model (AEM). Following data were taken from the EUROCONTROL data published in 2019 into national inventory:

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

Slovakia made in 2020 analysis of jet kerosene and aviation gasoline for heavy metals and according to this analysis was able to define a new emission factor for lead (***Table 3.65***) for this inventory.

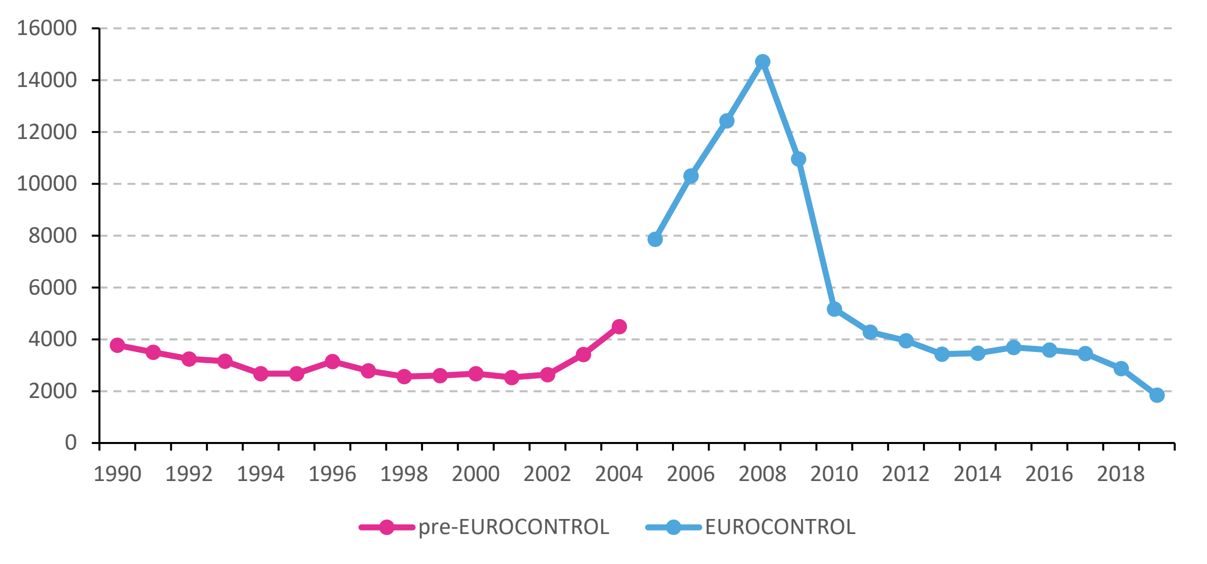
Table 3.65: *Average emission factors for the pollutants in civil aviation according to EUROCONTROL*

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

3.6.3.2 Category-specific QA/QC

Since 2011, the agreement of the European Commission (the EC) and the EUROCONTROL is in place. Based on this agreement, an annual comparison of aviation fuel consumption and the emissions data with AEM model calculations is prepared. The individual EU Member State provides the comparison of the EUROCONTROL and the UNFCCC reporting data in aviation. The information and data provided in this evaluation are intended to be used for QA/QC activities regarding emissions from aviation. The EC works towards making data from the EUROCONTROL available to the EU MS regularly, for quality check, however, this information is not possible to make publicly available. Consistency of the time-series (***Figure 3.5***) is maintained by using calculated average EFs from EUROCONTROL. The methodology is explained in ***Chapter 3.6.2.1***.

Figure 3.5: *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 SHMU archive the background documents.

3.6.4 ROAD TRANSPORTATION (NFR 1A3b)

Short distance passenger transport is an important part of road transportation. It is the most exploited type of transport in the Slovak Republic due to the high density and quality of the road network and interconnection of all municipalities. In recent years, road transport has expanded significantly in the transport of goods and persons. In 2019, the transport network included 496 km of highways, 271 km of motorways and 3 333 km of the category 1st class roads. Total roads network represented 18 072 km of roads in the Slovak Republic in 2019. Road transportation is the most important and key category with the highest share of emissions and continually increasing trend in fuels consumption within transport. There is a huge increase in emission of ammonia compared to base year – 1 292.6% (***Table 3.66***). This is caused by the expanding of light commercial vehicles in category EURO 5 and onwards, which have higher EFs than vehicles in category EURO 2, 3 and 4.

Table 3.66: *Overview of emissions in road transport in the years 1990-2019*

YEAR	EMISSIONS - ROAD TRANSPORT							
	kt						t	
	NOx	NMVOC	SO_X	NH_3	$PM_{2.5}$	CO	Priority HMs	PAHs
1990	43.813	26.066	2.418	0.025	2.806	193.013	9.151	0.086
1995	37.226	26.618	1.904	0.087	1.927	209.232	7.860	0.071
2000	31.586	20.183	0.693	0.349	1.444	168.310	0.445	0.069
2005	43.273	19.830	0.193	0.526	2.241	170.121	0.686	0.112
2010	36.840	11.787	0.028	0.470	2.178	89.211	0.747	0.143
2011	29.500	8.142	0.027	0.411	1.606	58.477	0.702	0.139
2012	30.946	7.997	0.028	0.418	1.663	56.294	0.746	0.150
2013	29.305	7.134	0.027	0.393	1.547	50.066	0.725	0.147
2014	29.722	6.226	0.028	0.361	1.534	42.984	0.741	0.153

YEAR	EMISSIONS - ROAD TRANSPORT							
	kt						t	
	NOx	NMVOC	SO_X	NH_3	$PM_{2.5}$	CO	Priority HMs	PAHs
2015	27.565	5.733	0.031	0.370	1.423	39.427	0.836	0.173
2016	26.118	5.458	0.031	0.379	1.418	35.542	0.854	0.180
2017	24.780	5.027	0.034	0.359	1.394	32.570	0.870	0.184
2018	25.263	4.852	0.033	0.346	1.375	29.692	0.901	0.192
2019	22.282	3.495	0.036	0.347	1.145	16.015	0.953	0.202
2005-2019	**-48.5%**	**-82.4%**	**-81.3%**	**-34.0%**	**-48.9%**	**-90.6%**	**38.9%**	**80.3%**
1990-2019	**-49.1%**	**-86.6%**	**-98.5%**	**1292.6%**	**-59.2%**	**-91.7%**	**-89.6%**	**135.0%**

The major share of emissions belongs to passenger cars (***Table 3.67***). Most of the priority HMs (Pb, Cd and Hg) comes from tyre and brake wear abrasion. The majority of NOx, NMVOC and CO emission is emitted in the cities (***Table 3.68***).

Table 3.67: *Overview of total emissions according to the type of vehicles in 2019*

VEHICLE CATEGORY	NOx	NMVOC	SOx	NH_3	TSP	CO	Priority HMs	PAH
	kt						t	
Passenger cars	10.52	1.09	0.02	0.29	0.31	12.11	0.01	0.12
Light duty vehicles	3.85	0.13	0.00	0.02	0.11	1.12	0.00	0.02
Heavy duty vehicles and buses	7.90	0.31	0.01	0.04	0.15	2.42	0.00	0.06
Mopeds & motorcycles	0.01	0.05	0.00	0.00	0.00	0.36	0.00	0.00
Gasoline evaporation	NA	1.92	NA	NA	NA	NA	NA	NE
Automobile tyre and brake wear abrasion	NA	NA	NA	NA	0.38	NE	0.94	NE
Automobile road abrasion	NA	NA	NA	NA	0.21	NE	0.00	NE

Table 3.68: *Results from COPERT in the distribution for agglomeration mode in 2019*

kt	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	CO
Urban	10.68	2.68	0.02	0.09	0.52	10.48
Rural	8.13	0.53	0.02	0.17	0.45	3.63
Highway	3.47	0.28	0.010	0.09	0.17	1.90

3.6.4.1 Methodological issues

COPERT model 5 was used for the estimation of road transport emissions. The model distinguishes vehicle categories and emission factors reflecting the recent development and research. These data are not available before 2000. The methodology is often referred to the name of the program (methodology "COPERT"). Calculation in model COPERT 5 is based on EMEP/EEA GB_{2019} methodology. This methodology is balancing fifteen different emissions including greenhouse gases from road transport. Preparation of basic pollutants inventory is based on the sequence calculation for each vehicle category and summing. Emission factors are set by the model and they differ for all types of fuel, different vehicle categories and different technological level. Statistically recorded fuel consumption and fuel consumption calculated through COPERT 5 methodology are equal. The COPERT 5 defined new vehicle categories for the calculation of pollutants, with the disaggregation into 5 base categories and 372 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[6].

Exhaust emissions from road transport are divided into two types:

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

The EFs values for air pollutants in COPERT are defined separately for the different types of fuels, types of vehicles and the different technological level of vehicles. The emission factors for pollutants such as SO_x, NOx, NH_3, PMs and partially CH_4 can be obtained by the simple formula of driving mode and consumed fuel. Emission factors are then calculated automatically by the model based on the input parameters such as the average speed, the quality of fuels, the age of vehicles, the weight of vehicles and the volume of cylinders.

Accurate and actual data on distance-based values and parameters are necessary to run the COPERT 5 model (***Table 3.69***). Particularly kilometres (km) travelled are not available in Slovakia. Therefore, new input data on mileages were requested from TID (odometers) and NCR (from the Police). As the unique key for binding data from these two registries, the VIN number (vehicle identification number) was used. Using MS Access, the average number of mileages was produced. Further data needed were: first registration of the vehicle, VIN, vehicle type, engine volume, weight of the vehicle, emission category and data from the odometer. At least that many years as are between two technical controls are needed. The mileages in those years can be calculated and if the mileages are divided by the number of years, the average annual mileages can be obtained. To distribute the number of vehicles to their appropriate COPERT category, the data on mileages were used from the estimation mentioned above. The recommendations provided within the framework of the COPERT 5 model, including consistency with fuel consumption, were used in addition. The main source of activity data such as intensity on urban, rural and highways is the Traffic Census of Slovakia, conducted every five years (2000, 2005, 2010 and 2015[7]).

Table 3.69: *Overview of input data used in COPERT 5 model in 2019*

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	**2 287 768**	**9 782.7**	**Heavy Duty Trucks**	**70 571**	**17 625.9**
Petrol Mini	9 458	5 268.0	Petrol >3.5 t	129	4 995.5
Petrol Small	816 290	4 254.1	Rigid <=7,5 t	21 259	27 366.4
Petrol Medium	357 939	4 551.7	Rigid 7,5 - 12 t	12 807	3 2316.7
Petrol Large	48 230	4 866.2	Rigid 12 - 14 t	3 247	30 240.9

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

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)*
2-Stroke	156	1 548.8	Rigid 14 - 20 t	4 085	21 343.5
Hybrid Mini	65	4 909.2	Rigid 20 - 26 t	1 041	12 396.2
Hybrid Small	379	11 669.2	Rigid 26 - 28 t	34	10 585.2
Hybrid Medium	6 257	16 039.0	Rigid 28 - 32 t	217	15 139.0
Hybrid Large-SUV-Executive	2 608	11 547.8	Rigid >32 t	158	7 175.0
Diesel Mini	364	2 394.7	Articulated 14 - 20 t	27 573	56 764.5
Diesel Small	25 600	10 093.2	Articulated 20 - 28 t	20	20 432.6
Diesel Medium	819 620	17 472.8	Articulated 50 - 60 t	1	14 806.7
Diesel Large-SUV-Executive	150 793	12 955.1	**Buses**	**7 650**	**31 864.3**
LPG Bifuel Mini	28	8 037.2	Urban Buses Midi <=15 t	707	38 296.9
LPG Bifuel Small	23 043	18 878.9	Urban Buses Standard 15 - 18 t	277	34 843.4
LPG Bifuel Medium	20 611	19 843.9	Urban Buses Articulated >18 t	45	24 047.9
LPG Large-SUV-Executive	4 324	17 812.9	Coaches Standard <=18 t	6 321	43 368.7
CNG Bifuel Small	1 249	13 162.4	Coaches Articulated >18 t	57	57 001.4
CNG Bifuel Medium	697	11 961.7	CNG Buses	243	20 712.5
CNG Large-SUV-Executive	57	8 088.9	**L-Category**	**133 751**	**909.1**
Light Commercial Vehicles	**246 175**	**10 722.1**	Mopeds 2-stroke <50 cm^3	560	190.4
Petrol N1- I	25 074	6 191.1	Mopeds 4-stroke <50 cm^3	27 850	312.3
Petrol N1-II	9 367	7 192.0	Motorcycles 2-stroke >50 cm^3	1 507	984.8
Petrol N1-III	2 511	8 178.4	Motorcycles 4-stroke <250 cm^3	45 144	762.0
Diesel N1- I	16 451	12 497.2	Motorcycles 4-stroke 250 - 750 cm^3	27 426	1 227.1
Diesel N1-II	70 231	12 890.6	Motorcycles 4-stroke >750 cm^3	31 264	1 978.0
Diesel N1-III	122 541	17 383.5			

CO_2 correction factor[8] was introduced in 2018 into the COPERT model. According to the EMEP/EEA air pollutant emission inventory Guidebook 2019, the CO_2 emissions of new passenger cars registered in Europe are monitored in order to meet the objectives of Regulation EC 443/2009. Empirical models have been constructed to check how well measured in-use fuel consumption of passenger cars can be predicted based on independent variables. The set of models based on type-approval fuel consumption, require vehicle mass and capacity to predict real-world fuel consumption. Moreover, this set of models does not distinguish between vehicle types and it is ideal to predict consumption of new car registrations because both vehicle mass and type-approval CO_2 are readily available from the CO_2 monitoring database[9]. A regression model has been developed considering the registration year as an additional variable to the currently used variables (mass and capacity of vehicle). The average mass, engine capacity and type-approval CO_2 values per passenger car category are required as user input to enable the CO_2 correction option. The mean FC_{Sample} is calculated as the average fuel consumption of the vehicle sample used in developing COPERT emission factors over the three parts (Urban, Road and Motorway) of the Common Artemis Driving Cycles (CADC). The sum of fuel consumption of the three CADC parts was used, each weighted by a 1/3 factor. It is noted that this ‘average’ fuel consumption was computed using actual vehicle performance (measurements), not COPERT emission factors. The correction factor is then calculated as:

$$Correction = FC_{In\ use}/FC_{Sample}$$

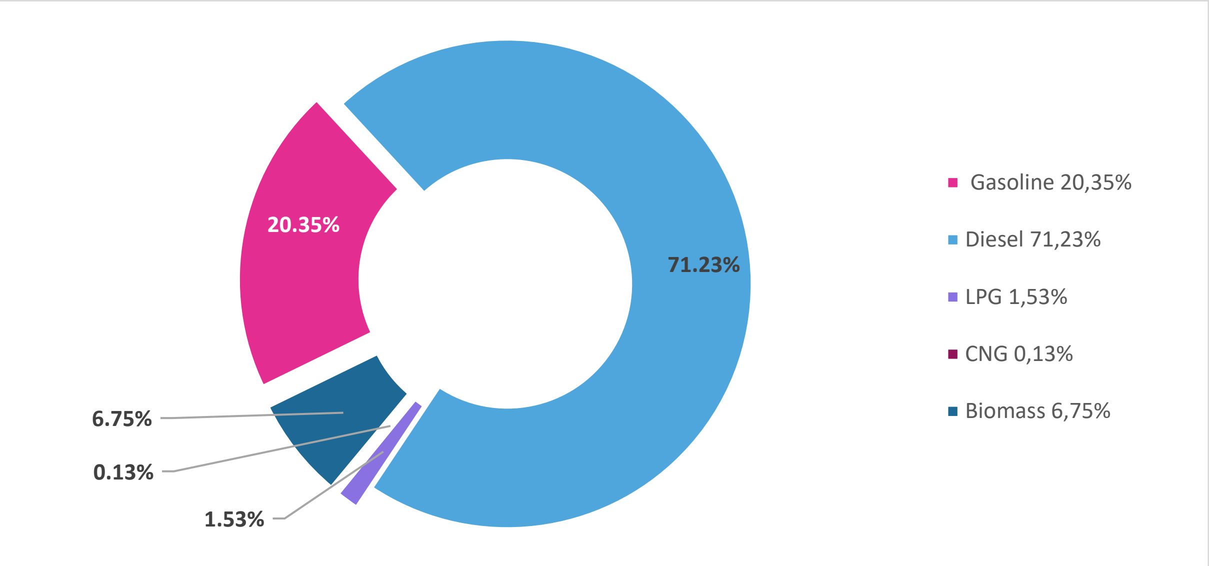
[8] https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-b-i/view, page 90
[9] https://www.eea.europa.eu/data-and-maps/data/co2-cars-emission-16

This correction coefficient is then used to calculate the modified fuel consumption and respective emission factors for hot emissions only and the introduction was possible only from the year 2010 as there are no data available for previous years.

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

The statistical consumptions of petrol, diesel oil and biofuels were received from the Ministry of Economy of the Slovak Republic (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 sale 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 71.23%, followed by gasoline with 20.35% share, then LPG (1.53%), CNG (0.13%) and biomass (6.75%) (***Figure 3.6***).

Figure 3.6: *Fuels balance in road transportation in 2019*



The blending of biomass in liquid fuels was considered and the bio-emissions are calculated since 2007 (the first year of using blended fuels in the transport in Slovakia). The information about fuels quality is provided by the Ministry of Economy of the Slovak Republic in terms of implementing Directive No 2009/29/EC and Directive No 2009/30/EC on the replacement of fossil fuels with bio-component. The share of biomass in liquid fuels in transport was calculated as a bio-component percentage (***Table 3.70***).

Table 3.70: *Estimated activity data and share of biomass for the time series 2007-2019*

YEAR	GASOLINE		DIESEL OIL	
	Biomass share % (energy)	*Biomass (TJ)*	*Biomass share % (energy)*	*Biomass (TJ)*
2007	2.30%	652.261	4.09%	2 677.29
2008	1.23%	358.172	4.77%	2 795.75
2009	2.58%	706.723	5.14%	3 090.30
2010	2.95%	779.130	5.28%	3 577.88
2011	2.97%	715.872	6.05%	3 741.68
2012	2.94%	710.557	5.79%	3 846.12
2013	3.21%	726.595	6.43%	4 107.36
2014	3.88%	859.329	5.65%	3 766.08
2015	3.33%	747.873	5.74%	4 342.97
2016	3.10%	725.623	6.68%	5 158.95
2017	4.06%	943.486	6.92%	5 464.18
2018	4.52%	1 018.32	6.97%	5 697.80
2019	4.46%	1 042.07	6.45%	5 371.36

In ETBE as 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 Fuel Quality Directive art. 7a (***Table 3.71***).

Table 3.71: *National fossil carbon content in FAME in 2019*

Feedstock	Volume (m^3)	C Fossil part	Carbon content	g fossil CO_2/g
Rapeseed	90 835.38	5.30%	75.50%	0.147
Palm oil	1 191.13	5.50%	71.80%	0.145
Sunflower seed	27 393.98	5.30%	77.20%	0.150
Used cooking oil[10]	39 250.91	5.00%	74.40%	0.147
National average		5.33%	75.49%	0.148

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. The report[11] is prepared by the MH SR with the cooperation of the Finance Administration of the SR and the Ministry of Environment of the Slovak Republic.

According to the recommendation ***SK-1A3b-2018-0001***, Slovakia managed to distinguish lube oil consumption in 2-stroke vehicles and 4-stroke vehicles (***Table 3.72***).The emissions from lube oil are allocated according to EMEP/EEA GB_{2019} and recommendations:

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

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

[11] *Report on the use of biofuels – in Slovak (https://www.mhsr.sk/energetika/obnovitelne-zdroje-energie/spravy-o-pouzivani-biozloziek)*

Table 3.72: *Overview of lube oil consumption in particular years*

Engine type	1990	1995	2000	2005	2010	2011	2012
2-stroke lube oil (t)	128.7	65.71	25.55	26.46	14.8227	14.7858	14.3672
4-stroke (t)	1999.9	1 887.86	1 999.67	2 979.76	3 616.1383	3 451.6106	3 712.6708
Engine type	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
2-stroke lube oil (t)	13.3597	12.0169	14.468	23.6603	2.0118	2.9329	1.2453
4-stroke (t)	3 636.456	3 720.0287	4 012.0265	4 211.1386	4 340.4322	4 501.7765	5 001.7346

Lube oil composition, including HMs was analysed and used for emission estimation for the years 2000-2019 (more info in ***Chapter 3.6.4.2***). For the years 1990-1999 were used reconstructed data for fuel composition (***Table 3.73***), vehicle fleet and estimations in line with the recommendations ***SK-1A3b-2018-0003***, ***SK-1A3b-2018-0004*** and ***SK-1A3b-2018-0005***.

The emissions of all HMs are dependent on content level (***Table 3.73***) 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[12] (Fuel Quality directive) and reported under article 8 (***SK-1A3b-2018-0002***). Lead emissions are allocated according to the previous paragraph.

Table 3.73: *Overview of HMs and sulphur content in the time-series 1990-1999*

S (ppm)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Petrol	324.00	324.00	324.00	324.00	324.00	324.00	324.00	324.00	324.00	120.00
Diesel	1080.00	1080.00	1080.00	1080.00	1080.00	1080.00	1080.00	1080.00	1080.00	400.00
Pb (ppm)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Petrol	20.00	18.40	16.96	15.66	14.50	13.45	12.50	11.65	10.89	10.20
Diesel	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Cd (ppm)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Petrol	0.010	0.009	0.008	0.007	0.006	0.005	0.004	0.003	0.002	0.001
Diesel	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Cu (ppm)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Petrol	1.70	1.53	1.36	1.19	1.02	0.85	0.68	0.51	0.34	0.17
Diesel	1.70	1.53	1.36	1.19	1.02	0.85	0.68	0.51	0.34	0.18
Cr (ppm)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Petrol	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.01
Diesel	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.01
Ni (ppm)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Petrol	0.07	0.06	0.06	0.05	0.04	0.04	0.03	0.02	0.02	0.01
Diesel	0.07	0.06	0.06	0.05	0.04	0.04	0.03	0.02	0.01	0.01
Se (ppm)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Petrol	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Diesel	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Zn (ppm)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Petrol	1.00	0.90	0.81	0.71	0.61	0.52	0.42	0.32	0.23	0.13
Diesel	1.00	0.90	0.80	0.71	0.61	0.51	0.41	0.31	0.21	0.12

[12] Directive 2009/30/EC of the European Parliament and of the Council amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC (https://eur-lex.europa.eu/legal-content/SK/TXT/PDF/?uri=CELEX:32009L0030&from=EN)

Hg (ppm)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Petrol	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
Diesel	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
As (ppm)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Petrol	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Diesel	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

3.6.4.2 Category-specific QA/QC

QC activities ensuring the quality standards for the preparation of the emissions inventory in road transportation are based on the cooperation of several experts and institutions. The activity data and the input parameters provided from the different data sources are collected and then checked for the basic quality criteria (consistency, transparency, etc.) and archived by the sectoral experts. The Transport Research Institute in Žilina is responsible for the data collection from different subjects in transport. Transport sectoral expert is responsible for the verification of these input parameters and the emissions calculation by the COPERT model.

The QA verification process includes the exercise of statistical and calculated data on fuel consumption. The Statistical Office of the Slovak Republic provides statistical data on fuel consumption. The calculated data on fuel consumption is a direct outcome from the COPERT model.

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

Analysis of fuels and lube oils composition

Slovakia is analysing the composition of fuels on regular basis. Delivering actual and the most recent data on the composition of fuels is crucial for correct calculation and estimation of country-specific emission factors.

The last data update of fuel composition was made in 2018. 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 implementation of recommendations ***SK-1A3b-2018-0001***, ***SK-1A3b-2018-0002*** and ***SK-1A3b-2018-0003***.

In ***Table 3.74*** are presented the fuels from the three greatest sellers in Slovakia. These sellers also represent different refineries that affect the Slovak market.

Table 3.74: *Composition of diesel oil and petrol needed for estimation 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	1.866	0.030
OMV	1.9	33	10	1.848	0.030
Unipetrol	3.1	33.4	11.4	1.838	0.030
Average	2.90	33.1	11.7	1.851	0.030

As it was mentioned above, lube oil is more important for the estimation of air pollutants, especially for HMs and sulphur oxides. Lube oils are the biggest source of HMs and sulphur oxides by brake wear and engine abrasions. The results of most sold lube oil brands are displayed in ***Table 3.75***. These data were used to estimate heavy metal emissions.

Table 3.75: *Composition of lube oil needed for estimation country-specific emission factors*

LUBE OIL BRANDS	ppm/wt										
	Pb	Cd	Cu	Cr	Ni	Se	Zn	Hg	As	S	H:C Ratio
Shell helix	0.098	0.039	0.063	0.069	0.065	0.037	1523	0.097	0.126	2166	2.07
Shell rimula	0.1	0.039	0.101	0.083	0.087	0.037	1503	0.026	0.156	2353	2.10
Castrol edge	0.017	0.298	0.01	0.044	0.03	0.037	1149	0.021	0.159	2198	2.07
Average	0.07	0.13	0.06	0.07	0.06	0.04	1392	0.05	0.15	2239	2.08

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 3.76***), that most the deregistered cars were in EURO 1 emission category or older categories.

Through deeper analysis (***Table 3.77***) it was discovered, that reduction of registered cars wasn´t present in all emission categories (EURO). Despite the rules of the SSP supported only new vehicles, purchases of 10 years old cars and older (outside of this program) occurred. This concerns two categories:

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

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

On the other hand, the SSP, a.s. 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, a.s. are missing. However, a small positive effect on GHG emissions and air pollutants is visible. The main positive outcomes of the SPP, a.s. are:

- The SSP, a.s. caused fuel consumption decrease;
- The SSP, a.s. has a moderate effect on air quality.

On the other hand, negative outcomes are also important:

- The SSP, a.s. failed in an intention to decrease the number of pre-EURO 4 vehicles;
- The SSP, a.s. accelerate registration of additional vehicles (not only new or modern ones);
- The SSP, a.s. has no significant effect on GHG emissions.

Table 3.76: *Number of scrapped passenger cars by age (according to the Automotive Industry Association statistics) in 2009*

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

***Table 3.77**: Yearly change (2008-2009) in 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**

NMVOC time-series inconsistency

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

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

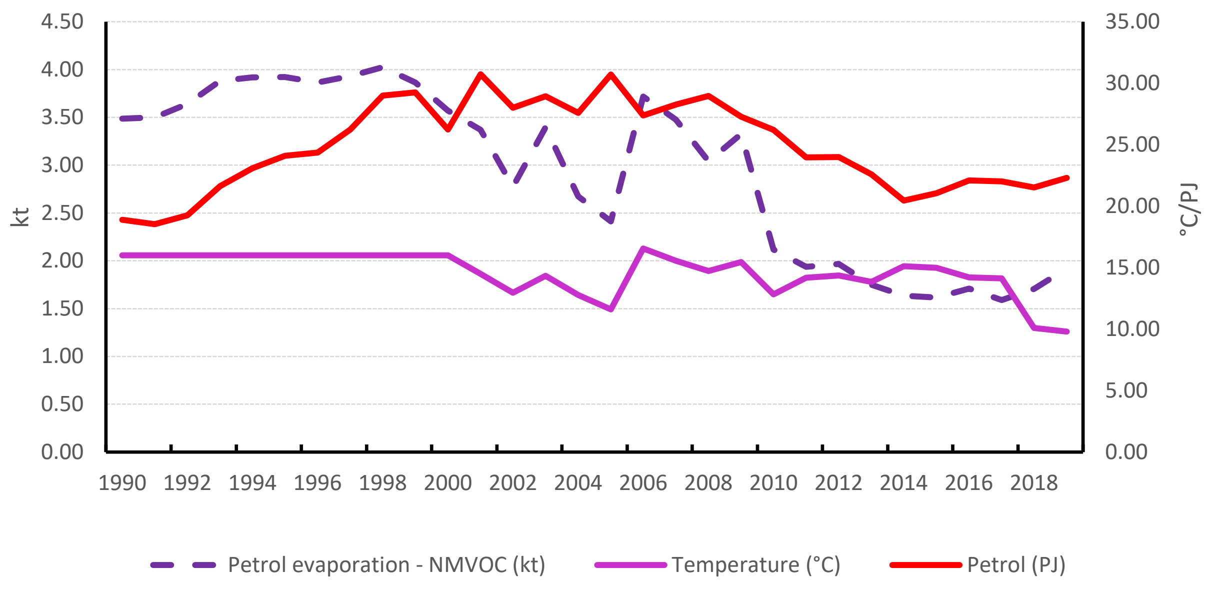
- Breathing losses through the tank vent. Breathing losses are due to evaporation of fuel in the tank during driving and parking, as a result of normal diurnal temperature variation;
- Fuel permeation/leakage. Various studies (e.g. CRC, 2004; Reuter et al., 1994) indicate that liquid fuel seepage and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

Also, three separate mechanisms are considered:

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

All three mechanisms are directly connected and dependant on temperature (ambient and vehicle). The dependence is possible to lower with newer technologies that recirculate the petrol vapour and minimalize its emissions. All inconsistencies in the category 1A3bv can be explained by ambient temperature (***Figure 3.7***) (according to recommendation ***SK-1A3bv-2018-0001***).

Figure 3.7: Ambient air temperature and evaporation emissions correlation



3.6.5 RAILWAYS (NFR 1A3c)

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 the EU funds. Improved quality and ecology of rail transport and the increase in passengers' number are the results of this modernisation. Modernisation of rail infrastructure results in an increase of operational speed to 160 km/h and an increase in safety. According to the Annual Report of Slovak Railways[13] in 2019, the length of managed railways was 3 629 km. The length of the electric railways was 1 587 km. Total NOx emissions from railways transport decreased by 12.95% compared to the year 2005 and by 75.37% compared to the base year (***Table 3.78***).

The decrease in fuels consumption was caused by the improvements of technical parameters (new locomotives and wagons and electrification of railways).

Table 3.78: *Overview of emissions in railways in the years 1990-2019*

YEAR	EMISSIONS							
	kt						t	
	NOx	NMVOC	SOx	NH_3	TSP	CO	Priority HMs	PAH
1990	6.19	0.55	0.002	0.0008	0.18	1.26	0.0012	0.009
1995	3.35	0.30	0.001	0.0004	0.10	0.68	0.0006	0.005
2000	2.56	0.23	0.001	0.0003	0.07	0.52	0.0005	0.004
2005	1.75	0.16	0.001	0.0002	0.05	0.36	0.0003	0.003
2010	1.44	0.13	0.001	0.0002	0.04	0.29	0.0003	0.002
2011	1.39	0.12	0.001	0.0002	0.04	0.28	0.0003	0.002
2012	1.18	0.10	0.000	0.0002	0.03	0.24	0.0002	0.002
2013	1.45	0.13	0.001	0.0002	0.04	0.30	0.0003	0.002
2014	1.38	0.12	0.001	0.0002	0.04	0.28	0.0003	0.002
2015	1.66	0.14	0.001	0.0003	0.05	0.47	0.0003	0.002
2016	1.69	0.14	0.000	0.0003	0.05	0.48	0.0003	0.002
2017	1.65	0.14	0.000	0.0003	0.05	0.47	0.0003	0.002
2018	1.64	0.14	0.000	0.0003	0.05	0.46	0.0003	0.002
2019	1.53	0.13	0.000	0.0003	0.05	0.43	0.0003	0.002
2005-2019	**-12.95%**	**-14.57%**	**-41.80%**	**19.12%**	**-7.17%**	**20.12%**	**-16.62%**	**-16.62%**
1990-2019	**-75.37%**	**-75.83%**	**-83.53%**	**-66.30%**	**-73.74%**	**-66.02%**	**-76.41%**	**-76.41%**

[13] Annual Report of Slovak Railway 201, pp. 14-15.

3.6.5.1 Methodological issues

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

The consumption of each powertrain according to tier 2 was obtained directly from companies operating these or from calculations based on data provided in the EMEP/EEA GB_{2019} The consumption of rail cars operated by one of the companies had to be calculated based on data provided by the guidebook and as a result of a field survey. The field survey focused on the average speed of rail cars. Based on the total mileage of rail cars, average consumption (kg/h) and average speed was the total consumption estimated. This estimation was adjusted afterwards according to the total consumption provided by companies (***Table 3.79***).

Table 3.79: *Consumption of each powertrain in particular years (2015-2019) in tonnes*

	2015	2016	2017	2018	2019
Line-haul locomotives	21 697.34	22 036.88	21 303.01	20 698.25	17 866.41
Shunting locomotives	0.00	0.00	0.00	0.00	0.00
Rail cars	7 258.29	7 650.57	7 717.25	7 727.51	10 012.98
Total	28 955.63	29 687.46	29 020.26	28 425.76	27 879.38

The emissions of the pollutants are calculated from the consumed fuels according to powertrain and multiplied by the appropriate emission factor. The consumption of diesel oil for the motor traction in the Slovak Republic was obtained from the Railways Company, Ltd. (ZSSK) and RegioJet for all years in time-series and the years 2015-2019 also for each powertrain.

3.6.5.2 Category-specific QA/QC

The verification process is based on cross-checking of the input data on fuel consumption from the Railways Company, Ltd. and the Statistical Office of the Slovak Republic. The preliminary results of emissions inventory are sent to other subjects (Ministry of the Environment of the Slovak Republic, Transport Research Institute in Žilina, Ministry of Transport, Construction and Regional Development of the Slovak Republic) for valuation and QA activities. The QC verification process includes the comparison of statistical and calculated data on fuel consumption.

3.6.6 NATIONAL NAVIGATION (NFR 1A3dii) AND INTERNATIONAL INLAND WATERWAYS (NFR 1A3dii(ii))

The major share of emissions from inland shipping in Slovakia is realized as transit on the Danube River. Due to lack of data were these two categories reported together as national emissions until 2016. Based on the information from the State Navigation Administration (the SNA), there are movements realized between the Gabčíkovo and Komárno ports on the Slovak territory (national transport). Due to the international character of shipping transportation on the Danube River, the ships do not stop their operation on the Slovak territory, but the transit continues to Austria or Hungary. The experts from the Slovak Shipping and Ports Company confirmed that before 2005, a negligible number of movements was between the Slovak ports registered. Inland shipping transportation on small lakes for tourist purposes was also estimated and added to the total emissions in this category.

Decreasing trends of emission of air pollutants were recognized compared to the previous years and compared to the base year (***Table 3.80***), despite an increase in touristic activities in Slovakia. The emissions for the years 2000 and 2005 were estimated to be negligible, because of increasing prices of diesel oil in the Slovak Republic and decreasing prices of fuels in the neighbouring countries (market discrepancies).

Table 3.80: Overview of emissions in navigation (national and international) in particular years

YEAR	EMISSIONS							
	kt						t	
	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	CO	Priority HMs	PAH
1990	1.626	0.055	0.410	0.0001	0.115	0.152	0.005	0.002
1995	1.433	0.049	0.361	0.0001	0.101	0.134	0.004	0.001
2000	0.001	0.000	0.000	0.0000	0.000	0.000	0.000	0.000
2005	0.018	0.001	0.004	0.0000	0.001	0.002	0.000	0.000
2010	0.837	0.028	0.211	0.0001	0.059	0.078	0.002	0.001
2011	0.743	0.025	0.187	0.0001	0.052	0.069	0.002	0.001
2012	0.259	0.009	0.065	0.0000	0.018	0.024	0.001	0.000
2013	0.408	0.014	0.103	0.0000	0.029	0.038	0.001	0.000
2014	0.474	0.016	0.120	0.0000	0.033	0.044	0.001	0.000
2015	0.714	0.024	0.180	0.0001	0.050	0.067	0.002	0.001
2016	0.597	0.020	0.151	0.0001	0.042	0.057	0.002	0.001
2017	0.588	0.020	0.148	0.0001	0.046	0.055	0.002	0.001
2018	0.534	0.020	0.148	0.0001	0.042	0.055	0.002	0.001
2019	0.5076	0.0173	0.1280	0.0001	0.036	0.049	0.001	0.001
2005-2019	**2760%**	**2766%**	**2761%**	**3201%**	**2781%**	**2831%**	**2761%**	**2736%**
1990-2019	**-69%**	**-69%**	**-69%**	**-64%**	**-69%**	**-68%**	**-68.78%**	**-69%**

3.6.6.1 Methodological issues

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

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

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

- River – basin of the Vah (Pieštany, Trenčín, Liptovská Mara dams);
- 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 increase in tourisms), it was necessary to propose an appropriate methodological approach for emissions estimation. Chosen activity data were:

- The number of trips per year:

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

- The duration of trips (in hours):

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

- The technical parameters of the most populated ships:

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

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

The average consumption based on the technical description of the engines is 12 litres of diesel oil per hour of work. The consumption of diesel oil in tons was calculated using the average density of diesel oil is **0.84 kg/dm³**.

The emissions are calculated from the consumed fuel by diesel motor boats multiplied by the emission factor. The emission factors are taken from the EMEP/EEA GB2019. Activity data for domestic navigation are shown in ***Tables 3.81*** and ***Table 3.82***.

Table 3.81: *The amount of diesel oil sold by shipping companies and allocation to the categories 1A3dii and 1A3di(ii) in selected years 2005-2019*

YEAR	SHIPPING COMPANIES	SALE OF DIESEL OIL *(t)*		
		NATIONAL	INTERNATIONAL	TOTAL
		1.A.3.d	1.D.1.b	1.A.3.d + 1.D.1.b
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
	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**

YEAR	SHIPPING COMPANIES	SALE OF DIESEL OIL (t)		
		NATIONAL	INTERNATIONAL	TOTAL
		1.A.3.d	1.D.1.b	1.A.3.d + 1.D.1.b
2017	Slovak Shipping and Ports (Danube)	1 492.9	4 478.7	5 971.6
	Slovak Water Management Enterprise	0.0	0.0	0.0
	Other companies	2.4	236.6	239.0
	Morsevo (Komárno)	0.0	1034.0	1034.0
	International shipping companies	0.0	168.5	168.5
	Total	**1 495.3**	**5 917.8**	**7 413.1**
2018	Slovak Shipping and Ports (Danube)	3 239.00	809.75	2 429.25
	Slovak Water Management Enterprise	0.00	0.00	0.00
	Other companies	232.00	2.32	229.68
	Morsevo (Komárno)	824.00	0.00	824.00
	International shipping companies	0.00	0.00	0.00
	Total	**4 295.00**	**812.07**	**3 482.93**
2019	Slovak Shipping and Ports (Danube)	1 327.00	3 981.00	5 308.00
	Slovak Water Management Enterprise	0.00	0.00	0.00
	Other companies	3.26	322.74	326.00
	Morsevo (Komárno)	0.00	760.00	760.00
	International shipping companies	0.00	0.00	0.00
	Total	**1 330.26**	**5 063.74**	**6 394.00**

Table 3.82: *The emission estimation in national shipping for touristic purposes (NFR 1A3d) in 2019*

ACTIVITY DATA	LOCATION						TOTAL
	Piestany long trip	Piestany short trip	Trencin	Lipt. Mara	Oravska Priehrada	Zempl. Sirava	
Number of Trips (per year)	354.00	0	66.00	180.00	460	310.00	**1 043**
Duration of Trip (hours)	1.00	0	0.35	1.00	1	0.75	
Total Duration (hours/year)	503.00	0	23.10	180.00	514	225.00	**1036.1**
Fuel Consumption (l/hour)	12.00	0	13.00	12.00	6.01	12.00	
Total Consumption (l/year)	6 036.00	0	300.30	1 920.00	3 089	2 700.00	**7 434.2**
Total Consumption (kg/year)	5 070.24	0	252.25	1 382.40	2 595	2 268.00	**6 244.7**
Total Consumption (TJ/year)	0.214	0.000	0.011	0.061	0.109	0.096	**0.429**

3.6.6.2 Category-specific QA/QC

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

3.6.7 PIPELINE TRANSPORT (NFR 1A3ei)

There is a significant decrease of fuel consumption in recent years and this trend is related to the decrease of natural gas transit through the Slovak Republic. The fuel emissions are shown in ***Table 3.83***.

Table 3.83: *Overview of emissions from pipeline transport in particular years*

YEAR	EMISSIONS (kt)				
	NOx	NMVOC	SOx	TSP	CO
1990	3.107	0.122	0.00085	0.00011	0.364
1995	3.086	0.121	0.00085	0.00011	0.361
2000	3.125	0.087	0.00098	0.00012	0.418
2005	3.974	0.238	0.00096	0.00004	0.365
2010	2.350	0.200	0.00390	0.00004	0.194
2011	2.494	0.211	0.01434	0.00003	0.171
2012	0.689	0.132	0.00001	0.00002	0.082
2013	0.658	0.149	0.00004	0.00002	0.066
2014	0.186	0.260	0.00001	0.00005	0.063
2015	0.227	0.233	0.00002	0.00008	0.049

YEAR	EMISSIONS (kt)				
	NOx	NMVOC	SOx	TSP	CO
2016	0.289	0.263	0.00001	0.00005	0.060
2017	0.252	0.215	0.00001	0.00008	0.089
2018	0.209	0.149	0.00001	0.00364	0.122
2019	0.288	0.127	0.00002	0.00457	0.089
2005-2019	**-93%**	**-47%**	**-98%**	**4 108%**	**-76%**
1990-2019	**-91%**	**4%**	**-99%**	**2200%**	**-76%**

3.6.7.1 Methodological issues

The activity data on the consumption of natural gas used for energy to drive turbines were obtained from the NEIS database. Tier 2 methodology and the country-specific emission factor was used for emissions estimation in the pipeline transport category.

3.6.7.2 Source-specific QA/QC

The accuracy of the reported data was guaranteed by verifying the data reported in last year's submission.

3.6.7.3 Source-specific realculations

This category was recalculated fo the period 1990-1999 due to change of calculation of historical years in all energy categories. In this submission, they were calculated using weighted average of impled emission factors for the period 2000-2004 (for PMs for 2005-2010) instead of average emission factors for period 2000-2015. The change is shown in the following table (***Table 3.84***).

Table 3.84: *Previos and refined emissions in the category 1A3ei*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	C	P	R	C	P	R	C
1990	5.6738	3.1069	-45%	0.2227	0.1220	-45%	0.0016	0.0009	-45%
1991	4.9704	3.1013	-38%	0.1951	0.1217	-38%	0.0014	0.0009	-38%
1992	4.2493	3.1065	-27%	0.1668	0.1219	-27%	0.0012	0.0009	-27%
1993	3.5190	3.1035	-12%	0.1381	0.1218	-12%	0.0010	0.0009	-12%
1994	2.1244	3.1256	47%	0.0834	0.1227	47%	0.0006	0.0009	47%
1995	3.6783	3.0858	-16%	0.1444	0.1211	-16%	0.0010	0.0008	-16%
1996	4.2422	3.1452	-26%	0.1665	0.1235	-26%	0.0012	0.0009	-26%
1997	3.9817	3.1149	-22%	0.1563	0.1223	-22%	0.0011	0.0009	-22%
1998	4.0473	3.1762	-22%	0.1589	0.1247	-22%	0.0011	0.0009	-22%
1999	3.9479	3.0349	-23%	0.1550	0.1191	-23%	0.0011	0.0008	-23%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	0.0002	0.0001	-45%	0.0002	0.0001	-45%	0.0002	0.0001	-45%	0.6643	0.3638	-45%
1991	0.0002	0.0001	-38%	0.0002	0.0001	-38%	0.0002	0.0001	-38%	0.5819	0.3631	-38%
1992	0.0001	0.0001	-27%	0.0001	0.0001	-27%	0.0001	0.0001	-27%	0.4975	0.3637	-27%
1993	0.0001	0.0001	-12%	0.0001	0.0001	-12%	0.0001	0.0001	-12%	0.4120	0.3634	-12%
1994	0.0001	0.0001	47%	0.0001	0.0001	47%	0.0001	0.0001	47%	0.2487	0.3659	47%
1995	0.0001	0.0001	-16%	0.0001	0.0001	-16%	0.0001	0.0001	-16%	0.4306	0.3613	-16%
1996	0.0001	0.0001	-26%	0.0001	0.0001	-26%	0.0001	0.0001	-26%	0.4967	0.3682	-26%
1997	0.0001	0.0001	-22%	0.0001	0.0001	-22%	0.0001	0.0001	-22%	0.4662	0.3647	-22%
1998	0.0001	0.0001	-22%	0.0001	0.0001	-22%	0.0001	0.0001	-22%	0.4739	0.3719	-22%
1999	0.0001	0.0001	-23%	0.0001	0.0001	-23%	0.0001	0.0001	-23%	0.4622	0.3553	-23%
2000	0.0002	0.0001	-25%	0.0002	0.0001	-25%	0.0002	0.0001	-25%	0.4181	0.4181	-
2001	0.0001	0.0001	-27%	0.0001	0.0001	-27%	0.0001	0.0001	-27%	0.3427	0.3427	-

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
2002	0.0001	0.0001	-2%	0.0001	0.0001	-2%	0.0001	0.0001	-2%	0.4037	0.4037	-
2003	0.0001	0.0001	-2%	0.0001	0.0001	-2%	0.0001	0.0001	-2%	0.3470	0.3470	-
2004	0.0002	0.0002	-2%	0.0002	0.0002	-2%	0.0002	0.0002	-2%	0.3849	0.3849	-

P – Previous, R – Refined

3.6.8 OTHER (NFR 1A3eii)

This category is not occurring in the Slovak Republic.

3.6.9 CATEGORY-SPECIFIC RECALCULATIONS

Recalculations made in the transport sector were provided and implemented in the line with the Improvement plan reflecting recommendations made during previous reviews (***Table 3.85, Table 3.86***).

Table 3.85: *Summary of the recalculations and changes in 1A3c*

NUMBER	CATEGORY	DESCRIPTION	REFERENCE
1.	1A3c	Recalculation of years 2015-2018 as a result of moving to a higher tier and according to recommendations ***SK-1A3c-2020-0001***.	See **Chapter 3.6.5.1**

Table 3.86: *Recalculations of air pollutants in railways for years 2015-2018*

Pollutants	2015			2016		
	Submission 2021	Submission 2020	Difference	Submission 2021	Submission 2020	Difference
NOx	1.6565	1.5173	9.2%	1.6936	1.5556	8.9%
NMVOC	0.1383	0.1346	2.7%	0.1417	0.1380	2.7%
NH_3	0.0003	0.0002	42.9%	0.0003	0.0002	42.9%
$PM_{2.5}$	0.0311	0.0397	-21.5%	0.0319	0.0407	-21.6%
PM_{10}	0.0340	0.0417	-18.4%	0.0349	0.0427	-18.5%
TSP	0.0499	0.0440	13.5%	0.0511	0.0451	13.3%
CO	0.4689	0.3098	51.4%	0.4793	0.3177	50.9%
Pollutants	**2017**			**2018**		
	Submission 2021	**Submission 2020**	**Difference**	**Submission 2021**	**Submission 2020**	**Difference**
NOx	1.6500	1.5207	8.5%	1.6394	1.4181	15.6%
NMVOC	0.1385	0.1349	2.7%	0.1377	0.1258	9.4%
NH_3	0.0003	0.0002	42.9%	0.0003	0.0002	52.3%
$PM_{2.5}$	0.0312	0.0398	-21.6%	0.0310	0.0371	-16.5%
PM_{10}	0.0341	0.0418	-18.5%	0.0339	0.0390	-13.1%
TSP	0.0499	0.0441	13.2%	0.0496	0.0411	20.6%
CO	0.4668	0.3105	50.3%	0.4638	0.2896	60.2%

3.6.10 CATEGORY-SPECIFIC IMPROVEMENTS AND IMPLEMENTATION

No improvements are planned for the next submission.

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 the 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, combustion technologies as well as on operational practices and maintenance.

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

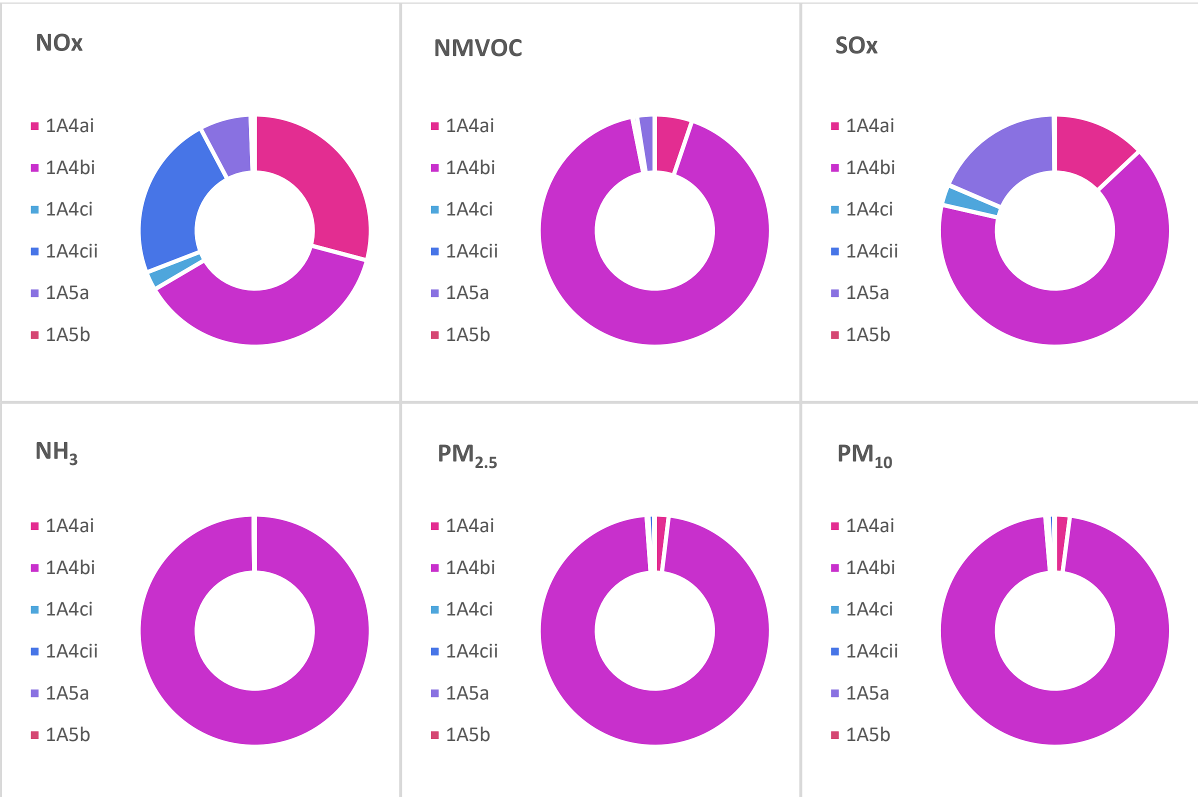
Relevant pollutants are SO_2, NOx, CO, NMVOC, particulate matter (PM), black carbon (BC), heavy metals, PAH, polychlorinated dibenzo-dioxins and furans (PCDD/F) and hexachlorobenzene (HCB). For solid fuels, generally, the emissions due to incomplete combustion are many times greater in small appliances than in bigger plants. This is particularly valid for manually-fed appliances and poorly controlled automatic installations.

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

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

All non-road mobile machinery is reported in category 1A4cii. From the figures below is clear that the main contributor to emissions in this subsector is category 1A4bi (***Figure 3.8***).

Figure 3.8: *Share of emissions of main pollutants in 1A4 and 1A5 in 2019*



3.7.2 COMMERCIAL/INSTITUTIONAL: STATIONARY (NFR 1A4ai)

3.7.2.1 Overview

The category covers the sources that cannot be clearly identified to particular activity but generally it is the combustion process. Activities listed within this category are shown in ***Table 3.87***.

Table 3.87: *Activities according to national categorization included in 1A4ai*

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

An overview of the emissions is shown in ***Table 3.88***. Most of the emissions have an overall decreasing trend due to the decrease in the volume of use of coal. Emissions of NMVOC, Cd, Cr, Zn and HCB increased significantly due to the preference of biomass fuels as a renewable source and political support of this fuel.

Table 3.88: *Overview of emissions in the category 1A4ai*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	2.7454	0.2273	2.1823	NO	0.8339	1.0077	1.4833	4.3293
1995	2.7469	0.2275	2.1835	NO	0.8344	1.0082	1.4841	4.3317
2000	2.7491	0.1819	2.8190	NO	1.0416	1.2586	1.8527	5.3649
2005	1.9757	0.0940	0.9169	NO	0.2511	0.3374	0.6377	2.1883
2010	2.0710	0.7784	0.5606	NO	0.2450	0.3000	0.4388	2.3221
2011	2.2152	0.9788	0.4986	NO	0.2597	0.3108	0.4357	2.5274
2012	2.3288	1.2330	0.4348	NO	0.2945	0.3445	0.4586	2.9270
2013	2.4146	1.5068	0.3968	NO	0.3166	0.3627	0.4524	3.1083
2014	2.6183	1.5829	0.3815	0.0001	0.3008	0.3378	0.4052	2.9019
2015	2.7388	1.7181	0.4286	0.0001	0.3118	0.3471	0.4124	2.8848
2016	2.6993	1.7454	0.3609	0.0001	0.3150	0.3507	0.4131	2.8042
2017	2.7854	1.7891	0.3608	0.0001	0.3287	0.3664	0.4278	2.7492
2018	2.6311	1.6964	0.2901	0.0001	0.2985	0.3305	0.3766	2.4489
2019	2.5737	1.8088	0.2527	0.0001	0.2799	0.3100	0.3593	2.4490
1990/2019	**-6%**	**696%**	**-88%**		**-66%**	**-69%**	**-76%**	**-43%**
2018/2019	**-2%**	**7%**	**-13%**	**-1%**	**-6%**	**-6%**	**-5%**	**0%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.7524	0.0419	0.0385	0.0240	0.1264	0.1097	0.1294	0.0103	2.3110
1995	0.3190	0.0118	0.0176	0.0116	0.0440	0.0455	0.0561	0.0044	0.7568
2000	0.1200	0.0039	0.0077	0.0056	0.0155	0.0169	0.0186	0.0018	0.2649
2005	0.0581	0.0089	0.0054	0.0049	0.0197	0.0099	0.0236	0.0012	0.3899
2010	0.2384	0.0517	0.0136	0.0086	0.1041	0.0399	0.0247	0.0044	2.1790
2011	0.2419	0.0622	0.0127	0.0078	0.1211	0.0423	0.0240	0.0045	2.5715
2012	0.2632	0.0791	0.0126	0.0075	0.1499	0.0484	0.0245	0.0051	3.2248
2013	0.2846	0.0916	0.0127	0.0074	0.1714	0.0537	0.0255	0.0056	3.7128
2014	0.2533	0.0916	0.0106	0.0062	0.1685	0.0499	0.0224	0.0056	3.6868
2015	0.2702	0.1005	0.0110	0.0063	0.1842	0.0538	0.0236	0.0059	4.0368
2016	0.2503	0.0946	0.0102	0.0060	0.1728	0.0503	0.0218	0.0056	3.7951
2017	0.2645	0.1001	0.0108	0.0063	0.1830	0.0530	0.0225	0.0059	4.0157
2018	0.2406	0.0915	0.0098	0.0057	0.1671	0.0483	0.0202	0.0055	3.6714

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2019	0.2477	0.0980	0.0096	0.0055	0.1780	0.0506	0.0208	0.0058	3.9246
1990/2019	**-67%**	**134%**	**-75%**	**-77%**	**41%**	**-54%**	**-84%**	**-44%**	**70%**
2018/2019	**3%**	**7%**	**-2%**	**-4%**	**7%**	**5%**	**3%**	**5%**	**7%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	1.4422	0.3148	0.4225	0.1791	0.1457	1.0620	0.0152	0.7376
1995	0.5907	0.1391	0.1864	0.0841	0.0698	0.4793	0.0041	0.3265
2000	0.2252	0.0580	0.0788	0.0401	0.0347	0.2115	0.0013	0.1242
2005	0.1480	0.0397	0.0585	0.0372	0.0347	0.1701	0.0034	0.0429
2010	0.5987	0.0966	0.1438	0.0665	0.0573	0.3641	0.0199	0.1730
2011	0.6484	0.0962	0.1470	0.0645	0.0553	0.3630	0.0239	0.1516
2012	0.7568	0.1042	0.1644	0.0682	0.0583	0.3951	0.0304	0.1349
2013	0.8486	0.1135	0.1843	0.0731	0.0626	0.4335	0.0352	0.1272
2014	0.8042	0.1055	0.1916	0.0699	0.0608	0.4277	0.0352	0.0853
2015	0.8710	0.1125	0.2046	0.0739	0.0642	0.4552	0.0387	0.0831
2016	0.8170	0.1065	0.1947	0.0709	0.0619	0.4340	0.0364	0.0713
2017	0.8614	0.1114	0.2056	0.0741	0.0647	0.4558	0.0385	0.0768
2018	0.7860	0.1022	0.1936	0.0685	0.0600	0.4244	0.0352	0.0684
2019	0.8269	0.1055	0.2041	0.0702	0.0615	0.4413	0.0377	0.0598
1990/2019	**-43%**	**-66%**	**-52%**	**-61%**	**-58%**	**-58%**	**148%**	**-92%**
2018/2019	**5%**	**3%**	**5%**	**2%**	**2%**	**4%**	**7%**	**-13%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.89*** below.

Table 3.89: *Overview of activity data in the category 1A4ai*

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	375.15	3 778.73	43 053.56	225.84	NO
1995	361.45	3 664.15	43 217.31	216.44	NO
2000	404.13	3 326.20	41 220.69	225.84	NO
2005	164.99	1 176.35	37 589.84	332.87	NO
2010	138.98	1 306.13	28 860.16	3 917.21	NO
2011	115.82	1 011.43	25 399.22	5 151.81	NO
2012	87.79	911.25	24 388.98	6 639.92	NO
2013	60.40	892.57	24 507.10	8 078.16	NO
2014	51.64	615.17	22 211.10	10 867.04	NO
2015	49.81	489.84	23 292.66	11 325.35	NO
2016	40.06	418.85	24 016.88	10 877.96	NO
2017	41.44	450.99	24 660.76	11 105.85	NO
2018	29.51	402.26	22 969.28	9 373.46	NO
2019	71.43	351.29	22 524.90	9 842.97	NO
1990/2019	**-81%**	**-91%**	**-48%**	**4258%**	**-**
2018/2019	**142%**	**-13%**	**-2%**	**5%**	**-**

3.7.2.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from

TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.90***).

Table 3.90: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	57.88	4.79	46.01	31.27	56%	68%	91.27

The emissions of heavy metals and POPs are calculated at Tier 2 level. The data (fuel, technology and specific information) is compiled in the NEIS database, therefore this detailed methodologies could be used focused to the combinations of the main installation types/fuels used in our country. Emission factors used for the calculation of emissions of heavy metals and POPs are default EF from EMEP/EEA GB_{2019} (***Table 3.91***).

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

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

Where:

E_i = annual emission of pollutant *i*,

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

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

Table 3.91: *Emission factors for heavy metals and POPs in the category 1A4ai*

T2	UNIT	LIQUID FUELS				HARD COAL/BROWN COAL	
		Standard boilers (> 50 KWth ≤ 1 MWth)	**Standard boilers** (> 1 MWth ≤ 50 MWth)	**Gas turbines** (50 kWth – 50 MWth)	**Stationary reciprocating engines** (50 kWth – 50 MWth)	**Standard boilers** (> 50 KWth ≤ 1 MWth)	**Standard boilers** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	20	10	0.012	0.15	200	100
Cd	[mg/GJ]	0.3	0.3	0.001	0.01	3	1
Hg	[mg/GJ]	0.1	0.1	0.12	0.11	7	9
As	[mg/GJ]	1	1	0.002	0.06	5	4
Cr	[mg/GJ]	20	20	0.2	0.2	15	15
Cu	[mg/GJ]	10	3	0.13	0.3	17.5	10
Ni	[mg/GJ]	300	200	0.005	0.01	13	10
Se	[mg/GJ]	NA	0.5	0.002	0.22	1.8	2
Zn	[mg/GJ]	10	5	0.42	58	200	150
PCDD/F	[ng I-TEQ/GJ]	10	10	1.8	0.99	203	100
B(a)P	[mg/GJ]	8	1	NE	1.9	45.5	13
B(b)F	[mg/GJ]	9	2	NE	15	58.9	17
B(k)F	[mg/GJ]	6	1	NE	1.7	23.7	9
I()P	[mg/GJ]	3	1	NE	1.5	18.5	6
PAHs	[mg/GJ]	26	5	NE	20.1	146.6	45
HCB	[µg/GJ]	NE	NE	NE	0.22	0.62	0.62
PCBs	[µg/GJ]	NE	NE	NE	0.13	170	170

T2	UNIT	GASEOUS FUELS				BIOMASS	
		Standard boilers (> 50 KWth ≤ 1 MWth)	**Standard boilers** (> 1 MWth ≤ 50 MWth)	**Gas turbines** (50 kWth – 50 MWth)	**Stationary reciprocating engines** (50 kWth – 50 MWth)	**Standard boilers** (> 50 KWth ≤ 1 MWth)	**Standard boilers** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	0.0015	0.0015	0.0015	0.04	27	27
Cd	[mg/GJ]	0.00025	0.00025	0.00025	0.003	13	13
Hg	[mg/GJ]	0.1	0.1	0.1	0.1	0.56	0.56
As	[mg/GJ]	0.12	0.12	0.12	0.05	0.19	0.19
Cr	[mg/GJ]	0.00076	0.00076	0.00076	0.05	23	23
Cu	[mg/GJ]	0.000076	0.000076	0.000076	0.01	6	6
Ni	[mg/GJ]	0.00051	0.00051	0.00051	0.05	2	2
Se	[mg/GJ]	0.011	0.011	0.011	0.2	0.5	0.5
Zn	[mg/GJ]	0.0015	0.0015	0.0015	2.9	512	512
PCDD/F	[ng I-TEQ/GJ]	0.5	0.5	0.5	0.57	100	100
B(a)P	[mg/GJ]	0.56	0.56	0.56	1.2	10	10
B(b)F	[mg/GJ]	0.84	0.84	0.84	9	16	16
B(k)F	[mg/GJ]	0.84	0.84	0.84	1.7	5	5
I()P	[mg/GJ]	0.84	0.84	0.84	1.8	4	4
PAHs	[mg/GJ]	3.08	3.08	3.08	13.7	35	35
HCB	[μg/GJ]	NA	NA	NA	NA	5	5
PCBs	[μg/GJ]	NA	NA	NA	NA	0.03	0.007

3.7.2.3 Completeness

Emissions of BC are reported as NE and ammonia emissions are not occurring in this category until 2014.

3.7.2.4 Source-specific recalculations

No recalculations in this submission for emissions of main pollutants.

The detailed information compiled in the NEIS database allowed to use of Tier 2 emission factors EMEP/EEA GB_{2019} for the calculation of emissions of HMs and POPs with the aim to improve the methodology for this category. Recalculations are shown in ***Table 3.92***.

Table 3.92: *Previous and refined emissions in the category 1A4ai*

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.5158	0.7524	46%	0.0099	0.0419	322%	0.0343	0.0385	12%	0.0196	0.0240	22%
1991	0.5142	0.6438	25%	0.0099	0.0335	240%	0.0342	0.0333	-3%	0.0196	0.0209	7%
1992	0.5126	0.5467	7%	0.0098	0.0264	169%	0.0341	0.0287	-16%	0.0195	0.0182	-7%
1993	0.5114	0.4606	-10%	0.0098	0.0205	109%	0.0341	0.0246	-28%	0.0195	0.0158	-19%
1994	0.5101	0.3850	-25%	0.0098	0.0156	60%	0.0340	0.0209	-39%	0.0195	0.0135	-31%
1995	0.5001	0.3190	-36%	0.0096	0.0118	23%	0.0334	0.0176	-47%	0.0192	0.0116	-40%
1996	0.4999	0.2617	-48%	0.0096	0.0088	-9%	0.0334	0.0148	-56%	0.0191	0.0099	-48%
1997	0.4913	0.5029	2%	0.0095	0.0106	12%	0.0329	0.0269	-18%	0.0189	0.0169	-11%
1998	0.4735	0.2950	-38%	0.0090	0.0069	-24%	0.0319	0.0165	-48%	0.0184	0.0108	-41%
1999	0.4408	0.2108	-52%	0.0084	0.0055	-35%	0.0300	0.0123	-59%	0.0174	0.0083	-52%
2000	0.4552	0.1200	-74%	0.0090	0.0039	-57%	0.0306	0.0077	-75%	0.0177	0.0056	-68%
2001	0.3623	0.1048	-71%	0.0067	0.0055	-17%	0.0255	0.0069	-73%	0.0152	0.0052	-66%
2002	0.3006	0.1718	-43%	0.0058	0.0058	0%	0.0217	0.0102	-53%	0.0132	0.0071	-46%
2003	0.2277	0.0192	-92%	0.0048	0.0054	14%	0.0172	0.0024	-86%	0.0108	0.0025	-77%
2004	0.1871	0.0947	-49%	0.0039	0.0071	79%	0.0147	0.0061	-59%	0.0094	0.0046	-51%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2005	0.1680	0.0581	-65%	0.0065	0.0089	37%	0.0133	0.0054	-60%	0.0086	0.0049	-42%
2006	0.1537	0.0761	-50%	0.0094	0.0095	0%	0.0120	0.0066	-45%	0.0078	0.0058	-26%
2007	0.1469	0.1535	5%	0.0118	0.0120	2%	0.0110	0.0101	-8%	0.0070	0.0077	9%
2008	0.1547	0.1419	-8%	0.0193	0.0170	-12%	0.0108	0.0088	-18%	0.0069	0.0070	1%
2009	0.2284	0.1987	-13%	0.0267	0.0265	-1%	0.0144	0.0129	-10%	0.0085	0.0085	-1%
2010	0.2746	0.2384	-13%	0.0497	0.0517	4%	0.0153	0.0136	-11%	0.0089	0.0086	-4%
2011	0.2677	0.2419	-10%	0.0650	0.0622	-4%	0.0133	0.0127	-5%	0.0076	0.0078	2%
2012	0.2872	0.2632	-8%	0.0808	0.0791	-2%	0.0132	0.0126	-5%	0.0074	0.0075	1%
2013	0.3235	0.2846	-12%	0.0995	0.0916	-8%	0.0138	0.0127	-8%	0.0076	0.0074	-2%
2014	0.2969	0.2533	-15%	0.1041	0.0916	-12%	0.0119	0.0106	-10%	0.0065	0.0062	-6%
2015	0.2984	0.2702	-9%	0.1127	0.1005	-11%	0.0113	0.0110	-3%	0.0063	0.0063	1%
2016	0.2879	0.2503	-13%	0.1122	0.0946	-16%	0.0108	0.0102	-6%	0.0060	0.0060	0%
2017	0.2986	0.2645	-11%	0.1154	0.1001	-13%	0.0112	0.0108	-4%	0.0062	0.0063	1%
2018	0.2573	0.2406	-7%	0.0985	0.0915	-7%	0.0099	0.0098	-1%	0.0056	0.0057	2%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.2604	0.0603	-77%	0.3103	0.0687	-78%	0.2220	0.0928	-58%
1991	0.0603	0.1264	109%	0.0687	0.1097	60%	0.09281	0.12942	39%
1992	0.0601	0.1044	74%	0.0684	0.0934	37%	0.09234	0.10947	19%
1993	0.0600	0.0853	42%	0.0682	0.0790	16%	0.09221	0.09172	-1%
1994	0.0598	0.0689	15%	0.0681	0.0662	-3%	0.09231	0.07604	-18%
1995	0.0597	0.0553	-7%	0.0679	0.0551	-19%	0.09199	0.06590	-28%
1996	0.0584	0.0440	-25%	0.0666	0.0455	-32%	0.08972	0.05607	-38%
1997	0.0587	0.0346	-41%	0.0666	0.0371	-44%	0.09152	0.04438	-52%
1998	0.0576	0.0550	-5%	0.0654	0.0696	6%	0.08958	0.06381	-29%
1999	0.0553	0.0335	-39%	0.0630	0.0410	-35%	0.08537	0.04007	-53%
2000	0.0518	0.0249	-52%	0.0587	0.0294	-50%	0.08185	0.02989	-63%
2001	0.0543	0.0155	-71%	0.0608	0.0169	-72%	0.09048	0.01855	-79%
2002	0.0419	0.0173	-59%	0.0482	0.0153	-68%	0.06377	0.02097	-67%
2003	0.0359	0.0231	-36%	0.0401	0.0245	-39%	0.06237	0.03589	-42%
2004	0.0291	0.0115	-61%	0.0308	0.0041	-87%	0.06343	0.02223	-65%
2005	0.0240	0.0197	-18%	0.0253	0.0145	-43%	0.05206	0.03146	-40%
2006	0.0252	0.0197	-22%	0.0230	0.0099	-57%	0.03159	0.02361	-25%
2007	0.0281	0.0219	-22%	0.0216	0.0123	-43%	0.02023	0.02328	15%
2008	0.0311	0.0309	0%	0.0212	0.0228	8%	0.01730	0.01947	13%
2009	0.0438	0.0377	-14%	0.0237	0.0226	-4%	0.01824	0.01902	4%
2010	0.0615	0.0601	-2%	0.0345	0.0301	-13%	0.02475	0.02216	-10%
2011	0.1029	0.1041	1%	0.0451	0.0399	-12%	0.03871	0.02468	-36%
2012	0.1266	0.1211	-4%	0.0472	0.0423	-10%	0.03470	0.02401	-31%
2013	0.1532	0.1499	-2%	0.0527	0.0484	-8%	0.03292	0.02453	-25%
2014	0.1859	0.1714	-8%	0.0610	0.0537	-12%	0.03154	0.02554	-19%
2015	0.1912	0.1685	-12%	0.0585	0.0499	-15%	0.02799	0.02238	-20%
2016	0.2051	0.1842	-10%	0.0603	0.0538	-11%	0.02791	0.02359	-15%
2017	0.2034	0.1728	-15%	0.0589	0.0503	-15%	0.02559	0.02178	-15%
2018	0.2093	0.1830	-13%	0.0609	0.0530	-13%	0.02655	0.02249	-15%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0095	0.0103	9%	0.9124	2.3110	153%
1991	0.0094	0.0088	-7%	0.9093	1.8921	108%
1992	0.0094	0.0075	-20%	0.9067	1.5309	69%
1993	0.0094	0.0063	-33%	0.9050	1.2236	35%
1994	0.0094	0.0053	-43%	0.9027	0.9671	7%
1995	0.0092	0.0044	-52%	0.8842	0.7568	-14%
1996	0.0092	0.0036	-61%	0.8864	0.5888	-34%
1997	0.0091	0.0067	-27%	0.8707	0.8948	3%
1998	0.0089	0.0040	-55%	0.8379	0.5509	-34%
1999	0.0084	0.0029	-65%	0.7828	0.4135	-47%
2000	0.0085	0.0018	-79%	0.8177	0.2649	-68%
2001	0.0074	0.0016	-78%	0.6389	0.3110	-51%
2002	0.0065	0.0024	-62%	0.5433	0.3869	-29%
2003	0.0054	0.0005	-90%	0.4331	0.2233	-48%
2004	0.0048	0.0015	-69%	0.3600	0.3587	0%
2005	0.0045	0.0012	-73%	0.4354	0.3899	-10%
2006	0.0042	0.0015	-65%	0.5300	0.4306	-19%
2007	0.0039	0.0024	-37%	0.6058	0.5989	-1%
2008	0.0041	0.0023	-43%	0.8955	0.7749	-13%
2009	0.0050	0.0035	-29%	1.2437	1.1925	-4%
2010	0.0059	0.0044	-26%	2.1497	2.1790	1%
2011	0.0058	0.0045	-22%	2.7100	2.5715	-5%
2012	0.0062	0.0051	-18%	3.3167	3.2248	-3%
2013	0.0069	0.0056	-19%	4.0530	3.7128	-8%
2014	0.0066	0.0056	-15%	4.1987	3.6868	-12%
2015	0.0067	0.0059	-12%	4.5214	4.0368	-11%
2016	0.0066	0.0056	-16%	4.4936	3.7951	-16%
2017	0.0068	0.0059	-13%	4.6223	4.0157	-13%
2018	0.0059	0.0055	-7%	3.9487	3.6714	-7%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.8148	1.4422	77%	0.8189	1.0620	30%	0.0036	0.0152	325%	0.6424	0.7376	15%
1991	0.8123	1.2256	51%	0.8173	0.9156	12%	0.0036	0.0121	240%	0.6404	0.6365	-1%
1992	0.8099	1.0336	28%	0.8155	0.7851	-4%	0.0036	0.0095	168%	0.6384	0.5454	-15%
1993	0.8080	0.8651	7%	0.8139	0.6721	-17%	0.0036	0.0073	106%	0.6368	0.4637	-27%
1994	0.8060	0.7176	-11%	0.8123	0.5683	-30%	0.0035	0.0056	57%	0.6353	0.3909	-38%
1995	0.7905	0.5907	-25%	0.8024	0.4793	-40%	0.0035	0.0041	20%	0.6229	0.3265	-48%
1996	0.7902	0.4826	-39%	0.7998	0.4023	-50%	0.0035	0.0031	-12%	0.6223	0.2700	-57%
1997	0.7770	0.8927	15%	0.7912	0.7098	-10%	0.0034	0.0034	1%	0.6117	0.5350	-13%
1998	0.7494	0.5303	-29%	0.7723	0.4415	-43%	0.0033	0.0023	-30%	0.5897	0.3120	-47%
1999	0.6991	0.3836	-45%	0.7366	0.3317	-55%	0.0030	0.0018	-40%	0.5487	0.2216	-60%
2000	0.7215	0.2252	-69%	0.7423	0.2115	-72%	0.0033	0.0013	-59%	0.5655	0.1242	-78%
2001	0.5780	0.2070	-64%	0.6557	0.1963	-70%	0.0024	0.0020	-16%	0.4520	0.1032	-77%
2002	0.4828	0.3188	-34%	0.5762	0.2807	-51%	0.0021	0.0020	-4%	0.3735	0.1767	-53%
2003	0.3711	0.0623	-83%	0.4883	0.0823	-83%	0.0018	0.0021	19%	0.2804	0.0073	-97%
2004	0.3077	0.1947	-37%	0.4317	0.1773	-59%	0.0014	0.0026	81%	0.2303	0.0876	-62%
2005	0.2924	0.1480	-49%	0.4048	0.1701	-58%	0.0024	0.0034	39%	0.2000	0.0429	-79%
2006	0.2852	0.1823	-36%	0.3803	0.2030	-47%	0.0036	0.0036	1%	0.1742	0.0617	-65%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2007	0.2837	0.3216	13%	0.3465	0.2944	-15%	0.0044	0.0044	0%	0.1592	0.1430	-10%
2008	0.3303	0.3311	0%	0.3573	0.2894	-19%	0.0074	0.0064	-14%	0.1490	0.1119	-25%
2009	0.4708	0.4283	-9%	0.4258	0.3142	-26%	0.0102	0.0101	0%	0.2252	0.1846	-18%
2010	0.6453	0.5987	-7%	0.4914	0.3641	-26%	0.0190	0.0199	4%	0.2223	0.1730	-22%
2011	0.7052	0.6484	-8%	0.4720	0.3630	-23%	0.0249	0.0239	-4%	0.1722	0.1516	-12%
2012	0.8070	0.7568	-6%	0.4957	0.3951	-20%	0.0310	0.0304	-2%	0.1553	0.1349	-13%
2013	0.9477	0.8486	-10%	0.5437	0.4335	-20%	0.0382	0.0352	-8%	0.1522	0.1272	-16%
2014	0.9307	0.8042	-14%	0.5170	0.4277	-17%	0.0400	0.0352	-12%	0.1051	0.0853	-19%
2015	0.9735	0.8710	-11%	0.5277	0.4552	-14%	0.0433	0.0387	-11%	0.0838	0.0831	-1%
2016	0.9562	0.8170	-15%	0.5177	0.4340	-16%	0.0431	0.0364	-16%	0.0714	0.0713	0%
2017	0.9869	0.8614	-13%	0.5345	0.4558	-15%	0.0443	0.0385	-13%	0.0769	0.0768	0%
2018	0.8467	0.7860	-7%	0.4683	0.4244	-9%	0.0378	0.0352	-7%	0.0688	0.0684	-1%

P – Previous, R – Refined

3.7.3 COMMERCIAL/INSTITUTIONAL: MOBILE (NFR 1A4aii)

3.7.3.1 Overview

After obtaining data from the Statistical Office of the Slovak Republic it was possible to separate all the categories for 2019. Results of the separation are in ***Table 3.93***.

Table 3.93*: Overview of emissions commercial/institutional: mobile (1A4aii) for 2019*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]	BC [kt]	Cd [t]	PAHs [t]
2019	0.0680	0.1496	0.0008	0.0003	0.0808	0.0808	0.0808	0.4843	0.0469	0.0004	2.7552

3.7.4 RESIDENTIAL: STATIONARY (NFR 1A4bi)

3.7.4.1 Overview

The emission inventory for households' heating has undergone the improvement of methodology and increase of methodological level from T1 to T2 in submission 2019 because households' heating is a significant contributor of particulate matters (approximately 80% as well as other emissions in Slovakia). The trend in emission, as well as fuel consumption, are relatively stable with a slight downward trend.

This category is key for most of the pollutants (NOx, SOx, NMVOC, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Cd, Hg, As, Cr, Ni, Zn, PCDD/F, PAHs, HCB, PCBs). The emission trend of all pollutants shows a very similar trend which correlates with the trend of biomass burning (wood) in Slovak households.

An overview of the emissions is shown in ***Table 3.94***.

Table 3.94: *Overview of emissions in the category 1A4bi*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	5.1971	136.8648	28.8620	0.3259	78.1729	79.3979	87.1231	5.6817	690.2921
1995	3.6223	63.0227	11.1223	0.7147	34.1807	34.7633	37.9143	2.6490	315.4333
2000	3.8857	47.1180	6.7151	0.9072	24.5206	24.9708	27.0765	2.0141	229.6318
2005	4.1456	48.6813	2.3431	2.0635	21.9844	22.4908	23.8950	2.1639	226.4921
2010	4.0201	46.3647	1.7528	2.0910	20.5575	21.0422	22.2990	2.0660	215.1242
2011	3.6592	43.4006	1.6277	1.9526	19.1940	19.6460	20.8239	1.9278	201.6142
2012	3.7751	47.3901	1.7450	2.1430	20.8628	21.3551	22.6300	2.1004	220.3918
2013	3.6917	44.1582	1.6218	1.9855	19.3900	19.8464	21.0368	1.9497	205.2521
2014	2.7537	26.2323	1.2132	1.1010	11.7489	12.0168	12.7773	1.1529	121.6985
2015	3.2537	36.2392	1.4173	1.6285	15.9562	16.3291	17.3203	1.5975	169.8696

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2016	3.4790	39.5439	1.4421	1.8327	16.6725	17.0698	18.0706	1.6926	187.4071
2017	3.6707	38.7782	1.6169	1.7605	17.1695	17.5676	18.6444	1.7136	184.6616
2018	3.1740	30.1454	1.3015	1.3765	13.3748	13.6838	14.5257	1.3333	144.9811
2019	3.3041	31.8039	1.2776	1.4996	14.0702	14.3982	15.2700	1.4129	154.0389
1990/2019	**-36%**	**-77%**	**-96%**	**360%**	**-82%**	**-82%**	**-82%**	**-75%**	**-78%**
2018/2019	**4%**	**6%**	**-2%**	**9%**	**5%**	**5%**	**5%**	**6%**	**6%**

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	0.4969	0.3172	0.0763	0.0626	1.0034	0.2607	0.1349	0.0533	6.1297
2013	0.4673	0.2942	0.0748	0.0594	0.9351	0.2438	0.1261	0.0505	5.7062
2014	0.2793	0.1640	0.0576	0.0421	0.5458	0.1420	0.0744	0.0316	3.2360
2015	0.3975	0.2426	0.0661	0.0523	0.7797	0.2054	0.1057	0.0431	4.7668
2016	0.4373	0.2668	0.0685	0.0517	0.8477	0.2278	0.1168	0.0466	5.0692
2017	0.4454	0.2625	0.0752	0.0603	0.8580	0.2276	0.1168	0.0486	5.2257
2018	0.3536	0.2054	0.0646	0.0498	0.6784	0.1803	0.0924	0.0386	4.1154
2019	0.3787	0.2235	0.0659	0.0507	0.7271	0.1939	0.0989	0.0409	4.4620
1990/2019	**-64%**	**227%**	**-82%**	**-92%**	**-70%**	**-56%**	**-69%**	**-73%**	**12%**
2018/2019	**7%**	**9%**	**2%**	**2%**	**7%**	**8%**	**7%**	**6%**	**8%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	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	8.8678	5.9609	4.3626	2.3611	3.1507	15.8353	2.3405	0.1060
2013	8.2384	5.5494	4.0977	2.1970	2.9449	14.7890	2.4393	0.1015
2014	4.7695	3.2658	2.4572	1.2916	1.7454	8.7600	2.0084	0.0681
2015	6.8563	4.5574	3.4065	1.8088	2.4437	12.2164	2.2895	0.0886
2016	7.4696	4.9155	3.6705	1.9723	2.6454	13.2036	2.0360	0.1041
2017	7.5707	4.8967	3.7432	1.9533	2.6824	13.2756	2.8869	0.1033
2018	5.9767	3.8073	2.9380	1.5245	2.1082	10.3781	2.3167	0.0832
2019	6.4474	4.0469	3.1203	1.6236	2.2517	11.0424	2.3582	0.0866
1990/2019	**-11%**	**-69%**	**-66%**	**-70%**	**-67%**	**-68%**	**-82%**	**-87%**
2018/2019	**8%**	**6%**	**6%**	**6%**	**7%**	**6%**	**2%**	**4%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.95*** below. This table represents fuels allocated to the fuel type for calculations. Fuels in the template are allocated following principle from IPCC 2006 Guidelines.

Table 3.95: *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	2391.54	3919.58	42706.76	NO	28588.64	1472.00	4786.82	NO
1995	776.15	1124.53	16578.16	NO	42360.63	1058.00	10554.05	NO
2000	520.51	1135.69	9566.68	28.78	60243.02	552.00	13401.63	23.44
2005	652.91	305.54	2660.03	51.78	59225.83	322.00	30702.27	96.75
2010	706.47	293.34	1588.60	185.17	55629.42	552.00	31445.73	357.29
2011	802.14	216.50	1390.84	288.50	49133.79	276.00	29376.04	523.34
2012	887.42	222.68	1418.31	392.86	47192.12	460.00	32182.72	785.81
2013	942.90	230.19	1177.86	506.85	48200.08	368.00	29772.52	944.59
2014	828.07	170.77	913.26	414.61	43395.60	184.00	16687.61	430.61
2015	982.83	147.10	955.40	570.61	43903.00	184.00	24654.61	884.13
2016	1025.72	204.57	804.37	641.48	44697.43	368.00	27800.63	1125.80
2017	1252.68	217.24	863.90	936.44	49339.18	368.00	26675.16	1256.85
2018	1056.04	131.98	652.26	862.55	45735.20	322.00	20857.68	1122.63
2019	1100.86	106.96	556.82	899.92	45951.45	276.00	22817.76	1383.13
1990/2019	**-54%**	**-97%**	**-99%**	**-**	**61%**	**-81%**	**377%**	**-**
2018/2019	**4%**	**-19%**	**-15%**	**4%**	**0%**	**-14%**	**9%**	**23%**

HC – Hard coal
BC – Brown coal
CB – Coal briquettes
LF – Liquid fuels
FW – Firewood
P&WB – Pellets and wooden briquettes

3.7.4.2 Methodological issues

The residential sector is a key emissions source in this category and represents 10.3% share of the total GHG emissions in the year 2019. The category 1A4b balanced mostly gaseous (natural gas), solid (coal) and biomass (wood) fuels. Whereas, the gaseous fuels consumption is consistent and accurate due to statistics made directly by the natural gas suppliers, solid fuels and biomass statistics is not fully covered by the ŠÚ SR. Direct statistics is missing or very complicated to obtain. Due to these reasons, several inconsistencies between fuels consumption reported in this category were recorded and commented on in the previous inventory. Major differences occurred between the data reported in the national energy balance provided by the ŠÚ SR and data reported by the companies selling solid fuels and biomass to households (data reported in the NEIS database). The Slovak NIS experts, therefore, planned to focus on better input data collection and removing these inconstancies and harmonise national statistics in this field.

In 2018, the Project Grant “Quality Improvement of Air Emission Accounts and Extension of Provided Time series” launched by the European Commission – EUROSTAT was successfully finished. Results were published online in several partial reports http://www.shmu.sk/sk/?page=2339 and on the international conference “Air Protection in Slovakia” held in the High Tatras on 11-13 November 2020. The Project Grant was carried out in cooperation with the Statistical Office of the Slovak Republic.

Cooperation with the Statistical Office of the Slovak Republic continued and resulted in the second statistical survey in households. This activity, together with the help and interest of other relevant national authorities, confirmed and improved the previous estimation of biomass consumption in households.

In previous inventory, data on solid fuels and biomass (wood) energy consumption in households collected and evaluated in a frame of this Project Grant were used for the first time. 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, revision of households energy statistics to the EUROSTAT as done for the year 2019. The revision will be focused on solid fuels and biomass (non-fossil fuels) and will be performed since the year 2012. With this revision, consistency in the reporting data in households will be improved.

Time series on fuel consumption (solid and biomass) from households reconstructed in the frame of the EUROSTAT project and published on the SHMÚ website[14] 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 statistical survey and further estimation of "total energy demand for heating" in households calculated using data from questionnaires and climatological data in different regions. In principle, the average value of "energy demand" is a parameter on heating demand (including preparation of hot water) for 1 m^2 of housing area for 1 year. Total housing area, energy effectivity of houses and climatological factors in regional scaling were taking into consideration for the calculation of total energy demand for heating in houses without a central heating system.

Emission factors

The country specific emission factors for combustion of solid fuels (hard and brown coal, briquettes, coal and wood), natural gas and fuel oil were obtained from results of VEC VŠB[15] measurement at low and nominal heat rating. These data were provided in cooperation with the air quality modellers´ team (Air Quality Department, SHMÚ) throughout their active participation in the project *LIFE Integrated Project: Implementation of Air Quality Plan for Małopolska Region – Małopolska in a healthy atmosphere*.[5]. The values were set for over-fire boilers, under-fire boilers, gasification boilers and automatic boilers.

Emission factors of air pollutants for two additional categories for fireplaces, stoves, masonry/built-in tile stoves (Tables 3-14 and 3-17) modern masonry/built-in tile stoves and pellets stoves (table 3-25) were obtained from the EMEP/EEA GB_{2016} (Tier 2). The GHGs emission factors for relevant fuel types were taken from IPCC Guidelines, tier 1 methodology. For category Modern masonry/built-in tile stoves and pellets stoves, emission factors only for combustion of wood, wooden pellets and briquettes were available.

Description of all EF is available in the **Final report on the implementation of the action**.

3.7.4.3 Completeness

All rising pollutants were reported.

3.7.4.4 Source-specific recalculations

Recalculations in biomass consumption for the years 2012-2018 was based on new data from the second statistical survey in households and based on the improvement process in households' data estimation. Cooperation with the ŠÚ SR and other authorities resulting in new information on electricity used for heating and hot water preparation. This caused changes in our household biomass consumption model.

The comparison of the original data and recalculated are summarized in the following table (***Table 3.96***).

Table 3.96: *Previous and refined emissions in the category 1A4bi*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	5.1523	5.1971	1%	166.2038	136.8648	-18%	29.0243	28.8620	-1%	0.3237	0.3259	1%
1991	4.8789	4.9265	1%	152.0746	124.7645	-18%	25.6894	25.5692	0%	0.5426	0.5470	1%
1992	4.7809	4.8242	1%	139.5225	114.5778	-18%	23.8240	23.7218	0%	0.4365	0.4398	1%
1993	3.9853	4.0233	1%	109.8097	89.8166	-18%	17.6968	17.6252	0%	0.6245	0.6300	1%
1994	3.7328	3.7627	1%	91.3115	74.8285	-18%	14.0990	14.0409	0%	0.6708	0.6766	1%
1995	3.6012	3.6223	1%	76.5433	63.0227	-18%	11.1789	11.1223	-1%	0.7085	0.7147	1%

[14] Detail information is provided in the Final Report "SK_AEA_Methodology_HH".
[15] https://powietrze.malopolska.pl/en/life-project/

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
1996	3.8255	3.8396	0%	69.0758	57.3084	-17%	8.9406	8.8924	-1%	0.9168	0.9250	1%
1997	3.6550	3.6667	0%	54.9362	45.5786	-17%	6.8555	6.8240	0%	0.7979	0.8054	1%
1998	3.9012	3.9132	0%	56.8003	47.1067	-17%	7.2095	7.1727	-1%	0.7922	0.7997	1%
1999	3.9777	3.9869	0%	52.1865	43.4227	-17%	6.2875	6.2544	-1%	0.8140	0.8214	1%
2000	3.8754	3.8857	0%	56.5627	47.1180	-17%	6.7517	6.7151	-1%	0.8989	0.9072	1%
2001	4.2474	4.2567	0%	55.3339	46.1640	-17%	6.0226	5.9926	0%	1.0192	1.0288	1%
2002	3.8197	3.8175	0%	39.0538	33.1395	-15%	3.1951	3.1755	-1%	0.9910	1.0001	1%
2003	3.9556	3.9507	0%	42.5124	36.3063	-15%	3.0652	3.0378	-1%	1.1647	1.1753	1%
2004	3.7981	3.7974	0%	44.6050	37.7369	-15%	2.5588	2.5396	-1%	1.4021	1.4139	1%
2005	4.1450	4.1456	0%	57.5756	48.6813	-15%	2.3661	2.3431	-1%	2.0455	2.0635	1%
2006	3.9245	3.9225	0%	56.0595	47.5621	-15%	2.4262	2.3965	-1%	1.9600	1.9788	1%
2007	3.7254	3.7264	0%	58.1326	49.2046	-15%	1.9838	1.9629	-1%	2.1728	2.1938	1%
2008	3.6460	3.6452	0%	51.5358	43.7698	-15%	1.8586	1.8376	-1%	1.9087	1.9313	1%
2009	3.5649	3.5680	0%	47.6246	40.3244	-15%	1.6118	1.5936	-1%	1.7846	1.7984	1%
2010	4.0158	4.0201	0%	54.6960	46.3647	-15%	1.7715	1.7528	-1%	2.0730	2.0910	1%
2011	3.6526	3.6592	0%	51.2636	43.4006	-15%	1.6454	1.6277	-1%	1.9382	1.9526	1%
2012	3.7144	3.7751	2%	54.5286	47.3901	-13%	1.7539	1.7450	-1%	2.0643	2.1430	4%
2013	3.5789	3.6917	3%	49.2669	44.1582	-10%	1.6171	1.6218	0%	1.8474	1.9855	7%
2014	2.9100	2.7537	-5%	35.3439	26.2323	-26%	1.2627	1.2132	-4%	1.2956	1.1010	-15%
2015	3.1285	3.2537	4%	40.4434	36.2392	-10%	1.4103	1.4173	0%	1.4882	1.6285	9%
2016	3.2786	3.4790	6%	42.7582	39.5439	-8%	1.4029	1.4421	3%	1.6040	1.8327	14%
2017	3.3669	3.6707	9%	40.3060	38.7782	-4%	1.5734	1.6169	3%	1.4329	1.7605	23%
2018	2.9319	3.1740	8%	32.1487	30.1454	-6%	1.2689	1.3015	3%	1.1340	1.3765	21%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			BC [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	74.4250	78.1729	5%	75.5867	79.3979	5%	82.9423	87.1231	5%	5.4104	5.6817	5%
1991	67.2019	70.2473	5%	68.2712	71.3692	5%	74.8197	78.2116	5%	4.9535	5.1787	5%
1992	61.8718	64.7594	5%	62.8511	65.7882	5%	68.9007	72.1188	5%	4.5443	4.7562	5%
1993	47.7548	49.6970	4%	48.5336	50.5106	4%	53.0967	55.2544	4%	3.5851	3.7335	4%
1994	39.3237	40.9834	4%	39.9772	41.6672	4%	43.6750	45.5164	4%	2.9952	3.1243	4%
1995	32.6444	34.1807	5%	33.1986	34.7633	5%	36.2116	37.9143	5%	2.5279	2.6490	5%
1996	28.8096	30.3911	5%	29.3213	30.9327	5%	31.8692	33.6187	5%	2.3117	2.4394	6%
1997	22.7087	23.9379	5%	23.1177	24.3706	5%	25.0963	26.4544	5%	1.8428	1.9436	5%
1998	23.5674	24.8347	5%	23.9890	25.2806	5%	26.0560	27.4567	5%	1.9024	2.0059	5%
1999	21.4330	22.6539	6%	21.8238	23.0681	6%	23.6682	25.0168	6%	1.7557	1.8561	6%
2000	23.1669	24.5206	6%	23.5911	24.9708	6%	25.5811	27.0765	6%	1.9027	2.0141	6%
2001	22.2292	23.5497	6%	22.6485	23.9949	6%	24.4995	25.9554	6%	1.8685	1.9802	6%
2002	15.0651	16.2545	8%	15.3722	16.5852	8%	16.5111	17.8211	8%	1.3492	1.4509	8%
2003	16.2214	17.6356	9%	16.5600	18.0021	9%	17.7531	19.3111	9%	1.4792	1.5997	8%
2004	16.4010	17.5848	7%	16.7615	17.9703	7%	17.8875	19.1842	7%	1.5558	1.6634	7%
2005	20.5393	21.9844	7%	21.0137	22.4908	7%	22.3187	23.8950	7%	2.0268	2.1639	7%
2006	20.1756	21.7184	8%	20.6371	22.2134	8%	21.9362	23.6223	8%	1.9773	2.1204	7%
2007	20.4932	21.9821	7%	20.9763	22.4988	7%	22.2311	23.8530	7%	2.0572	2.2003	7%
2008	18.2387	19.6395	8%	18.6659	20.0981	8%	19.7919	21.3183	8%	1.8229	1.9570	7%
2009	16.7485	17.9917	7%	17.1428	18.4135	7%	18.1663	19.5223	7%	1.6818	1.8001	7%
2010	19.1538	20.5575	7%	19.6070	21.0422	7%	20.7693	22.2990	7%	1.9305	2.0660	7%
2011	17.8839	19.1940	7%	18.3067	19.6460	7%	19.3955	20.8239	7%	1.8015	1.9278	7%
2012	18.9825	20.8628	10%	19.4313	21.3551	10%	20.5861	22.6300	10%	1.9129	2.1004	10%

YEAR	PM2.5 [kt]			PM10 [kt]			TSP [kt]			BC [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
2013	17.1363	19.3900	13%	17.5397	19.8464	13%	18.5899	21.0368	13%	1.7218	1.9497	13%
2014	12.3540	11.7489	-5%	12.6417	12.0168	-5%	13.4129	12.7773	-5%	1.2311	1.1529	-6%
2015	14.0174	15.9562	14%	14.3447	16.3291	14%	15.2168	17.3203	14%	1.4002	1.5975	14%
2016	14.7652	16.6725	13%	15.1123	17.0698	13%	16.0180	18.0706	13%	1.4841	1.6926	14%
2017	14.0618	17.1695	22%	14.3848	17.5676	22%	15.2813	18.6444	22%	1.3893	1.7136	23%
2018	11.1961	13.3748	19%	11.4526	13.6838	19%	12.1683	14.5257	19%	1.1046	1.3333	21%

YEAR	CO [kt]			Pb [t]			Cd [t]			Hg [t]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	684.3917	690.2921	1%	1.0484	1.0447	0%	0.0679	0.0684	1%	0.3281	0.3578	9%
1991	628.9304	633.1609	1%	0.9477	0.9465	0%	0.0971	0.0984	1%	0.3144	0.3194	2%
1992	576.4167	580.5721	1%	0.8719	0.8703	0%	0.0803	0.0813	1%	0.2909	0.3010	3%
1993	455.4254	457.7175	1%	0.6797	0.6807	0%	0.1031	0.1049	2%	0.2442	0.2286	-6%
1994	377.0106	379.0788	1%	0.5752	0.5767	0%	0.1071	0.1091	2%	0.2134	0.1914	-10%
1995	313.2049	315.4333	1%	0.4980	0.4997	0%	0.1104	0.1126	2%	0.1888	0.1634	-13%
1996	278.2660	280.9536	1%	0.4743	0.4769	1%	0.1388	0.1417	2%	0.1845	0.1469	-20%
1997	221.2264	223.3114	1%	0.3786	0.3810	1%	0.1200	0.1227	2%	0.1595	0.1247	-22%
1998	229.0210	231.1611	1%	0.3897	0.3920	1%	0.1195	0.1221	2%	0.1664	0.1325	-20%
1999	209.4909	211.8076	1%	0.3646	0.3671	1%	0.1220	0.1247	2%	0.1615	0.1254	-22%
2000	226.9698	229.6318	1%	0.3984	0.4016	1%	0.1346	0.1376	2%	0.1680	0.1279	-24%
2001	221.1874	223.8230	1%	0.3964	0.4001	1%	0.1513	0.1547	2%	0.1761	0.1278	-27%
2002	152.2823	155.5079	2%	0.3059	0.3087	1%	0.1450	0.1485	2%	0.1427	0.0942	-34%
2003	163.5619	167.4237	2%	0.3456	0.3489	1%	0.1700	0.1742	2%	0.1523	0.0962	-37%
2004	173.5834	176.6495	2%	0.3566	0.3617	1%	0.2041	0.2092	2%	0.1616	0.0868	-46%
2005	222.9733	226.4921	2%	0.4696	0.4777	2%	0.2967	0.3042	3%	0.2011	0.0889	-56%
2006	215.9670	219.8036	2%	0.4641	0.4716	2%	0.2848	0.2919	3%	0.1909	0.0857	-55%
2007	224.2700	227.7058	2%	0.4852	0.4939	2%	0.3148	0.3229	3%	0.1962	0.0770	-61%
2008	199.1714	202.7304	2%	0.4337	0.4410	2%	0.2769	0.2845	3%	0.1789	0.0750	-58%
2009	183.8011	186.4545	1%	0.4054	0.4125	2%	0.2589	0.2656	3%	0.1690	0.0719	-57%
2010	211.9591	215.1242	1%	0.4692	0.4771	2%	0.3005	0.3089	3%	0.1936	0.0806	-58%
2011	198.9324	201.6142	1%	0.4442	0.4516	2%	0.2809	0.2888	3%	0.1793	0.0740	-59%
2012	212.0575	220.3918	4%	0.4764	0.4969	4%	0.2988	0.3172	6%	0.1875	0.0763	-59%
2013	191.6109	205.2521	7%	0.4346	0.4673	8%	0.2674	0.2942	10%	0.1727	0.0748	-57%
2014	137.3752	121.6985	-11%	0.3150	0.2793	-11%	0.1883	0.1640	-13%	0.1289	0.0576	-55%
2015	157.4665	169.8696	8%	0.3637	0.3975	9%	0.2169	0.2426	12%	0.1445	0.0661	-54%
2016	166.6710	187.4071	12%	0.3914	0.4373	12%	0.2335	0.2668	14%	0.1524	0.0685	-55%
2017	157.4638	184.6616	17%	0.3716	0.4454	20%	0.2089	0.2625	26%	0.1466	0.0752	-49%
2018	125.8300	144.9811	15%	0.2964	0.3536	19%	0.1654	0.2054	24%	0.1213	0.0646	-47%

YEAR	As [t]			Cr [t]			Cu [t]			Ni [t]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	0.6353	0.6257	-1%	2.2514	2.3932	6%	0.4117	0.4375	6%	0.3130	0.3237	3%
1991	0.5710	0.5612	-2%	2.1143	2.2407	6%	0.3881	0.4114	6%	0.2901	0.2992	3%
1992	0.5276	0.5188	-2%	1.9264	2.0432	6%	0.3532	0.3746	6%	0.2652	0.2737	3%
1993	0.4010	0.3932	-2%	1.5701	1.6580	6%	0.2915	0.3078	6%	0.2129	0.2187	3%
1994	0.3215	0.3155	-2%	1.3183	1.3888	5%	0.2506	0.2636	5%	0.1789	0.1835	3%
1995	0.2560	0.2516	-2%	1.1100	1.1664	5%	0.2183	0.2287	5%	0.1517	0.1553	2%
1996	0.2063	0.2034	-1%	1.0172	1.0633	5%	0.2125	0.2207	4%	0.1402	0.1431	2%
1997	0.1612	0.1588	-1%	0.8184	0.8542	4%	0.1725	0.1789	4%	0.1124	0.1146	2%

YEAR	As [t]			Cr [t]			Cu [t]			Ni [t]		
	P	R	C	P	R	C	P	R	C	P	R	C
1998	0.1697	0.1672	-1%	0.8428	0.8803	4%	0.1766	0.1833	4%	0.1158	0.1181	2%
1999	0.1502	0.1480	-2%	0.7815	0.8154	4%	0.1672	0.1730	4%	0.1077	0.1096	2%
2000	0.1612	0.1589	-1%	0.8495	0.8867	4%	0.1827	0.1895	4%	0.1174	0.1195	2%
2001	0.1479	0.1462	-1%	0.8482	0.8824	4%	0.1864	0.1925	3%	0.1168	0.1187	2%
2002	0.0834	0.0826	-1%	0.6166	0.6386	4%	0.1482	0.1509	2%	0.0864	0.0872	1%
2003	0.0801	0.0799	0%	0.6707	0.6930	3%	0.1664	0.1690	2%	0.0949	0.0958	1%
2004	0.0747	0.0737	-1%	0.7430	0.7636	3%	0.1835	0.1860	1%	0.1023	0.1027	0%
2005	0.0757	0.0746	-1%	0.9863	1.0087	2%	0.2491	0.2517	1%	0.1348	0.1349	0%
2006	0.0732	0.0724	-1%	0.9486	0.9704	2%	0.2418	0.2444	1%	0.1307	0.1309	0%
2007	0.0656	0.0649	-1%	1.0046	1.0249	2%	0.2585	0.2609	1%	0.1374	0.1373	0%
2008	0.0608	0.0603	-1%	0.8889	0.9096	2%	0.2296	0.2319	1%	0.1218	0.1221	0%
2009	0.0543	0.0543	0%	0.8240	0.8411	2%	0.2143	0.2162	1%	0.1131	0.1131	0%
2010	0.0616	0.0618	0%	0.9533	0.9751	2%	0.2489	0.2512	1%	0.1305	0.1308	0%
2011	0.0574	0.0582	1%	0.8945	0.9147	2%	0.2345	0.2367	1%	0.1226	0.1229	0%
2012	0.0607	0.0626	3%	0.9536	1.0034	5%	0.2511	0.2607	4%	0.1308	0.1349	3%
2013	0.0560	0.0594	6%	0.8606	0.9351	9%	0.2273	0.2438	7%	0.1184	0.1261	7%
2014	0.0430	0.0421	-2%	0.6143	0.5458	-11%	0.1627	0.1420	-13%	0.0849	0.0744	-12%
2015	0.0484	0.0523	8%	0.7086	0.7797	10%	0.1882	0.2054	9%	0.0979	0.1057	8%
2016	0.0488	0.0517	6%	0.7536	0.8477	12%	0.2024	0.2278	13%	0.1043	0.1168	12%
2017	0.0522	0.0603	15%	0.7065	0.8580	21%	0.1884	0.2276	21%	0.0982	0.1168	19%
2018	0.0432	0.0498	15%	0.5656	0.6784	20%	0.1502	0.1803	20%	0.0785	0.0924	18%

YEAR	Se [t]			Zn [t]			PCDD/F [g I-TEQ]			B(a)P [t]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	0.1446	0.1510	4%	3.9904	3.9820	0%	7.6705	7.2341	-6%	7.6705	13.0128	70%
1991	0.1264	0.1313	4%	4.1481	4.1840	1%	7.4438	7.2002	-3%	7.4438	11.8559	59%
1992	0.1174	0.1221	4%	3.6807	3.7027	1%	6.6874	6.4403	-4%	6.6874	10.8758	63%
1993	0.0875	0.0902	3%	3.4677	3.5351	2%	5.8780	5.8256	-1%	5.8780	8.5829	46%
1994	0.0735	0.0758	3%	3.1970	3.2807	3%	5.3511	5.3547	0%	5.3511	7.2824	36%
1995	0.0640	0.0661	3%	2.9860	3.0831	3%	5.0139	5.0417	1%	5.0139	6.3108	26%
1996	0.0608	0.0628	3%	3.2727	3.4109	4%	5.4190	5.5181	2%	5.4190	6.0269	11%
1997	0.0480	0.0495	3%	2.7452	2.8671	4%	4.4926	4.6054	3%	4.4926	4.8231	7%
1998	0.0496	0.0512	3%	2.7708	2.8909	4%	4.5686	4.6705	2%	4.5686	4.9614	9%
1999	0.0463	0.0477	3%	2.7280	2.8533	5%	4.4710	4.5881	3%	4.4710	4.6467	4%
2000	0.0507	0.0521	3%	3.0000	3.1385	5%	4.8903	5.0213	3%	4.8903	5.0609	3%
2001	0.0496	0.0509	3%	3.2192	3.3804	5%	5.1767	5.3595	4%	5.1767	5.0515	-2%
2002	0.0382	0.0390	2%	2.8510	3.0116	6%	4.5435	4.7469	4%	4.5435	3.8899	-14%
2003	0.0435	0.0447	3%	3.2906	3.4813	6%	5.2651	5.4867	4%	5.2651	4.3856	-17%
2004	0.0414	0.0420	1%	3.8348	4.0682	6%	5.8786	6.1884	5%	5.8786	4.5745	-22%
2005	0.0523	0.0528	1%	5.4540	5.7984	6%	8.1973	8.6865	6%	8.1973	6.0544	-26%
2006	0.0527	0.0534	1%	5.2689	5.5998	6%	7.9633	8.4259	6%	7.9633	5.9428	-25%
2007	0.0531	0.0537	1%	5.7726	6.1420	6%	8.5896	9.1278	6%	8.5896	6.2047	-28%
2008	0.0475	0.0482	1%	5.1176	5.4392	6%	7.5957	8.0830	6%	7.5957	5.5062	-28%
2009	0.0445	0.0451	1%	4.7838	5.0900	6%	7.0913	7.5108	6%	7.0913	5.0894	-28%
2010	0.0507	0.0514	1%	5.5768	5.9301	6%	8.1995	8.6880	6%	8.1995	5.8444	-29%
2011	0.0480	0.0487	1%	5.2399	5.5733	6%	7.6618	8.1192	6%	7.6618	5.4624	-29%
2012	0.0512	0.0533	4%	5.5958	6.1297	10%	8.1812	8.8678	8%	8.1812	5.9609	-27%
2013	0.0472	0.0505	7%	5.0262	5.7062	14%	7.3938	8.2384	11%	7.3938	5.5494	-25%
2014	0.0347	0.0316	-9%	3.5697	3.2360	-9%	5.3114	4.7695	-10%	5.3114	3.2658	-39%

YEAR	Se [t]			Zn [t]			PCDD/F [g I-TEQ]			B(a)P [t]		
	P	R	C	P	R	C	P	R	C	P	R	C
2015	0.0397	0.0431	8%	4.1173	4.7668	16%	6.0640	6.8563	13%	6.0640	4.5574	-25%
2016	0.0423	0.0466	10%	4.4467	5.0692	14%	6.5879	7.4696	13%	6.5879	4.9155	-25%
2017	0.0414	0.0486	17%	4.0290	5.2257	30%	6.1409	7.5707	23%	6.1409	4.8967	-20%
2018	0.0333	0.0386	16%	3.1936	4.1154	29%	4.8898	5.9767	22%	4.8898	3.8073	-22%

YEAR	B(b)F [t]			B(k)F [t]			I()P [t]			PAHs [t]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	8.8364	9.1373	3%	5.3064	5.4515	3%	6.6101	6.8838	4%	33.209	34.4854	4%
1991	7.9937	8.1982	3%	4.8835	5.0030	2%	6.0612	6.2718	3%	30.392	31.3289	3%
1992	7.3316	7.5425	3%	4.4678	4.5819	3%	5.5522	5.7559	4%	27.829	28.7561	3%
1993	5.7573	5.8560	2%	3.5628	3.6411	2%	4.4127	4.5386	3%	22.105	22.6186	2%
1994	4.9007	4.9923	2%	3.0024	3.0726	2%	3.7369	3.8480	3%	18.753	19.1953	2%
1995	4.2831	4.3872	2%	2.5642	2.6327	3%	3.2198	3.3305	3%	16.219	16.6612	3%
1996	4.1289	4.2647	3%	2.3936	2.4712	3%	3.0507	3.1758	4%	15.439	15.9385	3%
1997	3.2969	3.4020	3%	1.9155	1.9780	3%	2.4436	2.5413	4%	12.362	12.7444	3%
1998	3.3931	3.4994	3%	1.9732	2.0368	3%	2.5140	2.6141	4%	12.719	13.1116	3%
1999	3.1840	3.2901	3%	1.8356	1.8989	3%	2.3485	2.4468	4%	11.900	12.2826	3%
2000	3.4744	3.5942	3%	1.9952	2.0664	4%	2.5569	2.6671	4%	12.959	13.3886	3%
2001	3.4844	3.6048	3%	1.9838	2.0569	4%	2.5577	2.6679	4%	12.964	13.3811	3%
2002	2.7085	2.8374	5%	1.4767	1.5485	5%	1.9429	2.0501	6%	9.912	10.3259	4%
2003	3.0781	3.2444	5%	1.6388	1.7250	5%	2.1761	2.3083	6%	11.143	11.6633	5%
2004	3.1799	3.2974	4%	1.7439	1.8226	5%	2.2963	2.4039	5%	11.734	12.0985	3%
2005	4.2074	4.3476	3%	2.3030	2.4055	4%	3.0397	3.1740	4%	15.563	15.9816	3%
2006	4.1399	4.3002	4%	2.2428	2.3482	5%	2.9680	3.1126	5%	15.223	15.7037	3%
2007	4.3121	4.4646	4%	2.3478	2.4558	5%	3.1079	3.2496	5%	15.930	16.3747	3%
2008	3.8160	3.9686	4%	2.0744	2.1790	5%	2.7464	2.8847	5%	14.079	14.5385	3%
2009	3.5581	3.6906	4%	1.9209	2.0114	5%	2.5520	2.6725	5%	13.077	13.4640	3%
2010	4.0795	4.2371	4%	2.2041	2.3137	5%	2.9301	3.0733	5%	15.000	15.4685	3%
2011	3.8384	3.9876	4%	2.0608	2.1627	5%	2.7477	2.8820	5%	14.054	14.4947	3%
2012	4.0860	4.3626	7%	2.1875	2.3611	8%	2.9219	3.1507	8%	14.932	15.8353	6%
2013	3.7205	4.0977	10%	1.9725	2.1970	11%	2.6471	2.9449	11%	13.510	14.7890	9%
2014	2.6781	2.4572	-8%	1.4107	1.2916	-8%	1.8966	1.7454	-8%	9.678	8.7600	-9%
2015	3.0690	3.4065	11%	1.6128	1.8088	12%	2.1724	2.4437	12%	11.071	12.2164	10%
2016	3.2633	3.6705	12%	1.7093	1.9723	15%	2.3077	2.6454	15%	11.75494	13.2036	12%
2017	3.1154	3.7432	20%	1.5993	1.9533	22%	2.1817	2.6824	23%	11.05777	13.2756	20%
2018	2.4947	2.9380	18%	1.2735	1.5245	20%	1.7439	2.1082	21%	8.81781	10.3781	18%

YEAR	HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE
1990	11.0803	13.2872	20%	0.7432	0.6582	-11%
1991	7.7191	9.3623	21%	0.6428	0.5761	-10%
1992	7.6558	9.2528	21%	0.5987	0.5349	-11%
1993	3.8773	4.7947	24%	0.4343	0.3944	-9%
1994	3.2852	4.0436	23%	0.3523	0.3198	-9%
1995	3.3701	4.0829	21%	0.2919	0.2632	-10%
1996	3.7488	4.4708	19%	0.2529	0.2259	-11%
1997	2.7158	3.2448	19%	0.1944	0.1744	-10%
1998	2.8337	3.3872	20%	0.2032	0.1822	-10%
1999	2.6600	3.1696	19%	0.1822	0.1633	-10%

YEAR	HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE
2000	2.9404	3.5156	20%	0.1976	0.1773	-10%
2001	2.6858	3.2054	19%	0.1827	0.1652	-10%
2002	2.5011	2.9059	16%	0.1186	0.1056	-11%
2003	3.3532	3.8818	16%	0.1295	0.1134	-12%
2004	1.8104	2.1098	17%	0.1094	0.1002	-8%
2005	1.7794	2.0659	16%	0.1214	0.1128	-7%
2006	2.4070	2.7924	16%	0.1264	0.1148	-9%
2007	1.8591	2.1652	16%	0.1166	0.1080	-7%
2008	1.7594	2.0476	16%	0.1056	0.0977	-7%
2009	1.7624	2.0469	16%	0.0975	0.0902	-7%
2010	1.8409	2.1280	16%	0.1088	0.1021	-6%
2011	1.8678	2.1496	15%	0.1033	0.0974	-6%
2012	2.0035	2.3405	17%	0.1104	0.1060	-4%
2013	2.0802	2.4393	17%	0.1036	0.1015	-2%
2014	1.7135	2.0084	17%	0.0792	0.0681	-14%
2015	1.9122	2.2895	20%	0.0903	0.0886	-2%
2016	2.0215	2.0360	1%	0.0949	0.1041	10%
2017	2.3823	2.8869	21%	0.0997	0.1033	4%
2018	1.9234	2.3167	20%	0.0802	0.0832	4%

P – Previous, R – Refined, C – Change

3.7.5 RESIDENTIAL: MOBILE (NFR 1A4bii)

3.9.4.1 Overview

After obtaining data from the Statistical Office of the Slovak Republic it was possible to separate all the categories for 2019. Results of the separation are in ***Table 3.97***.

Table 3.97*: Overview of emissions from residential: mobile (1A4bii) for 2019*

YEAR	NOx [t]	NMVOC [t]	SOx [t]	NH_3 [t]	$PM_{2.5}$ [t]	CO [t]	BC [t]	Cd [t]	PAHs [t]
2019	141.21	103.54	0.16	0.05	7.63	3 808	4.30	0.0000	0.0007

3.7.6 AGRICULTURE/FORESTRY/FISHING: STATIONARY (NFR 1A4ci)

3.7.6.1 Overview

Activities listed within this category are shown in ***Table 3.98***.

Table 3.98: *Activities according to national categorization included in 1A4ci*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	MEDIUM S.: NACE 01-03
6.12. Livestock farming with a projected number of breeding sites	combustion
6.20. Agricultural and food products driers with a projected production capacity in t/h	combustion

Overview of the emissions is shown in ***Table 3.99.***

Table 3.99: *Overview of emissions in the category 1A4ci*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.1088	0.0282	0.1466	0.0307	0.0701	0.1533	0.2780
1995	0.1156	0.0299	0.1557	0.0326	0.0744	0.1628	0.2952

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2000	0.1124	0.0056	0.1689	0.0418	0.0955	0.2089	0.4136
2005	0.1542	0.0092	0.1420	0.0462	0.0948	0.2044	0.2216
2010	0.1022	0.0108	0.0266	0.0329	0.0795	0.1791	0.1218
2011	0.1020	0.0128	0.0194	0.0357	0.0892	0.1984	0.1267
2012	0.1129	0.0129	0.0292	0.0303	0.0713	0.1543	0.1518
2013	0.1258	0.0144	0.0336	0.0276	0.0689	0.1528	0.1589
2014	0.2434	0.0395	0.0698	0.0313	0.0862	0.1967	0.2094
2015	0.2736	0.0196	0.0908	0.0297	0.0678	0.1451	0.2131
2016	0.2515	0.0157	0.0722	0.0308	0.0754	0.1648	0.2072
2017	0.2266	0.0147	0.0555	0.0269	0.0602	0.1265	0.1891
2018	0.2215	0.0256	0.0564	0.0363	0.0699	0.1343	0.2005
2019	0.2276	0.0201	0.0552	0.0389	0.0696	0.1312	0.2027
1990/2019	**109%**	**-29%**	**-62%**	**27%**	**-1%**	**-14%**	**-27%**
2018/2019	**3%**	**-22%**	**-2%**	**7%**	**0%**	**-2%**	**1%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0035	0.0001	0.0002	0.0002	0.0005	0.0006	0.0037	0.0000	0.0053
1995	0.0599	0.0009	0.0024	0.0016	0.0053	0.0089	0.0118	0.0007	0.0898
2000	0.0408	0.0009	0.0017	0.0012	0.0048	0.0063	0.0187	0.0005	0.0719
2005	0.0201	0.0008	0.0009	0.0007	0.0034	0.0033	0.0162	0.0002	0.0483
2010	0.0058	0.0006	0.0004	0.0003	0.0015	0.0010	0.0039	0.0001	0.0276
2011	0.0051	0.0008	0.0003	0.0003	0.0016	0.0009	0.0012	0.0001	0.0344
2012	0.0042	0.0008	0.0003	0.0002	0.0015	0.0007	0.0007	0.0001	0.0331
2013	0.0041	0.0008	0.0003	0.0003	0.0016	0.0007	0.0007	0.0001	0.0349
2014	0.0082	0.0031	0.0004	0.0003	0.0057	0.0017	0.0009	0.0003	0.1275
2015	0.0048	0.0013	0.0003	0.0002	0.0025	0.0009	0.0006	0.0003	0.0576
2016	0.0035	0.0008	0.0003	0.0002	0.0016	0.0007	0.0008	0.0003	0.0365
2017	0.0038	0.0008	0.0003	0.0002	0.0017	0.0007	0.0008	0.0002	0.0377
2018	0.0053	0.0020	0.0003	0.0002	0.0036	0.0011	0.0009	0.0003	0.0818
2019	0.0042	0.0013	0.0003	0.0002	0.0025	0.0008	0.0011	0.0003	0.0548
1990/2019	**17%**	**2370%**	**47%**	**22%**	**385%**	**39%**	**-70%**	**495%**	**941%**
2018/2019	**-22%**	**-35%**	**-5%**	**2%**	**-32%**	**-25%**	**33%**	**-8%**	**-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]	PCB [kg]
1990	0.0068	0.0020	0.0028	0.0015	0.0013	0.0075	0.0000	0.0031
1995	0.1141	0.0282	0.0368	0.0145	0.0116	0.0911	0.0002	0.0552
2000	0.0784	0.0197	0.0259	0.0108	0.0087	0.0651	0.0003	0.0363
2005	0.0398	0.0102	0.0137	0.0062	0.0052	0.0353	0.0003	0.0168
2010	0.0138	0.0036	0.0050	0.0027	0.0025	0.0138	0.0002	0.0040
2011	0.0133	0.0031	0.0046	0.0024	0.0022	0.0124	0.0003	0.0032
2012	0.0115	0.0027	0.0044	0.0022	0.0020	0.0113	0.0003	0.0024
2013	0.0117	0.0028	0.0051	0.0025	0.0023	0.0128	0.0003	0.0023
2014	0.0280	0.0048	0.0136	0.0039	0.0037	0.0260	0.0012	0.0016
2015	0.0150	0.0038	0.0133	0.0036	0.0035	0.0242	0.0005	0.0019
2016	0.0107	0.0033	0.0119	0.0033	0.0033	0.0217	0.0003	0.0017
2017	0.0114	0.0033	0.0112	0.0032	0.0031	0.0209	0.0003	0.0018
2018	0.0185	0.0038	0.0127	0.0035	0.0034	0.0234	0.0008	0.0010
2019	0.0137	0.0034	0.0121	0.0033	0.0033	0.0221	0.0005	0.0012
1990/2019	**101%**	**68%**	**337%**	**129%**	**158%**	**194%**	**4028%**	**-60%**
2018/2019	**-26%**	**-10%**	**-5%**	**-4%**	**-3%**	**-5%**	**-35%**	**20%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.100*** below.

Table 3.100: *Overview of activity data in the category 1A4ci*

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	42.65	210.52	1 015.84	73.46	NO
1995	58.78	206.46	1 086.01	74.42	NO
2000	47.35	197.46	1 060.56	72.61	NO
2005	159.91	100.24	1 930.10	85.17	NO
2010	50.35	38.59	1 677.71	69.99	NO
2011	36.71	18.80	1 500.25	119.47	NO
2012	29.40	14.09	1 356.93	249.89	NO
2013	36.01	13.29	1 590.77	299.07	NO
2014	66.47	9.08	1 755.51	1 240.14	NO
2015	40.08	10.86	1 502.22	1 520.94	NO
2016	98.12	9.76	1 805.38	1 271.10	NO
2017	87.89	10.67	1 537.70	1 164.30	NO
2018	86.26	6.45	1 409.16	1 187.64	NO
2019	115.71	7.73	1 595.10	1 025.93	NO
1990/2019	**171%**	**-96%**	**57%**	**1297%**	**-**
2018/2019	**34%**	**20%**	**13%**	**-14%**	**-**

3.7.6.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.101***).

Table 3.101: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	81.05	20.98	109.20	114.17	20%	46%	207.06

The emissions of heavy metals and POPs are calculated at Tier 2 level. The data (fuel, technology and specific information) is compiled in the NEIS database, therefore this detailed methodologies could be used focused to the combinations of the main installation types/fuels used in our country. Emission factors used for the calculation of heavy metals and POPs are default EF from EMEP/EEA GB_{2019} (***Table 3.102***).

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

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

Where:

E_i = annual emission of pollutant *i*,

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

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

Table 3.102: Emission factors for heavy metals and POPs in the category 1A4ci

T2	UNIT	LIQUID FUELS				HARD COAL/BROWN COAL	
		Standard boilers (> 50 KWth ≤ 1 MWth)	**Standard boilers** (> 1 MWth ≤ 50 MWth)	**Gas turbines** (50 kWth – 50 MWth)	**Stationary reciprocating engines** (50 kWth – 50 MWth)	**Standard boilers** (> 50 KWth ≤ 1 MWth)	**Standard boilers** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	20	10	0.012	0.15	200	100
Cd	[mg/GJ]	0.3	0.3	0.001	0.01	3	1
Hg	[mg/GJ]	0.1	0.1	0.12	0.11	7	9
As	[mg/GJ]	1	1	0.002	0.06	5	4
Cr	[mg/GJ]	20	20	0.2	0.2	15	15
Cu	[mg/GJ]	10	3	0.13	0.3	17.5	10
Ni	[mg/GJ]	300	200	0.005	0.01	13	10
Se	[mg/GJ]	NA	0.5	0.002	0.22	1.8	2
Zn	[mg/GJ]	10	5	0.42	58	200	150
PCDD/F	[ng I-TEQ/GJ]	10	10	1.8	0.99	203	100
B(a)P	[mg/GJ]	8	1	NE	1.9	45.5	13
B(b)F	[mg/GJ]	9	2	NE	15	58.9	17
B(k)F	[mg/GJ]	6	1	NE	1.7	23.7	9
I()P	[mg/GJ]	3	1	NE	1.5	18.5	6
PAHs	[mg/GJ]	26	5	NE	20.1	146.6	45
HCB	[µg/GJ]	NE	NE	NE	0.22	0.62	0.62
PCBs	[µg/GJ]	NE	NE	NE	0.13	170	170

T2	UNIT	GASEOUS FUELS				BIOMASS	
		Standard boilers (> 50 KWth ≤ 1 MWth)	**Standard boilers** (> 1 MWth ≤ 50 MWth)	**Gas turbines** (50 kWth – 50 MWth)	**Stationary reciprocating engines** (50 kWth – 50 MWth)	**Standard boilers** (> 50 KWth ≤ 1 MWth)	**Standard boilers** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	0.0015	0.0015	0.0015	0.04	27	27
Cd	[mg/GJ]	0.00025	0.00025	0.00025	0.003	13	13
Hg	[mg/GJ]	0.1	0.1	0.1	0.1	0.56	0.56
As	[mg/GJ]	0.12	0.12	0.12	0.05	0.19	0.19
Cr	[mg/GJ]	0.00076	0.00076	0.00076	0.05	23	23
Cu	[mg/GJ]	0.000076	0.000076	0.000076	0.01	6	6
Ni	[mg/GJ]	0.00051	0.00051	0.00051	0.05	2	2
Se	[mg/GJ]	0.011	0.011	0.011	0.2	0.5	0.5
Zn	[mg/GJ]	0.0015	0.0015	0.0015	2.9	512	512
PCDD/F	[ng I-TEQ/GJ]	0.5	0.5	0.5	0.57	100	100
B(a)P	[mg/GJ]	0.56	0.56	0.56	1.2	10	10
B(b)F	[mg/GJ]	0.84	0.84	0.84	9	16	16
B(k)F	[mg/GJ]	0.84	0.84	0.84	1.7	5	5
I()P	[mg/GJ]	0.84	0.84	0.84	1.8	4	4
PAHs	[mg/GJ]	3.08	3.08	3.08	13.7	35	35
HCB	[µg/GJ]	NA	NA	NA	NA	5	5
PCBs	[µg/GJ]	NA	NA	NA	NA	0.03	0.007

3.7.6.3 Completeness

Emissions of NH_3 and BC are reported as NE.

3.7.6.4 Source-specific recalculations

No recalculations in this submission for emissions of the main pollutants.

The detailed information compiled in the NEIS database allowed to use of Tier 2 emission factors EMEP/EEA GB_{2019} for the calculation of emissions of HMs and POPs with the aim to improve the methodology for this category. Recalculations are shown in ***Table 3.103***.

Table 3.103: *Previous and refined emissions in the category 1A4ci*

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0305	0.0035	-88%	0.0014	0.0001	-96%	0.0018	0.0002	-89%	0.0010	0.0002	-81%
1991	0.0304	0.0216	-29%	0.0014	0.0003	-77%	0.0018	0.0009	-50%	0.0010	0.0006	-34%
1992	0.0305	0.0359	18%	0.0014	0.0005	-62%	0.0018	0.0015	-19%	0.0010	0.0010	3%
1993	0.0304	0.0469	54%	0.0014	0.0007	-51%	0.0018	0.0019	6%	0.0010	0.0013	33%
1994	0.0303	0.0548	81%	0.0014	0.0008	-42%	0.0018	0.0022	23%	0.0010	0.0015	55%
1995	0.0301	0.0599	99%	0.0014	0.0009	-37%	0.0018	0.0024	36%	0.0010	0.0016	69%
1996	0.0303	0.0625	106%	0.0014	0.0009	-33%	0.0018	0.0025	41%	0.0010	0.0017	78%
1997	0.0293	0.0631	115%	0.0014	0.0010	-27%	0.0017	0.0026	47%	0.0009	0.0018	86%
1998	0.0296	0.0617	108%	0.0014	0.0011	-23%	0.0018	0.0025	43%	0.0010	0.0017	79%
1999	0.0289	0.0587	103%	0.0014	0.0011	-20%	0.0017	0.0024	40%	0.0010	0.0017	75%
2000	0.0287	0.0408	42%	0.0013	0.0009	-32%	0.0017	0.0017	0%	0.0009	0.0012	35%
2001	0.0243	0.0372	53%	0.0014	0.0011	-26%	0.0014	0.0016	9%	0.0009	0.0012	33%
2002	0.0288	0.0343	19%	0.0013	0.0011	-19%	0.0017	0.0015	-15%	0.0010	0.0011	6%
2003	0.0203	0.0253	25%	0.0013	0.0009	-26%	0.0012	0.0011	-10%	0.0008	0.0008	10%
2004	0.0191	0.0184	-3%	0.0012	0.0008	-33%	0.0012	0.0008	-28%	0.0008	0.0007	-10%
2005	0.0168	0.0201	20%	0.0012	0.0008	-36%	0.0010	0.0009	-11%	0.0007	0.0007	9%
2006	0.0091	0.0094	3%	0.0009	0.0006	-34%	0.0006	0.0005	-19%	0.0005	0.0005	-2%
2007	0.0069	0.0082	19%	0.0007	0.0006	-16%	0.0005	0.0004	-12%	0.0003	0.0004	11%
2008	0.0082	0.0077	-6%	0.0008	0.0006	-27%	0.0006	0.0005	-25%	0.0004	0.0004	-1%
2009	0.0085	0.0070	-17%	0.0009	0.0005	-37%	0.0006	0.0004	-31%	0.0004	0.0003	-8%
2010	0.0068	0.0058	-15%	0.0008	0.0006	-28%	0.0005	0.0004	-30%	0.0003	0.0003	-4%
2011	0.0049	0.0051	5%	0.0012	0.0008	-32%	0.0004	0.0003	-9%	0.0002	0.0003	14%
2012	0.0039	0.0042	8%	0.0010	0.0008	-21%	0.0003	0.0003	-10%	0.0002	0.0002	8%
2013	0.0038	0.0041	8%	0.0010	0.0008	-18%	0.0003	0.0003	-8%	0.0003	0.0003	9%
2014	0.0081	0.0082	0%	0.0033	0.0031	-5%	0.0005	0.0004	-21%	0.0004	0.0003	-30%
2015	0.0045	0.0048	6%	0.0015	0.0013	-9%	0.0004	0.0003	-23%	0.0004	0.0002	-32%
2016	0.0034	0.0035	5%	0.0010	0.0008	-17%	0.0004	0.0003	-29%	0.0004	0.0002	-36%
2017	0.0033	0.0038	16%	0.0009	0.0008	-6%	0.0004	0.0003	-24%	0.0003	0.0002	-29%
2018	0.0051	0.0053	4%	0.0020	0.0020	-2%	0.0004	0.0003	-18%	0.0003	0.0002	-28%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0049	0.0005	-90%	0.0042	0.0006	-86%	0.0062	0.0037	-40%
1991	0.0049	0.0019	-61%	0.0042	0.0032	-24%	0.0065	0.0048	-26%
1992	0.0049	0.0031	-37%	0.0042	0.0053	25%	0.0066	0.0062	-6%
1993	0.0049	0.0040	-17%	0.0042	0.0069	64%	0.0065	0.0079	22%
1994	0.0049	0.0048	-3%	0.0042	0.0081	92%	0.0067	0.0098	47%
1995	0.0050	0.0053	5%	0.0042	0.0089	110%	0.0082	0.0118	44%
1996	0.0049	0.0056	14%	0.0042	0.0093	120%	0.0070	0.0138	97%
1997	0.0049	0.0059	20%	0.0041	0.0094	130%	0.0078	0.0157	102%
1998	0.0052	0.0060	17%	0.0042	0.0093	121%	0.0110	0.0176	59%
1999	0.0053	0.0061	15%	0.0041	0.0089	116%	0.0130	0.0192	48%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2000	0.0047	0.0048	2%	0.0040	0.0063	59%	0.0067	0.0187	181%
2001	0.0058	0.0050	-14%	0.0037	0.0059	58%	0.0235	0.0205	-12%
2002	0.0062	0.0049	-21%	0.0043	0.0055	27%	0.0267	0.0215	-20%
2003	0.0050	0.0039	-22%	0.0031	0.0041	31%	0.0206	0.0169	-18%
2004	0.0054	0.0037	-32%	0.0031	0.0032	4%	0.0288	0.0223	-23%
2005	0.0047	0.0034	-28%	0.0027	0.0033	24%	0.0200	0.0162	-19%
2006	0.0038	0.0027	-31%	0.0017	0.0019	9%	0.0227	0.0184	-19%
2007	0.0019	0.0017	-10%	0.0011	0.0013	27%	0.0027	0.0040	51%
2008	0.0020	0.0016	-19%	0.0012	0.0013	4%	0.0027	0.0048	78%
2009	0.0023	0.0015	-35%	0.0013	0.0012	-11%	0.0031	0.0033	5%
2010	0.0020	0.0015	-24%	0.0011	0.0010	-4%	0.0022	0.0039	81%
2011	0.0023	0.0016	-28%	0.0009	0.0009	3%	0.0008	0.0012	41%
2012	0.0019	0.0015	-19%	0.0007	0.0007	6%	0.0006	0.0007	22%
2013	0.0019	0.0016	-16%	0.0007	0.0007	7%	0.0006	0.0007	27%
2014	0.0060	0.0057	-6%	0.0017	0.0017	-1%	0.0012	0.0009	-28%
2015	0.0028	0.0025	-9%	0.0009	0.0009	4%	0.0009	0.0006	-33%
2016	0.0019	0.0016	-16%	0.0006	0.0007	4%	0.0009	0.0008	-9%
2017	0.0018	0.0017	-6%	0.0006	0.0007	17%	0.0008	0.0008	-8%
2018	0.0037	0.0036	-3%	0.0011	0.0011	3%	0.0012	0.0009	-31%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0005	0.0000	-91%	0.0826	0.0053	-94%
1991	0.0005	0.0002	-50%	0.0826	0.0323	-61%
1992	0.0005	0.0004	-18%	0.0826	0.0538	-35%
1993	0.0005	0.0005	8%	0.0824	0.0703	-15%
1994	0.0005	0.0006	26%	0.0823	0.0821	0%
1995	0.0005	0.0007	37%	0.0825	0.0898	9%
1996	0.0005	0.0007	43%	0.0821	0.0942	15%
1997	0.0005	0.0007	48%	0.0813	0.0977	20%
1998	0.0005	0.0007	43%	0.0820	0.0986	20%
1999	0.0005	0.0007	38%	0.0813	0.0972	20%
2000	0.0005	0.0005	0%	0.0780	0.0719	-8%
2001	0.0004	0.0004	-2%	0.0790	0.0747	-5%
2002	0.0005	0.0004	-21%	0.0804	0.0728	-9%
2003	0.0004	0.0003	-22%	0.0688	0.0588	-15%
2004	0.0004	0.0002	-41%	0.0658	0.0469	-29%
2005	0.0003	0.0002	-31%	0.0645	0.0483	-25%
2006	0.0002	0.0001	-48%	0.0457	0.0315	-31%
2007	0.0002	0.0001	-42%	0.0349	0.0305	-13%
2008	0.0002	0.0001	-51%	0.0377	0.0278	-26%
2009	0.0002	0.0001	-52%	0.0421	0.0275	-35%
2010	0.0002	0.0001	-57%	0.0388	0.0276	-29%
2011	0.0002	0.0001	-48%	0.0490	0.0344	-30%
2012	0.0002	0.0001	-42%	0.0413	0.0331	-20%
2013	0.0002	0.0001	-39%	0.0422	0.0349	-17%
2014	0.0003	0.0003	6%	0.1336	0.1275	-5%
2015	0.0002	0.0003	20%	0.0614	0.0576	-6%
2016	0.0002	0.0003	10%	0.0422	0.0365	-13%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
2017	0.0002	0.0002	14%	0.0385	0.0377	-2%
2018	0.0002	0.0003	24%	0.0824	0.0818	-1%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0511	0.0068	-87%	0.0400	0.0075	-81%	0.0005	0.0000	-98%	0.0358	0.0031	-91%
1991	0.0510	0.0412	-19%	0.0400	0.0339	-15%	0.0005	0.0001	-86%	0.0357	0.0198	-44%
1992	0.0511	0.0686	34%	0.0402	0.0551	37%	0.0005	0.0001	-77%	0.0357	0.0331	-7%
1993	0.0509	0.0895	76%	0.0400	0.0714	79%	0.0005	0.0002	-70%	0.0356	0.0433	22%
1994	0.0508	0.1045	106%	0.0399	0.0833	108%	0.0005	0.0002	-64%	0.0355	0.0505	42%
1995	0.0505	0.1141	126%	0.0402	0.0911	127%	0.0005	0.0002	-61%	0.0351	0.0552	57%
1996	0.0508	0.1191	135%	0.0401	0.0954	138%	0.0005	0.0002	-58%	0.0355	0.0575	62%
1997	0.0493	0.1203	144%	0.0392	0.0966	146%	0.0005	0.0002	-53%	0.0341	0.0577	69%
1998	0.0496	0.1179	138%	0.0405	0.0950	135%	0.0005	0.0003	-48%	0.0342	0.0562	64%
1999	0.0485	0.1124	132%	0.0404	0.0910	125%	0.0005	0.0003	-44%	0.0331	0.0531	60%
2000	0.0481	0.0784	63%	0.0384	0.0651	70%	0.0005	0.0003	-49%	0.0336	0.0363	8%
2001	0.0417	0.0722	73%	0.0385	0.0602	56%	0.0006	0.0003	-42%	0.0262	0.0324	24%
2002	0.0477	0.0669	40%	0.0445	0.0560	26%	0.0005	0.0003	-36%	0.0320	0.0295	-8%
2003	0.0352	0.0500	42%	0.0340	0.0421	24%	0.0005	0.0003	-39%	0.0216	0.0215	0%
2004	0.0328	0.0361	10%	0.0344	0.0322	-6%	0.0005	0.0003	-45%	0.0195	0.0148	-24%
2005	0.0301	0.0398	32%	0.0317	0.0353	11%	0.0005	0.0003	-47%	0.0170	0.0168	-2%
2006	0.0174	0.0190	9%	0.0228	0.0188	-17%	0.0004	0.0002	-44%	0.0076	0.0067	-12%
2007	0.0141	0.0179	27%	0.0175	0.0166	-5%	0.0003	0.0002	-21%	0.0069	0.0064	-7%
2008	0.0163	0.0168	3%	0.0198	0.0163	-18%	0.0003	0.0002	-32%	0.0085	0.0061	-28%
2009	0.0170	0.0156	-8%	0.0185	0.0149	-20%	0.0003	0.0002	-41%	0.0085	0.0054	-36%
2010	0.0146	0.0138	-5%	0.0180	0.0138	-23%	0.0003	0.0002	-31%	0.0066	0.0040	-39%
2011	0.0133	0.0133	1%	0.0149	0.0124	-17%	0.0004	0.0003	-33%	0.0032	0.0032	1%
2012	0.0110	0.0115	5%	0.0137	0.0113	-17%	0.0004	0.0003	-22%	0.0024	0.0024	-1%
2013	0.0111	0.0117	5%	0.0153	0.0128	-17%	0.0004	0.0003	-19%	0.0023	0.0023	1%
2014	0.0287	0.0280	-2%	0.0266	0.0260	-2%	0.0013	0.0012	-6%	0.0016	0.0016	0%
2015	0.0149	0.0150	1%	0.0227	0.0242	7%	0.0006	0.0005	-10%	0.0019	0.0019	1%
2016	0.0110	0.0107	-3%	0.0221	0.0217	-2%	0.0004	0.0003	-19%	0.0017	0.0017	-1%
2017	0.0103	0.0114	11%	0.0198	0.0209	6%	0.0003	0.0003	-7%	0.0018	0.0018	-2%
2018	0.0181	0.0185	2%	0.0211	0.0234	11%	0.0008	0.0008	-3%	0.0011	0.0010	-6%

P – Previous, R – Refined

3.7.7 AGRICULTURE/FORESTRY/FISHING: OFF-ROAD VEHICLES AND OTHER MACHINERY (NFR 1A4cii)

3.7.7.1 Overview

In this category are reported emissions from off-road vehicles in the agriculture sector e.g. tractors, harvesters and it is not considered as a key category. Slovakia was able to separate the consumption in the years 2014-2019 in this report for category 1A4cii from other categories previously reported within this category (***Table 3.104***). It is according to recommendation ***SK-1A4cii-2018-0001***. Slovakia is analysing newly obtained data for further separation of the categories to fully implement the recommendation.

Table 3.104: *Overview of emissions of off-road vehicles in the Agriculture/forestry/fishing category (1A4cii) for the years 1990-2019*

YEARS	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery								
	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3[kt]	$PM_{2.5}$ [kt]	CO [kt]	BC [kt]	Cd [t]	PAHs [t]
1990	0.7290	0.1292	0.0005	0.0002	0.0424	2.6339	0.0259	0.0000	NE
1991	0.7290	0.1292	0.0005	0.0002	0.0424	2.6339	0.0259	0.0000	NE
1992	0.7290	0.1292	0.0005	0.0002	0.0424	2.6339	0.0259	0.0000	NE
1993	0.7290	0.1292	0.0005	0.0002	0.0424	2.6339	0.0259	0.0000	NE
1994	0.7290	0.1292	0.0005	0.0002	0.0424	2.6339	0.0259	0.0000	NE
1995	0.7290	0.1292	0.0005	0.0002	0.0424	2.6339	0.0259	0.0000	NE
1996	0.7290	0.1292	0.0005	0.0002	0.0424	2.6339	0.0259	0.0000	NE
1997	0.6783	0.1202	0.0005	0.0002	0.0394	2.4506	0.0241	0.0000	NE
1998	0.7290	0.1292	0.0005	0.0002	0.0424	2.6339	0.0259	0.0000	NE
1999	0.7436	0.1317	0.0005	0.0002	0.0432	2.6866	0.0264	0.0000	NE
2000	1.9933	0.5399	0.0016	0.0005	0.0993	15.5366	0.0592	0.0008	NE
2001	1.9003	0.5147	0.0015	0.0005	0.0947	14.8115	0.0565	0.0007	NE
2002	1.8998	0.5146	0.0015	0.0005	0.0947	14.8078	0.0565	0.0007	NE
2003	2.1113	0.5718	0.0016	0.0006	0.1052	16.4565	0.0627	0.0008	NE
2004	2.3704	0.6420	0.0018	0.0006	0.1181	18.4756	0.0704	0.0009	NE
2005	2.5183	0.6821	0.0020	0.0007	0.1255	19.6290	0.0748	0.0010	NE
2006	2.3273	0.6303	0.0018	0.0006	0.1160	18.1397	0.0692	0.0009	NE
2007	2.3367	0.6329	0.0018	0.0006	0.1165	18.2136	0.0694	0.0009	NE
2008	2.4697	0.6689	0.0019	0.0007	0.1231	19.2502	0.0734	0.0010	NE
2009	2.3508	0.6367	0.0018	0.0006	0.1172	18.3230	0.0699	0.0009	NE
2010	2.3466	0.6356	0.0018	0.0006	0.1169	18.2902	0.0697	0.0009	NE
2011	2.4071	0.6520	0.0019	0.0007	0.1200	18.7622	0.0715	0.0009	NE
2012	2.4465	0.6626	0.0019	0.0007	0.1219	19.0691	0.0727	0.0010	NE
2013	2.4863	0.6734	0.0019	0.0007	0.1239	19.3793	0.0739	0.0010	NE
2014	2.7238	0.2800	0.0016	0.0006	0.1512	0.9066	0.0878	0.0008	0.0006
2015	2.3857	0.2452	0.0014	0.0006	0.1324	0.7941	0.0769	0.0007	0.0006
2016	2.3524	0.2418	0.0014	0.0005	0.1306	0.7830	0.0758	0.0007	0.0005
2017	2.1801	0.2241	0.0013	0.0005	0.1210	0.7256	0.0703	0.0006	0.0005
2018	2.1801	0.2241	0.0013	0.0005	0.1210	0.7256	0.0703	0.0006	0.0005
2019	2.0423	0.2099	0.0012	0.0005	0.1134	0.6798	0.0658	0.0006	0.0005
1990/2019	**180%**	**63%**	**137%**	**153%**	**168%**	**-74%**	**154%**	**236980%**	**-**
2018/2019	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**

3.7.7.2 Source-specific recalculations

No recalculations were made.

3.7.8 AGRICULTURE/FORESTRY/FISHING: NATIONAL FISHING (NFR 1A4ciii)

3.7.8.1 Overview

The category is reported as NO - no activity in SR.

3.7.9 OTHER STATIONARY (INCLUDING MILITARY) (NFR 1A5a)

3.7.9.1 Overview

Activities listed within this category are shown in ***Table 3.105***.

Table 3.105: *Activities according to national categorization included in 1A5a*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW	MEDIUM S.: NACE 05-09; 35.2; 36-43
1.5. Biogas production with projected production capacity: quantity of processed raw material or biological waste in t/d	

Overview of the emissions is shown in ***Table 3.106***.

Table 3.106: *Overview of emissions in the category 1A5a*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.1822	0.0067	0.3165	0.0052	0.0377	0.0503	0.0952	0.2203
1995	0.1888	0.0069	0.3280	0.0054	0.0391	0.0521	0.0987	0.2282
2000	0.1571	0.0305	0.3803	0.0051	0.0575	0.0767	0.1453	0.2958
2005	0.1958	0.4743	0.3183	0.0043	0.0218	0.0322	0.0800	0.1827
2010	0.1304	0.5664	0.1006	0.0016	0.0120	0.0173	0.0351	0.1396
2011	0.1740	0.5174	0.1186	0.0015	0.0143	0.0197	0.0391	0.1770
2012	0.3651	0.6715	0.2344	0.0013	0.0244	0.0302	0.0510	0.2433
2013	0.6197	0.7291	0.2973	0.0016	0.0271	0.0324	0.0522	0.3603
2014	0.4491	0.7664	0.2368	0.0003	0.0230	0.0269	0.0388	0.2366
2015	0.4062	0.8148	0.2074	0.0020	0.0218	0.0259	0.0391	0.2101
2016	0.5112	0.8024	0.2863	0.0005	0.0264	0.0310	0.0455	0.2621
2017	0.6503	0.8948	0.3673	0.0006	0.0171	0.0212	0.0357	0.2710
2018	0.6149	0.8833	0.3471	0.0011	0.0155	0.0208	0.0442	0.2641
2019	0.6353	0.8573	0.3577	0.0018	0.0141	0.0165	0.0211	0.3601
1990/2019	**249%**	**12768%**	**13%**	**-65%**	**-63%**	**-67%**	**-78%**	**63%**
2018/2019	**3%**	**-3%**	**3%**	**67%**	**-9%**	**-21%**	**-52%**	**36%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.3689	0.0045	0.0244	0.0126	0.0438	0.0453	0.0468	0.0058	0.5534
1995	0.1470	0.0018	0.0098	0.0051	0.0178	0.0181	0.0227	0.0023	0.2214
2000	0.0356	0.0005	0.0024	0.0014	0.0054	0.0045	0.0178	0.0006	0.0543
2005	0.0131	0.0002	0.0009	0.0005	0.0022	0.0017	0.0087	0.0002	0.0214
2010	0.0080	0.0002	0.0006	0.0004	0.0013	0.0011	0.0042	0.0002	0.0147
2011	0.0052	0.0002	0.0005	0.0003	0.0009	0.0007	0.0026	0.0002	0.0135
2012	0.0442	0.0188	0.0014	0.0007	0.0339	0.0094	0.0056	0.0011	0.7492
2013	0.0521	0.0232	0.0017	0.0008	0.0416	0.0112	0.0058	0.0015	0.9243
2014	0.0572	0.0259	0.0016	0.0007	0.0463	0.0124	0.0063	0.0014	1.0291
2015	0.0631	0.0286	0.0017	0.0007	0.0511	0.0137	0.0069	0.0015	1.1328
2016	0.0578	0.0257	0.0017	0.0007	0.0461	0.0124	0.0061	0.0015	1.0220
2017	0.0747	0.0339	0.0021	0.0009	0.0606	0.0162	0.0066	0.0019	1.3474
2018	0.0284	0.0120	0.0010	0.0005	0.0216	0.0060	0.0030	0.0010	0.4819
2019	0.0254	0.0108	0.0009	0.0004	0.0195	0.0054	0.0026	0.0009	0.4354
1990/2019	**-93%**	**139%**	**-96%**	**-97%**	**-55%**	**-88%**	**-94%**	**-85%**	**-21%**
2018/2019	**-11%**	**-10%**	**-14%**	**-13%**	**-10%**	**-10%**	**-13%**	**-12%**	**-10%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.5352	0.1106	0.1450	0.0620	0.0477	0.3653	0.0018	0.4859
1995	0.2136	0.0445	0.0585	0.0253	0.0196	0.1479	0.0007	0.1933
2000	0.0518	0.0111	0.0150	0.0068	0.0054	0.0383	0.0002	0.0459
2005	0.0193	0.0043	0.0059	0.0028	0.0023	0.0153	0.0001	0.0166
2010	0.0126	0.0032	0.0055	0.0025	0.0021	0.0134	0.0001	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]	PCB [kg]
2011	0.0090	0.0028	0.0075	0.0026	0.0025	0.0154	0.0001	0.0062
2012	0.1534	0.0184	0.0380	0.0115	0.0099	0.0778	0.0072	0.0065
2013	0.1862	0.0231	0.0543	0.0154	0.0137	0.1066	0.0089	0.0050
2014	0.2058	0.0238	0.0516	0.0145	0.0125	0.1025	0.0100	0.0040
2015	0.2266	0.0256	0.0517	0.0150	0.0128	0.1051	0.0110	0.0045
2016	0.2052	0.0242	0.0542	0.0151	0.0131	0.1066	0.0099	0.0057
2017	0.2685	0.0309	0.0675	0.0188	0.0163	0.1336	0.0130	0.0056
2018	0.0989	0.0137	0.0389	0.0100	0.0091	0.0717	0.0046	0.0043
2019	0.0895	0.0124	0.0347	0.0089	0.0082	0.0642	0.0042	0.0031
1990/2019	**-83%**	**-89%**	**-76%**	**-86%**	**-83%**	**-82%**	**134%**	**-99%**
2018/2019	**-10%**	**-9%**	**-11%**	**-10%**	**-10%**	**-10%**	**-10%**	**-27%**

An overview of the activity data (energy consumption) for this source category is in ***Table 3.107*** below.

Table 3.107: *Overview of activity data in the category 1A5a*

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	10.04	318.74	1 867.55	201.96	NO
1995	10.71	315.99	1 958.98	199.46	NO
2000	13.05	300.32	1 841.01	200.73	NO
2005	4.50	199.38	2 846.78	267.09	49.83
2010	20.21	57.35	1 630.65	472.22	43.57
2011	12.64	36.82	1 561.37	1 060.63	13.29
2012	13.77	37.03	1 715.44	3 425.48	NO
2013	12.58	29.40	1 434.60	5 966.51	NO
2014	14.76	23.53	1 361.15	4 235.23	NO
2015	35.00	26.30	1 588.89	4 022.90	NO
2016	12.53	33.60	1 599.00	4 639.14	13.29
2017	20.04	32.70	1 552.10	6 168.42	13.29
2018	18.83	25.26	1 349.63	3 592.36	NO
2019	8.32	18.37	1 517.25	3 328.13	NO
1990/2019	**-17%**	**-94%**	**-19%**	**1548%**	**-**
2018/2019	**-56%**	**-27%**	**12%**	**-7%**	**-**

3.7.9.2 Methodological issues

Emission data is compiled in the NEIS, therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV**. PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS and were calculated in available years from 2005 to 2019.

The historical data (1990-1999) are not covered by the NEIS, therefore the emission factors used for reconstruction of historical years 1990-1999 (1990-2004 for $PM_{2.5}$, PM_{10}) were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 3.108***).

Table 3.108: *Emission factors for calculation of historical years*

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	NH_3 [g/GJ]	TSP [g/tGJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/tGJ]
EF	75.93	2.78	131.88	2.17	39.68	40%	53%	91.77

Emissions of heavy metals and POPs are calculated at the Tier 2 level. The data (fuel, technology and specific information) is compiled in the NEIS database, therefore this detailed methodologies could be used focused to the combinations of the main installation types/fuels used in our country. Emission factors used for the calculation of heavy metals and POPs are default EF from EMEP/EEA GB2019 (***Table 3.109***).

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

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

Where:

E_i = annual emission of pollutant *i*,

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

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

Table 3.109: *Emission factors for heavy metals and POPs in the category 1A5a*

T2	UNIT	LIQUID FUELS				HARD COAL/BROWN COAL	
		Standard boilers (> 50 KWth ≤ 1 MWth)	**Standard boilers** (> 1 MWth ≤ 50 MWth)	**Gas turbines** (50 kWth – 50 MWth)	**Stationary reciprocating engines** (50 kWth – 50 MWth)	**Standard boilers** (> 50 KWth ≤ 1 MWth)	**Standard boilers** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	20	10	0.012	0.15	200	100
Cd	[mg/GJ]	0.3	0.3	0.001	0.01	3	1
Hg	[mg/GJ]	0.1	0.1	0.12	0.11	7	9
As	[mg/GJ]	1	1	0.002	0.06	5	4
Cr	[mg/GJ]	20	20	0.2	0.2	15	15
Cu	[mg/GJ]	10	3	0.13	0.3	17.5	10
Ni	[mg/GJ]	300	200	0.005	0.01	13	10
Se	[mg/GJ]	NA	0.5	0.002	0.22	1.8	2
Zn	[mg/GJ]	10	5	0.42	58	200	150
PCDD/F	[ng I-TEQ/GJ]	10	10	1.8	0.99	203	100
B(a)P	[mg/GJ]	8	1	NE	1.9	45.5	13
B(b)F	[mg/GJ]	9	2	NE	15	58.9	17
B(k)F	[mg/GJ]	6	1	NE	1.7	23.7	9
I()P	[mg/GJ]	3	1	NE	1.5	18.5	6
PAHs	[mg/GJ]	26	5	NE	20.1	146.6	45
HCB	[µg/GJ]	NE	NE	NE	0.22	0.62	0.62
PCBs	[µg/GJ]	NE	NE	NE	0.13	170	170

T2	UNIT	GASEOUS FUELS				BIOMASS	
		Standard boilers (> 50 KWth ≤ 1 MWth)	**Standard boilers** (> 1 MWth ≤ 50 MWth)	**Gas turbines** (50 kWth – 50 MWth)	**Stationary reciprocating engines** (50 kWth – 50 MWth)	**Standard boilers** (> 50 KWth ≤ 1 MWth)	**Standard boilers** (>1 MWth ≤ 50 MWth)
Pb	[mg/GJ]	0.0015	0.0015	0.0015	0.04	27	27
Cd	[mg/GJ]	0.00025	0.00025	0.00025	0.003	13	13
Hg	[mg/GJ]	0.1	0.1	0.1	0.1	0.56	0.56
As	[mg/GJ]	0.12	0.12	0.12	0.05	0.19	0.19
Cr	[mg/GJ]	0.00076	0.00076	0.00076	0.05	23	23
Cu	[mg/GJ]	0.000076	0.000076	0.000076	0.01	6	6
Ni	[mg/GJ]	0.00051	0.00051	0.00051	0.05	2	2
Se	[mg/GJ]	0.011	0.011	0.011	0.2	0.5	0.5

T2	UNIT	GASEOUS FUELS				BIOMASS	
Zn	[mg/GJ]	0.0015	0.0015	0.0015	2.9	512	512
PCDD/F	[ng I-TEQ/GJ]	0.5	0.5	0.5	0.57	100	100
B(a)P	[mg/GJ]	0.56	0.56	0.56	1.2	10	10
B(b)F	[mg/GJ]	0.84	0.84	0.84	9	16	16
B(k)F	[mg/GJ]	0.84	0.84	0.84	1.7	5	5
I()P	[mg/GJ]	0.84	0.84	0.84	1.8	4	4
PAHs	[mg/GJ]	3.08	3.08	3.08	13.7	35	35
HCB	[µg/GJ]	NA	NA	NA	NA	5	5
PCBs	[µg/GJ]	NA	NA	NA	NA	0.03	0.007

3.7.9.3 Completeness

Emissions of BC are reported as NE.

3.7.9.4 Source-specific recalculations

No recalculations in this submission for emissions of main pollutants.

The detailed information compiled in the NEIS database allowed to use of Tier 2 emission factors EMEP/EEA GB_{2019} for the calculation of emissions of HMs and POPs with the aim to improve the methodology for this category. Recalculations are shown in ***Table 3.110***.

Table 3.110: *Previous and refined emissions in the category 1A5a*

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0428	0.3689	761%	0.0006	0.0045	663%	0.0027	0.0244	793%	0.0015	0.0126	749%
1991	0.0428	0.3119	629%	0.0006	0.0038	547%	0.0027	0.0206	656%	0.0015	0.0107	619%
1992	0.0428	0.2617	512%	0.0006	0.0032	444%	0.0027	0.0173	534%	0.0015	0.0090	504%
1993	0.0427	0.2178	410%	0.0006	0.0027	355%	0.0027	0.0144	429%	0.0015	0.0075	403%
1994	0.0426	0.1797	321%	0.0006	0.0022	277%	0.0027	0.0118	335%	0.0015	0.0061	313%
1995	0.0425	0.1470	246%	0.0006	0.0018	211%	0.0027	0.0098	260%	0.0015	0.0051	245%
1996	0.0424	0.1193	182%	0.0006	0.0015	154%	0.0027	0.0080	196%	0.0015	0.0042	187%
1997	0.0419	0.0961	129%	0.0006	0.0012	107%	0.0027	0.0064	140%	0.0015	0.0034	134%
1998	0.0418	0.0769	84%	0.0006	0.0010	68%	0.0027	0.0052	94%	0.0015	0.0028	91%
1999	0.0409	0.0613	50%	0.0006	0.0008	38%	0.0026	0.0041	57%	0.0015	0.0023	55%
2000	0.0404	0.0356	-12%	0.0006	0.0005	-16%	0.0026	0.0024	-7%	0.0014	0.0014	-4%
2001	0.0384	0.0302	-22%	0.0005	0.0004	-23%	0.0026	0.0020	-21%	0.0015	0.0012	-19%
2002	0.0378	0.0249	-34%	0.0005	0.0003	-37%	0.0025	0.0017	-32%	0.0014	0.0009	-32%
2003	0.0331	0.0206	-38%	0.0005	0.0003	-40%	0.0022	0.0014	-36%	0.0013	0.0008	-35%
2004	0.0316	0.0148	-53%	0.0006	0.0002	-61%	0.0021	0.0010	-52%	0.0012	0.0006	-50%
2005	0.0273	0.0131	-52%	0.0006	0.0002	-65%	0.0019	0.0009	-52%	0.0011	0.0005	-51%
2006	0.0255	0.0106	-58%	0.0006	0.0002	-67%	0.0017	0.0008	-54%	0.0010	0.0005	-46%
2007	0.0121	0.0114	-6%	0.0004	0.0002	-54%	0.0009	0.0009	-7%	0.0006	0.0005	-9%
2008	0.0147	0.0129	-12%	0.0008	0.0005	-31%	0.0010	0.0010	-2%	0.0006	0.0006	-7%
2009	0.0075	0.0070	-6%	0.0004	0.0002	-51%	0.0006	0.0005	-16%	0.0004	0.0003	-19%
2010	0.0083	0.0080	-4%	0.0003	0.0002	-50%	0.0007	0.0006	-11%	0.0004	0.0004	-14%
2011	0.0056	0.0052	-7%	0.0004	0.0002	-50%	0.0006	0.0005	-17%	0.0004	0.0003	-23%
2012	0.0443	0.0442	0%	0.0189	0.0188	-1%	0.0015	0.0014	-6%	0.0008	0.0007	-15%
2013	0.0524	0.0521	-1%	0.0233	0.0232	-1%	0.0018	0.0017	-6%	0.0010	0.0008	-20%
2014	0.0578	0.0572	-1%	0.0263	0.0259	-1%	0.0017	0.0016	-6%	0.0008	0.0007	-21%
2015	0.0629	0.0631	0%	0.0286	0.0286	0%	0.0018	0.0017	-6%	0.0009	0.0007	-19%
2016	0.0578	0.0578	0%	0.0257	0.0257	0%	0.0018	0.0017	-6%	0.0009	0.0007	-23%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2017	0.0748	0.0747	0%	0.0339	0.0339	0%	0.0022	0.0021	-7%	0.0011	0.0009	-24%
2018	0.0282	0.0284	1%	0.0120	0.0120	0%	0.0011	0.0010	-7%	0.0007	0.0005	-28%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0044	0.0438	884%	0.0056	0.0453	706%	0.0053	0.0468	779%
1991	0.0044	0.0371	735%	0.0056	0.0383	582%	0.0053	0.0402	658%
1992	0.0044	0.0312	602%	0.0056	0.0321	473%	0.0053	0.0346	547%
1993	0.0044	0.0261	488%	0.0056	0.0268	378%	0.0053	0.0299	459%
1994	0.0044	0.0216	389%	0.0056	0.0221	295%	0.0053	0.0260	391%
1995	0.0044	0.0178	304%	0.0056	0.0181	225%	0.0054	0.0227	324%
1996	0.0044	0.0146	231%	0.0056	0.0147	165%	0.0055	0.0201	266%
1997	0.0044	0.0120	174%	0.0055	0.0119	116%	0.0052	0.0180	244%
1998	0.0044	0.0097	124%	0.0055	0.0095	74%	0.0054	0.0163	205%
1999	0.0043	0.0080	84%	0.0054	0.0076	42%	0.0059	0.0150	154%
2000	0.0042	0.0054	28%	0.0053	0.0045	-14%	0.0055	0.0178	224%
2001	0.0040	0.0048	20%	0.0050	0.0039	-23%	0.0048	0.0175	263%
2002	0.0042	0.0036	-13%	0.0050	0.0032	-37%	0.0072	0.0100	40%
2003	0.0037	0.0032	-13%	0.0044	0.0026	-40%	0.0068	0.0108	59%
2004	0.0035	0.0025	-28%	0.0042	0.0019	-54%	0.0038	0.0100	163%
2005	0.0032	0.0022	-31%	0.0036	0.0017	-53%	0.0032	0.0087	174%
2006	0.0030	0.0020	-34%	0.0034	0.0014	-58%	0.0030	0.0086	189%
2007	0.0017	0.0016	-10%	0.0017	0.0014	-14%	0.0023	0.0030	32%
2008	0.0026	0.0024	-9%	0.0021	0.0016	-22%	0.0038	0.0034	-11%
2009	0.0015	0.0013	-10%	0.0011	0.0010	-11%	0.0033	0.0051	57%
2010	0.0014	0.0013	-8%	0.0012	0.0011	-7%	0.0028	0.0042	49%
2011	0.0011	0.0009	-17%	0.0008	0.0007	-12%	0.0018	0.0026	44%
2012	0.0340	0.0339	0%	0.0094	0.0094	0%	0.0050	0.0056	11%
2013	0.0418	0.0416	0%	0.0113	0.0112	-1%	0.0055	0.0058	5%
2014	0.0469	0.0463	-1%	0.0126	0.0124	-1%	0.0061	0.0063	3%
2015	0.0511	0.0511	0%	0.0137	0.0137	0%	0.0078	0.0069	-11%
2016	0.0459	0.0461	0%	0.0124	0.0124	0%	0.0058	0.0061	5%
2017	0.0605	0.0606	0%	0.0162	0.0162	0%	0.0066	0.0066	-1%
2018	0.0216	0.0216	0%	0.0060	0.0060	0%	0.0034	0.0030	-11%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0007	0.0058	731%	0.0661	0.5534	738%
1991	0.0007	0.0049	603%	0.0660	0.4682	609%
1992	0.0007	0.0041	490%	0.0660	0.3931	496%
1993	0.0007	0.0034	392%	0.0659	0.3273	397%
1994	0.0007	0.0028	306%	0.0658	0.2703	311%
1995	0.0007	0.0023	234%	0.0656	0.2214	238%
1996	0.0007	0.0019	175%	0.0654	0.1799	175%
1997	0.0007	0.0015	122%	0.0649	0.1451	124%
1998	0.0007	0.0012	79%	0.0646	0.1164	80%
1999	0.0007	0.0010	44%	0.0635	0.0931	47%
2000	0.0007	0.0006	-11%	0.0626	0.0543	-13%
2001	0.0007	0.0005	-27%	0.0603	0.0464	-23%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
2002	0.0007	0.0004	-37%	0.0597	0.0385	-35%
2003	0.0006	0.0003	-44%	0.0530	0.0320	-40%
2004	0.0006	0.0003	-57%	0.0550	0.0236	-57%
2005	0.0005	0.0002	-59%	0.0522	0.0214	-59%
2006	0.0005	0.0002	-60%	0.0483	0.0179	-63%
2007	0.0003	0.0002	-34%	0.0293	0.0190	-35%
2008	0.0003	0.0002	-23%	0.0453	0.0339	-25%
2009	0.0002	0.0001	-37%	0.0247	0.0150	-39%
2010	0.0002	0.0002	-31%	0.0222	0.0147	-34%
2011	0.0002	0.0002	-17%	0.0209	0.0135	-35%
2012	0.0010	0.0011	6%	0.7529	0.7492	0%
2013	0.0013	0.0015	16%	0.9267	0.9243	0%
2014	0.0013	0.0014	15%	1.0405	1.0291	-1%
2015	0.0013	0.0015	10%	1.1305	1.1328	0%
2016	0.0013	0.0015	17%	1.0184	1.0220	0%
2017	0.0017	0.0019	14%	1.3440	1.3474	0%
2018	0.0007	0.0010	37%	0.4773	0.4819	1%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0660	0.5352	711%	0.0590	0.3653	519%	0.0002	0.0018	762%	0.0542	0.4859	797%
1991	0.0659	0.4526	587%	0.0590	0.3092	424%	0.0002	0.0015	631%	0.0541	0.4108	659%
1992	0.0659	0.3798	476%	0.0590	0.2595	340%	0.0002	0.0013	514%	0.0541	0.3446	537%
1993	0.0657	0.3160	381%	0.0589	0.2160	267%	0.0002	0.0011	413%	0.0540	0.2867	431%
1994	0.0657	0.2606	297%	0.0589	0.1769	200%	0.0002	0.0009	325%	0.0539	0.2365	338%
1995	0.0655	0.2136	226%	0.0591	0.1479	150%	0.0002	0.0007	250%	0.0537	0.1933	260%
1996	0.0652	0.1736	166%	0.0585	0.1221	109%	0.0002	0.0006	185%	0.0536	0.1567	193%
1997	0.0647	0.1399	116%	0.0587	0.0992	69%	0.0002	0.0005	133%	0.0530	0.1261	138%
1998	0.0644	0.1122	74%	0.0588	0.0808	37%	0.0002	0.0004	88%	0.0528	0.1007	91%
1999	0.0631	0.0895	42%	0.0585	0.0646	10%	0.0002	0.0003	53%	0.0517	0.0802	55%
2000	0.0623	0.0518	-17%	0.0562	0.0383	-32%	0.0002	0.0002	-9%	0.0511	0.0459	-10%
2001	0.0598	0.0439	-27%	0.0598	0.0330	-45%	0.0002	0.0002	-16%	0.0486	0.0386	-20%
2002	0.0586	0.0364	-38%	0.0562	0.0269	-52%	0.0002	0.0001	-32%	0.0476	0.0322	-32%
2003	0.0516	0.0302	-42%	0.0537	0.0234	-56%	0.0002	0.0001	-36%	0.0415	0.0264	-36%
2004	0.0501	0.0218	-56%	0.0520	0.0173	-67%	0.0002	0.0001	-59%	0.0396	0.0188	-52%
2005	0.0441	0.0193	-56%	0.0480	0.0153	-68%	0.0002	0.0001	-64%	0.0339	0.0166	-51%
2006	0.0410	0.0161	-61%	0.0429	0.0151	-65%	0.0002	0.0001	-65%	0.0317	0.0133	-58%
2007	0.0207	0.0173	-16%	0.0272	0.0154	-43%	0.0002	0.0001	-52%	0.0146	0.0147	1%
2008	0.0258	0.0197	-24%	0.0280	0.0156	-45%	0.0003	0.0002	-28%	0.0168	0.0169	1%
2009	0.0138	0.0112	-19%	0.0207	0.0113	-45%	0.0002	0.0001	-52%	0.0084	0.0084	0%
2010	0.0146	0.0126	-13%	0.0215	0.0134	-38%	0.0001	0.0001	-51%	0.0098	0.0097	0%
2011	0.0111	0.0090	-19%	0.0215	0.0154	-28%	0.0001	0.0001	-50%	0.0063	0.0062	0%
2012	0.1546	0.1534	-1%	0.0779	0.0778	0%	0.0073	0.0072	-1%	0.0064	0.0065	3%
2013	0.1880	0.1862	-1%	0.0997	0.1066	7%	0.0090	0.0089	-1%	0.0051	0.0050	-2%
2014	0.2085	0.2058	-1%	0.0951	0.1025	8%	0.0101	0.0100	-1%	0.0041	0.0040	-3%
2015	0.2264	0.2266	0%	0.1009	0.1051	4%	0.0110	0.0110	0%	0.0046	0.0045	-3%
2016	0.2061	0.2052	0%	0.0988	0.1066	8%	0.0099	0.0099	0%	0.0058	0.0057	-2%
2017	0.2698	0.2685	0%	0.1258	0.1336	6%	0.0130	0.0130	0%	0.0057	0.0056	-2%
2018	0.0989	0.0989	0%	0.0593	0.0717	21%	0.0046	0.0046	0%	0.0043	0.0043	-1%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE

P – Previous, R – Refined

3.9.9 OTHER, MOBILE (INCLUDING MILITARY, LAND BASED AND RECREATIONAL BOATS) (NFR 1A5b)

3.9.9.1 Overview

This category was first time reported in the year 2018. Total fuel consumption was 169.78 TJ in 2019. This consumption includes petrol, diesel oil and jet fuel. Emissions of mobile combustion in the military are shown in ***Table 3.111***.

Table 3.111: *Overview of emissions from military based fuel consumption (in kt)*

YEAR	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
2015	0.0773	0.0004	0.0045	0.0000002	0.0004	0.0004	0.0004	0.0002	0.0337
2016	0.0779	0.0004	0.0045	0.0000002	0.0005	0.0005	0.0005	0.0002	0.0339
2017	0.0723	0.0004	0.0042	0.0000002	0.0004	0.0004	0.0004	0.0002	0.0315
2018	0.0564	0.0003	0.0033	0.0000002	0.0003	0.0003	0.0003	0.0002	0.0246
2019	0.0502	0.0003	0.0029	0.0000002	0.0003	0.0003	0.0003	0.0001	0.0219

3.8 FUGITIVE EMISSIONS (NFR 1B)

3.8.1 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 the mining activity. This category is key for emissions of NMVOC and TSP. Emissions in this category have a decreasing trend due to the decrease in the activity in the Slovak Republic. An overview of the emissions and activity data is shown in ***Table 3.112***.

Table 3.112: *Overview of emissions and activity data in the category 1B1a*

YEAR	COAL PRODUCED [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
1990	3.46	10.3680	0.1382	0.9677	2.0390
1995	3.76	11.2773	0.1504	1.0525	2.2179
2000	3.65	10.9479	0.1460	1.0218	2.1531
2005	2.51	7.5336	0.1004	0.7031	1.4816
2010	2.38	7.1326	0.0951	0.6657	1.4027
2011	2.38	7.1281	0.0950	0.6653	1.4019
2012	2.29	6.8766	0.0917	0.6418	1.3524
2013	2.35	7.0582	0.0941	0.6588	1.3881
2014	2.19	6.5632	0.0875	0.6126	1.2908
2015	1.94	5.8180	0.0776	0.5430	1.1442
2016	1.85	5.5414	0.0739	0.5172	1.0898
2017	1.83	5.5020	0.0734	0.5135	1.0821
2018	1.50	4.5060	0.0601	0.4206	0.8862
2019	1.43	4.2930	0.0572	0.4007	0.8443
1990/2019	**-59%**	**-59%**	**-59%**	**-59%**	**-59%**
2018/2019	**-5%**	**-5%**	**-5%**	**-5%**	**-5%**

3.8.1.2 Methodological issues

Tier 2 emission factors for Underground mining from EMEP/EEA GB_{2019} were used for calculations of NMVOC. PMs emissions were calculated using of Tier 1 emission factors due to absence of activity data about hole drilled (***Table 3.113***).

Table 3.113: *Emission factors in the category 1B1a*

T1/T2	UNIT	EF
NMVOC	[kg/t coal]	3
$PM_{2.5}$	[kg/t coal]	0.005
PM_{10}	[kg/t coal]	0.042
TSP	[kg/t coal]	0.089

3.8.1.3 Completeness

Notation keys were used following EMEP/EEA GB_{2019}.

3.8.1.4 Source-specific recalculations

No recalculations 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 reflects also the emissions within this category. This category is key for emissions of PM_{10}, Ni and PCDD/F.

An overview of the emissions is shown in ***Table 3.114***.

Table 3.114: *Overview of emissions and activity data in the category 1B1b*

YEAR	COKE PRODUCED [Mt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	2.34	0.0021	0.0180	0.0019	0.0087	0.1427	0.3416	0.8120	0.0699	1.0764
1995	1.85	0.0017	0.0143	0.0015	0.0069	0.1131	0.2707	0.6433	0.0554	0.8528
2000	1.60	0.0014	0.0123	0.0013	0.0059	0.0974	0.2332	0.5541	0.0477	0.7346
2005	1.74	0.0016	0.0134	0.0014	0.0064	0.1061	0.2540	0.6038	0.0520	0.8004
2010	1.55	0.0014	0.0119	0.0012	0.0057	0.0946	0.2263	0.5379	0.0463	0.7130
2011	1.52	0.0014	0.0117	0.0012	0.0056	0.0927	0.2219	0.5274	0.0454	0.6992
2012	1.47	0.0013	0.0113	0.0012	0.0054	0.0897	0.2146	0.5101	0.0439	0.6762
2013	1.44	0.0013	0.0111	0.0012	0.0053	0.0878	0.2102	0.4997	0.0430	0.6624
2014	1.47	0.0013	0.0113	0.0012	0.0054	0.0897	0.2146	0.5101	0.0439	0.6762
2015	1.53	0.0014	0.0118	0.0012	0.0057	0.0933	0.2234	0.5309	0.0457	0.7038
2016	1.54	0.0014	0.0119	0.0012	0.0057	0.0939	0.2248	0.5344	0.0460	0.7084
2017	1.49	0.0013	0.0115	0.0012	0.0055	0.0909	0.2175	0.5170	0.0445	0.6854
2018	1.50	0.0014	0.0116	0.0012	0.0056	0.0915	0.2190	0.5205	0.0448	0.6900
2019	1.32	0.0012	0.0102	0.0011	0.0049	0.0805	0.1927	0.4580	0.0395	0.6072
1990/2019	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**
2018/2019	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.8892	0.0164	0.0281	0.0304	0.3978	0.1123	0.2808	0.0374	0.5148
1995	0.7045	0.0130	0.0222	0.0241	0.3152	0.0890	0.2225	0.0297	0.4079
2000	0.6068	0.0112	0.0192	0.0208	0.2715	0.0767	0.1916	0.0256	0.3513
2005	0.6612	0.0122	0.0209	0.0226	0.2958	0.0835	0.2088	0.0278	0.3828

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2010	0.5890	0.0109	0.0186	0.0202	0.2635	0.0744	0.1860	0.0248	0.3410
2011	0.5776	0.0106	0.0182	0.0198	0.2584	0.0730	0.1824	0.0243	0.3344
2012	0.5586	0.0103	0.0176	0.0191	0.2499	0.0706	0.1764	0.0235	0.3234
2013	0.5472	0.0101	0.0173	0.0187	0.2448	0.0691	0.1728	0.0230	0.3168
2014	0.5586	0.0103	0.0176	0.0191	0.2499	0.0706	0.1764	0.0235	0.3234
2015	0.5814	0.0107	0.0184	0.0199	0.2601	0.0734	0.1836	0.0245	0.3366
2016	0.5852	0.0108	0.0185	0.0200	0.2618	0.0739	0.1848	0.0246	0.3388
2017	0.5662	0.0104	0.0179	0.0194	0.2533	0.0715	0.1788	0.0238	0.3278
2018	0.5700	0.0105	0.0180	0.0195	0.2550	0.0720	0.1800	0.0240	0.3300
2019	0.5016	0.0092	0.0158	0.0172	0.2244	0.0634	0.1584	0.0211	0.2904
1990/2019	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**
2018/2019	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]
1990	7.0200	0.3744	0.4680	0.2340	0.1638	8.2602
1995	5.5620	0.2966	0.3708	0.1854	0.1298	6.5446
2000	4.7908	0.2555	0.3194	0.1597	0.1118	5.6371
2005	5.2200	0.2784	0.3480	0.1740	0.1218	6.1422
2010	4.6500	0.2480	0.3100	0.1550	0.1085	5.4715
2011	4.5600	0.2432	0.3040	0.1520	0.1064	5.3656
2012	4.4100	0.2352	0.2940	0.1470	0.1029	5.1891
2013	4.3200	0.2304	0.2880	0.1440	0.1008	5.0832
2014	4.4100	0.2352	0.2940	0.1470	0.1029	5.1891
2015	4.5900	0.2448	0.3060	0.1530	0.1071	5.4009
2016	4.6200	0.2464	0.3080	0.1540	0.1078	5.4362
2017	4.4700	0.2384	0.2980	0.1490	0.1043	5.2597
2018	4.5000	0.2400	0.3000	0.1500	0.1050	5.2950
2019	3.9600	0.2112	0.2640	0.1320	0.0924	4.6596
1990/2019	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**	**-44%**
2018/2019	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**

3.8.2.2 Methodological issues

The category reports all emissions according to the method of EMEP/EEA GB_{2019}. Default emission factors were used for the calculation of the emissions (***Table 3.115***).

***Table 3.115:** Default EF used in fugitive emission from solid fuels transformation*

T1	UNIT	EF
NOx	g/Mg coke	0.9
NMVOC	g/Mg coke	7.7
SOx	g/Mg coke	0.8
NH_3	g/Mg coke	3.7
$PM_{2.5}$	g/Mg coke	61
PM_{10}	g/Mg coke	146
TSP	g/Mg coke	347
BC	% $PM_{2.5}$	0.49
CO	g/Mg coke	460
Pb	g/Mg coke	0.38
Cd	g/Mg coke	0.007
Hg	g/Mg coke	0.012
As	g/Mg coke	0.013
Cr	g/Mg coke	0.17
Cu	g/Mg coke	0.048
Ni	g/Mg coke	0.12
Se	g/Mg coke	0.016
Zn	g/Mg coke	0.22
PCDD/F	µg I-TEQ/Mg coke	3
B(a)P	g/Mg coke	0.16
B(b)F	g/Mg coke	0.2
B(k)F	g/Mg coke	0.1
I()P	g/Mg coke	0.07
PAHs	g/Mg coke	0.53

3.8.2.3 Completeness

Emissions HCB and PCBs are reported with notation key NE.

3.8.2.4 Source-specific recalculations

No recalculations in this submission.

3.8.3 FUGITIVE EMISSIONS FROM SOLID FUELS (NFR 1B1c)

3.8.3.1 Overview

There is no activity in the Slovak Republic, notation key NO is used.

3.8.4 FUGITIVE EMISSIONS OIL: EXPLORATION, PRODUCTION, TRANSPORT (NFR 1B2ai)

3.8.4.1 Overview

The category reports only NMVOC emissions. The definition of included activities is shown in ***Table 3.116***.

***Table 3.116:** Activities according to national categorization included in 1B2ai*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.2. Oil extraction and related transport and storage

The overview of emissions and activity data is shown in ***Table 3.117***. The production and transportation of crude oil show a decreasing trend since 1990.

Table 3.117: *Overview of emissions and activity data in the category 1B2ai*

YEAR	CRUDE OIL PRODUCED AND TRANSPORTED [Mt]	NMVOC [kt]
1990	13.65	1.3654
1995	13.66	1.3655
2000	9.36	0.9359
2005	10.69	1.0693
2010	10.09	1.0088
2011	9.93	0.9935
2012	8.43	0.8429
2013	9.80	0.9798
2014	8.96	0.8957
2015	9.94	0.9944
2016	9.18	0.9181
2017	9.59	0.9590
2018	9.47	0.9467
2019	9.00	0.9004
1990/2019	**-34%**	**-34%**
2018/2019	**-5%**	**-5%**

3.8.4.2 Methodological issues

For the calculation of NMVOC emissions is used the data from the NEIS database reported by the operators (definition of included activities is shown in ***Table 3.116***) and are completed by the calculations of emissions from the extracted oil. For the calculation the default: **EF = 0.1 kg/Mg oil** is used (Land-based activities).

3.8.4.3 Completeness

Notation key of NA is used for the other emissions except SO_X where NE is used in compliance with the EMEP/EEA GB_{2019}.

3.8.4.4 Source-specific recalculations

Due to change of emission factor to Tier 2 land based activities and unit error correction, emissions of NMVOC changed as shown in ***Table 3.118.***

Table 3.118: *Previous and refined emissions in the category 1B2ai*

YEAR	NMVOC [kt]		
	PREVIOUS	REFINED	CHANGE
1990	0.0286	1.3654	4681%
1991	0.0284	1.3653	4708%
1992	0.0274	1.3643	4879%
1993	0.0279	1.3648	4792%
1994	0.0281	1.3648	4753%
1995	0.0290	1.3655	4611%
1996	0.0266	1.2601	4633%
1997	0.0290	1.1154	3750%
1998	0.0286	1.1150	3802%
1999	0.0290	1.0466	3504%
2000	0.0281	0.9359	3226%
2001	0.0278	0.9606	3357%
2002	0.0275	0.9498	3358%
2003	0.0266	0.9971	3655%
2004	0.0939	1.0363	1004%

YEAR	NMVOC [kt]		
	PREVIOUS	REFINED	CHANGE
2005	0.0383	1.0693	2690%
2006	0.0197	1.1173	5565%
2007	0.0051	1.0665	20863%
2008	0.0057	1.0675	18564%
2009	0.0095	1.0700	11208%
2010	0.0190	1.0088	5213%
2011	0.0040	0.9935	24530%
2012	0.0116	0.8429	7179%
2013	0.0175	0.9798	5492%
2014	0.0302	0.8957	2864%
2015	0.0372	0.9944	2573%
2016	0.0346	0.9181	2551%
2017	0.0269	0.9590	3469%
2018	0.0218	0.9467	4246%

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 3.119***. Emissions in this category show a decreasing trend which is connected with a decrease in the activity.

Table 3.119: *Overview of emissions and activity data in the category 1B2aiv*

YEAR	CRUDE OIL REFINED [Mt]	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]	PCDD /F [g I-TEQ]
1990	6.22	0.0317	0.0317	0.0317	0.0317	0.0317	0.0317	0.0317	0.0317	0.0317	0.0355
1995	5.17	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0295
2000	5.44	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0310
2005	5.60	0.0285	0.0285	0.0285	0.0285	0.0285	0.0285	0.0285	0.0285	0.0285	0.0319
2010	5.45	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0311
2011	5.99	0.0306	0.0306	0.0306	0.0306	0.0306	0.0306	0.0306	0.0306	0.0306	0.0341
2012	5.40	0.0275	0.0275	0.0275	0.0275	0.0275	0.0275	0.0275	0.0275	0.0275	0.0308
2013	5.87	0.0299	0.0299	0.0299	0.0299	0.0299	0.0299	0.0299	0.0299	0.0299	0.0335
2014	5.22	0.0266	0.0266	0.0266	0.0266	0.0266	0.0266	0.0266	0.0266	0.0266	0.0298
2015	5.95	0.0304	0.0304	0.0304	0.0304	0.0304	0.0304	0.0304	0.0304	0.0304	0.0339
2016	5.74	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293	0.0327
2017	5.56	0.0283	0.0283	0.0283	0.0283	0.0283	0.0283	0.0283	0.0283	0.0283	0.0317
2018	5.46	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0278	0.0311
2019	5.11	0.0261	0.0261	0.0261	0.0261	0.0261	0.0261	0.0261	0.0261	0.0261	0.0291
1990/2019	**-18%**	**-18%**	**-18%**	**-18%**	**-18%**	**-18%**	**-18%**	**-18%**	**-18%**	**-18%**	**-18%**
2018/2019	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**	**-6%**

3.8.5.2 Methodological issues

Emission factors used for the calculation of heavy metals and POPs are default EF from EMEP/EEA GB_{2019} (***Table 3.120***).

Table 3.120: *Emission factors in the category 1B2aiv*

T1	UNIT	EF
Pb	g/Mg crude oil input	0.0051
Cd	g/Mg crude oil input	0.0051
Hg	g/Mg crude oil input	0.0051
As	g/Mg crude oil input	0.0051
Cr	g/Mg crude oil input	0.0051
Cu	g/Mg crude oil input	0.0051
Ni	g/Mg crude oil input	0.0051
Se	g/Mg crude oil input	0.0051
Zn	g/Mg crude oil input	0.0051
PCDD/F	µg I-TEQ/Mg crude oil input	0.0057

3.8.5.3 Completeness

The data from the NEIS covering fugitive emissions are reported in the chapter on Petroleum refining (NFR 1A1b), and notation key IE was used. Notation keys for PAHs, HCB and PCBs were used in compliance with EMEP/EEA GB_{2019}.

3.8.5.4 Source-specific recalculations

The recalculations were done due to error identification in the calculation (***Table 3.121***).

Table 3.121: *Previous and refined emissions in the category 1B2aiv*

YEAR	Pb [t]		Cd [t]		Hg [t]		As [t]		Cr [t]		CHANGE
	P	R	P	R	P	R	P	R	P	R	
1990	3E-05	0.0317	3E-05	0.0317	3E-05	0.0317	3E-05	0.0317	3E-05	0.0317	99900%
1991	3E-05	0.0258	3E-05	0.0258	3E-05	0.0258	3E-05	0.0258	3E-05	0.0258	99900%
1992	2E-05	0.0223	2E-05	0.0223	2E-05	0.0223	2E-05	0.0223	2E-05	0.0223	99900%
1993	2E-05	0.0218	2E-05	0.0218	2E-05	0.0218	2E-05	0.0218	2E-05	0.0218	99900%
1994	2E-05	0.0245	2E-05	0.0245	2E-05	0.0245	2E-05	0.0245	2E-05	0.0245	99900%
1995	3E-05	0.0264	3E-05	0.0264	3E-05	0.0264	3E-05	0.0264	3E-05	0.0264	99900%
1996	3E-05	0.0268	3E-05	0.0268	3E-05	0.0268	3E-05	0.0268	3E-05	0.0268	99900%
1997	3E-05	0.0272	3E-05	0.0272	3E-05	0.0272	3E-05	0.0272	3E-05	0.0272	99900%
1998	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	99900%
1999	3E-05	0.0277	3E-05	0.0277	3E-05	0.0277	3E-05	0.0277	3E-05	0.0277	99900%
2000	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	99900%
2001	3E-05	0.0280	3E-05	0.0280	3E-05	0.0280	3E-05	0.0280	3E-05	0.0280	99900%
2002	3E-05	0.0286	3E-05	0.0286	3E-05	0.0286	3E-05	0.0286	3E-05	0.0286	99900%
2003	3E-05	0.0288	3E-05	0.0288	3E-05	0.0288	3E-05	0.0288	3E-05	0.0288	99900%
2004	3E-05	0.0291	3E-05	0.0291	3E-05	0.0291	3E-05	0.0291	3E-05	0.0291	99900%
2005	3E-05	0.0285	3E-05	0.0285	3E-05	0.0285	3E-05	0.0285	3E-05	0.0285	99900%
2006	3E-05	0.0288	3E-05	0.0288	3E-05	0.0288	3E-05	0.0288	3E-05	0.0288	99900%
2007	3E-05	0.0304	3E-05	0.0304	3E-05	0.0304	3E-05	0.0304	3E-05	0.0304	99900%
2008	3E-05	0.0298	3E-05	0.0298	3E-05	0.0298	3E-05	0.0298	3E-05	0.0298	99900%
2009	3E-05	0.0291	3E-05	0.0291	3E-05	0.0291	3E-05	0.0291	3E-05	0.0291	99900%
2010	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	99900%
2011	3E-05	0.0306	3E-05	0.0306	3E-05	0.0306	3E-05	0.0306	3E-05	0.0306	99900%
2012	3E-05	0.0275	3E-05	0.0275	3E-05	0.0275	3E-05	0.0275	3E-05	0.0275	99900%
2013	3E-05	0.0299	3E-05	0.0299	3E-05	0.0299	3E-05	0.0299	3E-05	0.0299	99900%
2014	3E-05	0.0266	3E-05	0.0266	3E-05	0.0266	3E-05	0.0266	3E-05	0.0266	99900%
2015	3E-05	0.0304	3E-05	0.0304	3E-05	0.0304	3E-05	0.0304	3E-05	0.0304	99900%
2016	3E-05	0.0293	3E-05	0.0293	3E-05	0.0293	3E-05	0.0293	3E-05	0.0293	99900%
2017	3E-05	0.0283	3E-05	0.0283	3E-05	0.0283	3E-05	0.0283	3E-05	0.0283	99900%

YEAR	Pb [t]		Cd [t]		Hg [t]		As [t]		Cr [t]		CHANGE
	P	R	P	R	P	R	P	R	P	R	
2018	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	99900%

YEAR	Cu [t]		Ni [t]		Se [t]		Zn [t]		CHANGE
	P	R	P	R	P	R	P	R	
1990	3E-05	0.0317	3E-05	0.0317	3E-05	0.0317	3E-05	0.0317	99900%
1991	3E-05	0.0258	3E-05	0.0258	3E-05	0.0258	3E-05	0.0258	99900%
1992	2E-05	0.0223	2E-05	0.0223	2E-05	0.0223	2E-05	0.0223	99900%
1993	2E-05	0.0218	2E-05	0.0218	2E-05	0.0218	2E-05	0.0218	99900%
1994	2E-05	0.0245	2E-05	0.0245	2E-05	0.0245	2E-05	0.0245	99900%
1995	3E-05	0.0264	3E-05	0.0264	3E-05	0.0264	3E-05	0.0264	99900%
1996	3E-05	0.0268	3E-05	0.0268	3E-05	0.0268	3E-05	0.0268	99900%
1997	3E-05	0.0272	3E-05	0.0272	3E-05	0.0272	3E-05	0.0272	99900%
1998	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	99900%
1999	3E-05	0.0277	3E-05	0.0277	3E-05	0.0277	3E-05	0.0277	99900%
2000	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	99900%
2001	3E-05	0.0280	3E-05	0.0280	3E-05	0.0280	3E-05	0.0280	99900%
2002	3E-05	0.0286	3E-05	0.0286	3E-05	0.0286	3E-05	0.0286	99900%
2003	3E-05	0.0288	3E-05	0.0288	3E-05	0.0288	3E-05	0.0288	99900%
2004	3E-05	0.0291	3E-05	0.0291	3E-05	0.0291	3E-05	0.0291	99900%
2005	3E-05	0.0285	3E-05	0.0285	3E-05	0.0285	3E-05	0.0285	99900%
2006	3E-05	0.0288	3E-05	0.0288	3E-05	0.0288	3E-05	0.0288	99900%
2007	3E-05	0.0304	3E-05	0.0304	3E-05	0.0304	3E-05	0.0304	99900%
2008	3E-05	0.0298	3E-05	0.0298	3E-05	0.0298	3E-05	0.0298	99900%
2009	3E-05	0.0291	3E-05	0.0291	3E-05	0.0291	3E-05	0.0291	99900%
2010	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	99900%
2011	3E-05	0.0306	3E-05	0.0306	3E-05	0.0306	3E-05	0.0306	99900%
2012	3E-05	0.0275	3E-05	0.0275	3E-05	0.0275	3E-05	0.0275	99900%
2013	3E-05	0.0299	3E-05	0.0299	3E-05	0.0299	3E-05	0.0299	99900%
2014	3E-05	0.0266	3E-05	0.0266	3E-05	0.0266	3E-05	0.0266	99900%
2015	3E-05	0.0304	3E-05	0.0304	3E-05	0.0304	3E-05	0.0304	99900%
2016	3E-05	0.0293	3E-05	0.0293	3E-05	0.0293	3E-05	0.0293	99900%
2017	3E-05	0.0283	3E-05	0.0283	3E-05	0.0283	3E-05	0.0283	99900%
2018	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	3E-05	0.0278	99900%

3.8.6 DISTRIBUTION OF OIL PRODUCTS (NFR 1B2av)

3.8.6.1 Overview

The definition of stationary sources and emissions from their activities included in 1B2av are presented in following ***Table 3.122***. All data is from the operator – facility data.

Table 3.122: *Activities according to national categorization included in 1B2av*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.40. Gas stations according to projected annual turnover or current annual turnover in m^3/year

An overall trend of activity data is shown in ***Table 3.123***. The emissions in this category show an increasing trend which is connected with an increase in activity.

Table 3.123: *Overview of emissions and activity data in the category 1B2av*

YEAR	OIL CONSUMED [Mt]	NMVOC [kt]
1990	1.59	3.1841

YEAR	OIL CONSUMED [Mt]	NMVOC [kt]
1995	1.39	2.7738
2000	1.34	2.6887
2005	1.96	3.9290
2010	2.18	4.3668
2011	2.04	4.0887
2012	2.17	4.3479
2013	2.11	4.2168
2014	2.16	4.3160
2015	2.38	4.7571
2016	2.42	4.8460
2017	2.47	4.9337
2018	2.52	5.0320
2019	2.56	5.1259
1990/2019	**61%**	**61%**
2018/2019	**2%**	**2%**

3.8.6.2 Methodological issues

Emission factor EMEP/EEA GB_{2019} (**EF = 2 kg/Mg oil**) was used for the calculation of NMVOC emissions using of T1 methodology.

3.8.6.3 Completeness

Notation key of NA is used for the other emissions except of SO_X and PCDD/F, where NE is used in compliance with the EMEP/EEA GB_{2019}.

3.8.6.4 Source-specific recalculations

The recalculations were done due to error identification in the calculation (***Table 3.124***).

Table 3.124: *Previous and refined emissions in the category 1B2av*

YEAR	NMVOC [kt]		
	PREVIOUS	REFINED	CHANGE
1990	0.2729	3.1841	1067%
1991	0.2517	2.6873	968%
1992	0.2495	2.4791	894%
1993	0.2640	2.4575	831%
1994	0.2805	2.6085	830%
1995	0.2840	2.7738	877%
1996	0.2928	2.8028	857%
1997	0.3115	2.8945	829%
1998	0.3016	3.0844	923%
1999	0.2720	2.9848	997%
2000	0.3085	2.6887	771%
2001	0.5291	2.9627	460%
2002	0.5312	3.0457	473%
2003	0.5111	3.1389	514%
2004	0.4068	3.3192	716%
2005	0.4082	3.9290	862%
2006	0.3609	3.6588	914%
2007	0.3482	4.1848	1102%
2008	0.5309	4.3178	713%
2009	0.4939	3.9993	710%

YEAR	NMVOC [kt]		
	PREVIOUS	REFINED	CHANGE
2010	0.5164	4.3668	746%
2011	0.4811	4.0887	750%
2012	0.4415	4.3479	885%
2013	0.4395	4.2168	859%
2014	0.4361	4.3160	890%
2015	0.4534	4.7571	949%
2016	0.4746	4.8460	921%
2017	0.4707	4.9337	948%
2018	0.4978	5.0320	911%

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 3.125***. Emissions in this category show an increasing trend which is connected with an increase in activity. This category is key for emissions of NMVOC.

Table 3.125: *Overview of emissions and activity data in the 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	8.1155
1995	344.00	344.00	73 600.00	6 485.00	159.40	8.0932
2000	173.00	173.00	68 600.00	7 136.00	524.30	7.6606
2005	147.00	147.00	73 900.00	7 399.00	50.00	8.1643
2010	104.00	104.00	65 302.00	6 098.00	103.00	7.1711
2011	121.00	121.00	68 093.00	5 630.00	395.00	7.4360
2012	150.00	150.00	45 470.00	5 289.00	385.00	5.1444
2013	124.00	124.00	52 780.00	5 820.00	132.00	5.8980
2014	100.00	100.00	46 500.00	4 535.00	319.00	5.1554
2015	93.00	93.00	55 800.00	4 639.00	139.00	6.0764
2016	92.00	92.00	60 600.00	4 716.00	246.00	6.5746
2017	140.00	140.00	64 200.00	4 901.25	418.00	6.9799
2018	93.00	93.00	59 700.00	4 777.99	423.00	6.5087
2019	124.00	124.00	69 060.00	4 841.46	1 922.00	7.6071
1990/2019	**-72%**	**-72%**	**-6%**	**-27%**	**192100%**	**-6%**
2018/2019	**33%**	**33%**	**16%**	**1%**	**354%**	**17%**

3.8.7.2 Methodological issues

The calculation of reported emissions of NVMOC are performed by Tier 2 EF from EMEP/EEA GB_{2019} for the land based activities: **EF = 0.1 g/m^3 NG** for each activity.

3.8.7.3 Completeness

Notation keys were used in compliance with EMEP/EEA GB_{2019}.

3.8.7.4 Source-specific recalculations

No recalculations in this submission.

3.8.8 VENTING AND FLARING (OIL, GAS, COMBINED OIL AND GAS) (NFR 1B2c)

3.8.8.1 Overview

Emission 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. For emissions of BC, CO, HMs and POPs were used notation key NE in compliance with EMEP/EEA GB_{2019}.

3.8.9 OTHER FUGITIVE EMISSIONS FROM ENERGY PRODUCTION (NFR 1B2d)

3.8.9.1 Overview

Notation key NO is used in this category. Geothermal energy is not developed in the Slovak Republic. Most of the sources are used for recreational purposes and they are considered negligible.

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

Last update: 15.3.2020

4.1 OVERVIEW OF THE SECTOR INDUSTRY

The emissions covered by industry sector originate from industrial processes but also from combined combustion and technology processes, which are united reported for the basic unit (source). The emissions and facility data reported directly from an operator that is recorded in the NEIS database cannot be in some cases divided into separate combustion and technology emissions.

The reported data involve emissions and activity data from the technological processes in 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***.

National emission inventory of air pollutants is prepared from several sources to cover all potential sources of pollution.

The data sources:

a/ the NEIS database of stationary large and medium sources of air pollution providing facility data for nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOC) sulphur oxides (SOx), ammonia (NH_3), total suspended particles (TSP, PM_{10} and $PM_{2.5}$ are consequently compiled) and carbon monoxide (CO). All data that comes from the database is considered as T3 methodology. The reporting duties are bonded to the national legislative obligations for air pollution sources to report their annual balances of fuels, emissions and all auxiliary data necessary for compilation of final emissions.

b/ Estimations based on statistical data and emission factors for air pollutants, heavy metals (HM) and persistent organic pollutants (POPs). Emissions reported using this type of calculations are considered as T2 or T1.

Table 4.1: *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	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	T3	T3	NK	NK	NK
2B2	Nitric acid production	T3, NK	T3	NK	NK	NK	NK

NFR		METHODOLOGY/TIER					
	LONGNAME OF CATEGORY	NOx, NMVOC, SOx, CO	NH_3	$PM_{2.5}$, PM_{10}, TZL	BC	HM	POPs
2B3	Adipic acid production	NK	NK	NK	NK	NK	NK
2B5	Carbide production	T3, NK	NK	T3, NK	NK	NK	NK
2B6	Titanium dioxide production	NK	NK	NK	NK	NK	NK
2B7	Soda ash production	NK	NK	NK	NK	NK	NK
2B10 a	Chemical industry: Other	T3	T3	T3	T1	NK	NK
2B10 b	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	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	T3	T3	T3	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						
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	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	NK	NK
	OTHER INDUSTRIAL ACTIVITIES						
2H1	Pulp and paper industry	NK	NK	T3	T1	NK	NK
2H2	Food and beverages industry	T2, NK	NK	NK	NK	NK	NK
2H3	Other industrial processes	T3	T3	T3	NK	NK	NK
2I	Wood processing	T3	T3	T3	NK	NK	NK
2J	Production of POPs	NK	NK	NK	NK	NK	NK
2K	Consumption of POPs and heavy metals	NK	NK	NK	NK	T1, NK	T1, NK
2L	Other production, consumption, storage, transportation or handling of bulk products	NK	NK	NK	NK	NK	NK

4.2 TRENDS IN THE SECTOR INDUSTRY

From ***Table 4.2*** below is visible an overall decreasing trend of emissions of the air pollutants since 1990 due to the strict air protection legislation. This, together with the advancements and progress of abatement systems led to reduction of air pollutants as a result of the transposition of European legislation, continual improvement in the national legislation and endeavour of the industry to implement BAT technologies (if the investments are available).

Table 4.2: *Overview of the emissions in the category 2 - Industry*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	7.1410	45.9395	11.3514	0.2636	2.2822	4.6135	15.4827	0.0372	84.9006
1995	6.4542	43.9143	9.9861	0.2732	2.2357	3.7529	11.7817	0.0818	74.1671
2000	7.9732	38.1972	13.8987	0.2066	2.8386	4.8254	15.1159	0.1084	93.4023
2005	6.7460	38.1667	11.4326	0.3422	1.9691	4.0371	10.8802	0.3115	105.3450
2010	5.9232	27.7821	7.3039	0.1221	0.9559	2.1660	6.7127	0.1161	94.2074
2011	6.6758	31.9988	9.1971	0.2206	0.9439	2.0670	6.4540	0.1138	107.1259
2012	6.3180	26.2870	8.0287	0.2194	0.9191	1.6643	5.1780	0.1161	105.6835
2013	6.1896	26.8605	7.3562	0.1645	0.9606	2.0140	6.3800	0.1027	105.0621
2014	6.8971	28.6050	7.9909	0.1240	1.0435	2.0355	6.5122	0.1097	119.8514
2015	6.4984	31.9142	9.0579	0.1665	1.1808	3.6496	11.7870	0.1104	119.9171
2016	5.8978	30.1354	10.2515	0.2269	0.9090	1.9103	5.9485	0.1091	121.8027
2017	6.9338	28.2299	11.6807	0.2190	0.9744	2.4382	7.7015	0.1166	124.1939
2018	7.5900	30.4492	9.3687	0.2362	0.8714	1.7901	5.4600	0.1141	111.7930
2019	6.1286	26.4136	7.6988	0.2135	0.8244	1.9039	5.1503	0.1209	73.4620
1990/2019	**-14%**	**-43%**	**-32%**	**-19%**	**-64%**	**-59%**	**-67%**	**225%**	**-13%**
2018/2019	**-19%**	**-13%**	**-18%**	**-10%**	**-5%**	**6%**	**-6%**	**6%**	**-34%**

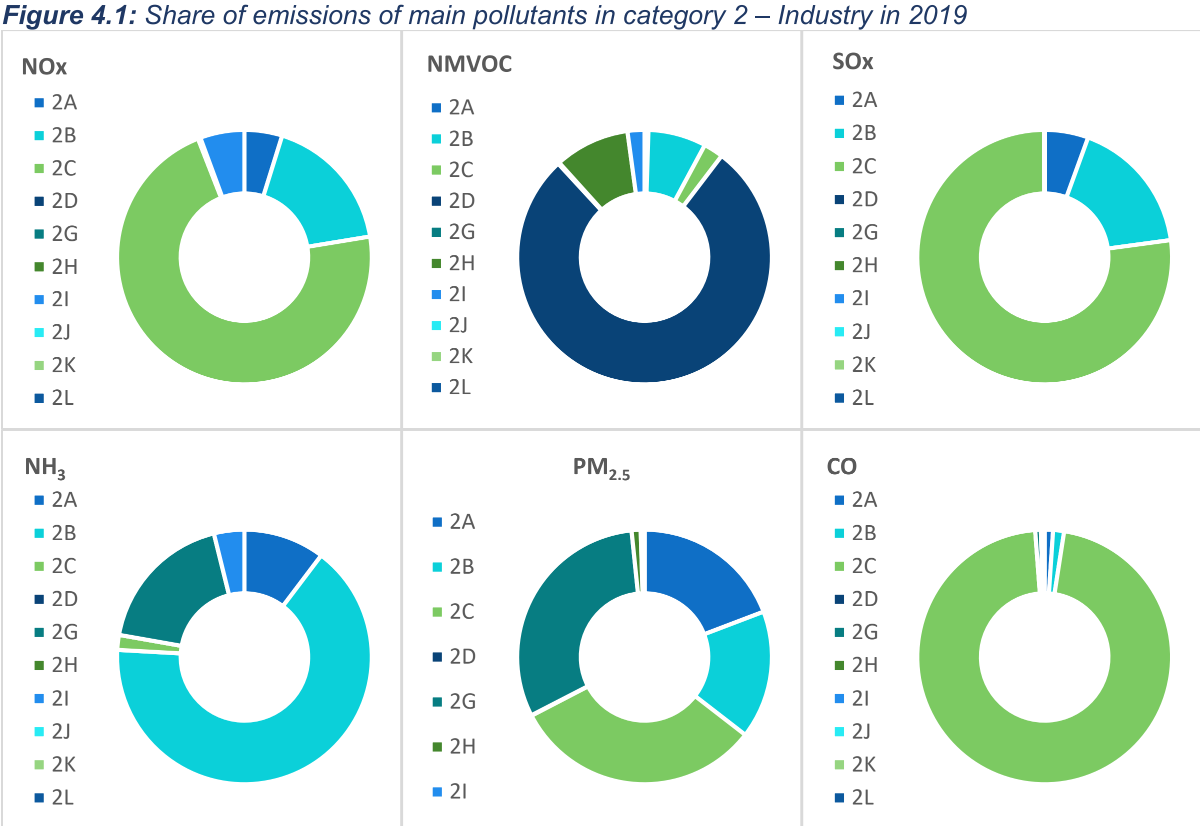
YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	20.7625	0.4291	0.2870	0.7113	1.4524	3.1739	1.3298	0.1628	9.1794
1995	17.7173	0.2973	0.2514	0.5941	1.2980	2.6334	1.0199	0.1642	8.3119
2000	19.0602	0.1254	0.2689	0.5348	0.8478	1.7324	0.9545	0.1695	9.2369
2005	6.3567	0.3048	0.1240	0.5359	0.9879	1.6343	0.2949	0.2568	7.4604
2010	4.9835	0.2534	0.1156	0.4882	1.5430	2.2446	0.2328	0.2900	0.7077
2011	5.0972	0.2555	0.1187	0.4571	1.5875	2.5973	0.2416	0.3012	0.8733
2012	5.2723	0.2595	0.1214	0.4704	1.6022	2.6732	0.2515	0.3164	0.9561
2013	5.7609	0.1510	0.1208	0.4783	1.0197	1.6999	0.2867	0.3179	1.1754
2014	5.5662	0.1498	0.1274	0.4746	1.2323	2.0575	0.2691	0.3269	1.1179
2015	5.4354	0.1451	0.1270	0.4618	1.4966	2.5821	0.2503	0.3209	1.0438
2016	5.6929	0.1494	0.1274	0.4856	1.7199	2.9668	0.2577	0.3224	1.0675
2017	6.1602	0.1578	0.1281	0.5057	1.6838	3.0116	0.2809	0.3297	1.1936
2018	5.5810	0.1465	0.1273	0.4659	1.6954	0.8570	0.2614	0.3294	1.1058
2019	4.4710	0.1293	0.1245	0.3639	1.8209	0.7934	0.2174	0.2718	1.6672
1990/2019	**-78%**	**-70%**	**-57%**	**-49%**	**25%**	**-75%**	**-84%**	**67%**	**-82%**
2018/2019	**-20%**	**-12%**	**-2%**	**-22%**	**7%**	**-7%**	**-17%**	**-17%**	**51%**

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	17.6516
2000	32.1912	0.0083	0.0024	0.0024	0.0013	9.6324	0.1080	18.3708
2005	33.6408	0.0139	0.0043	0.0043	0.0027	10.9545	0.1048	21.5444
2010	25.3479	0.0124	0.0037	0.0037	0.0020	10.3163	0.0744	15.8419
2011	29.0002	0.0124	0.0037	0.0037	0.0020	9.6945	0.0876	14.5899
2012	30.9156	0.0122	0.0036	0.0036	0.0020	10.2134	0.0943	15.5771
2013	29.5514	0.0123	0.0036	0.0036	0.0020	10.5400	0.0918	16.6341
2014	35.5490	0.0127	0.0037	0.0037	0.0021	11.3281	0.1137	17.1452
2015	35.2607	0.0129	0.0038	0.0038	0.0021	10.8482	0.1122	16.1628

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]
2016	35.6572	0.0131	0.0039	0.0039	0.0021	11.4669	0.1114	17.1424
2017	35.9652	0.0132	0.0039	0.0039	0.0021	11.8120	0.1124	17.6310
2018	35.5352	0.0131	0.0039	0.0039	0.0021	11.6302	0.1098	17.7796
2019	34.1062	0.0133	0.0039	0.0039	0.0022	9.3646	0.1040	14.1912
1990/2019	**-6%**	**-98%**	**-99%**	**-99%**	**-97%**	**-27%**	**-13%**	**-27%**
2018/2019	**-4%**	**1%**	**1%**	**1%**	**2%**	**-19%**	**-5%**	**-20%**

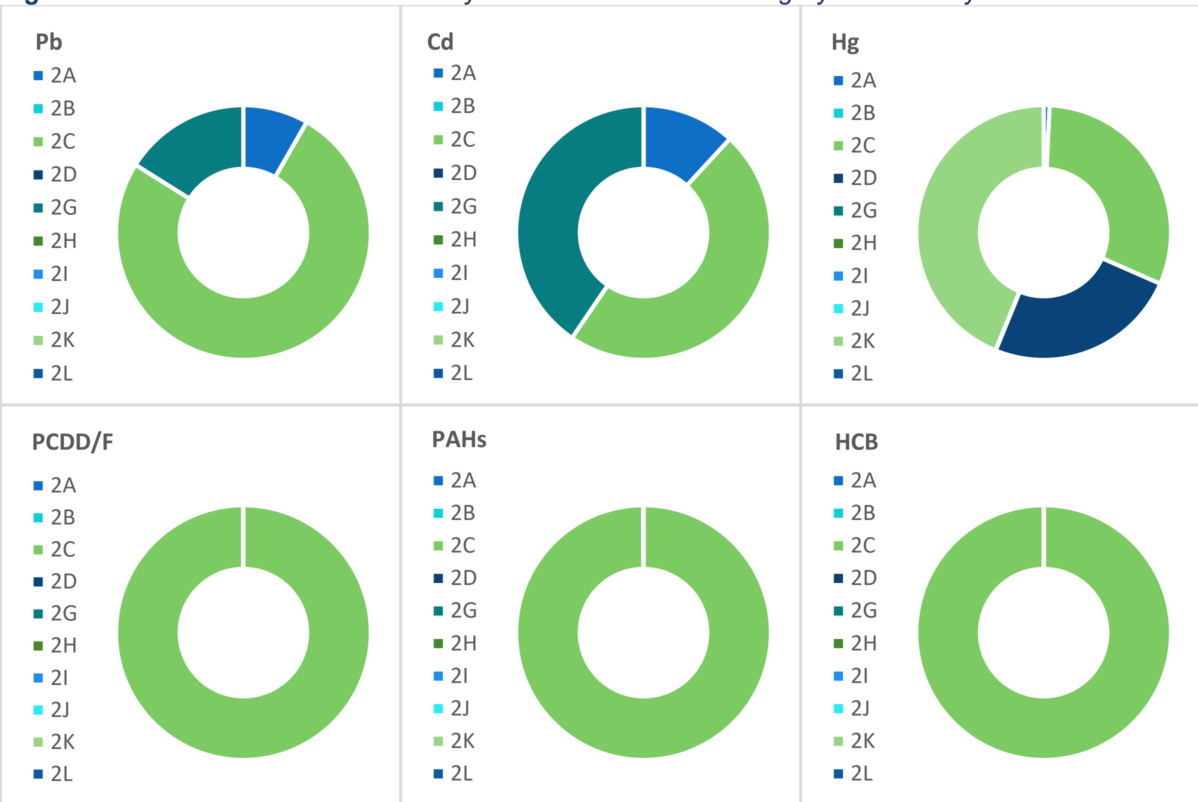
As shown in ***Figure 4.1***, the main contributor to the NOx emissions in the industry sector is Iron and steel production (2C1). The most significant decrease was recorded in the period 2001-2009, since then, emissions have a fluctuating trend. Solvents use contributes by averagely 78% to NMVOC emissions. Emission trend shows a decreasing trend due to stricter limits and technical requirements for solvents use. SOx emissions have a decreasing trend until 2009 in the sector industry, since then emissions are fluctuating. The most important industrial category for these emissions is Metal production 2C. Emissions of NH_3 have in long-term slightly decreasing trend. The fluctuations between 2004-2014 were caused by fluctuations in the Urine production industry. The main contributor to these emissions is subsector 2B – Chemical production. Emissions of PMs have a continuously decreasing trend. These emissions are mostly emitted by the subsectors 2C and 2G. The Fluctuation of CO emissions in the industry sector is connected with activity in the category Iron and steel production (2C1).

Figure 4.1: *Share of emissions of main pollutants in category 2 – Industry in 2019*



Metal production categories emitted most of the emissions of heavy metals and persistent organic pollutants. Emissions of these pollutants have in general decreasing trend (except Cr and Se). This trend is connected to the installation of abatement technologies in the Metal industry and the improvement of the technological processes (***Figure 4.2***).

Figure 4.2: *Share of emissions of heavy metals and POPs in category 2 – Industry in 2019*



4.3 RECALCULATIONS, IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

Industry sector undertakes continuing improvements. One of these further improvement re-categorisation of fuels in compliance with GHG inventory and change of the methodological approach for calculations of emissions of heavy metals and POPs.

The methodology used in the submission 2019 was assumed as outdated and impossible to further improvements. Therefore, all categories were recalculated using EMEP/EEA GB_{2019} emission factors for HMs and POPs on Tier 1 level in submission 2020. This step was followed by an improvement of the methodology of all key categories to a higher level in 2021 submission. Further improvement in planned in the following years.

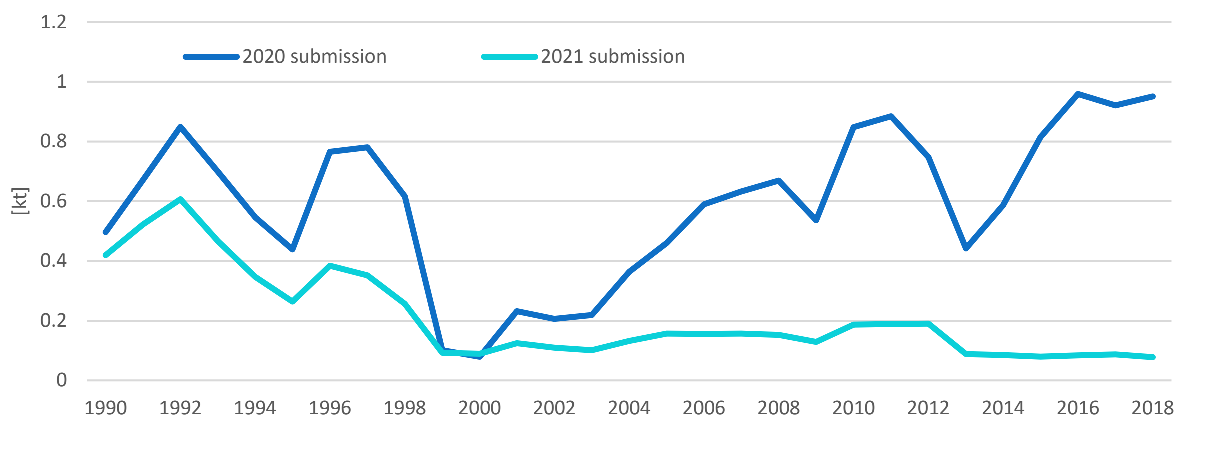
For most of the categories, historical years were recalculated consistently with the methodology for all the categories.

In the 2A category, several improvements were done. Road construction, as well as several other parameters, were added to the calculation for the category 2A5b.

In the 2C category, most significant changes were done following the recommendations No ***SK-2C1-2020-0001***, ***SK-2C3-2020-0001*** and ***SK-2C7a-2019-0002***. The recalculation was made to ensure compliance with the Protocol on Heavy metals under the LRTAP Convention. These categories were major contributors to emissions of Cd, which was not in compliance with the Protocol. The previous methodology did not include technological improvement and installation of abatement technologies.

Calculation of emissions using the higher Tier method was ensured by contacting of the largest plants and obtaining the data on all improvements on the plants during the period 1990-2019. Impact on the emissions of Cd in the 2C category is displayed in ***Figure 4.3***.

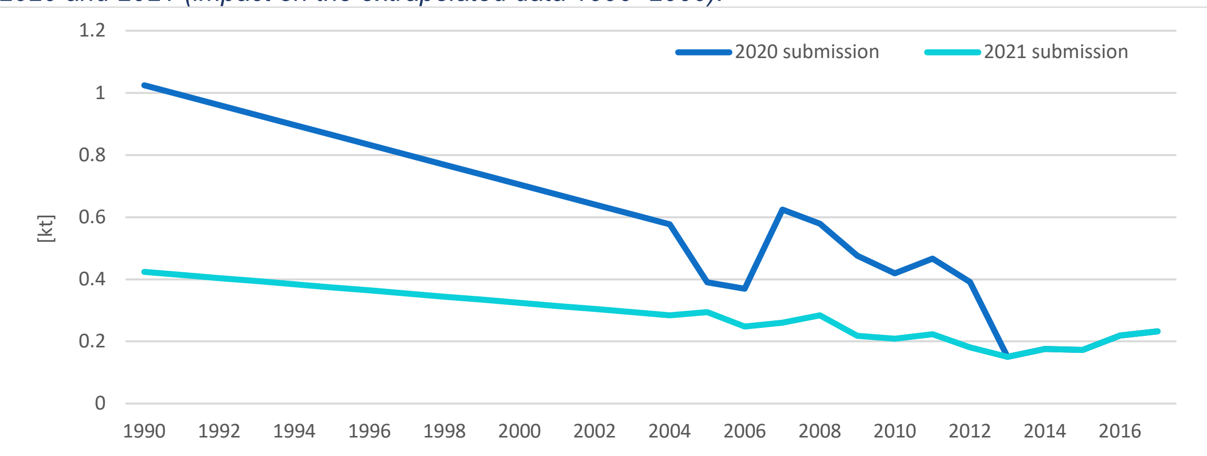
Figure 4.3: *Comparison of the Cd emissions in 2C category in submissions 2020 and 2021*



During the several recent years thorough QA/QC procedure was implemented in the 2D category. The procedure was performed with the cooperation with the GHG inventory team on the operator level. A huge effort has been made to identify incorrect and inconsistent activity data. Approximately 1000 sources of NMVOC emissions were checked in each year of the time series 2000 - 2019 in this way. Outliers and time series inconsistencies were identified, and operators were asked to explain them. The corrections have been made in the time series based on the answers of operators, if necessary.

The QA/QC process of harmonisation has finished in 2020. The methodological recalculation occurring in this submission was the recalculation of the Domestic solvent use including fungicides category (2D3a). The other recalculations in the categories 2D3d – 2D3i were based on the identified inconsistencies. However, it should be noted that the QA/QC process has been performed for years after 2000. The most significant changes occurred in the 1990–2000 period as the result of the extrapolation of the corrected data. As an example of the influence of the extrapolation, comparison of the NMVOC emissions from two last submissions for the category 2D3i – Other solvent use is shown in ***Figure 4.4.*** The comparison with the previous submission and impact on the NMVOC emissions is presented in ***Table 4.3***.

Figure 4.4: *Comparison of the NMVOC emissions in 2D3a-Other solvents use category in submissions 2020 and 2021 (impact on the extrapolated data 1990–2000).*



Recommendation No ***SK-2D3a-2019-0001***, ***SK-2D3h-2018-0001*** and ***SK-2D3g-2018-0001*** were included in the calculation in this submission.

Table 4.3: *Recalculations and changes in NMVOC emissions in the 2D3 category*

YEAR	SUBMISSION 2020	SUBMISSION 2021	CHANGE IN %
1990	67.886	38.503	-43.3%
1991	66.807	37.920	-43.2%
1992	65.786	37.400	-43.1%
1993	64.735	36.848	-43.1%
1994	63.729	36.340	-43.0%
1995	62.719	35.828	-42.9%
1996	61.695	35.304	-42.8%
1997	60.659	34.767	-42.7%
1998	59.628	34.237	-42.6%
1999	58.602	33.352	-43.1%
2000	56.346	29.603	-47.5%
2001	54.386	28.659	-47.3%
2002	56.508	31.753	-43.8%
2003	54.257	30.456	-43.9%
2004	54.929	32.150	-41.5%
2005	47.508	30.732	-35.3%
2006	51.171	32.781	-35.9%
2007	47.497	26.059	-45.1%
2008	51.530	28.460	-44.8%
2009	47.115	26.717	-43.3%
2010	43.818	22.416	-48.8%
2011	45.229	26.146	-42.2%
2012	39.808	21.197	-46.8%
2013	27.688	21.088	-23.8%
2014	24.138	22.502	-6.8%
2015	27.711	25.643	-7.5%
2016	25.058	23.925	-4.5%
2017	21.707	21.725	0.1%
2018	22.170	24.154	8.9%

4.4 MINERAL INDUSTRY (NFR 2A)

4.4.1 OVERVIEW

The category covers these NFR activities: Cement production (NFR 2A1), Lime production (NFR 2A2), Glass production (NFR 2A3), Quarrying and mining of minerals other than coal (NFR 2A5a), Construction and demolition (NFR 2A5b), Other mineral products (2A6). The 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 operates in several states. Slovakia produces a moderate range of mineral products and does not belong to a significant world producer of mineral commodities. Mining and quarrying sector is not a significant contributor to the country's economy.

Emissions of main pollutants decreased from the year 1990 significantly, with exception of SOx and NH_3, which have an increasing trend, as well as heavy metals (***Table 4.4***).

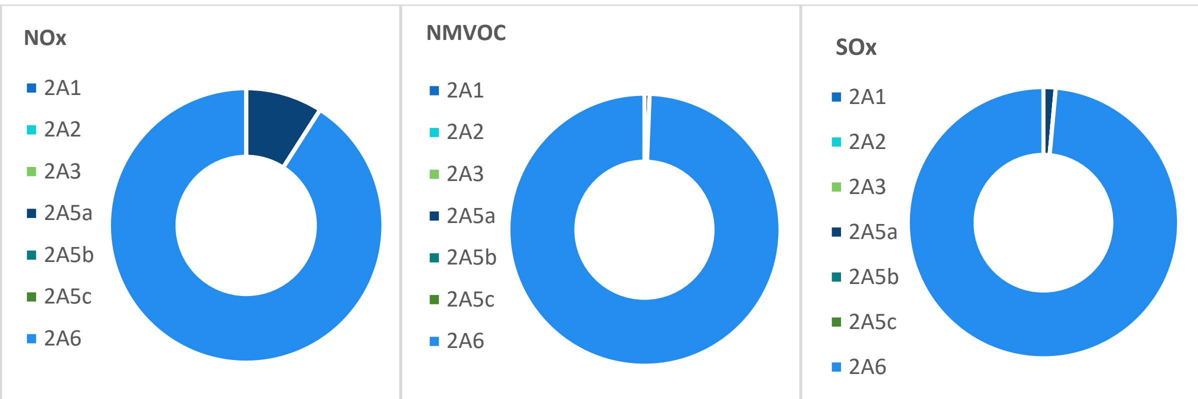
Table 4.4: Overview of emissions in the category 2A

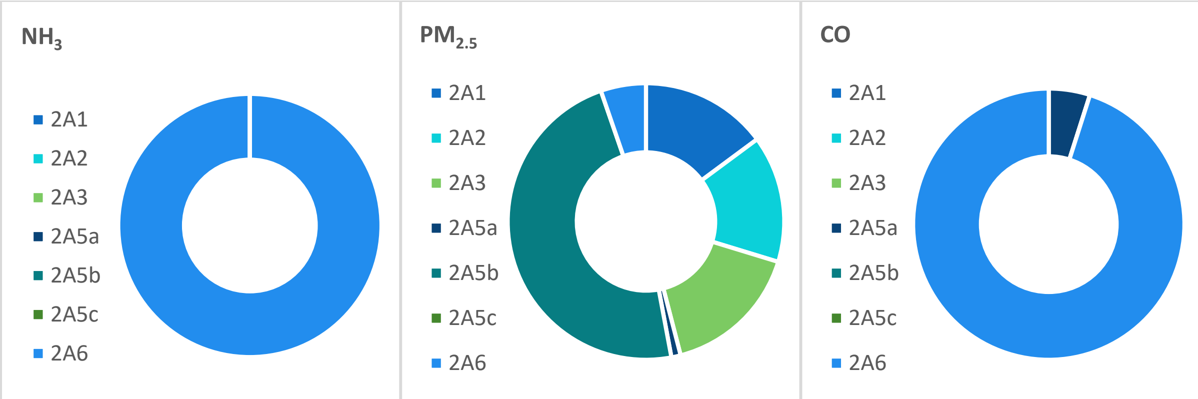
YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.3486	0.1733	0.1915	0.0007	0.3913	1.5852	5.2822	0.0024	1.3184
1995	0.3515	0.1744	0.1932	0.0007	0.2895	0.6449	2.0453	0.0019	1.3286
2000	0.4595	0.0805	0.2510	0.0001	0.3894	1.0087	3.1525	0.0030	1.1154
2005	0.4547	0.1583	0.4992	0.0041	0.3773	1.7916	6.0106	0.0012	1.7897
2010	0.3263	0.0536	0.3319	0.0129	0.2069	1.1171	3.9141	0.0008	0.4707
2011	0.2935	0.0519	0.3009	0.0137	0.2082	0.9759	3.2877	0.0009	0.4372
2012	0.2678	0.0608	0.3299	0.0227	0.1289	0.4945	1.7221	0.0008	0.3037
2013	0.2160	0.0598	0.3123	0.0214	0.1673	0.8003	2.6533	0.0011	0.3252
2014	0.2078	0.0501	0.3121	0.0210	0.1833	0.7709	2.5717	0.0017	0.2742
2015	0.2328	0.0742	0.3639	0.0248	0.3393	2.4445	8.1369	0.0014	0.3337
2016	0.2585	0.1176	0.4312	0.0228	0.1620	0.8479	2.8139	0.0015	0.5467
2017	0.2946	0.1265	0.4350	0.0234	0.1801	1.3160	4.4599	0.0006	0.5958
2018	0.3183	0.1485	0.4528	0.0241	0.1398	0.7650	2.5761	0.0005	0.8134
2019	0.2938	0.1292	0.4271	0.0220	0.1584	1.0263	3.4639	0.0008	0.7771
1990/2019	**-16%**	**-25%**	**123%**	**2866%**	**-60%**	**-35%**	**-34%**	**-65%**	**-41%**
2018/2019	**-8%**	**-13%**	**-6%**	**-9%**	**13%**	**34%**	**34%**	**57%**	**-4%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.2725	0.0058	0.0007	0.0140	0.0179	0.0016	0.0116	0.0724	0.0863
1995	0.3054	0.0072	0.0007	0.0173	0.0221	0.0017	0.0143	0.0895	0.0904
2000	0.3019	0.0070	0.0007	0.0168	0.0214	0.0017	0.0139	0.0869	0.0905
2005	0.4540	0.0139	0.0008	0.0337	0.0430	0.0020	0.0279	0.1742	0.1035
2010	0.5021	0.0182	0.0007	0.0439	0.0560	0.0017	0.0363	0.2272	0.0885
2011	0.5094	0.0185	0.0007	0.0446	0.0570	0.0017	0.0369	0.2309	0.0895
2012	0.4657	0.0193	0.0009	0.0466	0.0594	0.0021	0.0385	0.2409	0.1114
2013	0.4710	0.0195	0.0010	0.0471	0.0601	0.0023	0.0390	0.2436	0.1230
2014	0.4597	0.0190	0.0010	0.0460	0.0587	0.0022	0.0380	0.2378	0.1184
2015	0.4507	0.0187	0.0010	0.0451	0.0575	0.0024	0.0373	0.2331	0.1265
2016	0.4531	0.0188	0.0011	0.0453	0.0578	0.0025	0.0375	0.2344	0.1307
2017	0.4651	0.0192	0.0011	0.0465	0.0593	0.0025	0.0385	0.2406	0.1333
2018	0.4684	0.0194	0.0011	0.0468	0.0598	0.0025	0.0388	0.2423	0.1336
2019	0.3705	0.0153	0.0009	0.0370	0.0473	0.0022	0.0307	0.1916	0.1155
1990/2019	**36%**	**165%**	**34%**	**165%**	**165%**	**34%**	**165%**	**165%**	**34%**
2018/2019	**-21%**	**-21%**	**-14%**	**-21%**	**-21%**	**-14%**	**-21%**	**-21%**	**-14%**

Shares of NOx, NMVOC, SOx, NH_3, $PM_{2.5}$, CO emission in 2019 NFR categories included in the mineral industry are shown in ***Figure 4.5***.

Figure 4.5: *Shares of emissions of the main pollutants in 2A in 2019*





4.4.2 CEMENT PRODUCTION (NFR 2A1)

4.4.2.1 Overview

The cement manufacturing is a highly energy-demanding process based on several stages (quarrying a mixture of limestone and clay; grinding the limestone and clay; burning the slurry or powder to a high temperature in a kiln, to produce clinker; blending and grinding the clinker with gypsum to make cement). The chemical base of the process is the thermal decomposition of calcium carbonate at about 900°C (calcination) on calcium oxide CaO and carbon dioxide CO_2. Then the CaO reacts at high temperature (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, pyrolysis. All four cement producers (large point sources) in the Slovak Republic have approval to utilize alternative fuels (refuse-derived fuel - RDF and used tires, sludge, fly ash, beef and bone meal or similarly categorized fuel waste) and raw materials in the purpose of energy and resource recovery. The plant provides the yearly report on types and amounts of alternative fuel used.

Emission trends are shown in ***Table 4.5***.

Table 4.5: *Activity data and emissions in the category 2A1*

YEAR	CLINKER PRODUCED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	2835.75	0.0773	0.1824	0.4489	0.0023
1995	2235.75	0.0610	0.1438	0.3539	0.0018
2000	2313.71	0.0954	0.2251	0.5541	0.0029
2005	2352.68	0.0370	0.0872	0.2149	0.0011
2010	1653.59	0.0256	0.0598	0.1423	0.0008
2011	2433.86	0.0307	0.0716	0.1704	0.0009
2012	2126.12	0.0276	0.0644	0.1534	0.0008
2013	2161.32	0.0365	0.0852	0.2027	0.0011
2014	2415.34	0.0574	0.1340	0.3190	0.0017
2015	2506.12	0.0458	0.1068	0.2542	0.0014
2016	2599.39	0.0495	0.1154	0.2748	0.0015
2017	2698.82	0.0207	0.0484	0.1151	0.0006
2018	2695.74	0.0170	0.0396	0.0944	0.0005
2019	2854.64	0.0275	0.0643	0.1531	0.0008
1990/2019	**1%**	**-64%**	**-65%**	**-66%**	**-64%**
2018/2019	**6%**	**62%**	**62%**	**62%**	**62%**

4.4.2.2 Methodological issues

Activities listed within this category are shown in ***Table 4.6.***

Table 4.6: *Activities according to national categorization included in 2A1*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.2. Manufacture of cement with a projected production capacity in t/d

Emission data is compiled in the NEIS, therefore, the individual-specific EF could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV.**

Emission factors used for reconstruction of historical years 1990-1999 were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 4.7).***

Table 4.7: *Emission factors for calculation of historical years*

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

*EMEP/EEA GB_{2019}

4.4.2.3 Completeness

Pollutants originating from combustion actives were reported under the category **1A2f**, as these pollutants cannot be separated in the NEIS database in whole time series. Therefore, notation key IE was used for these pollutants and only particulate matter emissions were reported within this category.

4.4.2.4 Source-specific recalculations

No recalculations in this submission.

4.4.3 LIME PRODUCTION (NFR 2A2)

4.4.3.1 Overview

The production of lime during the year 2019 in Slovakia was operated by 5 companies in 7 stationary sources. All sources are covered by the NEIS database.

Production of lime, which is chemically calcium oxide (CaO), is performed by thermal decomposition of limestone at the temperatures of 1 040–1 300°C. Production is therefore highly energy-demanding process. Hydrated lime ($Ca(OH)_2$) is also produced by Slovak operators.

Relevant rising emissions from this manufacturing, their trends and activity data (***Table 4.8***) are presented in the following figures.

Table 4.8: *Activity data and emissions in the category 2A2*

YEAR	LIME PRODUCED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	1076.00	0.0083	0.0993	0.8279	0.0000
1995	803.00	0.0062	0.0741	0.6179	0.0000
2000	753.59	0.0056	0.0666	0.5552	0.0000
2005	913.08	0.0054	0.0644	0.5365	0.0000
2010	822.36	0.0040	0.0480	0.3999	0.0000
2011	856.05	0.0024	0.0288	0.2398	0.0000
2012	797.33	0.0022	0.0265	0.2206	0.0000
2013	716.54	0.0008	0.0096	0.0798	0.0000
2014	727.63	0.0021	0.0247	0.2059	0.0000

YEAR	LIME PRODUCED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
2015	680.20	0.0009	0.0102	0.0854	0.0000
2016	663.02	0.0006	0.0075	0.0628	0.0000
2017	640.06	0.0006	0.0073	0.0612	0.0000
2018	668.99	0.0007	0.0080	0.0667	0.0000
2019	586.05	0.0006	0.0071	0.0594	0.0000
1990/2019	**-46%**	**-93%**	**-93%**	**-93%**	**-93%**
2018/2019	**-12%**	**-11%**	**-11%**	**-11%**	**-11%**

4.4.3.2 Methodological issues

Activities listed within this category are shown in ***Table 4.9.***

Table 4.9: *Activities according to national categorization included in 2A2*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.3. Manufacture of lime with a designed production capacity of cement clinker in t/d

Emission data is compiled in the NEIS, therefore, the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV*.***

Emission factors used for reconstruction of historical years 1990–1999 were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 4.10***).

Table 4.10: *Emission factors for calculation of historical years*

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

*EMEP/EEA GB_{2019}

4.4.3.3 Completeness

Pollutants originating from combustion actives were reported under the category **1A2f**, as these pollutants cannot be separated in the NEIS database in whole time series. Therefore, notation key IE was used for these pollutants and only particulate matter emissions were reported within this category.

4.4.3.4 Source-specific recalculations

No recalculations in this submission.

4.4.4 GLASS PRODUCTION (NFR 2A3)

4.4.4.1 Overview

The emission from glass production is covered in the registry of the NEIS (4 companies: Johns Mansville Slovakia, Rona, Vetropack, R-Glass). Emission factors are given for process and combustion emissions together since they are recorded as united in annual data sets. It is not straightforward to separate these processes.

The basic raw material for glass production is silica (SiO_2). Limestone ($CaCO_3$), dolomite ($CaMg(CO_3)_2$), soda ash (Na_2CO_3), potash (K_2CO_3), Pb_3O_4, Al_2O_3, and colouring agents are used in the glass production process. The main emissions originated during the manufacturing are sulphur oxides (SO_x), nitrogen oxides (NO_x) and carbon dioxide (CO_2). However, other pollutants are also occurring: emissions of particulate matter (PMs) from handling raw materials, emissions of heavy metals are produced by the melting process or are presented in PM; carbon monoxide (CO), or nitrous oxide (N_2O). DIOX emissions were balanced for the first time in this submission. Reported emissions, their trends and activity data from glass production are presented below in ***Table 4.11.***

Table 4.11: *Activity data and emissions in the category 2A3*

YEAR	CONTAINER GLASS [kt]	GLASS FIBRE [kt]	LEAD CRYSTAL GLASS [kt]	WATER GLASS [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	48.26	93.08	13.26	78.69	0.0856	0.0894	0.0941	0.0001
1995	59.67	92.88	13.23	78.52	0.0897	0.0936	0.0985	0.0001
2000	57.96	93.94	13.38	79.41	0.1196	0.1248	0.1314	0.0001
2005	116.14	82.25	11.72	69.54	0.0512	0.0535	0.0563	0.0000
2010	151.45	44.19	6.29	37.36	0.0106	0.0110	0.0115	0.0000
2011	153.95	44.19	6.29	37.36	0.0113	0.0118	0.0124	0.0000
2012	160.58	103.83	-	36.70	0.0079	0.0082	0.0087	0.0000
2013	162.43	134.63	-	35.32	0.0117	0.0122	0.0128	0.0000
2014	158.51	125.45	-	35.99	0.0165	0.0172	0.0181	0.0000
2015	155.42	151.18	-	35.19	0.0187	0.0195	0.0205	0.0000
2016	156.25	156.08	-	40.90	0.0292	0.0305	0.0321	0.0000
2017	160.38	157.46	-	42.51	0.0216	0.0225	0.0237	0.0000
2018	161.53	155.98	-	43.63	0.0445	0.0464	0.0488	0.0000
2019	127.75	148.16		36.34	0.0301	0.0314	0.0331	0.0000
1990/2019	**165%**	**59%**	**-**	**-54%**	**-65%**	**-65%**	**-65%**	**-65%**
2018/2019	**-21%**	**-5%**	**-**	**-17%**	**-32%**	**-32%**	**-32%**	**-32%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.2725	0.0058	0.0007	0.0140	0.0179	0.0016	0.0116	0.0724	0.0863
1995	0.3054	0.0072	0.0007	0.0173	0.0221	0.0017	0.0143	0.0895	0.0904
2000	0.3019	0.0070	0.0007	0.0168	0.0214	0.0017	0.0139	0.0869	0.0905
2005	0.4540	0.0139	0.0008	0.0337	0.0430	0.0020	0.0279	0.1742	0.1035
2010	0.5021	0.0182	0.0007	0.0439	0.0560	0.0017	0.0363	0.2272	0.0885
2011	0.5094	0.0185	0.0007	0.0446	0.0570	0.0017	0.0369	0.2309	0.0895
2012	0.4657	0.0193	0.0009	0.0466	0.0594	0.0021	0.0385	0.2409	0.1114
2013	0.4710	0.0195	0.0010	0.0471	0.0601	0.0023	0.0390	0.2436	0.1230
2014	0.4597	0.0190	0.0010	0.0460	0.0587	0.0022	0.0380	0.2378	0.1184
2015	0.4507	0.0187	0.0010	0.0451	0.0575	0.0024	0.0373	0.2331	0.1265
2016	0.4531	0.0188	0.0011	0.0453	0.0578	0.0025	0.0375	0.2344	0.1307
2017	0.4651	0.0192	0.0011	0.0465	0.0593	0.0025	0.0385	0.2406	0.1333
2018	0.4684	0.0194	0.0011	0.0468	0.0598	0.0025	0.0388	0.2423	0.1336
2019	0.3705	0.0153	0.0009	0.0370	0.0473	0.0022	0.0307	0.1916	0.1155
1990/2019	**36%**	**165%**	**34%**	**165%**	**165%**	**34%**	**165%**	**165%**	**34%**
2018/2019	**-21%**	**-21%**	**-14%**	**-21%**	**-21%**	**-14%**	**-21%**	**-21%**	**-14%**

4.4.4.2 Methodological issues

Activities listed within this category are shown in ***Table 4.12***.

Table 4.12: *Activities according to national categorization included in 2A3*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.7. Manufacture of glass, glass products, including glass fibre wit projected melting capacity in t/d

Emission data is compiled in the NEIS database therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV*.***

Emission factors used for reconstruction of historical years 1990–1999 were calculated using a weighted average of IEF for each pollutant for the period 2000-2004 (***Table 4.13***).

Table 4.13: *Emission factors for calculation of historical years*

	TSP [g/t GLASS PRODUCED]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]
EF	403.28	91%	95%	0.06%

*EMEP/EEA GB_{2019}

HMs

Heavy metals are reported by the Tier 2/Tier 1 method.

The emissions of heavy metals are processed by the national emission factors presented in ***Table 4.14***. The methodology distinguishes several types of products.

Table 4.14: *Emission factors of heavy metals in 2A3*

EF [g/t [PRODUCT]/ TYPE OF PRODUCT	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
T1 method			0.003			0.007			0.37
T2 Container glass	2.9	0.12	-	0.29	0.37	-	0.24	1.5	-
T2 Glass Fibre	-	-	-	-	-	-	-	-	-
T2 Lead crystal glass	10	-	-	-	-	-	-	-	-
T2 Water glass	-	-	-	-	-	-	-	-	-

4.4.4.3 Completeness

Pollutants originating from combustion actives were reported under the category **1A2f**, as these pollutants cannot be separated in the NEIS database in whole time series. Therefore, notation key IE was used for these pollutants and only particulate matter emissions were reported within this category.

4.4.4.4 Source-specific recalculations

Historical years were recalculated error identification in the calculation (***Table 4.15***).

Table 4.15: *Previous and refined emissions in the category 2A3*

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			BC [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.2137	0.0856	-60%	0.2348	0.0894	-62%	0.2472	0.0941	-62%	0.0001	0.0001	-60%
1991	0.2134	0.0902	-58%	0.2345	0.0942	-60%	0.2468	0.0992	-60%	0.0001	0.0001	-58%
1992	0.2127	0.0949	-55%	0.2337	0.0990	-58%	0.2460	0.1042	-58%	0.0001	0.0001	-55%
1993	0.2126	0.0898	-58%	0.2336	0.0937	-60%	0.2459	0.0986	-60%	0.0001	0.0001	-58%
1994	0.2114	0.0847	-60%	0.2323	0.0884	-62%	0.2445	0.0930	-62%	0.0001	0.0001	-60%
1995	0.2097	0.0897	-57%	0.2304	0.0936	-59%	0.2425	0.0985	-59%	0.0001	0.0001	-57%
1996	0.2079	0.0896	-57%	0.2285	0.0935	-59%	0.2405	0.0984	-59%	0.0001	0.0001	-57%
1997	0.2068	0.0903	-56%	0.2272	0.0943	-59%	0.2392	0.0992	-59%	0.0001	0.0001	-56%
1998	0.1982	0.0993	-50%	0.2178	0.1036	-52%	0.2293	0.1091	-52%	0.0001	0.0001	-50%
1999	0.1947	0.0742	-62%	0.2140	0.0774	-64%	0.2252	0.0815	-64%	0.0001	0.0000	-62%
2000	0.1136	0.1196	5%	0.1248	0.1248	0%	0.1314	0.1314	0%	0.0001	0.0001	5%
2001	0.1025	0.1079	5%	0.1126	0.1126	0%	0.1186	0.1186	0%	0.0001	0.0001	5%
2002	0.0854	0.0899	5%	0.0938	0.0938	0%	0.0988	0.0988	0%	0.0001	0.0001	5%
2003	0.0850	0.0895	5%	0.0934	0.0934	0%	0.0983	0.0983	0%	0.0001	0.0001	5%
2004	0.0433	0.0456	5%	0.0476	0.0476	0%	0.0501	0.0501	0%	0.0000	0.0000	5%

P-Previous
R-Refined

4.4.5 QUARRYING AND MINING OF MINERALS OTHER THAN COAL (NFR 2A5a)

4.4.5.1 Overview

At the territory of the Slovak Republic was occurring the surface and underground quarrying and mining locations for various materials during the year 2019 (lignite, oil and natural gas are not included in category). Amongst them are metallic ores (Fe, Au, Ag, Pb, Zn – surface ore mining is not occurring), magnesite ore and building material (building stones, sandstones and sand, brick raw materials), limestone for cement and lime production, but also some other raw material (bentonite, perlite, talc and others). The emission rising from the extractions of these minerals are mainly particulate matters. The other air pollutants related to technological units and equipment necessary for quarrying, handling and processing of the material. Reported emissions from this category, their trends (***Table 4.16***) are presented on the following figures.

Table 4.16: *Overview of emissions in the category 2A5a*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.0080	0.0002	0.0068	0.0018	0.0213	0.1772	0.0218
1995	0.0086	0.0002	0.0073	0.0019	0.0230	0.1912	0.0235
2000	0.0139	0.0002	0.0055	0.0036	0.0430	0.3579	0.0374
2005	0.0214	0.0005	0.0144	0.0037	0.0446	0.3715	0.0431
2010	0.0254	0.0012	0.0200	0.0030	0.0359	0.3036	0.0350
2011	0.0202	0.0012	0.0065	0.0028	0.0330	0.2752	0.0272
2012	0.0221	0.0013	0.0071	0.0023	0.0277	0.2307	0.0236
2013	0.0295	0.0006	0.0085	0.0025	0.0304	0.2531	0.0340
2014	0.0270	0.0007	0.0075	0.0025	0.0296	0.2463	0.0449
2015	0.0292	0.0007	0.0106	0.0024	0.0293	0.2443	0.0320
2016	0.0302	0.0008	0.0092	0.0022	0.0270	0.2246	0.0391
2017	0.0367	0.0010	0.0079	0.0024	0.0262	0.2159	0.0423
2018	0.0289	0.0009	0.0055	0.0021	0.0250	0.2080	0.0359
2019	0.0303	0.0009	0.0062	0.0020	0.0242	0.2020	0.0382
1990/2019	**278%**	**429%**	**-8%**	**14%**	**14%**	**14%**	**75%**
2018/2019	**5%**	**-6%**	**14%**	**-3%**	**-3%**	**-3%**	**6%**

4.4.5.2 Methodological issues

Activities listed within this category are shown in ***Table 4.17***.

Table 4.17*: Activities according to national categorization included in 2A5a*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
2.10. Surface mining of ores
3.10. Quarries and related stone processing
3.11. Mining and processing of silicate raw materials and other raw materials for the production of construction materials. Or mining and processing of other materials used in the industry except for sand and gravel in the wet state.

Emission data is compiled in the NEIS database therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV*.***

For Quarries and related stone processing for emission calculation, it can be used the official bulletin of the Ministry of Environment (***Table 4.18***).

Table 4.18: Emission factors for stone processing

PROCESS - EQUIPMENT	EF FOR TSP IN G/T PROCESSED STONE							
	HUMIDITY IN %							
	0-0.5	0.5-1	1-1.5	1.5-2	2-3	3-4	4-5	5-7
Drilling of rock	9	6	4	3	2	1	0.5	0.2
Loading of cargo	0.2	0.2	0.1	0.1	0.1	0.1	0	0
Unloading of cargo	0.2	0.2	0.1	0.1	0.1	0.1	0	0
Primary crushing	15	10	6.5	4.3	2.4	1.1	0.5	0.2
Primary sorting	14	9	6.2	4.1	2.2	1	0.5	0.2
Transporting on conveyor belts	2	1.4	0.9	0.6	0.3	0.15	0.007	0.002
Secondary crushing	28	19	13	8.5	4.6	2.1	1	0.3
secondary sorting	27	18	12	8	4.4	2	1	0.3
Transporting on conveyor belts	4	2.7	1.8	1.2	0.7	0.2	0.14	0.04
Tertiary crushing	53	36	24	16	8.8	4	1.8	0.5
Tertiary sorting	51	35	23	15	8.5	3.8	1.7	0.5
Transporting on conveyor belts	8	5.5	3.7	2.5	1.4	0.6	0.3	0.1
Tertiary fine crushing (under 4 mm)	640	429	288	193	106	48	21	6.5
Tertiary fine sorting	604	405	271	182	100	45	20	6.1
Transporting on conveyor belts	33	22	15	10	5.5	2.5	1.1	0.3

Historical years 1990-1999 were recalculated due to change of IEF for the all rising pollutants. Average IEF of years 2000-2004 was replaced with a weighted average of these years (***Table 4.19***).

Table 4.19: Emission factors for calculation of historical years

	NOx [g/GJ ENERGY]	NMVOC [g/GJ ENERGY]	SOx [g/GJ ENERGY]	TSP [g/GJ ENERGY]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/GJ ENERGY]
EF	136.34	2.77	115.13	3 020.65	1%	12%	371.80

4.4.5.3 Completeness

All rising pollutants were reported.

4.4.5.4 Source-specific recalculations

Historical years were recalculated due to update of emission factors for historical years as weighted average IEF was used instead of average (***Table 4.20***).

Table 4.20: Previous and refined emissions in the category 2A5a

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0084	0.0080	-5%	0.0002	0.0002	1%	0.0064	0.0068	6%	0.0227	0.0218	-4%
1991	0.0085	0.0081	-5%	0.0002	0.0002	1%	0.0064	0.0068	6%	0.0229	0.0220	-4%
1992	0.0085	0.0081	-5%	0.0002	0.0002	1%	0.0065	0.0069	6%	0.0230	0.0222	-4%
1993	0.0086	0.0082	-5%	0.0002	0.0002	1%	0.0065	0.0069	6%	0.0231	0.0222	-4%
1994	0.0086	0.0082	-5%	0.0002	0.0002	1%	0.0066	0.0069	6%	0.0232	0.0224	-4%
1995	0.0091	0.0086	-5%	0.0002	0.0002	1%	0.0069	0.0073	6%	0.0245	0.0235	-4%
1996	0.0090	0.0085	-5%	0.0002	0.0002	1%	0.0068	0.0072	6%	0.0242	0.0233	-4%
1997	0.0093	0.0089	-5%	0.0002	0.0002	1%	0.0071	0.0075	6%	0.0252	0.0243	-4%
1998	0.0101	0.0096	-5%	0.0002	0.0002	1%	0.0077	0.0081	6%	0.0273	0.0263	-4%
1999	0.0114	0.0108	-5%	0.0002	0.0002	1%	0.0087	0.0092	6%	0.0307	0.0296	-4%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0019	0.0018	-6%	0.0227	0.0213	-6%	0.1888	0.1772	-6%
1991	0.0019	0.0018	-6%	0.0229	0.0215	-6%	0.1906	0.1788	-6%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1992	0.0019	0.0018	-6%	0.0230	0.0216	-6%	0.1918	0.1800	-6%
1993	0.0019	0.0018	-6%	0.0231	0.0217	-6%	0.1927	0.1807	-6%
1994	0.0019	0.0018	-6%	0.0233	0.0218	-6%	0.1938	0.1818	-6%
1995	0.0020	0.0019	-6%	0.0245	0.0230	-6%	0.2039	0.1912	-6%
1996	0.0020	0.0019	-6%	0.0242	0.0227	-6%	0.2017	0.1892	-6%
1997	0.0021	0.0020	-6%	0.0252	0.0237	-6%	0.2103	0.1973	-6%
1998	0.0023	0.0021	-6%	0.0273	0.0256	-6%	0.2275	0.2134	-6%
1999	0.0026	0.0024	-6%	0.0307	0.0288	-6%	0.2562	0.2403	-6%
2000	0.0036	0.0036	0%	0.0430	0.0430	0%	0.3579	0.3579	-
2001	0.0034	0.0034	0%	0.0405	0.0405	0%	0.3378	0.3378	-
2002	0.0037	0.0037	0%	0.0448	0.0448	0%	0.3735	0.3735	-
2003	0.0032	0.0032	0%	0.0379	0.0379	0%	0.3158	0.3158	-
2004	0.0034	0.0034	0%	0.0411	0.0411	0%	0.3425	0.3425	-

P-Previous
R-Refined

4.4.6 CONSTRUCTION AND DEMOLITION (NFR 2A5b)

4.4.6.1 Overview

The chapter covers the emissions of particulate matters originated from the activities of building and housing construction and demolition. The overall trends in emissions are shown in ***Table 4.22***.

Table 4.22: *Overview of activity data in 2A5b*

YEAR	HIGHWAYS AND EXPRESSWAYS [m^2]	AREA OF NEW BUILDINGS FOR ADMINISTRATION [m^2]	AREA OF COMPLETED FLATS [m^2]
1990	789248.57	429264.79	1988832.77
1995	0.00	354205.89	490154.69
2000	36000.00	279146.99	1388766.86
2005	1618920.00	163000.00	1658342.40
2010	1504692.00	81000.00	1220617.00
2011	416628.00	105000.00	1048634.00
2012	0.00	95000.00	1093354.00
2013	510480.00	24000.00	1113549.00
2014	207360.00	97000.00	1780000.00
2015	2038680.00	43421.00	1760000.00
2016	344160.00	233000.00	1860000.00
2017	1017360.00	54000.00	1910000.00
2018	0.00	66000.00	2140000.00
2019	518400.00	122000.00	2210000.00
1990/2019	**-34%**	**-72%**	**11%**
2018/2019	**-**	**85%**	**3%**

4.4.6.2 Methodological issues

The emissions are reported in the category according to the methodology of EMEP/EEA GB_{2019} in a division of Non-residential construction, Construction of apartments and Road construction. Construction of family houses was not included yet due to missing activity data.

Table 4.23: *EF used for the calculations in category 2A5b*

$EF_{GB2019 - division}$	$PM_{2.5}$ [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 this submission, parameters of the area affected (A), construction duration (d), control efficiency of applied emission reduction measures (CE), Thornthwaite precipitation-evaporation index (PE) and soil silt content (s) were taken into calculation following the ***Equation 4.1***.

Equation 4.1: *Tier 1 approach to estimating total fugitive PM emissions*

$$EM_{PM_i} = EF_{PM_i} \times A_{affected} \times d \times (1 - CE) \times \left(\frac{24}{PE}\right) \times \left(\frac{s}{9\%}\right)$$

Where:

EM PMs = PMs emission (kg PMs)

EF PM1 = the emission factor for this pollutant emission (kg PMs/[m² x year])

A affected = area affected by construction activity (m^2)

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 4.24*** and ***Table 4.25***.

Table 4.24: *Parameters used for the calculations in category 2A5b*

Parameter	d	CE	s	$A_{affected}$
Road construction	0.83	0.5	20%	36000*
Non-residential construction	0.83	0.5	20%	0.8
Construction of apartments	0.75	0	20%	1.3

*m^2/km

Thornthwaite precipitation-evaporation index was calculated using ***Equation 4.2***.

Equation 4.2: *Thornthwaite precipitation-evaporation index calculation*

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

Where:

P_i - monthly precipitation (in mm)

T_i - mean temperature (in °C)

Thornthwaite precipitation-evaporation index was calculated using parameters and the index in ***Table 4.25***.

Table 4.25: *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

PARAMETER	P_I	T_I	PE
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

4.4.6.3 Completeness

All rising pollutants were reported.

4.4.6.4 Source-specific recalculations

Recalculation was made due to the inclusion of road construction and additional parameters into the calculation (***Table 4.26***).

Table 4.26: *Previous and refined emissions in the category 2A5b*

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	PREVIOUS	REFINED	CHANGE	PREVIOUS	REFINED	CHANGE	PREVIOUS	REFINED	CHANGE
1990	0.1026	0.1074	5%	1.0259	1.0737	5%	3.4054	3.5836	5%
1991	0.0933	0.0853	-9%	0.9333	0.8528	-9%	3.0973	2.8449	-8%
1992	0.0816	0.0392	-52%	0.8162	0.3920	-52%	2.7073	1.3036	-52%
1993	0.0750	0.0352	-53%	0.7500	0.3518	-53%	2.4872	1.1695	-53%
1994	0.0527	0.0201	-62%	0.5274	0.2011	-62%	1.7456	0.6672	-62%
1995	0.0501	0.0191	-62%	0.5013	0.1905	-62%	1.6590	0.6323	-62%
1996	0.0495	0.1489	201%	0.4952	1.4886	201%	1.6394	4.9782	204%
1997	0.0531	0.0226	-57%	0.5308	0.2264	-57%	1.7584	0.7519	-57%
1998	0.0555	0.2055	270%	0.5546	2.0549	270%	1.8385	6.8731	274%
1999	0.0631	0.0381	-40%	0.6311	0.3806	-40%	2.0939	1.2672	-39%
2000	0.0696	0.0416	-40%	0.6958	0.4165	-40%	2.3100	1.3863	-40%
2001	0.0586	0.0379	-35%	0.5864	0.3788	-35%	1.9457	1.2618	-35%
2002	0.0701	0.1250	78%	0.7007	1.2497	78%	2.3273	4.1761	79%
2003	0.0674	0.1577	134%	0.6736	1.5772	134%	2.2374	5.2687	135%
2004	0.0576	0.0766	33%	0.5762	0.7657	33%	1.9164	2.5573	33%
2005	0.0661	0.1393	111%	0.6605	1.3926	111%	2.1962	4.6558	112%
2006	0.0664	0.1950	194%	0.6642	1.9497	194%	2.2071	6.5191	195%
2007	0.0770	0.1444	88%	0.7700	1.4444	88%	2.5580	4.8277	89%
2008	0.0775	0.1422	84%	0.7749	1.4221	84%	2.5736	4.7524	85%
2009	0.0754	0.1280	70%	0.7544	1.2805	70%	2.5101	4.2791	70%
2010	0.0447	0.0880	97%	0.4472	0.8799	97%	1.4879	2.9428	98%
2011	0.0420	0.0735	75%	0.4196	0.7348	75%	1.3951	2.4540	76%
2012	0.0423	0.0302	-29%	0.4230	0.3023	-29%	1.4069	1.0068	-28%
2013	0.0358	0.0601	68%	0.3581	0.6009	68%	1.1927	2.0080	68%
2014	0.0631	0.0504	-20%	0.6310	0.5040	-20%	2.1001	1.6812	-20%
2015	0.0571	0.2222	289%	0.5714	2.2219	289%	1.9033	7.4311	290%
2016	0.0791	0.0645	-18%	0.7910	0.6453	-18%	2.6289	2.1526	-18%
2017	0.0627	0.1189	90%	0.6270	1.1893	90%	2.0882	3.9747	90%
2018	0.0708	0.0626	-12%	0.7080	0.6259	-12%	2.3578	2.0858	-12%

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 the double-counting if reported in this category separately by T1.

4.4.8 OTHER MINERAL PRODUCTS (2A6)

4.4.8.1 Overview

The category covers other industrial activities of mineral industry not covered in described NFR categories. Reported emissions under the category and their trends are presented below (***Table 4.27***).

Table 4.27: *Overview of emissions in the category 2A6*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.3406	0.1731	0.1847	0.0007	0.1110	0.1191	0.1505	1.2966
1995	0.3428	0.1742	0.1859	0.0007	0.1117	0.1199	0.1515	1.3050
2000	0.4456	0.0803	0.2455	0.0001	0.1236	0.1327	0.1677	1.0779
2005	0.4333	0.1578	0.4848	0.0041	0.1408	0.1494	0.1757	1.7465
2010	0.3009	0.0524	0.3119	0.0129	0.0757	0.0825	0.1141	0.4357
2011	0.2734	0.0507	0.2944	0.0137	0.0877	0.0959	0.1359	0.4100
2012	0.2457	0.0595	0.3228	0.0227	0.0587	0.0654	0.1020	0.2801
2013	0.1865	0.0591	0.3039	0.0214	0.0558	0.0622	0.0969	0.2912
2014	0.1807	0.0494	0.3046	0.0210	0.0545	0.0614	0.1012	0.2293
2015	0.2036	0.0735	0.3534	0.0248	0.0494	0.0568	0.1014	0.3016
2016	0.2283	0.1168	0.4220	0.0228	0.0159	0.0221	0.0670	0.5076
2017	0.2579	0.1254	0.4271	0.0234	0.0158	0.0223	0.0693	0.5535
2018	0.2895	0.1476	0.4473	0.0241	0.0130	0.0200	0.0724	0.7775
2019	0.2636	0.1283	0.4208	0.0220	0.0098	0.0162	0.0682	0.7389
1990/2019	**-23%**	**-26%**	**128%**	**2866%**	**-91%**	**-86%**	**-55%**	**-43%**
2018/2019	**-9%**	**-13%**	**-6%**	**-9%**	**-25%**	**-19%**	**-6%**	**-5%**

4.4.8.2 Methodological issues

Activities listed within this category are shown in ***Table 4.28***.

Table 4.28: *Activities according to national categorization included in 2A6*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.4. Production of magnesium oxide from magnesite and production of alkaline refractory materials with a projected production capacity t/d
3.6. Installations for melting of mineral substances including the processing of melt materials and production of mineral fibres with a melting capacity projected in t/d
3.8. Manufacture of ceramic products by firing, roofing tiles, bricks, tiles, stoneware or porcelain:
-with a projected production capacity in t/d or
-with a kiln capacity in m^3 and with a setting density per kiln exceeding 300 kg/m 3
3.9. Production of lightweight non-metallic mineral products with a projected production capacity m^3/d
3.12. Production of unfired masonry materials and precast units with a projected production capacity m^3/h
3.13. Industrial production of concrete, mortar or other building materials with a projected production capacity in m^3/h
3.99. Other industrial production and processing of non-metallic mineral products - division by point 2.99
4.32. Production and processing of carbon materials:
a) production of charcoal with a projected production in kg/d

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
b) production of soot
c) burning carbonaceous materials, including impregnation
d) mechanical processing of carbonaceous materials

Emission data is compiled in the NEIS database therefore the individual-specific EF could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV*.***

Industrial production of concrete for emission calculation it can be used the official bulletin of the Ministry of Environment:

LFS - large fraction of stones

FFS - fine fraction of stones

Emission factors from Bulletin of Ministry of Environment are shown in ***Table 4.29*** (valid for 2000-2018). Emission factors for the historical years were calculated as a weighted average of IEF of the period 2000-2004 (***Table 4.20***).

Table 4.29: *Emission factors provided by Bulletin of MoE*

PROCESS	EF	
	TSP	PM_{10}
	g/m^3	
Transport and loading of LFS into boxes - fugitive emissions	3.8	1.8
Transport and loading of FFS into boxes - fugitive emissions	1	0.5
loading of LFS into underground storage or transport equipment - fugitive emissions	3.8	1.8
loading of FFS into underground storage or transport equipment - fugitive emissions	1	0.5
Transport of LFS to mixing drum or convoy or above-ground storage	3.8	1.8
Transport of FFS to mixing drum or convoy or above-ground storage	1	0.5
transport of cement into silo (abated)	0.1	0.1
transport of ash or cinder (abated)	0.2	0.1
filling the stock over mixing drum with FFS	3.8	1.8
filling the stock over mixing drum with LFS	1	0.5
filling the drum with solid material - abated	0.2	0.1
average humidity and batching of materials	19.7	9.5

Table 4.30: *Emission factors for calculation of historical years*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH_3 [g/GJ]	TSP [g/GJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/GJ]
EF	159.01	80.81	86.22	0.35	70.26	74%	79%	605.28

4.4.8.3 Completeness

All rising pollutants were reported.

4.4.8.4 Source-specific recalculations

Historical years were recalculated due to update of emission factors (***Table 4.31***).

Table 4.31: *Previous and refined emissions in the category 2A6*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.3421	0.3406	-0.4%	0.1695	0.1731	2.1%	0.1831	0.1847	0.9%	0.0006	0.0007	15.1%
1991	0.3424	0.3409	-0.4%	0.1697	0.1733	2.1%	0.1833	0.1849	0.9%	0.0006	0.0007	15.1%
1992	0.3429	0.3413	-0.4%	0.1699	0.1735	2.1%	0.1835	0.1851	0.9%	0.0006	0.0007	15.1%
1993	0.3420	0.3405	-0.4%	0.1695	0.1731	2.1%	0.1831	0.1846	0.9%	0.0006	0.0007	15.1%

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1994	0.3428	0.3413	-0.4%	0.1699	0.1735	2.1%	0.1835	0.1851	0.9%	0.0006	0.0007	15.1%
1995	0.3443	0.3428	-0.4%	0.1706	0.1742	2.1%	0.1843	0.1859	0.9%	0.0006	0.0007	15.1%
1996	0.3421	0.3406	-0.4%	0.1696	0.1731	2.1%	0.1831	0.1847	0.9%	0.0006	0.0007	15.1%
1997	0.3441	0.3426	-0.4%	0.1705	0.1741	2.1%	0.1842	0.1858	0.9%	0.0006	0.0007	15.1%
1998	0.3459	0.3444	-0.4%	0.1714	0.1750	2.1%	0.1852	0.1868	0.9%	0.0007	0.0008	15.1%
1999	0.3471	0.3455	-0.4%	0.1720	0.1756	2.1%	0.1858	0.1874	0.9%	0.0007	0.0008	15.1%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.1101	0.1110	0.8%	0.1183	0.1191	0.7%	0.1504	0.1505	0.1%	1.2966	1.2966	0.0%
1991	0.1102	0.1111	0.8%	0.1184	0.1192	0.7%	0.1505	0.1507	0.1%	1.2979	1.2979	0.0%
1992	0.1103	0.1112	0.8%	0.1185	0.1194	0.7%	0.1507	0.1508	0.1%	1.2994	1.2994	0.0%
1993	0.1101	0.1110	0.8%	0.1183	0.1191	0.7%	0.1503	0.1505	0.1%	1.2962	1.2962	0.0%
1994	0.1103	0.1112	0.8%	0.1185	0.1194	0.7%	0.1507	0.1508	0.1%	1.2993	1.2993	0.0%
1995	0.1108	0.1117	0.8%	0.1191	0.1199	0.7%	0.1513	0.1515	0.1%	1.3050	1.3050	0.0%
1996	0.1101	0.1110	0.8%	0.1183	0.1191	0.7%	0.1504	0.1505	0.1%	1.2967	1.2967	0.0%
1997	0.1107	0.1116	0.8%	0.1190	0.1198	0.7%	0.1512	0.1514	0.1%	1.3042	1.3042	0.0%
1998	0.1113	0.1122	0.8%	0.1196	0.1204	0.7%	0.1520	0.1522	0.1%	1.3110	1.3110	0.0%
1999	0.1117	0.1126	0.8%	0.1200	0.1208	0.7%	0.1525	0.1527	0.1%	1.3154	1.3154	0.0%
2000	0.1228	0.1236	0.7%	0.1319	0.1327	0.6%	0.1677	0.1677	-	1.0779	1.0779	-
2001	0.1021	0.1028	0.7%	0.1096	0.1103	0.6%	0.1394	0.1394	-	1.2592	1.2592	-
2002	0.0960	0.0967	0.7%	0.1031	0.1037	0.6%	0.1311	0.1311	-	1.2713	1.2713	-
2003	0.1152	0.1160	0.7%	0.1238	0.1245	0.6%	0.1573	0.1573	-	1.6922	1.6922	-
2004	0.1508	0.1518	0.7%	0.1620	0.1630	0.6%	0.2059	0.2059	-	1.6028	1.6028	-

P-Previous
R-Refined

4.5 CHEMICAL PRODUCTS (2B)

4.5.1 OVERVIEW

The category covers the NFR activities: Ammonia production (2B1), Nitric acid production (2B2), Adipic acid production (2B3), Carbide production (2B5), Titanium dioxide production (2B6), Soda ash production (2B7), Chemical industry: other (2B10a), Storage, handling and transport of chemical products (2B10b).

Emissions from this category have in the general decreasing trend, except for the emissions of NOx (***Table 4.32***). It was caused by stricter legislation and adoption of emissions limits for the main pollutants. Emissions of NOx originate mostly from the category 2B10a which includes the production of various organic and inorganic compounds, fertilizers etc.

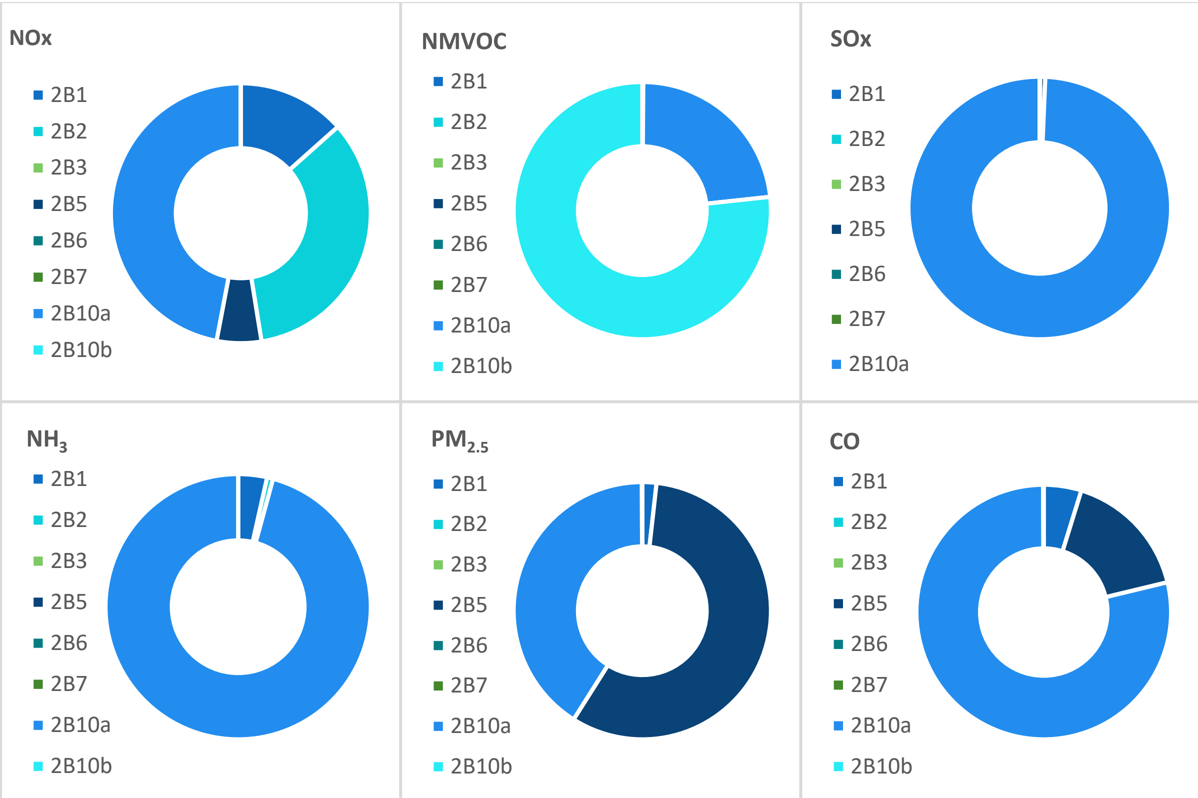
Not all are occurring at the territory of Slovakia. Shares of released emission of main air pollutants in 2019 NFR categories included are provided in the figure below (***Figure 4.6***).

Table 4.32: *Overview of emissions in category 2B*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	1.0829	6.0322	1.6193	0.2449	0.2095	0.3308	0.5077	0.0034	4.1970
1995	1.2687	5.8719	1.5772	0.2368	0.3545	0.5731	0.9131	0.0033	4.1210
2000	1.2470	5.9168	0.9387	0.1699	0.3386	0.5499	0.8822	0.0027	5.0582
2005	1.0212	3.1771	1.0770	0.2241	0.2083	0.3384	0.5437	0.0017	1.5312
2010	0.6434	1.9941	1.2018	0.0684	0.0843	0.1411	0.2328	0.0009	1.0593

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
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
1990/2019	**0%**	**-68%**	**-18%**	**-43%**	**-36%**	**-33%**	**-28%**	**-71%**	**-76%**
2018/2019	**-11%**	**-8%**	**-4%**	**-14%**	**13%**	**14%**	**16%**	**-23%**	**-13%**

Figure 4.6: *Shares of emissions in 2B in 2019*



4.5.2 AMMONIA PRODUCTION (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 up to 600 atmospheres and temperature of 400°C are needed. Emission trends and activity data from this category are shown in ***Table 4.33***. Emission of particulate matter from this source decreased significantly in 2004 due to abatement technology installation.

Table 4.33: *Activity data and emissions in the category 2B1*

YEAR	AMMONIA PRODUCED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	360.00	0.2136	0.0038	0.0011	0.0036	0.0212	0.0354	0.0590	0.0702

YEAR	AMMONIA PRODUCED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1995	383.80	0.2277	0.0041	0.0012	0.0038	0.0226	0.0377	0.0629	0.0748
2000	403.00	0.2182	0.0049	0.0015	0.0040	0.0320	0.0533	0.0888	0.0161
2005	426.35	0.2711	0.0045	0.0013	0.0043	0.0039	0.0066	0.0109	0.1064
2010	233.56	0.1274	0.0017	0.0007	0.0023	0.0021	0.0035	0.0058	0.0427
2011	455.48	0.2496	0.0033	0.0014	0.0046	0.0041	0.0068	0.0113	0.0837
2012	377.30	0.2037	0.0027	0.0011	0.0038	0.0033	0.0056	0.0093	0.0683
2013	474.91	0.2436	0.0032	0.0013	0.0047	0.0040	0.0066	0.0111	0.0776
2014	346.27	0.1799	0.0024	0.0010	0.0035	0.0029	0.0049	0.0082	0.0573
2015	476.94	0.2279	0.0030	0.0012	0.0048	0.0037	0.0062	0.0104	0.0764
2016	403.96	0.2017	0.0026	0.0011	0.0040	0.0033	0.0055	0.0092	0.0676
2017	458.88	0.2253	0.0029	0.0012	0.0046	0.0037	0.0061	0.0102	0.0755
2018	516.74	0.2354	0.0030	0.0012	0.0052	0.0037	0.0061	0.0102	0.0787
2019	491.95	0.1449	0.0022	0.0008	0.0049	0.0024	0.0040	0.0066	0.0490
1990/2019	**37%**	**-32%**	**-42%**	**-29%**	**37%**	**-89%**	**-89%**	**-89%**	**-30%**
2018/2019	**-5%**	**-38%**	**-25%**	**-35%**	**-5%**	**-35%**	**-35%**	**-35%**	**-38%**

4.5.2.2 Methodological issues

Activities listed within this category are shown in ***Table 4.34***.

Table 4.34: *Activities according to national categorization included in 2B1*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.27 Ammonia production

Emission data is compiled in the NEIS database therefore the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology is presented in **ANNEX IV*.***

Emissions of NH_3 were calculated using Tier 1 emission factor from the EMEP/EEA GB_{2019}. Historical years were calculated using a weighted average of IEF for each pollutant from the period 2000-2004 (***Table 4.35***).

Table 4.35: *Emission factors for calculation of historical years and NH_3 and CO emissions*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	NH_3 *[g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/t]
EF	593.41	10.67	3.10	10	163.77	36%	60%	194.97

*EMEP/EEA GB 2019 – Tier 1

4.5.2.3 Completeness

All rising pollutants were reported.

4.5.2.4 Source-specific recalculations

Emissions were recalculated due to change of emission factors for historical years and inclusion of the data from the NEIS database for emissions of CO in this category. Change of emissions shown in the table below.

Table 4.36: *Previous and refined emissions in the category 2B1*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			TSP [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.2116	0.2136	1%	0.0038	0.0038	1%	0.0011	0.0011	1%	0.0594	0.0590	-1%
1991	0.2067	0.2086	1%	0.0037	0.0037	1%	0.0011	0.0011	1%	0.0580	0.0576	-1%
1992	0.2023	0.2043	1%	0.0036	0.0037	1%	0.0011	0.0011	1%	0.0568	0.0564	-1%

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			TSP [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1993	0.1216	0.1228	1%	0.0022	0.0022	1%	0.0006	0.0006	1%	0.0341	0.0339	-1%
1994	0.2080	0.2100	1%	0.0037	0.0038	1%	0.0011	0.0011	1%	0.0584	0.0580	-1%
1995	0.2256	0.2277	1%	0.0041	0.0041	1%	0.0012	0.0012	1%	0.0633	0.0629	-1%
1996	0.2420	0.2443	1%	0.0044	0.0044	1%	0.0013	0.0013	1%	0.0679	0.0674	-1%
1997	0.2409	0.2432	1%	0.0043	0.0044	1%	0.0013	0.0013	1%	0.0676	0.0671	-1%
1998	0.2141	0.2162	1%	0.0039	0.0039	1%	0.0011	0.0011	1%	0.0601	0.0597	-1%
1999	0.2139	0.2160	1%	0.0038	0.0039	1%	0.0011	0.0011	1%	0.0601	0.0596	-1%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0052	0.0212	305%	0.0087	0.0354	305%	0.0360	0.0702	95%
1991	0.0051	0.0207	305%	0.0085	0.0345	305%	0.0352	0.0686	95%
1992	0.0050	0.0203	305%	0.0083	0.0338	305%	0.0344	0.0671	95%
1993	0.0030	0.0122	305%	0.0050	0.0203	305%	0.0207	0.0403	95%
1994	0.0051	0.0209	305%	0.0086	0.0348	305%	0.0354	0.0690	95%
1995	0.0056	0.0226	305%	0.0093	0.0377	305%	0.0384	0.0748	95%
1996	0.0060	0.0243	305%	0.0100	0.0405	305%	0.0412	0.0803	95%
1997	0.0060	0.0242	305%	0.0099	0.0403	305%	0.0410	0.0799	95%
1998	0.0053	0.0215	305%	0.0088	0.0358	305%	0.0364	0.0710	95%
1999	0.0053	0.0215	305%	0.0088	0.0358	305%	0.0364	0.0710	95%
2000	0.0078	0.0320	308%	0.0130	0.0533	308%	0.0403	0.0161	-60%
2001	0.0057	0.0233	308%	0.0095	0.0388	308%	0.0412	0.1215	195%
2002	0.0080	0.0326	308%	0.0133	0.0543	308%	0.0400	0.0981	145%
2003	0.0061	0.0248	308%	0.0101	0.0413	308%	0.0354	0.0498	41%
2004	0.0010	0.0039	308%	0.0016	0.0066	308%	0.0408	0.0998	145%
2005	0.0039	0.0039	0%	0.0066	0.0066	0%	0.0426	0.1064	150%
2006	0.0032	0.0032	0%	0.0054	0.0054	0%	0.0355	0.0802	126%
2007	0.0033	0.0033	0%	0.0055	0.0055	0%	0.0362	0.0674	86%
2008	0.0029	0.0029	0%	0.0049	0.0049	0%	0.0328	0.0598	82%
2009	0.0027	0.0027	0%	0.0044	0.0044	0%	0.0344	0.0546	59%
2010	0.0021	0.0021	0%	0.0035	0.0035	0%	0.0234	0.0427	83%
2011	0.0041	0.0041	0%	0.0068	0.0068	0%	0.0455	0.0837	84%
2012	0.0033	0.0033	0%	0.0056	0.0056	0%	0.0377	0.0683	81%
2013	0.0040	0.0040	0%	0.0066	0.0066	0%	0.0475	0.0776	63%
2014	0.0029	0.0029	0%	0.0049	0.0049	0%	0.0346	0.0573	65%
2015	0.0037	0.0037	0%	0.0062	0.0062	0%	0.0477	0.0764	60%
2018	0.0033	0.0033	0%	0.0055	0.0055	0%	0.0404	0.0676	67%
2017	0.0037	0.0037	0%	0.0061	0.0061	0%	0.0459	0.0755	65%
2018	0.0037	0.0037	0%	0.0061	0.0061	0%	0.0517	0.0787	52%

P-Previous
R-Refined

4.5.3 NITRIC ACID PRODUCTION (2B2)

4.5.3.1 Overview

NO_X emissions have an overall increasing trend since 1990 due to the increase in the production of nitric acid (***Table 4.37***). Significant increase and subsequent decrease of NH_3 emissions between 2006/2007 were recorded due to temporal malfunction on the source. Significant decrease in 2019 was caused by single source started to use new technology to produce Nitric acid.

Table 4.37: *Activity data and emissions in the category 2B2*

YEAR	ANITRIC ACID PRODUCED [kt]	NOx [kt]	NH_3[kt]
1990	400.54	0.1741	0.0039
1995	398.80	0.1733	0.0039
2000	407.22	0.1770	0.0040
2005	497.68	0.2163	0.0048
2010	510.97	0.3313	0.0026
2011	593.75	0.3711	0.0034
2012	550.51	0.3299	0.0035
2013	611.65	0.3609	0.0012
2014	580.09	0.3446	0.0011
2015	634.31	0.3251	0.0009
2016	568.55	0.3128	0.0039
2017	646.23	0.3407	0.0041
2018	529.76	0.3955	0.0038
2019	528.71	0.3673	0.0010
1990/2019	**32%**	**111%**	**-74%**
2018/2019	**0%**	**-7%**	**-73%**

4.5.3.2 Methodological issues

The definition of activities covered by the category 2B2 is provided in ***Table 4.38***. 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 4.38: *Activities according to national categorization included in 2B2*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.22 Production of inorganic acids

Since 2005, N_2O, NH_3 and NOx emissions are monitored by the 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 in 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 (already owned the second plant). The plant was modernized in the same way as the other.

Emission data is compiled in the NEIS, therefore the individual specific EF were used for sources recorded in the database.

For a reconstruction of historical years before 2000 (data in the NEIS are recorded since 2000), rounded weighted average of IEF of available data was used (excluding the year of malfunction), therefore implied emission factor for this period for nitrogen oxides was **IEF_{NOx}= 434.60 g/t** and for ammonia, **IEF_{NH3} =9.74 g/t**.

4.5.3.3 Completeness

All rising pollutants were reported.

4.5.3.4 Source-specific recalculations

Emissions of historic years were recalculated due to change of emission factor and correction of emissions data for the years 2005-2007. (***Table 4.39***).

Table 4.39: Previous and refined emissions in the category 2B2

YEAR	NOx [kt]			NH_3 [kt]		
	PREVIOUS	REFINED	CHANGE	PREVIOUS	REFINED	CHANGE
1990	0.2403	0.1741	-28%	0.0020	0.0039	95%
1991	0.1811	0.1312	-28%	0.0015	0.0029	95%
1992	0.1671	0.1210	-28%	0.0014	0.0027	95%
1993	0.1402	0.1015	-28%	0.0012	0.0023	95%
1994	0.2165	0.1568	-28%	0.0018	0.0035	95%
1995	0.2393	0.1733	-28%	0.0020	0.0039	95%
1996	0.2681	0.1942	-28%	0.0022	0.0044	95%
1997	0.2528	0.1831	-28%	0.0021	0.0041	95%
1998	0.2264	0.1640	-28%	0.0019	0.0037	95%
1999	0.1839	0.1332	-28%	0.0015	0.0030	95%
2000	0.2443	0.1770	-28%	0.0020	0.0040	95%
2001	0.2786	0.2018	-28%	0.0023	0.0045	95%
2002	0.2423	0.1755	-28%	0.0020	0.0039	95%
2003	0.2728	0.1976	-28%	0.0023	0.0044	95%
2004	0.3149	0.2281	-28%	0.0026	0.0051	95%
2005	0.2986	0.2163	-28%	0.0025	0.0048	95%
2006	0.3384	0.2420	-28%	0.0028	0.0101	259%
2007	0.2935	0.0073	-97%	0.0024	0.0044	80%

4.5.4 ADIPIC ACID PRODUCTION (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 (2B5)

4.5.5.1 Overview

The production of calcium carbide in the Slovak Republic started in 1992. The production of the other specified activities under national legislation (e.g. other inorganic compounds such as sodium, calcium, silicon, phosphorus or silicon carbide) is not occurring in the Slovak Republic.

Calcium carbide is manufactured by heating the mixture of lime and carbon (the reaction of CaO and coke) to 2000 to 2100°C in a submerged arc furnace. At those temperatures, the lime is reduced by carbon to calcium carbide and carbon monoxide (according to the reaction: $CaO + 3C \rightarrow CaC_2 + CO$). Since 2015, the calcined anthracite is used instead of other bituminous coal.

The main emissions from the production of calcium carbide (CaC_2) are dust. However, the reported emissions in category cover all sub-processes of the manufacturing as they are together in data set under the category. Relevant rising emissions from this manufacturing, their trends and activity data (***Table 4.40***) are presented. This category is a key category of PM_{10} and TSP.

Table 4.40: Activity data and emissions in the category 2B5

YEAR	CARBIDE PRODUCED [kt]	NOx [kt]	NMVOC[kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	NO	NO	NO	NO	NO	NO	NO	NO
1995	84.30	0.1968	0.0000	0.0144	0.1502	0.2503	0.4172	0.0638
2000	88.82	0.3865	0.0000	0.0250	0.1586	0.2644	0.4406	0.0679
2005	97.03	0.0688	0.0000	0.0089	0.1114	0.1856	0.3093	0.0660
2010	98.26	0.0561	0.0000	0.0027	0.0326	0.0543	0.0905	0.2789

YEAR	CARBIDE PRODUCED [kt]	NOx [kt]	NMVOC[kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2011	107.40	0.0565	0.0000	0.0027	0.0310	0.0516	0.0860	0.2791
2012	100.48	0.0522	0.0000	0.0043	0.0605	0.1008	0.1681	0.3169
2013	81.79	0.0433	0.0000	0.0058	0.0725	0.1208	0.2013	0.3324
2014	74.30	0.0505	0.0000	0.0053	0.0707	0.1179	0.1965	0.2972
2015	56.18	0.0502	0.0000	0.0067	0.0617	0.1028	0.1713	0.2817
2016	67.95	0.0590	0.0000	0.0083	0.0462	0.0770	0.1284	0.3341
2017	71.64	0.0580	0.0000	0.0083	0.0482	0.0803	0.1338	0.2139
2018	70.15	0.0535	0.0000	0.0079	0.0436	0.0726	0.1210	0.1890
2019	69.71	0.0600	0.0002	0.0083	0.0767	0.1279	0.2132	0.1688
1990/2019	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
2018/2019	**-1%**	**12%**	**512%**	**4%**	**76%**	**76%**	**76%**	**-11%**

4.5.5.2 Methodological issues

The definition of activities covered by category 2B5 is provided in ***Table 4.41***. The characteristic of involved industrial activity is wider, but the only activity of calcium carbide production belonging to the occurring production activities.

Table 4.41: *Activities according to national categorization included in 2B5*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.25 Production of non-metals, metal oxides or other inorganic compounds such as sodium, calcium, silicon, phosphorus, calcium carbide, silicon carbide

Emission data is compiled in the NEIS, therefore, the individual-specific EF were used for sources recorded in the database. Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004 (***Table 4.42***).

Table 4.42: *Emission factors for calculation of historical years*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/t]
EF	2 334.16	0.12	171.03	4 949.16	36%	60%	757.16

4.5.5.3 Completeness

All rising pollutants were reported. Notation key was used in compliance with EMEP/EEA GB_{2019}. In the years 1990 and 1991, notation key NO was used, because the production started in 1992.

4.5.5.4 Source-specific recalculations

Historical years were recalculated due to change of emission factors for this period (***Table 4.43***). NMVOC emission data for the period 2000-2005 were recalculated due to error correction in the database.

Table 4.43: *Previous and refined emissions in the category 2B5*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1992	0.0238	0.0233	-2%	0.0005	0.0000	-100%	0.0017	0.0017	-2%	0.0076	0.0076	0%
1993	0.1191	0.1167	-2%	0.0027	0.0000	-100%	0.0087	0.0086	-2%	0.0379	0.0379	0%
1994	0.1751	0.1716	-2%	0.0040	0.0000	-100%	0.0128	0.0126	-2%	0.0557	0.0557	0%
1995	0.2008	0.1968	-2%	0.0046	0.0000	-100%	0.0146	0.0144	-2%	0.0638	0.0638	0%
1996	0.2144	0.2101	-2%	0.0049	0.0000	-100%	0.0156	0.0154	-2%	0.0682	0.0681	0%
1997	0.2301	0.2255	-2%	0.0053	0.0000	-100%	0.0168	0.0165	-2%	0.0732	0.0731	0%
1998	0.2110	0.2068	-2%	0.0048	0.0000	-100%	0.0154	0.0152	-2%	0.0671	0.0671	0%
1999	0.1926	0.1888	-2%	0.0044	0.0000	-100%	0.0140	0.0138	-2%	0.0612	0.0612	0%

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2000	0.3865	0.3865	-	0.0059	0.0000	-100%	0.0250	0.0250	-	0.0679	0.0679	-
2001	0.4137	0.4137	-	0.0042	0.0000	-100%	0.0288	0.0288	-	0.0708	0.0708	-
2002	0.1017	0.1017	-	0.0054	0.0000	-100%	0.0101	0.0101	-	0.0700	0.0700	-
2003	0.1032	0.1032	-	0.0055	0.0000	-100%	0.0095	0.0095	-	0.0695	0.0695	-
2004	0.1364	0.1364	-	0.0054	0.0000	-100%	0.0103	0.0103	-	0.0921	0.0921	-
2005	0.0688	0.0688	-	0.0053	0.0000	-100%	0.0089	0.0089	-	0.0660	0.0660	-

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1992	0.0178	0.0178	0%	0.0297	0.0297	0%	0.0495	0.0495	0%
1993	0.0891	0.0891	0%	0.1485	0.1485	0%	0.2475	0.2475	0%
1994	0.1310	0.1310	0%	0.2183	0.2183	0%	0.3638	0.3638	0%
1995	0.1502	0.1502	0%	0.2504	0.2503	0%	0.4173	0.4172	0%
1996	0.1604	0.1604	0%	0.2673	0.2673	0%	0.4455	0.4454	0%
1997	0.1721	0.1721	0%	0.2869	0.2869	0%	0.4782	0.4781	0%
1998	0.1579	0.1579	0%	0.2632	0.2631	0%	0.4386	0.4385	0%
1999	0.1441	0.1441	0%	0.2402	0.2401	0%	0.4003	0.4002	0%
2000	0.1586	0.1586	0%	0.2644	0.2644	0%	0.4406	0.4406	-
2001	0.1266	0.1266	0%	0.2110	0.2110	0%	0.3516	0.3516	-
2002	0.1200	0.1200	0%	0.2000	0.2000	0%	0.3333	0.3333	-
2003	0.1247	0.1247	0%	0.2078	0.2078	0%	0.3464	0.3464	-
2004	0.3414	0.3414	0%	0.5691	0.5691	0%	0.9485	0.9485	-

P-Previous
R-Refined

4.5.6 TITANIUM DIOXIDE PRODUCTION (2B6)

4.5.6.1 Overview

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

4.5.7 SODA ASH PRODUCTION (2B7)

4.5.7.1 Overview

Soda ash is not produced in the Slovak Republic and NO notation key was used.

4.5.8 CHEMICAL INDUSTRY: OTHER (2B10a)

4.5.8.1 Overview

The category included various activities of the chemical industry. The overview of emissions and activity data is provided in ***Table 4.44.*** Emissions of air pollutants show a decreasing tendency in the long-term.

Table 4.44: *Overview of emissions in the category 2B10a*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.6952	2.9146	1.6182	0.2373	0.1882	0.2954	0.4488	0.0034	4.1268
1995	0.6708	2.8125	1.5615	0.2290	0.1817	0.2851	0.4331	0.0033	3.9823
2000	0.4653	3.2955	0.9122	0.1619	0.1480	0.2322	0.3528	0.0027	4.9742
2005	0.4649	1.3922	1.0667	0.2149	0.0930	0.1463	0.2234	0.0017	1.3587
2010	0.1286	0.6126	1.1984	0.0635	0.0497	0.0833	0.1365	0.0009	0.7377
2011	0.4867	0.8527	1.3355	0.1589	0.0884	0.1398	0.2152	0.0016	0.5813

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2012	0.4064	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
1990/2019	**-27%**	**-85%**	**-18%**	**-43%**	**-71%**	**-69%**	**-67%**	**-71%**	**-80%**
2018/2019	**-5%**	**-11%**	**-4%**	**-13%**	**-23%**	**-22%**	**-20%**	**-23%**	**-11%**

4.5.8.2 Methodological issues

The definition of activities covered by category 2B10a is provided in ***Table 4.45***.

Table 4.45: *Activities according to national categorization included in 2B2*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.6 Production of synthetic rubbers
4.7 Production of basic plastic materials based on synthetic and natural polymers excluding synthetic rubber
4.8 Production of simple hydrocarbons (linear or cyclic, saturated or unsaturated, aliphatic or aromatic)
4.9 Production of halogenated organic compounds
4.10 Production of organic compounds containing oxygen
4.11 Production of organic compounds containing sulphur
4.12 Production of organic compounds containing nitrogen excluding carbamide
4.13 Production of organic compounds containing phosphorus
4.14 Production of organometallic compounds
4.15 Production of plant protection products or biocides
4.16 Production of auxiliary agents for the rubber industry
4.17 Production and processing of viscose
4.21 Production of inorganic gases and compounds except for ammonia
4.23 Production of inorganic hydroxides
4.26 Production of inorganic salts excluding fertilizers
4.28 Production of carbamide
4.29 Production of phosphorous-, nitrogen- or potassium-based fertilisers (simple or compound fertilisers excluding carbamide)
4.30 Production of inorganic pigments, refining a 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 (***Table 4.46***).

Table 4.46: *Emission factors for calculation of historical years*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH_3 [g/GJ]	TSP [g/GJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/GJ]
EF	352.13	1476.34	819.68	120.20	227.33	42%	66%	1.8%	2090.38

*Tier 1 EMEP/EEA GB_{2019}

4.5.8.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2019}.

4.5.8.4 Source-specific recalculations

Historical years were recalculated due to change of emission factors for this period and correction of emissions in the NEIS database (***Table 4.47***).

Table 4.47: *Previous and refined emissions of main pollutants*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.7122	0.6952	-2%	2.8582	2.9146	2%	1.6861	1.6182	-4%	0.4632	0.2373	-49%
1991	0.7083	0.6914	-2%	2.8424	2.8985	2%	1.6768	1.6093	-4%	0.4607	0.2360	-49%
1992	0.7079	0.6909	-2%	2.8407	2.8968	2%	1.6758	1.6083	-4%	0.4604	0.2358	-49%
1993	0.7078	0.6908	-2%	2.8401	2.8962	2%	1.6755	1.6080	-4%	0.4603	0.2358	-49%
1994	0.7064	0.6895	-2%	2.8348	2.8908	2%	1.6724	1.6050	-4%	0.4595	0.2354	-49%
1995	0.6873	0.6708	-2%	2.7581	2.8125	2%	1.6271	1.5615	-4%	0.4470	0.2290	-49%
1996	0.7040	0.6871	-2%	2.8251	2.8808	2%	1.6666	1.5995	-4%	0.4579	0.2345	-49%
1997	0.6840	0.6676	-2%	2.7447	2.7988	2%	1.6192	1.5540	-4%	0.4448	0.2279	-49%
1998	0.6592	0.6434	-2%	2.6451	2.6973	2%	1.5604	1.4976	-4%	0.4287	0.2196	-49%
1999	0.6217	0.6068	-2%	2.4948	2.5441	2%	1.4718	1.4125	-4%	0.4044	0.2071	-49%
2000	0.4653	0.4653	0%	3.2960	3.2955	0%	0.9122	0.9122	0%	0.3147	0.1619	-49%
2001	0.4070	0.4070	0%	2.5685	2.5685	0%	1.1841	1.1841	0%	0.3122	0.1458	-53%
2002	0.7473	0.7473	0%	2.2835	2.2835	0%	1.3006	1.3006	0%	0.3772	0.1266	-66%
2003	0.4881	0.4881	0%	1.7051	1.7051	0%	1.2962	1.2962	0%	0.3403	0.1295	-62%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.1874	0.1882	0%	0.2967	0.2954	0%	0.4569	0.4488	-2%	3.9943	4.1268	3%
1991	0.1864	0.1872	0%	0.2951	0.2938	0%	0.4544	0.4463	-2%	3.9723	4.1041	3%
1992	0.1863	0.1871	0%	0.2949	0.2936	0%	0.4541	0.4460	-2%	3.9699	4.1016	3%
1993	0.1862	0.1871	0%	0.2949	0.2935	0%	0.4540	0.4460	-2%	3.9691	4.1008	3%
1994	0.1859	0.1867	0%	0.2943	0.2930	0%	0.4532	0.4451	-2%	3.9617	4.0931	3%
1995	0.1808	0.1817	0%	0.2863	0.2851	0%	0.4409	0.4331	-2%	3.8544	3.9823	3%
1996	0.1852	0.1861	0%	0.2933	0.2920	0%	0.4516	0.4436	-2%	3.9481	4.0791	3%
1997	0.1800	0.1808	0%	0.2849	0.2837	0%	0.4388	0.4310	-2%	3.8357	3.9629	3%
1998	0.1734	0.1742	0%	0.2746	0.2734	0%	0.4228	0.4153	-2%	3.6965	3.8192	3%
1999	0.1636	0.1643	0%	0.2590	0.2578	0%	0.3988	0.3917	-2%	3.4866	3.6022	3%
2000	0.1447	0.1480	2%	0.2291	0.2322	1%	0.3528	0.3528	-	4.9742	4.9742	-
2001	0.1579	0.1614	2%	0.2499	0.2533	1%	0.3848	0.3848	-	4.2664	4.2664	-
2002	0.1410	0.1442	2%	0.2233	0.2263	1%	0.3438	0.3438	-	3.7367	3.7367	-
2003	0.1014	0.1037	2%	0.1606	0.1627	1%	0.2473	0.2473	-	1.0519	1.0519	-
2004	0.1274	0.1303	2%	0.2017	0.2044	1%	0.3106	0.3106	-	1.0448	1.0448	-

P-Previous
R-Refined

4.5.9 STORAGE, HANDLING AND TRANSPORT OF CHEMICAL PRODUCTS (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 its trends are presented in ***Table 4.48***.

Table 4.48: *Overview of emissions in the category 2B10b*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.0001	3.1138	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
1995	0.0001	3.0553	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
2000	0.0001	2.6163	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
2005	0.0001	1.7804	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
2010	0.0001	1.3799	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2011	0.0001	1.3636	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2012	0.0001	1.1992	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2013	0.0001	1.4284	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2014	0.0001	1.3556	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2015	0.0001	1.6226	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2016	0.0000	1.5281	0.0000	NO	0.0000	0.0000	0.0000	0.0000
2017	0.0002	1.5373	0.0000	NO	0.0000	0.0000	0.0000	0.0002
2018	0.0001	1.5985	0.0000	NO	0.0000	0.0001	0.0001	0.0006
2019	0.0002	1.4921	0.0000	NO	0.0001	0.0001	0.0001	0.0008
1990/2019	**158%**	**-52%**	**32%**	**-**	**3880%**	**3881%**	**3881%**	**6371%**
2018/2019	**23%**	**-7%**	**975%**	**-**	**49%**	**49%**	**49%**	**34%**

4.5.9.2 Methodological issues

Activities listed within this category are shown in ***Table 4.49***.

Table 4.49: *Activities according to national categorization included in 2B10b*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.5 Distribution storages for pumping and individual pumping equipment for fuels, greases, petrochemicals and other organic liquids having a vapour pressure according to the Annex. 3 second part of section 2.2, except for liquefied hydrocarbon gases and compressed natural gas diesel, according: 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 2000-2019. Historical years were linearly extrapolated.

4.5.9.3 Completeness

All rising pollutants were reported. Notation key was used in compliance with EMEP/EEA GB_{2019}.

4.5.9.4 Source-specific recalculations

No recalculations in this submission.

4.6 METAL PRODUCTION (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 4.50***) due to stricter legislation and adoption of emission limits as well as BAT technologies in this industry.

In this submission, emissions of HMs and POPs were recalculated in several categories due to the application of higher Tier methods. Recommendations ***SK-2C1-2020-0001***, ***SK-2C3-2020-0001*** and ***SK-2C7a-2019-0002*** were included in the calculations.

Table 4.50: *Overview of emissions in the category 2C*

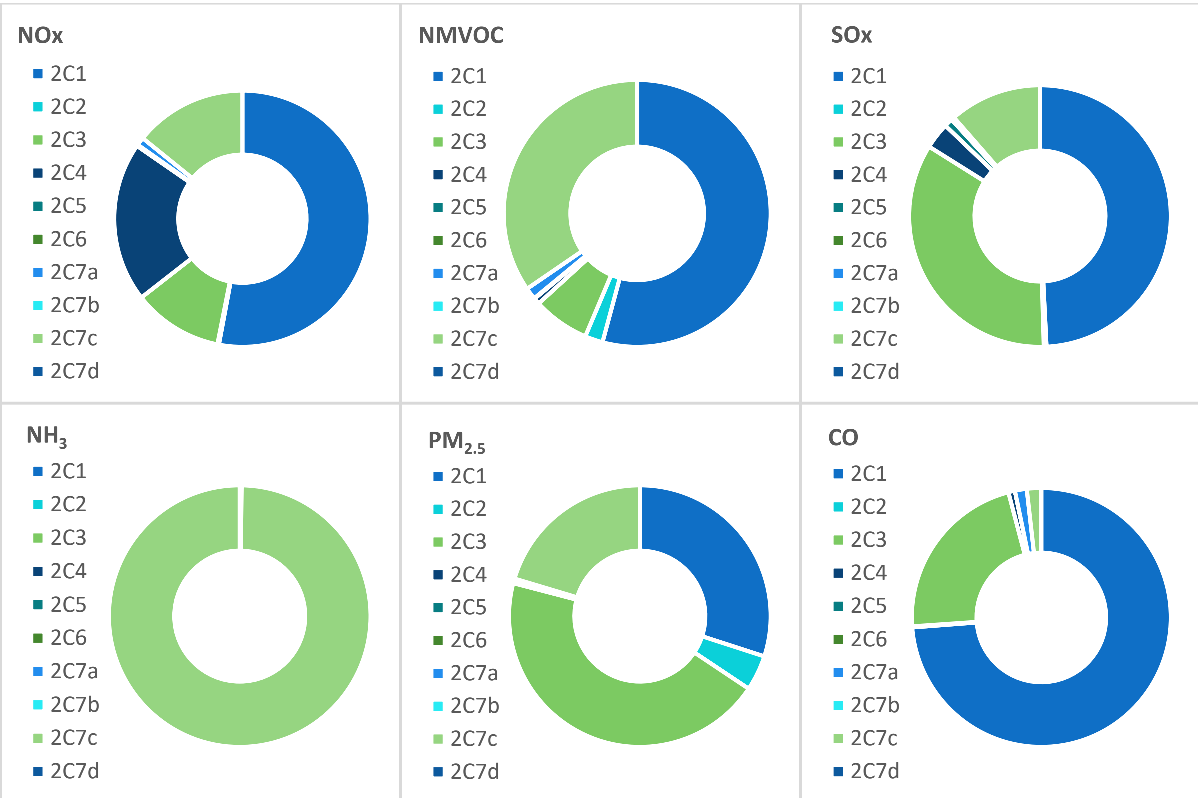
YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	5.3963	0.3870	9.5383	0.0108	1.4968	2.2897	8.7253	0.0208	78.9513
1995	4.5234	0.3638	8.2131	0.0112	1.3362	2.0442	7.8120	0.0167	68.0688
2000	6.0021	0.2698	12.7058	0.0081	1.8061	2.7317	10.0320	0.0366	86.6576
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
1990/2019	**-19%**	**71%**	**-38%**	**-63%**	**-82%**	**-85%**	**-89%**	**-80%**	**-10%**
2018/2019	**-23%**	**-24%**	**-21%**	**29%**	**-27%**	**-35%**	**-58%**	**-9%**	**-35%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	20.4632	0.4196	0.2036	0.6972	1.4332	3.1534	1.3089	0.0903	9.0824
1995	17.3194	0.2641	0.1670	0.5766	1.2737	2.5534	0.9858	0.0746	8.1779
2000	18.3403	0.0890	0.1839	0.5172	0.8178	1.4653	0.9079	0.0825	8.9934
2005	5.2889	0.1563	0.0390	0.5011	0.9325	1.1513	0.1753	0.0826	7.0866
2010	4.3882	0.1870	0.0302	0.4442	1.4849	2.1420	0.1676	0.0628	0.5642
2011	4.0686	0.1886	0.0338	0.4116	1.5200	2.2541	0.1597	0.0703	0.5879
2012	4.1822	0.1904	0.0360	0.4228	1.5302	2.2688	0.1633	0.0755	0.6133
2013	4.4960	0.0877	0.0353	0.4298	0.9438	1.2057	0.1958	0.0742	0.7679
2014	4.4133	0.0845	0.0419	0.4274	1.1597	1.6176	0.1811	0.0891	0.7471
2015	4.2147	0.0793	0.0413	0.4154	1.4238	2.0979	0.1607	0.0877	0.6391
2016	4.4318	0.0835	0.0416	0.4390	1.6461	2.4611	0.1665	0.0880	0.6460
2017	4.6382	0.0876	0.0421	0.4574	1.6034	2.3616	0.1775	0.0891	0.6853
2018	4.3200	0.0779	0.0412	0.4177	1.6199	0.3579	0.1684	0.0871	0.6854
2019	3.3822	0.0616	0.0384	0.3256	1.7593	0.3333	0.1338	0.0802	1.2879
1990/2019	**-83%**	**-85%**	**-81%**	**-53%**	**23%**	**-89%**	**-90%**	**-11%**	**-86%**
2018/2019	**-22%**	**-21%**	**-7%**	**-22%**	**9%**	**-7%**	**-21%**	**-8%**	**88%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [t]	PCB [t]
1990	36.2050	0.6066	0.6066	0.6066	0.0741	12.4963	0.1195	18.9415
1995	30.4281	0.2934	0.2934	0.2934	0.0359	10.3806	0.0975	17.1152
2000	32.1864	0.0077	0.0022	0.0022	0.0011	9.5126	0.1080	17.8307
2005	33.6304	0.0111	0.0032	0.0032	0.0016	10.8661	0.1048	21.0056
2010	25.3396	0.0114	0.0033	0.0033	0.0016	10.2497	0.0744	15.2988
2011	28.9905	0.0114	0.0033	0.0033	0.0016	9.6207	0.0876	14.0504
2012	30.9075	0.0112	0.0032	0.0032	0.0016	10.1409	0.0943	15.0364
2013	29.5446	0.0114	0.0033	0.0033	0.0016	10.5211	0.0918	16.0928
2014	35.5426	0.0117	0.0034	0.0034	0.0017	11.2788	0.1137	16.6033
2015	35.2496	0.0120	0.0034	0.0034	0.0017	10.8461	0.1122	15.6204
2016	35.6490	0.0122	0.0035	0.0035	0.0017	11.4649	0.1114	16.5994
2017	35.9566	0.0121	0.0035	0.0035	0.0017	11.8098	0.1124	17.0872
2018	35.5253	0.0122	0.0035	0.0035	0.0017	11.6280	0.1098	17.2349
2019	34.0962	0.0122	0.0035	0.0035	0.0017	9.3622	0.1040	13.6458
1990/2019	**-6%**	**-98%**	**-99%**	**-99%**	**-98%**	**-25%**	**-13%**	**-28%**
2018/2019	**-4%**	**1%**	**1%**	**1%**	**1%**	**-19%**	**-5%**	**-21%**

The major contributors of emissions of main pollutants, heavy metals and POPs is Iron and steel production. Shares of released emissions of air pollutants in 2019 included in NFR categories 2C are presented in ***Figure 4.7***.

Figure 4.7: *Shares of emissions in 2C in 2019*



4.6.2 IRON AND STEEL PRODUCTION

4.6.2.1 Overview

Overview of the activity data, emissions and its trends are shown in ***Table 4.51***. Emission of most of the pollutants decreased slightly in 2019 compared to the year 2018.

Figures below show the emission trend of the pollutants for which 2C1 is a key category. Emissions show an overall decreasing trend due to installation of abatement technologies (***Table 4.51***).

Table 4.51: *Trends in emissions of air pollutants and activity data in 2C1*

YEAR	SINTER PRODUCED [kt]	PIG IRON PRODUCED (DRY ESP) [kt]	STEEL PRODUCED – BASIC OXYGEN FURNACE (DRY ESP) [kt]	STEEL PRODUCED – BASIC OXYGEN FURNACE (WSV) [kt]	STEEL PRODUCED – ELECTRIC FURNACE [kt]
1990	3982.00	3561.00	1685.12	1876.38	310.73
1995	3251.00	3207.00	1516.93	1690.47	314.64
2000	3598.90	3166.38	1652.45	1867.54	316.36
2005	3494.50	3681.42	1850.11	2388.01	356.90
2010	2480.14	3648.84	2050.13	2351.65	331.25
2011	2920.13	3346.41	1794.40	2166.62	374.22
2012	3141.77	3519.76	2009.26	2226.93	372.40
2013	3060.35	3616.85	1998.74	2345.51	711.34
2014	3790.90	3862.62	2114.37	2325.11	527.85
2015	3740.27	3738.49	2059.96	2250.98	315.05
2016	3712.50	3986.68	2225.58	2373.86	293.80
2017	3747.75	4107.94	2235.21	2477.75	356.80
2018	3659.90	4036.85	2345.02	2296.82	380.30
2019	3468.10	3184.55	1821.11	1789.91	327.78
1990/2019	**-13%**	**-11%**	**8%**	**-5%**	**5%**
2018/2019	**-5%**	**-21%**	**-22%**	**-22%**	**-14%**

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	3.2565	0.2243	7.7580	0.0011	1.1859	1.8758	8.0130	0.0043	63.8386
1995	2.9480	0.2030	7.0230	0.0010	1.0736	1.6981	7.2538	0.0039	57.7904
2000	4.0544	0.1578	11.0293	0.0007	1.3391	2.1181	9.0476	0.0048	72.0819
2005	2.6012	0.5416	7.4668	0.0000	0.3871	0.6021	2.3878	0.0014	78.0150
2010	2.2977	0.4037	3.8171	0.0000	0.1815	0.3135	1.7197	0.0007	71.3394
2011	2.2507	0.4809	4.6387	0.0000	0.1950	0.3448	2.0300	0.0007	84.3314
2012	2.5147	0.5077	4.4449	0.0000	0.2128	0.3790	2.2720	0.0008	83.4974
2013	2.7281	0.4807	3.5912	0.0000	0.2320	0.4129	2.4985	0.0008	85.3261
2014	3.2091	0.5369	3.6345	0.0000	0.2742	0.4820	2.8250	0.0010	98.9535
2015	3.0538	0.5460	4.8942	0.0000	0.2620	0.4560	2.6219	0.0009	97.6335
2016	2.7957	0.4971	4.4276	0.0000	0.2148	0.3825	2.2128	0.0008	96.7478
2017	3.2859	0.5143	6.2832	0.0000	0.2156	0.3857	2.2470	0.0008	100.8391
2018	3.5863	0.5405	4.4805	0.0000	0.1830	0.3283	1.9362	0.0007	89.0361
2019	2.3250	0.3580	2.9195	0.0000	0.0788	0.1337	0.6737	0.0003	52.2224
1990/2019	**-29%**	**60%**	**-62%**	**-100%**	**-93%**	**-93%**	**-92%**	**-93%**	**-18%**
2018/2019	**-35%**	**-34%**	**-35%**	**-11%**	**-57%**	**-59%**	**-65%**	**-57%**	**-41%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	19.7015	0.0902	0.2027	0.5258	0.8239	1.5349	0.9446	0.0903	9.0824
1995	16.5822	0.0806	0.1662	0.4677	0.7375	1.3722	0.8233	0.0746	8.1779
2000	18.3350	0.0884	0.1839	0.5168	0.8142	1.4591	0.9079	0.0825	8.9934
2005	4.4864	0.0794	0.0383	0.4343	0.3975	0.2150	0.1709	0.0826	7.0866
2010	4.3877	0.0777	0.0286	0.4270	0.3888	0.2238	0.1676	0.0628	0.5642
2011	4.0680	0.0730	0.0321	0.3934	0.3603	0.2245	0.1597	0.0703	0.5879
2012	4.1815	0.0748	0.0344	0.4046	0.3705	0.2392	0.1633	0.0755	0.6130
2013	4.4956	0.0851	0.0344	0.4264	0.3961	0.2472	0.1958	0.0742	0.7678

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2014	4.4128	0.0809	0.0407	0.4227	0.3903	0.2710	0.1811	0.0891	0.7470
2015	4.2142	0.0744	0.0397	0.4089	0.3740	0.2608	0.1607	0.0877	0.6391
2016	4.4312	0.0777	0.0398	0.4313	0.3934	0.2690	0.1665	0.0880	0.6460
2017	4.6377	0.0821	0.0404	0.4501	0.4114	0.2754	0.1775	0.0891	0.6853
2018	4.3198	0.0771	0.0394	0.4177	0.3829	0.2708	0.1684	0.0871	0.6854
2019	3.3818	0.0607	0.0363	0.3256	0.2998	0.2306	0.1338	0.0802	1.2879
1990/2019	**-83%**	**-33%**	**-82%**	**-38%**	**-64%**	**-85%**	**-86%**	**-11%**	**-86%**
2018/2019	**-22%**	**-21%**	**-8%**	**-22%**	**-22%**	**-15%**	**-21%**	**-8%**	**88%**

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	22.2568	10.2302	0.0744	15.2988
2011	25.7285	9.6011	0.0876	14.0504
2012	27.6448	10.1216	0.0943	15.0363
2013	28.0032	10.5016	0.0918	16.0928
2014	33.3774	11.2586	0.1137	16.6033
2015	32.2961	10.8255	0.1122	15.6204
2016	32.1250	11.4440	0.1114	16.5993
2017	32.6029	11.7890	0.1124	17.0872
2018	32.0462	11.6072	0.1098	17.2348
2019	29.9911	9.3413	0.1040	13.6457
1990/2019	**-15%**	**-12%**	**-13%**	**-28%**
2018/2019	**-6%**	**-20%**	**-5%**	**-21%**

4.6.2.2 Methodological issues

Activities defined in national legislation involved in the category are presented in ***Table 4.52***.

Table 4.52: *Activities according to national categorization included in 2C1*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
2.1 Treatment, roasting and sintering of ferrous metal ores and manipulation with these materials in powder form
2.2 Production of pig iron in a blast furnace with a projected production capacity in t/h
2.3 Production of steel, for instance, converters, Siemens-Martin furnaces, double-heart tandem furnaces, electric furnaces, 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 kilojoule per hammer - ≤ 20 MW and projected power in kilojoule per hammer

The category covers sources of several companies operating in the Slovak Republic (for the year 2019).

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; ZTS Metalurg, a.s.; Ironworks Železiarne Podbrezová a.s., Slovakia steel mills, a.s

In category is also included 14 operators of secondary metallurgical production and processing of ferrous metals. Only operators of large sources are presented.

Cat. 2.5: U.S. Steel Košice, a.s; ZTS Metalurg, a.s; Ironworks Železiarne Podbrezová a.s; Slovakia steel mills a.s; Kovohuty, a.s .

Pig iron and steel are produced mainly in blast furnaces and by the EAF processes. The plant with blast furnaces is one complex with many energy-related installations (coke ovens, heating plant, manufacturing of steel products, etc.).

The plant UNEX Prakovce did not produce steel since 2013. The new plant, Slovakia Steel Mills, started their production by the EAF technology in 2013. However, due to the sanctions to Russian Federation, its production decreased and at the end of 2014, the production was stopped.

Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004 (***Table 4.53***). Emissions of BC were calculated using EMEP/EEA GB_{2019} emission factor thought the whole time series.

Table 4.53: *Emission factors for calculation of historical years*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	NH_3 [g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/t]
EF	438.08	30.17	1043.62	0.15	1077.92	15%	23%	0.36%	8587.70

*Tier 1 EMEP/EEA GB_{2019}

<u>Heavy metals and POPs</u>

As a part of the process to improve the inventory of heavy metals and POPs, emissions factors used for calculation was changed to Tier 2 level of EMEP/EEA GB_{2019} (***Table 4.54***).

Table 4.54*: Emission factor for heavy metals and POPs used in calculations for iron and steel production*

A	T	P	AT	Pb [g/t]	Hg [g/t]	Cd [g/t]	As [g/t]	Cr [g/t]	Cu [g/t]
Sinter production	-	1990-2002	None	3.5	0.004	0.049	0.0180	0.0160	0.0330
Sinter production	-	2003-2019	Dry ESP	0.0099	0.000011	0.009	0.0001	0.0013	0.0300
Pig iron production	-	1990-2002	Dry ESP Upper EFs	0.000006	0.00000001	0.000056	0.0000	0.0000	0.0150
Pig iron production	-	2003-2019	Dry ESP default EFs	0.000009	0.000000015	0.000084	0.00000045	0.000006	0.15
Steel production	Basic oxygen furnace	1990-2005	Dry ESP Upper EFs	0.015	0.00025	0.0006	0.0015	0.0013	0.02
Steel production	Basic oxygen furnace	2006-2019	Dry ESP default EFs	0.025	0.0003	0.0009	0.002	0.002	
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	2002-2019	wSV Default EFs	1.8	0.03	0.0018	0.18	0.16	0.02
Steel production	Electric furnace	1990-2019	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	-	-	-
Sinter production	-	2003-2019	Dry ESP	0.00025	0.02	0.06	8	-	-	-
Pig iron production	-	1990-2002	Dry ESP Upper EFs	-	-	0.073	0.002	-	-	-

Pig iron production	-	2003-2019	Dry ESP default EFs	-	-	0.073		-	-	-
Steel production	Basic oxygen furnace	1990-2005	Dry ESP Upper EFs	0.0005	-	0.023	0.69	-	-	-
Steel production	Basic oxygen furnace	2006-2019	Dry ESP default EFs	-	-	-	0.69	-	-	-
Steel production	Basic oxygen furnace	1990-2001	wSV Upper EFs	0.3	-	4.5	0.69	-	-	-
Steel production	Basic oxygen furnace	2002-2019	wSV Default EFs	0.06	-	2.7	0.69	-	-	-
Steel production	Electric furnace	1990-2019	Fabric filter retrofitted-upper Efs	0.075	-	0.45	3	-	-	-

A-Activity
T-Technology
P-Period
AT-Abatement technology

4.6.2.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2019}.

4.6.2.4 Source-specific recalculations

Emissions were recalculated following the recommendation ***SK-2C1-2020-0001*** (***Table 4.55***). Also, one source was reallocated to the category 2C7a and historical data were recalculated using weighted average EF (from IEF for the period 2000-2004) for main pollutants.

Table 4.55: *Previous and refined emissions in the category 2C1*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	4.3231	3.2565	-25%	0.1577	0.2243	42%	11.0227	7.7580	-30%	0.0007	0.0011	53%
1991	3.8889	2.9118	-25%	0.1419	0.2006	41%	9.9158	6.9367	-30%	0.0006	0.0010	52%
1992	3.6362	2.7202	-25%	0.1327	0.1874	41%	9.2715	6.4803	-30%	0.0006	0.0009	52%
1993	3.9177	2.9415	-25%	0.1429	0.2026	42%	9.9892	7.0074	-30%	0.0006	0.0010	53%
1994	4.0714	3.0566	-25%	0.1486	0.2105	42%	10.3811	7.2816	-30%	0.0007	0.0010	53%
1995	3.9321	2.9480	-25%	0.1435	0.2030	42%	10.0259	7.0230	-30%	0.0006	0.0010	52%
1996	3.6059	2.6941	-25%	0.1316	0.1856	41%	9.1941	6.4181	-30%	0.0006	0.0009	52%
1997	3.7796	2.8290	-25%	0.1379	0.1949	41%	9.6371	6.7394	-30%	0.0006	0.0009	52%
1998	3.8121	2.8539	-25%	0.1391	0.1966	41%	9.7200	6.7988	-30%	0.0006	0.0010	52%
1999	4.1750	3.1365	-25%	0.1523	0.2160	42%	10.6453	7.4720	-30%	0.0007	0.0010	53%
2000	4.0544	4.0544	0%	0.1578	0.1578	0%	11.0293	11.0293	-	0.0007	0.0007	-
2001	4.6937	4.6928	0%	0.1517	0.1517	0%	10.1136	10.1136	0%	0.0009	0.0009	-
2002	3.1955	3.1946	0%	0.1609	0.1609	0%	7.4765	7.4765	0%	0.0017	0.0017	-
2003	3.4887	3.4885	0%	0.3394	0.3394	0%	7.1981	7.1981	0%	0.0028	0.0028	-
2004	2.9550	2.9550	-	0.4564	0.4564	-	7.9813	7.9813	-	0.0000	0.0000	-
2005	2.6012	2.6012	-	0.5416	0.5416	-	7.4668	7.4668	-	0.0000	0.0000	-
2006	2.3307	2.3307	-	0.3204	0.3204	-	7.5192	7.5192	-	0.0000	0.0000	-
2007	2.3638	2.3632	0%	0.3450	0.3450	-	6.6128	6.6128	0%	0.0000	0.0000	-
2008	2.2449	2.2442	0%	0.3159	0.3159	-	5.0685	5.0685	0%	0.0000	0.0000	-
2009	1.6387	1.6378	0%	0.3414	0.3414	-	3.0740	3.0740	0%	0.0000	0.0000	-
2010	2.2989	2.2977	0%	0.4037	0.4037	0%	3.8173	3.8171	0%	0.0000	0.0000	-

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
2011	2.2516	2.2507	0%	0.4809	0.4809	0%	4.6387	4.6387	0%	0.0000	0.0000	-
2012	2.5153	2.5147	0%	0.5077	0.5077	0%	4.4450	4.4449	0%	0.0000	0.0000	-
2013	2.7281	2.7281	0%	0.4807	0.4807	0%	3.5912	3.5912	0%	0.0000	0.0000	-
2014	3.2091	3.2091	-	0.5369	0.5369	0%	3.6345	3.6345	-	0.0000	0.0000	-
2015	3.0538	3.0538	-	0.5460	0.5460	0%	4.8942	4.8942	-	0.0000	0.0000	-
2016	2.7957	2.7957	-	0.4971	0.4971	0%	4.4276	4.4276	-	0.0000	0.0000	-
2017	3.2859	3.2859	-	0.5143	0.5143	0%	6.2832	6.2832	-	0.0000	0.0000	-
2018	3.5863	3.5863	-	0.5405	0.5405	0%	4.4805	4.4805	-	0.0000	0.0000	-

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	C	P	R	C	P	R	CHANGE	P	R	C
1990	1.3887	1.1859	-15%	2.1691	1.8758	-14%	9.0424	8.0130	-11%	0.0050	0.0043	-15%
1991	1.2493	1.0604	-15%	1.9513	1.6773	-14%	8.1343	7.1647	-12%	0.0045	0.0038	-15%
1992	1.1681	0.9906	-15%	1.8245	1.5669	-14%	7.6058	6.6933	-12%	0.0042	0.0036	-15%
1993	1.2585	1.0712	-15%	1.9657	1.6944	-14%	8.1945	7.2377	-12%	0.0045	0.0039	-15%
1994	1.3079	1.1131	-15%	2.0428	1.7607	-14%	8.5160	7.5209	-12%	0.0047	0.0040	-15%
1995	1.2631	1.0736	-15%	1.9729	1.6981	-14%	8.2246	7.2538	-12%	0.0045	0.0039	-15%
1996	1.1583	0.9811	-15%	1.8093	1.5519	-14%	7.5423	6.6290	-12%	0.0042	0.0035	-15%
1997	1.2142	1.0302	-15%	1.8964	1.6296	-14%	7.9057	6.9609	-12%	0.0044	0.0037	-15%
1998	1.2246	1.0393	-15%	1.9128	1.6439	-14%	7.9737	7.0222	-12%	0.0044	0.0037	-15%
1999	1.3412	1.1422	-15%	2.0948	1.8067	-14%	8.7328	7.7175	-12%	0.0048	0.0041	-15%
2000	1.3896	1.3391	-4%	2.1704	2.1181	-2%	9.0478	9.0476	0%	0.0050	0.0048	-4%
2001	1.3236	1.2751	-4%	2.0674	2.0169	-2%	8.6186	8.6156	0%	0.0048	0.0046	-4%
2002	1.1782	1.1350	-4%	1.8403	1.7952	-2%	7.6716	7.6685	0%	0.0042	0.0041	-4%
2003	0.6712	0.6468	-4%	1.0484	1.0230	-2%	4.3706	4.3701	0%	0.0024	0.0023	-4%
2004	0.6198	0.5973	-4%	0.9682	0.9448	-2%	4.0360	4.0360	-	0.0022	0.0022	-4%
2005	0.3871	0.3871	-	0.6021	0.6021	-	2.3878	2.3878	-	0.0014	0.0014	-
2006	0.4054	0.4054	-	0.6334	0.6334	-	2.8159	2.8159	-	0.0015	0.0015	-
2007	0.2989	0.2982	0%	0.4808	0.4799	0%	2.2868	2.1685	-5%	0.0011	0.0011	0%
2008	0.2652	0.2641	0%	0.4241	0.4227	0%	2.0209	1.8392	-9%	0.0010	0.0010	0%
2009	0.2054	0.2043	-1%	0.3254	0.3239	0%	1.4984	1.3118	-12%	0.0007	0.0007	-1%
2010	0.1821	0.1815	0%	0.3143	0.3135	0%	1.7725	1.7197	-3%	0.0007	0.0007	0%
2011	0.1953	0.1950	0%	0.3451	0.3448	0%	2.0534	2.0300	-1%	0.0007	0.0007	0%
2012	0.2131	0.2128	0%	0.3793	0.3790	0%	2.2904	2.2720	-1%	0.0008	0.0008	0%
2013	0.2320	0.2320	0%	0.4129	0.4129	0%	2.4998	2.4985	0%	0.0008	0.0008	0%
2014	0.2742	0.2742	-	0.4820	0.4820	-	2.8250	2.8250	-	0.0010	0.0010	-
2015	0.2620	0.2620	-	0.4560	0.4560	-	2.6219	2.6219	-	0.0009	0.0009	-
2016	0.2148	0.2148	-	0.3825	0.3825	-	2.2128	2.2128	-	0.0008	0.0008	-
2017	0.2156	0.2156	-	0.3857	0.3857	-	2.2470	2.2470	-	0.0008	0.0008	-
2018	0.1830	0.1830	-	0.3283	0.3283	-	1.9362	1.9362	-	0.0007	0.0007	-

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	17.8123	19.7015	11%	0.0774	0.0902	16%	0.3872	0.2027	-48%	1.5489	0.5258	-66%
1991	16.0235	20.0715	25%	0.0697	0.0839	20%	0.3483	0.2160	-38%	1.3933	0.4804	-66%
1992	14.9824	20.7311	38%	0.0651	0.0807	24%	0.3257	0.2296	-29%	1.3028	0.4587	-65%
1993	16.1421	17.2877	7%	0.0702	0.0811	16%	0.3509	0.1762	-50%	1.4037	0.4710	-66%
1994	16.7754	17.1288	2%	0.0729	0.0833	14%	0.3647	0.1715	-53%	1.4587	0.4847	-67%
1995	16.2014	16.5822	2%	0.0704	0.0806	14%	0.3522	0.1662	-53%	1.4088	0.4677	-67%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	C	P	R	C	P	R	C	P	R	C
1996	14.8573	16.5586	11%	0.0646	0.0756	17%	0.3230	0.1717	-47%	1.2919	0.4337	-66%
1997	15.5731	17.3666	12%	0.0677	0.0792	17%	0.3385	0.1799	-47%	1.3542	0.4559	-66%
1998	15.7072	16.2872	4%	0.0683	0.0783	15%	0.3415	0.1644	-52%	1.3658	0.4525	-67%
1999	17.2024	17.5001	2%	0.0748	0.0851	14%	0.3740	0.1751	-53%	1.4959	0.4955	-67%
2000	17.6472	18.3350	4%	0.0767	0.0884	15%	0.3836	0.1839	-52%	1.5345	0.5168	-66%
2001	18.7200	18.9316	1%	0.0814	0.0932	15%	0.4070	0.1875	-54%	1.6278	0.5477	-66%
2002	20.2886	16.2235	-20%	0.0882	0.0854	-3%	0.4411	0.1773	-60%	1.7642	0.4554	-74%
2003	21.6374	4.2719	-80%	0.0941	0.0752	-20%	0.4704	0.0403	-91%	1.8815	0.4135	-78%
2004	21.9362	4.2927	-80%	0.0954	0.0759	-20%	0.4769	0.0398	-92%	1.9075	0.4148	-78%
2005	21.1371	4.4864	-79%	0.0919	0.0794	-14%	0.4595	0.0383	-92%	1.8380	0.4343	-76%
2006	23.9801	4.8045	-80%	0.1043	0.0852	-18%	0.5213	0.0388	-93%	2.0852	0.4664	-78%
2007	23.8015	4.5040	-81%	0.1035	0.0804	-22%	0.5174	0.0367	-93%	2.0697	0.4362	-79%
2008	21.2152	3.8230	-82%	0.0922	0.0690	-25%	0.4612	0.0335	-93%	1.8448	0.3685	-80%
2009	18.3556	3.4323	-81%	0.0798	0.0621	-22%	0.3990	0.0226	-94%	1.5961	0.3315	-79%
2010	21.7719	4.3877	-80%	0.0947	0.0777	-18%	0.4733	0.0286	-94%	1.8932	0.4270	-77%
2011	19.9421	4.0680	-80%	0.0867	0.0730	-16%	0.4335	0.0321	-93%	1.7341	0.3934	-77%
2012	21.1995	4.1815	-80%	0.0922	0.0748	-19%	0.4609	0.0344	-93%	1.8434	0.4046	-78%
2013	23.2557	4.4956	-81%	0.1011	0.0851	-16%	0.5056	0.0344	-93%	2.0222	0.4264	-79%
2014	22.8497	4.4128	-81%	0.0993	0.0809	-19%	0.4967	0.0407	-92%	1.9869	0.4227	-79%
2015	21.2795	4.2142	-80%	0.0925	0.0744	-20%	0.4626	0.0397	-91%	1.8504	0.4089	-78%
2016	22.5089	4.4312	-80%	0.0979	0.0777	-21%	0.4893	0.0398	-92%	1.9573	0.4313	-78%
2017	23.3209	4.6377	-80%	0.1014	0.0821	-19%	0.5070	0.0404	-92%	2.0279	0.4501	-78%
2018	23.1116	4.3198	-81%	0.1005	0.0771	-23%	0.5024	0.0394	-92%	2.0097	0.4177	-79%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	17.4250	0.8239	-95%	0.2711	1.5349	466%	0.5421	0.9446	74%
1991	15.6751	0.7445	-95%	0.2438	1.4911	512%	0.4877	0.9082	86%
1992	14.6567	0.7042	-95%	0.2280	1.4920	554%	0.4560	0.8995	97%
1993	15.7912	0.7399	-95%	0.2456	1.3776	461%	0.4913	0.8403	71%
1994	16.4107	0.7643	-95%	0.2553	1.4042	450%	0.5106	0.8514	67%
1995	15.8492	0.7375	-95%	0.2465	1.3722	457%	0.4931	0.8233	67%
1996	14.5343	0.6792	-95%	0.2261	1.2655	460%	0.4522	0.7891	75%
1997	15.2345	0.7138	-95%	0.2370	1.3290	461%	0.4740	0.8278	75%
1998	15.3657	0.7127	-95%	0.2390	1.2757	434%	0.4780	0.8023	68%
1999	16.8285	0.7813	-95%	0.2618	1.3918	432%	0.5236	0.8698	66%
2000	17.2636	0.8142	-95%	0.2685	1.4591	443%	0.5371	0.9079	69%
2001	18.3130	0.8648	-95%	0.2849	1.5312	438%	0.5697	0.9507	67%
2002	19.8475	0.4110	-98%	0.3087	0.6943	125%	0.6175	0.4662	-25%
2003	21.1670	0.3787	-98%	0.3293	0.2218	-33%	0.6585	0.1612	-76%
2004	21.4594	0.3803	-98%	0.3338	0.2187	-34%	0.6676	0.1636	-75%
2005	20.6776	0.3975	-98%	0.3217	0.2150	-33%	0.6433	0.1709	-73%
2006	23.4588	0.4260	-98%	0.3649	0.2729	-25%	0.7298	0.1843	-75%
2007	23.2841	0.3991	-98%	0.3622	0.2637	-27%	0.7244	0.1752	-76%
2008	20.7540	0.3385	-98%	0.3228	0.2375	-26%	0.6457	0.1521	-76%
2009	17.9566	0.3035	-98%	0.2793	0.1830	-34%	0.5586	0.1369	-75%
2010	21.2986	0.3888	-98%	0.3313	0.2238	-32%	0.6626	0.1676	-75%
2011	19.5086	0.3603	-98%	0.3035	0.2245	-26%	0.6069	0.1597	-74%
2012	20.7387	0.3705	-98%	0.3226	0.2392	-26%	0.6452	0.1633	-75%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2013	22.7502	0.3961	-98%	0.3539	0.2472	-30%	0.7078	0.1958	-72%
2014	22.3530	0.3903	-98%	0.3477	0.2710	-22%	0.6954	0.1811	-74%
2015	20.8169	0.3740	-98%	0.3238	0.2608	-19%	0.6476	0.1607	-75%
2016	22.0196	0.3934	-98%	0.3425	0.2690	-21%	0.6851	0.1665	-76%
2017	22.8139	0.4114	-98%	0.3549	0.2754	-22%	0.7098	0.1775	-75%
2018	22.6092	0.3829	-98%	0.3517	0.2708	-23%	0.7034	0.1684	-76%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0774	0.0903	17%	15.4889	9.0824	-41%
1991	0.0697	0.0948	36%	13.9335	8.1826	-41%
1992	0.0651	0.0999	53%	13.0282	7.7141	-41%
1993	0.0702	0.0787	12%	14.0366	8.1771	-42%
1994	0.0729	0.0771	6%	14.5873	8.4660	-42%
1995	0.0704	0.0746	6%	14.0882	8.1779	-42%
1996	0.0646	0.0762	18%	12.9194	7.4889	-42%
1997	0.0677	0.0799	18%	13.5418	7.8679	-42%
1998	0.0683	0.0737	8%	13.6584	7.8703	-42%
1999	0.0748	0.0788	5%	14.9586	8.6313	-42%
2000	0.0767	0.0825	8%	15.3454	8.9934	-41%
2001	0.0814	0.0845	4%	16.2782	9.5589	-41%
2002	0.0882	0.0820	-7%	17.6422	6.4299	-64%
2003	0.0941	0.0876	-7%	18.8151	6.7807	-64%
2004	0.0954	0.0864	-9%	19.0750	6.7986	-64%
2005	0.0919	0.0826	-10%	18.3801	7.0866	-61%
2006	0.1043	0.0855	-18%	20.8523	0.7372	-96%
2007	0.1035	0.0810	-22%	20.6970	0.7230	-97%
2008	0.0922	0.0741	-20%	18.4480	0.6655	-96%
2009	0.0798	0.0496	-38%	15.9614	0.5348	-97%
2010	0.0947	0.0628	-34%	18.9321	0.5642	-97%
2011	0.0867	0.0703	-19%	17.3409	0.5879	-97%
2012	0.0922	0.0755	-18%	18.4344	0.6130	-97%
2013	0.1011	0.0742	-27%	20.2224	0.7678	-96%
2014	0.0993	0.0891	-10%	19.8693	0.7470	-96%
2015	0.0925	0.0877	-5%	18.5039	0.6391	-97%
2016	0.0979	0.0880	-10%	19.5730	0.6460	-97%
2017	0.1014	0.0891	-12%	20.2791	0.6853	-97%
2018	0.1005	0.0871	-13%	20.0971	0.6854	-97%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	11.6167	35.2527	203%	1.8587	10.6024	470%	0.1162	0.1195	3%	9.6806	18.9415	96%
1991	10.4501	37.2917	257%	1.6720	11.3669	580%	0.1045	0.1280	23%	8.7084	18.7092	115%
1992	9.7711	39.3860	303%	1.5634	12.1383	676%	0.0977	0.1366	40%	8.1426	18.8832	132%
1993	10.5275	30.7694	192%	1.6844	9.5153	465%	0.1053	0.1037	-2%	8.7729	17.0963	95%
1994	10.9405	30.0777	175%	1.7505	9.5058	443%	0.1094	0.1006	-8%	9.1171	17.4339	91%
1995	10.5661	29.1714	176%	1.6906	9.4646	460%	0.1057	0.0975	-8%	8.8051	17.1152	94%
1996	9.6896	29.9422	209%	1.5503	8.7729	466%	0.0969	0.1012	4%	8.0746	15.6983	94%
1997	10.1564	31.3535	209%	1.6250	9.1983	466%	0.1016	0.1061	4%	8.4636	16.4619	95%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	C	P	R	C	P	R	C	P	R	C
1998	10.2438	28.8403	182%	1.6390	8.3167	407%	0.1024	0.0966	-6%	8.5365	15.7162	84%
1999	11.2190	30.7248	174%	1.7950	8.9904	401%	0.1122	0.1028	-8%	9.3492	17.1249	83%
2000	11.5090	32.1754	180%	1.8414	9.4995	416%	0.1151	0.1080	-6%	9.5909	17.8307	86%
2001	12.2087	32.8508	169%	1.9534	9.7630	400%	0.1221	0.1099	-10%	10.1739	18.6400	83%
2002	13.2317	31.6451	139%	2.1171	10.4364	393%	0.1323	0.1046	-21%	11.0264	20.1730	83%
2003	14.1113	33.7594	139%	2.2578	11.4394	407%	0.1411	0.1116	-21%	11.7595	21.8252	86%
2004	14.3062	33.3693	133%	2.2890	11.1202	386%	0.1431	0.1098	-23%	11.9219	21.6648	82%
2005	13.7851	31.9584	132%	2.2056	10.8470	392%	0.1379	0.1048	-24%	11.4876	21.0056	83%
2006	15.6392	31.0985	99%	2.5023	11.8357	373%	0.1564	0.1065	-32%	13.0327	17.2956	33%
2007	15.5227	29.4857	90%	2.4836	11.4556	361%	0.1552	0.1000	-36%	12.9356	17.2680	33%
2008	13.8360	27.2492	97%	2.2138	10.1738	360%	0.1384	0.0921	-33%	11.5300	15.5925	35%
2009	11.9710	17.7603	48%	1.9154	8.4763	343%	0.1197	0.0580	-52%	9.9759	13.1398	32%
2010	14.1991	22.2568	57%	2.2719	10.2302	350%	0.1420	0.0744	-48%	11.8326	15.2988	29%
2011	13.0057	25.7285	98%	2.0809	9.6011	361%	0.1301	0.0876	-33%	10.8381	14.0504	30%
2012	13.8258	27.6448	100%	2.2121	10.1216	358%	0.1383	0.0943	-32%	11.5215	15.0363	31%
2013	15.1668	28.0032	85%	2.4267	10.5016	333%	0.1517	0.0918	-39%	12.6390	16.0928	27%
2014	14.9020	33.3774	124%	2.3843	11.2586	372%	0.1490	0.1137	-24%	12.4183	16.6033	34%
2015	13.8780	32.2961	133%	2.2205	10.8255	388%	0.1388	0.1122	-19%	11.5650	15.6204	35%
2016	14.6797	32.1250	119%	2.3488	11.4440	387%	0.1468	0.1114	-24%	12.2331	16.5993	36%
2017	15.2093	32.6029	114%	2.4335	11.7890	384%	0.1521	0.1124	-26%	12.6744	17.0872	35%
2018	15.0728	32.0462	113%	2.4116	11.6072	381%	0.1507	0.1098	-27%	12.5607	17.2348	37%

P-Previous
R-Refined
C-Change

4.6.3 FERROALLOYS PRODUCTION (2C2)

4.6.3.1 Overview

Ferroalloys are produced by the reduction reaction of iron ore and added metal and/or metalloid oxides or other materials in arc furnaces and submerged arc furnaces. As shown emissions of all rising pollutants gave a decreasing trend due to installation of abatement technologies. Activity data, emissions and its trends are presented in ***Table 4.56***.

Table 4.56: *Activity data and emissions in the category 2C2*

YEAR	FERROALLOYS PRODUCED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	169.00	0.4317	0.0376	0.2914	0.0000	0.1543	0.1956	0.2175	0.0154	2.8995
1995	134.80	0.3443	0.0300	0.2325	0.0000	0.1231	0.1560	0.1735	0.0123	2.3127
2000	94.73	0.5886	0.0241	0.1150	0.0000	0.2957	0.3749	0.4167	0.0296	2.7839
2005	108.72	0.0065	0.0121	0.0119	NO	0.0294	0.0373	0.0414	0.0029	0.5220
2010	96.83	0.0190	0.0152	0.0260	0.0000	0.0245	0.0311	0.0346	0.0025	0.0506
2011	77.56	0.0311	0.0089	0.0363	0.0000	0.0173	0.0220	0.0244	0.0017	0.0784
2012	101.59	0.0257	0.0091	0.0311	0.0000	0.0143	0.0181	0.0202	0.0014	0.0782
2013	65.68	0.0298	0.0100	0.0319	0.0000	0.0173	0.0219	0.0244	0.0017	0.1076
2014	91.23	0.0215	0.0159	0.0259	0.0000	0.0180	0.0228	0.0253	0.0018	0.1026
2015	95.52	0.0232	0.0176	0.0304	0.0000	0.0159	0.0201	0.0224	0.0016	0.0943
2016	106.27	0.0120	0.0165	0.0226	0.0000	0.0096	0.0121	0.0135	0.0010	0.1051
2017	129.48	0.0081	0.0195	0.0124	0.0000	0.0113	0.0144	0.0160	0.0011	0.1025
2018	113.69	0.0107	0.0245	0.0173	0.0000	0.0142	0.0180	0.0200	0.0014	0.1273
2019	105.52	0.0081	0.0143	0.0195	0.0000	0.0115	0.0146	0.0162	0.0012	0.0907

YEAR	FERROALLOYS PRODUCED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990/2019	-38%	-98%	-62%	-93%	-84%	-93%	-93%	-93%	-93%	-97%
2018/2019	-7%	-25%	-42%	12%	-37%	-19%	-19%	-19%	-19%	-29%

4.6.3.2 Methodological issues

Activities of cast iron and cast iron product according to national legislation were separated to the individual category 2C2.

Table 4.57: *Activities according to national categorization included in 2C2*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
2.4 Ferrous metal foundries – production of cast iron and cast iron products with a projected production capacity in t/d

Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004 (***Table 4.58***). Emissions of BC were calculated using EMEP/EEA GB_{2019} emission factor thought the whole time series.

Table 4.58: *Emission factors for calculation of historical years*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	NH_3 [g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/t]
EF	2 554.18	222.64	1 724.52	0.13	1 574.00	71%	90%	10%	17 156.55

*Tier 1 EMEP/EEA GB_{2019}

4.6.3.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2019}. Notation keys were used for emissions of HMs and POPs due to possible double-counting with the Energy categories.

4.6.3.4 Source-specific recalculations

Historical years were recalculated due to change of emission factors for this period (***Table 4.59***).

Table 4.59: *Previous and refined emissions in the category 2C2*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	2.7810	0.4317	-84%	0.2157	0.0376	-83%	1.7401	0.2914	-83%	0.0001	0.0000	-75%
1991	2.7728	0.4214	-85%	0.2151	0.0367	-83%	1.7350	0.2845	-84%	0.0001	0.0000	-75%
1992	2.7775	0.4087	-85%	0.2154	0.0356	-83%	1.7379	0.2759	-84%	0.0001	0.0000	-76%
1993	2.7609	0.3831	-86%	0.2141	0.0334	-84%	1.7275	0.2587	-85%	0.0001	0.0000	-77%
1994	2.7773	0.3711	-87%	0.2154	0.0324	-85%	1.7378	0.2506	-86%	0.0001	0.0000	-78%
1995	2.7302	0.3443	-87%	0.2118	0.0300	-86%	1.7083	0.2325	-86%	0.0001	0.0000	-79%
1996	2.7186	0.3320	-88%	0.2109	0.0289	-86%	1.7011	0.2242	-87%	0.0001	0.0000	-80%
1997	2.7829	0.3065	-89%	0.2158	0.0267	-88%	1.7413	0.2069	-88%	0.0001	0.0000	-82%
1998	2.5853	0.3414	-87%	0.2005	0.0298	-85%	1.6177	0.2305	-86%	0.0001	0.0000	-78%
1999	2.4946	0.2968	-88%	0.1935	0.0259	-87%	1.5609	0.2004	-87%	0.0001	0.0000	-81%

YEAR	$PM_{2.5}$ [kt]		PM_{10} [kt]		TSP [kt]		BC [kt]		CHANGE	CO [kt]		
	P	R	P	R	P	R	P	R		P	R	CHANGE
1990	1.0100	0.1543	1.2805	0.1956	1.4235	0.2175	0.1010	0.0154	-85%	17.6009	2.8995	-84%
1991	1.0070	0.1506	1.2767	0.1910	1.4193	0.2123	0.1007	0.0151	-85%	17.5491	2.8308	-84%
1992	1.0087	0.1461	1.2789	0.1852	1.4217	0.2059	0.1009	0.0146	-86%	17.5789	2.7450	-84%
1993	1.0027	0.1369	1.2713	0.1736	1.4132	0.1930	0.1003	0.0137	-86%	17.4738	2.5735	-85%
1994	1.0086	0.1326	1.2788	0.1682	1.4216	0.1870	0.1009	0.0133	-87%	17.5774	2.4928	-86%
1995	0.9915	0.1231	1.2571	0.1560	1.3975	0.1735	0.0992	0.0123	-88%	17.2795	2.3127	-87%
1996	0.9873	0.1187	1.2518	0.1505	1.3916	0.1673	0.0987	0.0119	-88%	17.2061	2.2304	-87%

YEAR	PM2.5 [kt]		PM10 [kt]		TSP [kt]		BC [kt]		CHANGE	CO [kt]		
	P	R	P	R	P	R	P	R		P	R	CHANGE
1997	1.0107	0.1095	1.2814	0.1389	1.4245	0.1544	0.1011	0.0110	-89%	17.6132	2.0588	-88%
1998	0.9389	0.1220	1.1904	0.1547	1.3233	0.1720	0.0939	0.0122	-87%	16.3625	2.2932	-86%
1999	0.9060	0.1061	1.1486	0.1345	1.2769	0.1495	0.0906	0.0106	-88%	15.7883	1.9937	-87%
2000	0.2957	0.2957	0.3749	0.3749	0.4167	0.4167	0.0296	0.0296	0%	2.7839	2.7839	0%
2001	0.1064	0.1064	0.1349	0.1349	0.1499	0.1499	0.0106	0.0106	0%	2.5911	2.5911	0%
2002	0.0865	0.0865	0.1097	0.1097	0.1220	0.1220	0.0087	0.0087	0%	2.7566	2.7566	0%
2003	0.0672	0.0672	0.0852	0.0852	0.0947	0.0947	0.0067	0.0067	0%	2.2963	2.2963	0%
2004	0.0328	0.0328	0.0416	0.0416	0.0462	0.0462	0.0033	0.0033	0%	0.6335	0.6335	0%

P-Previous
R-Refined

4.6.4 ALUMINIUM PRODUCTION (2C3)

4.6.4.1 Overview

Aluminium is produced by the electrolysis of alumina dissolved in the cryolite-based melt (t = 950°C). The main additives to cryolite (Na_3AlF_6) are aluminium fluoride (AlF_3) and CaF_2. In Slovakia, the plants for aluminium production use a modern technology where the majority of HF and other fluorides escaped from the electrolytic cells is absorbed and adsorbed on alumina. Alumina is used subsequently in the electrolytic process. The anodes are made from graphite. So-called pre-baked anodes for aluminium products are made in separate plants. Due to this technology, emissions are much lower than in the Søderberg process.

Emissions of main pollutants from this category were reallocated from 2C7c to this category. Emissions of the main pollutants have an increasing trend due to the increase in production. PAHs have decreased due to the change of technology for the production of aluminium from pre-baked anodes to Søderberg process (***Table 4.60***).

Table 4.60: *Activity data and emissions in the category 2C3*

YEAR	ALUMINIUM PRODUCED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	PM2.5 [kt]	PM10 [kt]	TSP [kt]	BC [kt]	CO [kt]	PAHs [t]
1990	67.40	0.2258	0.0016	0.7164	0.0484	0.0545	0.0591	0.0011	5.7010	1.8939
1995	32.60	0.1092	0.0008	0.3465	0.0234	0.0263	0.0286	0.0005	2.7575	0.9161
2000	109.81	0.2916	0.0029	1.1785	0.0944	0.1063	0.1152	0.0022	7.8868	0.0132
2005	159.20	0.6886	0.1461	1.3099	0.1194	0.1343	0.1457	0.0027	12.9913	0.0191
2010	163.00	0.5196	0.0355	1.3825	0.1206	0.1353	0.1471	0.0028	13.4722	0.0196
2011	162.84	0.5497	0.0312	2.2302	0.0629	0.0706	0.0767	0.0014	13.5448	0.0195
2012	160.66	0.5141	0.0283	1.3916	0.0701	0.0787	0.0855	0.0016	13.3409	0.0193
2013	163.30	0.5130	0.0260	1.3879	0.0681	0.0764	0.0831	0.0016	13.3071	0.0196
2014	167.67	0.4927	0.0538	2.0785	0.0975	0.1094	0.1189	0.0022	14.0622	0.0201
2015	171.33	0.4430	0.0873	1.6566	0.0811	0.0910	0.0990	0.0019	14.2394	0.0206
2016	173.64	0.4425	0.1152	2.8449	0.0835	0.0937	0.1018	0.0019	18.0049	0.0208
2017	173.49	0.5510	0.0487	2.4411	0.1050	0.1178	0.1281	0.0024	16.5521	0.0208
2018	173.72	0.5378	0.0361	2.0605	0.1082	0.1213	0.1319	0.0025	16.4582	0.0208
2019	174.79	0.4974	0.0453	2.0394	0.1175	0.1318	0.1433	0.0027	15.5812	0.0210
1990/2019	**159%**	**120%**	**2807%**	**185%**	**143%**	**142%**	**143%**	**143%**	**173%**	**-99%**
2018/2019	**1%**	**-8%**	**25%**	**-1%**	**9%**	**9%**	**9%**	**9%**	**-5%**	**1%**

4.6.4.2 Methodological issues

Emissions of main pollutants were excluded from the category 2C7c. Activities of aluminium production according to national legislation were separated into the individual category 2C3.

Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004 (***Table 4.61***). Emissions of BC were calculated using EMEP/EEA GB_{2019} emission factor thought the whole time series.

Table 4.61: *Emission factors for calculation of historical years*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/t]
EF	3 350.77	23.11	10 629.29	876.41	82%	92%	2.3%	84 584.75

<u>POPs</u>

POPs were calculated using Tier 2 emission factors from EMEP/EEA GB_{2019} for primary aluminium production (***Table 4.62***)

Table 4.62: *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]
Pre-baked anodes	1990-1995	9	9	9	1.1	28.1
Søderberg anodes	1996-2019	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_{2019}.

4.6.4.4 Source-specific recalculations

Tier 2 EMEP/EEA GB_{2019} emission factors for primary aluminium production were used following the recommendation No ***SK-2C3-2020-0001***. Recalculations are shown in ***Table 4.63.*** Emissions of main pollutants were removed from the category 2C7c and allocated in this category for the first time in this submission.

Table 4.635: *Previous and refined emissions of main pollutants*

YEAR	B(a)P [g/t]			B(b)F [g/t]			B(k)F [g/t]			I()P [g/t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.6066	0.6066	-	0.6066	0.6066	-	0.6066	0.6066	-	0.0741	0.0741	-
1991	0.5967	0.5967	-	0.5967	0.5967	-	0.5967	0.5967	-	0.0729	0.0729	-
1992	0.5553	0.5553	-	0.5553	0.5553	-	0.5553	0.5553	-	0.0679	0.0679	-
1993	0.3474	0.3474	-	0.3474	0.3474	-	0.3474	0.3474	-	0.0425	0.0425	-
1994	0.2952	0.2952	-	0.2952	0.2952	-	0.2952	0.2952	-	0.0361	0.0361	-
1995	0.2934	0.2934	-	0.2934	0.2934	-	0.2934	0.2934	-	0.0359	0.0359	-
1996	1.0026	0.0078	-99%	1.0026	0.0022	-100%	1.0026	0.0022	-100%	0.1225	0.0011	-99%
1997	0.9917	0.0077	-99%	0.9917	0.0022	-100%	0.9917	0.0022	-100%	0.1212	0.0011	-99%
1998	0.9720	0.0076	-99%	0.9720	0.0022	-100%	0.9720	0.0022	-100%	0.1188	0.0011	-99%
1999	0.9828	0.0076	-99%	0.9828	0.0022	-100%	0.9828	0.0022	-100%	0.1201	0.0011	-99%
2000	0.9883	0.0077	-99%	0.9883	0.0022	-100%	0.9883	0.0022	-100%	0.1208	0.0011	-99%
2001	0.9906	0.0077	-99%	0.9906	0.0022	-100%	0.9906	0.0022	-100%	0.1211	0.0011	-99%
2002	0.9883	0.0077	-99%	0.9883	0.0022	-100%	0.9883	0.0022	-100%	0.1208	0.0011	-99%
2003	1.0046	0.0078	-99%	1.0046	0.0022	-100%	1.0046	0.0022	-100%	0.1228	0.0011	-99%
2004	1.4120	0.0110	-99%	1.4120	0.0031	-100%	1.4120	0.0031	-100%	0.1726	0.0016	-99%
2005	1.4328	0.0111	-99%	1.4328	0.0032	-100%	1.4328	0.0032	-100%	0.1751	0.0016	-99%
2006	1.4246	0.0111	-99%	1.4246	0.0032	-100%	1.4246	0.0032	-100%	0.1741	0.0016	-99%
2007	1.4442	0.0112	-99%	1.4442	0.0032	-100%	1.4442	0.0032	-100%	0.1765	0.0016	-99%
2008	1.4670	0.0114	-99%	1.4670	0.0033	-100%	1.4670	0.0033	-100%	0.1793	0.0016	-99%
2009	1.3464	0.0105	-99%	1.3464	0.0030	-100%	1.3464	0.0030	-100%	0.1646	0.0015	-99%
2010	1.4670	0.0114	-99%	1.4670	0.0033	-100%	1.4670	0.0033	-100%	0.1793	0.0016	-99%
2011	1.4656	0.0114	-99%	1.4656	0.0033	-100%	1.4656	0.0033	-100%	0.1791	0.0016	-99%

YEAR	B(a)P [g/t]			B(b)F [g/t]			B(k)F [g/t]			I()P [g/t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2012	1.4459	0.0112	-99%	1.4459	0.0032	-100%	1.4459	0.0032	-100%	0.1767	0.0016	-99%
2013	1.4697	0.0114	-99%	1.4697	0.0033	-100%	1.4697	0.0033	-100%	0.1796	0.0016	-99%
2014	1.5090	0.0117	-99%	1.5090	0.0034	-100%	1.5090	0.0034	-100%	0.1844	0.0017	-99%
2015	1.5420	0.0120	-99%	1.5420	0.0034	-100%	1.5420	0.0034	-100%	0.1885	0.0017	-99%
2016	1.5628	0.0122	-99%	1.5628	0.0035	-100%	1.5628	0.0035	-100%	0.1910	0.0017	-99%
2017	1.5614	0.0121	-99%	1.5614	0.0035	-100%	1.5614	0.0035	-100%	0.1908	0.0017	-99%
2018	1.5635	0.0122	-99%	1.5635	0.0035	-100%	1.5635	0.0035	-100%	0.1911	0.0017	-99%

P-Previous
R-Refined

4.6.5 MAGNESIUM PRODUCTION (2C4)

4.6.5.1 Overview

The production of magnesium does not occur in the Slovak Republic. In this category is allocated the non-metallurgical production of magnesite clinker. There is inconsistency with the GHG inventory caused by reporting of this production in this category. It is planned for the future submissions to reallocate this activity into the category **2C7c**.

The trends of emission and activity data are presented in ***Table 4.64.***

Table 4.64: *Activity data and emissions on the category 2C4*

YEAR	MAGNESITE CLINKER [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	345.39	1.2005	0.0106	0.5604	0.0010	0.0028	0.0341	0.2839	3.8679
1995	235.12	0.8172	0.0072	0.3815	0.0007	0.0019	0.0232	0.1932	2.6330
2000	330.93	0.9611	0.0097	0.3510	0.0017	0.0035	0.0422	0.3520	3.8178
2005	384.62	1.2604	0.0089	0.8608	0.0009	0.0011	0.0133	0.1104	4.5563
2010	319.16	1.2674	0.0069	0.2942	0.0002	0.0004	0.0043	0.0354	1.9697
2011	281.79	1.3406	0.0069	0.3566	0.0002	0.0004	0.0044	0.0363	2.9037
2012	247.04	0.9418	0.0055	0.2503	0.0002	0.0003	0.0037	0.0306	2.9057
2013	234.75	0.9582	0.0050	0.1927	0.0001	0.0003	0.0036	0.0299	2.6620
2014	225.85	0.9248	0.0047	0.1800	0.0000	0.0002	0.0028	0.0234	2.6315
2015	207.46	0.8528	0.0043	0.1765	0.0000	0.0002	0.0026	0.0216	2.6385
2016	176.99	0.5162	0.0035	0.1330	0.0000	0.0002	0.0023	0.0190	1.6368
2017	294.12	0.6514	0.0049	0.1612	0.0000	0.0002	0.0028	0.0231	1.2759
2018	303.91	0.8721	0.0052	0.1722	0.0000	0.0003	0.0041	0.0344	0.9580
2019	261.54	0.8859	0.0049	0.1921	0.0000	0.0002	0.0020	0.0169	0.5766
1990/2019	**-24%**	**-26%**	**-53%**	**-66%**	**-100%**	**-94%**	**-94%**	**-94%**	**-85%**
2018/2019	**-14%**	**2%**	**-4%**	**12%**	**-12%**	**-51%**	**-51%**	**-51%**	**-40%**

4.6.5.4 Methodological issues

Activities defined in national legislation involved in the category are presented in ***Table 4.65***.

Table 4.65: *Activities according to national categorization included in 2C4*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.4 Production of magnesium oxide from magnesite and production of basic refractory materials with projected production capacity in t/d

Historical years for this source category were calculated using a weighted average of IEF for each pollutant from the period 2000-2004 (***Table 4.66***).

Table 4.66: Emission factors for calculation of historical years

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	NH_3 [g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/t]
EF	3 475.76	30.58	1 622.54	2.86	821.92	1%	12%	11 198.71

4.6.5.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2019}.

4.6.5.4 Source-specific recalculations

Historical years were recalculated due to change of emission factors for this period (***Table 4.67***).

Table 4.67: Previous and refined emissions in the category 2C4

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	1.2017	1.2005	0%	0.0105	0.0106	0%	0.5585	0.5604	0%	0.0010	0.0010	0%
1991	0.7157	0.7149	0%	0.0063	0.0063	0%	0.3326	0.3337	0%	0.0006	0.0006	0%
1992	0.6107	0.6101	0%	0.0054	0.0054	0%	0.2838	0.2848	0%	0.0005	0.0005	0%
1993	0.6278	0.6272	0%	0.0055	0.0055	0%	0.2918	0.2928	0%	0.0005	0.0005	0%
1994	0.5684	0.5678	0%	0.0050	0.0050	0%	0.2642	0.2651	0%	0.0005	0.0005	0%
1995	0.8180	0.8172	0%	0.0072	0.0072	0%	0.3802	0.3815	0%	0.0007	0.0007	0%
1996	0.8378	0.8369	0%	0.0073	0.0074	0%	0.3894	0.3907	0%	0.0007	0.0007	0%
1997	0.8631	0.8623	0%	0.0076	0.0076	0%	0.4012	0.4025	0%	0.0007	0.0007	0%
1998	1.0475	1.0464	0%	0.0092	0.0092	0%	0.4869	0.4885	0%	0.0009	0.0009	0%
1999	1.1093	1.1082	0%	0.0097	0.0097	0%	0.5156	0.5173	0%	0.0009	0.0009	0%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0029	0.0028	-1%	0.0343	0.0341	-1%	0.2855	0.2839	-1%	3.8674	3.8679	0%
1991	0.0017	0.0017	-1%	0.0204	0.0203	-1%	0.1700	0.1691	-1%	2.3032	2.3035	0%
1992	0.0015	0.0014	-1%	0.0174	0.0173	-1%	0.1451	0.1443	-1%	1.9653	1.9656	0%
1993	0.0015	0.0015	-1%	0.0179	0.0178	-1%	0.1492	0.1483	-1%	2.0206	2.0208	0%
1994	0.0014	0.0013	-1%	0.0162	0.0161	-1%	0.1350	0.1343	-1%	1.8293	1.8296	0%
1995	0.0019	0.0019	-1%	0.0233	0.0232	-1%	0.1943	0.1932	-1%	2.6327	2.6330	0%
1996	0.0020	0.0020	-1%	0.0239	0.0237	-1%	0.1990	0.1979	-1%	2.6961	2.6965	0%
1997	0.0021	0.0020	-1%	0.0246	0.0245	-1%	0.2051	0.2039	-1%	2.7778	2.7782	0%
1998	0.0025	0.0025	-1%	0.0299	0.0297	-1%	0.2489	0.2475	-1%	3.3711	3.3716	0%
1999	0.0026	0.0026	-1%	0.0316	0.0314	-1%	0.2635	0.2621	-1%	3.5701	3.5706	0%
2000	0.0035	0.0035	0%	0.0422	0.0422	0%	0.3520	0.3520	0%	3.8178	3.8178	0%
2001	0.0037	0.0037	0%	0.0439	0.0439	0%	0.3661	0.3661	0%	4.2224	4.2224	0%
2002	0.0028	0.0028	0%	0.0338	0.0338	0%	0.2815	0.2815	0%	3.7377	3.7377	0%
2003	0.0026	0.0026	0%	0.0315	0.0315	0%	0.2628	0.2628	0%	3.7588	3.7588	0%
2004	0.0020	0.0020	0%	0.0242	0.0242	0%	0.2016	0.2016	0%	4.6096	4.6096	0%

P-Previous
R-Refined

4.6.6 LEAD PRODUCTION (2C5)

4.6.6.1 Overview

The production, regeneration and disposal of electric accumulators and cells were occurring in the Slovak Republic in the period 2011-2019. Therefore this activity was included in the category 2C5. The trends of emissions from production and activity data are presented in ***Table 4.68***.

Table 4.68: Activity data and emissions in the category 2C5

YEAR	LEAD PRODUCED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO[kt]
1990	NO	NO	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO	NO	NO	NO
2005	NO	NO	NO	NO	NO	NO	NO	NO
2010	NO	NO	NO	NO	NO	NO	NO	NO
2011	0.05	0.0213	0.0002	0.0163	0.0001	0.0002	0.0005	0.0012
2012	0.20	0.0174	0.0002	0.0137	0.0000	0.0002	0.0005	0.0011
2013	0.26	0.0062	0.0004	0.0450	0.0001	0.0004	0.0010	0.0014
2014	0.29	0.0076	0.0005	0.0579	0.0001	0.0005	0.0012	0.0017
2015	0.32	0.0054	0.0004	0.0270	0.0001	0.0003	0.0007	0.0012
2016	0.29	0.0082	0.0007	0.0299	0.0001	0.0003	0.0008	0.0016
2017	0.30	0.0085	0.0008	0.0314	0.0001	0.0004	0.0009	0.0017
2018	0.05	0.0027	0.0001	0.0303	0.0001	0.0002	0.0005	0.0008
2019	0.07	0.0076	0.0005	0.0621	0.0001	0.0005	0.0012	0.0020
1990/2019	-	-	-	-	-	-	-	-
2018/2019	**39%**	**177%**	**223%**	**105%**	**117%**	**117%**	**117%**	**141%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Zn [t]	PCDD/F [g I-TEQ]	PCB [kg]
1990	NO	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO	NO	NO
2005	NO	NO	NO	NO	NO	NO	NO
2010	NO	NO	NO	NO	NO	NO	NO
2011	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
2012	0.0002	0.0000	0.0000	0.0001	0.0000	0.0007	0.0000
2013	0.0003	0.0000	0.0000	0.0001	0.0000	0.0008	0.0000
2014	0.0003	0.0000	0.0000	0.0001	0.0000	0.0009	0.0000
2015	0.0004	0.0000	0.0000	0.0001	0.0000	0.0010	0.0000
2016	0.0003	0.0000	0.0000	0.0001	0.0000	0.0009	0.0000
2017	0.0003	0.0000	0.0000	0.0001	0.0000	0.0010	0.0000
2018	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
2019	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
1990/2019	-	-	-	-	-	-	-
2018/2019	**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 4.69***.

Table 4.69: Activities according to national categorization included in 2C5

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.39 Production, regeneration and disposal of electric accumulators and cells

HMs and POPs

HMs and POPs were balanced using Tier 2/Tier 1 emission factors for Secondary lead production - current technology level from EMEP/EEA GB_{2019} (***Table 4.70***).

Table 4.70: *Emission factors of HMs and POPs for secondary lead production in 2C5*

TECHNOLOGY	Pb [g/t]	Cd [g/t]	Hg [g/t]*	As [g/t]	Zn [g/t]	PCDD/F [µg I-TEQ/t]	PCBs [µg/t]
Current technology	1.1	0.05	0.1	0.3	0.05	3.2	2.6

*Tier 1

4.6.6.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB2019.

4.6.6.4 Source-specific recalculations

Emissions of heavy metals and POPs were recalculated due to the usage of the higher tier method for the Secondary lead production (***Table 4.71***).

Table 4.71: *Previous and refined emissions in the category 2C5*

YEAR	Pb [t]			Cd [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2011	0.0001	0.0001	-39%	0.0000	0.0000	-50%	0.0000	0.0000	200%
2012	0.0004	0.0002	-39%	0.0000	0.0000	-50%	0.0000	0.0001	200%
2013	0.0005	0.0003	-39%	0.0000	0.0000	-50%	0.0000	0.0001	200%
2014	0.0005	0.0003	-39%	0.0000	0.0000	-50%	0.0000	0.0001	200%
2015	0.0006	0.0004	-39%	0.0000	0.0000	-50%	0.0000	0.0001	200%
2016	0.0005	0.0003	-39%	0.0000	0.0000	-50%	0.0000	0.0001	200%
2017	0.0005	0.0003	-39%	0.0000	0.0000	-50%	0.0000	0.0001	200%
2018	0.0001	0.0001	-39%	0.0000	0.0000	-50%	0.0000	0.0000	200%

YEAR	Zn [t]			PCDD/F [g I-TEQ]			PCB [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2011	0.0000	0.0000	-92%	0.0002	0.0002	-29%	0.0000	0.0000	30%
2012	0.0001	0.0000	-92%	0.0009	0.0007	-29%	0.0000	0.0000	30%
2013	0.0002	0.0000	-92%	0.0012	0.0008	-29%	0.0000	0.0000	30%
2014	0.0002	0.0000	-92%	0.0013	0.0009	-29%	0.0000	0.0000	30%
2015	0.0002	0.0000	-92%	0.0015	0.0010	-29%	0.0000	0.0000	30%
2016	0.0002	0.0000	-92%	0.0013	0.0009	-29%	0.0000	0.0000	30%
2017	0.0002	0.0000	-92%	0.0014	0.0010	-29%	0.0000	0.0000	30%
2018	0.0000	0.0000	-92%	0.0002	0.0002	-29%	0.0000	0.0000	30%

4.6.7 ZINC PRODUCTION (2C6)

4.6.7.1 Overview

The category is reported with notation key NO except the period 2012-2014 when activity data were recorded. Overview of emissions is shown in ***Table 4.72***.

Table 4.72: *Activity data and emissions in the category 2C6*

YEAR	ZINC PROD [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	Pb [t]	Cd [t]	Hg [t]
1990	NO	NO	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO	NO	NO	NO
2005	NO	NO	NO	NO	NO	NO	NO	NO
2010	NO	NO	NO	NO	NO	NO	NO	NO
2011	NO	NO	NO	NO	NO	NO	NO	NO

YEAR	ZINC PROD [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	Pb [t]	Cd [t]	Hg [t]
2012	0.04	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2013	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2014	0.02	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2015	NO	NO	NO	NO	NO	NO	NO	NO
2016	NO	NO	NO	NO	NO	NO	NO	NO
2017	NO	NO	NO	NO	NO	NO	NO	NO
2018	NO	NO	NO	NO	NO	NO	NO	NO
2019	NO	NO	NO	NO	NO	NO	NO	NO
1990/2019	-	-	-	-	-	-	-	-
2018/2019	-	-	-	-	-	-	-	-

YEAR	As [t]	Zn [t]	PCDD/F [g I-TEQ]	PCBs [kg]
1990	NO	NO	NO	NO
1995	NO	NO	NO	NO
2000	NO	NO	NO	NO
2005	NO	NO	NO	NO
2010	NO	NO	NO	NO
2011	NO	NO	NO	NO
2012	0.0000	0.0002	0.0002	0.0000
2013	0.0000	0.0002	0.0002	0.0000
2014	0.0000	0.0001	0.0001	0.0000
2015	NO	NO	NO	NO
2016	NO	NO	NO	NO
2017	NO	NO	NO	NO
2018	NO	NO	NO	NO
2019	NO	NO	NO	NO
1990/2019	-	-	-	-
2018/2019	-	-	-	-

4.6.7.2 Methodological issues

Tie 1 methodology from EMEP/EEA GB_{2019} was used to calculate emissions from this source. Emission factors are displayed in ***Table 4.73***.

Table 4.73: *Emission factors in the category 2C6*

	SOx [g/t]	$PM_{2.5}$ [g/t]	PM_{10} [g/t]	TSP [g/t]	Pb [g/t]	Cd [g/t]	Hg [g/t]	As [g/t]	Zn [g/t]	PCDD/F [μg I-TEQ/t]	PCBs [g/t]
EF	1350	12	13	0.2	16	0.04	0.04	0.03	5	5	2

4.6.7.3 Completeness

All rising pollutants were reported. Notation keys were used following the EMEP/EEA GB_{2019}. For the period 1990-2013 and 2015-2019, notation key NO was used.

4.6.7.3 Source-specific recalculations

This category was recalculated due to the correction of the conversion factor for HMs and PCDD/F (***Table 4.74***).

Table 4.74: Previous and refined emissions in the category 2C6

YEAR	Pb [t]			Cd [t]			As [t]		
	PREVIOUS	REFINED	CHANGE	PREVIOUS	REFINED	CHANGE	PREVIOUS	REFINED	CHANGE
2012	0.0000	0.0000	99900%	0.0000	0.0000	99900%	0.0000	0.0000	99900%
2013	0.0000	0.0000	99900%	0.0000	0.0000	99900%	0.0000	0.0000	99900%
2014	0.0000	0.0000	99900%	0.0000	0.0000	99900%	0.0000	0.0000	99900%

YEAR	Zn [t]			PCDD/F [g I-TEQ]		
	PREVIOUS	REFINED	CHANGE	PREVIOUS	REFINED	CHANGE
2012	0.0000	0.0002	99900%	0.0000	0.0002	99900%
2013	0.0000	0.0002	99900%	0.0000	0.0002	99900%
2014	0.0000	0.0001	99900%	0.0000	0.0001	99900%

4.6.8 COPPER PRODUCTION (2C7a)

4.6.8.1 Overview

Pollutants released during copper production are particulate matter (PM), sulphur oxides (SOx), nitrogen oxides (NOx), volatile organic compounds (non-methane VOC and methane (CH_4)), carbon monoxide (CO), carbon dioxide (CO_2), nitrous oxide (N_2O), trace elements, and selected persistent organic pollutants (POPs). The POPs are mostly dioxins and furans, which are emitted from shaft furnaces, converters, and flame furnaces.

Emissions of air pollutants were excluded from the category 2C7c - Other metal production although the definition of activity according to the categorization of the Annex No 6 of decree no 410/2012 coll. as amended do not divide for the specific type of metal production only general: Treatment of non-ferrous metals ores and manipulation with these materials in powder form.

Activity data, emissions and its trend are shown in ***Table 4.75***. Emission trend of these pollutants is increasing due to the activity within the category.

Table 4.75: Activity data and emissions in the category 2C7a

YEAR	PRIMARY COPPER [kt]	SECONDARY COPPER [kt[	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	19041.50	19041.50	0.0161	0.0036	0.0098	0.0048	0.0061	0.0145	0.0000	1.4800
1995	8377.25	25131.75	0.0141	0.0031	0.0087	0.0042	0.0054	0.0128	0.0000	1.3023
2000	-	220.35	0.0000	0.0000	0.0004	0.0000	0.0001	0.0001	0.0000	0.0001
2005	-	33441.00	0.0047	0.0036	0.0112	0.0075	0.0095	0.0106	0.0000	1.7321
2010	-	68508.32	0.0416	0.0843	0.0944	0.0116	0.0146	0.0682	0.0000	3.0990
2011	-	72485.16	0.0383	0.0733	0.0842	0.0093	0.0118	0.0360	0.0000	2.6989
2012	-	72485.16	0.0386	0.0467	0.0701	0.0071	0.0089	0.0280	0.0000	1.7787
2013	-	34231.58	0.0393	0.0066	0.0236	0.0027	0.0034	0.0051	0.0000	0.2434
2014	-	48092.81	0.0169	0.0048	0.0252	0.0019	0.0025	0.0027	0.0000	0.1995
2015	-	65609.00	0.0246	0.0165	0.0827	0.0086	0.0109	0.0121	0.0000	1.4275
2016	-	78289.11	0.0373	0.0171	0.0938	0.0078	0.0099	0.0110	0.0000	1.5884
2017	-	74504.99	0.0212	0.0137	0.0767	0.0067	0.0085	0.0094	0.0000	1.2507
2018	-	77309.00	0.0508	0.0088	0.0209	0.0010	0.0013	0.0015	0.0000	0.9727
2019	-	91216.30	0.0449	0.0094	0.0231	0.0012	0.0015	0.0017	0.0000	1.0432
1990/2019	**-**	**379%**	**180%**	**163%**	**135%**	**-75%**	**-75%**	**-88%**	**-75%**	**-30%**
2018/2019	**-**	**18%**	**-11%**	**7%**	**10%**	**14%**	**14%**	**14%**	**14%**	**7%**

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	0.0009	0.1714	0.6093	1.6185	0.3643	0.9523	0.0000
1995	0.7372	0.1835	0.0008	0.1089	0.5361	1.1812	0.1624	1.2567	0.0000
2000	0.0053	0.0005	0.0000	0.0004	0.0035	0.0062	0.0000	0.0110	0.0000
2005	0.8026	0.0769	0.0008	0.0669	0.5351	0.9363	0.0043	1.6721	0.0000
2010	0.0005	0.1093	0.0016	0.0172	1.0961	1.9182	0.0000	3.0829	0.0001
2011	0.0005	0.1156	0.0017	0.0182	1.1598	2.0296	0.0000	3.2618	0.0001
2012	0.0005	0.1156	0.0017	0.0182	1.1598	2.0296	0.0000	3.2618	0.0001
2013	0.0001	0.0025	0.0008	0.0033	0.5477	0.9585	0.0000	1.5404	0.0000
2014	0.0001	0.0036	0.0011	0.0047	0.7695	1.3466	0.0000	2.1642	0.0000
2015	0.0002	0.0049	0.0015	0.0064	1.0497	1.8371	0.0000	2.9524	0.0001
2016	0.0002	0.0058	0.0018	0.0076	1.2526	2.1921	0.0000	3.5230	0.0001
2017	0.0002	0.0055	0.0017	0.0072	1.1921	2.0861	0.0000	3.3527	0.0001
2018	0.0002	0.0007	0.0018	NO	1.2369	0.0871	0.0000	3.4789	0.0001
2019	0.0002	0.0008	0.0021	NO	1.4595	0.1028	0.0000	4.1047	0.0001
1990/2019	**-100%**	**-100%**	**140%**	**-**	**140%**	**-94%**	**-100%**	**331%**	**140%**
2018/2019	**18%**	**18%**	**18%**	**-**	**18%**	**18%**	**18%**	**18%**	**18%**

4.6.8.2 Methodological issues

Emissions from copper production were excluded from the category 2C7c and reallocated into this category. Emissions data for the period 2000-2019 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 (***Table 4.76***).

Table 4.76: *Emission factors for calculation of historical years*

	NOx [g/t]	NMVOC [g/t]	SOx [g/t]	TSP [g/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/t]
EF	422.07	93.54	258.25	381.14	33%	42%	38 862.82

<u>Heavy metals and POPs</u>

Far calculation of heavy metals and POPs, Tier 2/Tier 1 EF from EMEP/EEA GB_{2019} were used (***Table 4.77***). To use a higher Tier method, it was necessary to contact only 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 the secondary copper production in the year 1990, but as the data before 2000 are very unclear due to 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 the primary copper production of 5% per year until 1999. On the contrary, ration of secondary copper production is increasing of 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, as the whole report from the operator was not yet fully implemented (***Table 4.78***).

***Table 4.77**: Emission factor for heavy metals and POPs in the category 2C7a*

TECHNOLOGY	PERIOD	Pb [g/t]	Cd [g/t]	Hg [g/t]	As [g/t]	Cr [g/t]	Cu [g/t]	Ni [g/t]	PCDD/F [µg I-TEQ/t]	PCBs [µg/t]
T1 Copper production	1990-2019	-	-	0.023	-	16	-	-	-	0.9
T2 Primary production	1990-1999	16	15	-	7	-	57	19	0.01	-
T2 Secondary production	1990-2019	24	2.3	-	2	-	28	0.13	50	-

***Table 4.78:** Efficiency of the abatement technology*

ABATEMENT	PERIOD	Pb [g/t]*	Cd [g/t]	As [g/t]	Cu [g/t]	Ni [g/t]*	PCDD/F [µg I-TEQ/t]
State of art fabric filter	2006-2012	99.97%	30.64%	87.47%	0%	99.97%	0%
State of art fabric filter	2013-2017	99.99%	96.79%	95.14%	0%	99.99%	10%
State of art fabric filter	2018-2019	99.99%	99.60%	100.00%	96%	99.99%	10%

*Default values form EMEP/EEA GB_{2019}

4.6.8.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2019}. Emissions of the main pollutants were reported for the first time in this submission.

4.6.8.4 Source-specific recalculations

This category was recalculated following recommendation No ***SK-2C7a-2019-0002***. ***(Table 4.79)*** Emissions of main pollutants were reallocated from the category 2C7c to this category and emissions of HMs and POPs were recalculated using Tier 2 EMEP/EEA GB_{2019}. Activity data form the periods 2008-2010, 2012-2014 and 2017 were changed according to data collected by the operator.

***Table 4.79:** Previous and refined emissions in the category 2C7a*

YEAR	Pb [t]			Cd[t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.7236	0.7617	5%	0.4189	0.3294	-21%	0.0009	0.0009	-	0.1523	0.1714	13%
1991	1.0388	1.1154	7%	0.6014	0.4382	-27%	0.0013	0.0013	-	0.2187	0.2324	6%
1992	1.3541	1.4824	9%	0.7839	0.5260	-33%	0.0016	0.0016	-	0.2851	0.2851	-
1993	1.0857	1.2115	12%	0.6286	0.3854	-39%	0.0013	0.0013	-	0.2286	0.2143	-6%
1994	0.8174	0.9293	14%	0.4732	0.2629	-44%	0.0010	0.0010	-	0.1721	0.1506	-13%
1995	0.6367	0.7372	16%	0.3686	0.1835	-50%	0.0008	0.0008	-	0.1340	0.1089	-19%
1996	1.2104	1.4270	18%	0.7008	0.3083	-56%	0.0015	0.0015	-	0.2548	0.1911	-25%
1997	1.2311	1.4773	20%	0.7127	0.2725	-62%	0.0015	0.0015	-	0.2592	0.1782	-31%
1998	0.9477	1.1572	22%	0.5487	0.1781	-68%	0.0011	0.0011	-	0.1995	0.1247	-38%
1999	0.0445	0.0553	24%	0.0258	0.0069	-73%	0.0001	0.0001	-	0.0094	0.0053	-44%
2000	0.0042	0.0053	26%	0.0024	0.0005	-79%	0.0000	0.0000	-	0.0009	0.0004	-50%
2001	0.2596	0.3279	26%	0.1503	0.0314	-79%	0.0003	0.0003	-	0.0547	0.0273	-50%
2002	0.2028	0.2562	26%	0.1174	0.0245	-79%	0.0002	0.0002	-	0.0427	0.0213	-50%
2003	0.2164	0.2734	26%	0.1253	0.0262	-79%	0.0003	0.0003	-	0.0456	0.0228	-50%
2004	0.4640	0.5861	26%	0.2686	0.0562	-79%	0.0006	0.0006	-	0.0977	0.0488	-50%
2005	0.6354	0.8026	26%	0.3679	0.0769	-79%	0.0008	0.0008	-	0.1338	0.0669	-50%
2006	0.8383	0.0003	-100%	0.4853	0.0704	-85%	0.0010	0.0010	-	0.1765	0.0111	-94%
2007	0.9130	0.0003	-100%	0.5286	0.0767	-85%	0.0011	0.0011	-	0.1922	0.0120	-94%
2008	0.9971	0.0004	-100%	0.5773	0.0837	-85%	0.0012	0.0012	0%	0.2099	0.0131	-94%
2009	0.7878	0.0003	-100%	0.4561	0.0668	-85%	0.0010	0.0010	1%	0.1658	0.0105	-94%
2010	1.3017	0.0005	-100%	0.7536	0.1093	-85%	0.0016	0.0016	0%	0.2740	0.0172	-94%
2011	1.3772	0.0005	-100%	0.7973	0.1156	-85%	0.0017	0.0017	-	0.2899	0.0182	-94%
2012	1.1306	0.0005	-100%	0.6546	0.1156	-82%	0.0014	0.0017	22%	0.2380	0.0182	-92%

YEAR	Pb [t]			Cd[t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2013	0.5893	0.0001	-100%	0.3412	0.0025	-99%	0.0007	0.0008	10%	0.1241	0.0033	-97%
2014	0.8406	0.0001	-100%	0.4866	0.0036	-99%	0.0010	0.0011	9%	0.1770	0.0047	-97%
2015	1.2466	0.0002	-100%	0.7217	0.0049	-99%	0.0015	0.0015	-	0.2624	0.0064	-98%
2016	1.4875	0.0002	-100%	0.8612	0.0058	-99%	0.0018	0.0018	-	0.3132	0.0076	-98%
2017	1.4155	0.0002	-100%	0.8195	0.0055	-99%	0.0017	0.0017	0%	0.2980	0.0072	-98%
2018	1.4689	0.0002	-100%	0.8504	0.0007	-100%	0.0018	0.0018	-	0.3092	NO	-

YEAR	Cr [t]			Cu [t]			Ni		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.6093	0.6093	-	1.2187	1.6185	33%	0.5332	0.3643	-32%
1991	0.8748	0.8748	-	1.7496	2.2444	28%	0.7655	0.4714	-38%
1992	1.1403	1.1403	-	2.2805	2.8222	24%	0.9977	0.5472	-45%
1993	0.9143	0.9143	-	1.8286	2.1801	19%	0.8000	0.3848	-52%
1994	0.6884	0.6884	-	1.3767	1.5789	15%	0.6023	0.2491	-59%
1995	0.5361	0.5361	-	1.0723	1.1812	10%	0.4691	0.1624	-65%
1996	1.0193	1.0193	-	2.0386	2.1533	6%	0.8919	0.2487	-72%
1997	1.0367	1.0367	-	2.0734	2.0961	1%	0.9071	0.1918	-79%
1998	0.7981	0.7981	-	1.5962	1.5413	-3%	0.6983	0.1006	-86%
1999	0.0375	0.0375	-	0.0750	0.0690	-8%	0.0328	0.0025	-92%
2000	0.0035	0.0035	-	0.0071	0.0062	-13%	0.0031	0.0000	-99%
2001	0.2186	0.2186	-	0.4372	0.3826	-13%	0.1913	0.0018	-99%
2002	0.1708	0.1708	-	0.3415	0.2989	-13%	0.1494	0.0014	-99%
2003	0.1823	0.1823	-	0.3645	0.3189	-13%	0.1595	0.0015	-99%
2004	0.3907	0.3907	-	0.7814	0.6837	-13%	0.3419	0.0032	-99%
2005	0.5351	0.5351	-	1.0701	0.9363	-13%	0.4682	0.0043	-99%
2006	0.7060	0.7060	-	1.4119	1.2354	-13%	0.6177	0.0000	-100%
2007	0.7688	0.7688	-	1.5376	1.3454	-13%	0.6727	0.0000	-100%
2008	0.8397	0.8397	0%	1.6794	1.4695	-12%	0.7347	0.0000	-100%
2009	0.6634	0.6702	1%	1.3268	1.1728	-12%	0.5805	0.0000	-100%
2010	1.0961	1.0961	0%	2.1923	1.9182	-12%	0.9591	0.0000	-100%
2011	1.1598	1.1598	-	2.3195	2.0296	-13%	1.0148	0.0000	-100%
2012	0.9521	1.1598	22%	1.9042	2.0296	7%	0.8331	0.0000	-100%
2013	0.4963	0.5477	10%	0.9925	0.9585	-3%	0.4342	0.0000	-100%
2014	0.7078	0.7695	9%	1.4157	1.3466	-5%	0.6194	0.0000	-100%
2015	1.0497	1.0497	-	2.0995	1.8371	-13%	0.9185	0.0000	-100%
2016	1.2526	1.2526	-	2.5053	2.1921	-13%	1.0960	0.0000	-100%
2017	1.1920	1.1921	0%	2.3840	2.0861	-12%	1.0430	0.0000	-100%
2018	1.2369	1.2369	-	2.4739	0.0871	-96%	1.0823	0.0000	-100%

YEAR	PCDD/F [g I-TEQ]			PCB [kg]		
	P	R	CHANGE	P	R	CHANGE
1990	0.1904	0.9523	400%	0.0000	0.0000	-
1991	0.2734	1.5038	450%	0.0000	0.0000	-
1992	0.3563	2.1383	500%	0.0000	0.0000	-
1993	0.2857	1.8574	550%	0.0000	0.0000	-
1994	0.2151	1.5059	600%	0.0001	0.0001	-
1995	0.1675	1.2567	650%	0.0001	0.0001	-
1996	0.3185	2.5484	700%	0.0000	0.0000	-
1997	0.3240	2.7539	750%	0.0000	0.0000	-

YEAR	PCDD/F [g I-TEQ]			PCB [kg]		
	P	R	CHANGE	P	R	CHANGE
1998	0.2494	2.2447	800%	0.0001	0.0001	-
1999	0.0117	0.1114	850%	0.0001	0.0001	-
2000	0.0011	0.0110	900%	0.0000	0.0000	-
2001	0.0683	0.6832	900%	0.0000	0.0000	-
2002	0.0534	0.5337	900%	0.0000	0.0000	-
2003	0.0570	0.5695	900%	0.0000	0.0000	-
2004	0.1221	1.2210	900%	0.0000	0.0000	-
2005	0.1672	1.6721	900%	0.0000	0.0000	-
2006	0.2206	1.9855	800%	0.0000	0.0000	-
2007	0.2403	2.1623	800%	0.0000	0.0000	-
2008	0.2624	2.3616	800%	0.0000	0.0000	-
2009	0.2073	1.8848	809%	0.0000	0.0000	-
2010	0.3425	3.0829	800%	0.0000	0.0000	0%
2011	0.3624	3.2618	800%	0.0000	0.0000	1%
2012	0.2975	3.2618	996%	0.0001	0.0001	0%
2013	0.1551	1.5404	893%	0.0001	0.0001	-
2014	0.2212	2.1642	878%	0.0001	0.0001	22%
2015	0.3280	2.9524	800%	0.0000	0.0000	10%
2016	0.3914	3.5230	800%	0.0000	0.0000	9%
2017	0.3725	3.3527	800%	0.0001	0.0001	-
2018	0.3865	3.4789	800%	0.0001	0.0001	-

4.6.9 NIKEL PRODUCTION (2C7b)

4.6.9.1 Overview

The category is reported with notation key NO. This production is not occurring in the Slovak Republic. Notation key for fuel was changed from NA to NO likewise in 2B1 where the use of NO key for fuels was advised by the TERT.

4.6.10 OTHER METAL PRODUCTION (2C7c)

4.6.10.1 Overview

The trends of emission from other metal production are presented in ***Table 4.80***. An increasing trend of emissions is connected to the increase of activity data. The decrease in emissions of PMs is connected to the installation of abatement technologies.

Table 4.80: *Overview of emissions in the category 2C7c*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.2657	0.1094	0.2022	0.0087	0.1006	0.1236	0.1374	1.1643
1995	0.2905	0.1196	0.2210	0.0095	0.1100	0.1351	0.1502	1.2729
2000	0.1063	0.0752	0.0316	0.0057	0.0734	0.0902	0.1003	0.0871
2005	0.3427	0.0650	0.1916	0.0048	0.0827	0.1028	0.1143	2.3732
2010	0.7161	0.1150	0.1530	0.0034	0.0591	0.0732	0.0843	1.9161
2011	0.8045	0.1569	0.1901	0.0034	0.0543	0.0668	0.0740	1.6049
2012	0.8273	0.0957	0.2179	0.0043	0.0679	0.0817	0.0901	1.5350
2013	0.4912	0.0991	0.3648	0.0043	0.0674	0.0809	0.0892	1.2957
2014	0.5004	0.1515	0.3776	0.0043	0.0817	0.0981	0.1081	1.3517
2015	0.6116	0.1223	0.4510	0.0037	0.0841	0.1002	0.1102	1.4086

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2016	0.6011	0.2443	0.7525	0.0032	0.0729	0.0882	0.0973	1.3989
2017	0.7102	0.2579	0.8209	0.0030	0.0731	0.0892	0.0985	1.6520
2018	0.6371	0.2562	0.7342	0.0031	0.0526	0.0654	0.0725	1.4052
2019	0.6226	0.2283	0.6774	0.0040	0.0535	0.0652	0.0800	1.2715
1990/2019	**134%**	**109%**	**235%**	**-54%**	**-47%**	**-47%**	**-42%**	**9%**
2018/2019	**-2%**	**-11%**	**-8%**	**29%**	**2%**	**0%**	**10%**	**-10%**

4.6.10.2 Methodological issues

Activities defined in national legislation involved in the category are presented in ***Table 4.81***. Emissions from Aluminium and Copper production were removed and allocated in the relevant categories.

Table 4.81: *Activities according to national categorization included in 2C7c*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
2.6 Treatment of non-ferrous metals ores and manipulation with these materials in powder form.
2.7 Production of non-ferrous metals and their mutual alloys and production of ferroalloys from crude ores, concentrates or secondary raw materials by metallurgical, chemical or electrolytic processes.
2.8 Melting of non-ferrous metals including the alloyage, remelting and refining of metal scrap with a projected melting capacity in t/d: a) for lead and cadmium b) for other non-ferrous metal
2.9 Surface treatment of metals, coating application and related activities except for organic solvents use and powder coating a) Surface treatment - by using an 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 treatment, 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 2000-2019 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 (***Table 4.82***).

Table 4.82: *Emission factors for calculation of historical years*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH_3 [g/GJ]	TSP [g/GJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/GJ]
EF	232 173.93	95 633.52	176 668.20	7 615.01	120 069.23	73%	90%	1 017 423.02

4.6.10.3 Completeness

All rising pollutants were reported. Emissions from Aluminum and Copper production were removed from his category. Notation keys were used in compliance with EMEP/EEA GB_{2019}.

4.6.10.4 Source-specific recalculations

This category was recalculated due to the removal of several sources from the category and recalculation of historical years (***Table 4.83***). Emissions of BC were removed from this category as the EF used in the previous submission was not related to this category.

Table 4.83: *Previous and refined emissions in the category 2C7c*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.8261	0.2657	-68%	0.1054	0.1094	4%	2.0090	0.2022	-90%	0.0080	0.0087	9%
1991	0.8476	0.2737	-68%	0.1082	0.1128	4%	2.0614	0.2083	-90%	0.0082	0.0090	10%
1992	0.8592	0.2775	-68%	0.1097	0.1143	4%	2.0896	0.2112	-90%	0.0083	0.0091	10%
1993	0.8795	0.2830	-68%	0.1122	0.1166	4%	2.1390	0.2153	-90%	0.0085	0.0093	9%
1994	0.9022	0.2904	-68%	0.1151	0.1196	4%	2.1942	0.2210	-90%	0.0087	0.0095	10%
1995	0.8979	0.2905	-68%	0.1146	0.1196	4%	2.1838	0.2210	-90%	0.0087	0.0095	10%
1996	0.9120	0.2938	-68%	0.1164	0.1210	4%	2.2180	0.2236	-90%	0.0088	0.0096	10%
1997	0.9274	0.3032	-67%	0.1184	0.1249	6%	2.2556	0.2307	-90%	0.0089	0.0099	11%
1998	0.9496	0.3143	-67%	0.1212	0.1295	7%	2.3094	0.2391	-90%	0.0092	0.0103	13%
1999	0.9711	0.3248	-67%	0.1239	0.1338	8%	2.3619	0.2472	-90%	0.0094	0.0107	14%
2000	0.3979	0.1063	-73%	0.0782	0.0752	-4%	1.2100	0.0316	-97%	0.0057	0.0057	-
2001	0.4081	0.0976	-76%	0.0582	0.0549	-6%	1.2922	0.1157	-91%	0.0070	0.0070	-
2002	0.4906	0.0759	-85%	0.0741	0.0707	-5%	1.3489	0.0551	-96%	0.0045	0.0045	-
2003	0.5313	0.0553	-90%	0.0749	0.0704	-6%	1.4005	0.0612	-96%	0.0052	0.0052	-
2004	1.0571	0.5127	-52%	0.0829	0.0779	-6%	1.7648	0.3816	-78%	0.0054	0.0054	-
2005	1.0360	0.3427	-67%	0.2146	0.0650	-70%	1.5127	0.1916	-87%	0.0048	0.0048	-
2006	0.9225	0.3511	-62%	0.1388	0.1015	-27%	1.5358	0.1991	-87%	0.0038	0.0038	-
2007	1.1288	0.5421	-52%	0.2326	0.1219	-48%	1.5006	0.0860	-94%	0.0040	0.0040	-
2008	1.0840	0.4634	-57%	0.2714	0.1636	-40%	1.5340	0.0900	-94%	0.0040	0.0040	-
2009	0.8254	0.2755	-67%	0.2310	0.1162	-50%	1.5268	0.0452	-97%	0.0070	0.0070	-
2010	1.2762	0.7161	-44%	0.2347	0.1150	-51%	1.6297	0.1530	-91%	0.0034	0.0034	-
2011	1.3917	0.8045	-42%	0.2615	0.1569	-40%	2.5044	0.1901	-92%	0.0034	0.0034	-
2012	1.3795	0.8273	-40%	0.1708	0.0957	-44%	1.6797	0.2179	-87%	0.0043	0.0043	-
2013	1.0435	0.4912	-53%	0.1318	0.0991	-25%	1.7763	0.3648	-79%	0.0043	0.0043	-
2014	1.0100	0.5004	-50%	0.2102	0.1515	-28%	2.4813	0.3776	-85%	0.0043	0.0043	-
2015	1.0792	0.6116	-43%	0.2261	0.1223	-46%	2.1903	0.4510	-79%	0.0037	0.0037	-
2016	1.0810	0.6011	-44%	0.3766	0.2443	-35%	3.6912	0.7525	-80%	0.0032	0.0032	-
2017	1.2824	0.7102	-45%	0.3203	0.2579	-19%	3.3387	0.8209	-75%	0.0030	0.0030	-
2018	1.2257	0.6371	-48%	0.3012	0.2562	-15%	2.8157	0.7342	-74%	0.0031	0.0031	-

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
1990	0.2180	0.1006	-54%	0.2561	0.1236	-52%	0.2809	0.1374	-51%	16.0954	1.1643	-93%
1991	0.2236	0.1036	-54%	0.2628	0.1273	-52%	0.2883	0.1416	-51%	16.5149	1.1995	-93%
1992	0.2267	0.1051	-54%	0.2664	0.1291	-52%	0.2922	0.1435	-51%	16.7411	1.2160	-93%
1993	0.2321	0.1072	-54%	0.2727	0.1316	-52%	0.2991	0.1464	-51%	17.1369	1.2401	-93%
1994	0.2380	0.1100	-54%	0.2797	0.1351	-52%	0.3068	0.1502	-51%	17.5791	1.2728	-93%
1995	0.2369	0.1100	-54%	0.2784	0.1351	-51%	0.3054	0.1502	-51%	17.4955	1.2729	-93%
1996	0.2406	0.1112	-54%	0.2827	0.1367	-52%	0.3102	0.1519	-51%	17.7694	1.2875	-93%
1997	0.2447	0.1148	-53%	0.2875	0.1410	-51%	0.3154	0.1568	-50%	18.0705	1.3288	-93%
1998	0.2505	0.1190	-53%	0.2944	0.1462	-50%	0.3230	0.1625	-50%	18.5016	1.3772	-93%
1999	0.2562	0.1230	-52%	0.3011	0.1511	-50%	0.3303	0.1680	-49%	18.9221	1.4233	-92%
2000	0.1672	0.0734	-56%	0.1965	0.0902	-54%	0.2155	0.1003	-53%	7.9739	0.0871	-99%
2001	0.1532	0.0557	-64%	0.1800	0.0685	-62%	0.1975	0.0761	-61%	8.0808	0.1676	-98%
2002	0.1284	0.0546	-57%	0.1509	0.0671	-56%	0.1655	0.0746	-55%	10.3992	0.1456	-99%
2003	0.1249	0.0417	-67%	0.1468	0.0513	-65%	0.1611	0.0570	-65%	12.4361	0.0649	-99%
2004	0.1874	0.0955	-49%	0.2202	0.1173	-47%	0.2416	0.1304	-46%	17.3221	3.2499	-81%
2005	0.2096	0.0827	-61%	0.2467	0.1028	-58%	0.2706	0.1143	-58%	17.0967	2.3732	-86%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	C	P	R	C	P	R	C	P	R	C
2006	0.1652	0.0741	-55%	0.1948	0.0909	-53%	0.2136	0.1008	-53%	17.7329	2.7898	-84%
2007	0.1705	0.0660	-61%	0.2012	0.0799	-60%	0.2209	0.0887	-60%	17.7676	2.2124	-88%
2008	0.2331	0.0841	-64%	0.2741	0.1034	-62%	0.3009	0.1149	-62%	17.9195	1.8795	-90%
2009	0.1946	0.0531	-73%	0.2276	0.0658	-71%	0.2495	0.0733	-71%	17.6289	1.2852	-93%
2010	0.1907	0.0591	-69%	0.2224	0.0732	-67%	0.2468	0.0843	-66%	18.4346	1.9161	-90%
2011	0.1262	0.0543	-57%	0.1489	0.0668	-55%	0.1634	0.0740	-55%	17.8252	1.6049	-91%
2012	0.1448	0.0679	-53%	0.1690	0.0817	-52%	0.1852	0.0901	-51%	16.6361	1.5350	-91%
2013	0.1382	0.0674	-51%	0.1608	0.0809	-50%	0.1760	0.0892	-49%	14.8450	1.2957	-91%
2014	0.1811	0.0817	-55%	0.2099	0.0981	-53%	0.2297	0.1081	-53%	15.6133	1.3517	-91%
2015	0.1739	0.0841	-52%	0.2022	0.1002	-50%	0.2213	0.1102	-50%	17.0755	1.4086	-92%
2016	0.1642	0.0729	-56%	0.1918	0.0882	-54%	0.2102	0.0973	-54%	20.9922	1.3989	-93%
2017	0.1848	0.0731	-60%	0.2155	0.0892	-59%	0.2360	0.0985	-58%	19.4547	1.6520	-92%
2018	0.1619	0.0526	-67%	0.1881	0.0654	-65%	0.2059	0.0725	-65%	18.8361	1.4052	-93%

P-Previous
R-Refined
C-Change

4.6.11 STORAGE, HANDLING AND TRANSPORT OF METAL PRODUCTS (2C7D)

4.6.11.1 Overview

Activities of storage, handling and transport of metal products are usually involved in individual sources. Emissions of air pollutants are from this reason reported with notation key IE.

4.7 SOLVENTS AND OTHER PRODUCT USE (NFR 2D, 2G)

The chapter provides information on emission inventory of NMVOC for the sector solvents, which covers NFR categories 2D3a, 2D3b, 2D3c, 2D3d, 2D3a, 2D3h, 2D3e, 2D3f, 2D3g, 2D3i and 2G. In categories 2D3b and 2D3c are relevant emissions of PMs, TSP, BC and PCDD/F and in sources of 2D3c is emitted besides CO emissions. In the category 2D3i, emissions of lubricant consumption in transport were added. The categories included in emission balance are listed in ***Table 4.84***.

Table 4.84: *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 so-called solvents are non-methane volatile organic compounds (NMVOC). They are part of many different substances, which are used in the 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, variety of household products or car care products, fuels, hydraulic fluids and others. However, the fuels are not the primary objective of this chapter. Their versatility leads to more difficult tracking the fluxes and some categories are estimated, especially for domestic use.

Emissions released from this subsector are listed in ***Table 4.85***. Shares of released emissions of NMVOC in 2019 included in NFR categories 2D are presented in ***Figure 4.8***.

Figure 4.8 *The share in NMVOC emissions of individual categories in 2D in 2019*

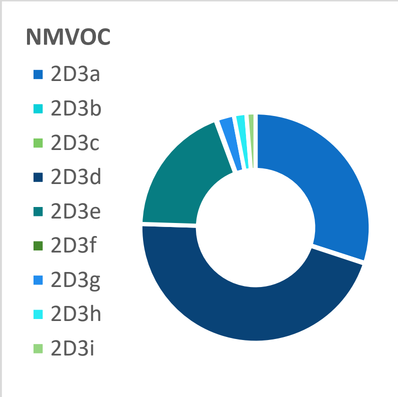


Table 4.85: *Overview of emissions in the category 2D*

YEAR	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	Cd [t]	Hg [t]	As [t]
1990	38.5027	0.0990	0.1254	0.2920	0.0020	0.0000	0.0297	0.0001
1995	35.8277	0.0495	0.0626	0.1403	0.0010	0.0000	0.0300	0.0000
2000	29.6027	0.0477	0.0600	0.0834	0.0007	0.0000	0.0302	0.0000
2005	30.7325	0.0039	0.0062	0.0165	0.0001	0.0000	0.0302	0.0000
2010	22.4157	0.0014	0.0026	0.0087	0.0000	0.0000	0.0304	0.0000
2011	26.1459	0.0016	0.0030	0.0108	0.0000	0.0000	0.0302	0.0000
2012	21.1965	0.0015	0.0026	0.0088	0.0000	0.0000	0.0303	0.0000
2013	21.0883	0.0015	0.0028	0.0104	0.0000	0.0000	0.0303	0.0000
2014	22.5021	0.0011	0.0023	0.0095	0.0000	0.0000	0.0303	0.0000
2015	25.6429	0.0005	0.0020	0.0129	0.0000	NO	0.0304	NO
2016	23.9248	0.0007	0.0015	0.0066	0.0000	NO	0.0304	NO
2017	21.7249	0.0005	0.0012	0.0059	0.0000	NO	0.0305	NO
2018	24.1538	0.0005	0.0011	0.0052	0.0000	NO	0.0305	NO
2019	20.5470	0.0004	0.0010	0.0051	0.0000	NO	0.0306	NO
1990/2019	**-47%**	**-100%**	**-99%**	**-98%**	**-100%**	**-**	**3%**	**-**
2018/2019	**-15%**	**-8%**	**-6%**	**-2%**	**-7%**	**-**	**0%**	**-**

YEAR	Cr [t]	Ni [t]	Se [t]	PCDD/F [g I-TEQ]	PAHs [t]
1990	0.0008	0.0065	0.0001	0.0257	0.3319
1995	0.0004	0.0033	0.0000	0.0120	0.1681
2000	0.0003	0.0023	0.0000	0.0043	0.1185
2005	0.0002	0.0016	0.0000	0.0079	0.0823
2010	0.0002	0.0013	0.0000	0.0074	0.0644
2011	0.0002	0.0014	0.0000	0.0088	0.0717
2012	0.0002	0.0014	0.0000	0.0072	0.0703
2013	0.0000	0.0003	0.0000	0.0060	0.0169
2014	0.0001	0.0009	0.0000	0.0055	0.0473
2015	NO	NO	NO	0.0103	NO

YEAR	Cr [t]	Ni [t]	Se [t]	PCDD/F [g I-TEQ]	PAHs [t]
2016	NO	NO	NO	0.0074	NO
2017	NO	NO	NO	0.0077	NO
2018	NO	NO	NO	0.0090	NO
2019	NO	NO	NO	0.0093	NO
1990/2019	**-**	**-**	**-**	**-64%**	**-**
2018/2019	**-**	**-**	**-**	**3%**	**-**

4.7.1 DOMESTIC SOLVENT USE INCLUDING FUNGICIDES (NFR 2D3a)

4.7.1.1 Overview

Emissions of NMVOCs have increasing character in this category due to the trend in activity data. Emissions, its trend and activity data are shown in ***Table 4.86***.

In this submission, the NMVOC emissions were recalculated due to the change of the methodology. The higher tier (Tier 2) was used.

Table 4.86: *Activity data and emissions in the category 2D3a*

YEAR	INHABITANTS	NMVOC [kt]	Hg [t]
1990	5297774	4.6887	0.0297
1995	5363676	4.7589	0.0300
2000	5400679	4.4477	0.0302
2005	5387285	4.6860	0.0302
2010	5431024	3.6796	0.0304
2011	5394251	4.7223	0.0302
2012	5407579	5.8156	0.0303
2013	5413393	4.0732	0.0303
2014	5418649	3.8580	0.0303
2015	5423800	4.4401	0.0304
2016	5430798	5.3332	0.0304
2017	5437754	6.4964	0.0305
2018	5446771	6.3239	0.0305
2019	5457873	6.1607	0.0306
1990/2019	**3%**	**31%**	**3%**
2018/2019	**0%**	**-3%**	**0%**

4.7.1.2 Methodological issues

This category is performed by the Tier 2 method for the first time (NMVOC emissions). It is a combination of Tier 2a and Tier 2b method. 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 the most sources were calculated using Tier 2a method. Solvent contents and emission factors were taken from EMEP/EEA GB_{2019} (***Table 4.87***). Emissions from the insecticides, fungicides and herbicides were calculated using Tier 2b method, emission factors were taken from EMEP/EEA GB_{2019} (***Table 4.88***).

Table 4.87: *Used solvent contents and emissions factors (per t of solvent) for Tier 2a method according to the EMEP/EEA GB_{2019}.*

SOURCE	SOLVENT CONTENT [%]	EF NMVOC [kg/t]
Perfumes and toilet waters	80	950
Hair lacquers	90	950
Pre-shave, shaving or aftershave preparations	80	950
Personal deodorants and antiperspirants	50	950
Polishes, creams and similar preparations, for footwear or leather	45	950
Polishes, creams and similar preparations, for the maintenance of wooden furniture, floors or other woodwork	80	950
Soap in forms excluding bars, cakes or moulded shapes, paper, wadding, felt and non-wovens impregnated or coated with soap/detergent, flakes, granules or powders	5	950
Windscreen wipers, defrosters and demisters for motorcycles or motor vehicles	50	500

Table 4.88: *Used solvent contents and emissions factors (per t of product) for Tier 2b method according to the EMEP/EEA GB_{2019}.*

SOURCE	EF NMVOC [kg/t]
Insecticides	150
Fungicides	150
Herbicides, anti-sprouting products and plant-growth regulators	150

Historical data: The emissions are taken from the Statistical Office of the Slovak republic for the years 1999 to 2019. 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 4.89***.

Table 4.89: *Activity data (consumption = production + import – export) in the category 2D3a*

YEAR	PERFUMES AND TOILET WATERS	HAIR LACQUERS	PRE-SHAVE, SHAVING OR AFTERSHAVE PREPARATIONS	PERSONAL DEODORANTS AND ANTIPERSPIRANTS
1999	0.888	0.409	1.160	2.163
2000	0.890	0.410	1.162	2.166
2001	0.887	0.409	1.158	2.159
2002	0.887	0.409	1.159	2.159
2003	0.887	0.409	1.159	2.161
2004	0.889	0.409	1.161	2.163
2005	0.890	0.410	1.162	2.166
2006	0.891	0.411	1.164	2.169
2007	0.892	0.411	1.166	2.172
2008	0.894	0.412	1.168	2.177
2009	0.897	0.413	1.171	2.183
2010	0.865	0.264	0.855	1.858
2011	1.580	0.164	1.065	1.596
2012	0.662	0.514	2.735	1.800

YEAR	PERFUMES AND TOILET WATERS	HAIR LACQUERS	PRE-SHAVE, SHAVING OR AFTERSHAVE PREPARATIONS	PERSONAL DEODORANTS AND ANTIPERSPIRANTS
2013	0.653	0.097	0.665	1.822
2014	0.529	0.117	0.736	1.853
2015	0.948	0.249	0.840	1.768
2016	0.880	0.216	1.002	2.439
2017	1.282	0.775	1.421	3.265
2018	1.155	0.952	1.306	2.940
2019	1.105	0.805	1.135	2.587

YEAR	POLISHES, CREAMS AND SIMILAR PREPARATIONS, FOR FOOTWEAR OR LEATHER	POLISHES, CREAMS AND SIMILAR PREPARATIONS, FOR THE MAINTENANCE OF WOODEN FURNITURE, FLOORS OR OTHER WOODWORK	SOAP IN FORMS EXCLUDING BARS, CAKES OR MOULDED SHAPES, PAPER, WADDING, FELT AND NON-WOVENS IMPREGNATED OR COATED WITH SOAP/DETERGENT, FLAKES, GRANULES OR POWDERS
1999	0.132	0.199	1.656
2000	0.061	0.203	2.351
2001	0.150	0.192	2.590
2002	0.164	0.144	3.370
2003	0.133	0.136	3.583
2004	0.103	0.268	2.879
2005	0.092	0.413	3.266
2006	0.085	0.461	2.678
2007	0.152	0.433	2.681
2008	0.180	0.504	1.671
2009	0.143	0.337	1.669
2010	0.202	0.145	1.246
2011	0.236	0.613	1.337
2012	0.264	0.549	5.065
2013	0.288	0.649	3.902
2014	0.292	0.721	3.286
2015	0.238	0.655	3.275
2016	0.170	1.154	3.508
2017	0.258	0.722	3.158
2018	0.170	0.717	3.305
2019	0.136	0.772	3.316

YEAR	WINDSCREEN WIPERS, DEFROSTERS AND DEMISTERS FOR MOTORCYCLES OR MOTOR VEHICLES	INSECTICIDES	FUNGICIDES	HERBICIDES, ANTI-SPROUTING PRODUCTS AND PLANT-GROWTH REGULATORS
1999	0.032	1.551	1.929	4.568
2000	0.031	1.554	1.932	4.574
2001	0.045	1.548	1.925	4.559
2002	0.061	1.549	1.926	4.560
2003	0.066	1.550	1.927	4.563
2004	0.094	1.552	1.929	4.568
2005	0.120	1.554	1.932	4.574
2006	0.365	1.556	1.934	4.580
2007	0.133	1.558	1.938	4.588
2008	0.679	1.562	1.942	4.598
2009	0.346	1.566	1.947	4.610
2010	0.500	1.189	1.376	3.317

YEAR	WINDSCREEN WIPERS, DEFROSTERS AND DEMISTERS FOR MOTORCYCLES OR MOTOR VEHICLES	INSECTICIDES	FUNGICIDES	HERBICIDES, ANTI-SPROUTING PRODUCTS AND PLANT-GROWTH REGULATORS
2011	0.139	1.187	1.904	4.564
2012	0.138	1.260	2.189	4.114
2013	0.282	1.291	1.604	5.446
2014	0.166	1.487	1.321	4.169
2015	0.081	2.082	2.044	4.230
2016	0.466	1.963	2.310	4.572
2017	0.433	1.586	2.478	4.677
2018	0.594	1.714	1.985	5.102
2019	0.707	1.967	2.340	6.105

4.7.1.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.1.4 Source-specific recalculations

The recalculation of the whole time series has been made due to the methodology change (use of higher tier) following the Recommendation No ***SK-2D3a-2019-0001***. Impact on the NMVOC emissions is presented in **Chapter 4.3** where the impact of all recalculations provided in the 2D category is presented.

4.7.2 ROAD PAVING WITH ASPHALT (NFR 2D3b)

4.7.2.1 Overview

Numbers of operators vary around 50 installations, yearly. The operators ensure the obligation of regular emission monitoring and yearly emission balance in line with national legislation by way of continuous or discontinuous monitoring or by the approved way of determining the yearly emissions. The yearly emission balances are reported under the fees decisions (Act No 401/1998 on air pollution charges as amended). Discontinuous monitoring can be performed solely by the authorized and accredited person in line with national requirements. The category reports NMVOC, $PM_{2.5}$, PM_{10}, TSP, BC and PCDD/PCDF emissions. The emissions show a decreasing overall trend (***Table 4.90***).

Table 4.90: *Activity data and emissions in the category 2D3b*

YEAR	ASPHALT USED [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	PCDD/F [g I-TEQ]
1990	366800.00	0.0705	0.0163	0.0218	0.1874	0.0009	0.0257
1995	170986.00	0.0328	0.0076	0.0102	0.0873	0.0004	0.0120
2000	60963.00	0.0117	0.0022	0.0030	0.0258	0.0001	0.0043
2005	112992.00	0.0191	0.0001	0.0014	0.0117	0.0000	0.0079
2010	105650.00	0.0144	0.0001	0.0008	0.0069	0.0000	0.0074
2011	125300.00	0.0182	0.0001	0.0011	0.0088	0.0000	0.0088
2012	102250.00	0.0149	0.0001	0.0008	0.0070	0.0000	0.0072
2013	85950.00	0.0152	0.0001	0.0010	0.0086	0.0000	0.0060
2014	79195.00	0.0137	0.0001	0.0010	0.0082	0.0000	0.0055
2015	147300.00	0.0201	0.0001	0.0015	0.0124	0.0000	0.0103
2016	105800.00	0.0189	0.0001	0.0007	0.0058	0.0000	0.0074
2017	109993.00	0.0187	0.0001	0.0006	0.0054	0.0000	0.0077
2018	128394.00	0.0199	0.0000	0.0006	0.0047	0.0000	0.0090
2019	132501.00	0.0165	0.0000	0.0005	0.0046	0.0000	0.0093
1990/2019	**-64%**	**-77%**	**-100%**	**-97%**	**-98%**	**-100%**	**-64%**
2018/2019	**3%**	**-17%**	**-2%**	**-2%**	**-1%**	**-2%**	**3%**

4.7.2.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators. No small sources are on the territory of the SR, thus data from the NEIS covers all activity. The category uses the Tier 3 method.

Table 4.91: *Industrial activities included in 2D3b according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.5 Manufacturing of bituminous mixtures with the projected production capacity of the mixture in tonnes/hour.

The sources are considered as mixed and have inseparable combustion and technological emissions at release because NFR code assignment is associated with the entire source coding (3.5). However, most of the sources use the natural gas (NG) as a fuel, therefore NO_X, SO_X and CO are assumed of having the combustion origin. And it is also assumed that VOC, TSP and PMs do not create a significant part of released emissions from NG. The allocation of 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 category (approx. 70 %) report their emissions by way of mass flow multiplied by the number of operational hours per related year. Mass balance is determined by authorized measurement according to ISO standard procedures.

Equation 4.3: *Calculation No 1*

$$Em\,[t] = q[kg/h] \times t[h] \times 10^{-3}$$

Where

q = Mass flow

t = Number of operational hours for related year

The rest of operators (approx. 30 %) report the emissions by the calculation:

Equation 4.4: *Calculation No 2*

$$Em\,[t] = (1 - \eta/100) \times EF\,[kg/M\,of\,AD] \times AD\,[M\,of\,AD] \times 10^{-3}$$

Where

EF = Emission Factor

AD = Activity Data (M of AD = Quantity of related Activity Data).

In case of activity data is fuel, because of mix sources (combined combustion and technological process), the emissions are performed by the calculation:

Equation 4.5: *Other calculations*

$$Em[t] = (1 - \eta/100) \times EF\,[kg/t] \times AD\,[t] \times 10^{-3}$$

$$EM_{Total} = (1 - 1 - \eta/100) \times EF[kg/mil.m^3] \times AD\,[th.m^3]$$

Where

EF = Emission Factor

AD = Quantity of fuel

For EF please see **ANNEX IV, Chapter A4.6**.

Abatement: The abatement techniques with individual effectiveness are also in the registry of the NEIS and final emissions are calculated with respect of separator 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. Algorithm for calculation of PM_{10} and $PM_{2.5}$ is applicable only for data 2005 and newer due to the database structure. Emissions are calculated from the values of TSP as their fraction according to Interim Study 2008[1] prepared for SHMU with the base of GAINS methodology published by IIASA[2].

Activity data: Some information can be found in the NEIS. The production is independently obtained from the Research Institute of Engineering Constructions who is authorized by the Slovak Association for Asphalt roads (SAAV) for collecting and verification of data. The activity data is in form of annual reports of produced and used asphalt and asphalt mixtures in the road construction sector.

POPs: Emissions of PCDD/F were calculated using UNEP Toolkit for Asphalt mixing:

$EF_{PCDD/F}$=0.00007 [mg/Mg Asphalt]

Historical data: The emissions are taken from the NEIS for years 2005 to 2019.

The national emission factors are used for the calculation of historical data. The EFs were calculated as a weighted average from the values of implied emission factors, which were calculated for every available year in the period 2000-2004 and related yearly consumption of asphalt. PMs were calculated as an average of share from TSP in previous years 2000–2004.

EF_{NMVOC} = 0.19 [g/Mg Asphalt]

EF_{TSP} = 0.51 [g/Mg Asphalt]

$EF_{PM2.5}$ = 8.71% EF_{TSP}

EF_{PM10} = 11.65% % EF_{TSP}

4.7.2.3. Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.2.4 Source-specific recalculations

Emissions from historical years were recalculated due to change of emissions factors. Impact of recalculations on the NMVOC emissions in the category 2D is shown in Chapter 4.3. Impact on the emissions of PMs in this category is in ***Table 4.92***.

Table 4.92: *Previous and refined emission of PMs in the category 2D3b*

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			BC [kt]		
	PREVIOUS	REFINED	CHANGE	PREVIOUS	REFINED	CHANGE	PREVIOUS	REFINED	CHANGE
1990	0.0019	0.0163	771%	0.0225	0.0218	-3%	0.0001	0.0009	771%
1991	0.0008	0.0073	771%	0.0100	0.0097	-3%	0.0000	0.0004	771%
1992	0.0010	0.0088	771%	0.0121	0.0117	-3%	0.0001	0.0005	771%
1993	0.0007	0.0057	771%	0.0079	0.0077	-3%	0.0000	0.0003	771%
1994	0.0008	0.0067	771%	0.0092	0.0089	-3%	0.0000	0.0004	771%
1995	0.0009	0.0076	771%	0.0105	0.0102	-3%	0.0000	0.0004	771%
1996	0.0010	0.0085	771%	0.0117	0.0113	-3%	0.0001	0.0005	771%
1997	0.0007	0.0063	771%	0.0087	0.0084	-3%	0.0000	0.0004	771%
1998	0.0007	0.0062	771%	0.0086	0.0083	-3%	0.0000	0.0004	771%
1999	0.0008	0.0067	771%	0.0093	0.0090	-3%	0.0000	0.0004	771%
2000	0.0003	0.0022	771%	0.0031	0.0030	-3%	0.0000	0.0001	771%

[1] SHMU, ECOSYS: *Návrh výpočtu tuhých znečisťujúcich látok s aerodynamickým priemerom menších ako 10 a 2.5 μm (PM10 a PM2.5),* Bratislava, August 2008, Interim report.
[2] Z. KLIMONT, J. COFALA, I. BERTOK, M. AMANN, C. HEYES, F. GYARFAS: *Modelling Particulate Emissions in Europe (A Framework to Estimate Reduction Potential and Control Costs)*, 2002, IIASA Interim Report. IIASA, Laxenburg, Austria: IR-02-076Z., available at: http://pure.iiasa.ac.at/6712

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			BC [kt]		
	PREVIOUS	REFINED	CHANGE	PREVIOUS	REFINED	CHANGE	PREVIOUS	REFINED	CHANGE
2001	0.0006	0.0049	771%	0.0067	0.0065	-3%	0.0000	0.0003	771%
2002	0.0005	0.0047	771%	0.0064	0.0063	-3%	0.0000	0.0003	771%
2003	0.0002	0.0017	771%	0.0024	0.0023	-3%	0.0000	0.0001	771%
2004	0.0001	0.0009	771%	0.0013	0.0012	-3%	0.0000	0.0001	771%

4.7.3 ASPHALT ROOFING (NFR 2D3c)

4.7.3.1 Overview

The category reports NMVOC, $PM_{2.5}$, PM_{10}, TSP and BC emissions. Emissions have an overall decreasing trend (***Table 4.93***).

Table 4.93: *Activity data and emissions in the category 2D3c*

YEAR	ASPHALT USED FOR ROOFING [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	130.17	0.0467	0.0827	0.1036	0.1046	0.0011
1995	65.92	0.0237	0.0419	0.0525	0.0530	0.0005
2000	46.47	0.0163	0.0454	0.0570	0.0575	0.0006
2005	32.28	0.0058	0.0038	0.0047	0.0048	0.0000
2010	25.26	0.0024	0.0014	0.0017	0.0017	0.0000
2011	28.10	0.0024	0.0015	0.0019	0.0019	0.0000
2012	27.59	0.0023	0.0014	0.0018	0.0018	0.0000
2013	6.64	0.0029	0.0014	0.0018	0.0018	0.0000
2014	18.54	0.0026	0.0011	0.0013	0.0013	0.0000
2015	NE	0.0010	0.0004	0.0005	0.0005	0.0000
2016	NE	0.0020	0.0006	0.0008	0.0008	0.0000
2017	NE	0.0013	0.0004	0.0006	0.0006	0.0000
2018	NE	0.0021	0.0004	0.0005	0.0005	0.0000
2019	NE	0.0019	0.0004	0.0005	0.0005	0.0000
1990/2019	**-**	**-96%**	**-100%**	**-100%**	**-100%**	**-100%**
2018/2019	**-**	**-9%**	**-9%**	**-9%**	**-9%**	**-9%**

4.7.3.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.91*: Industrial activities included in 2D3c according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.37 Production of waterproofing materials and floor coverings with a projected amount of raw materials processed in kg/h.

No small sources are on the territory of SR thus the Tier 3 method is used.

$$Em_{TOTAL} = Em_{NEIS}$$

The category code is associated with the sources, therefore some emissions from technological processes are inseparable from the combustion processes. Mix source of combustion and non-combustion emissions. NFR code is assigned to the source. The source in the NEIS database is a technological facility (installation) or a particular part of the facility (installation). Source uses fuel directly into the technological process. Therefore source's output/discharge emissions compiled by the NEIS or based on measurements contains the fractions of non- and combustion emissions that are inseparable.

Activity data: Provided activity data (used asphalt) is obtained from statistics and are harmonized with GHG emission inventory.

Historical data: The emissions are taken from the NEIS for the years 2005 to 2019.

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 of share from TSP in previous years 2000–2004. BC is calculated according to EF from EMEP/EEA GB_{2019}.

EF_{NMVOC} = 358.89 [g/Mg Asphalt Use for Roofing]

EF_{TSP} = 1 088.76 [g/Mg Asphalt Use for Roofing]

$EF_{PM2.5}$ = 79% EF_{TSP}

EF_{PM10} 99% EF_{TSP}

EF_{BC} = 0.013% $EF_{PM2.5}$

4.7.3.3 Completeness

All pollutants are covered. Emissions of CO were reallocated from this category to category **1A2gviii**, as they originate from combustion of fuels. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.3.4 Source-specific recalculation

Emissions from historical years were recalculated due to change of emissions factors. Impact of recalculations on the NMVOC emissions in the category 2D is shown in **Chapter 4.3**. Impact on the emissions of PMs in this category is in ***Table 4.94***.

Table 4.94: *Previous and refined emission of PMs in the category 2D3c*

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			BC [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.1120	0.0827	-26%	0.1403	0.1036	-26%	0.1417	0.1046	-26%	0.0015	0.0011	-26%
1991	0.0715	0.0528	-26%	0.0896	0.0662	-26%	0.0906	0.0669	-26%	0.0009	0.0007	-26%
1992	0.0724	0.0535	-26%	0.0908	0.0670	-26%	0.0917	0.0677	-26%	0.0009	0.0007	-26%
1993	0.0434	0.0321	-26%	0.0544	0.0402	-26%	0.0550	0.0406	-26%	0.0006	0.0004	-26%
1994	0.0535	0.0395	-26%	0.0671	0.0495	-26%	0.0677	0.0500	-26%	0.0007	0.0005	-26%
1995	0.0567	0.0419	-26%	0.0711	0.0525	-26%	0.0718	0.0530	-26%	0.0007	0.0005	-26%
1996	0.0519	0.0383	-26%	0.0650	0.0480	-26%	0.0657	0.0485	-26%	0.0007	0.0005	-26%
1997	0.0493	0.0364	-26%	0.0618	0.0456	-26%	0.0625	0.0461	-26%	0.0006	0.0005	-26%
1998	0.0434	0.0321	-26%	0.0544	0.0402	-26%	0.0550	0.0406	-26%	0.0006	0.0004	-26%
1999	0.0538	0.0397	-26%	0.0675	0.0498	-26%	0.0681	0.0503	-26%	0.0007	0.0005	-26%
2000	0.0454	0.0454	0%	0.0570	0.0570	0%	0.0575	0.0575	-	0.0006	0.0006	0%
2001	0.0305	0.0305	0%	0.0383	0.0383	0%	0.0387	0.0387	-	0.0004	0.0004	0%
2002	0.0277	0.0277	0%	0.0347	0.0347	0%	0.0350	0.0350	-	0.0004	0.0004	0%
2003	0.0039	0.0039	0%	0.0049	0.0049	0%	0.0050	0.0050	-	0.0001	0.0001	0%
2004	0.0038	0.0038	0%	0.0047	0.0047	0%	0.0048	0.0048	-	0.0000	0.0000	0%

P-Previous
R-Refined

4.7.4 COATING APPLICATIONS (NFR 2D3d)

4.7.4.1 Overview

The category reports NMVOC emissions. Emissions have an overall decreasing trend (***Table 4.95***).

Table 4.95: *Activity data and emissions in the category 2D3d*

YEAR	COATINGS APPLIED [kt]	NMVOC [kt]
1990	NE	16.2918
1995	NE	16.0548

YEAR	COATINGS APPLIED [kt]	NMVOC [kt]
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
1990/2019	**-**	**-43%**
2018/2019	**-36%**	**-22%**

4.7.4.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators. Small sources on the territory of SR not covered by the NEIS are calculated from statistical data. Combination of T2+T3 is used.

***Table 4.96**: Industrial activities included in 2D3d according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
6.1 Paint shops in the automotive industry with a projected consumption of organic solvents in tonnes/year
6.2 Surface coating of road vehicles with a total projected consumption of organic solvents in tonnes/year: a) in automotive manufacturing of small series b) surface coating of road vehicles in cases where the activity is performed by unautomated technological units c) car repair – vehicle spraying in car paint shops)
6.3 Surface coating with a projected consumption of organic solvents in tonnes/year: a) of metal and plastics, including the ships covering, aircraft and railway trackage vehicle; textile, fabric, film and paper coating b) on winding wire c) on reel strips of metallic materials
6.9 Industrial wood processing: a) mechanical processing of wooden lumps with projected processing capacity in v m^3/day b) mechanical processing of disintegrated wooden mass such as sawdust, shavings, chips with a projected processing capacity in v m^3/day c) production of agglomerated materials with projected consumption of polycondensated adhesives in tonnes of dry matter/year Processing and surface treatment using organic solvents including associated activities, such as deburring, according to a projected consumption of organic solvents in tonnes/year: a) adhesive application b) wood and plastic lamination c) coating application d) impregnation

Emissions: Decree No 410/2012 Coll. as amended defined limit >= 0.6 t/yr. for the obligation of solvents evidence and registering into the NEIS as a medium source of air pollution. The cat. 6.9 in Slovak legislation covers more activities concerning to the wood processing as defined in the NFR. Therefore, the mechanical processing of wood is included. Yearly numbers of operators vary around 450 and cover large and medium sources. Emissions taken from the NEIS database are processed by the system and abatement of environmental technology, recovery fluxes or separators are already taken into account in final emissions.

Emission calculations:

Em $_{TOTAL}$ = Em $_{SMALL SOURCES}$ + Em $_{NEIS}$

Calculations in the NEIS: Reporting of solvents in the NEIS evidence is performed in Balance sheets of organic solvents for individual releases. Quantity of VOC is calculated by equations:

Equation 4.6: *Equation a)*

$$E\ [t] = c[mg/m^3] \times V[th.m^3] \times 10^{-6}$$

Where

c = concentration of air pollutant

V = quantity/volume of released waste gas

Equation 4.7: *Equation b)*

$$E\ [t] = q[kg/h] \times t[h] \times 10^{-3}$$

Where

q = mass flow

t = number of operational hours for related year

Equation 4.8: *Equation c) Direct and indirect balance in case of unambiguous emission dependence*

$$E = 01 + F$$

Where

O1 = Emissions released by outputs

F = Fugitive emissions are differently calculated for direct and indirect emissions

Calculations of Small Sources: Small sources were balanced. The balance is performed by a top-down approach. The statistical data is processed and total solvents consumption is calculated according to the scheme of the interim studies on specific solvents 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 as 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 the 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 years 2005 to 2019. 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 4.97: *Statistical activity data of total product consumption in t*

YEAR	SB	WB
2001	32 009	21 231
2002	36 099	23 569

YEAR	SB	WB
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

Table 4.98: *2D3d - Emission of NMVOC (t) in the division of Small sources and Industrial sources*

YEAR	EM SS	EM NEIS
2005	12 410	2 215
2006	14 927	2 720
2007	10 436	2 858
2008	13 157	2 745
2009	13 201	2 368
2010	10 908	2 666
2011	8 071	3 014
2012	7 338	3 371
2013	8 438	3 036
2014	10 158	3 204
2015	11 843	3 342
2016	9 674	3 490
2017	7 468	3 658
2018	8 157	3 857
2019	5 184	4 150

4.7.4.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.4.4 Source-specific recalculations

In this submission, the historical data were recalculated. Identified outliers in the time series were checked at the operators and corrected when necessary. The corrections of several outliers resulted in the change of the extrapolated trend. Impact on the NMVOC emissions is presented in **Chapter 4.3**.

4.7.5 DEGREASING (NFR 2D3e)

4.7.5.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (***Table 4.99***). The peak of recorded emission in 2011 relates to the activity data from statistics, namely decrease of exported solvents and increased amount of imported.

Table 4.99: *Activity data and emissions in the category 2D3e*

YEAR	SOLVENTS USED [kt]	NMVOC [kt]
1990	10.73	10.5242
1995	9.42	9.2301
2000	8.10	7.9361
2005	7.00	6.8824
2010	3.85	3.7372
2011	8.92	8.8211
2012	3.14	3.0365
2013	4.25	4.1564
2014	3.91	3.8076
2015	4.71	4.6319
2016	4.09	4.0113
2017	2.73	2.6479
2018	4.49	4.4097
2019	3.94	3.8703
1990/2019	**-63%**	**-63%**
2018/2019	**-12%**	**-12%**

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. Combination of T2 + T3 is used.

Table 4.100: *Industrial activities included in 2D3e according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
6.4. Degreasing and cleaning of metal surfaces, electrocomponents, plastics and other materials including the removal of old coatings by organic solvents with a projected consumption in tonnes/year: a) organic solvents according to § 26 paragraph. 1 b) other organic solvents

Decree No 410/2012 Coll. as amended defined the limit >= 0.6 t/yr. for the obligation of solvents evidence and registering into the NEIS as a medium source of air pollution. Emissions taken from the NEIS database are processed by the system and abatement of environmental technology, recovery fluxes or separators are already taken into account in final emissions.

$$Em_{TOTAL} = Em_{SMALL\ SOURCES} + Em_{NEIS}$$

Calculations in the NEIS: Please, see methods of Calculations in the NEIS in **ANNEX IV Chapter A4.1-A4.5**.

Calculations of Small Sources: The calculation of small sources is balanced likewise in 2D3d. The balance is performed by a top-down approach. The statistical data are processed and total solvents consumption is calculated but without the step of calculating the VOC specific content because of the specific pure solvents that are used for this purposes in SR (for VOC using for degreasing activities are Trichlorethylene, Tetrachlorethylene (perchloroethylene), 1-propanol (propanol) and 2-propanol (i-propanol) and Acetone are balanced). For the small sources, the assumption of no separator technology is used and the conversion of solvents used to the air is 100%.

Small sources calculation:

Production + Import – Export = Total Product Consumption

Total Product Consumption → Calculation of Total Solvents Consumption

Total Solvents Consumption - Industrial Solvents Consumption = Small Sources

Table 4.101: *2D3e- Emission of NMVOC (t) in the division of small sources and industrial sources*

YEAR	EM SS	EM NEIS
2005	6 680	202
2006	6 866	178
2007	5 742	193
2008	5 418	162
2009	4 864	121
2010	3 627	110
2011	8 700	121
2012	2 934	102
2013	4 060	96
2014	3 719	89
2015	4 542	90
2016	3 918	94
2017	2 536	112
2018	4 312	97
2019	3785	85

4.7.5.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.5.4 Source-specific recalculations

In this submission, the historical data were recalculated. Identified outliers in the time series were checked at the operators and corrected when necessary. The corrections of several outliers resulted in the change of the extrapolated trend. Impact on the NMVOC emissions is presented in **Chapter 4.3**.

4.7.6 DRY CLEANING (NFR 2D3f)

4.7.6.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (***Table 4.102***).

Table 4.102: *Activity data and emissions in the category 2D3f*

YEAR	SOLVENTS USED [kt]	NMVOC [kt]
1990	0.09	0.0642
1995	0.08	0.0595
2000	0.07	0.0548
2005	0.07	0.0500
2010	0.06	0.0455
2011	0.06	0.0468
2012	0.05	0.0401
2013	0.04	0.0395
2014	0.05	0.0439
2015	0.05	0.0429
2016	0.04	0.0409
2017	0.04	0.0364
2018	0.04	0.0361
2019	0.04	0.0334
1990/2019	**-60%**	**-48%**
2018/2019	**-16%**	**-7%**

4.7.6.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.103: *Industrial activities included in 2D3f according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
6.5. Dry cleaning of textiles, bleaching and dyeing of fabrics and other fibrous materials such as linen, cotton, jute, by: a) a projected consumption of organic solvents in tonnes/year b) a projected amount of bleached or dyed textiles or fibres in tonnes/day

Numbers of operators have declined from 127 to approximately 100 in the recent 10 years that is the driver of decline. No small sources are on the territory of SR, because Decree defined limit = 0 for the obligation of solvents evidence and registering into the NEIS as a medium source of air pollution.

$$Em_{TOTAL} = Em_{NEIS}$$

<u>*Calculations in the NEIS:*</u> Reporting of solvents in the NEIS evidence is performed in Balance sheets of organic solvents for individual releases. Quantity of VOC is calculated by equations:

Equation 4.9: *Equation a)*

$$E\ [t] = c[mg/m^3] \times V[th.m^3] \times 10^{-6}$$

Where

c = concentration of air pollutant

V = quantity/volume of released waste gas

Equation 4.10: *Equation b)*

$$E\ [t] = q[kg/h] \times t[h] \times 10^{-3}$$

Where

q = mass flow

t = number of operational hours for related year

Equation 4.11: *Equation* c) Direct and indirect balance in case of unambiguous emission dependence

$$E = O1 + F$$

Where

O1 = Emissions released by outputs

F = Fugitive emissions are differently calculated for direct and indirect emissions

Historical data: The emissions are taken from the NEIS for years 2005 to 2019. Due to the absence of statistical data before 2001 as well as data in the NEIS before 2005, the historical data are extrapolated with a linear trend.

4.7.6.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.6.4 Source-specific recalculations

In this submission, the historical data were recalculated. Identified outliers in the time series were checked at the operators and corrected when necessary. The corrections of several outliers resulted in the change of the extrapolated trend. Impact on the NMVOC emissions is presented in **Chapter 4.3.**

4.7.7 CHEMICAL PRODUCTS (NFR 2D3g)

4.7.7.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (***Table 4.104***). The most remarkable decline was in 2006. Emissions of HMs and PAHs were reported for the first time in this submission.

Table 4.104: *Activity data and emissions in the category 2D3g*

YEAR	SOLVENTS USED [kt]	ASPHALT USED [kt]	NMVOC [kt]	Cd [t]	As [t]	Cr [t]	Ni [t]	Se [t]	PAHs [t]
1990	7.27	130.17	4.2144	0.0000	0.0001	0.0008	0.0065	0.0001	0.3319
1995	8.21	65.92	3.4669	0.0000	0.0000	0.0004	0.0033	0.0000	0.1681
2000	9.14	46.47	2.7194	0.0000	0.0000	0.0003	0.0023	0.0000	0.1185
2005	10.21	32.28	2.7519	0.0000	0.0000	0.0002	0.0016	0.0000	0.0823
2010	10.51	25.26	0.6295	0.0000	0.0000	0.0002	0.0013	0.0000	0.0644
2011	9.02	28.10	0.7138	0.0000	0.0000	0.0002	0.0014	0.0000	0.0717
2012	9.41	27.59	0.7165	0.0000	0.0000	0.0002	0.0014	0.0000	0.0703
2013	8.77	6.64	0.6870	0.0000	0.0000	0.0000	0.0003	0.0000	0.0169
2014	9.03	18.54	0.7091	0.0000	0.0000	0.0001	0.0009	0.0000	0.0473
2015	9.33	-	0.5895	NE	NE	NE	NE	NE	NE
2016	9.97	-	0.5772	NE	NE	NE	NE	NE	NE
2017	10.08	-	0.5635	NE	NE	NE	NE	NE	NE
2018	9.76	-	0.5674	NE	NE	NE	NE	NE	NE
2019	9.38	-	0.5044	NE	NE	NE	NE	NE	NE
1990/2019	**29%**	**-**	**-88%**	**-**	**-**	**-**	**-**	**-**	**-**
2018/2019	**-4%**	**-**	**-11%**	**-**	**-**	**-**	**-**	**-**	**-**

4.7.7.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.105: *Industrial activities included in 2D3g according to national categorization*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.19 Manufacture of paints, varnishes, inks, glues and adhesives with projected consumption of organic solvents in tonnes/year
4.20 Manufacture of pharmaceutical products with a projected consumption of organic solvents in tonnes/year
4.33 Manufacturing and processing of rubber: a) with a projected consumption of organic solvents in tonnes/year b) production of raw rubber compounds c) processing of the rubber compounds with a projected capacity in kg/hour
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 addition of styrene or epoxy resins with amines, such as the production of boats, trucks, car parts, with a projected consumption of raw materials in kg/day d) the processing of amino and phenolic resins with a projected consumption of raw materials in kg/day e) production of polyurethane products with a projected consumption of organic solvents in tonnes/year f) manufacturing expanded plastic, such as polystyrene foam, with a projected consumption of organic blowing agents in tonnes/year
6.10 Manufacturing and processing of leather: a) manufacture of leather with projected quantities for tonne/day b) treatment of the leather, except footwear and shoe production, coating and other applications on the leather, with a projected consumption of organic solvents in tonnes/year
6.11 Manufacturing of footwear with a projected consumption of organic solvents in tonnes/year

No small sources occur on the territory of the SR. However, the limit threshold for reporting into the NEIS is not 0, but there is an assumption of no existence of SS for these kinds of products and activities. Thus facility data from the NEIS (b/ Tier 3: Em TOTAL = 100% NEIS) is used.

$Em_{TOTAL} = Em_{NEIS}$

Emissions of HMs and PAHs were calculated using the Tier 2 method for Asphalt blowing from the EMEP/EEA GB_{2019}. Emission factors used for the calculation are listed in ***Table 4.106***.

Table 4.1069: *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

<u>*Calculations in the NEIS:*</u> Reporting of solvents in the NEIS evidence is performed in Balance sheets of organic solvents for individual releases. Quantity of VOC is calculated by equations:

Equation 4.12: *Equation a)*

$$E\ [t] = c[mg/m^3] \times V[th.m^3] \times 10^{-6}$$

Where

c = concentration of air pollutant

V = quantity/volume of released waste gas

Equation 4.13: *Equation b)*

$$E\ [t] = q[kg/h] \times t[h] \times 10^{-3}$$

Where

q = mass flow

t = number of operational hours for related year

Equation 4.14: *Equation* c) Direct and indirect balance in case of unambiguous emission dependence

$$E = O1 + F$$

Where

O1 = Emissions released by outputs

F = Fugitive emissions are differently calculated for direct and indirect emissions

The activities of 6.10 were included here according to guidebook **2D3g** Table 3-13 manufacturing of shoes and similarly 6.11 according to the EMEP/EEA GB_{2019} Table 3-14 Leather tanning instead of 2D3i, where the activities were before.

The other emissions are recorded from sources in the NEIS categorization, but emissions are assumed to not relate to technology (NO_X, SO_X, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO) were allocated to the **1A2gviii** to be in line with EMEP/EEA GB_{2019}.

Historical data: The emissions are taken from the NEIS for years 20005 to 2019. Due to the absence of any statistical data before 2001 as well as data in the NEIS before 2005, the historical data are extrapolated with a linear trend.

4.7.7.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}. Emissions of HMs and PAHs were reported for the first time in this inventory following the recommendation No ***SK-2D3g-2018-0001***.

4.7.7.4 Source-specific recalculations

In this submission, the historical data were recalculated. Identified outliers and inconsistencies in the time series were checked at the operators and corrected when necessary. Emissions of PAHs and HMs were calculated following the Recommendation No ***SK-2D3g-2018-0001***. The corrections resulted in the change of the extrapolated trend. Impact on the NMVOC emissions is presented in **Chapter 4.3**.

4.7.8 PRINTING (NFR 2D3h)

4.7.8.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (***Table 4.107***).

Table 4.107: *Activity data and emissions in the category 2D3h*

YEAR	SOLVENTS USED [kt]	NMVOC [kt]
1990	4.48	2.1784
1995	4.60	1.8269
2000	4.72	1.4754
2005	4.47	1.4178
2010	4.87	0.5250
2011	5.28	0.5129
2012	5.17	0.6804
2013	4.35	0.4905
2014	5.01	0.5291
2015	5.08	0.5604
2016	5.46	0.5581
2017	6.07	0.6018
2018	5.74	0.5220
2019	5.16	0.3623
1990/2019	**15%**	**-83%**
2018/2019	**-10%**	**-31%**

4.7.8.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators. Small sources on the territory of SR not covered by the NEIS are calculated from the statistical data. Combination of T2 + T3 is used.

Table 4.108: *Industrial activities included in 2D3h according to national categorization.*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
6.7. Polygraphy according to a projected consumption of organic solvents in tonnes /year: a) publication rotogravure b) other rotogravure c) headset web offset printing d) flexography e) varnishing and laminating technology f) rotary screen printing on textiles, paperboard g) other printing techniques, such as cold offset, sheet-fed equipment and other

Emission calculations:

$$Em_{TOTAL} = Em_{SMALL\ SOURCES} + Em_{NEIS}$$

Please, see methods of Calculations in the NEIS in **ANNEX IV Chapter A4.1-A4.5**

Calculations of Small Sources: Small sources were balanced. The balance is performed by a top-down approach. The statistical data are processed and total solvents consumption is calculated. From the total balance of 2D3d, the printing inks have been separated and allocated into 2D3h as small sources.

Small sources calculation:

Production + Import – Export = Total Product Consumption

Total Product Consumption → 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 2019. Due to the absence of any statistical data before 2001 as well as data in the NEIS before 2005, the historical data are extrapolated with a linear trend.

4.7.8.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.8.4 Source-specific recalculations

In this submission, the historical data were recalculated. Identified outliers and inconsistencies in the time series were checked at the operators and corrected when necessary. The corrections resulted in the change of the extrapolated trend. Impact on the NMVOC emissions is presented in **Chapter 4.3**.

4.7.9 OTHER SOLVENT USE (NFR 2D3i)

4.7.9.1 Overview

The category reports NMVOC emissions. Emissions of NMVOC originated from the NEIS database are shown in ***Table 4.109***. Emissions in this category calculated from lubricant consumption in transport are presented in ***Table 4.110***.

Table 4.109: *Overview of emissions of NMVOC fin the category 2D3i*

YEAR	SOLVENT USED [kt]	NMVOC [kt]
1990	0.56	0.4239
1995	0.54	0.3741
2000	0.51	0.3243
2005	0.39	0.2942
2010	0.42	0.2085
2011	0.47	0.2232
2012	0.39	0.1809
2013	0.39	0.1504
2014	0.35	0.1761
2015	0.42	0.1729
2016	0.48	0.2195
2017	0.78	0.2328
2018	0.88	0.2581
2019	0.96	0.2635
1990/2019	**69%**	**-38%**
2018/2019	**9%**	**2%**

Table 4.110: *Emissions from lubricant consumption in transport*

YEAR	SOx	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
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

YEAR	SOx	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2010	0.0271	0.0003	0.0004	0.0002	0.0004	0.0003	0.0002	0.0002	0.0001	6.7983
2011	0.0259	0.0003	0.0003	0.0002	0.0004	0.0002	0.0002	0.0002	0.0001	6.4890
2012	0.0278	0.0003	0.0004	0.0002	0.0004	0.0003	0.0002	0.0002	0.0001	6.9798
2013	0.0273	0.0003	0.0004	0.0002	0.0004	0.0003	0.0002	0.0002	0.0001	6.8365
2014	0.0279	0.0003	0.0004	0.0002	0.0004	0.0003	0.0002	0.0002	0.0001	6.9937
2015	0.0301	0.0003	0.0004	0.0002	0.0005	0.0003	0.0002	0.0002	0.0001	7.5426
2016	0.0316	0.0004	0.0004	0.0002	0.0005	0.0003	0.0002	0.0002	0.0002	7.9169
2017	0.0326	0.0004	0.0004	0.0002	0.0005	0.0003	0.0002	0.0002	0.0002	8.1600
2018	0.0338	0.0004	0.0005	0.0002	0.0005	0.0003	0.0002	0.0002	0.0002	8.4633
2019	0.0036	0.0036	0.0005	0.0003	0.0006	0.0004	0.0002	0.0003	0.0002	6.9608
1990/2019	**129%**	**139%**	**135%**	**142%**	**139%**	**138%**	**122%**	**143%**	**112%**	**129%**
2018/2019	**4%**	**4%**	**4%**	**4%**	**4%**	**4%**	**4%**	**4%**	**4%**	**4%**

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. Combination of T2 + T3 is used. Activities included in this category are listed in ***Table 4.111***.

Table 4.111: *Industrial activities included in 2D3i according to national categorization.*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.35 Industrial extraction of vegetable oil and animal fat and vegetable oil refining with a projected consumption of organic solvents in tonnes/year
6.6. Adhesive coating - bonding of materials other than wood, wood products and agglomerated materials, leather and footwear production with a projected consumption of organic solvents in tonnes/year

Emission calculations in the industry:

$$Em_{TOTAL} = Em_{SMALL\ SOURCES} + Em_{NEIS}$$

Please, see methods of Calculations in the NEIS in **ANNEX IV Chapter A4.1-A4.5**.

Historical data: The emissions are taken from the NEIS for years 2000 to 2019. Due to the absence of statistical data before 2001 as well as data in the NEIS before 2000, the historical data are extrapolated with a linear trend.

Emission calculations in transport are based on the model COPERT.

4.7.9.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}

4.7.9.4 Source-specific recalculation

In this submission, the historical data were recalculated. Identified outliers and inconsistencies in the time series were checked at the operators and corrected when necessary. The corrections resulted in the change of the extrapolated trend. Impact on the NMVOC emissions is presented in **Chapter 4.3**.

4.7.10 OTHER PRODUCT USE (2G)

4.7.10.1 Overview

In this category, emissions arising from tobacco combustion and use of fireworks are reported.

Tobacco smoke contains many toxicologically significant chemicals and groups of chemicals, including polycyclic aromatic hydrocarbons (benzopyrene), tobacco-specific nitrosamines, aldehydes, carbon monoxide, hydrogen cyanide, nitrogen oxides, benzene, toluene, phenols, aromatic amines (nicotine, ABP (4-Aminobiphenyl)). The chemical composition of smoke depends on puff frequency, intensity, volume, and duration at different stages of cigarette consumption[3].

Fireworks produce smoke and dust that may contain residues of heavy metals, sulfur-coal compounds and some low concentration toxic chemicals. These by-products of fireworks combustion will vary depending on the mix of ingredients of a particular firework. This activity is no significant contributor to national totals.

Emissions in this sector were reported for the first time in this submission. ***Table 4.112*** below shows a significant increase in emissions in this category from 1990 due to increase of tobacco and fireworks use. In ***Table 4.112*** emission trend of NMVOC is shown. Substantial increase in emissions in 2005 and 2009 is a result of an increase in tobacco combusted. These peaks were caused by the growth of imported tobacco after Slovakia entered EU (2005) and last year of operation of an only Slovak tobacco factory in 2009.

Table 4.112: *Overview of emissions in the category Other product use*

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	0.0447	0.1196	0.0024	0.1025	0.6670	0.6671	0.6671	0.3001	1.3667
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
1990/2019	**1322%**	**1312%**	**2580%**	**1312%**	**1312%**	**1313%**	**1313%**	**1312%**	**1321%**
2018/2019	**6%**	**7%**	**-9%**	**7%**	**7%**	**7%**	**7%**	**7%**	**7%**

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	0.1346	0.0000	0.0010	0.0122	0.4810	0.0902	0.2702
2010	0.0932	0.0483	0.0000	0.0002	0.0019	0.1009	0.0276	0.0549
2011	0.5192	0.0484	0.0000	0.0009	0.0103	0.3415	0.0436	0.1959
2012	0.6244	0.0498	0.0000	0.0011	0.0124	0.4023	0.0482	0.2314
2013	0.7939	0.0439	0.0001	0.0013	0.0158	0.4919	0.0516	0.2845
2014	0.6932	0.0464	0.0001	0.0012	0.0138	0.4377	0.0491	0.2524
2015	0.7700	0.0472	0.0001	0.0013	0.0153	0.4818	0.0523	0.2782
2016	0.8080	0.0471	0.0001	0.0014	0.0161	0.5032	0.0537	0.2908
2017	1.0569	0.0509	0.0001	0.0018	0.0210	0.6475	0.0649	0.3750
2018	0.7925	0.0493	0.0001	0.0013	0.0158	0.4966	0.0542	0.2867
2019	0.7184	0.0524	0.0001	0.0012	0.0143	0.4579	0.0530	0.2638
1990/2019	**2580%**	**1330%**	**2580%**	**2580%**	**2580%**	**2336%**	**1771%**	**2366%**

[3] U.S. Dept. of Health and Human Services, 1981: The Health Consequences of Smoking: The Changing Cigarette

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Zn [t]
2018/2019	**-9%**	**6%**	**-9%**	**-9%**	**-9%**	**-8%**	**-2%**	**-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	0.0001	0.0000	0.0000	0.0000	0.0002	0.0001
1995	0.0005	0.0002	0.0002	0.0002	0.0012	0.0005
2000	0.0006	0.0002	0.0002	0.0002	0.0013	0.0006
2005	0.0027	0.0011	0.0011	0.0011	0.0061	0.0027
2010	0.0010	0.0004	0.0004	0.0004	0.0022	0.0010
2011	0.0010	0.0004	0.0004	0.0004	0.0022	0.0010
2012	0.0010	0.0004	0.0004	0.0004	0.0022	0.0010
2013	0.0009	0.0004	0.0004	0.0004	0.0019	0.0009
2014	0.0009	0.0004	0.0004	0.0004	0.0021	0.0009
2015	0.0009	0.0004	0.0004	0.0004	0.0021	0.0009
2016	0.0009	0.0004	0.0004	0.0004	0.0021	0.0009
2017	0.0010	0.0004	0.0004	0.0004	0.0022	0.0010
2018	0.0010	0.0004	0.0004	0.0004	0.0022	0.0010
2019	0.0010	0.0004	0.0004	0.0004	0.0023	0.0010
1990/2019	**1312%**	**1312%**	**1312%**	**1312%**	**1312%**	**1312%**
2018/2019	**7%**	**7%**	**7%**	**7%**	**7%**	**7%**

4.7.10.2 Methodological issues

Activity data about amounts of fireworks and tobacco, import/export data from the Statistical Office of the Slovak Republic were used. There was no production of firework in the Slovak Republic in the whole time series. For calculations of fireworks used ***Equation 4.15*** for the period 1991-2019 was used:

Equation 4.15: *Amount of product used in the Slovak Republic in a particular year*

$$Product\ total\ = Product\ import\ total - Product\ export\ total$$

There was a single producer of tobacco products, which operated until 2008; therefore, production data are confidential. Operator produced cigarettes until the year 2004 and cigars and cigarillos until the year 2008, hence ***Equation 4.15*** was used for cigarettes for period 2005-2019 and cigars and cigarillos for period 2009-2019. For the previous periods, it was assumed that the production was equal to export and only import data entered into calculations. For the next submission, obtaining of confidential data about the production of tobacco product were planned. ***Table 4.113*** shows the results of these calculations.

Table 4.113*: 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	24.70	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

YEAR	TOBACCO COMBUSTED [kt]	FIREWORKS USED [kt]
2019	9.45	0.92

Emission factors for the calculations originate from the Tier 2 methodology in EMEP/EEA GB2019 (***Table 4.115, 4.116***). **Condensable component of PMs** is included in emission factors for tobacco combustion, for use of fireworks is this information unknown.

Table 4.115: *Emission factors in the category Other product use – Use of fireworks*

POLLUTANT	NOx	SOx	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
Unit	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]
Value	260	3020	51.94	99.92	109.83	7150	784	1.48	0.057	1.33	15.6	444	30	260

Table 4.116: *Emission factors in the category Other product use – Tobacco combustion*

POLLUTANT	NOx	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Cd	Cu	Ni
Unit	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[% of PM2.5]	[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	PAH
Unit	[µg I-TEQ/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]
Value	0.1	0.111	0.045	0.045	0.045	0.246

4.7.10.3 Completeness

All rising pollutants were reported.

4.7.10.4 Source-specific recalculations

Emissions were recalculated due to the correction of the conversion factor.

Table 4.117: *Previous and refined emissions in the category 2G*

YEAR	Cd [t]			Cu [t]			Ni [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0001	0.0037	6655%	0.0152	0.0188	24%	0.0010	0.0028	176%	0.0089	0.0107	20%
1991	0.0000	0.0023	4658%	0.0139	0.0161	16%	0.0009	0.0021	120%	0.0081	0.0093	14%
1992	0.0001	0.0060	6691%	0.0247	0.0307	24%	0.0017	0.0046	177%	0.0145	0.0174	20%
1993	0.0001	0.0254	16924%	0.0372	0.0625	68%	0.0025	0.0152	500%	0.0218	0.0344	58%
1994	0.0001	0.0190	16405%	0.0289	0.0478	65%	0.0020	0.0114	482%	0.0169	0.0264	56%
1995	0.0002	0.0260	12885%	0.0524	0.0782	49%	0.0036	0.0165	364%	0.0307	0.0436	42%
1996	0.0004	0.0306	7740%	0.1082	0.1384	28%	0.0073	0.0224	207%	0.0633	0.0785	24%
1997	0.0004	0.0332	9124%	0.0981	0.1310	33%	0.0066	0.0231	247%	0.0575	0.0739	29%
1998	0.0004	0.0311	7484%	0.1137	0.1443	27%	0.0077	0.0230	199%	0.0666	0.0819	23%
1999	0.0010	0.0353	3292%	0.3016	0.3358	11%	0.0204	0.0375	84%	0.1766	0.1937	10%
2000	0.0008	0.0294	3500%	0.2368	0.2654	12%	0.0160	0.0303	89%	0.1386	0.1530	10%
2001	0.0008	0.0368	4576%	0.2255	0.2616	16%	0.0153	0.0333	118%	0.1321	0.1501	14%
2002	0.0013	0.0329	2346%	0.3942	0.4258	8%	0.0267	0.0424	59%	0.2309	0.2466	7%
2003	0.0010	0.0298	2986%	0.2808	0.3096	10%	0.0190	0.0334	76%	0.1644	0.1788	9%
2004	0.0010	0.0371	3591%	0.2906	0.3267	12%	0.0197	0.0377	92%	0.1702	0.1882	11%
2005	0.0013	0.1346	10314%	0.3477	0.4810	38%	0.0236	0.0902	283%	0.2036	0.2702	33%
2006	0.0005	0.0347	7555%	0.1258	0.1601	27%	0.0085	0.0257	201%	0.0737	0.0908	23%
2007	0.0006	0.0839	13979%	0.1538	0.2371	54%	0.0104	0.0521	399%	0.0900	0.1317	46%
2008	0.0005	0.0425	8470%	0.1363	0.1784	31%	0.0092	0.0303	228%	0.0798	0.1009	26%
2009	0.0005	0.0301	5607%	0.1493	0.1789	20%	0.0101	0.0249	146%	0.0875	0.1022	17%
2010	0.0002	0.0483	21445%	0.0528	0.1009	91%	0.0036	0.0276	669%	0.0309	0.0549	78%
2011	0.0010	0.0484	4612%	0.2941	0.3415	16%	0.0199	0.0436	119%	0.1722	0.1959	14%

YEAR	Cd [t]			Cu [t]			Ni [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2012	0.0012	0.0498	3960%	0.3537	0.4023	14%	0.0239	0.0482	102%	0.2071	0.2314	12%
2013	0.0015	0.0439	2746%	0.4496	0.4919	9%	0.0304	0.0516	70%	0.2633	0.2845	8%
2014	0.0014	0.0464	3326%	0.3926	0.4377	11%	0.0265	0.0491	85%	0.2299	0.2524	10%
2015	0.0015	0.0472	3049%	0.4361	0.4818	10%	0.0295	0.0523	78%	0.2554	0.2782	9%
2016	0.0016	0.0471	2900%	0.4577	0.5032	10%	0.0309	0.0537	74%	0.2680	0.2908	8%
2017	0.0020	0.0509	2392%	0.5986	0.6475	8%	0.0405	0.0649	60%	0.3505	0.3750	7%
2018	0.0015	0.0493	3092%	0.4489	0.4966	11%	0.0304	0.0542	79%	0.2629	0.2867	9%

4.8 OTHER PROCESSES (NFR 2H)

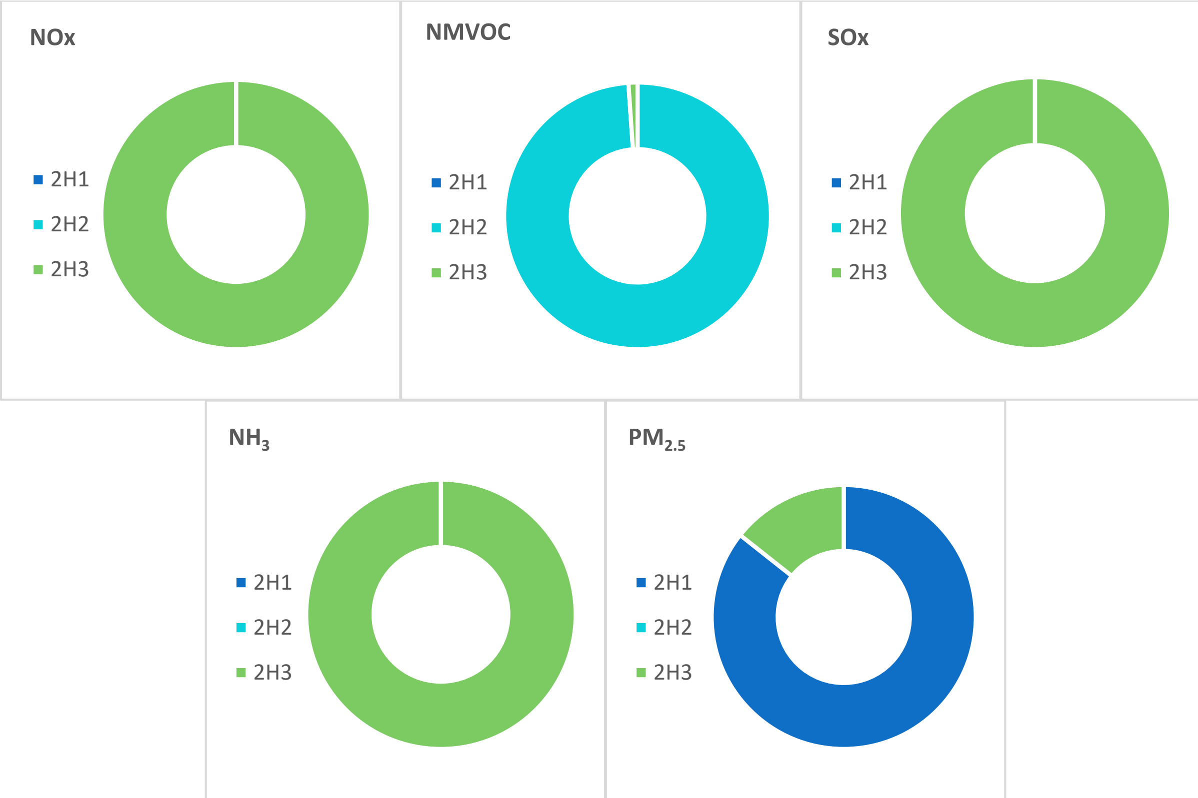
The chapter is divided into 3 industrial activities: Pulp and paper industry (2H1), Food and beverages industry (2H2) and other industrial processes (2H3). Overview of emissions and their trends are listed in ***Table 4.118***. Emissions of PMs and NH_3 have a decreasing trend due to installation of abatement technologies on the plants during the time series. Emissions of NOx, NMVOC, SOx and CO have substantially increasing trend, but this category does not belong among key categories for the Slovak Republic. NMVOC emissions from the category 2H2 were calculated for the first time in this submission.

Table 4.118: *Overview of emissions in the category 2H*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.0002	0.5413	0.0000	0.0018	0.0183	0.0682	0.1673	0.0005	0.0000
1995	0.0003	1.3633	0.0000	0.0021	0.0291	0.1089	0.2671	0.0007	0.0000
2000	0.0001	2.1723	0.0000	0.0059	0.0389	0.1454	0.3565	0.0010	0.0000
2005	0.0007	2.8004	0.0000	0.0000	0.0547	0.2133	0.5295	0.0013	0.0001
2010	0.0001	2.3961	0.0000	0.0000	0.0146	0.0545	0.1336	0.0003	0.0001
2011	0.0002	2.5713	0.0000	0.0000	0.0265	0.1020	0.2525	0.0006	0.0001
2012	0.0003	2.2111	0.0000	0.0000	0.0232	0.0897	0.2223	0.0005	0.0001
2013	0.0001	2.7312	0.0000	0.0000	0.0305	0.1189	0.2953	0.0007	0.0001
2014	0.0009	2.9193	0.0012	0.0000	0.0171	0.0655	0.1617	0.0004	0.0000
2015	0.0014	2.6587	0.0020	0.0000	0.0102	0.0377	0.0923	0.0002	0.0001
2016	0.0021	2.8654	0.0030	0.0000	0.0095	0.0342	0.0832	0.0002	0.0014
2017	0.0021	2.8323	0.0030	0.0000	0.0106	0.0384	0.0935	0.0002	NO
2018	0.0021	2.4215	0.0031	0.0000	0.0101	0.0363	0.0883	0.0002	NO
2019	0.0021	2.5180	0.0030	0.0000	0.0095	0.0337	0.0859	0.0002	NO
1990/2019	**757%**	**365%**	**87778%**	**-100%**	**-48%**	**-51%**	**-49%**	**-62%**	**-**
2018/2019	**-2%**	**4%**	**-2%**	**-76%**	**-6%**	**-7%**	**-3%**	**-6%**	**-**

Shares of NO_X, NMVOC, SO_X, NH_3, $PM_{2.5}$ emission in 2019 included in NFR categories are shown in ***Figure 4.9***.

Figure 4.9: *Shares of emissions in 2H in 2019*



4.8.1 PULP AND PAPER INDUSTRY (NFR 2H1)

4.8.1.1 Overview

Pulp and paper production consists of three major processing steps: pulping, bleaching and paper production. The type of pulping and the amount of bleaching used depends on the nature of the feedstock and the desired qualities of the end product.

Several companies were operating during the year 2019 in the pulp and paper industry in the Slovak Republic. Among them only one is categorized as a medium source, the rest are large sources. In ***Table 4.119*** can be seen that emissions of all pollutants decreased in general since the year 1990.

Table 4.119: *Activity data and emissions in the category 2H1*

YEAR	PULP PRODUCED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	179.23	0.0175	0.0654	0.1604	0.0005
1995	283.87	0.0277	0.1036	0.2541	0.0007
2000	388.64	0.0383	0.1431	0.3508	0.0010
2005	492.58	0.0518	0.2019	0.5012	0.0013
2010	592.09	0.0120	0.0447	0.1094	0.0003
2011	622.76	0.0234	0.0901	0.2231	0.0006
2012	635.18	0.0204	0.0790	0.1959	0.0005
2013	637.44	0.0276	0.1077	0.2675	0.0007
2014	649.37	0.0137	0.0524	0.1294	0.0004
2015	691.78	0.0069	0.0250	0.0609	0.0002
2016	680.46	0.0064	0.0230	0.0557	0.0002
2017	692.87	0.0076	0.0274	0.0666	0.0002
2018	666.82	0.0071	0.0255	0.0618	0.0002
2019	636.44	0.0067	0.0241	0.0583	0.0002
1990/2019	**255%**	**-62%**	**-63%**	**-64%**	**-62%**

YEAR	PULP PRODUCED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
2018/2019	**-5%**	**-6%**	**-6%**	**-6%**	**-6%**

4.8.1.2 Methodological issues

Activities assigned in this category are listed in ***Table 4.120***.

Table 4.120: *Activities according to national categorization included in 2H1*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.18 Manufacture of pulp and derivatives thereof, including the treatment of waste to products of this manufacture
4.36 Production and refinement of paper, cardboard with projected output in t/d

Emission data is compiled in the NEIS database, therefore, the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology of the NEIS is presented in **ANNEX IV.** The following table presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.

Historical years from 1990-1999 were calculated using a weighted average of implied emission factors from the period 2000-2004. Emission of BC was calculated using Tier 1 emission factor from EMEP/EEA GB_{2019} (***Table 4.121***).

Table 4.121: *Emission factors for calculation of historical years and BC*

	$PM_{2.5}$ %TSP	PM_{10} %TSP	TSP [g/t]	BC %$PM_{2.5}$
EF	11%	41%	895.06	2.60%

4.8.1.3 Completeness

Heavy metals, PCDD/F and HCB are reported with notation key NA, other POPs are reported using notation key NE in complying with the EMEP/EEA GB_{2019}. Combustion emissions (NOx, NMVOC, SOx, NH_3, CO) were allocated to the category **1A2d**, therefore, notation key IE was used.

4.8.1.4 Source-specific recalculations

Historical years were recalculated using calculated emission factors from a weighted average of implied emission factors from the period 2000-2004 (***Table 4.122***).

Table 4.122*: Previous and refined emissions from the category 2H1*

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			BC [kt[		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.1075	0.0175	-84%	0.1434	0.0654	-54%	0.1792	0.1604	-10%	0.0028	0.0005	-84%
1991	0.1201	0.0196	-84%	0.1602	0.0731	-54%	0.2002	0.1792	-10%	0.0031	0.0005	-84%
1992	0.1326	0.0216	-84%	0.1768	0.0807	-54%	0.2210	0.1978	-10%	0.0034	0.0006	-84%
1993	0.1452	0.0236	-84%	0.1936	0.0883	-54%	0.2420	0.2166	-10%	0.0038	0.0006	-84%
1994	0.1579	0.0257	-84%	0.2105	0.0960	-54%	0.2631	0.2355	-10%	0.0041	0.0007	-84%
1995	0.1703	0.0277	-84%	0.2271	0.1036	-54%	0.2839	0.2541	-10%	0.0044	0.0007	-84%
1996	0.1827	0.0298	-84%	0.2437	0.1112	-54%	0.3046	0.2726	-10%	0.0048	0.0008	-84%
1997	0.1956	0.0319	-84%	0.2608	0.1190	-54%	0.3260	0.2918	-10%	0.0051	0.0008	-84%
1998	0.2081	0.0339	-84%	0.2775	0.1266	-54%	0.3469	0.3105	-10%	0.0054	0.0009	-84%
1999	0.2202	0.0359	-84%	0.2936	0.1340	-54%	0.3670	0.3285	-10%	0.0057	0.0009	-84%
2000	0.2105	0.0383	-82%	0.2806	0.1431	-49%	0.3508	0.3508	-	0.0055	0.0010	-82%
2001	0.1602	0.0291	-82%	0.2136	0.1089	-49%	0.2669	0.2669	-	0.0042	0.0008	-82%
2002	0.1746	0.0318	-82%	0.2328	0.1187	-49%	0.2910	0.2910	-	0.0045	0.0008	-82%
2003	0.1778	0.0324	-82%	0.2370	0.1209	-49%	0.2963	0.2963	-	0.0046	0.0008	-82%
2004	0.4336	0.0789	-82%	0.5782	0.2948	-49%	0.7227	0.7227	-	0.0113	0.0021	-82%

P-Previous
R-Refined

4.8.2 FOOD AND BEVERAGES INDUSTRY (NFR 2H2)

4.8.2.1 Overview

Food manufacturing may involve the heating of fats and oils and foodstuffs containing them, the baking of cereals, flour and beans, fermentation in the making of bread, the cooking of vegetables and meats, and the drying of residues. These processes may occur in sources varying in size from domestic households to manufacturing plants.

Alcoholic beverage is produced by fermentation of sugar, which comes from fruit, cereals or other vegetables. Sugar is converted by yeast into the 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 the category **1A2e**. In this category, only process emissions were reported (***Table 4.123***).

Table 4.123: *Activity data and emissions in the category 2H2*

YEAR	BREAD TYPICAL EUROPE [kt]	WHITE BREAD [kt]	CAKES, BISCUITS AND BREAKFAST CEREALS [kt]	MEAT, FISH AND POULTRY [kt]	SUGAR [kt]	MARGARINE ADN SOLID COOKING FATS [kt]	ANIMAL FEED [kt]	COFEE ROASTING [kt]
1990	20.78	0.69	15.34	20.69	27.31	3.23	89.05	-
1995	53.57	1.77	39.54	53.35	70.41	8.34	229.57	-
2000	86.40	2.85	63.77	86.04	113.55	13.45	370.24	-
2005	110.04	3.63	81.22	109.59	144.63	17.13	471.57	-
2010	99.62	2.60	69.63	110.13	148.34	8.86	136.37	1.90
2011	95.83	2.81	71.78	91.76	177.92	8.20	110.75	2.10
2012	93.42	2.74	66.94	77.00	138.43	7.17	170.19	2.20
2013	89.11	2.60	67.57	60.84	176.89	15.06	252.29	2.01
2014	91.30	2.60	65.22	59.56	199.58	13.89	214.47	2.03
2015	89.74	2.62	72.28	111.79	171.19	13.55	234.04	2.23
2016	87.18	2.88	39.10	125.36	197.12	13.92	213.44	2.35
2017	87.61	2.63	40.60	153.60	187.72	14.02	272.23	2.50
2018	83.71	2.56	38.44	147.28	150.28	13.59	257.50	2.22
2019	84.98	2.50	34.89	168.06	155.77	14.01	282.46	2.43
1990/2019	**309%**	**265%**	**127%**	**712%**	**470%**	**333%**	**217%**	**-**
2018/2019	**2%**	**-2%**	**-9%**	**14%**	**4%**	**3%**	**10%**	**9%**

YEAR	WINE UNSPECIFIED COLOUR [kt]	BEER INCLUDING DE-ALCOHOLIZIED [kt]	SPIRITS UNSPECIFIED SORT [kt]	OTHER SPIRITS [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
1990	16.42	73.24	0.12	1.11	0.5188	0.0004	0.0014	0.0035
1995	42.34	188.81	0.32	2.87	1.3374	0.0009	0.0036	0.0091
2000	68.29	304.52	0.51	4.62	2.1570	0.0005	0.0018	0.0045
2005	86.98	387.86	0.65	5.89	2.7474	0.0021	0.0083	0.0209
2010	85.52	300.16	0.73	5.79	2.3026	0.0014	0.0057	0.0142
2011	95.22	297.32	0.52	6.12	2.5446	0.0015	0.0060	0.0149
2012	84.90	299.84	0.49	5.19	2.1770	0.0012	0.0049	0.0121
2013	85.23	288.25	0.96	4.61	2.7045	0.0016	0.0065	0.0162
2014	82.48	264.80	0.96	4.56	2.8881	0.0018	0.0073	0.0181

YEAR	WINE UNSPECIFIED COLOUR [kt]	BEER INCLUDING DE-ALCOHOLIZED [kt]	SPIRITS UNSPECIFIED SORT [kt]	OTHER SPIRITS [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
2015	84.21	240.43	0.25	5.21	2.6251	0.0020	0.0079	0.0198
2016	76.68	228.34	0.36	5.17	2.8287	0.0017	0.0069	0.0173
2017	83.24	239.93	0.40	7.88	2.8079	0.0020	0.0079	0.0197
2018	74.27	423.69	0.41	7.97	2.3984	0.0020	0.0080	0.0200
2019	79.33	408.88	0.40	8.00	2.4905	0.0016	0.0064	0.0199
1990/2019	**383%**	**458%**	**231%**	**619%**	**380%**	**351%**	**351%**	**465%**
2018/2019	**7%**	**-3%**	**-1%**	**0%**	**4%**	**-21%**	**-21%**	**0%**

4.8.2.2 Methodological issues

Emissions of were calculated using Tier 2 emission factors from the EMEP/EEA GB_{2019} (***Table 4.124***). Activity data were obtained from the national PRODCOM database and Import/export statistics for the period 2005-2019. Historical data were extrapolated using GDP as a surrogate.

Emission data of PMS was compiled in the NEIS database, therefore, the individual-specific EF were used for sources recorded in the database. Otherwise, general EFs of the Bulletin of the Ministry of Environment and detailed methodology of the NEIS is presented in ANNEX IV. The following table presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.

Historical years from 1990-1999 were calculated using a weighted average of implied emission factors from the period 2000-2004. Emission of BC was calculated using Tier 1 emission factor from EMEP/EEA GB2019 (***Table 4.124***).

Table 4.124: *Emission factors for calculation of NMVOC in the category 2H2*

	NMVOC [kg/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	TSP [g/t]
Bread typical Europe	4.5	10.00%	40.00%	19.94
White bread	4.5			
Cakes, biscuits and breakfast cereals	1			
Meat, fish and poultry	0.3			
Sugar	10			
Margarine and solid cooking fats	10			
Animal feed	1			
Coffee roasting	0.55			
Wine unspecified colour	0.08			
Beer including de-alcoholized	0.035			
Spirits unspecified sort	15			
Other spirits	0.4			

4.8.2.3 Completeness

All rising pollutants were reported. Notation keys were used following EMEP/EEA GB_{2019}.

4.8.2.4 Source-specific recalculations

This category was calculated for the first time in this submission.

4.8.3 OTHER INDUSTRIAL PROCESSES (NFR 2H3)

4.8.3.1 Overview

This category includes various sources such as body shops, grain silos, galvanic lines etc. ***Table 4.125*** shows 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.

Table 4.125: *Overview of emissions in the category 2H3*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.0002	0.0225	0.0000	0.0018	0.0004	0.0014	0.0034	0.0000
1995	0.0003	0.0258	0.0000	0.0021	0.0005	0.0016	0.0039	0.0000
2000	0.0001	0.0153	0.0000	0.0059	0.0001	0.0005	0.0012	0.0000
2005	0.0007	0.0530	0.0000	0.0000	0.0008	0.0030	0.0074	0.0001
2010	0.0001	0.0935	0.0000	0.0000	0.0012	0.0041	0.0100	0.0001
2011	0.0002	0.0268	0.0000	0.0000	0.0017	0.0059	0.0145	0.0001
2012	0.0003	0.0341	0.0000	0.0000	0.0016	0.0059	0.0143	0.0001
2013	0.0001	0.0267	0.0000	0.0000	0.0013	0.0048	0.0116	0.0001
2014	0.0009	0.0312	0.0012	0.0000	0.0016	0.0058	0.0142	0.0000
2015	0.0014	0.0336	0.0020	0.0000	0.0014	0.0048	0.0116	0.0001
2016	0.0021	0.0367	0.0030	0.0000	0.0014	0.0043	0.0102	0.0014
2017	0.0021	0.0243	0.0030	0.0000	0.0010	0.0031	0.0073	NO
2018	0.0021	0.0231	0.0031	0.0000	0.0010	0.0028	0.0065	NO
2019	0.0021	0.0275	0.0030	0.0000	0.0011	0.0033	0.0076	NO
1990/2019	**757%**	**22%**	**87778%**	**-100%**	**185%**	**135%**	**124%**	**-**
2018/2019	**-2%**	**19%**	**-2%**	**-76%**	**19%**	**17%**	**17%**	**-**

4.8.3.2 Methodological issues

Activities listed in ***Table 4.126*** were reported in this category.

Table 4.126: *Activities according to national categorization included in 2H3*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	
5.99	Other plants and technologies of waste treatment
6.99	Other industrial technologies, manufacturing, processing equipment not specified in points 1 to 5

Total category emissions represent 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 1990-1999 were calculated using a weighted average of implied emission factors for the period 2000-2004 (***Table 4.127***). Activity data for the calculation of implied emission factors are the total energy used in this category.

Table 4.127: *Emission factors for calculation of historical years*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH_3 [g/GJ]	$PM_{2.5}$ %TSP	PM_{10} %TSP	TSP [g/GJ]	CO [g/GJ]
EF	441.18	40 599.77	6.23	3 314.83	12%	41%	6 090.68	73.27

4.8.3.3 Completeness

Notation keys are reported in compliance with the EMEP/EEA GB_{2019}. Notation key for the CO in period 2017-2019 was changed to NO.

4.8.31.4 Source-specific recalculations

Historical years were recalculated using EMEP/EEA GB_{2019} emission factors (***Table 4.128***). Several outliers were replaced by extrapolated data.

Table 4.128: Previous and refined emissions from the category 2H3

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0003	0.0002	-15%	0.0391	0.0225	-42%	0.0000	0.0000	29%	0.0031	0.0018	-40%
1991	0.0003	0.0003	-11%	0.0384	0.0230	-40%	0.0000	0.0000	35%	0.0031	0.0019	-39%
1992	0.0003	0.0003	-7%	0.0387	0.0231	-40%	0.0000	0.0000	41%	0.0032	0.0019	-41%
1993	0.0003	0.0003	-11%	0.0402	0.0231	-42%	0.0000	0.0000	49%	0.0032	0.0019	-41%
1994	0.0003	0.0003	-22%	0.0414	0.0232	-44%	0.0000	0.0000	11%	0.0032	0.0019	-40%
1995	0.0003	0.0003	-1%	0.0370	0.0258	-30%	0.0000	0.0000	47%	0.0028	0.0021	-24%
1996	0.0002	0.0003	5%	0.0348	0.0236	-32%	0.0000	0.0000	57%	0.0032	0.0019	-40%
1997	0.0002	0.0003	33%	0.0406	0.0262	-36%	0.0000	0.0000	103%	0.0035	0.0021	-39%
1998	0.0004	0.0003	-12%	0.0472	0.0292	-38%	0.0000	0.0000	161%	0.0034	0.0024	-31%
1999	0.0005	0.0004	-27%	0.0475	0.0346	-27%	0.0000	0.0000	-27%	0.0029	0.0028	-1%
2000	0.0001	0.0001	-	0.0153	0.0153	0%	0.0000	0.0000	-	0.0008	0.0059	601%
2001	0.0001	0.0001	-	0.0239	0.0239	-	0.0000	0.0000	-30%	0.0056	0.0056	-
2002	0.0001	0.0001	-	0.0692	0.0692	-	0.0000	0.0000	-	0.0048	0.0048	-
2003	0.0011	0.0011	-	0.0806	0.0806	-	0.0000	0.0000	-	0.0032	0.0032	-
2004	0.0013	0.0013	-	0.0490	0.0490	-	0.0000	0.0000	-	0.0000	0.0000	-
2005	0.0007	0.0007	-	0.0530	0.0530	-	0.0000	0.0000	-	0.0000	0.0000	-
2006	0.0004	0.0004	-	0.0626	0.0626	-	0.0000	0.0000	-	0.0000	0.0000	-
2007	0.0005	0.0005	-	0.0446	0.0446	-	0.0000	0.0000	-	0.0000	0.0000	-
2008	0.0006	0.0006	-	0.0639	0.0639	-	0.0000	0.0000	-	0.0000	0.0000	-
2009	0.0003	0.0003	-	0.0934	0.0934	-	0.0000	0.0000	-	0.0000	0.0000	-
2010	0.0001	0.0001	-	0.0935	0.0935	-	0.0000	0.0000	-	0.0000	0.0000	-
2011	0.0002	0.0002	-	0.0268	0.0268	-	0.0000	0.0000	-	0.0000	0.0000	-
2012	0.0003	0.0003	-	0.0341	0.0341	-	0.0000	0.0000	-	0.0000	0.0000	-
2013	0.0001	0.0001	-	0.0267	0.0267	-	0.0012	0.0000	-100%	0.0000	0.0000	-

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt[		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0005	0.0004	-27%	0.0022	0.0014	-36%	0.0054	0.0034	-38%	0.0001	0.0000	-25%
1991	0.0005	0.0004	-24%	0.0021	0.0014	-33%	0.0053	0.0035	-35%	0.0001	0.0000	-22%
1992	0.0005	0.0004	-24%	0.0022	0.0014	-34%	0.0054	0.0035	-36%	0.0001	0.0000	-20%
1993	0.0006	0.0004	-27%	0.0022	0.0014	-36%	0.0056	0.0035	-38%	0.0001	0.0000	-22%
1994	0.0006	0.0004	-30%	0.0023	0.0014	-39%	0.0058	0.0035	-40%	0.0001	0.0000	-28%
1995	0.0005	0.0005	-10%	0.0020	0.0016	-21%	0.0051	0.0039	-23%	0.0001	0.0000	-14%
1996	0.0005	0.0004	-15%	0.0020	0.0015	-25%	0.0049	0.0035	-28%	0.0000	0.0000	-13%
1997	0.0006	0.0005	-17%	0.0022	0.0016	-27%	0.0056	0.0039	-29%	0.0000	0.0000	6%
1998	0.0007	0.0005	-22%	0.0026	0.0018	-32%	0.0066	0.0044	-33%	0.0001	0.0001	-14%
1999	0.0007	0.0006	-14%	0.0029	0.0021	-25%	0.0071	0.0052	-27%	0.0001	0.0001	-26%
2000	0.0001	0.0001	17%	0.0005	0.0005	3%	0.0012	0.0012	-	0.0000	0.0000	-
2001	0.0004	0.0005	17%	0.0016	0.0017	3%	0.0040	0.0040	-	0.0000	0.0000	41%
2002	0.0009	0.0010	17%	0.0036	0.0037	3%	0.0089	0.0089	-	0.0000	0.0000	-
2003	0.0012	0.0014	17%	0.0047	0.0048	3%	0.0117	0.0117	-	0.0001	0.0001	-
2004	0.0010	0.0012	17%	0.0040	0.0041	3%	0.0099	0.0099	-	0.0002	0.0002	-
2005	0.0008	0.0008	-	0.0030	0.0030	-	0.0074	0.0074	-	0.0001	0.0001	-
2006	0.0007	0.0007	-	0.0028	0.0028	-	0.0070	0.0070	-	0.0004	0.0004	-
2007	0.0011	0.0011	-	0.0045	0.0045	-	0.0112	0.0112	-	0.0011	0.0011	-
2008	0.0015	0.0015	-	0.0043	0.0043	-	0.0099	0.0099	-	0.0012	0.0012	-
2009	0.0010	0.0010	-	0.0033	0.0033	-	0.0080	0.0080	-	0.0009	0.0009	-
2010	0.0012	0.0012	-	0.0041	0.0041	-	0.0100	0.0100	-	0.0001	0.0001	-

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt[		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2011	0.0017	0.0017	-	0.0059	0.0059	-	0.0145	0.0145	-	0.0001	0.0001	-
2012	0.0016	0.0016	-	0.0059	0.0059	-	0.0143	0.0143	-	0.0001	0.0001	-
2013	0.0013	0.0013	-	0.0048	0.0048	-	0.0116	0.0116	-	0.0001	0.0001	-
2014	0.0016	0.0016	-	0.0058	0.0058	-	0.0142	0.0142	-	0.0000	0.0000	-
2015	0.0014	0.0014	-	0.0048	0.0048	-	0.0116	0.0116	-	0.0000	0.0001	241%

P-Previous
R-Refined

4.9 WOOD PROCESSING (NFR 2I)

4.9.1 OVERVIEW

The present chapter addresses emissions of dust from the processing of wood. This includes the manufacture of plywood, reconstituted wood products and engineered wood products. This source category is only important for particulate emissions.

Emission trends in this category, where emissions decreasing in general. Overview of emissions and its trends are presented in ***Table 4.129***.

Table 4.129: *Overview of emissions in the category 2I*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.3117	0.2996	0.0023	0.0026	0.0492	0.1962	0.4900	0.3966
1995	0.3017	0.2901	0.0022	0.0025	0.0477	0.1899	0.4744	0.3840
2000	0.2549	0.1294	0.0016	0.0006	0.0747	0.1865	0.4660	0.2749
2005	0.3207	0.4017	0.0018	0.0058	0.0306	0.1213	0.3026	0.4673
2010	0.0759	0.2189	0.0025	0.0002	0.0104	0.0382	0.0939	0.3387
2011	0.1658	0.2091	0.0023	NO	0.0075	0.0300	0.0751	0.0925
2012	0.1614	0.1947	0.0022	NO	0.0081	0.0323	0.0808	0.0924
2013	0.1167	0.1756	0.0011	NO	0.0066	0.0262	0.0656	0.0761
2014	0.5389	0.3945	0.0000	0.0001	0.0071	0.0285	0.0713	0.4715
2015	0.2167	0.5026	0.0000	0.0083	0.0045	0.0178	0.0446	0.4119
2016	0.1600	0.2590	0.0000	0.0083	0.0044	0.0175	0.0437	0.1440
2017	0.2112	0.5449	0.0000	0.0093	0.0041	0.0165	0.0412	0.2100
2018	0.3401	0.7039	0.0000	0.0096	0.0038	0.0152	0.0379	0.3539
2019	0.3445	0.5681	0.0001	0.0082	0.0040	0.0160	0.0399	0.3448
1990/2019	**11%**	**90%**	**-98%**	**221%**	**-92%**	**-92%**	**-92%**	**-13%**
2018/2019	**1%**	**-19%**	**16%**	**-15%**	**5%**	**5%**	**5%**	**-3%**

4.9.2 METHODOLOGICAL ISSUES

The definition of activities covered by category 2I is provided in ***Table 4.130***. The activity is involved in 2D3d, where only VOC is balanced. Other rising emissions (NO_X, SO_X, NMVOC, NH_3, TSP, $PM_{2.5}$, PM_{10}, CO) are reported here.

Table 4.130: *Activities according to national categorization included in 2I*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
6.9 Industrial wood processing:
a) mechanical processing of wooden lumps with projected processing capacity in v m^3/day
b) mechanical processing of disintegrated wooden mass such as sawdust, shavings, chips with a projected processing capacity in v m^3/day
c) production of agglomerated materials with projected consumption of polycondensated adhesives in t of dry matter/year

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
Processing and surface treatment using organic solvents including associated activities, such as deburring, according to a projected consumption of organic solvents in tonnes/year: a) adhesive application b) wood and plastic lamination c) coating application d) impregnation

Historical years from 1990-1999 were calculated using a weighted average of implied emission factors from the period 2000-2004 (***Table 4.131***). Activity data for the calculation of implied emission factors is the total energy used in this category.

Table 4.131: *Emission factors for calculation of historical years*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH_3 [g/GJ]	$PM_{2.5}$ %TSP	PM_{10} %TSP	TSP [g/GJ]	CO [g/GJ]
EF	533 488.04	512 899.12	3 938.45	4 388.26	10%	40%	838 858.63	678 981.14

4.9.3 COMPLETENESS

Notation keys are reported in compliance with the EMEP/EEA GB_{2019}.

4.9.4 SOURCE-SPECIFIC RECALCULATIONS

Historical years were recalculated using EMEP/EEA GB_{2019} emission factors (***Table 4.132***).

Table 4.132*: Previous and refined emissions from the category 2I*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.3215	0.3117	-3%	0.3089	0.2996	-3%	0.0023	0.0023	-2%	0.0026	0.0026	-2%
1991	0.3195	0.3097	-3%	0.3070	0.2978	-3%	0.0023	0.0023	-2%	0.0026	0.0025	-2%
1992	0.3198	0.3100	-3%	0.3073	0.2981	-3%	0.0023	0.0023	-2%	0.0026	0.0026	-2%
1993	0.3206	0.3108	-3%	0.3080	0.2988	-3%	0.0023	0.0023	-2%	0.0026	0.0026	-2%
1994	0.3203	0.3105	-3%	0.3078	0.2985	-3%	0.0023	0.0023	-2%	0.0026	0.0026	-2%
1995	0.3112	0.3017	-3%	0.2991	0.2901	-3%	0.0023	0.0022	-2%	0.0025	0.0025	-2%
1996	0.3232	0.3133	-3%	0.3105	0.3012	-3%	0.0024	0.0023	-2%	0.0026	0.0026	-2%
1997	0.3146	0.3050	-3%	0.3023	0.2932	-3%	0.0023	0.0023	-2%	0.0026	0.0025	-2%
1998	0.3035	0.2942	-3%	0.2916	0.2828	-3%	0.0022	0.0022	-2%	0.0025	0.0024	-2%
1999	0.2925	0.2836	-3%	0.2811	0.2726	-3%	0.0021	0.0021	-2%	0.0024	0.0023	-2%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.2007	0.0492	-75%	0.5012	0.1962	-61%	0.5012	0.4900	-2%	0.4074	0.3966	-3%
1991	0.1994	0.0489	-75%	0.4981	0.1950	-61%	0.4981	0.4870	-2%	0.4049	0.3942	-3%
1992	0.1996	0.0490	-75%	0.4986	0.1952	-61%	0.4986	0.4875	-2%	0.4053	0.3946	-3%
1993	0.2001	0.0491	-75%	0.4998	0.1956	-61%	0.4998	0.4886	-2%	0.4063	0.3955	-3%
1994	0.1999	0.0491	-75%	0.4993	0.1954	-61%	0.4993	0.4882	-2%	0.4059	0.3951	-3%
1995	0.1943	0.0477	-75%	0.4852	0.1899	-61%	0.4852	0.4744	-2%	0.3944	0.3840	-3%
1996	0.2017	0.0495	-75%	0.5038	0.1972	-61%	0.5038	0.4926	-2%	0.4096	0.3987	-3%
1997	0.1964	0.0482	-75%	0.4905	0.1920	-61%	0.4905	0.4796	-2%	0.3987	0.3882	-3%
1998	0.1894	0.0465	-75%	0.4731	0.1852	-61%	0.4731	0.4626	-2%	0.3846	0.3744	-3%
1999	0.1826	0.0715	-61%	0.4561	0.1785	-61%	0.4561	0.4459	-2%	0.3707	0.3609	-3%
2000	0.1865	0.0747	-60%	0.4660	0.1865	-60%	0.4660	0.4660	-	0.2749	0.2749	-
2001	0.1969	0.0788	-60%	0.4919	0.1969	-60%	0.4919	0.4919	-	0.3236	0.3236	-
2002	0.1958	0.0784	-60%	0.4889	0.1957	-60%	0.4889	0.4889	-	0.3454	0.3454	-
2003	0.1461	0.0585	-60%	0.3650	0.1461	-60%	0.3650	0.3650	-	0.3052	0.3052	-

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2004	0.1239	0.0496	-60%	0.3095	0.1239	-60%	0.3095	0.3095	-	0.4678	0.4678	-

P-Previous
R-Refined

4.10 PRODUCTION OF POPS (NFR 2J)

4.10.1 OVERVIEW

This activity is not occurring in the Slovak Republic, therefore notation key NO was used.

4.11 CONSUMTION OF POPS AND HEAVY METALS (NFR 2K)

4.11.1 OVERVIEW

The present chapter deals with emissions from the consumption of POPs and heavy metals. These are used in e.g. refrigerators, air conditioning equipment and electrical equipment. Category reports the emissions of Hg and PCBs. The trend of emissions and activity data are presented in ***Table 4.133***.

Table 4.133: *Activity data and emissions in the category 2K*

YEAR	INHABITANTS	Hg [t]	PCBs [kg]
1990	5297774	0.0530	0.5298
1995	5363676	0.0536	0.5364
2000	5400679	0.0540	0.5401
2005	5387285	0.0539	0.5387
2010	5431024	0.0543	0.5431
2011	5394251	0.0539	0.5394
2012	5407579	0.0541	0.5408
2013	5413392.5	0.0541	0.5413
2014	5418649	0.0542	0.5419
2015	5423800	0.0542	0.5424
2016	5430798	0.0543	0.5431
2017	5437754	0.0544	0.5438
2018	5446770.5	0.0545	0.5447
2019	5454147	0.0545	0.5454
1990/2019	**3%**	**3%**	**3%**
2018/2019	**0%**	**0%**	**0%**

4.11.2 METHODOLOGICAL ISSUES

Emission of Hg and PCB are calculated by Tier 1 method according to EMEP/EEA GB_{2019}. Activity data were obtained from the ŠÚ SR – number national population - Mid-year population.

EF = Inhabitants * EF(Default)

Other pollutants (NO_X, NMVOC, SO_X, NH_3, PMs, TSP, BC, CO, POPs) are reported in compliance with EMEP/EEA Guidebook with notation key NA, as well as fuels, and with notation key NE for heavy metals and HCB.

A simple equation was needed to balance the emissions of Hg and PCBs from this source category:

$$E = EF\ GB_{2019} \times AD(\text{ŠÚ}\ SR)$$

Emission factors used for the calculation are shown in ***Table 4.134***.

Table 4.134: *Emission factors in the category 2K*

	Hg [g/capita]	PCBs [g/capita]
EF	0.01	0.1

4.11.3 COMPLETENESS

Notation keys were used in compliance with the EMEP/EEA GB_{2019}.

4.11.4 SOURCE-SPECIFIC RECALCULATIONS

No recalculations in this submission.

4.12 OTHER PRODUCTION, CONSUMPTION, STORAGE, TRANSPORTATION OR HANDLING OF BULK PRODUCTS (NFR 2L)

4.12.1 OVERVIEW

The category is reported with notation key NO. This production is not occurring in the Slovak Republic. Notation key for fuel was changed from NA to NO likewise in 2B1 where the use of NO key for fuels was advised by TERT.

CHAPTER 5: AGRICULTURE (NFR 3)

Last update: 15.3.2021

This chapter was prepared by the sectoral expert involved in the National Inventory System of the Slovak Republic:

INSTITUTE	CHAPTER	SECTORAL EXPERT
Slovak Hydrometeorological Institute	All chapters	Kristína Tonhauzer

The anthropogenic activities in the agriculture sector significantly contribute to the concentration changes of some gases in the atmosphere. Ammonia emitted from agriculture considered as the most relevant gas from planning abatements to reduce their influence on the environment. Sources of ammonia (NH_3), particulate matter (PM), total suspended particulate (TSP), the non-methane volatile organic compound (NMVOC) and nitrogen oxides (NOx) emissions are analysed according to the $EMEP/EEA_{2019}$ when principles of good practice in agriculture are taken into account. The emissions of NH_3, NOx, PM, TSP, and NMVOC can be reduced if effective measures are implemented in agricultural practice. The abatements were implemented for the conditions of the Slovak Republic. The absence of sufficient data about the storage and application of manure resulted in the fact that the emissions were evaluated in the same way as usual. Slovak agricultural inventory takes advantage of parallel inventory preparation and reporting of greenhouse gases (GHG) and air pollutants ensuring efficiency and consistency in the compilation of emission inventories because of a wide range of substances using common datasets and inputs. Therefore, a link is established between the NH_3, NOx and N_2O emission estimates following the N-flow concepts in the agricultural emission inventories. Consequently, consistency between the two inventories is a principle of the emission estimate.

The emissions balance is compiled annually based on sectoral statistics and in recent years based on 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, 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 number of livestock and animal productions are provided annually by the Statistical Office of the Slovak Republic (ŠU SR). The Central Control and Testing Institute in Agriculture (UKSÚP) provided the soil data to the SHMÚ annually, based on cooperation agreement between the both institutions.

5.1 OVERVIEW OF THE SECTOR (NFR 3)

The share of agriculture and food industry in the national economy has increased in the macro-economic indicators (Gross value-added, intermediate consumption, employee's average wage, sectoral employment) in 2019. The share of foreign agri-food trade in exports and imports decreased by 52.5% from 2.3 billion euro in 2018 to 1.1 billion euro in 2019. Agriculture, according to preliminary data, achieved a positive economic result in 2019. The economic result was influenced by the increase in prices of agricultural products, which was reflected in increased sales, especially in crop production. The subsidies from the Common Agricultural Policies (CAP) played the decisive role of the financial support for Slovak agriculture. The subsidies from the CAP increase by 11.9% due to an increase in the EU resources by 9.1% and national resources of the Slovak republic (by 19.8%). The faster increase in funding from direct payments (by 9.4%) and a slower increase from the RDP SR 2014-2020 (by 4.6%)

influences the increase of subsidies from the CAP. The structure of gross agricultural output at current prices stagnated inter-annually.

The share of crop and animal production is 62.8% to 37.2%. The total production of slaughter animals decreased by 13.4% due to the decrease in the number of livestock except for the production of slaughter poultry and pigs. The prices of raw products decreased compared to the previous year by 0.3%. The significant decrease in prices was visible in hen eggs (7.5%), and an increase in prices slaughter pigs by 4.8% and slaughter cattle by 1.4% (Green Report 2019).[1]

Slovak farmers adapted to changes in Agriculture after 1990. They invested in the development of their farms to avoid bankrupt, and to be self-competitiveness in this sector. The EU policy supported the used tools as the base of transformation. The EU policy and measures transformed into the Slovak legal system. Farmers had to follow new strict criteria like more balanced feeding rations changing of housing systems, new storage capacity for organic waste, which was supported by the Decree No 410/2012 Coll. and Nitrates Directive and subsidies from the Common agriculture policies.[2]

Table 5.1: *Overview of the GHG gases and Tiers reported in the Agriculture sector according to the CRF categories in 2019*

CATEGORY (CODE AND NAME)	TIER/POLLUTANTS
3B1a Dairy cattle	NH_3-T2, NOx-T2, PM-T1, NMVOC-T2, TSP-T1
3B1b Non-dairy cattle	NH_3-T2, NOx-T2, PM-T1, NMVOC-T2, TSP-T1
3B2 Sheep	NH_3-T2, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B3 Swine	NH_3-T2, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4d Goats	NH_3-T2, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4e Horses	NH_3-T2, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4gi Laying hens	NH_3-T2, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4gii Broilers	NH_3-T2, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4giii Turkeys	NH_3-T2, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3B4giv Other poultry	NH_3-T2, NOx-T2,PM-T1, NMVOC-T1, TSP-T1
3Da1 Inorganic N-fertilizers	NH_3-T2,NOx-T1
3Da2 Animal manure applied to the soil	NH_3-T2, NMVOC-T2,NOx-T2
3Da3 Urine and dung deposited by grazing animals	NH_3-T2, NMVOC-T2, NOx-T2
3Dc Farm-level agricultural operations including storage, handling, and transport of agricultural products	PMs-T2, TSP-T1
3De Cultivated Crops	NMVOC-T2

[1] http://www.mpsr.sk/index.php?navID=122&id=13741 (In Slovak)

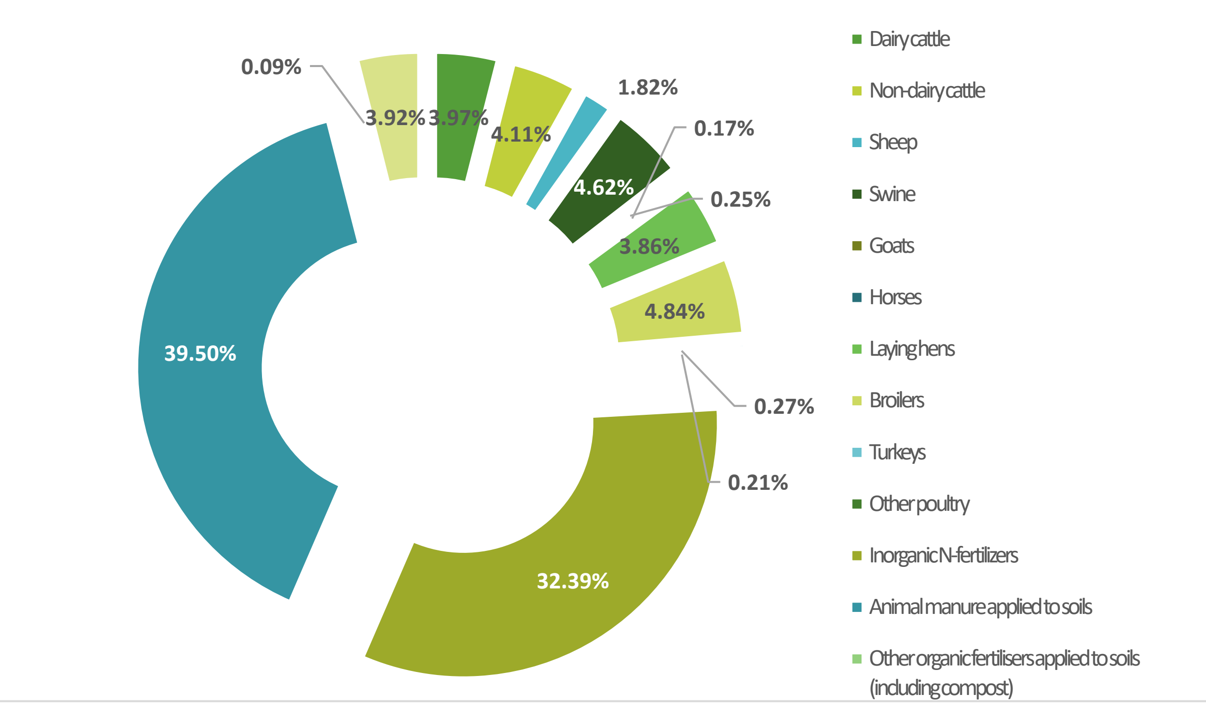
[2] http://www.mpsr.sk/index.php?start&navID=78&id=1325%20 (in Slovak)

5.2 EMISSION TRENDS

5.2.1 AMMONIA (NH_3)

Sector agriculture is a dominant contributor to NH_3 emissions, with a 90% share of the national total in 2019. The largest share of ammonia emissions was generated by 3D Agricultural soils, which produced 21.52 Gg (76%) of NH_3 within the sector in 2019. The key NH_3 emissions source is the Animal manure applied to soils with the share of 39.50%, followed by the category Inorganic N-fertilizers representing 32.39% of the total NH_3 emissions. Emissions from 3B1 Cattle, 3B3 Swine and 3B2 Sheep produced 4.12 Gg of NH_3 (15%) in the sector in 2019. ***Figure 5.1*** shows the distribution of significant categories of ammonia from agriculture for 2019.

Figure 5.1: *NH_3 emissions per subsectors in %*



Agricultural NH_3 emissions have decreased by 49% since 1990, and 2 % decreasing compare to the previous year (***Table 5.2*** and ***Figure 5.2***). The main drivers of this drop were the significant decrease in the emissions from cattle and swine, due to the dramatic reduction in livestock population. Focusing on the period between 2011 and 2015, NH_3 emissions from the manure management are relatively stable with the smooth increase due to increase of non-dairy cattle, swine and poultry categories. NH_3 emissions in 3D Agricultural soils decreased due to the decrease of consumption of some type of Inorganic N-fertilizers.

Figure 5.2: *NH_3 emission trend by sectors*

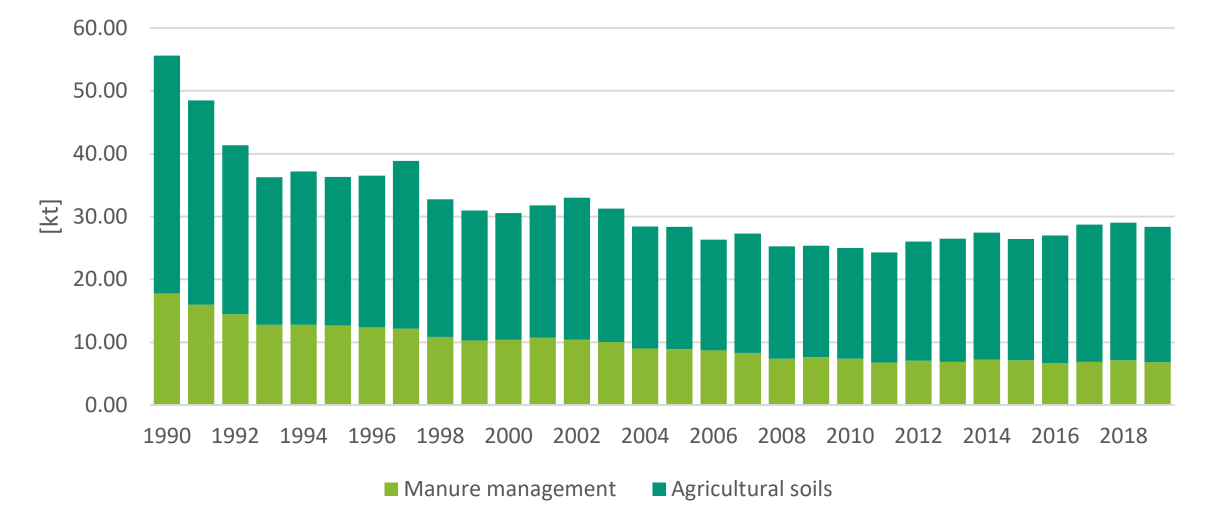


Table 5.2: *NH_3 emission time-series by sub-sectors in Gg*

YEARS	3B MANURE MANAGEMENT	3D AGRICULTURAL SOILS	3 AGRICULTURE TOTAL
	in Gg		
1990	17.76	37.89	55.65
1995	12.66	23.66	36.32
2000	10.39	20.18	30.56
2005	8.92	19.45	28.36
2010	7.38	17.63	25.00
2011	6.79	17.51	24.30
2012	7.09	18.93	26.03
2013	6.85	19.65	26.50
2014	7.21	20.23	27.44
2015	7.13	19.28	26.41
2016	6.68	20.32	27.00
2017	6.88	21.85	28.74
2018	7.13	21.91	29.05
2019	6.84	21.52	28.36
1990/2019	**-61.51%**	**-43.20%**	**-49.04%**
2005/2019	**-23.36%**	**10.68%**	**-0.02%**

5.2.2 PARTICULATE MATTERS

In 2019, agriculture accounted for 1.4% (0.249 Gg) of $PM_{2.5}$, 13.02% (3.02 Gg) of PM_{10} and 15.4% (4.75 Gg) of the national total, TSP emissions. The Agriculture sector is no key source for particulate matter. The contribution of the 3Dc was 80% (2.42 Gg) to the total PM_{10} emissions from the sector.

$PM_{2.5}$, TSP emissions from agriculture have stagnated in the 2005-2019 period (***Table 5.3*** and ***Figure 5.4)*** as a result of the decreasing emissions from 3B Manure management and increasing partial emissions from 3D Agricultural Soils. PM_{10} emissions from Agriculture are shown in ***Figure 5.3***.

Figure 5.3: *PM$_{10}$ emission trends by sectors*

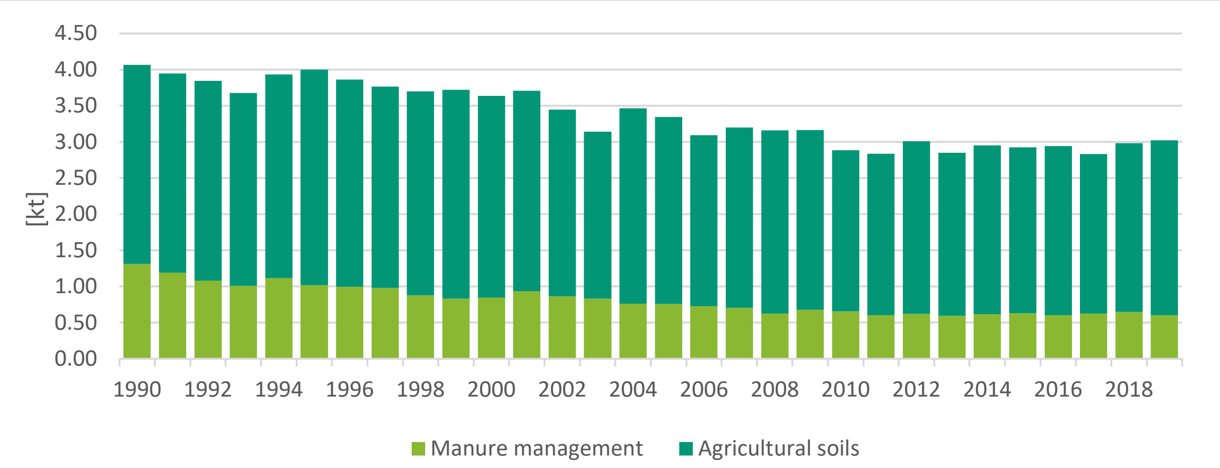


Figure 5.4: *PM$_{2.5}$ emission trends by sectors*

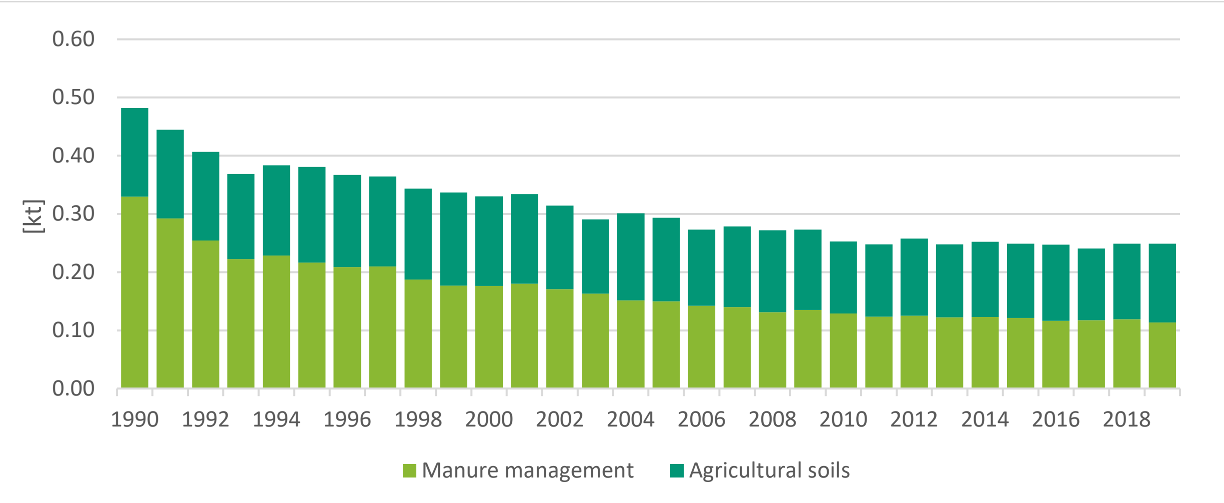


Table 5.3: *TSP emission time-series by sub-sectors in Gg*

YEARS	3B MANURE MANAGEMENT	3D AGRICULTURAL SOILS	3 AGRICULTURE TOTAL
		in Gg	
1990	5.33	2.08	7.41
1995	4.34	2.18	6.51
2000	3.36	1.84	5.21
2005	2.92	1.73	4.65
2010	2.50	1.87	4.36
2011	2.30	1.88	4.18
2012	2.39	1.87	4.25
2013	2.27	1.91	4.19
2014	2.32	1.88	4.20
2015	2.38	1.86	4.24
2016	2.29	1.90	4.19
2017	2.34	1.88	4.22
2018	2.42	1.88	4.31
2019	2.25	2.50	4.75
1990/2019	**-57.90%**	**20.43%**	**-35.92%**
2005/2019	**-23.03%**	**44.53%**	**2.14%**

5.2.3 NON-METHANE VOLATILE ORGANIC COMPOUNDS (NMVOC)

In 2019, Agricultural NMVOC emissions consisted of 7.75 Gg and 7.8% share of the national total (***Table 5.4***). The primary agricultural source of MNVOC emissions is the 3B Manure management accounting for 7.6% of national total NMVOC emission (7.57Gg). NMVOC emissions from animal husbandry mainly originate from silage feeding and partly digested fat, carbohydrate and protein decomposition in the rumen and the manure. Consequently, Cattle farming is the most important source of agricultural NMVOC emissions (67%), while cultivated crops were an insignificant source with a share of 2.4% of total NMVOC emissions in 2019. NMVOC emissions have decreased by 66.1% over the period 1990-2019, as a result of the dropping of animal livestock.

5.4 Table: *NMVOC emission time-series by sub-sectors in Gg*

YEARS	3B MANURE MANAGEMENT	3D AGRICULTURAL SOILS	3 AGRICULTURE TOTAL
	in Gg		
1990	22.69	0.14	22.83
1995	14.45	0.15	14.60
2000	11.87	0.13	11.99
2005	10.44	0.12	10.56
2010	8.86	0.13	8.99
2011	8.58	0.13	8.71
2012	8.69	0.13	8.81
2013	8.42	0.13	8.55
2014	8.39	0.13	8.52
2015	8.63	0.13	8.76
2016	8.31	0.13	8.45
2017	8.41	0.13	8.54
2018	7.86	0.13	7.99
2019	7.57	0.18	7.75
1990/2019	**-66.66%**	**33.94%**	**-66.06%**
2005/2019	**-27.52%**	**53.80%**	**-26.60%**

5.2.4 NITROGEN OXIDES (NOx)

In 2019, Agricultural NOx emissions consisted of 7.21 Gg and 12% share of the national total Agricultural NOx emissions have decreased by 47% since 1990 (***Table 5.5***). The primary drivers of this drop are the significant decrease in the emissions from cattle and swine, due to the dramatic decline in livestock population. Focusing on the period between 2016-2019, NOx emissions from the agricultural sector increased due to a markedly increase in inorganic fertilizer.

Table 5.5: *NOx emission time-series by sub-sectors in Gg*

YEARS	3B MANURE MANAGEMENT	3D AGRICULTURAL SOILS	3 AGRICULTURE TOTAL
	in Gg		
1990	0.337	13.237	13.575
1995	0.221	5.848	6.068
2000	0.194	5.446	5.640
2005	0.176	5.497	5.673
2010	0.150	5.491	5.641
2011	0.142	5.655	5.797

YEARS	3B	3D	3
	MANURE MANAGEMENT	AGRICULTURAL SOILS	AGRICULTURE TOTAL
	in Gg		
2012	0.146	6.071	6.216
2013	0.141	6.584	6.725
2014	0.148	6.888	7.036
2015	0.146	6.750	6.896
2016	0.139	6.975	7.114
2017	0.142	6.834	6.976
2018	0.148	7.146	7.294
2019	0.145	7.062	7.207
1990/2019	**-56.90%**	**-46.65%**	**-46.91%**
2005/2019	**-17.57%**	**28.47%**	**27.04%**

5.3 CATEGORY-SPECIFIC IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

According to the Final Review Report 2020 of the second phase of the review of national air pollution emission inventories (published in 20.11.2020), the improvement was made as a reflection to identified recommendations from the previous reviews:

- Recommendation No ***SK-3B1a-2020-0002***- the lack of transparency concerning E-NH_3 (housing, storage and application) in cattle were implemented in IIR. A detailed description of activity data and parameters used for Tier 2 NMVOC calculation for 3B1a and 3B1b were implemented. More information is available in ***Chapter 5.8.6***

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 sectoral level) and follow basic QA/QC rules and activities as defined in the EMEP/EEA GB_{2019}.

The QC checks (e.g., consistency check between NFR data and national statistics) were done during the NFR and IIR compilation, the General QC questionnaire was filled in and archived by QA/QC manager.

An opportunity to cross-check the activity data and emissions with the pollutions inventory to ensure the consistency between the two inventories provides. In the last two years, the QA/QC procedures had significantly improved. QA/QC provides an additional opportunity to crosscheck the activity data and emissions with the GHGs inventory to ensure consistency between the two inventories. In the last two years, the QA/QC procedures had significantly improved.

The QA/QC extended by check of activity data for rounding errors, compared to the original data sources.

- Check the correct use of the units in the calculation sheets.
- Check of reasons for data gaps and provide explanations.
- Cross-check of data sources of the activity data if possible (e.g., total annual milk yield per cow, amount of wool, harvested area).
- Check of recalculation differences.

- Check for errors between the calculation sheets and the templates

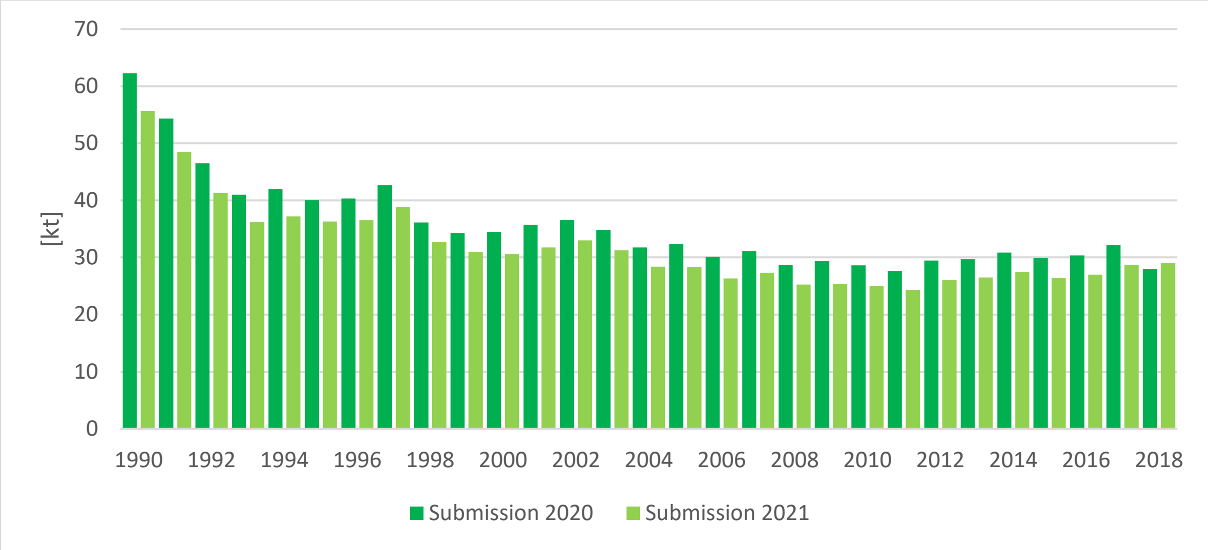
5.5 CATEGORY-SPECIFIC RECALCULATIONS

Recalculations made in the agriculture sector were provided and implemented in line with the Improvement Plan reflecting recommendations made during previous reviews. Sectoral emissions in Agriculture was recalculated in line with revised EMEP/EEA GB_{2019} compare to EMEP/EEA GB_{2016} and due to methodological changes related to shifting in the higher tier in Particular matters.

Table 5.6: *shows an overview of these recalculations and corrections, which were corrected and implemented in the 2021 submission.*

CATEGORY	YEAR	POLLUTION	DESCRIPTION	REFERENCES
		15.FEBRUARY 2021		
3B	1990-2018	NH_3, NOx	Implementation of EMEP/EEA Guideline 2019	5.5
3B2	1994,2005	NH_3, NOx, NMVOC	Inconsistent transcription between CRF and calculation sheets were found in the growing lamb's category.	5.5
3B1	1990-2018	NMVOC	Recalculation is connected with recalculation in ammonia emission in this category	5.5
3B2	1990-2018	NMVOC	Implementation of EMEP/EEA Guideline 2019 – revision of EF	
3B1b	1990-2018	NH_3, NOx	The incorrect cell connection was found in Excel. The bodyweight and Nitrogen excretion rate in the Non-dairy cattle category (Calves and Heifers) were revised.	5.5
3B2	1991-2018	PM_{10}, $PM_{2.5}$, TSP	Double counting of emissions in Mature ewes was found.	5.5
3B1	2009	NH_3, NOx, TSP, PM_{10}, $PM_{2.5}$	Incorrect numbers of dairy cattle were found and were corrected	5.5
3B2	1994	NH_3, NO_X	The inconsistent number of rams between calculations and source of AD were found in the isolated year 1994. Recalculations have an impact on nitrogen cross manure systems and emissions.	5.5
3Da1	2018	NH_3,NOx	Activity data on individual types of nitrogen fertilizers were revised, due to wrongness redistribution of the individual type of fertilizers	5.5
3Da2a	1990-2018	NH_3, NOx	Implementation of EMEP/EEA Guideline 2019	5.5
3Da3	1990-2018	NH_3	Implementation of EMEP/EEA Guideline 2019	5.5
3Da3	1990-2004 except 2000 and 2009	NOx	Recalculation of this category is connected with recalculation in 3B1b and 3B1a	5.5
3Dc	1990-2018	PM_{10}, $PM_{2.5}$	Implementation of tier 2 approach.	5.11
3Dc	1996 - 2018	TSP	Revision of grassland area	5.11
3De	1990 - 2018	NMVOC	Recalculation of this category is connected with revision of EFs	5.5

Figure 5.5: *Comparison of NH_3 emissions from the Agriculture sector due to recalculations*



NH_3 & NOx emissions: Implementation of EMEP/EEA Guidebook2019 significantly changed the emission of ammonia in all time-series. Revision nitrogen losses shares caused recalculation of ammonia emissions in 3B and 3D subsectors. Sectoral emissions in 3B Manure management decreased especially in Cattle, Swine, Horses, Laying hens, Broilers categories. Emissions from the Application of manure into the soils drop as well. In contrast with mentioned emission categories, NH_3 emissions from pasture increased. Other recalculations were done base on quality control of emissions and AD in these sectors. A list of corrections is available in ***Table 5.6***

The activity data in 3Da1 on individual types of nitrogen fertilizers were revised in 2018, due to the lack of IFASTAT data on individual types of nitrogen fertilizers in the 2020 submission. The used officially statistical information from the UKSÚP was not consistent with IFASTAT data on the level of individual types of fertilizers. Redistribution of the individual type of fertilizers was needed mainly due to low consumption of urea, nitrogen solution and lack of data on other N straight. Results of redistribution are visible in ***Table 5.7***

Table 5.7: *Result of redistribution of fertilizer type*

INVENTORY YEAR	TYPE OF FERTILIZERS *(t)*									
	Ammonium nitrate (N)	**Ammonium sulphate (N)**	**Calc. amm. nitrate (N)**	**Nitrogen solutions (N)**	**Other N straight (N)**	**Urea (N)**	**Ammonium phosphate (N)**	**NK compound (N)**	**NPK compound (N)**	**Other NP (N)**
SUBMISSION 2020 (YEAR 2018)	48 372	12 858	31 983	1 004	NO	4 781	1 125	NO	28 853	NO
SUBMISSION 2021 (YEAR 2018)	**1 100**	**1 103**	31 983	**16 463**	**25 966**	**41 299**	1 125	NO	**9 939**	NO

Recalculation of NH_3 leads to an increase in emission compared to the previous submission of 3.9% (2018) (***Figure 5.5***. Recalculation of NOx leads to an increase of emission compared to the previous submission of 1.9% compared to the previous submission (2018) (***Figure 5.6***)

Figure 5.6: Comparison of NOx emissions from the Agriculture sector due to recalculations

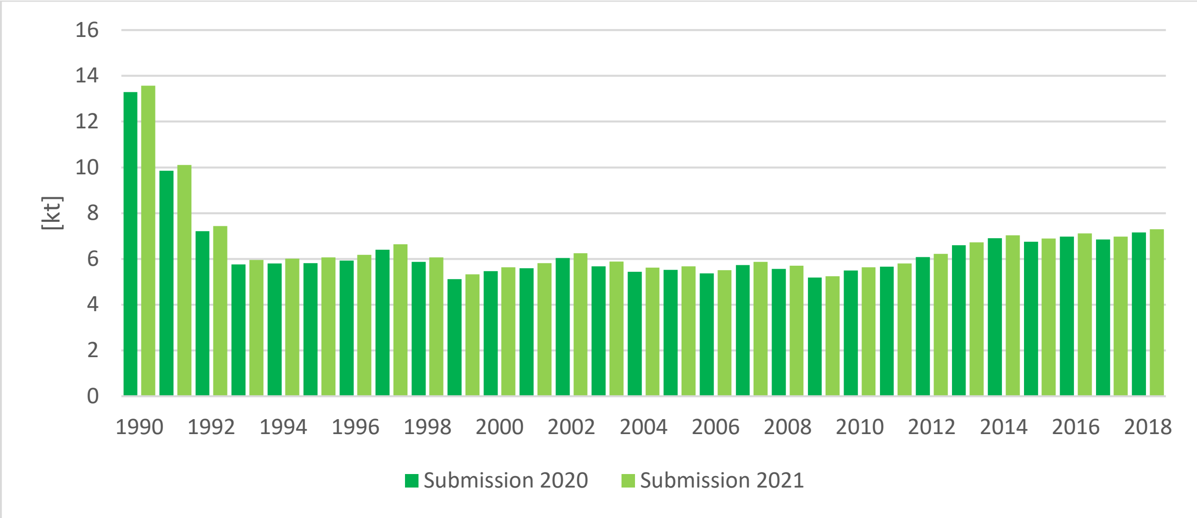
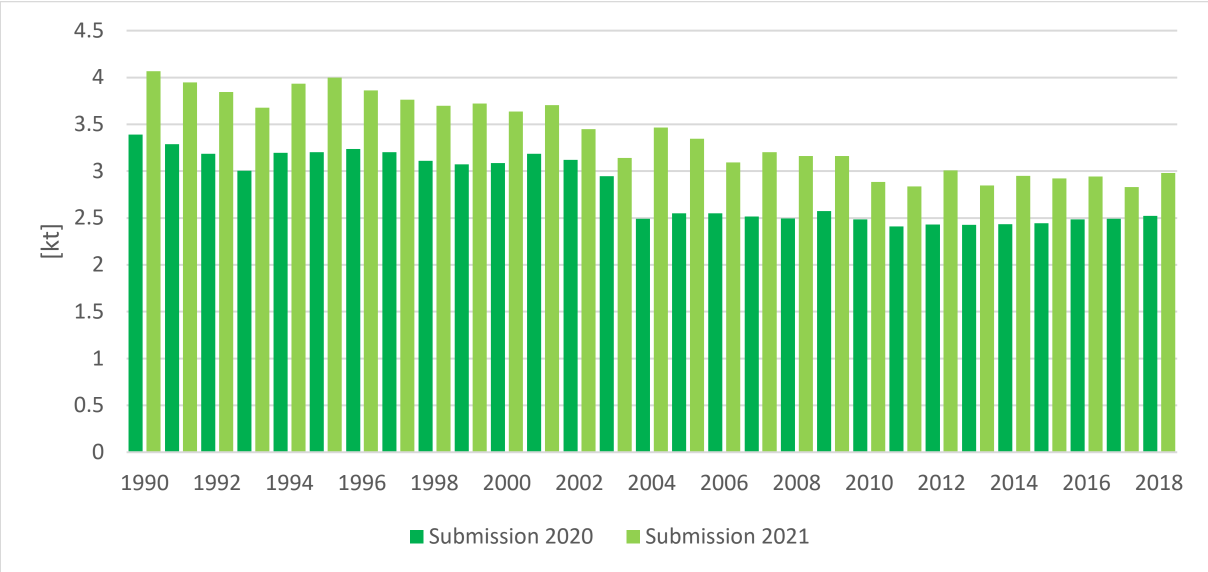


Figure 5.7: Comparison of PM_{10} emissions from the Agriculture sector due to recalculations



PM_{10} emissions & $PM_{2.5}$ emissions: In 2019, Implementation of the Tier 2 method in 3Dc Farm-level agricultural operations including storage, handling and transport of agricultural products was done. Included high tier method refines the estimate emissions in this category. Incorrect numbers of dairy cattle were found and were corrected in the isolated year 2009. Double counting of PM emissions in Mature ewes was found in 1991-2018, due to double of activity data. The area of grassland was also recalculated due to the wrong link between sheets in Excel. Recalculation of PM_{10} and $PM_{2.5}$ leads to an increase in emissions by 29.4 % and 0.1% compared to the previous submission (2018). More information's are available in ***Chapter 5.11.1***.

Figure 5.8: *Comparison of $PM_{2.5}$ emissions from the Agriculture sector due to recalculations*

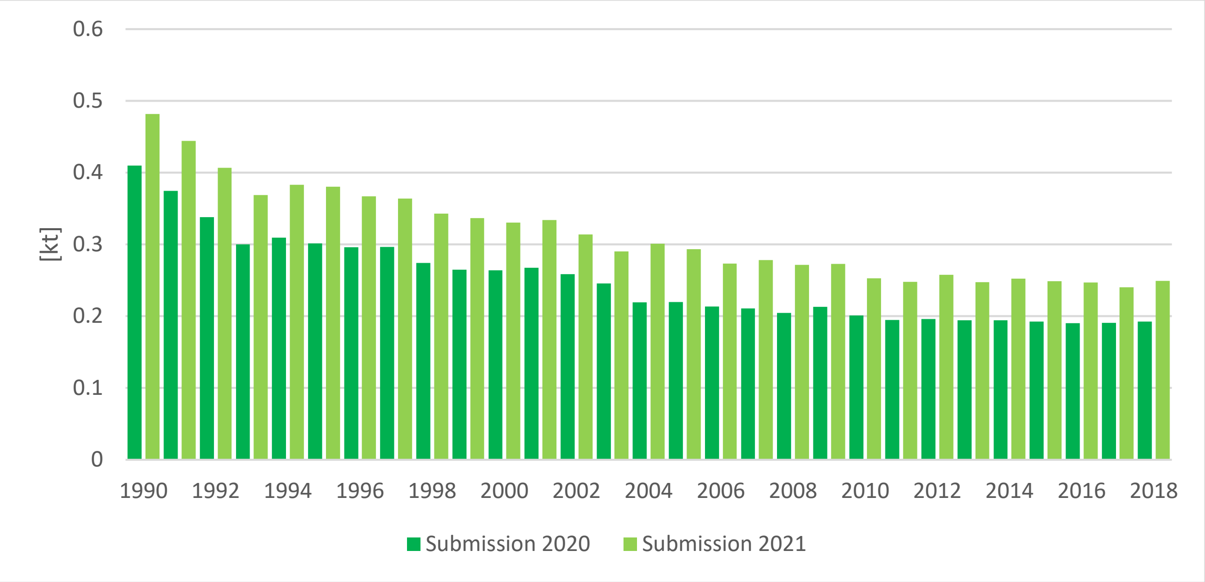
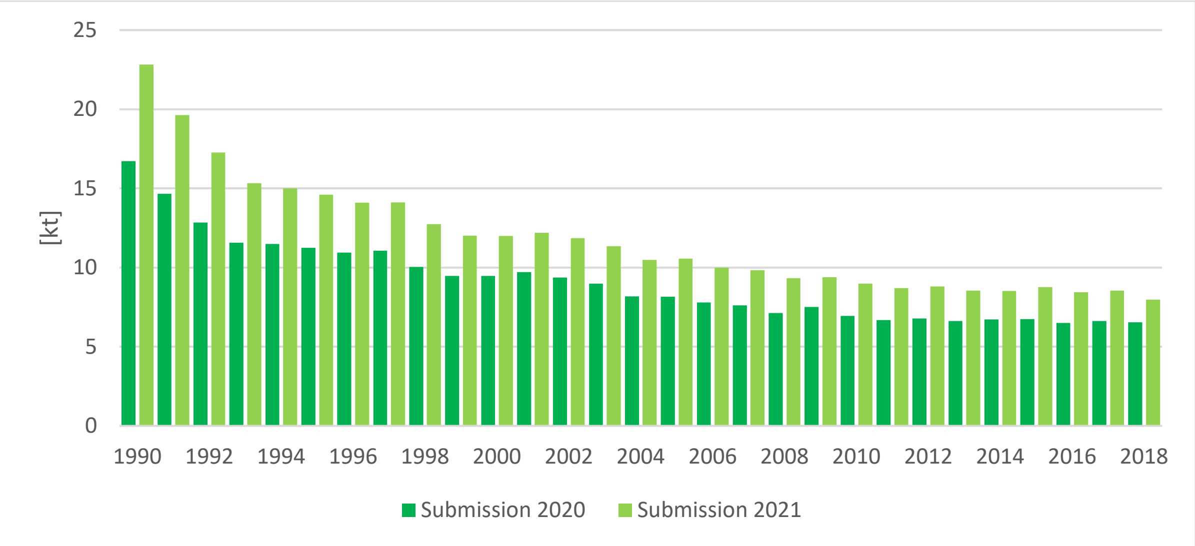
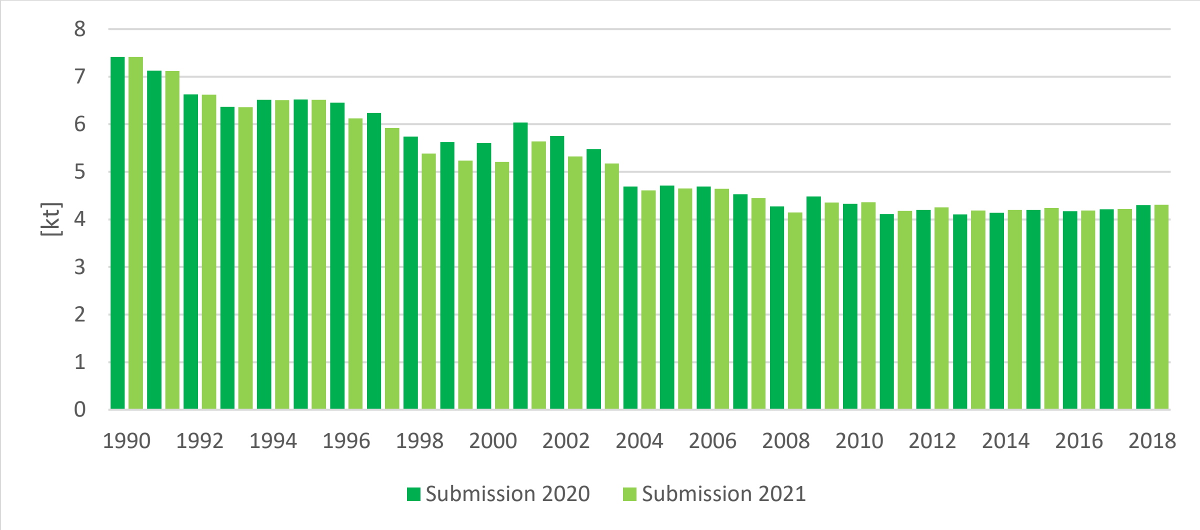


Figure 5.9: *Comparison of NMVOC emissions from the Agriculture sector due to recalculations*



NMVOC emissions: Implementation of EMEP/EEA Guidebook$_{2019}$ and revision of ammonia emissions in all time-series had to influence NMVOC cattle emissions. Revision of NMVOC in the sheep category is also in line with the implementation of EMEP/EEA Guidebook$_{2019}$. Used emission factor was changed. Revision of EF in cultivated crops- 3De category was done as well. Recalculation of NMVOC leads to an increase in emissions by 22.2% compared to the previous submission (2018). More information is available in ***Chapters 5.8.6*** and ***5.10***.

Figure 5.10: *Comparison of TSP emissions from the Agriculture sector due to recalculations*



TSP emissions: Double counting of PM emissions in mature ewes was found in 1991-2018, due to double activity data. The area of grassland was also recalculated due to the wrong link between sheets in Excel. Recalculation of TSP leads to increase emissions by 0.1 % compared to the previous submission (2018). More information's are available in ***Chapters 5.8.2*** and ***5.11***.

5.6 NATIONAL CIRCUMSTANCES AND TIME-SERIES CONSISTENCY

Slovak farmers have been adapted to changes in agriculture after 1990. They invested in the development of their farms to avoid bankrupt and to be self-competitive in this sector. The EU policy supported the used tools as the base of transformation. The EU policy and measures were transformed into the Slovak legal system. Farmers had to follow new strict criteria like higher milk yield, changing of housing systems, a decrease of pasture time, new storage capacity for organic waste, which was supported by the Decree No 389/2005 Coll. 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 inventory. The most significant animals in Slovakia are cattle and swine.

Cattle breeding in the Slovak Republic is comparable with the Western European countries, which is documented by a high milk yield of dairy cattle and high daily weight gains of non-daily cattle. To maintain a high milk yield and high daily gains, food rich in proteins and cereals is important. Dairy cows in three Slovak regions (Bratislava, Trnava, and Nitra) produce 20-23 litres/day. In other regions, milk productivity is 14-15 litres/day. Lower milk production relates to feeding. In this case, pasture is included in the feeding ratio. It is typical for semi-intensive farming in regions Košice, Prešov, Banská Bystrica or Žilina. These circumstances are documented in ***Figures 5.12*** and ***5.13***. Highly productive dairy cows (milked 23 litres/day) need to be fed by 8 kg of cereals with excellent digestibility and high nutrition. Annual increases in milking productivity document an increase in the productivity of animal production. Balanced and sustainable farming in Slovakia has an impact on the high value of AGEI (287.3 MJ/head/day) (***Table 5.11***).

[3] Nitrates Directive http://www.mpsr.sk/index.php?start&navID=78&id=1325%20 (in Slovak)

Table 5.8: The comparison of the Slovak milk yield with other regions in 2019

DAIRY COWS	SLOVAKIA[4]	WESTERN EUROPE[5] (AVERAGE)	EASTERN EUROPE[6] (AVERAGE)	NORTH AMERICA[6] (AVERAGE)
	kg/year/head			
Milk yield	7 379	7 465	4 853	10 304

***Figure 5.11**: Trend in average gross energy intake (MJ/day) in different Slovak regions*

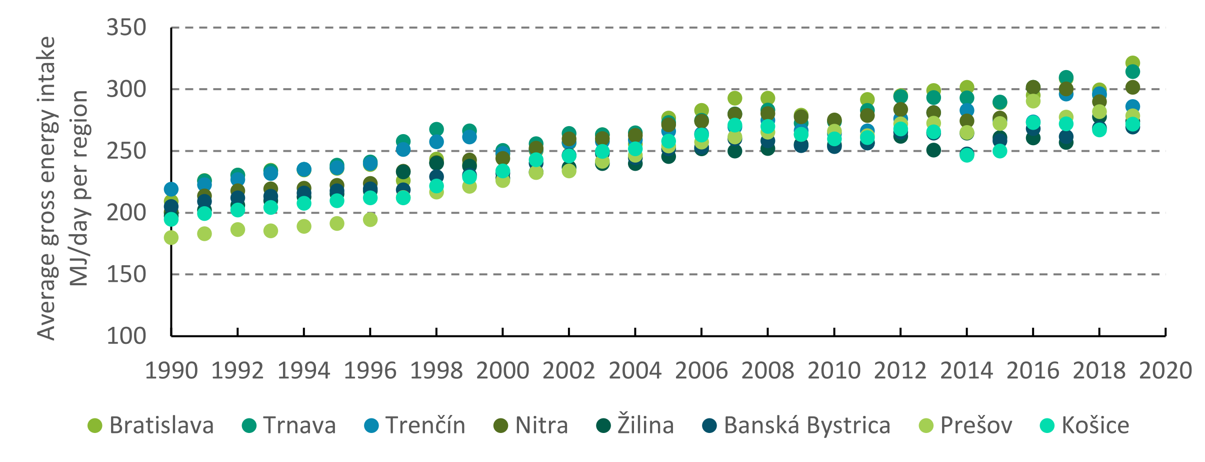
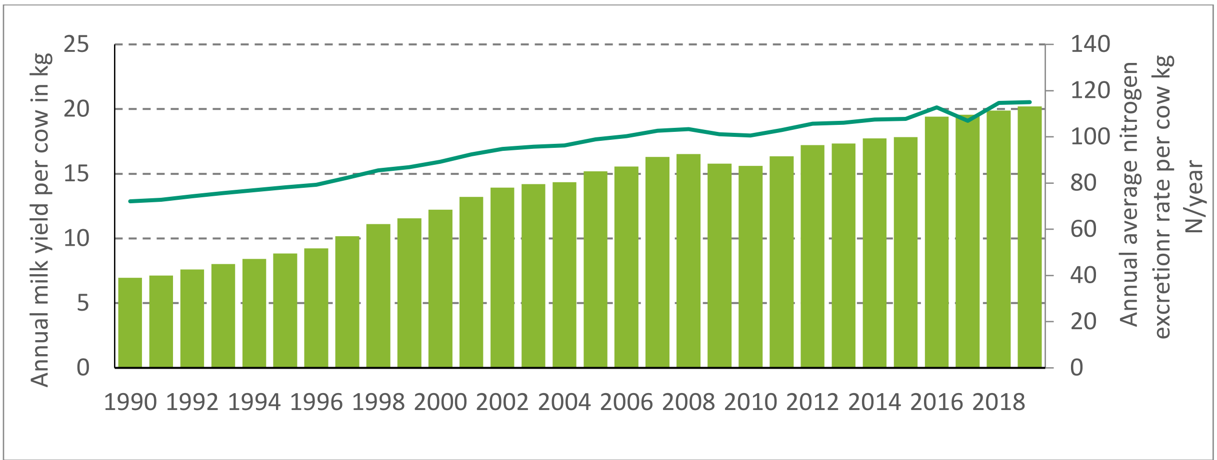


***Figure 5.12:** Correlation of milk production (kg/day/head) and nitrogen excretion rate (kg N/y/head)*

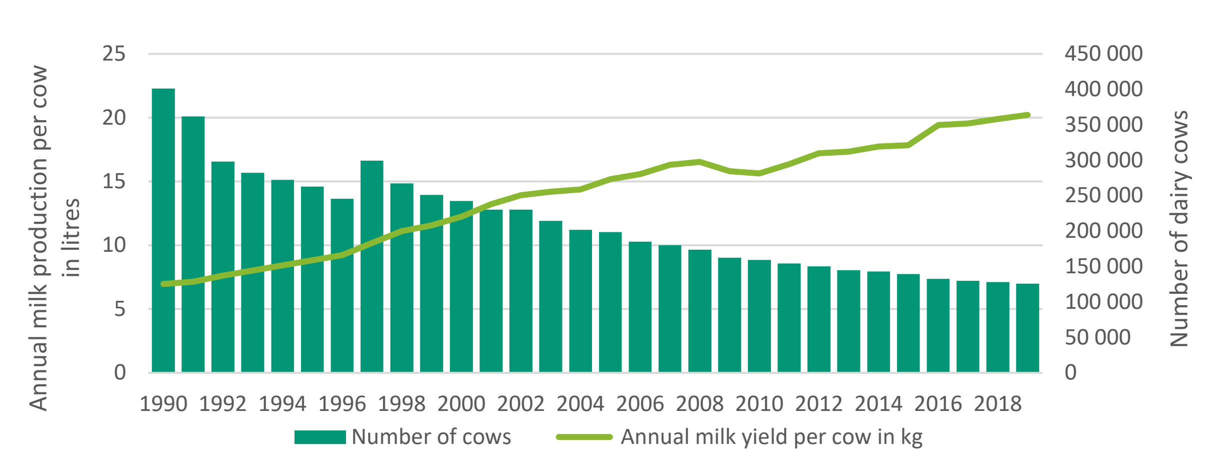


The number of dairy cows decreased according to data from the ŠU SR by 69% in 2019 compared to 1990 (***Figure 5.12***). Milk production increased up to 186% in 2019 (***Figure 5.13***) compared to 1990, despite the continuously decreasing number of dairy cows. The main reason for this trend is the increase in average performance. The high-performance average is the result of good animal husbandry, breeding conditions, new synergy with technologies and animal genetics. All factors contribute together to achieving milk yields of up to 10 000 kg of milk per head per year.

***Figure 5.13:** Trend in dairy cattle population and dairy milk production (kg/head/day)*

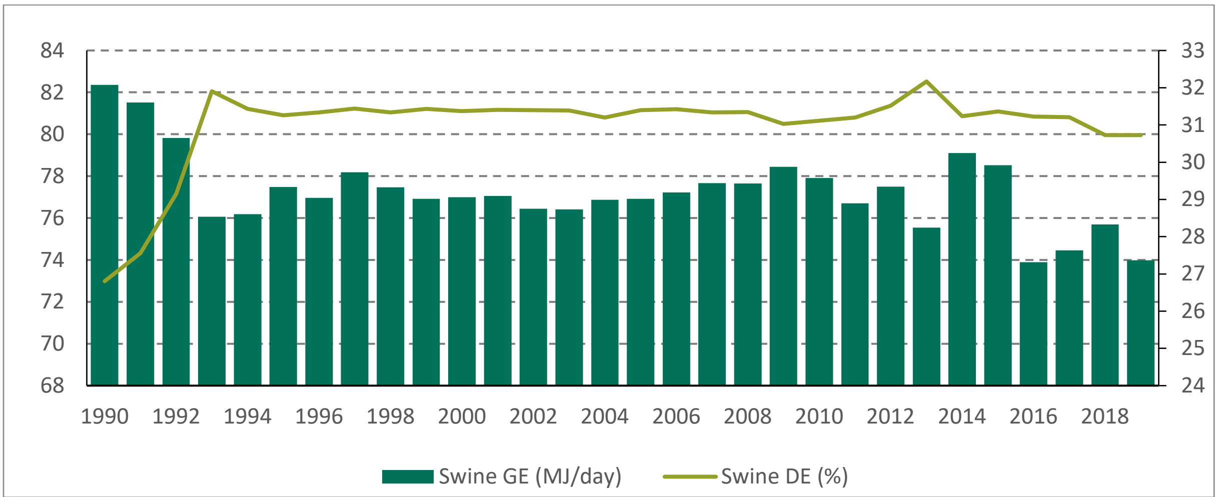
[4] The animal production, sales of primary production and crop balance (in Slovak) www.statistics.sk

[5] Producing Animals (Slaughtered), Milk Production http://www.fao.org/faostat/en/#data/QL



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 Slovak conditions for the whole year. Housing technology and diet can significantly affect the production of greenhouse gases. Stall conditions can be very variable. Pigs are bred in intensive farming on rosette floors, which is one of the low emission technics. Another part of pigs, mainly in semi-intensive farming, are reared on straw. Deep bedding is used mostly at micro and small farms. Diet has a significant impact on emissions production. The main component of the feeding is cereals (barley, triticale, wheat about 80-90%). Complementary feed ingredients are soybean scrap, rapeseed scrap, and beer brewing waste. The resultant feeding rations have a high nutritional value and are easily digestible (***Figure 5.14***). After 1990, the digestibility of feeding dose increased significantly due to the increase of cereals, vitamins, dietary fibre, crude proteins and amino acids. These changes affect the increase in pig performance. The opposite trend is visible last 4 years meanly in breeding pigs, a decrease in digestibility and IGE is visible in ***Figure 5.8***. 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. The farmers do not invest and no spend extra funds on higher pig husbandry costs.

Figure 5.14: *Trend of feed digestibility and gross energy intake of swine in the Slovak Republic*



5.8.5 PARTICULAR MATTERS (PM_{10}, $PM_{2.5}$ & TSP)

The significant sources of particular matters are dust from straw, silage and residue of feed. The activity of animals contributes production of emission feathers from poultry residues skin and others. The particular matters have a filterable character.

In 2019, manure management contributed 3.2% and 0.79% to the national total PM emissions given as TSP 8.6% of the sectorial emissions relates to poultry production. Total $PM_{2.5}$ from manure management decreased from 0.33 Gg in 1990 to 0.11 Gg in 2019, which is a decrease of 66% compared to a basic year and a decrease by nearly 7% compared to the previous year. Total PM_{10} from manure management decreased from 1.31 Gg in 1990 to 0.60 Gg in 2019, which is a decrease of 54% compared to 1990 and an increase of 4% compared to the previous year. Total TSP from manure management decreased from 5.33 Gg in 1990 to 2.25 Gg in 2019, which is a decrease of 58% and a decrease of 7% 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_{2019}. The PM emissions are related to the annual average population (AAP) and to the time the animal is housed (***Table 5.18***). The PM emission from grazing animals is considered negligible.

If the AAP is estimated from the number of places (n_{places}), according to the equation:

$$AAP = n_{places} x (1 - t_{empty}/365)$$

where: **AAP:** annual average population, Number of animals of a particular category that are present, on average, within the year, $\mathbf{n_{places}}$**:** animal places**,** Average capacity for a livestock category in the animal housing that is usually occupied, $\mathbf{t_{empty}}$: Empty period, The average duration during the year when the animal place is empty (in d)

Table 5.18: *Time to spend animals into grassland*

CATEGORIES	GRASSING TIME
	days
Dairy cattle	150
Calves	148
Heifers unpregnant	9
Heifers pregnant	9
Fattening	0
Oxen	0
Suckled cows	200
Calves	290
Heifers unpregnant	225
Heifers pregnant	225
Fattening	0
Oxen	0
Breeding bulls	90
Sows 180 kg	0
Piglets	0
Fattening pigs	0
Laying hens including cocks	0
Broilers	0
Turkeys	0
Ducks	0
Geese	0

CATEGORIES	GRASSING TIME
	days
Horses	109
Goats	181
Mature ewes	181

5.8.5.2 Emission factors (PM_{10}, $PM_{2.5}$ & TSP)

PM_{10}, $PM_{2.5}$, TSP emissions from manure management were calculated using the default Tier 1 emissions factors for each category of farm animals (***Table 5.19***). The same emissions factors were used for all years.

Table 5.19: *Default emissions PM and TSP factors*

CATEGORIES	EMISSION FACTOR TSP	EMISSION FACTOR PM_{10}	EMISSION FACTOR $PM_{2.5}$
	[kg/head/year^{-1}]	*[kg/head/year^{-1}]*	*[kg/head/year^{-1}]*
Dairy cattle	1.38	0.63	0.41
Calves	0.34	0.16	0.1
Hefers unpregnant	0.59	0.27	0.18
Hefers pregnant	0.59	0.27	0.18
Fattening	0.59	0.27	0.18
Oxen	0.59	0.27	0.18
Suckled cows	0.59	0.27	0.18
Calves	0.34	0.16	0.1
Hefers unpregnant	0.59	0.27	0.18
Hefers 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
Wearners	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	1.38	0.63	0.41
Growing lambs unpregnant	0.34	0.16	0.1
Rams	0.59	0.27	0.18
Mature ewes	0.59	0.27	0.18
Growing lambs pregnant	0.59	0.27	0.18
Growing lambs unpregnant	0.59	0.27	0.18
Rams	0.59	0.27	0.18

5.8.5.3 Activity data

The number of livestock describes **Chapter 5.8.3.**

5.8.5.4 Category-specific recalculations

The primary driver of recalculation of PM emissions in whole time series was correcting of double-counting of PM emissions in mature ewes which was found in 1991-2019, due to double of activity data. Agriculture is not a significant contributor to mentioned emissions and emissions are under the threshold of significance.

The recalculation let to decreasing of TSP and PMs emissions from manure management by 0.23% and PM_{10} and $PM_{2.5}$ in 2018 (0.36% and 1.3%), as shown in ***Table 5.20***. The recalculation let to a decrease of the total PM_{10} by 0.37% (***Table 5.20***).

Table 5.20: *The impact of recalculations of TSP, $PM_{2.5}$, PM_{10} emissions in manure management in 1990–2018*

CATEGORY	MANURE MANAGEMENT PM_{10} *[kt]*		MANURE MANAGEMENT $PM_{2.5}$ *[kt]*		MANURE MANAGEMENT TSP *[kt]*	
YEAR OF SUBMISSION	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
1990	1.313	1.313	0.330	0.330	5.333	5.333
1991	1.193	1.190	0.294	0.292	5.030	5.024
1992	1.084	1.079	0.257	0.254	4.527	4.516
1993	1.011	1.009	0.224	0.222	4.374	4.370
1994	1.119	1.117	0.230	0.228	4.435	4.430
1995	1.022	1.020	0.218	0.216	4.340	4.335
1996	0.998	0.996	0.210	0.209	4.216	4.211
1997	0.981	0.979	0.211	0.210	4.014	4.009
1998	0.879	0.877	0.189	0.187	3.508	3.503
1999	0.834	0.831	0.179	0.177	3.384	3.378
2000	0.848	0.845	0.178	0.176	3.371	3.365
2001	0.937	0.935	0.181	0.180	3.788	3.784
2002	0.865	0.863	0.172	0.171	3.495	3.490
2003	0.835	0.833	0.165	0.163	3.365	3.360
2004	0.763	0.761	0.153	0.151	2.962	2.958
2005	0.761	0.759	0.151	0.150	2.921	2.917
2006	0.730	0.728	0.143	0.142	2.870	2.866
2007	0.706	0.704	0.142	0.140	2.721	2.716
2008	0.627	0.624	0.133	0.131	2.405	2.400
2009	0.689	0.680	0.141	0.135	2.597	2.577
2010	0.657	0.655	0.130	0.129	2.501	2.496
2011	0.604	0.602	0.125	0.124	2.305	2.300
2012	0.624	0.622	0.127	0.125	2.394	2.388
2013	0.599	0.596	0.124	0.122	2.279	2.274
2014	0.620	0.617	0.124	0.123	2.323	2.317
2015	0.631	0.628	0.123	0.121	2.385	2.379
2016	0.605	0.602	0.118	0.116	2.295	2.289
2017	0.628	0.625	0.119	0.118	2.345	2.340
2018	0.649	0.646	0.120	0.119	2.429	2.424
Submissions 2020/2021		**-0.36%**		**-1.30%**		**-0.23%**

5.8.6 NMVOC EMISSIONS

The main source of NMVOC emissions occurs from the enteric fermentation of ruminants. Especially, NMVOC emissions arise during stomach fermentation of partially digestible and non-digestible fats, carbohydrates and proteins. NMVOC are emitted during breathing or as flatus. The storage of silage manure is another source of NMVOC emissions.

Cattle are the main contributor of NMVOCs from all farm animals (59%), followed by poultry (33%), pigs (7%) and another animal. Weather conditions, as high temperature, wind speed, and wind direction affects the amount of emissions. These parameters were not taken into consideration in the NMVOC emission balance.

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 GB2019.

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 GB2019.

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 5.21-Table 5.22)***.

NMVOC for cattle is based on the following equations [1]:

$$\mathrm{E_{NMVOC\,i} = N_A.\left(E_{NMVOC.storr\ silage\ \ i} + E_{NMVOC.silage\ feeding\ i+} + E_{NMVOC.\ \ house\ i} + E_{MVOC.applic.i} + E_{NMVOC.pasture\ i}\right)}$$

$$\mathrm{E_{NMVOC.silage\ store\ i} = MJ_i.\,x_{house\ i}\left(EF_{NMVOC.silage\ feeding\ \ i}.\,Frac_{silage}\right)}$$

$$\mathrm{E_{NMVOC.\ \ silage\ feeding\ i} = MJ_i.\,x_{housing\ i}.\left(EF_{NMVOC\ feed\ silage\ i}.\,Frac_{silage}\right)}$$

$$\mathrm{E_{NMVOC\ house\ i} = MJ_i.\,x_{house\ i}.\left(EF_{NMVOC\ silage}\right)}$$

$$\mathrm{E_{NMVOC\ manure\ store\ i} = E_{NMVOC\ \ house\ i}.\,x_{house\ i}.\left(\frac{E_{NH_3\ storage\ i}}{E_{NH_3\ house\ i}}\right)}$$

$$\mathrm{E_{NMVOC\ application\ i} = E_{NMVOC\ \ house\ i}.\,x_{house\ i}.\left(\frac{E_{NH_3\ appli\ i}}{E_{NH_3\ house\ i}}\right)}$$

$$\mathrm{E_{NMVOC\ graz\ i} = MJ_i.\,(1 - x_{house\ i}).\,EF_{NMVOC.graz\ i}}$$

Where:

$\boldsymbol{MJ_i}$: Gross feed intake in MJ year. $\boldsymbol{x_i}$: Share of time the animals spend in the animal house (%),$\boldsymbol{Frac_{silage}}$: If silage feeding is dominant $\boldsymbol{Frac_{silage}}$ 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. $\boldsymbol{E_{NH_3\,applic\ i}}$ $\boldsymbol{E_{NH_3\,house\ i}}$ $\boldsymbol{E_{NH_3\,storage\,i}}$. Emissions from 3B Manure Management.

***Table 5.21:** Overview of parameters in dairy cattle categories in particular years*

DAIRY CATTLE	BE [MJ/year]	FRACTION OF SILAGE	$E_{Housing\_slurry}$ [Gg]	$E_{Housing\_solid}$ [Gg]	$E_{storage\_slurry}$ [Gg]	$E_{storage\ FYM}$ [Gg]	$E_{slurry\ application}$ [Gg]	$E_{soild\_application}$ [Gg]	$E_{pasture}$ [Gg]
1990	95 606	0.515	0.380	0.866	0.082	1.020	0.629	5.362	1.212
1991	90 071	0.503	0.308	0.801	0.066	0.943	0.510	4.957	1.103
1992	90 184	0.505	0.262	0.673	0.056	0.792	0.433	4.165	0.928
1993	90 728	0.506	0.251	0.649	0.054	0.764	0.415	4.018	0.894
1994	91 556	0.506	0.245	0.638	0.053	0.751	0.405	3.948	0.878
1995	92 447	0.506	0.239	0.626	0.051	0.736	0.395	3.872	0.861
1996	92 731	0.506	0.225	0.594	0.049	0.700	0.373	3.679	0.817
1997	94 338	0.505	0.275	0.755	0.059	0.889	0.455	4.674	1.034
1998	95 625	0.500	0.254	0.699	0.055	0.823	0.420	4.329	0.957
1999	96 477	0.506	0.252	0.665	0.054	0.783	0.417	4.116	0.914
2000	98 771	0.505	0.247	0.661	0.053	0.778	0.408	4.090	0.907
2001	100 412	0.511	0.241	0.651	0.052	0.762	0.398	4.028	0.893
2002	101 109	0.510	0.231	0.672	0.050	0.787	0.383	4.156	0.914
2003	101 531	0.513	0.231	0.628	0.049	0.735	0.381	3.884	0.860
2004	101 827	0.515	0.218	0.594	0.047	0.694	0.360	3.672	0.814
2005	102 927	0.515	0.208	0.605	0.044	0.706	0.343	3.742	0.823
2006	104 118	0.517	0.232	0.559	0.049	0.651	0.383	3.456	0.777
2007	104 676	0.517	0.205	0.566	0.044	0.659	0.339	3.501	0.775
2008	105 371	0.519	0.200	0.550	0.043	0.639	0.330	3.401	0.753
2009	103 978	0.517	0.214	0.554	0.045	0.640	0.353	3.420	0.763
2010	103 901	0.519	0.195	0.484	0.041	0.561	0.323	2.992	0.671
2011	105 628	0.523	0.198	0.478	0.042	0.554	0.327	2.954	0.665
2012	106 895	0.521	0.191	0.482	0.040	0.555	0.315	2.973	0.666
2013	107 906	0.522	0.198	0.462	0.042	0.531	0.326	2.850	0.644
2014	104 803	0.520	0.177	0.469	0.037	0.531	0.292	2.888	0.645
2015	109 602	0.517	0.158	0.463	0.033	0.516	0.258	2.842	0.629
2016	111 167	0.513	0.162	0.460	0.033	0.512	0.265	2.824	0.627
2017	112 583	0.512	0.140	0.430	0.028	0.476	0.229	2.639	0.582
2018	104 551	0.510	0.170	0.447	0.035	0.498	0.278	2.745	0.615
2019	104 535	0.509	0.195	0.411	0.039	0.479	0.318	2.669	0.610

***all parameters are weighted average represent aggregation in level SR.**

***Table 5.22:** Overview of parameters for non-dairy cattle categories in particular years*

DAIRY CATTLE	BE [MJ/year]	FRACTION OF SILAGE	$E_{Housing\_slurry}$ [Gg]	$E_{Housing\_solid}$ [Gg]	$E_{storage\_slurry}$ [Gg]	$E_{storage\ FYM}$ [Gg]	$E_{slurry\ application}$ [Gg]	$E_{soild\_application}$ [Gg]	$E_{pasture}$ [Gg]
1990	45 558	0.254	0.702	1.600	0.151	1.883	0.393	5.405	0.675
1991	44 203	0.252	0.544	1.415	0.117	1.666	0.348	4.867	0.675
1992	46 541	0.248	0.468	1.203	0.101	1.416	0.293	4.212	0.646
1993	46 395	0.245	0.376	0.975	0.081	1.147	0.213	3.221	0.490
1994	45 463	0.237	0.337	0.879	0.073	1.034	0.163	2.722	0.414
1995	46 019	0.244	0.349	0.915	0.075	1.077	0.200	2.680	0.436
1996	45 711	0.249	0.340	0.897	0.073	1.056	0.194	2.678	0.433
1997	40 483	0.287	0.275	0.756	0.059	0.889	0.142	1.507	0.095
1998	41 767	0.296	0.240	0.661	0.052	0.778	0.125	1.344	0.098
1999	42 762	0.280	0.238	0.628	0.051	0.739	0.140	1.378	0.109
2000	43 489	0.277	0.226	0.606	0.049	0.713	0.116	1.346	0.125
2001	43 695	0.285	0.225	0.609	0.048	0.713	0.102	1.210	0.114
2002	44 186	0.272	0.200	0.581	0.043	0.681	0.086	1.106	0.122
2003	44 306	0.265	0.208	0.566	0.045	0.663	0.091	1.205	0.152
2004	44 813	0.270	0.187	0.510	0.040	0.596	0.079	1.063	0.134

DAIRY CATTLE	BE [MJ/year]	FRACTION OF SILAGE	$E_{Housing\_slurry}$ [Gg]	$E_{Housing\_solid}$ [Gg]	$E_{storage\_slurry}$ [Gg]	$E_{storage\ FYM}$ [Gg]	$E_{slurry\ application}$ [Gg]	$E_{soild\_application}$ [Gg]	$E_{pasture}$ [Gg]
2005	45 349	0.269	0.174	0.507	0.037	0.591	0.077	1.218	0.138
2006	46 333	0.260	0.195	0.470	0.042	0.548	0.126	1.756	0.179
2007	46 527	0.261	0.173	0.476	0.037	0.554	0.082	1.303	0.177
2008	47 247	0.250	0.167	0.461	0.036	0.535	0.070	1.222	0.180
2009	47 214	0.261	0.183	0.472	0.039	0.545	0.081	1.299	0.177
2010	48 384	0.230	0.172	0.427	0.037	0.494	0.062	1.260	0.220
2011	48 585	0.229	0.177	0.428	0.038	0.495	0.060	1.258	0.219
2012	48 599	0.223	0.176	0.444	0.037	0.512	0.070	1.424	0.263
2013	49 187	0.226	0.189	0.441	0.040	0.508	0.077	1.480	0.291
2014	47 343	0.237	0.171	0.453	0.036	0.513	0.069	1.634	0.323
2015	50 233	0.224	0.152	0.448	0.032	0.499	0.061	1.645	0.338
2016	50 099	0.216	0.152	0.431	0.031	0.480	0.061	1.623	0.334
2017	51 499	0.221	0.143	0.436	0.029	0.483	0.080	1.764	0.370
2018	42 684	0.222	0.168	0.442	0.034	0.493	0.086	1.904	0.391
2019	44 998	0.221	0.202	0.427	0.041	0.497	0.086	1.874	0.385

Table 5.23: *Overview of emissions factors for non-dairy cattle categories*

NMVOC EMISSION FACTORS							
EF_{NMVOC}.silage feeding*	**(kg NMVOC kg/MJ feed intake)**	0.000200	0.000200	0.000200	0.000200	0.000200	0.000200
EF_{NMVOC} house*	**(kg NMVOC kg/MJ feed intake)**	0.000035	0.000035	0.000035	0.000035	0.000035	0.000035
EF_{NMVOC} graz *	**(kg NMVOC kg/MJ feed intake)**	0.000007	0.000007	0.000007	0.000007	0.000007	0.000007

Other animals

NMVOC emissions from other animal categories were calculated using the Tier 1 methodology and emission factors outlined in the EMEP/EEA GB_{2019}. Used emission factors summarized in ***Table 5.24***. There is no evidence about adding silage into feeding ration for other animal categories.

Table 5.24 *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

5.8.6.3 Activity data

See **Chapter 5.8.3**.

5.8.4.4 Category-specific recalculations

Implementation of EMEP/EEA $Guidebook_{2019}$ and revision of ammonia emissions in all time-series influenced NMVOC cattle emissions. Revision of NMVOC in the sheep category is also in line with the implementation of EMEP/EEA $Guidebook_{2019}$. Used emission factor was changed. Revision of EF in cultivated crops- 3De category was done as well. Recalculation of NMVOC leads to an increase in emissions by 22.2% compared to the previous submission (2018). Recalculation leads to the increasing of NMVOC emissions in 2018 by 27.41%.

Table 5.25: *The effect of recalculations NMVOC emissions in 1990–2018*

CATEGORY	MANURE MANAGEMENT NMVOC *[kt]*	
YEAR OF SUBMISSION	2020	2021
1990	16.210	22.694
1991	14.159	19.490
1992	12.340	17.131
1993	11.054	15.207
1994	10.976	14.877
1995	10.715	14.454
1996	10.417	13.978
1997	10.522	13.991
1998	9.501	12.620
1999	8.935	11.896
2000	8.942	11.866
2001	9.202	12.068
2002	8.843	11.738
2003	8.474	11.224
2004	7.827	10.366
2005	7.799	10.438
2006	7.428	9.883

CATEGORY	MANURE MANAGEMENT NMVOC *[kt]*	
YEAR OF SUBMISSION	**2020**	**2021**
2007	7.240	9.712
2008	6.756	9.218
2009	7.145	9.267
2010	6.580	8.861
2011	6.314	8.582
2012	6.422	8.686
2013	6.265	8.416
2014	6.371	8.391
2015	6.380	8.629
2016	6.136	8.315
2017	6.253	8.409
2018	6.165	7.855
Submission 2020/2021 (2018)	**27.41%**	

5.9 AGRICULTURAL SOILS (NFR 3D)

Emitted gas: *NH_3, NMVOC, NOx, TSP, PM_{10}, $PM_{2.5}$*
Methods: *Tier 1, Tier 2*
Emission factors: *D*
Key sources: *Yes*
Particular significant subcategories: *Inorganic N-fertilizers, Animal manure applied to the soils*

The NFR sector 3D contains NH_3 and NOx emissions from Inorganic N-fertilizer (3Da1), Animal manure applied to soils (3Da2a), Sewage sludge applied to soils (3Da2b), Other organic fertilizers applied to soils (3Da2c), Urine and dung deposited during grazing (3Da3) as well as PM and NMVOC emissions from crop production (3De).

The emission sources are calculated according to the revised EMEP/EEA GB_{2019}. The major reason for the overall decreasing trend is a sharp decrease in the use of synthetic fertilizers in the early 90-ties and the continual decrease in the use of animal manure with the decrease in the number of animals. Since 1999, the trend is stable with the small fluctuations caused by changes in animal population and inter-annual changes in categories, 3D1 - Inorganic Nitrogen Fertilizers.

Table 5.26: *NH_3 emissions (Gg) in agricultural soils according to the subcategories in particular years*

YEAR	3D NH_3 EMISSIONS FROM MANAGED SOILS (Gg)					
	3Da1 Inorganic-N fertilizers	**3Da2a Animal manure applied to soils**	**3Da2b Sewage sludge applied to soils**	**3Da2c Other organic Fertilizers applied to soils**	**3Da3 Urine and dung deposited by grazing animal**	**Total emissions**
1990	7.71	27.92	0.00	0.08	2.17	37.89
1995	2.91	19.17	0.00	0.07	1.51	23.66
2000	3.04	15.80	0.00	0.07	1.27	20.18
2005	4.36	13.90	0.00	0.01	1.17	19.45
2010	4.52	11.97	0.00	0.03	1.11	17.63
2011	4.98	11.40	0.00	0.03	1.10	17.51
2012	5.95	11.77	0.01	0.07	1.14	18.93
2013	6.94	11.38	0.00	0.20	1.13	19.65

YEAR	3D NH_3 EMISSIONS FROM MANAGED SOILS (Gg)					
	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
2014	7.14	11.69	0.00	0.26	1.15	20.23
2015	6.17	11.62	NO	0.36	1.14	19.28
2016	8.04	11.13	NO	0.03	1.12	20.32
2017	9.59	11.12	NO	0.04	1.10	21.85
2018	9.20	11.55	NO	0.02	1.14	21.91
2019	9.19	11.20	NO	0.02	1.11	21.52

Table 5.27: *NOx emissions (Gg) in agricultural soils according to the subcategories in particular years*

YEAR	3D NOx EMISSIONS FROM MANAGED SOILS (Gg)					
	3Da1 Inorganic-N fertilizers	3Da2a Animal manure applied to soils	3Da2b Sewage sludge applied to soils	3Da2c Other organic Fertilizers applied to soils	3Da3 Urine and dung deposited by grazing animal	Total emissions
1990	8.89	2.75	0.0011	0.04	1.56	13.24
1995	2.78	1.93	0.0002	0.03	1.10	5.85
2000	2.91	1.59	0.0005	0.04	0.91	5.45
2005	3.25	1.39	0.0012	0.00	0.85	5.50
2010	3.47	1.18	0.0012	0.01	0.83	5.49
2011	3.72	1.10	0.0005	0.01	0.82	5.66
2012	4.04	1.14	0.0017	0.04	0.85	6.07
2013	4.54	1.10	0.0007	0.10	0.84	6.58
2014	4.76	1.14	0.0000	0.13	0.85	6.89
2015	4.59	1.14	NO	0.18	0.84	6.75
2016	5.05	1.08	NO	0.01	0.83	6.98
2017	4.90	1.10	NO	0.02	0.81	6.83
2018	5.16	1.14	NO	0.01	0.83	7.15
2019	5.14	1.10	NO	0.01	0.81	7.06

Figure 5.15: *The share of NH_3 emissions by categories within agricultural soils in 2019*

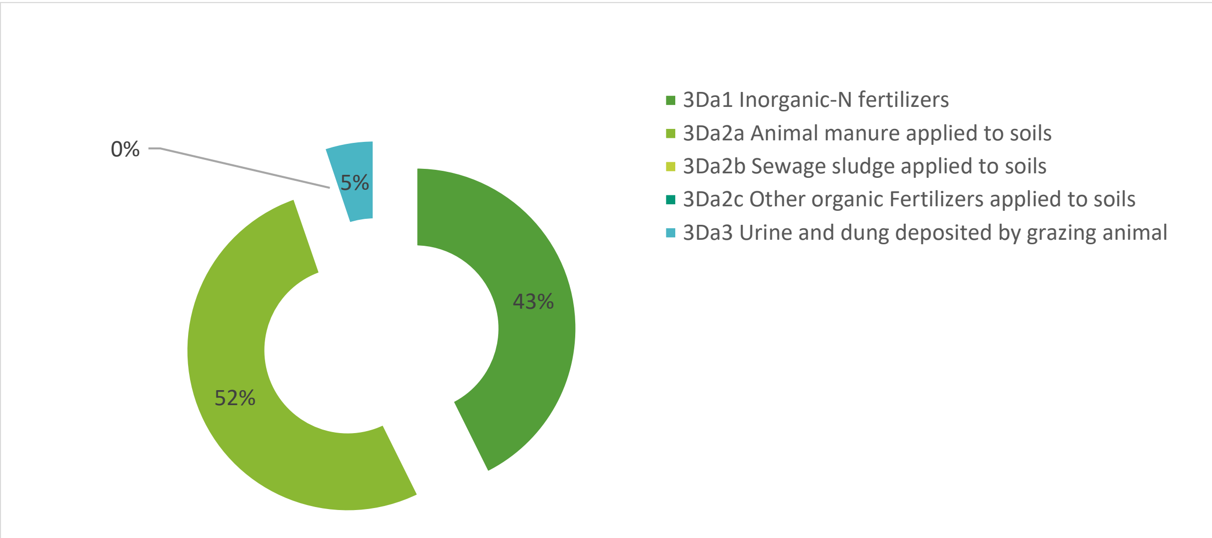
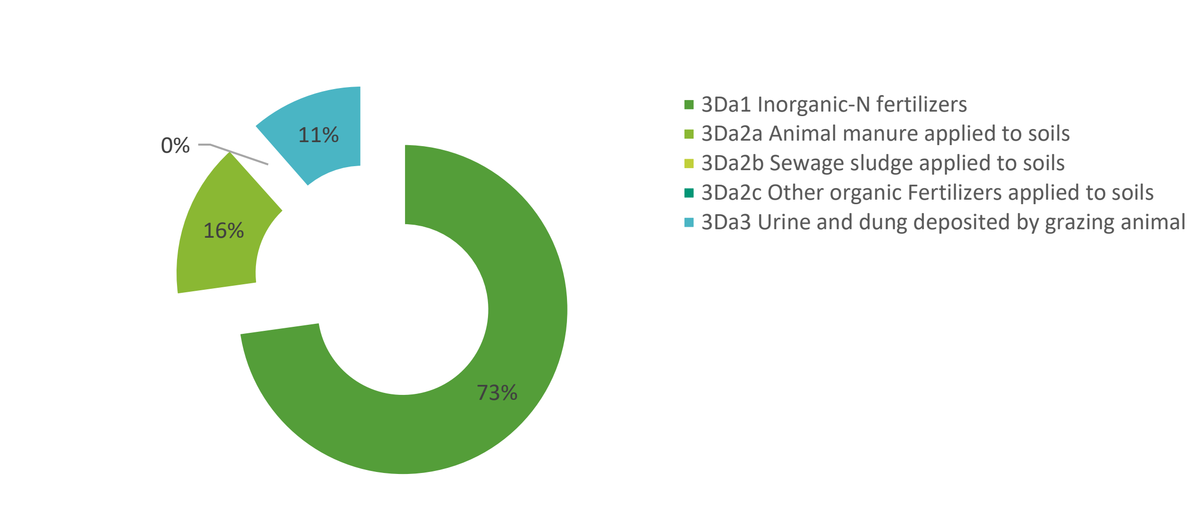


Figure 5.16: *The share of NOx emissions by categories within agricultural soils in 2019*



5.9.1 ACTIVITY DATA

Data of sown areas were taken from the ŠÚ SR. Data is available on 20th May every year (***Table 5.16***).

Table 5.28: *A Sown area in thousand hectares for years 1990-2019*

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	835 000	239 559	13 572
2000	406 400	29 800	178 300	567 291	245 900	22 800
2005	375 801	32 500	215 547	486 853	222 000	24 500
2010	349 700	29 370	280 000	539 196	138 930	17 240
2011	364 000	13 358	261 600	566 982	136 325	16 158
2012	388 700	28 568	225 100	553 844	147 994	15 773
2013	368 200	35 408	254 800	568 389	121 304	13 901
2014	380 200	29 369	243 400	554 929	138 826	15 367
2015	379 400	15 175	247 400	552 863	138 920	16 422
2016	417 700	12 843	254 000	532 552	115 364	14 834
2017	374 781	10 380	292 854	527 913	121 026	15 932
2018	408 168	14 292	259 801	526 054	126 887	12 817
2019	406 821	13 556	671 294	513 592	126 372	12 088
1990/2019	**-1%**	**-67%**	**901%**	**-37%**	**-37%**	**-16%**
2018/2019	**0%**	**-5%**	**158%**	**-2%**	**0%**	**-6%**

5.9.2 CATEGORY-SPECIFIC RECALCULATIONS

The activity data in 3Da1 on individual types of nitrogen fertilizers were revised in 2018, due to the lack of IFASTAT data on individual types of nitrogen fertilizers in the 2020 submission. The used officially statistical information from the UKSÚP was not consistent with IFASTAT data on the level of individual types of fertilizers. Redistribution of the individual type of fertilizers was needed mainly due to low consumption of urea, nitrogen solution and lack of data on other N straight. Results of redistribution are visible in **Table 5.9**. Emissions from the Application of manure into the soils drop as well. In contrast with mentioned emission categories. NH_3 emissions from pasture increased due to an increase in losses of nitrogen.

Recalculation led to increasing (***Table 5.29***) NOx and NH_3 in emissions compared to the previous submission from this category at 14% and 38% in 2017.

Table 5.29: *The impact of recalculations of NH_3 emissions in Inorganic N Fertilizers use in 2018*

Category	3Da1 Inorganic N Fertilizers *[kt]*	
Year of submission	**2020**	**2021**
2018	4.5	9.2
2020/2021		**104%**

Table 5.30: *The impact of recalculations of NH_3, NOx emissions in Organic N Fertilizers use in 1990–2018*

CATEGORY	3Da2 ORGANIC N FERTILIZERS NH_3 *[kt]*		3Da2 ORGANIC N FERTILIZERS NOx *[kt]*	
YEAR OF SUBMISSION	**2020**	**2021**	**2020**	**2021**
1990	30.42	27.92	2.54	2.75
1991	27.16	25.08	2.28	2.48
1992	24.15	22.14	2.04	2.20
1993	21.30	19.58	1.80	1.96
1994	20.89	19.09	1.77	1.93
1995	20.26	19.17	1.73	1.93
1996	19.93	18.68	1.69	1.89
1997	19.74	18.45	1.67	1.86
1998	17.71	16.42	1.50	1.66
1999	17.01	15.83	1.43	1.59
2000	17.49	15.80	1.46	1.59
2001	17.80	16.41	1.49	1.67
2002	17.19	15.81	1.45	1.60
2003	16.67	15.28	1.39	1.55
2004	15.31	13.96	1.26	1.40
2005	15.73	13.90	1.28	1.39
2006	15.12	13.45	1.24	1.35
2007	14.73	13.12	1.19	1.30
2008	13.60	12.21	1.08	1.18
2009	14.30	12.30	1.13	1.21
2010	13.48	11.97	1.07	1.18
2011	12.69	11.40	0.99	1.10
2012	13.12	11.77	1.03	1.14
2013	12.66	11.38	1.00	1.10
2014	13.20	11.69	1.04	1.14
2015	13.11	11.62	1.04	1.14
2016	12.51	11.13	0.98	1.08
2017	12.67	11.12	1.00	1.10
2018	13.18	11.55	1.04	1.14
2020/2021 (2018)		**-12%**	**10%**	

Table 5.31: *The impact of recalculations of NH_3 emissions in Urine and dung deposited by grazing animals in 1990–2018*

CATEGORY	3Da3 URINE AND DUNG DEPOSITED BY GRAZING ANIMALS NH_3 *[kt]*	
YEAR OF SUBMISSION	**2020**	**2021**
1990	1.49	2.17
1991	1.37	2.01

CATEGORY	3Da3 URINE AND DUNG DEPOSITED BY GRAZING ANIMALS NH_3 *[kt]*	
YEAR OF SUBMISSION	**2020**	**2021**
1992	1.24	1.81
1993	1.09	1.59
1994	1.05	1.50
1995	1.05	1.51
1996	1.02	1.46
1997	1.04	1.39
1998	0.95	1.28
1999	0.93	1.26
2000	0.94	1.27
2001	0.90	1.23
2002	0.92	1.25
2003	0.89	1.22
2004	0.85	1.16
2005	0.86	1.17
2006	0.84	1.15
2007	0.85	1.16
2008	0.84	1.15
2009	0.83	1.07
2010	0.81	1.11
2011	0.80	1.10
2012	0.82	1.14
2013	0.81	1.13
2014	0.82	1.15
2015	0.80	1.14
2016	0.79	1.12
2017	0.77	1.10
2018	0.79	1.14
2020/2021 (2018)		**44%**

5.9.3 INORGANIC N FERTILIZERS (NFR 3Da1)

The applied amounts of synthetic fertilizers into cultivated soils were very low in the last 15 years. In the present, the amount of synthetic fertilizers applied to the agricultural soils increased again. This fact is the main driver in increasing emissions in the sector. The potential for the volatilization of ammonia emissions can vary in a very large range. The best information on NH_3 emissions from cultivated soils in the Slovak Republic is based on the applied nitrogen fertilizers. Emissions also depend on the type of fertilizers, soil parameters (pH), meteorological conditions and time of fertilizers' application concerning crop development. Applied nitrogen fertilizers were provided by the ŠÚ SR.

5.9.3.1 Activity data

Activity data on synthetic fertilizers consumption is based on the combination of two databases. IFASTAT and database by the Central Control Testing and Testing Institute (UKSÚP). The national total of nitrogen from fertilizers was used from the UKSÚP and the distribution of type of fertilizers was taken from the IFASTAT (1990-2017). The UKSÚP data was used in 2018 and 2019. This data was disseminated according to Act No 202/2008 Coll. on fertilizers. The farmers have duty reported the amount of applied nitrogen into the UKSÚP each year. The UKSÚP as admin of databases made validation each year.

The consumption of synthetic fertilizers decreased during the last decade of the 20th century, from 222 kt in 1990 to 128.5 kt in 2019 (42%). Consumption of synthetic fertilizers increased by 58% in 2019 compared with 2005 and then decreased by almost 0.3%% in comparison with the year 2018. Decreasing numbers of domestic livestock caused the demand for inorganic nitrogen is bigger. Missing organic nitrogen compensates for a higher consumption of synthetic fertilizers.

Table 5.32: *Input parameters in 3Da1 Inorganic N fertilizers in particular years*

YEAR	TYPE OF FERTILIZERS [*t*]									
	Ammonium nitrate	Ammonium sulphate	Calc. amm. nitrate	Nitrogen solutions	Other N straight	Urea	Ammonium phosphate	NK compound	NPK compound	Other NP
1990	83 356	22 156	55 114	1 731	NO	8 239	1 939	NO	49 220	500
1991	54 885	14 589	36 289	1 140	NO	5 425	1 276	NO	32 238	5 000
1992	33 824	8 991	22 364	702	NO	3 343	787	NO	14 208	400
1993	24 323	6 465	16 082	505	NO	2 404	566	NO	14 208	300
1994	11 400	4 700	22 000	8 500	NO	10 169	700	NO	11 000	200
1995	16 000	6 100	24 200	7 600	NO	3 787	NO	NO	11 400	500
1996	4 000	6 200	29 500	8 600	500	9 064	NO	NO	11 700	4 900
1997	4 000	7 000	25 000	9 000	500	27 517	NO	NO	10 000	5 000
1998	5 600	6 300	35 100	8 300	1 000	10 342	NO	NO	14 200	1 000
1999	3 100	4 500	29 300	8 000	NO	9 892	NO	NO	9 800	800
2000	2 200	4 900	29 000	10 000	NO	3 553	900	NO	12 600	800
2001	2 000	5 000	30 000	10 000	NO	5 032	1 000	NO	13 000	1 000
2002	5 300	5 300	34 200	10 700	NO	18 760	1 000	NO	13 000	NO
2003	8 000	9 000	23 000	14 000	NO	8 300	5 000	NO	14 000	NO
2004	4 000	9 000	30 000	10 000	NO	7 911	4 000	NO	15 000	NO
2005	3 000	10 000	31 000	9 000	NO	8 317	5 000	NO	15 000	NO
2006	5 000	8 000	36 000	8 000	NO	681	7 000	NO	14 000	NO
2007	7 000	11 000	29 000	8 000	NO	8 935	8 000	NO	17 000	NO
2008	5 000	9 000	38 000	2 000	NO	13 737	3 000	NO	17 000	NO
2009	3 000	6 000	32 000	3 000	NO	15 058	1 000	NO	17 000	NO
2010	4 000	9 000	33 000	2 000	NO	11 873	1 000	NO	26 000	NO
2011	2 000	1 000	40 000	17 000	6 000	13 969	1 000	NO	12 000	NO
2012	NO	1 000	41 000	18 000	7 000	19 004	1 000	NO	12 000	2 000
2013	NO	2 000	45 000	18 000	12 000	25 581	1 000	NO	10 000	NO
2014	2 000	2 000	45 000	15 000	15 000	28 036	1 000	NO	10 000	1 000
2015	2 000	1 300	44 000	17 000	14 000	19 473	1 000	NO	14 000	2 000
2016	2 000	1 600	42 800	18 100	13 600	30 536	3 300	NO	12 300	2 000
2017	NO	2 000	40 000	23 600	NO	37 741	1 600	900	12 000	4 700
2018	1 100	1 103	31 983	16 463	25 966	41 299	1 125	NO	9 939	NO
2019	880	1 365	34	16 814	53 258	39 779	1 717	3 348	10 982	355

5.9.3.2 Methodological issues

NH_3 emissions from Inorganic-N fertilizers were calculated using the Tier 2 methodology according to the EMEP/EEA GB_{2019}. To reflect average Slovak conditions, the emission factors for cool climate and a pH value lower than 7 was chosen. NOx was calculated using the simpler Tier 1 methodology.

***Table 5.33:** Emission factors per fertilizers type*

TYPE OF FERTILIZERS	EMISSION FACTOR FOR NORMAL PH (g NH_3 (kg N applied)$^{-1}$))
Ammonium nitrate (AN)	15
Ammonium sulphate (AS)	90
Calcium ammonium nitrate (CAN)	8
N solutions	98
Other straight N compounds	10
Urea	155
Ammonium phosphates (AP)	50
NK Mixtures	15
NPK Mixtures	50
NP Mixtures	50

***Table 5.34:** Input parameters and EFs in 3Da1 Inorganic N fertilizers in particular years*

YEAR	NITROGEN INPUT INTO SOILS	EMISSION FACTOR NH_3	EMISSION FACTOR NOx	EMISSIONS NH_3	EMISSIONS NOx
	[kg/year]	*[kg NH_3/kg N]*	*[kg NOx/kg N]*	*[Gg]*	*[Gg]*
1990	222 255 000	0.03	0.04	7.71	8.89
1995	69 587 000	0.04	0.04	2.91	2.78
2000	72 653 000	0.04	0.04	3.04	2.91
2005	81 317 000	0.05	0.04	4.36	3.25
2010	86 873 000	0.05	0.04	4.52	3.47
2011	92 969 000	0.05	0.04	4.98	3.72
2012	101 004 000	0.06	0.04	5.95	4.04
2013	113 581 390	0.06	0.04	6.94	4.54
2014	119 036 050	0.06	0.04	7.14	4.76
2015	114 773 000	0.05	0.04	6.17	4.59
2016	126 235 769	0.08	0.04	8.04	5.05
2017	122 541 152	0.08	0.04	9.59	4.90
2018	128 976 885	0.07	0.04	9.20	5.16
2019	128 532 971	0.07	0.04	9.19	5.14
1990/2019	**-42%**			**19,2%**	**-42,0%**
2018/2019	**-0.3%**			**-0,149%**	**-0,344%**

5.9.4 ANIMAL MANURE APPLIED TO THE SOILS (NFR 3Da2a) NH_3, NOx, NMVOC

Livestock number and information on animal waste management systems are described in **Chapters 5.8.1** and **5.8.3**. This application is connected with utilization NH_3, PM, NMVOC, N_2O and NOx losses. A detailed description of the methods applied for the calculation of N_2O emissions is given in the report "Slovak republic National Inventory Report 2019" – Submission under the United Nations Framework Convention on Climate Change and the Kyoto Protocol". For this calculation was applied country-specific methodology.

At application evaporate around 50% of ammonia. During this operation are the highest emissions of ammonia. It is a key source of emissions. During application (spreading) is formed on the fields a 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 direct incorporation of manure into soils, the ammonia losses are reduced. The crops have sufficient nitrogen for grown. The

Ministry of Agriculture and Rural development issue Regulation Decree No 410/2012 Coll. ordering the solid into the soil organic fertilizers in 48 hours, and the liquid from arable land to 24 hours after application. This regulation is rather to prevent rafting fertilizers into surface waters to prevent the escape of ammonia because ammonia emissions are substantial immediately after application. First 6 hours after application evaporate of 50 % ammonia, then emissions decreased.

5.9.4.1 Activity data

See **Chapter 5.8.3**.

5.9.4.2 Methodological issues-Method-NH_3, NOx

Default NH_3 emission factors of the EMEP/EEA GB_{2019} 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_{2019}. The Default NOx emission factor of the EMEP/EEA GB_{2019} for spreading was used. NH_3 and NOx emission were calculated using the nitrogen flow approach similarly, to the calculation of EFs for emissions from housing and storage.

5.9.4.3 Methodological issues-Method- NMVOC

Cattle

All references for calculation are in **Chapter 5.8.6.2**. Used notation key IE.

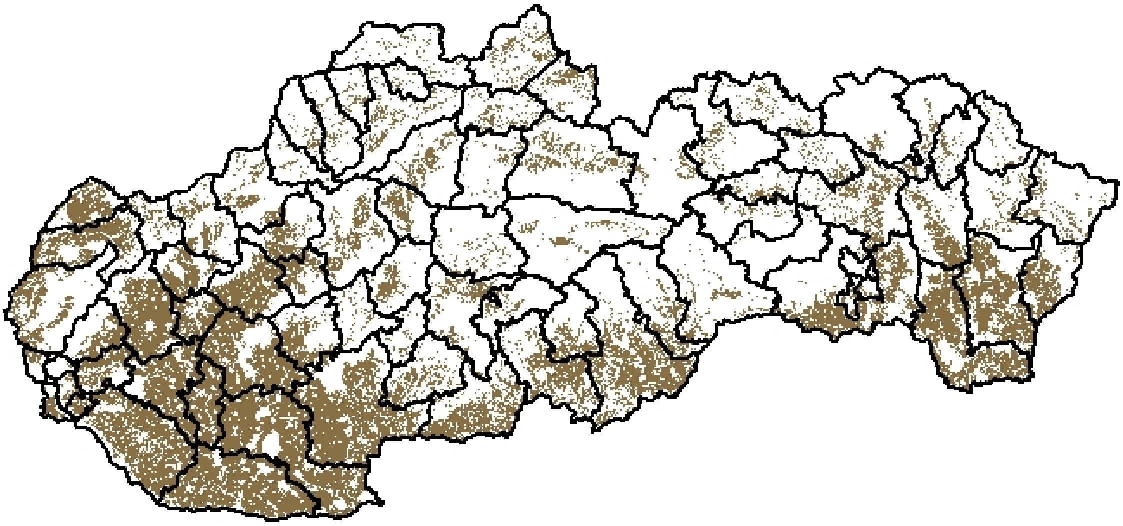
5.9.5 SEWAGE SLUDGE APPLIED TO SOILS (NFR 3Da2b)

The reduction of organic matter in the soil is dependent on the continuous decline of livestock production. The decrease in the number of organic fertilizers causes pressure to find alternative sources of organic fertilizers. Sewage sludge is one of the ways to resolve this issue. Sludge is a potential source of nutrients and organic matter. Sewage sludge must be stabilized and afterwards applied to the soils. Sludge must be treated biologically, chemically or by heat, long-term storage or any other appropriate process. These processes cause a significant reduction in health risks and save the environment. Act No 188/2003 Coll. regulates the application of sludge to agricultural soils. Sludge from domestic or urban treatment plants can be applied to agricultural soils. Application of other sludge is prohibited by Slovak law.

5.9.5.1 Activity data

Activity data on sewage sludge consumption in agriculture (***Table 5.38***) is based on the data provided by the Water Research Institute. Sewage sludge was applied to the soil even before the year 2010, but there is no available statistics. Missing data were extrapolated by SHMÚ. The Water Research Institute informed that sewage sludge was not applied to agricultural soils in the year 2019. The notation key NO was used in these years.

Figure 5.17: The map of sensitive parts of Slovakia where sludge cannot be applied



Brown area: area, where it is allowed to apply sewage sludge.

5.9.5.2 Methodological issues - Method-NH_3, NOx

Default methodology Tier 1 and default emission factors were used for the estimation of direct NH_3 and NOx emissions from sewage sludge applied to soils. The methodology was following the EMEP/EEA GB_{2019}. Percentage of pure nitrogen in sewage sludge was provided from the Soil Science and Conservation Research Institute.[6] Emissions were estimated using these equations:

$$A_{\text{sewage sludge}} = N_{\text{sewage sludge}} * P_N$$

$$NO_{\text{sewage sludge}} = A_{\text{sewage sludge}} * EF_{NO}$$

$$NH_{3\ \text{sewage sludge}} = A_{\text{sewage sludge}} * EF_{NH3}$$

where: **$NH_{3\ \text{sewage sludge}}$. NO $_{\text{sewage sludge}}$:** Emissions from sewage sludge applied into the soil in kg. $N_{\text{Sewage sludge}}$: the amount of sludge from wastewater treatment in kg. **P_N:** Weight percentage of nitrogen from sewage sludge (3.31%).
$EF_{NO.\ NH3}$: Emissions factors for NH_3 and NO kg NO respectively NH_3.

Table 5.35: Input parameters and EFs in 3Da2b - Sewage Sludge in particular years

YEARS	AMOUNT OF SEWAGE SLUDGE	NITROGEN INPUT INTO SOILS	EMISSION FACTORS NH_3	EMISSION FACTORS NOx	EMISSIONS NH_3	EMISSIONS NOx
	(kg/year)	(kg NH_3/kg N)	(kg NH_3/kg N)	(kg NOx/kg N)	(Gg)	(Gg)
1990	817 114	27 046	0.13	0.04	0.0035	0.0011
1995	137 909	4 565	0.13	0.04	0.0006	0.0002
2000	399 606	13 227	0.13	0.04	0.0017	0.0005
2005	877 203	29 035	0.13	0.04	0.0038	0.0012
2010	923 000	30 551	0.13	0.04	0.0040	0.0012
2011	358 000	11 850	0.13	0.04	0.0015	0.0005
2012	1 254 000	41 507	0.13	0.04	0.0054	0.0017
2013	518 000	17 146	0.13	0.04	0.0022	0.0007

[6] *Guideline for sewage sludge application (In Slovak):*http://www.vupop.sk/dokumenty/prv/prirucka_pre_aplikaciu_kalu.pdf

YEARS	AMOUNT OF SEWAGE SLUDGE	NITROGEN INPUT INTO SOILS	EMISSION FACTORS NH_3	EMISSION FACTORS NOx	EMISSIONS NH_3	EMISSIONS NOx
	(kg/year)	*(kg NH_3/kg N)*	*(kg NH_3/kg N)*	*(kg NOx/kg N)*	*(Gg)*	*(Gg)*
2014	8 000	265	0.13	0.04	0.0000	0.0000
2015	NO	NO	0.13	0.04	NO	NO
2016	NO	NO	0.13	0.04	NO	NO
2017	NO	NO	0.13	0.04	NO	NO
2018	NO	NO	0.13	0.04	NO	NO
2019	NO	NO	0.13	0.04	NO	NO
1990/2019	**-100%**	**-100%**			**-100%**	**-100%**
2018/2019	**-100%**	**-100%**			**-100%**	**-100%**

5.9.6 OTHER ORGANIC FERTILIZERS APPLIED TO SOILS (NFR 3Da2c)

Emissions of NH_3 and NOx from compost applied to soils contributed less than 1% to the emissions from agricultural soils in 2019.

5.9.6.1 Activity data

Other Organic Fertilizers applied to soils contents the composted waste, digestant from biogas stations and green matter. Consumption of organic fertilizers (***Table 5.36***) is based on the data provided by the UKSÚP. Data are available from 2000 to 2019 Other organic nitrogen fertilizers were applied to the soil even before the year 2000, but there are no available statistics. Missing data was extrapolated in spreadsheets. Percentage of pure nitrogen from compost was provided by the Soil Science and Conservation Research Institute.

Table 5.36: *Input parameters used for compost in particular years*

YEAR	AD AMOUNT OF COMPOST APPLIED INTO SOILS (T)	AD AMOUNT OF FUGATE APPLIED INTO SOILS	AD AMOUNT OF VITAHLUM APPLIED INTO SOILS	TOTAL	PURE INPUT OF NITROGEN KG
1990	142 858	NO	NO	142 858	1 000 006
1995	122 381	NO	NO	122 381	856 668
2000	74 923	NO	50 641	125 564	878 947
2005	7 006	NO	3 552	10 558	73 903
2010	40 097	NO	4 999	45 096	315 670
2011	50 583	NO	2 261	52 844	369 906
2012	18 291	108 181	NO	126 472	885 307
2013	63 145	301 580	500	365 225	2 556 576
2014	85 907	382 111	NO	468 018	3 276 124
2015	90 967	543 489	1 015	635 471	4 448 299
2016	38 519	NO	6 917	45 437	318 057
2017	39 597	32 517	7 053	79 166	501 450
2018	37 175	NO	6 081	43 257	302 796
2019	37 618	5 682	NO	43 300	303 106

5.9.6.2 Methodological issues – Methods – NOx, NH_3

Default methodology Tier 1 according to EMEP/EEA GB_{2019} and default emission factor (0.08 kg NH_3 kg^{-1} waste N applied and 0.04 kg.NO) were used for the estimation of NOx, and NH_3 emissions from compost applied to soils. The percentage of nitrogen in used compost was provided by the Soil Science and Conservation Research Institute.[7] Amount of compost applied to soils provided by the UKSÚP. Emissions were estimated using these equations:

$$A_{compost} = N_{compost} * P_N$$

$$NO_{compost} = A_{compost} * EF_{NO}$$

$$NH_{3\ compost} = A_{compost} * EF_{NH_3}$$

Where: $\mathbf{N_{compost}}$ is the input of pure nitrogen in compost applied to the soil in kg. $\mathbf{N_{compost}}$ is the amount of compost from the composting plant. $\mathbf{P_N}$ is 1 tonne of compost = 7 kg N

Table 5.37: *Emission factors and emissions in 3Da2c - Other organic fertilizers applied to soils*

YEARS	EMISSION FACTORS NH_3	EMISSION FACTORS NOx	EMISSIONS NH_3	EMISSIONS NOx
	[kg NH_3/kg N]	*[kg NOx/kg N]*	*[Gg]*	*[Gg]*
1990	0.08	0.04	0.08	0.04
1995	0.08	0.04	0.07	0.03
2000	0.08	0.04	0.07	0.04
2005	0.08	0.04	0.01	0.00
2010	0.08	0.04	0.03	0.01
2011	0.08	0.04	0.03	0.01
2012	0.08	0.04	0.07	0.04
2013	0.08	0.04	0.20	0.10
2014	0.08	0.04	0.26	0.13
2015	0.08	0.04	0.36	0.18
2016	0.08	0.04	0.03	0.01
2017	0.08	0.04	0.04	0.02
2018	0.08	0.04	0.02	0.01
2019	0.08	0.04	0.02	0.01
1990/2019	**-**	**-**	**-70%**	**-70%**
2018/2019	**-**	**-**	**0.1%**	**0.1%**

5.9.7 URINE AND DUNG DEPOSITED BY GRAZING ANIMALS (NFR 3Da3)

Pasture is typical for some livestock categories. Animals 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, 41% of non-dairy cattle stays only for 150 days. Results of the analysis of AWMS were used for the calculation of nitrogen input from animal husbandry into N-cycle. Emissions from pasture were based on the proportion of the pasture for housing that was made by the NPPC - VÚŽV. The proportion of the pasture for the category of animals is demonstrated in ***Table 5.12-5.14***.

5.9.7.1 Activity data

This analysis was based on the questionnaires from 222 agricultural subjects (21.3% of total subjects in Slovakia). These subjects cultivated 14.7% of total agricultural land and 15.2% of arable land. The duration of the grazing period can vary significantly depending on weather conditions in different parts

[7] *Guideline for sewage sludge application (In Slovak):*http://www.vupop.sk/dokumenty/prv/prirucka_pre_aplikaciu_kalu.pdf

of the Slovak Republic. Reliable data for statistical evaluation is not available, but significant differences can be found in this regard. NH_3 and NOx emissions from pasture were based on the proportion of the pasture for housing that was made by the NPPC - VÚŽV. Activity data is summarized in ***Table 5.16***. Activity data in this category are consistent with the activity data used for estimation in category 3B - Manure Management.

5.9.7.2 Methodological issues – Methods –NH_3, NOx

The estimation of NH_3 and NOx from pasture is based on the Tier 2 method according to the EMEP/EEA GB_{2019}. 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 5.38: *Input parameters, EFs and emissions in 3Da3- Urine and dung deposited by grazing animals*

YEARS	NITROGEN EXCRETED DURING PASTURE	EMISSION FACTORS NH_3	EMISSION FACTORS NOx	EMISSIONS NOx	EMISSIONS NH_3
	[kg/year]	*[kg NH_3/kg N]*	*[kg NOx/kg N]*	*[Gg]*	*[Gg]*
1990	14 709 368	0.148	0.106	1.559	2.174
1995	10 339 335	0.146	0.106	1.096	1.514
2000	6 914 661	0.183	0.132	0.913	1.268
2005	6 427 598	0.183	0.132	0.850	1.174
2010	7 407 080	0.149	0.112	0.827	1.107
2011	7 339 829	0.150	0.112	0.823	1.101
2012	7 849 988	0.145	0.109	0.853	1.141
2013	7 844 224	0.144	0.107	0.841	1.127
2014	8 105 558	0.142	0.105	0.852	1.148
2015	8 077 931	0.141	0.104	0.842	1.135
2016	7 902 001	0.139	0.105	0.831	1.124
2017	7 683 159	0.143	0.106	0.814	1.099
2018	8 165 248	0.139	0.102	0.834	1.138
2019	7 875 680	0.141	0.103	0.809	1.112
1990/2019	**-46.46%**	**-4.48%**	**-3.04%**	**-48.85%**	**-48.09%**
2018/2019	**-3.55%**	**1.32%**	**0.57%**	**-2.28%**	**-3.00%**

5.9.7.3 Methodological issues –Methods - NMVOC

Cattle

All references for calculation are in **Chapter 5.8.6.2**. The used notation key is IE.

5.10 NMVOC EMISSIONS FROM CULTIVATED CROPS (NFR 3De)

Emissions of NMVOC from crops may arise to attract pollinating insects, eliminate waste products or as a means of losing surplus energy. It is difficult to quantify NMVOCs in atmospheric samples. Temperature and light intensity, plant growth stage, water stress, air pollution, and senescence can influence NMVOCs. NMVOC emissions from crop production are reported under the NFR 3De category.

5.10.1 ACTIVITY DATA

Data of sown areas were taken from the ŠÚ SR. Data is available on 20^{th} May every year.

Table 5.39: *Sowing areas in time series*

YEAR	CROPS - SOWING AREAS			
	WHEAT	RAY	OIL PLANTS/RAPESEED	MEADOWS
1990	412 423	40 474	67 087	1 547 194
1991	418 158	46 335	70 906	1 547 048
1992	408 196	38 332	91 622	1 571 109
1993	354 431	23 637	67 351	1 544 226
1994	398 058	23 196	74 760	1 593 086
1995	442 874	31 162	87 883	1 479 104
1996	437 846	31 201	125 691	1 475 567
1997	417 562	29 019	136 400	1 472 124
1998	415 033	29 745	140 562	1 469 171
1999	431 700	34 400	140 250	1 460 602
2000	406 400	29 800	178 300	1 450 491
2001	446 500	31 500	180 900	1 409 222
2002	406 100	38 200	204 000	1 377 482
2003	308 400	38 000	213 100	1 379 379
2004	369 400	25 200	199 000	1 360 893
2005	375 801	32 500	215 547	1 357 201
2006	350 900	28 717	252 200	1 344 079
2007	360 800	36 408	233 600	1 342 805
2008	374 400	41 388	250 600	1 349 311
2009	380 300	33 555	271 600	1 351 779
2010	349 700	29 370	280 000	1 354 436
2011	364 000	13 358	261 600	1 358 423
2012	388 700	28 568	225 100	1 359 979
2013	368 200	35 408	254 800	1 362 002
2014	380 200	29 369	243 400	1 362 092
2015	379 400	15 175	247 400	1 350 180
2016	417 700	12 843	254 000	1 347 293
2017	374 781	10 380	292 854	1 342 885
2018	408 168	14 292	259 801	1 348 019
2019	406 821	13 556	671 294	1 353 153

5.10.2 METHODOLOGICAL ISSUES - METHODS

Emissions were estimated according to the EMEP/EEA GB_{2019} Tier 2 methodology. Used emission factors presented in ***Table 5.40***.

Table 5.40: *Used emission factors in kg/ha*

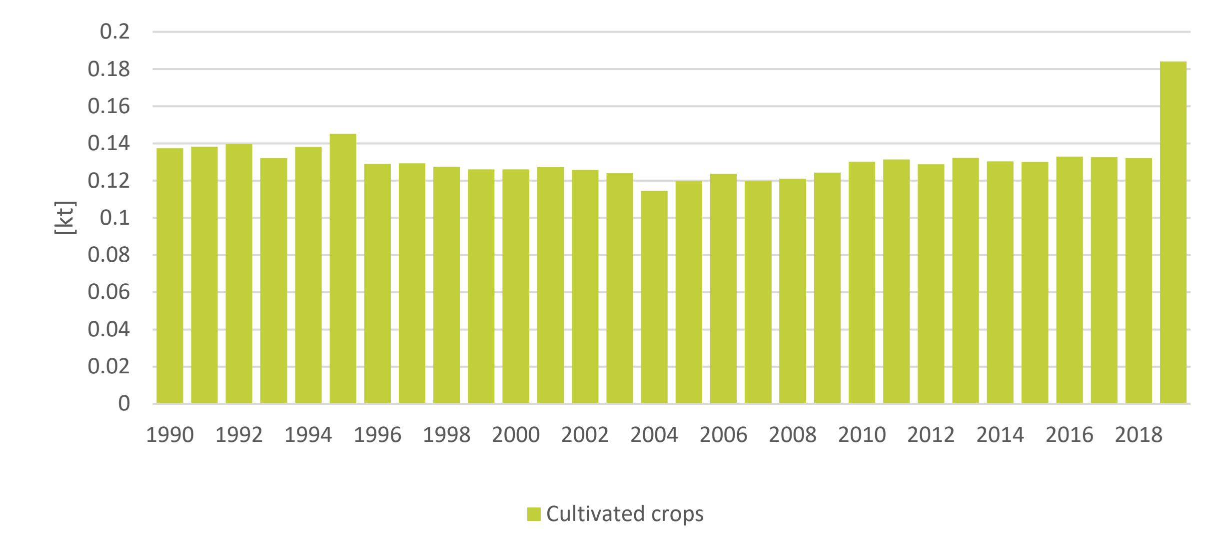
TYPE OF CROPS	EMISSION FACTORS (*kg/ha*)
Wheat	0.11
Rye	0.05
Rapeseed	0.13
Grass	0.1

Calculations were prepared following the following equation:

$$E_{NMVOC} = S_{Area} * EF_{NMVOC}$$

Where: $\mathbf{E_{NMVOC}}$: Amount of the emitted pollutant (kg).$\mathbf{S_{Area}}$: Annual sown area (ha).$\mathbf{EF_{NMVOC}}$: Annual default emission factor (**kg.ha^{-1}**)

Figure 5.18: *Trend of NMVOC emissions from NFR 3De cultivated crops*



5.10.3 CATEGORY-SPECIFIC RECALCULATIONS

The recalculations of NMVOC emissions were made for the years 1990-2018, due to the implementation of revised emission factors in the meadows area (0,1 kg/ha instead of 0.56 kg/ha). The 3De category is not a significant contributor to mentioned emissions and emissions are under the threshold of significance. The changes describe ***Table 5.41***.

The recalculation led to decreased in emission from the Cultivated crops (NFR 3De) by 64%.

Table 5.41: *The impact of recalculations of NMVOC emissions in 3De category in 1990-2018*

CATEGORY	NMVOC EMISSIONS FROM FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE. HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCT *[kt]*	
YEAR OF SUBMISSION	**2020**	**2021**
1990	0.511	0.137
1991	0.510	0.138
1992	0.512	0.140
1993	0.515	0.132
1994	0.522	0.138
1995	0.529	0.145
1996	0.536	0.129
1997	0.537	0.129
1998	0.539	0.127
1999	0.532	0.126
2000	0.529	0.126
2001	0.513	0.127
2002	0.520	0.126
2003	0.509	0.124
2004	0.356	0.115
2005	0.364	0.120
2006	0.373	0.124
2007	0.368	0.120
2008	0.374	0.121
2009	0.372	0.124
2010	0.364	0.130

CATEGORY	NMVOC EMISSIONS FROM FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE. HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCT *[kt]*	
YEAR OF SUBMISSION	**2020**	**2021**
2011	0.365	0.131
2012	0.362	0.129
2013	0.363	0.132
2014	0.361	0.130
2015	0.366	0.130
2016	0.372	0.133
2017	0.370	0.133
2018	0.370	0.132
Submission 2020/2021	**-64%**	

5.11 PM AND TSP EMISSIONS FROM FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE, HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCTS (NFR 3Dc)

5.11.1 METHODOLOGICAL ISSUES - METHODS

Pollution TSP was calculated using the Tier 1 methodology from EMEP/EEA GB_{2019}. $PM_{2.5}$, PM_{10} were calculated using by Tier 2 EMEP/EEA GB_{2019} methodology. Emission factors for wet climate were used. In emission estimation, all operations with crops were considered only one time.

***Table 5.42:** Used emission factors in kg/ha*

EF TSP	1.56			
Crop (PM_{10}) kg/h	**SOIL CULTIVATION**	**HARVESTING**	**CLEANING**	**DRYING**
Wheat	0.25	2.70	0.19	0.56
Rye	0.25	2.00	0.16	0.37
Barley	0.25	2.30	0.16	0
Oat	0.25	3.40	0.25	1
Other arable	0.25	0.00	0.00	0.00
Grass	0.25	0.25	0	0
Crop ($PM_{2.5}$) kg/ha	**SOIL CULTIVATION**	**HARVESTING**	**CLEANING**	**DRYING**
Wheat	0.015	0.0200	0.0090	0.168
Rye	0.015	0.0150	0.0080	0.111
Barley	0.015	0.0160	0.0080	0.129
Oat	0.015	0.0250	0.0125	0.198
Other arable	0.015	0.0000	0.0000	0.00
Grass	0.015	0.0100	0.0000	0

Emissions were calculated with the following equation (tier 1 approach):

$$E_{TSP} = EF_{TSP} * \sum S_{area}$$

Where:

$\boldsymbol{E_{TSP}}$ Emissions PM_{10} and $PM_{2.5}$ (kg.a^{-1}).$\boldsymbol{EF_{TSP}}$ Annual default emission factor in (kg ha^{-1}).$\boldsymbol{S_{area}}$ the annual sown area of the crop in ha

$$E_{PM} = \sum_{1=l}^{l} \sum_{n=0}^{Nlk} EF_{PM} * S_{area}$$

where:

$\boldsymbol{E_{PM}}$ Emissions PM_{10} and $PM_{2.5}$ (kg.a^{-1}).$\boldsymbol{EF_{PM}}$ Annual default emission factor in (kg ha^{-1}).$\boldsymbol{S_{area}}$ the annual sown area of the crop in ha, $N_{l,k}$ is the number of times the $k_{t,h}$ operation is performed on the crop in a^{-1}

5.11.2 ACTIVITY DATA

Data of sown areas were taken from the ŠÚ SR. Data is available on 20th May every year.

5.11.3 CATEGORY-SPECIFIC RECALCULATIONS

In 2019, the Implementation of the Tier 2 method in 3Dc Farm-level agricultural operations including storage, handling and transport of agricultural products was done. Included high tier method refines the estimated emissions in this category. More information is available in the previous chapter. Recalculation of PM_{10} and $PM_{2.5}$ leads to increase emissions by 24.65 % and 81% compared to the previous submission (2018). Recalculation of TSP leads to increase emissions by 0.64 % compared to the previous submission (2018).

Table 5.43: *The impact of recalculations of TSP and PMs emissions in 3De category in 1990-2018*

CATEGORY	FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE, HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCTS - PM_{10} *[kt]*		FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE, HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCTS - $PM_{2.5}$ *[kt]*		FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE, HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCTS - TSP *[kt]*	
YEAR OF SUBMISSION	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
1990	2.079	2.755	0.080	0.152	2.079	2.079
1991	2.096	2.756	0.081	0.152	2.096	2.096
1992	2.103	2.765	0.081	0.152	2.103	2.103
1993	1.993	2.669	0.077	0.147	1.993	1.993
1994	2.076	2.817	0.080	0.155	2.076	2.076
1995	2.179	2.979	0.084	0.164	2.179	2.179
1996	2.238	2.865	0.086	0.159	2.238	1.910
1997	2.223	2.785	0.085	0.154	2.223	1.910
1998	2.233	2.821	0.086	0.156	2.233	1.879
1999	2.240	2.889	0.086	0.160	2.240	1.861
2000	2.238	2.791	0.086	0.154	2.238	1.844
2001	2.251	2.771	0.087	0.154	2.251	1.855
2002	2.257	2.585	0.087	0.144	2.257	1.832
2003	2.113	2.307	0.081	0.127	2.113	1.816

CATEGORY	FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE, HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCTS - PM_{10} *[kt]*		FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE, HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCTS - $PM_{2.5}$ *[kt]*		FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE, HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCTS - TSP *[kt]*	
YEAR OF SUBMISSION	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
2004	1.729	2.705	0.066	0.150	1.729	1.655
2005	1.791	2.587	0.069	0.143	1.791	1.733
2006	1.821	2.364	0.070	0.131	1.821	1.778
2007	1.809	2.497	0.070	0.138	1.809	1.731
2008	1.869	2.536	0.072	0.141	1.869	1.746
2009	1.886	2.483	0.073	0.138	1.886	1.778
2010	1.828	2.230	0.070	0.124	1.828	1.869
2011	1.805	2.235	0.069	0.124	1.805	1.881
2012	1.805	2.387	0.069	0.133	1.805	1.866
2013	1.828	2.253	0.070	0.125	1.828	1.914
2014	1.815	2.333	0.070	0.130	1.815	1.884
2015	1.814	2.295	0.070	0.128	1.814	1.864
2016	1.881	2.341	0.072	0.131	1.881	1.899
2017	1.865	2.205	0.072	0.123	1.865	1.881
2018	1.873	2.335	0.072	0.130	1.873	1.885
Submissions 2020/2021		**24.65%**		**80.78%**		**0.64%**

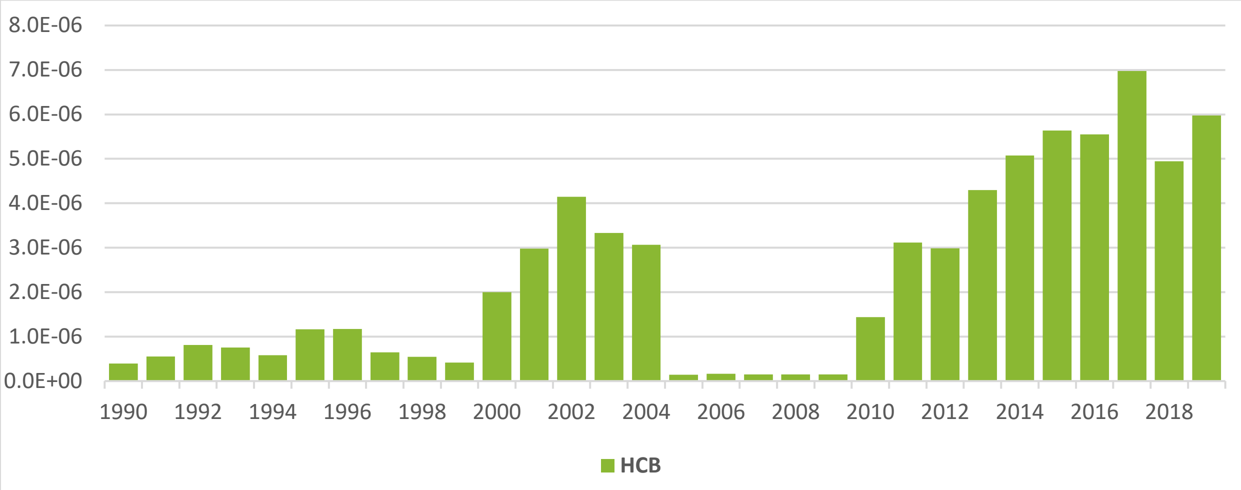
5.12 AGRICULTURE OTHER INCLUDING USE OF PESTICIDES (NFR 3Df)

A scope of pesticides is used in the Slovak agricultural sector, and a very small amount of them contain Hexachlorobenzene (HCB) as an impurity. HCB as the active substance is carried out in the Slovak Republic and is forbidden in consonance with the Stockholm Convention on Persistent Organic Pollutants and these substances.

5.12.1 METHODOLOGICAL ISSUES - METHODS

Emission of HCB from the use of pesticides is based on the amount of effectual substance used and emission factors for each type of pesticides. Impurity factors of used pesticides were taken from Table 4 of EMEP/EEA GB_{2019}.

Figure 5.19: *HCB from pesticides used*



5.12.2 ACTIVITY DATA

Data on pesticide consumption was provided with the Central Control and Testing Institute in Agriculture. Consumptions are collected annually direct from the Farmers base of Government Regulation of the Slovak Republic no. 186/2012 Coll. on the review of authorized plant protection products.

Table 5.44: *Consumption of pesticides in kilograms*

YEAR	NAME OF PESTICIDE *[kg]*					
	ATRAZIN	CLOPIRALID	CHLOROTHALONIL	ENDOSULFAN	PICLORAM	SIMAZIN
1990	148 842	5 506	25	19	NO	3 897
1991	208 958	3 755	50	NO	NO	7 848
1992	120 966	509	1 692	NO	NO	2 314
1993	134 141	1 975	1 377	NO	NO	3 207
1994	149 153	3 531	651	30	NO	2 834
1995	90 263	4 583	3 511	111	NO	9 096
1996	122 760	6 810	3 438	32	NO	2 198
1997	115 959	8 255	1 703	5	NO	2 384
1998	100 017	6 181	1 434	2	NO	1 748
1999	89 351	7 424	1 034	NO	NO	1 276
2000	96 329	6 808	4 716	NO	NO	1 036
2001	95 050	8 536	7 151	1	NO	734
2002	84 964	10 208	10 093	NO	NO	213
2003	87 533	5 752	8 074	NO	NO	699
2004	79 208	8 124	7 331	NO	636	481
2005	6 715	9 175	5 437	NO	1 219	250
2006	NO	9 512	7 690	NO	1 261	NO
2007	NO	10 315	4 773	NO	1 591	NO
2008	NO	9 160	5 292	NO	1 522	NO
2009	NO	9 817	2 958	NO	1 965	NO
2010	NO	6 324	3 418	NO	1 094	NO
2011	NO	6 517	7 594	NO	1 199	NO
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

YEAR	NAME OF PESTICIDE *[kg]*					
	ATRAZIN	CLOPIRALID	CHLOROTHALONIL	ENDOSULFAN	PICLORAM	SIMAZIN
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

5.12.3 CATEGORY-SPECIFIC RECALCULATIONS

No recalculation in this submission.

5.13 FIELD BURNING OF AGRICULTURAL RESIDUES (NFR 3F)

The Field burning of agricultural residues is strictly prohibited by law in the Slovak Republic. Therefore, no emissions from this category were estimated, and the notation key NO was used. The prohibition of activity results from the law mentioned below:

- Act No. 223/2001 Coll. on wastes and amendment and implement of some acts in the wording of the Act No. 553/2001 Coll. the Act No. 96/2002 Coll., the 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

CHAPTER 6: WASTE (NFR 5)

Last update: 15.3.2021

6.1 OVERVIEW OF THE SECTOR

This chapter represents emissions from the activities involved in the NFR categories listed in ***Table 6.1***. Waste sector emits all reported pollutants (ammonia, sulphur oxides, heavy metals, particulate matters, black carbon, carbon oxides, persistent organic pollutants, non-methane organic pollutants, nitrogen oxides) due to the variety of activities and diverse waste treatment manners. Emissions from waste incineration with energy use were allocated in the energy sector (**NFR 1A**).

Table 6.1: *Categories included in the Waste sector and method used for calculations (NFR 5)*

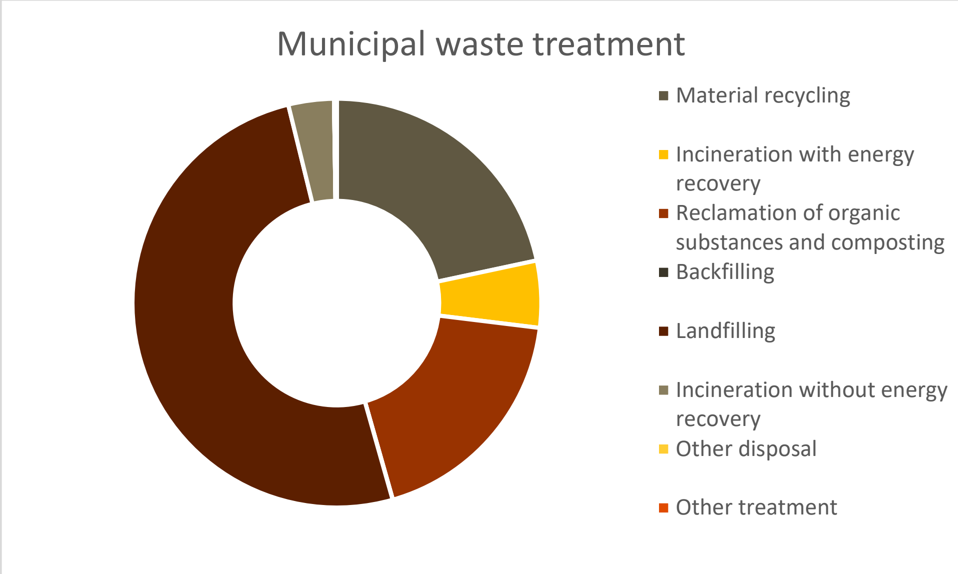
NFR CODE	LONGNAME	METHOD
5A	Biological treatment of waste - Solid waste disposal on land	T2
5B1	Biological treatment of waste - Composting	T2
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	T1
5C1a	Municipal waste incineration	T3/T2
5C1bi	Industrial waste incineration	T1
5C1bii	Hazardous waste incineration	T1
5C1biii	Clinical waste incineration	T2
5C1biv	Sewage sludge incineration	-
5C1bv	Cremation	T1
5C1bvi	Other waste incineration	-
5C2	Open burning of waste	
5D1	Domestic wastewater handling	T1/T2
5D2	Industrial wastewater handling	T1
5D3	Other wastewater handling	-
5E	Other waste	T2

The main source of activity data is national statistics represented by data from the ŠÚ SR. In line with statistics, total waste is classified by three ways of treatment:

a) **Recovery** (material recycling – not involved in the inventory, incineration with energy recovery – relevant emissions allocated in energy chapter, backfilling – not included, reclamation of organic substances and composting – included in **Chapter 6.6.1**, other recovery – not involved);
b) **Disposal** (landfilling (**Chapter 6.5**) and incineration without energy recovery (**Chapter 6.7**) – included in the inventory, other disposal – not involved)
c) Waste temporary stored in place of origin – not included in the inventory.

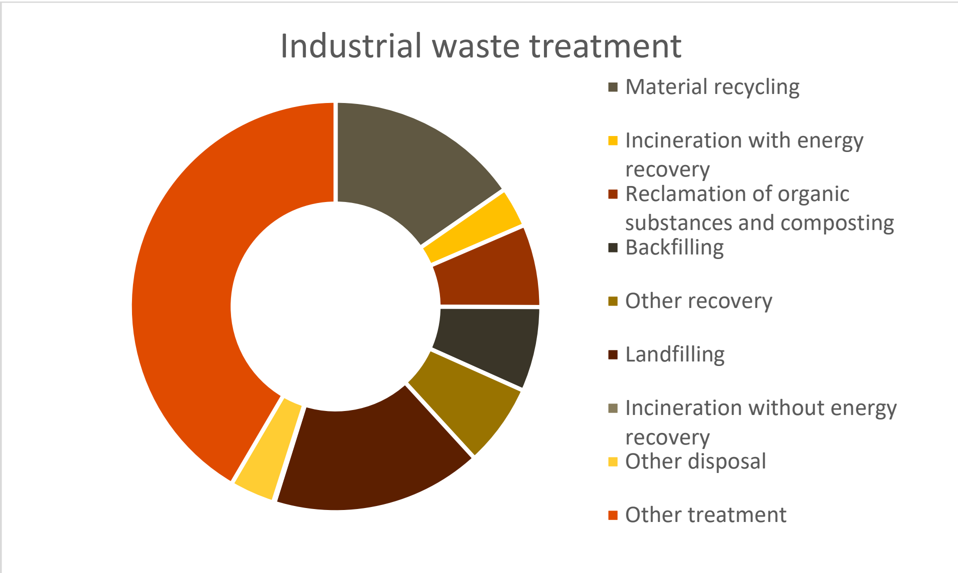
According to the annual statistics of the Statistical Office of the Slovak Republic, total municipal waste produced in the Slovak Republic in 2019 was 2 369.73 kt. Amount of municipal waste produced increased compared to the previous year (1.9%). Generation of the municipal waste per capita (434.63) in the Slovak Republic is still below the European average. However, the predominant waste treatment is still landfilling (51%) and there is still insufficiency in the recovery of waste (46%). In 2018, prevailed waste recovery treatment material recycling (48% of recovered waste, 22% of all waste); in 2019, it was material recycling (47% of recovered waste, 22% of all waste). ***Figure 6.1*** shows a detailed share of municipal waste treatment.

Figure 6.1: Municipal waste treatment in the Slovak Republic in 2019



In the year 2019, total industrial and other waste was produced in an amount of 10 037.94 kt. The amount decreased by 10% compared to the year 2018. The largest share represents waste from construction and demolition (44%) which has increased by 12% annually due to significant year-on-year growth in construction output in all three construction segments - residential, non-residential and civil engineering.

Figure 6.2: Industrial waste treatment in the Slovak Republic in 2019



In general, in most waste categories, the **condensable component of PMs** is not included in emission factors.

Emissions of air pollutants (excluding NMVOC and NH_3) in this sector are emitted into the air by waste incineration plants. The trend in the incineration categories is decreasing until 2008. From 2009 emissions of all main pollutants are increasing. Emissions of heavy metals and POPs have generally decreasing character.

Wastewater handling and composting are the main contributors to ammonia emissions in this sector. The ratio of the population using the connection to no sewage systems or using no septic tanks etc. decreased since 1990 significantly.

Non-methane volatile compounds are formed mainly at waste disposal sites. These emissions are increasing in the long term. Summary values for waste categories are given in ***Table 6.2***. The overall trend dramatically declines since 1990 due to the continual development of the legislative.

Share of waste sector categories on the emissions of the main pollutants is available in ***Figure 6.3***.

Figure 6.3: *Share of subsectors of the waste sector on emissions of the main pollutants in 2019*

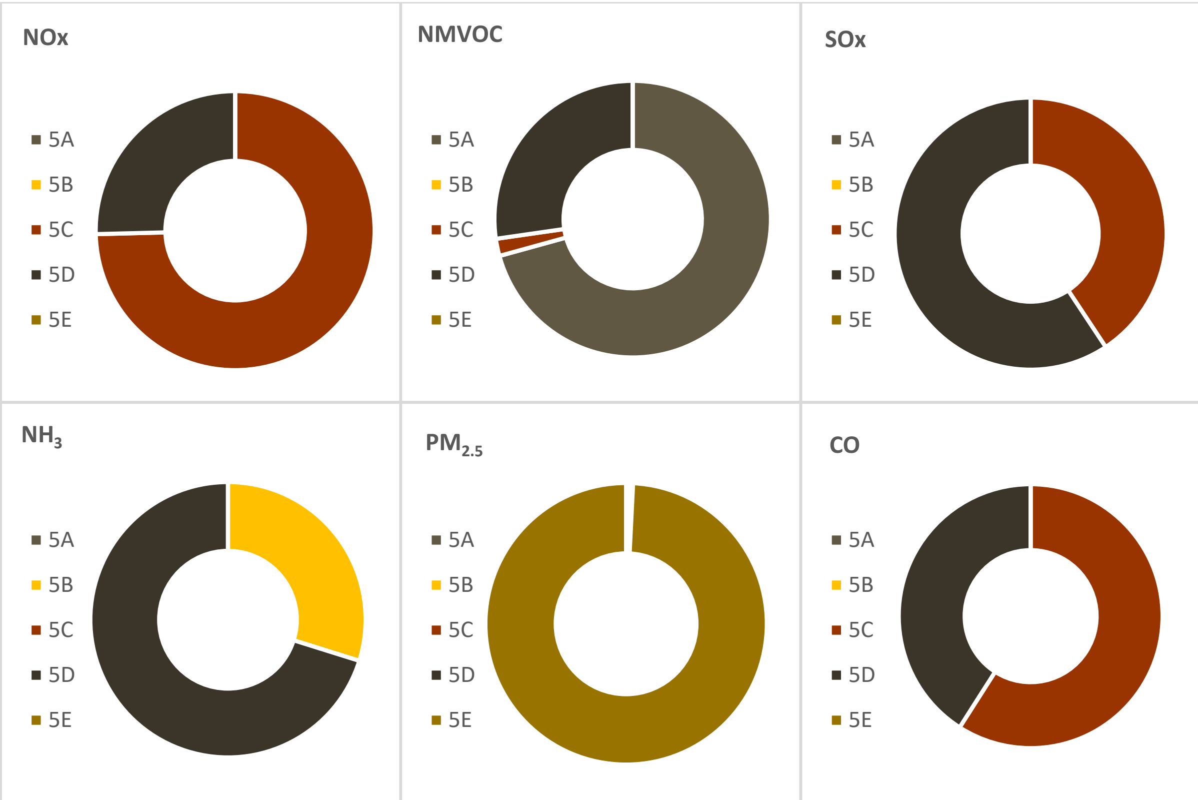


Table 6.2: *The overview of the pollutants in the Waste sector and their trends*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [k]
1990	0.0215	1.4514	0.0071	1.2872	0.1447	0.1460	0.1518	0.0001	0.0106
1995	0.0226	1.5150	0.0075	1.1947	0.1524	0.1533	0.1586	0.0001	0.0112
2000	0.0180	2.2390	0.0033	1.2606	0.1435	0.1444	0.1499	0.0001	0.0098
2005	0.0201	1.4362	0.0047	1.2131	0.1521	0.1528	0.1569	0.0001	0.0070
2010	0.0218	0.9599	0.0044	1.0738	0.1798	0.1805	0.1817	0.0000	0.0060
2011	0.0228	0.9222	0.0048	1.0491	0.1988	0.1995	0.2009	0.0000	0.0068
2012	0.0193	0.9155	0.0042	1.0696	0.1937	0.1944	0.1956	0.0000	0.0050
2013	0.0212	0.9931	0.0046	1.0197	0.1854	0.1863	0.1878	0.0000	0.0068
2014	0.0209	0.9135	0.0046	1.0297	0.1625	0.1632	0.1643	0.0000	0.0078
2015	0.0224	0.9396	0.0060	1.0771	0.1894	0.1901	0.1913	0.0000	0.0097
2016	0.0224	0.9763	0.0044	1.0188	0.1948	0.1955	0.1966	0.0000	0.0049
2017	0.0210	0.9946	0.0046	1.0160	0.2038	0.2045	0.2056	0.0000	0.0045
2018	0.0239	1.0023	0.0051	0.9921	0.1846	0.1852	0.1862	0.0000	0.0052
2019	0.0265	1.0046	0.0061	0.9699	0.1664	0.1670	0.1678	0.0000	0.0057
1990/2019	**23%**	**-31%**	**-14%**	**-25%**	**15%**	**14%**	**11%**	**-99%**	**-46%**
2018/2019	**11%**	**0%**	**20%**	**-2%**	**-10%**	**-10%**	**-10%**	**-32%**	**8%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0718	0.0068	0.1052	0.0016	0.0020	0.0145	0.0017	0.0001	0.0010

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1995	0.0711	0.0068	0.1053	0.0017	0.0021	0.0145	0.0017	0.0001	0.0011
2000	0.0773	0.0072	0.1146	0.0017	0.0021	0.0154	0.0018	0.0001	0.0012
2005	0.0477	0.0050	0.0828	0.0017	0.0020	0.0131	0.0013	0.0002	0.0017
2010	0.0031	0.0014	0.0226	0.0019	0.0018	0.0066	0.0008	0.0003	0.0021
2011	0.0030	0.0016	0.0226	0.0020	0.0019	0.0081	0.0009	0.0002	0.0020
2012	0.0037	0.0015	0.0213	0.0020	0.0019	0.0058	0.0007	0.0003	0.0020
2013	0.0044	0.0015	0.0255	0.0020	0.0019	0.0056	0.0008	0.0003	0.0025
2014	0.0041	0.0013	0.0248	0.0017	0.0016	0.0051	0.0008	0.0003	0.0024
2015	0.0039	0.0015	0.0271	0.0020	0.0019	0.0054	0.0008	0.0003	0.0027
2016	0.0043	0.0015	0.0269	0.0021	0.0019	0.0048	0.0007	0.0003	0.0027
2017	0.0050	0.0016	0.0233	0.0021	0.0020	0.0046	0.0007	0.0003	0.0023
2018	0.0047	0.0015	0.0289	0.0020	0.0019	0.0047	0.0008	0.0004	0.0029
2019	0.0046	0.0014	0.0324	0.0019	0.0017	0.0040	0.0008	0.0004	0.0033
1990/2019	**-94%**	**-80%**	**-69%**	**13%**	**-13%**	**-72%**	**-53%**	**246%**	**246%**
2018/2019	**-2%**	**-8%**	**12%**	**-7%**	**-7%**	**-13%**	**0%**	**14%**	**14%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [t]	PCB [t]
1990	74.7530	0.0000	0.0000	0.0000	0.0000	0.0001	0.2321	0.0461
1995	74.0681	0.0000	0.0000	0.0000	0.0000	0.0001	0.2298	0.0460
2000	80.3034	0.0000	0.0000	0.0000	0.0000	0.0001	0.2498	0.0501
2005	53.4046	0.0000	0.0000	0.0000	0.0000	0.0001	0.2359	0.0499
2010	5.5655	0.0000	0.0000	0.0000	0.0000	0.0000	0.1186	0.0280
2011	6.9761	0.0000	0.0000	0.0000	0.0000	0.0000	0.1630	0.0368
2012	4.5597	0.0000	0.0000	0.0000	0.0000	0.0000	0.0730	0.0186
2013	4.6294	0.0000	0.0000	0.0000	0.0000	0.0001	0.0734	0.0196
2014	4.3253	0.0000	0.0000	0.0000	0.0000	0.0001	0.0723	0.0193
2015	4.1536	0.0000	0.0000	0.0000	0.0000	0.0000	0.0596	0.0174
2016	3.5593	0.0000	0.0000	0.0000	0.0000	0.0000	0.0339	0.0122
2017	3.4475	0.0000	0.0000	0.0000	0.0000	0.0001	0.0196	0.0082
2018	3.5770	0.0000	0.0000	0.0000	0.0000	0.0001	0.0349	0.0128
2019	3.0568	0.0000	0.0000	0.0000	0.0000	0.0001	0.0245	0.0117
1990/2019	**-96%**	**246%**	**246%**	**246%**	**246%**	**-58%**	**-89%**	**-75%**
2018/2019	**-15%**	**14%**	**14%**	**14%**	**14%**	**-3%**	**-30%**	**-8%**

Several categories were recalculated throught the whole time series. Activity data from the national statistics for incineration of industrial waste were reconsidered, as there was a different definition of waste in national legislation and also the methodology for data collection and processing was not transparent and comparable with another national database. National statistics are based on the information on waste production and the final treatment of waste is not recorded. Same waste can be recorded in the national statistics database several times as it can change its categorisation (according to waste catalogue) after its processing or sterilisation, which can lead to significant overestimations. Therefore activity data from the NEIS database were used as these data are reported to the database by each of the operators. Activity data for emissions estimation of waste incineration were disaggregated into waste incineration with and without energy recovery. Emissions from waste incineration with energy recovery are reported under the energy sector, subcategory **1A** and without energy utilisation are reported under **5C**. The methodology used for each category is summarised in the following table (***Table 6.3***). Emissions of NMVOC in the category 5A was recalculated following the recommendation from the NECD review 2020.

Table 6.3: *The overview of the activity data source and methodology used for the Waste categories*

NFR	TIER	AD SOURCE	NEIS CATEGORIES (DECREE NO 410/2012)	METHOD FOR 2020 REPORTING	ALLOC./ NK
5A	T1	ŠÚ SR	-	Em $_{TOTAL}$ = AD * EF$_{(GB2019)}$	
5B1	T2	ŠÚ SR	-	Em $_{TOTAL}$ = AD * EF$_{(GB2019)}$	
5B2	T1	ŚÚ SR	-	Em $_{TOTAL}$ = AD * EF$_{(GB2019)}$	
5C1a	T3*	NEIS*	-	Em $_{TOTAL}$ = AD * EF$_{(GB2019)}$-1-ATE)	1A1a
	T3	NEIS**	NEIS: 5.1	Em $_{TOTAL}$ = 100% NEIS	1A1a
5C1bi	T1	NEIS	-	Em $_{TOTAL}$ = AD * Ef$_{(GB2019)}$	
	T1	NEIS**	NEIS: 5.1	Em $_{TOTAL}$ = 100% NEIS	1A1b,1A2c; 1A2f
5C1bii	T2	NEIS	-	Em $_{TOTAL}$ = AD * Ef$_{(GB2019)}$	
5C1biii	T2	NEIS	-	Em $_{TOTAL}$ = AD*(EF$_{GB2019}$-(1-ATE))	
5C1biv	-	-	-	-	NO
5C1bv	T1	Operators	-	Em $_{TOTAL}$ = AD * EF$_{(GB2019)}$	
5C1bvi	-	-	-	-	NO
5C2	-	-	-	-	NO
5D1	T1/T2	ŠÚ SR	-	Em $_{TOTAL}$ = AD * EF$_{(GB2019)}$	
5D2	T1	ŚÚ SR		Em $_{TOTAL}$ = AD * EF$_{(GB2019)}$	
5D3					NO
5E	T2	FAI MI	-	Em $_{TOTAL}$ = AD * EF$_{(GB2019)}$	
6A	-	-	-	-	NO

* for POPs and heavy metals
** with Energy Recovery
FAI MI - Fire Appraisal Institute of the Ministry of Interior
ATE –abatement technology efficiency

6.3 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$_{2019}$.

The QC checks (e.g. consistency check between NFR data and national statistics) were done during the NFR and IIR compilation, General QC questionnaire was filled and is archived by 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 previous year's data an 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) and Clinical waste incinerators (CWI) was ensured by comparing data from the NEIS database with the data published by operators in their annual reports of operation. NEIS database has its QAQC procedures which ensure verification of the reported data.

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 (VÚVH) and the national censuses.

Data on the use of retention tanks were based on population censuses done in years 1991, 2001 and 2011, these censuses were also used to verify population distribution to individual wastewater pathways. Additional information was collected from the SHMÚ and the Association of Wastewater Treatment Experts. The data available in the statistical reports were verified by a comparison of the same category and previous years.

Verification of activity data from Other waste was ensured by comparing data with previous year submission.

6.4 SECTOR-SPECIFIC IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

The reviews of Waste Chapter by TERT resulted in one recommendation. This is described below and referenced to relevant paragraphs of this chapter. Improvements are implemented in line with the Improvement Plan for the year 2021.

The recommendation No. ***SK-5A-2020-0001*** asks for the usage of higher tier methodology for the calculation of the NMVOC emissions using data of CH_4 generation from GHG inventory and methodology mentioned in the note of Table 3-1 in the EMEP/EEA GB_{2019}. This is described in **Chapter 6.5.4**.

In this submission, emissions from hazardous waste burning without energy recovery were reallocated from the category **5C1bi** and **5C1biii**. Several sources were reallocated due to the main type of waste burned to **5C1bi** (burn mainly non-hazardous industrial waste), **5C1bii** (burn mainly hazardous waste) and **5C1biii** (burn mainly hazardous/non-hazardous clinical waste). Some sources were not reported correctly.

Also due to discrepancy in the use of activity data for domestic wastewater treatment, it was assumed that the best way is to use data used also for the GHG inventory.

There were also several error corrections and small improvement of the inventory in this sector. All recalculations and their cause are described in relevant Source-specific recalculations categories.

6.5 SOLID WASTE DISPOSAL ON LAND (NFR 5A)

6.5.1 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 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. Next legislative regulation on solid waste management and

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[1] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/1991/238/
[2] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/1992/606/vyhlasene_znenie.html

disposal entered into force on 1st July 2001. The 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 the Act No. 79/2015 Coll.[5] on waste, which introduces extended responsibility of producers and transfers organisation and financing waste recycling schemes from the state to organisations of waste producers. Regulation No. 372/2015 Coll.[6] describes technical parameters of landfill. New landfills must be provided with the building of the isolation by bio-membrane or geotextile, a drainage system and degassing system.

These measurements decline the release of the emissions in the atmosphere. In 2016, new legislation restricting the landfill of bio-waste entered into force[7]. As shown in ***Table 6.4***, this act caused a significant reduction in landfilling of these types of waste.

Table 6.4: *Activity data and emissions in the category 5A*

YEAR	CH_4 [kt]	WASTE – TOTAL [kt]	DEPOSITED MSW [kt]	DEPOSITED ISW [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
1990	27.92	6854.59	1 368.49	5 486.10	0.4419	0.0002	0.0015	0.0032
1995	26.69	4689.81	1 116.15	3 573.66	0.4224	0.0002	0.0010	0.0022
2000	30.51	4512.68	1 055.93	3 456.75	0.4828	0.0001	0.0010	0.0021
2005	35.50	4114.93	1 226.57	2 888.36	0.5618	0.0001	0.0009	0.0019
2010	41.08	3808.78	1 411.54	2 397.24	0.6502	0.0001	0.0008	0.0018
2011	42.70	4114.95	1 320.07	2 794.87	0.6759	0.0001	0.0009	0.0019
2012	43.54	4014.83	1 297.48	2 717.35	0.6891	0.0001	0.0009	0.0019
2013	44.10	4938.15	1 201.91	3 736.24	0.6980	0.0002	0.0011	0.0023
2014	43.73	3765.66	1 210.04	2 555.61	0.6922	0.0001	0.0008	0.0017
2015	44.36	3933.54	1 303.85	2 629.69	0.7021	0.0001	0.0009	0.0018
2016	44.28	3789.33	1 289.90	2 499.44	0.7009	0.0001	0.0008	0.0018
2017	44.67	3830.22	1 312.79	2 517.43	0.7069	0.0001	0.0008	0.0018
2018	44.99	3344.08	1 250.28	2 093.80	0.7121	0.0001	0.0007	0.0015
2019	44.89	2864.97	1 198.25	1 666.72	0.7104	0.0001	0.0006	0.0013
1990/2019	**61%**	**-58%**	**-12%**	**-70%**	**61%**	**-58%**	**-58%**	**-58%**
2018/2019	**0%**	**-14%**	**-4%**	**-20%**	**0%**	**-14%**	**-14%**	**-14%**

In comparison with the base year, emissions of NMVOC in this category shows increasing character due to continual disposal of waste on the landfill sites. Emissions of PMs decreased in the long term, although the last four years is the emission trend stable. The decrease in the year 2005 was caused by the regression in construction and demolition activities.

6.5.2 METHODOLOGICAL ISSUES

Activity data for this category was obtained from publications Waste in the Slovak Republic[8]. Amount of solid waste deposited to landfill sites was used. For the calculations, ***Equation 1*** was applied. Activity data in the period 1990-1997 were not available; therefore, extrapolated data were used.

Equation 6.1: *Total emissions of the pollutant in the category Solid waste disposal on land*

$$Em_{TOTAL} = (Deposited\ municipal\ waste + Deposited\ industrial\ waste) * EF_{(GB2019)}$$

For calculation of NMVOCs, CH_4 emissions from GHG inventory were taken following recommendation ***SK-5A-2020-0001*** to use emissions of CH_4 from the GHG inventory and following the instructions given

[3] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2001/223/20160101
[4] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2001/283/20011201.html
[5] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/79/20170101
[6] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/372/20160101.html
[7] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/79/20170101
[8] Waste in the Slovak Republic – Yearbook – available since 2008 https://slovak.statistics.sk/

in the note of Table 3-1 of EMEP/EEA GB_{2019} (Part solid waste disposal on land). Tier 1 emission factors from EMEP/EEA GB_{2019} were used (***Table 6.5***).

The **condensable component of PMs** is not included in EF.

Table 6.5: *Emissions factors in the category Solid waste disposal on land*

POLLUTANT	TSP	PM_{10}	$PM_{2.5}$
Unit	[g/t]	[g/t]	[g/t]
Value	0.463	0.219	0.033

6.5.3 COMPLETENESS

The ammonia and carbon monoxide emissions were reported as not estimated due to no emission factor. Notation key for these pollutants is NE.

6.5.4 SOURCE-SPECIFIC RECALCULATIONS

NMVOCs emissions were recalculated to recommendation ***SK-5A-2020-0001***. ***Table 6.6*** shows the difference between 2018 and 2019 submission and percentage change.

Table 6.6: *Previous and refined emissions of NMVOC from landfilling*

YEAR	PREVIOUS [kt]	REFINED [kt]	CHANGE
1990	10.6932	0.4419	-96%
1991	8.9447	0.4550	-95%
1992	8.7954	0.4558	-95%
1993	7.4856	0.4602	-94%
1994	7.8662	0.4166	-95%
1995	7.3161	0.4224	-94%
1996	7.7549	0.4277	-94%
1997	7.5580	0.4410	-94%
1998	6.9401	0.4551	-93%
1999	6.8550	0.4678	-93%
2000	7.0398	0.4828	-93%
2001	6.9750	0.4944	-93%
2002	7.4326	0.5056	-93%
2003	7.7251	0.5239	-93%
2004	8.5130	0.5447	-94%
2005	6.4193	0.5618	-91%
2006	10.9691	0.5757	-95%
2007	8.6799	0.5922	-93%
2008	7.1462	0.6027	-92%
2009	6.3666	0.6265	-90%
2010	5.9417	0.6502	-89%
2011	6.4193	0.6759	-89%
2012	6.2631	0.6891	-89%
2013	7.7035	0.6980	-91%
2014	5.8744	0.6922	-88%
2015	6.1363	0.7021	-89%
2016	5.9114	0.7009	-88%
2017	5.9751	0.7069	-88%
2018	5.2168	0.7121	-86%

6.6 BIOLOGICAL TREATMENT OF WASTE (NFR 5B)

6.6.1 COMPOSTING (NFR 5B1)

6.6.1.1 Overview of the category

In 2006 Act No. 223/2001 Coll. [9] came into force, which prohibits the landfilling of biodegradable waste from gardens and parks, including the cemeteries and other green waste. The change in legislation also brought the obligation of municipalities to introduce and ensure 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 2019 to 21. There is a range of private and municipal companies, which provide composting of municipal and agricultural waste. With the support of the EU and Governmental grants, the number of municipalities composting waste is growing fast.

Since the year 2007, the amount of composted biodegradable waste, as well as the NH_3 emissions from this category, are continually increasing. This increase was caused by improving composting plants capacity and political force on municipalities to create conditions for kitchen and garden waste from households to be composted.

Emission of NH_3 and activity data from this source are displayed in ***Table 6.7***.

Table 6.7*: Overview of the activity data, emissions and trends in the category Composting of waste*

YEAR	COMPOSTED WASTE [kt]	NH_3 [kt]
1990	649.00	0.1558
1995	664.46	0.1595
2000	665.35	0.1597
2005	624.15	0.1498
2010	669.26	0.1606
2011	752.39	0.1806
2012	849.32	0.2038
2013	750.52	0.1801
2014	873.22	0.2096
2015	1 135.48	0.2725
2016	925.74	0.2222
2017	1 084.58	0.2603
2018	1 162.12	0.2789
2019	1 097.59	0.2634
1990/2019	**69%**	**69%**
2018/2019	**-6%**	**-6%**

6.6.1.2 Methodological issues

Activity data provided by the Statistical Office of the Slovak Republic in the yearbook "*Waste in the Slovak Republic*" [10] was used. Amount of composted municipal solid waste is published since 1992. The missing data for 1990 and 1991 were extrapolated. Data on industrial waste composting were collected and published since 1997. Methodology and emission factors of Tier 2 – Compost production from GB_{2019} was applied (***Table 6.8***).

[9] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2001/223/20160101

[10] Waste in the Slovak Republic – Yearbook – available since 2008, https://slovak.statistics.sk/

Table 6.8: *Emission factors in the category Composting of waste*

POLLUTANT	NH_3
Unit	[kg/t]
Value	0.24

6.6.1.3 Completeness

Notation keys used were following EMEP/EEA GB_{2019}.

6.6.1.4 Source-specific recalculations

No recalculation in this submission.

6.6.2 ANAEROBIC DIGESTION AT BIOGAS FACILITIES (NFR 5B2)

6.6.2.1 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, development of biogas facilities was significant.

In 2019 seventy-eight biogas stations operated. After the Decree No. 221/2013 Coll.[12], which provides price regulation in the electricity sector, entered into force, emissions started to increase since 2014. ***Table 6.9*** shows the NH_3 emission trend in this category.

Table 6.9: *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]
2001	0.11	0.0038
2005	0.11	0.0061
2010	0.12	0.0087
2011	0.14	0.0086
2012	0.18	0.0109
2013	0.20	0.0116
2014	0.21	0.0192
2015	0.23	0.0260
2016	0.34	0.0267
2017	0.26	0.0283
2018	0.26	0.0256
2019	0.33	0.0258
2001/2019	**584%**	**584%**
2018/2019	**1%**	**1%**

6.6.2.2 Methodological issues

The biggest part of biogas facilities are energy producers, so emission from these sources was allocated into **1A5a**. Only sources without energy recovery were included in this category. Amount of the nitrogen entering into biogas facility was used as activity data. This amount was balanced from the nitrogen cycle used in the agricultural sector. Default emission factor from EMEP/EEA GB_{2019} was used.

[11] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2009/309/20150801
[12] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2013/221/vyhlasene_znenie.html

6.6.2.3 Completeness

Notation keys used in the inventory follows the EMEP/EEA GB_{2019}.

6.6.2.4 Source-specific recalculations

No recalculations in this submission.

6.7 WASTE INCINERATION AND OPEN BURNING OF WASTE (5C)

6.7.1 MUNICIPAL SOLID WASTE INCINERATION (NFR 5C1a)

6.7.1.1 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 in operation in 1978 and significantly modernised in 2002. Currently installed capacity is 135 Gg/y, the incinerator can be characterised as a continuously operated stoker. The MSW incinerator in Košice with capacity 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 6.10***. As shown, the amount of incinerated municipal waste shows a slightly increasing trend since 1990, due to the gradual prioritization of MSW incineration before landfilling.

Municipal waste incineration with energy recovery is a key category for the main heavy metals (Pb, Cd, Hg), several of 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 installation of modern air pollution control system. Incineration plant KOSIT was reconstructed in the year 2005, also part of it was the installation of the new air pollution control system, therefore emission for this plant decreased significantly since the year 2006 (***Table 6.10***).

Table 6.10: *Overview of the activity data, emissions and trends in the category Municipal waste incineration*

YEAR	MSW [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	179.61	0.3233	0.0036	0.3053	0.0005	1.6524	2.4606	3.2868	0.0578	0.1257
1995	159.34	0.2868	0.0032	0.2709	0.0005	1.4660	2.1830	2.9160	0.0513	0.1115
2000	220.21	0.3964	0.0044	0.3744	0.0007	1.2825	1.9098	2.5510	0.0449	0.1541
2005	193.18	0.2224	0.0016	0.0385	0.0006	0.0055	0.0082	0.0110	0.0002	0.0647
2010	191.93	0.1381	0.0018	0.0066	0.0006	0.0007	0.0010	0.0013	0.0000	0.0074
2011	204.13	0.1628	0.0018	0.0069	0.0006	0.0005	0.0007	0.0009	0.0000	0.0071
2012	180.55	0.1578	0.0020	0.0063	0.0005	0.0009	0.0013	0.0017	0.0000	0.0070
2013	181.52	0.1398	0.0026	0.0075	0.0005	0.0008	0.0012	0.0016	0.0000	0.0081
2014	211.89	0.1504	0.0023	0.0109	0.0006	0.0012	0.0018	0.0023	0.0000	0.0098
2015	200.76	0.1239	0.0021	0.0067	0.0006	0.0008	0.0012	0.0016	0.0000	0.0081
2016	216.54	0.1426	0.0016	0.0087	0.0006	0.0008	0.0012	0.0016	0.0000	0.0068
2017	231.89	0.1450	0.0016	0.0096	0.0007	0.0011	0.0016	0.0021	0.0000	0.0077
2018	245.61	0.1541	0.0018	0.0094	0.0007	0.0009	0.0013	0.0017	0.0000	0.0069
2019	243.04	0.1619	0.0007	0.0055	0.0007	0.0013	0.0019	0.0026	0.0000	0.0062
1990/2019	**35%**	**-50%**	**-80%**	**-98%**	**35%**	**-100%**	**-100%**	**-100%**	**-100%**	**-95%**

YEAR	MSW [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2018/2019	**-1%**	**5%**	**-62%**	**-42%**	**-1%**	**52%**	**52%**	**52%**	**52%**	**-10%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Ni [t]	Se [t]	Zn [t]	PCDD/F [g--TEQ]	PAHs [t]	HCB [kg]	PCB [kg]
1990	18.6791	0.6107	0.5029	0.3844	0.0216	0.0021	0.1616	628.6224	0.0019	0.3592	0.9519
1995	16.5718	0.5418	0.4462	0.3410	0.0191	0.0019	0.1434	557.7038	0.0017	0.3187	0.8445
2000	22.9021	0.7487	0.6166	0.4713	0.0264	0.0026	0.1982	770.7454	0.0023	0.4404	1.1671
2005	7.6674	0.2525	0.2096	0.1592	0.0124	0.0023	0.0986	258.2458	0.0020	0.3864	1.0239
2010	0.0086	0.0033	0.0054	0.0019	0.0078	0.0022	0.0518	0.6718	0.0020	0.3839	1.0173
2011	0.0092	0.0035	0.0057	0.0020	0.0082	0.0024	0.0551	0.7145	0.0021	0.4083	1.0819
2012	0.0081	0.0031	0.0051	0.0018	0.0072	0.0021	0.0487	0.6319	0.0019	0.3611	0.9569
2013	0.0081	0.0031	0.0051	0.0018	0.0073	0.0021	0.0490	0.6353	0.0019	0.3630	0.9620
2014	0.0093	0.0036	0.0059	0.0020	0.0088	0.0025	0.0572	0.7416	0.0022	0.4238	1.1230
2015	0.0090	0.0034	0.0056	0.0020	0.0081	0.0023	0.0542	0.7026	0.0021	0.4015	1.0640
2016	0.0095	0.0037	0.0061	0.0021	0.0090	0.0025	0.0585	0.7579	0.0023	0.4331	1.1477
2017	0.0100	0.0039	0.0065	0.0021	0.0099	0.0027	0.0626	0.8116	0.0024	0.4638	1.2290
2018	0.0104	0.0042	0.0069	0.0022	0.0108	0.0029	0.0663	0.8596	0.0026	0.4912	1.3017
2019	0.0104	0.0041	0.0068	0.0022	0.0106	0.0028	0.0656	0.8507	0.0026	0.4861	1.2881
1990/2019	**-100%**	**-99%**	**-99%**	**-99%**	**-51%**	**35%**	**-59%**	**-100%**	**35%**	**35%**	**35%**
2018/2019	**0%**	**-1%**	**-1%**	**0%**	**-2%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**	**-1%**

6.7.1.2 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[13] were used to calculate emissions in this category. There are no MSW incinerators without energy recovery in the Slovak Republic, therefore these emissions are reported in the category **1A1a** as these operators use waste to produce energy and heat which is sold to the clients thought the central heating system.

Activity data from NEIS database was verified with other sources of data (see **ANNEX VIII**) and for the consistency, the NEIS database data was considered as the best for the inventory.

For reporting of emissions of NO_X, SO_X, NH_3, CO, TSP, $PM_{2.5}$ and PM_{10} data from the NEIS database for the period 2005-2019 were applied. For the period 1990-2004, extrapolated data based on total MWS incinerated were used. Municipal solid waste incineration (MSWI) sources assigned to the category 5.1 (according to the Annex No. 6 of Decree No. 410/2012 Coll.[14] as amended) are defined as Waste incineration plants: a/ burning hazardous waste with a projected capacity in t/d; b/ burning non-hazardous waste with a capacity in t/h. Further selection based on the NACE categorisation and SNAP coding in the database is also applied to separate the installation combusted industrial waste.

Tier 2 emission factors from EMEP/EEAGB$_{2019}$ for heavy metals and POPs were used in calculations of emissions except for Selene and Ideno (1,2,3) Pyrene for which Tier 1 emission factors were used. Abatement technology efficiency for heavy metals was calculated separately for each operator by comparing emissions factors from data from discontinues measurements of heavy metals on stokes with the value of EMEP/EEA GB$_{2019}$ Tier 2 emission factors for uncontrolled incinerators. The average value of abatement technology efficiency excluding extreme values was used for calculation of heavy metals emissions in this submission. For the period 1990-2002, no data about abatement technology was recorded, therefore only emission factors for uncontrolled plants were used.

[13] Waste in the Slovak Republic – Yearbook – available since 2008 https://slovak.statistics.sk/
[14] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2012/410/

Values of emission factors are given in ***Table 6.11*** and values of abatement technology efficiency, separately for each operator in ***Table 6.12***.

Table 6.11: *Emission factors in the category 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 6.12: *Abatement technology efficiency for heavy metals and PCDD/F in the category 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%

6.7.1.3 Completeness

Municipal waste incineration without energy recovery is not occurring in the Slovak Republic, therefore notation key NO was used. Emissions from MSW incineration with energy recovery were reported in the energy sector under **1A1a**.

6.7.1.4 Source-specific recalculations

No recalculations in this submission.

6.7.2 NON-MUNICIPAL SOLID WASTE INCINERATION (NFR 5C1b)

6.7.2.1 Overview of the category

The non-municipal waste incineration sector has undergone significant changes since 1990, but detailed research of their impact has not been done, yet. The key drivers of these changes were stricter legislation, the new standards (EU approximation) and commercialisation of waste services. This led to replacing small incineration units in factories by regional incinerators. Existing large incinerators were modernised to comply with the new standards or were decommissioned.

From the total of 13 non-MSW incinerators and co-incineration plants operating in 2019, only the Slovnaft and waste co-incineration plants have installed capacity exceeding 2 t/hour. The following companies are using the largest waste incineration facilities:

- Slovnaft Inc., Bratislava (3.7 t/hour) – incinerate industrial sludge with energy recovery;
- Duslo Inc., Šaľa (1.26 t/hour) – with energy recovery;
- Light Stabilizers Ltd., Strážske (0.18 t/hour) – without energy recovery;
- Fecupral Ltd.., Prešov (0.15 t/hour) – without energy recovery;
- Archiv SB Ltd., Liptovský Mikuláš (0.15 t/hour) – without energy recovery;
- FCC Environment Ltd., Kysucké Nové Mesto (0.4 t/hour) – without energy recovery.

Incineration of medical waste occurs in the following plants:

- University H, Martin (0.098 t/hour) - without energy recovery ;
- Nemocnica s Poliklinikou, Bojnice (0.05 t/hour) - without energy recovery.

Co-incineration on waste-derived fuels occurs in the following plants:

- CRH Inc., Rohožník (34.5 t/hour) – cement production – with energy recovery;
- CRH Inc., Turňa nad Bodvou (9 t/hour) – cement production – with energy recovery;

- Carmeuse Ltd., Košice-Šaca (7.2 t/hour) - lime production – with energy recovery;
- Cemmac Inc., Horné Sŕnie (65,5 t/year) - cement production – with energy recovery;
- Považská cementáreň Inc., Ladce (.5 t/hour) - cement production – with energy recovery.

Most of the industrial waste is burned in co-incineration plants producing cement and lime. These emissions are allocated in the category **1A2f**. The increasing trend of incinerated waste in this category is caused by the increase of the prize of traditional fuels and political support of energy recovery of waste instead of its disposal.

Emissions from ISW burned with energy recovery in Slovnaft incineration plant were allocated in **1A1b** and Duslo incineration plant in **1A2c**.

Emissions from ISW burned without energy recovery are allocated in the category **5C1bi** (occurring only in 1990-2006). Emissions from the Light Stabilizers incineration plant were allocated in the category **2B10a**. Emissions from the plants which incinerate mostly hazardous waste (Fecupral, Archiv SB, FCC Environment) were allocated in the category **5C1bii** and emissions from plants incinerating medical waste in category **5C1biii**.

The trend of incinerated waste in this category is relatively stable except the peak in 2005 when operators used last year before stricter emission limits, connected with entering of the Slovak Republic to 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 6.13*** shows activity data of waste incineration with and without energy recovery and its allocation into NFR categories.

Table 6.13: *Overview of activity data and allocation into NFR categories*

YEAR	NON-MSW INCINERATED WITH E RECOVERY [kt]	NON-MSW INCINERATED WITHOUT E RECOVERY [kt]	1A1b [kt]	1A2c [kt]	1A2f [kt]	2B10a [kt]	5C1bi [kt]	5C1bii [kt]	5C1biii [kt]
1990	39.08	7.20	13.00	8.78	17.29	-	4.63	0.39	2.18
1995	35.03	7.13	13.02	8.07	13.94	-	4.58	0.38	2.16
2000	30.54	7.75	13.01	6.94	10.59	-	4.98	0.42	2.35
2005	83.44	5.48	11.98	7.40	64.06	-	1.63	1.94	1.92
2010	217.08	2.80	1.47	6.73	208.87	1.14	-	1.66	1.13
2011	241.33	3.16	5.39	6.75	229.19	1.10	-	1.58	1.58
2012	247.51	2.76	3.33	5.48	238.70	0.84	-	2.09	0.67
2013	277.80	3.28	12.51	4.84	260.45	0.88	-	2.62	0.66
2014	311.15	3.13	3.73	3.85	303.56	0.81	-	2.48	0.65
2015	306.08	2.75	3.55	4.54	298.00	0.87	-	2.22	0.53
2016	328.92	2.71	3.25	4.67	321.00	-	-	2.45	0.26
2017	350.01	3.19	3.84	5.34	340.83	1.13	-	3.08	0.11
2018	364.07	3.04	2.16	5.10	356.81	1.16	-	2.77	0.27
2019	384.44	2.83	2.39	4.07	377.98	1.02	-	2.67	0.16
1990/2019	**884%**	**-61%**	**-82%**	**-54%**	**2086%**	**-**	**-**	**589%**	**-93%**
2018/2019	**6%**	**-7%**	**10%**	**-20%**	**6%**	**-12%**	**-**	**-4%**	**-40%**

6.7.2.2 Category-specific recalculations

In this submission, emissions from hazardous waste burning without energy recovery were reallocated from the category **5C1bi** and **5C1biii**. Several sources were reallocated due to the main type of waste burned to **5C1bi** (burn mainly non-hazardous industrial waste), **5C1bii** (burn mainly hazardous waste) and **5C1biii** (burn mainly hazardous/non-hazardous clinical waste). Some sources were not reported correctly.

6.7.2.3 Industrial waste incineration (5C1bi)

Industrial waste incineration without energy recovery had a decreasing trend from 1990 to 2006. After 2006, there was no industrial waste incineration excluding hazardous waste (included in the category **5C1bii)** due to strict legislation and emission limits for the waste incineration plants. Activity data and resulting emissions are shown in ***Table 6.14***.

Table 6.14: *Overview of activity data and emissions in the category 5C1bi*

YEAR	IW INCINERATED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	6.04	0.0053	0.0447	0.0003	0.0000	0.0000	0.0001	0.0000	0.0004
1995	5.97	0.0052	0.0442	0.0003	0.0000	0.0000	0.0001	0.0000	0.0004
2000	6.49	0.0056	0.0480	0.0003	0.0000	0.0000	0.0001	0.0000	0.0005
2005	1.13	0.0010	0.0083	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
2010	NO	NO	NO	NO	NO	NO	NO	NO	NO
2011	NO	NO	NO	NO	NO	NO	NO	NO	NO
2012	NO	NO	NO	NO	NO	NO	NO	NO	NO
2013	NO	NO	NO	NO	NO	NO	NO	NO	NO
2014	NO	NO	NO	NO	NO	NO	NO	NO	NO
2015	NO	NO	NO	NO	NO	NO	NO	NO	NO
2016	NO	NO	NO	NO	NO	NO	NO	NO	NO
2017	NO	NO	NO	NO	NO	NO	NO	NO	NO
2018	NO	NO	NO	NO	NO	NO	NO	NO	NO
2019	NO	NO	NO	NO	NO	NO	NO	NO	NO
1990/2019	-	-	-	-	-	-	-	-	-
2018/2019	-	-	-	-	-	-	-	-	-

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Ni [t]	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]
1990	0.0078	0.0006	0.0003	0.0001	0.0008	2.1127	0.0001	0.0121
1995	0.0078	0.0006	0.0003	0.0001	0.0008	2.0909	0.0001	0.0119
2000	0.0084	0.0006	0.0004	0.0001	0.0009	2.2725	0.0001	0.0130
2005	0.0015	0.0001	0.0001	0.0000	0.0002	0.3946	0.0000	0.0023
2010	NO	NO	NO	NO	NO	NO	NO	NO
2011	NO	NO	NO	NO	NO	NO	NO	NO
2012	NO	NO	NO	NO	NO	NO	NO	NO
2013	NO	NO	NO	NO	NO	NO	NO	NO
2014	NO	NO	NO	NO	NO	NO	NO	NO
2015	NO	NO	NO	NO	NO	NO	NO	NO
2016	NO	NO	NO	NO	NO	NO	NO	NO
2017	NO	NO	NO	NO	NO	NO	NO	NO
2018	NO	NO	NO	NO	NO	NO	NO	NO
2019	NO	NO	NO	NO	NO	NO	NO	NO
1990/2019	-	-	-	-	-	-	-	-
2018/2019	-	-	-	-	-	-	-	-

6.7.2.3.1 Methodological issues

For industrial waste incineration sources without energy recovery, data from the NEIS database were used. Using statistical data was reconsidered after a detailed analysis and comparing the data with other sources. Statistical data were assumed as highly overestimated. Detailed description can be found in **ANNEX VIII**. In this submission, hazardous waste was excluded from this category and allocated in the category **5C1bii**.

Tier 1 methodology from the EMEP/EEA GB_{2019} was used to calculate emissions in this category. Emission factors are shown in ***Table 6.15***.

The **condensable component of PMs** is not included in EFs.

Table 6.15: *Emission factors in the category Industrial waste incineration without E recovery*

POLLUTANT	NOx	NMVOC	SOx	$PM_{2.5}$	PM_{10}	TSP	BC	CO
Unit	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	% of $PM_{2.5}$	[kg/t]
Value	0.87	7.4	0.047	0.004	0.007	0.01	0.035	0.07

POLLUTANT	Pb	Cd	Hg	As	Ni	Se	PCDD/F	PAHs	HCB
Unit	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	µg/t I-TEQ	mg/t	mg/t
Value	1.3	0.1	0.056	0.016	0.14	0.06	350	38.87	3

6.7.2.3.2 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 comply with EMEP/EEA GB_{2019}.

6.7.2.3.3 Source-specific recalculations

Industrial waste was recalculated due to exclusion of hazardous waste from the calculation. Also, one source was reallocated to the energy category (to **1A2c**). Recalculation of the amount of industrial waste is shown in ***Table 6.16***.

Table 6.16: *Previous and refined amount of incinerated industrial waste with and without energy recovery*

YEAR	IW WITHOUT ENERGY RECOVERY [kt]			NOx [kt]		NMVOC [kt]		SOx [kt]		CHANGE
	P	R	CHANGE	P	R	P	R	P	R	
1990	11.23	6.04	-46%	0.0097	0.0053	0.0824	0.0447	0.0005	0.0003	-46%
1991	10.73	6.03	-44%	0.0093	0.0052	0.0789	0.0446	0.0005	0.0003	-43%
1992	10.23	6.01	-41%	0.0089	0.0052	0.0755	0.0445	0.0005	0.0003	-41%
1993	9.78	6.05	-38%	0.0085	0.0053	0.0724	0.0448	0.0005	0.0003	-38%
1994	9.28	6.05	-35%	0.0081	0.0053	0.0689	0.0448	0.0004	0.0003	-35%
1995	8.73	5.97	-32%	0.0077	0.0052	0.0651	0.0442	0.0004	0.0003	-32%
1996	8.27	6.05	-27%	0.0073	0.0053	0.0619	0.0448	0.0004	0.0003	-28%
1997	7.83	6.16	-21%	0.0069	0.0054	0.0590	0.0456	0.0004	0.0003	-23%
1998	7.36	5.90	-20%	0.0065	0.0051	0.0557	0.0437	0.0004	0.0003	-22%
1999	6.68	5.93	-11%	0.0060	0.0052	0.0509	0.0439	0.0003	0.0003	-14%
2000	6.27	6.49	4%	0.0057	0.0056	0.0481	0.0480	0.0003	0.0003	0%
2001	6.04	6.71	11%	0.0055	0.0058	0.0467	0.0497	0.0003	0.0003	6%
2002	5.33	9.08	70%	0.0049	0.0079	0.0418	0.0672	0.0003	0.0004	61%
2003	4.66	3.77	-19%	0.0043	0.0033	0.0366	0.0279	0.0002	0.0002	-24%
2004	4.10	4.05	-1%	0.0039	0.0035	0.0333	0.0300	0.0002	0.0002	-10%
2005	4.51	1.13	-75%	0.0043	0.0010	0.0364	0.0083	0.0002	0.0001	-77%
2006	3.49	2.03	-42%	0.0034	0.0018	0.0290	0.0150	0.0002	0.0001	-48%
2007	1.86	NO	-	0.0020	NO	0.0171	NO	0.0001	NO	-
2008	2.64	NO	-	0.0026	NO	0.0225	NO	0.0001	NO	-
2009	2.63	NO	-	0.0030	NO	0.0254	NO	0.0002	NO	-
2010	2.55	NO	-	0.0025	NO	0.0214	NO	0.0001	NO	-
2011	1.85	NO	-	0.0019	NO	0.0158	NO	0.0001	NO	-
2012	1.74	NO	-	0.0017	NO	0.0148	NO	0.0001	NO	-
2013	2.34	NO	-	0.0023	NO	0.0193	NO	0.0001	NO	-
2014	2.07	NO	-	0.0020	NO	0.0174	NO	0.0001	NO	-
2015	1.06	NO	-	0.0010	NO	0.0088	NO	0.0001	NO	-

YEAR	IW WITHOUT ENERGY RECOVERY [kt]			NOx [kt]		NMVOC [kt]		SOx [kt]		CHANGE
	P	R	CHANGE	P	R	P	R	P	R	
2016	0.53	NO	-	0.0007	NO	0.0058	NO	0.0000	NO	-
2017	1.59	NO	-	0.0020	NO	0.0174	NO	0.0001	NO	-
2018	1.59	NO	-	0.0015	NO	0.0127	NO	0.0001	NO	-

YEAR	$PM_{2.5}$ [kt]		PM_{10} [kt]		BC [kt]		CO [kt]		CHANGE
	P	R	P	R	P	R	P	R	
1990	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0008	0.0004	-46%
1991	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0007	0.0004	-43%
1992	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0007	0.0004	-41%
1993	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0007	0.0004	-38%
1994	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0007	0.0004	-35%
1995	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0006	0.0004	-32%
1996	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0006	0.0004	-28%
1997	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0006	0.0004	-23%
1998	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0005	0.0004	-22%
1999	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005	0.0004	-14%
2000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005	0.0005	0%
2001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0005	6%
2002	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0004	0.0006	61%
2003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0003	-24%
2004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0003	-10%
2005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0001	-77%
2006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0001	-48%
2007	0.0000	NO	0.0000	NO	0.0000	NO	0.0002	NO	-
2008	0.0000	NO	0.0000	NO	0.0000	NO	0.0002	NO	-
2009	0.0000	NO	0.0000	NO	0.0000	NO	0.0002	NO	-
2010	0.0000	NO	0.0000	NO	0.0000	NO	0.0002	NO	-
2011	0.0000	NO	0.0000	NO	0.0000	NO	0.0001	NO	-
2012	0.0000	NO	0.0000	NO	0.0000	NO	0.0001	NO	-
2013	0.0000	NO	0.0000	NO	0.0000	NO	0.0002	NO	-
2014	0.0000	NO	0.0000	NO	0.0000	NO	0.0002	NO	-
2015	0.0000	NO	0.0000	NO	0.0000	NO	0.0001	NO	-
2016	0.0000	NO	0.0000	NO	0.0000	NO	0.0001	NO	-
2017	0.0000	NO	0.0000	NO	0.0000	NO	0.0002	NO	-
2018	0.0000	NO	0.0000	NO	0.0000	NO	0.0001	NO	-

YEAR	Pb [t]		Cd [t]		Hg [t]		As [t]		Ni [t]		CHANGE
	P	R	P	R	P	R	P	R	P	R	
1990	0.0145	0.0078	0.0011	0.0006	0.0006	0.0003	0.0002	0.0001	0.0016	0.0008	-46%
1991	0.0139	0.0078	0.0011	0.0006	0.0006	0.0003	0.0002	0.0001	0.0015	0.0008	-43%
1992	0.0133	0.0078	0.0010	0.0006	0.0006	0.0003	0.0002	0.0001	0.0014	0.0008	-41%
1993	0.0127	0.0079	0.0010	0.0006	0.0005	0.0003	0.0002	0.0001	0.0014	0.0008	-38%
1994	0.0121	0.0079	0.0009	0.0006	0.0005	0.0003	0.0001	0.0001	0.0013	0.0008	-35%
1995	0.0114	0.0078	0.0009	0.0006	0.0005	0.0003	0.0001	0.0001	0.0012	0.0008	-32%
1996	0.0109	0.0079	0.0008	0.0006	0.0005	0.0003	0.0001	0.0001	0.0012	0.0008	-28%
1997	0.0104	0.0080	0.0008	0.0006	0.0004	0.0003	0.0001	0.0001	0.0011	0.0009	-23%
1998	0.0098	0.0077	0.0008	0.0006	0.0004	0.0003	0.0001	0.0001	0.0011	0.0008	-22%
1999	0.0089	0.0077	0.0007	0.0006	0.0004	0.0003	0.0001	0.0001	0.0010	0.0008	-14%
2000	0.0085	0.0084	0.0007	0.0006	0.0004	0.0004	0.0001	0.0001	0.0009	0.0009	0%

YEAR	Pb [t]		Cd [t]		Hg [t]		As [t]		Ni [t]		CHANGE
	P	R	P	R	P	R	P	R	P	R	
2001	0.0082	0.0087	0.0006	0.0007	0.0004	0.0004	0.0001	0.0001	0.0009	0.0009	6%
2002	0.0073	0.0118	0.0006	0.0009	0.0003	0.0005	0.0001	0.0001	0.0008	0.0013	61%
2003	0.0064	0.0049	0.0005	0.0004	0.0003	0.0002	0.0001	0.0001	0.0007	0.0005	-24%
2004	0.0059	0.0053	0.0005	0.0004	0.0003	0.0002	0.0001	0.0001	0.0006	0.0006	-10%
2005	0.0064	0.0015	0.0005	0.0001	0.0003	0.0001	0.0001	0.0000	0.0007	0.0002	-77%
2006	0.0051	0.0026	0.0004	0.0002	0.0002	0.0001	0.0001	0.0000	0.0005	0.0003	-48%
2007	0.0030	NO	0.0002	NO	0.0001	NO	0.0000	NO	0.0003	NO	-
2008	0.0040	NO	0.0003	NO	0.0002	NO	0.0000	NO	0.0004	NO	-
2009	0.0045	NO	0.0003	NO	0.0002	NO	0.0001	NO	0.0005	NO	-
2010	0.0038	NO	0.0003	NO	0.0002	NO	0.0000	NO	0.0004	NO	-
2011	0.0028	NO	0.0002	NO	0.0001	NO	0.0000	NO	0.0003	NO	-
2012	0.0026	NO	0.0002	NO	0.0001	NO	0.0000	NO	0.0003	NO	-
2013	0.0034	NO	0.0003	NO	0.0001	NO	0.0000	NO	0.0004	NO	-
2014	0.0031	NO	0.0002	NO	0.0001	NO	0.0000	NO	0.0003	NO	-
2015	0.0016	NO	0.0001	NO	0.0001	NO	0.0000	NO	0.0002	NO	-
2016	0.0010	NO	0.0001	NO	0.0000	NO	0.0000	NO	0.0001	NO	-
2017	0.0030	NO	0.0002	NO	0.0001	NO	0.0000	NO	0.0003	NO	-
2018	0.0022	NO	0.0002	NO	0.0001	NO	0.0000	NO	0.0002	NO	-

YEAR	PCDD/F [g I-TEQ]		PAHs [t]		HCB [kg]		CHANGE
	P	R	P	R	P	R	
1990	3.8954	2.1127	0.0002	0.0001	0.0223	0.0121	-46%
1991	3.7299	2.1095	0.0002	0.0001	0.0213	0.0121	-43%
1992	3.5693	2.1044	0.0002	0.0001	0.0204	0.0120	-41%
1993	3.4228	2.1171	0.0002	0.0001	0.0196	0.0121	-38%
1994	3.2591	2.1174	0.0002	0.0001	0.0186	0.0121	-35%
1995	3.0781	2.0909	0.0002	0.0001	0.0176	0.0119	-32%
1996	2.9294	2.1170	0.0002	0.0001	0.0167	0.0121	-28%
1997	2.7918	2.1550	0.0002	0.0001	0.0160	0.0123	-23%
1998	2.6322	2.0658	0.0002	0.0001	0.0150	0.0118	-22%
1999	2.4080	2.0744	0.0001	0.0001	0.0138	0.0119	-14%
2000	2.2768	2.2725	0.0001	0.0001	0.0130	0.0130	0%
2001	2.2097	2.3487	0.0001	0.0001	0.0126	0.0134	6%
2002	1.9782	3.1778	0.0001	0.0002	0.0113	0.0182	61%
2003	1.7323	1.3204	0.0001	0.0001	0.0099	0.0075	-24%
2004	1.5773	1.4177	0.0001	0.0001	0.0090	0.0081	-10%
2005	1.7214	0.3946	0.0001	0.0000	0.0098	0.0023	-77%
2006	1.3713	0.7098	0.0001	0.0000	0.0078	0.0041	-48%
2007	0.8102	NO	0.0000	NO	0.0046	NO	-
2008	1.0655	NO	0.0001	NO	0.0061	NO	-
2009	1.2005	NO	0.0001	NO	0.0069	NO	-
2010	1.0117	NO	0.0001	NO	0.0058	NO	-
2011	0.7461	NO	0.0000	NO	0.0043	NO	-
2012	0.6986	NO	0.0000	NO	0.0040	NO	-
2013	0.9127	NO	0.0001	NO	0.0052	NO	-
2014	0.8242	NO	0.0000	NO	0.0047	NO	-
2015	0.4179	NO	0.0000	NO	0.0024	NO	-
2016	0.2763	NO	0.0000	NO	0.0016	NO	-
2017	0.8210	NO	0.0000	NO	0.0047	NO	-

YEAR	PCDD/F [g I-TEQ]		PAHs [t]		HCB [kg]		CHANGE
	P	R	P	R	P	R	
2018	0.5994	NO	0.0000	NO	0.0034	NO	-

P-Previous
R-Refined

6.7.2.4 Hazardous Waste Incineration (NFR 5C1bii)

Emissions from hazardous waste incineration were excluded from the category **5C1bi** in this submission and allocated in this category. Emissions in this category have an increasing trend due to legislation which set the preference for the incineration of waste instead of disposal at the landfill sites.

***Table 6.16:** Overview of activity data and emissions in the category 5C1bii*

YEAR	HW INCINERATED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	388.32	0.0003	0.0029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1995	384.31	0.0003	0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2000	417.70	0.0004	0.0031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2005	1941.04	0.0017	0.0144	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
2010	1663.76	0.0014	0.0123	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
2011	1581.15	0.0014	0.0117	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
2012	2089.73	0.0018	0.0155	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
2013	2624.16	0.0023	0.0194	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2014	2476.55	0.0022	0.0183	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2015	2218.48	0.0019	0.0164	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2016	2448.45	0.0021	0.0181	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2017	3078.46	0.0027	0.0228	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2018	2774.91	0.0024	0.0205	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
2019	2674.48	0.0023	0.0198	0.0001	0.0000	0.0000	0.0000	0.0000	0.0002
1990/2019	**589%**	**589%**	**589%**	**589%**	**589%**	**589%**	**589%**	**589%**	**589%**
2018/2019	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Ni [t]	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]
1990	0.0005	0.0000	0.0000	0.0000	0.0001	0.1359	0.0000	0.0008
1995	0.0005	0.0000	0.0000	0.0000	0.0001	0.1345	0.0000	0.0008
2000	0.0005	0.0000	0.0000	0.0000	0.0001	0.1462	0.0000	0.0008
2005	0.0025	0.0002	0.0001	0.0000	0.0003	0.6794	0.0000	0.0039
2010	0.0022	0.0002	0.0001	0.0000	0.0002	0.5823	0.0000	0.0033
2011	0.0021	0.0002	0.0001	0.0000	0.0002	0.5534	0.0000	0.0032
2012	0.0027	0.0002	0.0001	0.0000	0.0003	0.7314	0.0000	0.0042
2013	0.0034	0.0003	0.0001	0.0000	0.0004	0.9185	0.0001	0.0052
2014	0.0032	0.0002	0.0001	0.0000	0.0003	0.8668	0.0000	0.0050
2015	0.0029	0.0002	0.0001	0.0000	0.0003	0.7765	0.0000	0.0044
2016	0.0032	0.0002	0.0001	0.0000	0.0003	0.8570	0.0000	0.0049
2017	0.0040	0.0003	0.0002	0.0000	0.0004	1.0775	0.0001	0.0062
2018	0.0036	0.0003	0.0002	0.0000	0.0004	0.9712	0.0001	0.0055
2019	0.0035	0.0003	0.0001	0.0000	0.0004	0.9361	0.0001	0.0053
1990/2019	**589%**	**589%**	**589%**	**589%**	**589%**	**589%**	**589%**	**589%**
2018/2019	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**	**-4%**

6.7.2.4.1 Methodological issues

For hazardous waste incineration sources without energy recovery, data from the NEIS database were used. Using statistical data was reconsidered after a detailed analysis and comparing the data with other sources. Statistical data were assumed as highly overestimated. Detailed description can be found in **ANNEX VIII**. In this submission, hazardous waste was excluded from the category **5C1bi** and allocated in this category. Abatement technology installed at the incineration plants is not included in the methodology.

Tier 1 methodology from the EMEP/EEA GB_{2019} was used to calculate emissions in this category. Emission factors are shown in ***Table 6.17***.

The **condensable component of PMs** is not included in EFs.

Table 6.17: *Emission factors in the category Industrial waste incineration without E recovery*

POLLUTANT	NOx	NMVOC	SOx	$PM_{2.5}$	PM_{10}	TSP	BC	CO
Unit	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	% of $PM_{2.5}$	[kg/t]
Value	0.87	7.4	0.047	0.004	0.007	0.01	0.035	0.07

POLLUTANT	Pb	Cd	Hg	As	Ni	Se	PCDD/F	PAHs	HCB
Unit	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	µg/t I-TEQ	mg/t	mg/t
Value	1.3	0.1	0.056	0.016	0.14	0.06	350	38.87	3

6.7.2.4.2 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 comply with EMEP/EEA GB_{2019}.

6.7.2.4.3 Source-specific recalculations

Hazardous waste incineration was excluded from the category **5C1bi** and included in this category for the first time in this submission.

6.7.2.5 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[15] and emission limits connected to the accession of the Slovak Republic to the European Union in the year 2005. Older plants without any (or minimal) abatement technology, non-compliant with emission limits stopped operation. From 2006 to 2010 only reconstructed plants or new plants with air pollution control technologies operated. In the year 2005, there were twenty-four plants incinerated clinical waste, mostly small ones within the hospital facility area, in 2018 it was only seven and only two of them as a part of the hospital areal. Over the past five years, mostly large plants focused on the incineration of different types of toxic and hazardous waste have been used to dispose of clinical waste.

The most significant pollutants from clinical waste incineration are heavy metals or dioxins and furans and polycyclic aromatic hydrocarbons, which can be present in hospital waste or can be formed during

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[15] Act 245/2003 Coll. on Integrated Prevention and Control of Environmental Pollution and on the amendment and amendment of certain Acts (only in Slovak)
Act 532/2005 Coll. amending Act no. 245/2003 Coll. on integrated pollution prevention and control, and on the amendment of certain laws as amended, and on amendments to certain laws (only in Slovak)
Act 571/2005 Coll. amending Act no. 478/2002 Coll. on the protection of the air and amending Act no. 401/1998 Coll. on Air Pollution Charges as amended (Air Act), as amended, and on amendments to certain laws (only in Slovak)
DECREE of the Ministry of the Environment of the Slovak Republic 575/2005 Z. amending Decree of the Ministry of the Environment of the Slovak Republic no. 706/2002 Coll. on air pollution sources, on emission limits, on technical requirements and general conditions of operation, on the list of pollutants, on the categorization of sources of air pollution and on the requirements for ensuring the dispersion of pollutant emissions as amended (only in Slovak)
https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2005/575/20051227

the combustion and post-combination processes. Organics in the flue gas can exist in the vapour phase or can be condensed or absorbed on fine particulates.

Other pollutants released are sulphur oxides, nitrogen oxides, volatile organic compounds, carbon monoxide, carbon dioxide and nitrous oxide. Carbon monoxide emissions result when carbon in the waste is not completely oxidised to carbon dioxide (CO_2). Nitrogen oxides are products of combustion processes. Nitrogen oxides are formed during combustion through oxidation of nitrogen in the waste, and oxidation of atmospheric nitrogen. ***Table 6.18*** shows emissions released to the air from this activity using the methodology described below.

Table 6.18: *Overview of the activity data, emissions and emission trends in the category Clinical waste incineration without E recovery*

YEAR	CW INCINERATED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	2183.19	0.0039	0.0015	0.0020	0.0041	0.0001	0.0033
1995	2160.61	0.0039	0.0015	0.0019	0.0041	0.0001	0.0032
2000	2348.34	0.0042	0.0016	0.0021	0.0044	0.0001	0.0035
2005	2281.76	0.0041	0.0016	0.0014	0.0030	0.0001	0.0034
2010	1132.52	0.0020	0.0008	0.0001	0.0003	0.0000	0.0017
2011	1579.63	0.0028	0.0011	0.0001	0.0004	0.0000	0.0024
2012	669.64	0.0012	0.0005	0.0001	0.0002	0.0000	0.0010
2013	658.54	0.0012	0.0005	0.0001	0.0002	0.0000	0.0010
2014	651.03	0.0012	0.0005	0.0001	0.0001	0.0000	0.0010
2015	526.57	0.0009	0.0004	0.0000	0.0001	0.0000	0.0008
2016	264.20	0.0005	0.0002	0.0000	0.0001	0.0000	0.0004
2017	112.97	0.0002	0.0001	0.0000	0.0000	0.0000	0.0002
2018	266.19	0.0005	0.0002	0.0000	0.0001	0.0000	0.0004
2019	159.81	0.0003	0.0001	0.0000	0.0000	0.0000	0.0002
1990/2019	**-93%**	**-93%**	**-93%**	**-99%**	**-99%**	**-99%**	**-93%**
2018/2019	**-40%**	**-40%**	**-40%**	**-40%**	**-40%**	**-40%**	**-40%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]	PCBs [kg]
1990	0.0629	0.0053	0.0950	0.0002	0.0007	0.0116	0.0007	71.1008	0.0000	0.2183	0.0437
1995	0.0622	0.0052	0.0941	0.0002	0.0007	0.0114	0.0006	70.3653	0.0000	0.2161	0.0432
2000	0.0676	0.0057	0.1022	0.0002	0.0008	0.0124	0.0007	76.4793	0.0000	0.2348	0.0470
2005	0.0430	0.0037	0.0662	0.0001	0.0005	0.0098	0.0007	50.7984	0.0000	0.2282	0.0456
2010	NO	0.0001	0.0018	0.0000	0.0000	0.0028	0.0003	3.1711	0.0000	0.1133	0.0227
2011	NO	0.0002	0.0026	0.0000	0.0000	0.0039	0.0005	4.4230	0.0000	0.1580	0.0316
2012	NO	0.0001	0.0011	0.0000	0.0000	0.0016	0.0002	1.8750	0.0000	0.0670	0.0134
2013	NO	0.0001	0.0011	0.0000	0.0000	0.0016	0.0002	1.8439	0.0000	0.0659	0.0132
2014	NO	0.0001	0.0011	0.0000	0.0000	0.0016	0.0002	1.8229	0.0000	0.0651	0.0130
2015	NO	0.0001	0.0009	0.0000	0.0000	0.0013	0.0002	1.4744	0.0000	0.0527	0.0105
2016	NO	0.0000	0.0004	0.0000	0.0000	0.0006	0.0001	0.7398	0.0000	0.0264	0.0053
2017	NO	0.0000	0.0002	0.0000	0.0000	0.0003	0.0000	0.3163	0.0000	0.0113	0.0023
2018	NO	0.0000	0.0004	0.0000	0.0000	0.0007	0.0001	0.7453	0.0000	0.0266	0.0053
2019	NO	0.0000	0.0003	0.0000	0.0000	0.0004	0.0000	0.4475	0.0000	0.0160	0.0032
1990/2019	**-**	**-100%**	**-100%**	**-100%**	**-100%**	**-97%**	**-93%**	**-99%**	**-93%**	**-93%**	**-93%**
2018/2019	**-**	**-40%**	**-40%**	**-40%**	**-40%**	**-40%**	**-40%**	**-40%**	**-40%**	**-40%**	**-40%**

Category clinical waste incineration is a key category for the emissions PCDD/PCDF and Hg. Increase in 2005 and subsequently a rapid decrease in 2006 for both pollutants were caused by the adoption of strict legislation and emission limits for this activity related to entering of the Slovak Republic to the European Union. From 2009 emissions are slightly increasing, but after the year 2011 emissions are decreasing due to strict emissions limits for the clinical waste incineration plants. Most of the hospitals closed theis plants, because the operation of such a plant is very expensive and its capacity is mostly not covered. Also, other treatments, such as sterilisation of waste became more available in the Slovak Republic.

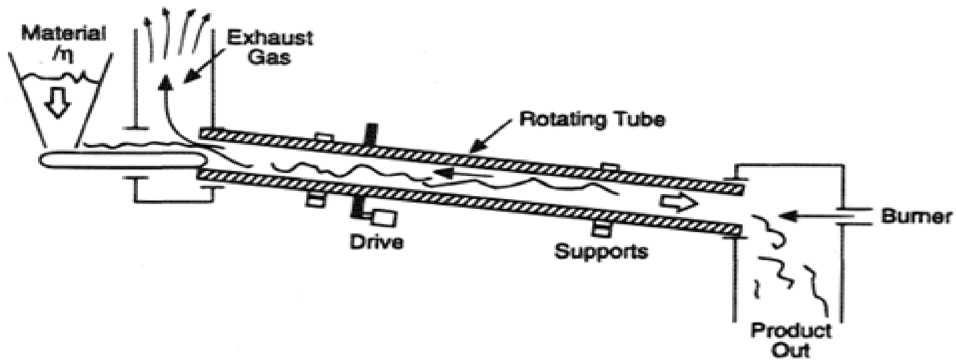
6.7.2.5.1 Methodological issues

Activity data for this source of pollution is the NEIS database, which contains detailed information about amounts and types of waste incinerated in each plant for the years 2005-2019. Historical data were extrapolated using the trend of the category hospital and veterinary wastes. Activity data from the NEIS database were used as in the national statistics, separation of clinical and veterinary waste is not possible. Data from national statistics were considered as overestimated for the incineration of waste with or without energy recovery. Detailed information can be found in **ANNEX VIII**.

Clinical waste incineration **with energy recovery** was considered in this submission as not occurring. After discussion with the operators, which burn also other hazardous waste and use the heat to produce energy, it was assumed all clinical waste is burned without energy recovery. Several incinerating plants were removed from this category as they burn mostly the hazardous waste and only partly the clinical waste. Emissions were therefore allocated in the category **5C1bii**.

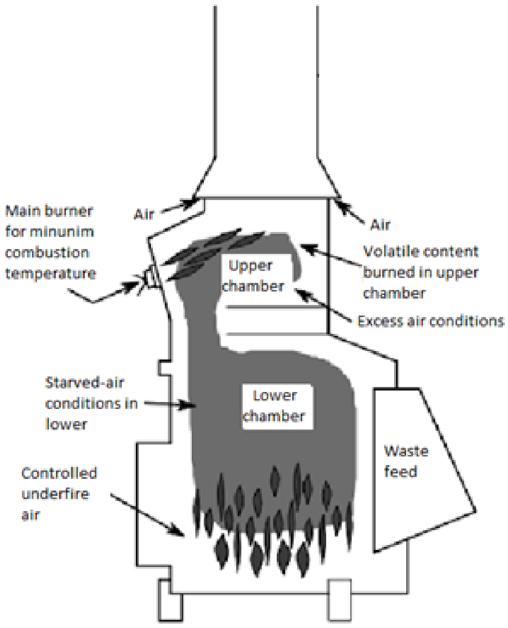
In the EMEP/EEA GB_{2019}, there are described two types of abatement technologies. **Rotary kiln (*Figure 6.4*)** is defined as technology where waste is fed into a slightly inclined, rotating, refractory-lined drum, which acts as a grate surface. The rotating action of the drum mixes it with air supplied through the walls.

Figure 6.4: *Scheme of rotary kiln*



Source: https://www.911metallurgist.com/blog/rotary-kiln-lining

Figure 6.5: Scheme of controlled air incinerator



Source: http://managemedmedicalwastedisposal.com/blog/date/2016/09

Controlled air incinerator (modular-starved air incinerators) consists of two stages. During the first stage (starved air section), the air-to-fuel ratio is kept low to promote drying and volatilisation at temperatures of ~800–900 °C. In the second stage (secondary combustion chamber), excess air is added and temperatures elevated to ~1000 °C by support burners to ensure complete gas (***Figure 6.5***).

Data about the technology used to incinerate clinical waste and abatement technologies are available from the year 2000 when were these data published as a part of the Waste Management Program for the period 2001-2005. This program is updated every 5 years.

Emission estimates were calculated using the Tier 2 approach. Emission factors were taken from the EMEP/EEA GB2019. Technology specific information was collected from operators and Waste management Programs, and plants using controlled rotary kiln and controlled air incineration were identified. ***Table 6.19*** shows the analysis of the distribution of clinical waste burned by combustion technologies in the period 1990-2019.

Table 6.19: *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		% OF WASTE BURNED IN WI WITH AIR POLLUTION CONTROL (APC)
		CONTROLLED AIR WI	ROTARY KILN WI	
1990-1999	80%	20%	-	20%
2000	77%	23%	-	23%
2001	63%	37%	-	37%
2002	66%	34%	-	34%
2003	62%	38%	-	38%
2004	52%	48%	-	48%
2005	-	100%	-	100%
2006	-	100%	-	100%
2007	-	100%	-	100%
2008	-	100%	-	100%
2009	-	100%	-	100%
2010	-	100%	-	100%
2011	-	100%	-	100%
2012	-	100%	-	100%
2013	-	100%	-	100%
2014	-	100%	-	100%
2015	-	100%	-	100%
2016	-	100%	-	100%
2017	-	100%	-	100%
2018	-	100%	-	100%
2019	-	100%	-	100%
	No abatement			
	The default value of abatement efficiency (GB2019)			

Operators of clinical waste were assigned to combustion technology on the base of data from Waste Management Programs and the NEIS database. Information about the type of air pollution control technology is available in Waste Management Programs (historical years) and the NEIS database (after 2005).

Emission factors and efficiencies of abatement technologies, which were used in calculations for incineration with/without energy recovery, are shown in ***Table 6.20***.

Table 6.20: *Emission factors and abatement technology efficiencies in the category Clinical waste incineration*

POLLUTANT	NOx	CO	NMVOC	SOx	TSP	BC*	Pb	Cd	Hg	As	Cr	Cu	Ni
Unit	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[kg/t]	[% of TSP]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]	[g/t]
Value	1.8	1.5	0.7	1.1	2.3	2.3	36	3	54	0.1	0.4	6	0.3
% Efficiency rotary kiln	-	88	-	59	99	-	100	100	73	-	98	100	99
% Efficiency controlled air	-	-	-	92	90	-	100	96	97	99	96	59	-

* Tier 1

POLLUTANT	PCDD/F	Total 4 PAHs	HCB	PCB
Unit	[mg I-TEQ/t]	[mg/t]	[g/t]	[g/t]
Value	40	0.04	0.1	0.02
% Efficiency	93	-	-	-

6.7.2.5.2 Completeness

All rising pollutants are recorded and reported.

6.7.2.5.3 Source-specific recalculations

This category was recalculated to increase accuracy and completeness. Activity data were recalculated because of reallocation of several sources to the category **5C1bii** as they mainly incinerate hazardous waste (***Table 6.21***). Also, several sources were reallocated to the category **5C1bii** as they burned mainly hazardous waste.

Table 6.21*: Previous and refined activity data and emissions in the category Clinical waste incineration*

YEAR	CWI [kt]			NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	Change	P	R	Change	P	R	Change	P	R	Change
1990	7.17	2.18	-70%	0.0129	0.0039	-70%	0.0050	0.0015	-70%	0.0079	0.0020	-75%
1991	6.84	2.18	-68%	0.0123	0.0039	-68%	0.0048	0.0015	-68%	0.0075	0.0020	-74%
1992	6.50	2.17	-67%	0.0117	0.0039	-67%	0.0046	0.0015	-67%	0.0072	0.0020	-73%
1993	6.15	2.19	-64%	0.0111	0.0039	-64%	0.0043	0.0015	-64%	0.0068	0.0020	-71%
1994	5.81	2.19	-62%	0.0105	0.0039	-62%	0.0041	0.0015	-62%	0.0064	0.0020	-69%
1995	5.52	2.16	-61%	0.0099	0.0039	-61%	0.0039	0.0015	-61%	0.0061	0.0019	-68%
1996	5.12	2.19	-57%	0.0092	0.0039	-57%	0.0036	0.0015	-57%	0.0056	0.0020	-65%
1997	4.80	2.23	-54%	0.0086	0.0040	-54%	0.0034	0.0016	-54%	0.0049	0.0020	-59%
1998	4.50	2.13	-53%	0.0081	0.0038	-53%	0.0031	0.0015	-53%	0.0045	0.0019	-57%
1999	4.17	2.14	-49%	0.0075	0.0039	-49%	0.0029	0.0015	-49%	0.0041	0.0019	-53%
2000	3.66	2.35	-36%	0.0066	0.0042	-36%	0.0026	0.0016	-36%	0.0034	0.0021	-39%
2001	3.59	2.16	-40%	0.0065	0.0039	-40%	0.0025	0.0015	-40%	0.0034	0.0019	-44%
2002	3.15	2.12	-33%	0.0057	0.0038	-33%	0.0022	0.0015	-33%	0.0026	0.0015	-42%
2003	2.68	2.00	-25%	0.0048	0.0036	-25%	0.0019	0.0014	-25%	0.0019	0.0015	-22%
2004	2.27	2.28	0%	0.0041	0.0041	0%	0.0016	0.0016	0%	0.0015	0.0016	11%
2005	2.74	2.28	-17%	0.0049	0.0041	-17%	0.0019	0.0016	-17%	0.0021	0.0014	-31%
2006	1.14	0.96	-16%	0.0020	0.0017	-16%	0.0008	0.0007	-16%	0.0002	0.0001	-62%

YEAR	CWI [kt]			NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	Change	P	R	Change	P	R	Change	P	R	Change
2007	1.42	1.18	-17%	0.0026	0.0021	-17%	0.0010	0.0008	-17%	0.0002	0.0001	-35%
2008	1.47	1.01	-31%	0.0026	0.0018	-31%	0.0010	0.0007	-31%	0.0002	0.0001	-47%
2009	1.55	0.89	-42%	0.0028	0.0016	-42%	0.0011	0.0006	-42%	0.0002	0.0001	-62%
2010	2.00	1.13	-43%	0.0036	0.0020	-43%	0.0014	0.0008	-43%	0.0004	0.0001	-76%
2011	2.56	1.58	-38%	0.0046	0.0028	-38%	0.0018	0.0011	-38%	0.0005	0.0001	-70%
2012	1.73	0.67	-61%	0.0031	0.0012	-61%	0.0012	0.0005	-61%	0.0003	0.0001	-82%
2013	1.78	0.66	-63%	0.0032	0.0012	-63%	0.0012	0.0005	-63%	0.0004	0.0001	-85%
2014	1.79	0.65	-64%	0.0032	0.0012	-64%	0.0013	0.0005	-64%	0.0004	0.0001	-85%
2015	2.67	0.53	-80%	0.0048	0.0009	-80%	0.0019	0.0004	-80%	0.0004	0.0000	-90%
2016	2.62	0.26	-90%	0.0047	0.0005	-90%	0.0018	0.0002	-90%	0.0005	0.0000	-95%
2017	2.99	0.11	-96%	0.0054	0.0002	-96%	0.0021	0.0001	-96%	0.0007	0.0000	-99%
2018	2.75	0.27	-90%	0.0049	0.0005	-90%	0.0019	0.0002	-90%	0.0005	0.0000	-96%

YEAR	TSP [kt]			BC [kt]			CO [kt]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.1648	0.0041	-98%	0.0038	0.0001	-98%	0.0108	0.0033	-70%
1991	0.1573	0.0041	-97%	0.0036	0.0001	-97%	0.0103	0.0033	-68%
1992	0.1495	0.0041	-97%	0.0034	0.0001	-97%	0.0098	0.0033	-67%
1993	0.1416	0.0041	-97%	0.0033	0.0001	-97%	0.0092	0.0033	-64%
1994	0.1337	0.0041	-97%	0.0031	0.0001	-97%	0.0087	0.0033	-62%
1995	0.1269	0.0041	-97%	0.0029	0.0001	-97%	0.0083	0.0032	-61%
1996	0.1178	0.0041	-96%	0.0027	0.0001	-96%	0.0077	0.0033	-57%
1997	0.1019	0.0042	-96%	0.0023	0.0001	-96%	0.0072	0.0033	-54%
1998	0.0937	0.0040	-96%	0.0022	0.0001	-96%	0.0067	0.0032	-53%
1999	0.0854	0.0040	-95%	0.0020	0.0001	-95%	0.0063	0.0032	-49%
2000	0.0714	0.0044	-94%	0.0016	0.0001	-94%	0.0054	0.0035	-34%
2001	0.0697	0.0039	-94%	0.0016	0.0001	-94%	0.0053	0.0032	-38%
2002	0.0548	0.0033	-94%	0.0013	0.0001	-94%	0.0046	0.0032	-31%
2003	0.0401	0.0032	-92%	0.0009	0.0001	-92%	0.0039	0.0030	-23%
2004	0.0304	0.0035	-89%	0.0007	0.0001	-89%	0.0033	0.0034	4%
2005	0.0425	0.0030	-93%	0.0010	0.0001	-93%	0.0040	0.0034	-14%
2006	0.0043	0.0002	-95%	0.0001	0.0000	-95%	0.0016	0.0014	-10%
2007	0.0031	0.0003	-91%	0.0001	0.0000	-91%	0.0020	0.0018	-12%
2008	0.0032	0.0002	-93%	0.0001	0.0000	-93%	0.0021	0.0015	-26%
2009	0.0050	0.0002	-96%	0.0001	0.0000	-96%	0.0023	0.0013	-42%
2010	0.0086	0.0003	-97%	0.0002	0.0000	-97%	0.0029	0.0017	-41%
2011	0.0097	0.0004	-96%	0.0002	0.0000	-96%	0.0037	0.0024	-36%
2012	0.0063	0.0002	-98%	0.0001	0.0000	-98%	0.0024	0.0010	-59%
2013	0.0068	0.0002	-98%	0.0002	0.0000	-98%	0.0024	0.0010	-59%
2014	0.0071	0.0001	-98%	0.0002	0.0000	-98%	0.0025	0.0010	-60%
2015	0.0097	0.0001	-99%	0.0002	0.0000	-99%	0.0039	0.0008	-80%
2016	0.0091	0.0001	-99%	0.0002	0.0000	-99%	0.0036	0.0004	-89%
2017	0.0091	0.0000	-100%	0.0002	0.0000	-100%	0.0036	0.0002	-95%
2018	0.0094	0.0001	-99%	0.0002	0.0000	-99%	0.0037	0.0004	-89%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.2580	0.0629	-76%	0.0215	0.0053	-75%	0.3870	0.0950	-75%
1991	0.2463	0.0628	-75%	0.0205	0.0053	-74%	0.3694	0.0949	-74%
1992	0.2341	0.0626	-73%	0.0195	0.0053	-73%	0.3511	0.0947	-73%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	P	R	Change	P	R	Change	P	R	Change
1993	0.2216	0.0630	-72%	0.0185	0.0053	-71%	0.3323	0.0952	-71%
1994	0.2093	0.0630	-70%	0.0174	0.0053	-70%	0.3140	0.0953	-70%
1995	0.1986	0.0622	-69%	0.0165	0.0052	-68%	0.2979	0.0941	-68%
1996	0.1844	0.0630	-66%	0.0154	0.0053	-65%	0.2766	0.0952	-66%
1997	0.1579	0.0642	-59%	0.0132	0.0054	-59%	0.2376	0.0969	-59%
1998	0.1449	0.0615	-58%	0.0121	0.0052	-57%	0.2182	0.0929	-57%
1999	0.1319	0.0618	-53%	0.0111	0.0052	-53%	0.1987	0.0933	-53%
2000	0.1099	0.0676	-38%	0.0092	0.0057	-38%	0.1670	0.1022	-39%
2001	0.1072	0.0599	-44%	0.0090	0.0050	-44%	0.1630	0.0906	-44%
2002	0.0831	0.0482	-42%	0.0070	0.0041	-41%	0.1272	0.0735	-42%
2003	0.0594	0.0473	-20%	0.0051	0.0040	-20%	0.0919	0.0721	-22%
2004	0.0442	0.0512	16%	0.0038	0.0044	15%	0.0691	0.0783	13%
2005	0.0633	0.0430	-32%	0.0054	0.0037	-31%	0.0978	0.0662	-32%
2006	0.0032	NO	-	0.0004	0.0001	-70%	0.0077	0.0015	-80%
2007	NO	NO	-	0.0002	0.0001	-11%	0.0036	0.0019	-46%
2008	NO	NO	-	0.0002	0.0001	-25%	0.0038	0.0016	-57%
2009	0.0025	NO	-	0.0004	0.0001	-72%	0.0062	0.0014	-76%
2010	0.0074	NO	-	0.0008	0.0001	-83%	0.0152	0.0018	-88%
2011	0.0070	NO	-	0.0009	0.0002	-78%	0.0155	0.0026	-84%
2012	0.0045	NO	-	0.0006	0.0001	-86%	0.0110	0.0011	-90%
2013	0.0055	NO	-	0.0006	0.0001	-87%	0.0136	0.0011	-92%
2014	0.0058	NO	-	0.0007	0.0001	-88%	0.0136	0.0011	-92%
2015	0.0065	NO	-	0.0008	0.0001	-92%	0.0147	0.0009	-94%
2016	0.0062	NO	-	0.0008	0.0000	-96%	0.0166	0.0004	-97%
2017	0.0063	NO	-	0.0008	0.0000	-98%	0.0228	0.0002	-99%
2018	0.0064	NO	-	0.0008	0.0000	-96%	0.0174	0.0004	-98%

YEAR	As [t]			Cr [t]			Cu [t]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.0007	0.0002	-76%	0.0029	0.0007	-75%	0.0430	0.0116	-73%
1991	0.0007	0.0002	-74%	0.0027	0.0007	-74%	0.0410	0.0115	-72%
1992	0.0007	0.0002	-73%	0.0026	0.0007	-73%	0.0390	0.0115	-70%
1993	0.0006	0.0002	-71%	0.0025	0.0007	-71%	0.0369	0.0116	-69%
1994	0.0006	0.0002	-70%	0.0023	0.0007	-70%	0.0349	0.0116	-67%
1995	0.0006	0.0002	-69%	0.0022	0.0007	-68%	0.0331	0.0114	-65%
1996	0.0005	0.0002	-66%	0.0020	0.0007	-65%	0.0307	0.0116	-62%
1997	0.0004	0.0002	-59%	0.0018	0.0007	-59%	0.0273	0.0118	-57%
1998	0.0004	0.0002	-58%	0.0016	0.0007	-57%	0.0253	0.0113	-55%
1999	0.0004	0.0002	-53%	0.0015	0.0007	-53%	0.0232	0.0113	-51%
2000	0.0003	0.0002	-40%	0.0012	0.0008	-38%	0.0196	0.0124	-37%
2001	0.0003	0.0002	-46%	0.0012	0.0007	-44%	0.0191	0.0112	-41%
2002	0.0002	0.0001	-44%	0.0009	0.0005	-41%	0.0157	0.0099	-37%
2003	0.0002	0.0001	-25%	0.0007	0.0005	-21%	0.0122	0.0096	-22%
2004	0.0001	0.0001	8%	0.0005	0.0006	15%	0.0097	0.0107	10%
2005	0.0002	0.0001	-35%	0.0007	0.0005	-31%	0.0127	0.0098	-23%
2006	0.0000	0.0000	-95%	0.0001	0.0000	-71%	0.0029	0.0024	-19%
2007	0.0000	0.0000	-89%	0.0000	0.0000	-14%	0.0033	0.0029	-11%
2008	0.0000	0.0000	-92%	0.0000	0.0000	-28%	0.0033	0.0025	-25%
2009	0.0000	0.0000	-89%	0.0001	0.0000	-72%	0.0041	0.0022	-46%

YEAR	As [t]			Cr [t]			Cu [t]		
	P	R	Change	P	R	Change	P	R	Change
2010	0.0000	0.0000	-96%	0.0001	0.0000	-84%	0.0054	0.0028	-48%
2011	0.0000	0.0000	-95%	0.0001	0.0000	-78%	0.0068	0.0039	-42%
2012	0.0000	0.0000	-97%	0.0001	0.0000	-86%	0.0044	0.0016	-63%
2013	0.0000	0.0000	-98%	0.0001	0.0000	-88%	0.0044	0.0016	-63%
2014	0.0000	0.0000	-98%	0.0001	0.0000	-88%	0.0045	0.0016	-65%
2015	0.0000	0.0000	-98%	0.0001	0.0000	-92%	0.0070	0.0013	-82%
2016	0.0000	0.0000	-99%	0.0001	0.0000	-96%	0.0064	0.0006	-90%
2017	0.0001	0.0000	-100%	0.0001	0.0000	-98%	0.0063	0.0003	-96%
2018	0.0000	0.0000	-99%	0.0001	0.0000	-96%	0.0067	0.0007	-90%

YEAR	Ni [t]			PCDD/F [g I-TEQ]			PAHs [t]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.0022	0.0007	-70%	286.6787	71.1008	-75%	0.0000	0.0000	-70%
1991	0.0021	0.0007	-68%	273.6436	70.9939	-74%	0.0000	0.0000	-68%
1992	0.0020	0.0007	-67%	260.0757	70.8204	-73%	0.0000	0.0000	-67%
1993	0.0018	0.0007	-64%	246.1786	71.2469	-71%	0.0000	0.0000	-64%
1994	0.0017	0.0007	-62%	232.5693	71.2599	-69%	0.0000	0.0000	-62%
1995	0.0017	0.0006	-61%	220.6320	70.3653	-68%	0.0000	0.0000	-61%
1996	0.0015	0.0007	-57%	204.8924	71.2456	-65%	0.0000	0.0000	-57%
1997	0.0014	0.0007	-54%	176.6528	72.5238	-59%	0.0000	0.0000	-54%
1998	0.0013	0.0006	-53%	162.3733	69.5215	-57%	0.0000	0.0000	-53%
1999	0.0013	0.0006	-49%	147.9875	69.8113	-53%	0.0000	0.0000	-49%
2000	0.0011	0.0007	-34%	123.7859	76.4793	-38%	0.0000	0.0000	-36%
2001	0.0010	0.0006	-38%	120.8061	67.9133	-44%	0.0000	0.0000	-40%
2002	0.0009	0.0006	-31%	94.6544	55.6879	-41%	0.0000	0.0000	-33%
2003	0.0008	0.0006	-23%	68.8565	54.4788	-21%	0.0000	0.0000	-25%
2004	0.0007	0.0007	5%	51.9984	59.3449	14%	0.0000	0.0000	0%
2005	0.0008	0.0007	-14%	70.6984	50.7984	-28%	0.0000	0.0000	-17%
2006	0.0003	0.0003	-9%	4.0173	2.6749	-33%	0.0000	0.0000	-16%
2007	0.0004	0.0004	-11%	0.5681	3.2958	480%	0.0000	0.0000	-17%
2008	0.0004	0.0003	-26%	0.5879	2.8375	383%	0.0000	0.0000	-31%
2009	0.0005	0.0003	-42%	3.3717	2.4982	-26%	0.0000	0.0000	-42%
2010	0.0006	0.0003	-40%	8.9278	3.1711	-64%	0.0000	0.0000	-43%
2011	0.0007	0.0005	-36%	8.7143	4.4230	-49%	0.0000	0.0000	-38%
2012	0.0005	0.0002	-58%	5.6776	1.8750	-67%	0.0000	0.0000	-61%
2013	0.0005	0.0002	-58%	6.7313	1.8439	-73%	0.0000	0.0000	-63%
2014	0.0005	0.0002	-60%	7.0529	1.8229	-74%	0.0000	0.0000	-64%
2015	0.0008	0.0002	-80%	8.1970	1.4744	-82%	0.0000	0.0000	-80%
2016	0.0007	0.0001	-89%	7.8767	0.7398	-91%	0.0000	0.0000	-90%
2017	0.0007	0.0000	-95%	8.0830	0.3163	-96%	0.0000	0.0000	-96%
2018	0.0007	0.0001	-89%	8.1001	0.7453	-91%	0.0000	0.0000	-90%

YEAR	HCB [kg]			PCBs [kg]		
	P	R	Change	P	R	Change
1990	0.7167	0.2183	-70%	0.1433	0.0437	-70%
1991	0.6841	0.2180	-68%	0.1368	0.0436	-68%
1992	0.6502	0.2175	-67%	0.1300	0.0435	-67%
1993	0.6154	0.2188	-64%	0.1231	0.0438	-64%
1994	0.5814	0.2188	-62%	0.1163	0.0438	-62%

YEAR	HCB [kg]			PCBs [kg]		
	P	R	Change	P	R	Change
1995	0.5516	0.2161	-61%	0.1103	0.0432	-61%
1996	0.5122	0.2188	-57%	0.1024	0.0438	-57%
1997	0.4799	0.2227	-54%	0.0960	0.0445	-54%
1998	0.4498	0.2135	-53%	0.0900	0.0427	-53%
1999	0.4174	0.2144	-49%	0.0835	0.0429	-49%
2000	0.3660	0.2348	-36%	0.0732	0.0470	-36%
2001	0.3588	0.2160	-40%	0.0718	0.0432	-40%
2002	0.3149	0.2118	-33%	0.0630	0.0424	-33%
2003	0.2684	0.2004	-25%	0.0537	0.0401	-25%
2004	0.2273	0.2283	0%	0.0455	0.0457	0%
2005	0.2735	0.2282	-17%	0.0547	0.0456	-17%
2006	0.1136	0.0955	-16%	0.0227	0.0191	-16%
2007	0.1420	0.1177	-17%	0.0284	0.0235	-17%
2008	0.1470	0.1013	-31%	0.0294	0.0203	-31%
2009	0.1550	0.0892	-42%	0.0310	0.0178	-42%
2010	0.1995	0.1133	-43%	0.0399	0.0227	-43%
2011	0.2561	0.1580	-38%	0.0512	0.0316	-38%
2012	0.1728	0.0670	-61%	0.0346	0.0134	-61%
2013	0.1780	0.0659	-63%	0.0356	0.0132	-63%
2014	0.1792	0.0651	-64%	0.0358	0.0130	-64%
2015	0.2673	0.0527	-80%	0.0535	0.0105	-80%
2016	0.2624	0.0264	-90%	0.0525	0.0053	-90%
2017	0.2989	0.0113	-96%	0.0598	0.0023	-96%
2018	0.2747	0.0266	-90%	0.0549	0.0053	-90%

P–Previous
R–Refined

6.7.2.6 Sewage Sludge Incineration (NFR 5C1BIV)

Sewage sludge incineration without energy recovery is not occurring in the Slovak Republic, therefore notation key NO was used.

6.7.3 CREMATION (NFR 5C1BV)

An annual increase of 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, $PM_{2.5}$, PM_{10} emissions driven by the activity data. As shown in ***Table 6.22***, cremation shows an increasing trend in Slovakia, though in 2017 a slight decrease and subsequently increase in 2018 was recorded.

Table 6.22: *Overview of activity data, emissions and emission trends in the category Cremation*

YEAR	HUMAN BODIES CREMATED [BODY]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	6 010	0.0050	0.0001	0.0007	0.0002	0.0002	0.0002	0.0008
1995	6 744	0.0056	0.0001	0.0008	0.0002	0.0002	0.0003	0.0009
2000	7 528	0.0062	0.0001	0.0009	0.0003	0.0003	0.0003	0.0011
2005	10 418	0.0086	0.0001	0.0012	0.0004	0.0004	0.0004	0.0015
2010	13 167	0.0109	0.0002	0.0015	0.0005	0.0005	0.0005	0.0018
2011	12 583	0.0104	0.0002	0.0014	0.0004	0.0004	0.0005	0.0018
2012	12 701	0.0105	0.0002	0.0014	0.0004	0.0004	0.0005	0.0018
2013	15 561	0.0128	0.0002	0.0018	0.0005	0.0005	0.0006	0.0022
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	16 824	0.0139	0.0002	0.0019	0.0006	0.0006	0.0006	0.0024
2016	16 907	0.0139	0.0002	0.0019	0.0006	0.0006	0.0007	0.0024
2017	14 582	0.0120	0.0002	0.0016	0.0005	0.0005	0.0006	0.0020
2018	18 264	0.0151	0.0002	0.0021	0.0006	0.0006	0.0007	0.0026
2019	20 800	0.0172	0.0003	0.0024	0.0007	0.0007	0.0008	0.0029
1990/2019	**246%**	**246%**	**246%**	**246%**	**246%**	**246%**	**246%**	**246%**
2018/2019	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0002	0.0000	0.0090	0.0001	0.0001	0.0001	0.0001	0.0001	0.0010
1995	0.0002	0.0000	0.0100	0.0001	0.0001	0.0001	0.0001	0.0001	0.0011
2000	0.0002	0.0000	0.0112	0.0001	0.0001	0.0001	0.0001	0.0001	0.0012
2005	0.0003	0.0001	0.0155	0.0001	0.0001	0.0001	0.0002	0.0002	0.0017
2010	0.0004	0.0001	0.0196	0.0002	0.0002	0.0002	0.0002	0.0003	0.0021
2011	0.0004	0.0001	0.0187	0.0002	0.0002	0.0002	0.0002	0.0002	0.0020
2012	0.0004	0.0001	0.0189	0.0002	0.0002	0.0002	0.0002	0.0003	0.0020
2013	0.0005	0.0001	0.0232	0.0002	0.0002	0.0002	0.0003	0.0003	0.0025
2014	0.0005	0.0001	0.0227	0.0002	0.0002	0.0002	0.0003	0.0003	0.0024
2015	0.0005	0.0001	0.0251	0.0002	0.0002	0.0002	0.0003	0.0003	0.0027
2016	0.0005	0.0001	0.0252	0.0002	0.0002	0.0002	0.0003	0.0003	0.0027
2017	0.0004	0.0001	0.0217	0.0002	0.0002	0.0002	0.0003	0.0003	0.0023
2018	0.0005	0.0001	0.0272	0.0002	0.0002	0.0002	0.0003	0.0004	0.0029
2019	0.0006	0.0001	0.0310	0.0003	0.0003	0.0003	0.0004	0.0004	0.0033
1990/2019	**246%**	**246%**	**246%**	**246%**	**246%**	**246%**	**246%**	**246%**	**246%**
2018/2019	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	0.0025
1995	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0028
2000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0011	0.0031
2005	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0016	0.0043
2010	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0020	0.0054
2011	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0019	0.0052
2012	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0019	0.0052
2013	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0023	0.0064
2014	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0023	0.0062
2015	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0025	0.0069
2016	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0025	0.0069
2017	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0022	0.0060
2018	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0027	0.0075
2019	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0031	0.0085
1990/2019	**246%**	**246%**	**246%**	**246%**	**246%**	**246%**	**246%**	**246%**
2018/2019	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**	**14%**

As shown in ***Table 6.22***, cremation shows an increasing trend in Slovakia, though in 2016 a slight decrease and subsequently increase in 2018 was recorded.

6.7.3.1 Methodological Issue

The source of activity data for air pollutants came from operators of Cremation facilities, which report numbers 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_{2019} emission factors. The values are given in the tables below (***Table 6.23***).

Inclusion/exclusion of the **condensable component of PMs** is unknown.

Table 6.23: *Emission factors in the category Cremation*

POLLUTANT	NOx	NMVOC	SOx	$PM_{2.5}$	PM_{10}	TSP	CO	Pb
Unit	[kg/body]	[kg/body]	[kg/body]	[g/body]	[g/body]	[g/body]	[kg/body]	[mg/body]
Value	0.825	0.013	0.11	34.7	34.7	38.56	0.14	30.03

POLLUTANT	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
Unit	[mg/body]	[g/body]	[mg/body]	[mg/body]	[mg/body]	[mg/body]	[mg/body]	[mg/body]
Value	5.03	1.49	13.61	13.56	12.43	17.33	19.78	160.12

POLLUTANT	PCDD/F	B(a)P	B(b)F	B(k)F	I()P	PAHs	HCB	PCB
Unit	[μg/body]	[μg/body]	[μg/body]	[μg/body]	[μg/body]	[μg/body]	[mg/body]	[mg/body]
Value	0.027	13.2	7.21	6.44	6.99	33.84	0.15	0.41

6.7.3.2 Completeness

All rising pollutants are recorded and reported.

6.7.3.3 Source-specific recalculations

Recalculations of emissions were made in this submission due to error correction of the activity data and correction of the conversion factor for the emissions of PCDD/F (***Table 6.24***).

Table 6.24*: Previous and refined activity data and emissions in the category Clinical waste incineration*

YEAR	AMOUNT OF BODIES CREMATED			NOx [kt]			NMVOC [kt]		
	P	R	Change	P	R	Change	P	R	Change
1990	6010	6010	0%	0.0050	0.0050	0%	0.0001	0.0001	0%
1991	6138	6138	0%	0.0051	0.0051	0%	0.0001	0.0001	0%
1992	6267	6267	0%	0.0052	0.0052	0%	0.0001	0.0001	0%
1993	6395	6395	0%	0.0053	0.0053	0%	0.0001	0.0001	0%
1994	6524	6524	0%	0.0054	0.0054	0%	0.0001	0.0001	0%
1995	6744	6744	0%	0.0056	0.0056	0%	0.0001	0.0001	0%
1996	6965	6965	0%	0.0057	0.0057	0%	0.0001	0.0001	0%
1997	7185	7185	0%	0.0059	0.0059	0%	0.0001	0.0001	0%
1998	7406	7406	0%	0.0061	0.0061	0%	0.0001	0.0001	0%
1999	7626	7626	0%	0.0063	0.0063	0%	0.0001	0.0001	0%
2000	7528	7528	0%	0.0062	0.0062	0%	0.0001	0.0001	0%
2001	7856	7856	0%	0.0065	0.0065	0%	0.0001	0.0001	0%
2002	8253	7627	-8%	0.0068	0.0063	-8%	0.0001	0.0001	-8%
2003	8627	7824	-9%	0.0071	0.0065	-9%	0.0001	0.0001	-9%
2004	9453	9359	-1%	0.0078	0.0077	-1%	0.0001	0.0001	-1%
2005	9542	10418	9%	0.0079	0.0086	9%	0.0001	0.0001	9%
2006	9842	10599	8%	0.0081	0.0087	8%	0.0001	0.0001	8%
2007	11001	11636	6%	0.0091	0.0096	6%	0.0001	0.0002	6%
2008	11203	13187	18%	0.0092	0.0109	18%	0.0001	0.0002	18%
2009	11976	8034	-33%	0.0099	0.0066	-33%	0.0002	0.0001	-33%

YEAR	AMOUNT OF BODIES CREMATED			NOx [kt]			NMVOC [kt]		
	P	R	Change	P	R	Change	P	R	Change
2010	12332	13167	7%	0.0102	0.0109	7%	0.0002	0.0002	7%
2011	12332	12583	2%	0.0102	0.0104	2%	0.0002	0.0002	2%
2012	12686	12701	0%	0.0105	0.0105	0%	0.0002	0.0002	0%
2013	13102	15561	19%	0.0108	0.0128	19%	0.0002	0.0002	19%
2014	13233	15243	15%	0.0109	0.0126	15%	0.0002	0.0002	15%
2015	14398	16824	17%	0.0119	0.0139	17%	0.0002	0.0002	17%
2016	12991	16907	30%	0.0107	0.0139	30%	0.0002	0.0002	30%
2017	12072	14582	21%	0.0100	0.0120	21%	0.0002	0.0002	21%
2018	14494	18264	26%	0.0120	0.0151	26%	0.0002	0.0002	26%

YEAR	SOx [kt]			TSP [kt]			CO [kt]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.0007	0.0007	0%	0.0002	0.0002	0%	0.0008	0.0008	0%
1991	0.0007	0.0007	0%	0.0002	0.0002	0%	0.0009	0.0009	0%
1992	0.0007	0.0007	0%	0.0002	0.0002	0%	0.0009	0.0009	0%
1993	0.0007	0.0007	0%	0.0002	0.0002	0%	0.0009	0.0009	0%
1994	0.0007	0.0007	0%	0.0003	0.0003	0%	0.0009	0.0009	0%
1995	0.0008	0.0008	0%	0.0003	0.0003	0%	0.0009	0.0009	0%
1996	0.0008	0.0008	0%	0.0003	0.0003	0%	0.0010	0.0010	0%
1997	0.0008	0.0008	0%	0.0003	0.0003	0%	0.0010	0.0010	0%
1998	0.0008	0.0008	0%	0.0003	0.0003	0%	0.0010	0.0010	0%
1999	0.0009	0.0009	0%	0.0003	0.0003	0%	0.0011	0.0011	0%
2000	0.0009	0.0009	0%	0.0003	0.0003	0%	0.0011	0.0011	0%
2001	0.0009	0.0009	0%	0.0003	0.0003	0%	0.0011	0.0011	0%
2002	0.0009	0.0009	-8%	0.0003	0.0003	-8%	0.0012	0.0011	-8%
2003	0.0010	0.0009	-9%	0.0003	0.0003	-9%	0.0012	0.0011	-9%
2004	0.0011	0.0011	-1%	0.0004	0.0004	-1%	0.0013	0.0013	-1%
2005	0.0011	0.0012	9%	0.0004	0.0004	9%	0.0013	0.0015	9%
2006	0.0011	0.0012	8%	0.0004	0.0004	8%	0.0014	0.0015	8%
2007	0.0012	0.0013	6%	0.0004	0.0004	6%	0.0015	0.0016	6%
2008	0.0013	0.0015	18%	0.0004	0.0005	18%	0.0016	0.0018	18%
2009	0.0014	0.0009	-33%	0.0005	0.0003	-33%	0.0017	0.0011	-33%
2010	0.0014	0.0015	7%	0.0005	0.0005	7%	0.0017	0.0018	7%
2011	0.0014	0.0014	2%	0.0005	0.0005	2%	0.0017	0.0018	2%
2012	0.0014	0.0014	0%	0.0005	0.0005	0%	0.0018	0.0018	0%
2013	0.0015	0.0018	19%	0.0005	0.0006	19%	0.0018	0.0022	19%
2014	0.0015	0.0017	15%	0.0005	0.0006	15%	0.0019	0.0021	15%
2015	0.0016	0.0019	17%	0.0006	0.0006	17%	0.0020	0.0024	17%
2016	0.0015	0.0019	30%	0.0005	0.0007	30%	0.0018	0.0024	30%
2017	0.0014	0.0016	21%	0.0005	0.0006	21%	0.0017	0.0020	21%
2018	0.0016	0.0021	26%	0.0006	0.0007	26%	0.0020	0.0026	26%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0090	0.0090	0%
1991	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0091	0.0091	0%
1992	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0093	0.0093	0%
1993	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0095	0.0095	0%
1994	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0097	0.0097	0%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	P	R	Change	P	R	Change	P	R	Change
1995	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0100	0.0100	0%
1996	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0104	0.0104	0%
1997	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0107	0.0107	0%
1998	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0110	0.0110	0%
1999	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0114	0.0114	0%
2000	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0112	0.0112	0%
2001	0.0002	0.0002	0%	0.0000	0.0000	0%	0.0117	0.0117	0%
2002	0.0002	0.0002	-8%	0.0000	0.0000	-8%	0.0123	0.0114	-8%
2003	0.0003	0.0002	-9%	0.0000	0.0000	-9%	0.0129	0.0117	-9%
2004	0.0003	0.0003	-1%	0.0000	0.0000	-1%	0.0141	0.0139	-1%
2005	0.0003	0.0003	9%	0.0000	0.0001	9%	0.0142	0.0155	9%
2006	0.0003	0.0003	8%	0.0000	0.0001	8%	0.0147	0.0158	8%
2007	0.0003	0.0003	6%	0.0001	0.0001	6%	0.0164	0.0173	6%
2008	0.0003	0.0004	18%	0.0001	0.0001	18%	0.0167	0.0196	18%
2009	0.0004	0.0002	-33%	0.0001	0.0000	-33%	0.0178	0.0120	-33%
2010	0.0004	0.0004	7%	0.0001	0.0001	7%	0.0184	0.0196	7%
2011	0.0004	0.0004	2%	0.0001	0.0001	2%	0.0184	0.0187	2%
2012	0.0004	0.0004	0%	0.0001	0.0001	0%	0.0189	0.0189	0%
2013	0.0004	0.0005	19%	0.0001	0.0001	19%	0.0195	0.0232	19%
2014	0.0004	0.0005	15%	0.0001	0.0001	15%	0.0197	0.0227	15%
2015	0.0004	0.0005	17%	0.0001	0.0001	17%	0.0215	0.0251	17%
2016	0.0004	0.0005	30%	0.0001	0.0001	30%	0.0194	0.0252	30%
2017	0.0004	0.0004	21%	0.0001	0.0001	21%	0.0180	0.0217	21%
2018	0.0004	0.0005	26%	0.0001	0.0001	26%	0.0216	0.0272	26%

YEAR	As [t]			Cr [t]			Cu [t]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
1991	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
1992	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
1993	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
1994	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
1995	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
1996	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
1997	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
1998	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
1999	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
2000	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
2001	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0001	0.0001	0%
2002	0.0001	0.0001	-8%	0.0001	0.0001	-8%	0.0001	0.0001	-8%
2003	0.0001	0.0001	-9%	0.0001	0.0001	-9%	0.0001	0.0001	-9%
2004	0.0001	0.0001	-1%	0.0001	0.0001	-1%	0.0001	0.0001	-1%
2005	0.0001	0.0001	9%	0.0001	0.0001	9%	0.0001	0.0001	9%
2006	0.0001	0.0001	8%	0.0001	0.0001	8%	0.0001	0.0001	8%
2007	0.0001	0.0002	6%	0.0001	0.0002	6%	0.0001	0.0001	6%
2008	0.0002	0.0002	18%	0.0002	0.0002	18%	0.0001	0.0002	18%
2009	0.0002	0.0001	-33%	0.0002	0.0001	-33%	0.0001	0.0001	-33%
2010	0.0002	0.0002	7%	0.0002	0.0002	7%	0.0002	0.0002	7%
2011	0.0002	0.0002	2%	0.0002	0.0002	2%	0.0002	0.0002	2%

YEAR	As [t]			Cr [t]			Cu [t]		
	P	R	Change	P	R	Change	P	R	Change
2012	0.0002	0.0002	0%	0.0002	0.0002	0%	0.0002	0.0002	0%
2013	0.0002	0.0002	19%	0.0002	0.0002	19%	0.0002	0.0002	19%
2014	0.0002	0.0002	15%	0.0002	0.0002	15%	0.0002	0.0002	15%
2015	0.0002	0.0002	17%	0.0002	0.0002	17%	0.0002	0.0002	17%
2016	0.0002	0.0002	30%	0.0002	0.0002	30%	0.0002	0.0002	30%
2017	0.0002	0.0002	21%	0.0002	0.0002	21%	0.0002	0.0002	21%
2018	0.0002	0.0002	26%	0.0002	0.0002	26%	0.0002	0.0002	26%

YEAR	Ni [t]			Se [t]			Zn [kt]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0010	0.0010	0%
1991	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0010	0.0010	0%
1992	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0010	0.0010	0%
1993	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0010	0.0010	0%
1994	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0010	0.0010	0%
1995	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0011	0.0011	0%
1996	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0011	0.0011	0%
1997	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0012	0.0012	0%
1998	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0012	0.0012	0%
1999	0.0001	0.0001	0%	0.0002	0.0002	0%	0.0012	0.0012	0%
2000	0.0001	0.0001	0%	0.0001	0.0001	0%	0.0012	0.0012	0%
2001	0.0001	0.0001	0%	0.0002	0.0002	0%	0.0013	0.0013	0%
2002	0.0001	0.0001	-8%	0.0002	0.0002	-8%	0.0013	0.0012	-8%
2003	0.0001	0.0001	-9%	0.0002	0.0002	-9%	0.0014	0.0013	-9%
2004	0.0002	0.0002	-1%	0.0002	0.0002	-1%	0.0015	0.0015	-1%
2005	0.0002	0.0002	9%	0.0002	0.0002	9%	0.0015	0.0017	9%
2006	0.0002	0.0002	8%	0.0002	0.0002	8%	0.0016	0.0017	8%
2007	0.0002	0.0002	6%	0.0002	0.0002	6%	0.0018	0.0019	6%
2008	0.0002	0.0002	18%	0.0002	0.0003	18%	0.0018	0.0021	18%
2009	0.0002	0.0001	-33%	0.0002	0.0002	-33%	0.0019	0.0013	-33%
2010	0.0002	0.0002	7%	0.0002	0.0003	7%	0.0020	0.0021	7%
2011	0.0002	0.0002	2%	0.0002	0.0002	2%	0.0020	0.0020	2%
2012	0.0002	0.0002	0%	0.0003	0.0003	0%	0.0020	0.0020	0%
2013	0.0002	0.0003	19%	0.0003	0.0003	19%	0.0021	0.0025	19%
2014	0.0002	0.0003	15%	0.0003	0.0003	15%	0.0021	0.0024	15%
2015	0.0002	0.0003	17%	0.0003	0.0003	17%	0.0023	0.0027	17%
2016	0.0002	0.0003	30%	0.0003	0.0003	30%	0.0021	0.0027	30%
2017	0.0002	0.0003	21%	0.0002	0.0003	21%	0.0019	0.0023	21%
2018	0.0003	0.0003	26%	0.0003	0.0004	26%	0.0023	0.0029	26%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCB [kg]		
	P	R	Chan.	P	R	Chan.	P	R	Chan.	P	R	Chan.
1990	0.1623	0.0002	-100%	0.0000	0.0000	0%	0.0009	0.0009	0%	0.0025	0.0025	0%
1991	0.1657	0.0002	-100%	0.0000	0.0000	0%	0.0009	0.0009	0%	0.0025	0.0025	0%
1992	0.1692	0.0002	-100%	0.0000	0.0000	0%	0.0009	0.0009	0%	0.0026	0.0026	0%
1993	0.1727	0.0002	-100%	0.0000	0.0000	0%	0.0010	0.0010	0%	0.0026	0.0026	0%
1994	0.1761	0.0002	-100%	0.0000	0.0000	0%	0.0010	0.0010	0%	0.0027	0.0027	0%
1995	0.1821	0.0002	-100%	0.0000	0.0000	0%	0.0010	0.0010	0%	0.0028	0.0028	0%
1996	0.1880	0.0002	-100%	0.0000	0.0000	0%	0.0010	0.0010	0%	0.0029	0.0029	0%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCB [kg]		
	P	R	Chan.	P	R	Chan.	P	R	Chan.	P	R	Chan.
1997	0.1940	0.0002	-100%	0.0000	0.0000	0%	0.0011	0.0011	0%	0.0029	0.0029	0%
1998	0.2000	0.0002	-100%	0.0000	0.0000	0%	0.0011	0.0011	0%	0.0030	0.0030	0%
1999	0.2059	0.0002	-100%	0.0000	0.0000	0%	0.0011	0.0011	0%	0.0031	0.0031	0%
2000	0.2033	0.0002	-100%	0.0000	0.0000	0%	0.0011	0.0011	0%	0.0031	0.0031	0%
2001	0.2121	0.0002	-100%	0.0000	0.0000	0%	0.0012	0.0012	0%	0.0032	0.0032	0%
2002	0.2228	0.0002	-100%	0.0000	0.0000	-8%	0.0012	0.0011	-8%	0.0034	0.0031	-8%
2003	0.2329	0.0002	-100%	0.0000	0.0000	-9%	0.0013	0.0012	-9%	0.0035	0.0032	-9%
2004	0.2552	0.0003	-100%	0.0000	0.0000	-1%	0.0014	0.0014	-1%	0.0039	0.0038	-1%
2005	0.2576	0.0003	-100%	0.0000	0.0000	9%	0.0014	0.0016	9%	0.0039	0.0043	9%
2006	0.2657	0.0003	-100%	0.0000	0.0000	8%	0.0015	0.0016	8%	0.0040	0.0043	8%
2007	0.2970	0.0003	-100%	0.0000	0.0000	6%	0.0017	0.0017	6%	0.0045	0.0048	6%
2008	0.3025	0.0004	-100%	0.0000	0.0000	18%	0.0017	0.0020	18%	0.0046	0.0054	18%
2009	0.3234	0.0002	-100%	0.0000	0.0000	-33%	0.0018	0.0012	-33%	0.0049	0.0033	-33%
2010	0.3330	0.0004	-100%	0.0000	0.0000	7%	0.0018	0.0020	7%	0.0051	0.0054	7%
2011	0.3330	0.0003	-100%	0.0000	0.0000	2%	0.0018	0.0019	2%	0.0051	0.0052	2%
2012	0.3425	0.0003	-100%	0.0000	0.0000	0%	0.0019	0.0019	0%	0.0052	0.0052	0%
2013	0.3538	0.0004	-100%	0.0000	0.0000	19%	0.0020	0.0023	19%	0.0054	0.0064	19%
2014	0.3573	0.0004	-100%	0.0000	0.0000	15%	0.0020	0.0023	15%	0.0054	0.0062	15%
2015	0.3887	0.0005	-100%	0.0000	0.0000	17%	0.0022	0.0025	17%	0.0059	0.0069	17%
2016	0.3508	0.0005	-100%	0.0000	0.0000	30%	0.0019	0.0025	30%	0.0053	0.0069	30%
2017	0.3259	0.0004	-100%	0.0000	0.0000	21%	0.0018	0.0022	21%	0.0049	0.0060	21%
2018	0.3913	0.0005	-100%	0.0000	0.0000	26%	0.0022	0.0027	26%	0.0059	0.0075	26%

YEAR	HCB [kg]			PCBs [kg]		
	P	R	Change	P	R	Change
1990	0.0009	0.0009	0%	0.0025	0.0025	0%
1991	0.0009	0.0009	0%	0.0025	0.0025	0%
1992	0.0009	0.0009	0%	0.0026	0.0026	0%
1993	0.0010	0.0010	0%	0.0026	0.0026	0%
1994	0.0010	0.0010	0%	0.0027	0.0027	0%
1995	0.0010	0.0010	0%	0.0028	0.0028	0%
1996	0.0010	0.0010	0%	0.0029	0.0029	0%
1997	0.0011	0.0011	0%	0.0029	0.0029	0%
1998	0.0011	0.0011	0%	0.0030	0.0030	0%
1999	0.0011	0.0011	0%	0.0031	0.0031	0%
2000	0.0011	0.0011	0%	0.0031	0.0031	0%
2001	0.0012	0.0012	0%	0.0032	0.0032	0%
2002	0.0012	0.0011	-8%	0.0034	0.0031	-8%
2003	0.0013	0.0012	-9%	0.0035	0.0032	-9%
2004	0.0014	0.0014	-1%	0.0039	0.0038	-1%
2005	0.0014	0.0016	9%	0.0039	0.0043	9%
2006	0.0015	0.0016	8%	0.0040	0.0043	8%
2007	0.0017	0.0017	6%	0.0045	0.0048	6%
2008	0.0017	0.0020	18%	0.0046	0.0054	18%
2009	0.0018	0.0012	-33%	0.0049	0.0033	-33%
2010	0.0018	0.0020	7%	0.0051	0.0054	7%
2011	0.0018	0.0019	2%	0.0051	0.0052	2%
2012	0.0019	0.0019	0%	0.0052	0.0052	0%
2013	0.0020	0.0023	19%	0.0054	0.0064	19%

YEAR	HCB [kg]			PCBs [kg]		
	P	R	Change	P	R	Change
2014	0.0020	0.0023	15%	0.0054	0.0062	15%
2015	0.0022	0.0025	17%	0.0059	0.0069	17%
2016	0.0019	0.0025	30%	0.0053	0.0069	30%
2017	0.0018	0.0022	21%	0.0049	0.0060	21%
2018	0.0022	0.0027	26%	0.0059	0.0075	26%

P-Previous
R-Refined
Chan.-Change

6.7.4 OPEN BURNING OF WASTE (5C2)

This activity is against the law of the Slovak Republic (Decree No. 79/2015 Coll. about Waste.[16] as amended). It is forbidden to perform the open burning of waste. Notation key NO is used.

6.8 WASTEWATER HANDLING (NFR 5D)

6.8.1 DOMESTIC WASTEWATER HANDLING (NFR 5D1)

6.8.1.1 Overview of the category

Council Directive 91/271/EEC[17] concerning urban waste-water treatment as well as obligations arising from in 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 restore the hardware already functioning sewage treatment plants.

Generally, about two-thirds of the population are discharging wastewater through sewers and one third is using 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 a majority of the WWT plants.

This category involves also emissions from using of latrines in Slovakia. The number of households without connection to public sewage system decreased significantly in comparison to the base year. ***Table 6.25*** shows emission trend of NH_3.

Table 6.25: *Overview, activity data and emission trends in the category Domestic wastewater handling*

YEAR	DOMESTIC WW DISCH. [th. m^3]	POP. USING DRY TOIL. [inhab]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO[kt]
1990	370 257.35	685 274	0.0041	0.0948	0.0041	1.1281	0.0009	0.0009	0.0009	0.0021
1995	402 528.74	623 177	0.0045	0.1030	0.0044	1.0315	0.0010	0.0010	0.0010	0.0023
2000	447 129.41	522 718	0.0007	0.0077	0.0000	1.0968	0.0001	0.0001	0.0001	0.0001
2005	411 842.63	439 790	0.0046	0.1773	0.0019	1.0536	0.0005	0.0005	0.0005	0.0018
2010	454 069.00	338 340	0.0073	0.1974	0.0027	0.9016	0.0007	0.0007	0.0007	0.0023
2011	364 941.00	252 109	0.0082	0.2046	0.0031	0.8573	0.0008	0.0008	0.0008	0.0026
2012	337 545.00	246 164	0.0058	0.1805	0.0026	0.8520	0.0004	0.0004	0.0004	0.0020
2013	400 954.00	196 245	0.0048	0.1924	0.0026	0.8250	0.0006	0.0006	0.0006	0.0034
2014	377 445.00	156 568	0.0050	0.1879	0.0027	0.7982	0.0008	0.0008	0.0008	0.0045
2015	362 142.00	147 745	0.0056	0.2056	0.0039	0.7754	0.0011	0.0011	0.0011	0.0064

[16] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/79/20190101.html
[17] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31991L0271&from=EN

YEAR	DOMESTIC WW DISCH. [th. m³]	POP. USING DRY TOIL. [inhab]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO[kt]
2016	385 463.00	100 235	0.0058	0.2097	0.0023	0.7627	0.0005	0.0005	0.0005	0.0019
2017	382 392.00	42 356	0.0060	0.2180	0.0027	0.7205	0.0004	0.0004	0.0004	0.0021
2018	369 599.00	21 807	0.0059	0.2249	0.0028	0.6809	0.0004	0.0004	0.0004	0.0021
2019	381 036.00	8 255	0.0067	0.2275	0.0036	0.6735	0.0005	0.0005	0.0005	0.0023
1990/2019	**3%**	**-99%**	**62%**	**140%**	**-13%**	**-40%**	**-46%**	**-46%**	**-44%**	**10%**
2018/2019	**3%**	**-62%**	**14%**	**1%**	**26%**	**-1%**	**18%**	**18%**	**22%**	**11%**

As shown in ***Table 6.25***, emissions of NMVOC decreased from 1996 to 2001, since 2002 emissions show an increasing trend due to increase of households connected to a public sewage system and water supply. Emission trend of NH_3 is decreasing due to decrease of inhabitants using dry toilettes.

6.8.1.2 Methodological issues

Source of activity data is national statistical data of volume of handled wastewater released into watercourses. EMEP/EEA GB_{2019} (Tier 1) were used to calculate emissions of NMVOC emitted into the air during wastewater handling. In the table below, the emission factor used to calculate emissions are shown. Notation keys from EMEP/EEA GB_{2019} were applied for other pollutants. Also, data from the NEIS database for incineration of residual gases were included in the calculation.

For the usage of dry toilettes, the principle of calculation consisted of determining the percentage of use of dry toilettes in Slovak households (based on information from censuses 2001 and 2011). Activity data were then calculated by multiplying of this percentage by middle year population in the Slovak Republic. This parameter has been multiplied with Tier 2 emissions factors for dry toilettes form EMEP/EEA GB_{2019} (***Table 6.26***).

Table 6.26: *Emission factors in the category Domestic wastewater handling*

POLLUTANT	NMVOC	NH_3
Unit	[mg/m³[	[kg/person]
Value	15	1.6

6.8.1.3 Completeness

Sources of emissions are well covered.

6.8.1.4 Source-specific recalculations

Emissions were recalculated due to the inclusion of emissions from incineration of residual gases, which were reported as NE in the previous submission, and change of source of activity data to comply with data used in the GHG inventory(***Table 6.27***).

Table 6.27*: Previous and refined activity data and NH_3 emissions in the category Domestic wastewater treatment*

YEAR	DOMESTIC WASTEWATER DISCHARGED [th. m³]			NMVOC [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	462220.19	370257.35	-20%	0.0069	0.0948	1267%	1.0964	1.1281	3%
1991	417590.31	334506.99	-20%	0.0063	0.0856	1267%	1.0370	1.0656	3%
1992	491517.78	393725.93	-20%	0.0074	0.1008	1267%	1.0303	1.0639	3%
1993	459549.15	368117.74	-20%	0.0069	0.0942	1267%	1.0165	1.0480	3%
1994	493515.82	395326.44	-20%	0.0074	0.1012	1267%	1.0112	1.0450	3%
1995	502507.00	402528.74	-20%	0.0075	0.1030	1267%	0.9971	1.0315	3%
1996	585963.00	469380.43	-20%	0.0088	0.1201	1267%	0.9693	1.0094	4%

YEAR	DOMESTIC WASTEWATER DISCHARGED [th. m³]			NMVOC [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1997	497153.00	461261.93	-7%	0.0075	0.1181	1483%	0.9404	0.9798	4%
1998	484980.00	449155.10	-7%	0.0073	0.1150	1480%	0.9086	0.9470	4%
1999	490133.00	438625.24	-11%	0.0074	0.1123	1427%	0.8718	0.9093	4%
2000	461531.00	447129.41	-3%	0.0069	0.0990	1330%	0.8363	1.0968	31%
2001	416800.59	429677.93	3%	0.0063	0.0818	1208%	0.7872	1.0603	35%
2002	461761.00	409638.01	-11%	0.0069	0.1530	2108%	0.7901	1.0799	37%
2003	427342.00	394355.91	-8%	0.0064	0.1414	2106%	0.7590	1.0680	41%
2004	399762.00	394902.89	-1%	0.0060	0.1694	2725%	0.7336	1.0717	46%
2005	387150.32	411842.63	6%	0.0058	0.1773	2953%	0.7037	1.0536	50%
2006	408262.00	400446.87	-2%	0.0061	0.1977	3129%	0.6894	1.0337	50%
2007	378485.18	387240.52	2%	0.0057	0.1943	3323%	0.6451	1.0059	56%
2008	346911.00	379759.86	9%	0.0052	0.1895	3541%	0.6000	0.9714	62%
2009	377483.00	377483.00	0%	0.0057	0.1908	3269%	0.5923	0.9355	58%
2010	454069.00	454069.00	0%	0.0068	0.1974	2798%	0.5413	0.9016	67%
2011	364941.00	364941.00	0%	0.0055	0.2046	3637%	0.4034	0.8573	113%
2012	337545.00	337545.00	0%	0.0051	0.1805	3465%	0.3939	0.8520	116%
2013	400954.00	400954.00	0%	0.0060	0.1924	3098%	0.3140	0.8250	163%
2014	377445.00	377445.00	0%	0.0057	0.1879	3218%	0.2505	0.7982	219%
2015	362142.00	362142.00	0%	0.0054	0.2056	3684%	0.2364	0.7754	228%
2016	385463.00	385463.00	0%	0.0058	0.2097	3527%	0.1604	0.7627	376%
2017	424269.00	382392.00	-10%	0.0064	0.2180	3326%	0.0678	0.7205	963%
2018	409241.00	369599.00	-10%	0.0061	0.2249	3563%	0.0349	0.6809	1851%

P-Previous
R-Refined

6.8.2 INDUSTRIAL WASTEWATER HANDLING (NFR 5D2)

6.8.2.1 Overview of the category

Water consumption for industrial purposes and resulting discharge of wastewater have significantly decreased in the period 1990–2019. This decrease is caused by general modernisation of the Slovak industries and stricter standards for discharge of industrial wastewater to public sewers or watercourses.

***Table 6.28:** Overview of emissions and trends in the category Industrial wastewater handling*

YEAR	INDUSTRIAL WASTEWATER DISCHARGED [th.m³]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	191 163.24	0.0029	0.8655	0.0001	0.0034	0.0050	0.0050	0.0050	0.0039
1995	207 824.90	0.0032	0.9410	0.0001	0.0037	0.0054	0.0054	0.0054	0.0042
2000	230 852.15	0.0009	1.6042	0.0000	0.0041	0.0044	0.0044	0.0044	0.0047
2005	212 633.64	0.0002	0.6727	0.0001	0.0036	0.0000	0.0000	0.0000	0.0001
2010	230 670.00	0.0001	0.0990	0.0000	0.0029	0.0000	0.0000	0.0000	0.0000
2011	198 242.00	0.0000	0.0287	0.0000	0.0026	0.0000	0.0000	0.0000	0.0000
2012	190 699.00	0.0000	0.0298	0.0000	0.0028	0.0000	0.0000	0.0000	0.0000
2013	202 692.00	0.0000	0.0826	0.0000	0.0029	0.0001	0.0001	0.0001	0.0000
2014	189 387.00	0.0000	0.0145	0.0000	0.0028	0.0000	0.0000	0.0000	0.0000
2015	188 578.00	0.0000	0.0150	0.0000	0.0032	0.0000	0.0000	0.0000	0.0000
2016	189 571.00	0.0000	0.0472	0.0001	0.0072	0.0000	0.0000	0.0000	0.0000
2017	187 218.00	0.0000	0.0466	0.0000	0.0069	0.0000	0.0000	0.0000	0.0000
2018	186 178.00	0.0000	0.0444	0.0000	0.0067	0.0000	0.0000	0.0000	0.0000

YEAR	INDUSTRIAL WASTEWATER DISCHARGED [th.m^3]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2019	189 901.00	0.0000	0.0465	0.0001	0.0072	0.0000	0.0000	0.0000	0.0000
1990/2019	**-1%**	**-98%**	**-95%**	**-8%**	**111%**	**-100%**	**-100%**	**-100%**	**-100%**
2018/2019	**2%**	**30%**	**5%**	**33%**	**7%**	**-12%**	**-12%**	**7%**	**31%**

In ***Table 6.30***, activity data, emissions and their trends are displayed. Emissions of NH_3 have increased since 2016 due to the increase of emissions from residual gases burning,

6.8.2.2 Methodological issues

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_{2019} was used and its value is **15mg/m^3**. Also, emissions from residual gasses incineration were included in the inventory in this submission. The data were taken from the NEIS database.

6.8.2.3 Completeness

NH_3 and PMs are reported as NE due to change of approach used to calculate emissions and absence of emission factors in EMEP/EEA GB_{2019}.

6.8.2.4 Source-specific recalculations

Emissions were recalculated due to the inclusion of emissions from incineration of residual gases, which were reported as NE in the previous submission (***Table 6.29***).

Table 6.29*: Previous and refined NMVOC emissions in the category of Industrial wastewater treatment*

YEAR	NMVOC [kt]		
	PREVIOUS	REFINED	CHANGE
1990	0.0046	0.8655	18796%
1991	0.0045	0.7820	17240%
1992	0.0044	0.9204	20656%
1993	0.0044	0.8605	19662%
1994	0.0043	0.9241	21519%
1995	0.0047	0.9410	19898%
1996	0.0035	1.0973	30859%
1997	0.0047	1.0783	22666%
1998	0.0046	1.0500	22505%
1999	0.0042	1.0254	24470%
2000	0.0038	1.6042	42137%
2001	0.0035	1.0462	29987%
2002	0.0036	1.0521	29331%
2003	0.0034	0.7167	21015%
2004	0.0029	0.7628	25914%
2005	0.0034	0.6727	19617%
2006	0.0035	0.4001	11182%
2007	0.0033	0.2633	7971%
2008	0.0032	0.3183	9714%
2009	0.0031	0.0993	3054%
2010	0.0035	0.0990	2761%
2011	0.0030	0.0287	867%
2012	0.0029	0.0298	941%
2013	0.0030	0.0826	2618%

YEAR	NMVOC [kt]		
	PREVIOUS	REFINED	CHANGE
2014	0.0028	0.0145	410%
2015	0.0028	0.0150	429%
2016	0.0028	0.0472	1559%
2017	0.0028	0.0466	1559%
2018	0.0028	0.0444	1491%

6.8.3 OTHER WASTEWATER HANDLING (NFR 5D3)

6.8.3.1 Overview of the category

This activity is not occurring in the Slovak Republic, therefore notation key NO was used.

6.9 OTHER WASTE (NFR 5E)

6.9.1 OVERVIEW OF THE CATEGORY

This chapter covers emissions from:

- Car fires
- Detached house fires
- Industrial building fires
- Apartment building fires

In ***Table 6.30*** and ***Table 6.31*** overview of statistical activity data and emission trends are displayed. This category is key for emissions of PCDD/F.

Table 6.30*: Overview of the activity data in the category Other waste*

YEAR	CAR FIRE [No. of fires]	DETACHED HOUSES [No. of fires]	APARTMENT BUILDINGS [No. of fires]	INDUSTRIAL BUILDINGS [No. of fires]
1990	612	102	719	594
1995	644	107	757	626
2000	587	97	592	960
2005	660	98	764	706
2010	837	139	989	615
2011	784	125	1 119	603
2012	785	159	1 098	561
2013	822	128	1 061	519
2014	772	152	915	494
2015	822	135	1 094	514
2016	812	122	1 139	496
2017	814	119	1 197	521
2018	811	119	1 059	520
2019	679	99	952	460

Table 6.31: *Overview of emissions in the category Other waste*

YEAR	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	Pb [t]	Hg [t]	Cd [t]	As [t]	Cr [t]	Cu [t]	PCDD/F [g I-TEQ]
1990	0.1384	0.1384	0.1384	0.0004	0.0008	0.0008	0.0013	0.0012	0.0028	1.4034
1995	0.1456	0.1456	0.1456	0.0004	0.0009	0.0009	0.0013	0.0013	0.0030	1.4772
2000	0.1386	0.1386	0.1386	0.0004	0.0008	0.0008	0.0013	0.0012	0.0028	1.4052
2005	0.1511	0.1511	0.1511	0.0004	0.0009	0.0009	0.0014	0.0013	0.0031	1.5320
2010	0.1785	0.1785	0.1785	0.0005	0.0010	0.0010	0.0017	0.0016	0.0037	1.8118
2011	0.1974	0.1974	0.1974	0.0006	0.0012	0.0012	0.0018	0.0017	0.0041	1.9994
2012	0.1927	0.1927	0.1927	0.0006	0.0011	0.0011	0.0018	0.0017	0.0040	1.9529
2013	0.1840	0.1840	0.1840	0.0005	0.0011	0.0011	0.0017	0.0016	0.0038	1.8666
2014	0.1610	0.1610	0.1610	0.0005	0.0009	0.0009	0.0015	0.0014	0.0033	1.6352
2015	0.1876	0.1876	0.1876	0.0005	0.0011	0.0011	0.0017	0.0017	0.0039	1.9023
2016	0.1936	0.1936	0.1936	0.0006	0.0011	0.0011	0.0018	0.0017	0.0040	1.9621
2017	0.2027	0.2027	0.2027	0.0006	0.0012	0.0012	0.0019	0.0018	0.0042	2.0533
2018	0.1834	0.1834	0.1834	0.0005	0.0011	0.0011	0.0017	0.0016	0.0038	1.8600
2019	0.1651	0.1651	0.1651	0.0005	0.0010	0.0010	0.0015	0.0015	0.0034	1.6727
1990/2019	**19%**	**19%**	**19%**	**19%**	**19%**	**19%**	**20%**	**20%**	**19%**	**19%**
2018/2019	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**

6.9.2 METHODOLOGICAL ISSUES

Activity data were obtained from the fire statistics provided by Fire Appraisal Institute of the Ministry of Interior (***Table 6.32***). Emissions from fires were calculated multiplying of activity data (number of fires) with emission factor from EMEP/EEA GB_{2019} (***Table 6.33***). Historical data (1990-1998) were extrapolated.

Table 6.32: *Emission factors for calculation of emissions in category Other waste*

POLLUTANT	TSP,PMs	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

6.9.3 COMPLETENESS

All rising pollutants were recorded and reported.

6.9.4 SOURCE-SPECIFIC RECALCULATIONS

No recalculations in this submission.

.

CHAPTER 7: OTHER AND NATURAL EMISSIONS (NFR 6, NFR 11)

Last update: 15.3.2021

7.1 OTHER SOURCES (NFR 6A)

7.1.1 OVERVIEW OF THE CATEGORY

No other activities have occurred in the Slovak Republic. Notation key NO is used.

7.2 VOLCANOES (NFR 11A)

7.2.1 OVERVIEW OF THE CATEGORY

There is no active volcano in Slovakia, therefore notation key NO was used.

7.3 FOREST FIRES (NFR 11B)

7.3.1 OVERVIEW OF THE CATEGORY

Fire can occur naturally (lightning, smouldering of organic material under sunny weather) or artificially, and often intentionally by human activity. In general, fires that are deliberately set by humans (including pyromania) in the world can be mentioned. Unfortunately, the situation in Slovakia and Central Europe is very similar.

Main reasons of forest fires are negligence and underestimation of risk, pyromania (a disease tendency to armpit) and attempt to benefit financially on 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 [18]

Forest fires are important sources of a large number of particulates and trace gases are produced, including the products of incomplete combustion (CO, NMVOCs) and nitrogen and sulphur. In ***Table 7.1***, emissions in this category are shown.

Table 7.1: *Overview of main pollutants emissions in the category Forest fires*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.256	0.116	0.009	0.010	1.091	1.333	2.061	0.098	9.119
1995	0.179	0.035	0.003	0.003	0.815	0.996	1.540	0.073	6.375
2000	0.625	0.464	0.035	0.040	2.286	2.794	4.318	0.206	22.302
2005	0.609	0.264	0.020	0.023	2.496	3.051	4.715	0.225	21.729
2010	0.465	0.096	0.007	0.008	2.074	2.535	3.917	0.187	16.574
2011	0.557	0.201	0.015	0.017	2.327	2.844	4.395	0.209	19.874
2012	1.063	0.842	0.064	0.072	3.581	4.377	6.765	0.322	37.931

[18] IPCC 2006 GL

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2013	0.352	0.135	0.010	0.012	1.450	1.772	2.739	0.131	12.554
2014	0.524	0.096	0.007	0.008	2.356	2.880	4.451	0.212	18.692
2015	0.588	0.176	0.013	0.015	2.514	3.073	4.749	0.226	20.977
2016	0.487	0.087	0.007	0.008	2.189	2.675	4.135	0.197	17.352
2017	0.541	0.149	0.011	0.013	2.335	2.853	4.410	0.210	19.283
2018	0.534	0.124	0.009	0.011	2.348	2.870	4.435	0.211	19.041
2019	0.625	0.231	0.018	0.020	2.585	3.159	4.882	0.233	22.295

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.606	0.036	0.048	0.021	0.014	0.119	0.011	0.073
1995	0.453	0.027	0.036	0.015	0.010	0.089	0.008	0.054
2000	1.270	0.076	0.102	0.043	0.029	0.250	0.022	0.152
2005	1.387	0.083	0.111	0.047	0.032	0.273	0.024	0.166
2010	1.152	0.069	0.092	0.039	0.027	0.227	0.020	0.138
2011	1.293	0.078	0.103	0.044	0.030	0.255	0.023	0.155
2012	1.990	0.119	0.159	0.068	0.046	0.392	0.035	0.239
2013	0.806	0.048	0.064	0.027	0.019	0.159	0.014	0.097
2014	1.309	0.079	0.105	0.045	0.030	0.258	0.023	0.157
2015	1.397	0.084	0.112	0.047	0.032	0.275	0.025	0.168
2016	1.216	0.073	0.097	0.041	0.028	0.240	0.021	0.146
2017	1.297	0.078	0.104	0.044	0.030	0.256	0.023	0.156
2018	0.001	0.078	0.104	0.044	0.030	0.257	0.023	0.157
2019	1.436	0.086	0.115	0.049	0.033	0.283	0.025	0.172

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 Institute of Fire Engineering and Expertise of the Ministry of the Interior of the Slovak Republic data about area burned by wildfires to air pollutants inventory, compilation team. Activity data for the period 1990-2001 were changed in comparison with the last submission due to consistency with GHGs inventory. Tier 2 emissions factors for temperate forests from EMEP/EEA GB_{2019} were used to calculate emissions of main pollutants and particulate matter from this category. To maintain consistency with GHGs inventory, emissions of NOx and CO were calculated using emission factors and methodology from $IPCC_{2006}$ Guidelines, ***Chapter 2.4: Non-CO_2 Emissions*** [6]. POPs were calculated using country-specific emission factors (Most, et al, 1992). ***Table 7.3*** shows the emission factors used to estimate emissions in this category.

***Table 7.2**: Activity data used in the category 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	26.51	94.70	121.21
1995	70.42	9.00	81.57	90.58
2000	927.25	134.10	119.89	253.99
2005	527.96	81.92	195.42	277.34
2010	191.96	31.64	198.80	230.44
2011	402.55	66.98	191.55	258.52
2012	1683.46	283.61	114.33	397.94
2013	270.26	45.88	115.25	161.12
2014	191.73	32.56	229.25	261.81
2015	352.57	60.08	219.30	279.38

YEAR	AREA AFFECTED BY WILDFIRES [ha]	BIOMASS BURNED BY WILDFIRES [kt]	BIOMASS BURNED BY CONTROLLED FIRES [kt]	TOTAL BIOMASS BURNED [kt]
2016	174.88	29.94	213.28	243.22
2017	297.66	51.03	208.36	259.39
2018	248.38	42.63	218.26	260.90
2019	462.17	79.78	207.39	287.17

***Table 7.3:** Emission factors in the category Forest fires*

POLLUTANT	NMVOC	SOx	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO	NOx
Unit	[kg/ha area burned]			[g/kg dm]			[% of $PM_{2.5}$]	[g/kg dm]	
Value	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

Recalculation in this submission was made due to the recalculation of activity data for the amount of biomass burned (***Table 7.4***).

***Table 7.4**: Previous and refined activity data and emissions in the category Forest fires*

YEAR	AMOUNT OF BIOMASS BURNED [kt]			$PM_{2.5}$ [kt]			PM_{10} [kt]		
	P	R	Change	P	R	Change	P	R	Change
1990	121.79	121.21	-0.48%	1.0961	1.0909	-0.48%	1.3397	1.3333	-0.48%
1991	99.39	98.88	-0.51%	0.8945	0.8899	-0.51%	1.0933	1.0877	-0.51%
1992	124.37	123.23	-0.92%	1.1193	1.1091	-0.92%	1.3681	1.3555	-0.92%
1993	211.40	208.70	-1.28%	1.9026	1.8783	-1.28%	2.3254	2.2957	-1.28%
1994	77.48	77.40	-0.11%	0.6973	0.6966	-0.11%	0.8523	0.8514	-0.11%
1995	90.70	90.58	-0.14%	0.8163	0.8152	-0.14%	0.9977	0.9963	-0.14%
1996	116.69	116.32	-0.31%	1.0502	1.0469	-0.31%	1.2835	1.2796	-0.31%
1997	101.34	101.28	-0.06%	0.9120	0.9115	-0.06%	1.1147	1.1141	-0.06%
1998	99.56	99.51	-0.05%	0.8960	0.8956	-0.05%	1.0952	1.0946	-0.05%
1999	457.66	453.90	-0.82%	4.1189	4.0851	-0.82%	5.0343	4.9929	-0.82%
2000	254.85	253.99	-0.34%	2.2937	2.2859	-0.34%	2.8034	2.7939	-0.34%
2001	142.18	142.04	-0.10%	1.2796	1.2784	-0.10%	1.5640	1.5625	-0.10%
2002	207.25	206.75	-0.24%	1.8653	1.8608	-0.24%	2.2798	2.2743	-0.24%
2003	365.58	364.25	-0.36%	3.2902	3.2783	-0.36%	4.0213	4.0068	-0.36%
2004	164.02	163.91	-0.07%	1.4762	1.4752	-0.07%	1.8043	1.8030	-0.07%
2005	277.75	277.34	-0.15%	2.4997	2.4960	-0.15%	3.0552	3.0507	-0.15%
2006	189.87	189.77	-0.05%	1.7088	1.7079	-0.05%	2.0886	2.0875	-0.05%
2007	274.64	274.26	-0.14%	2.4718	2.4684	-0.14%	3.0211	3.0169	-0.14%
2008	202.51	202.45	-0.03%	1.8226	1.8221	-0.03%	2.2276	2.2270	-0.03%
2009	264.74	264.54	-0.07%	2.3826	2.3809	-0.07%	2.9121	2.9100	-0.07%
2010	230.51	230.44	-0.03%	2.0746	2.0740	-0.03%	2.5356	2.5348	-0.03%
2011	258.67	258.52	-0.06%	2.3280	2.3267	-0.06%	2.8454	2.8438	-0.06%

YEAR	AMOUNT OF BIOMASS BURNED [kt]			$PM_{2.5}$ [kt]			PM_{10} [kt]		
	P	R	Change	P	R	Change	P	R	Change
2012	398.55	397.94	-0.16%	3.5870	3.5814	-0.16%	4.3841	4.3773	-0.16%
2013	161.22	161.12	-0.06%	1.4510	1.4501	-0.06%	1.7735	1.7723	-0.06%
2014	261.89	261.81	-0.03%	2.3570	2.3563	-0.03%	2.8808	2.8799	-0.03%
2015	279.53	279.38	-0.05%	2.5157	2.5144	-0.05%	3.0748	3.0732	-0.05%
2016	243.29	243.22	-0.03%	2.1896	2.1890	-0.03%	2.6762	2.6754	-0.03%
2017	259.52	259.39	-0.05%	2.3357	2.3345	-0.05%	2.8547	2.8533	-0.05%
2018	261.00	260.90	-0.04%	2.3490	2.3481	-0.04%	2.8710	2.8699	-0.04%

YEAR	TSP [kt]			BC [kt]			PCDD/F [g I-TEQ]		
	P	R	Change	P	R	Change	P	R	Change
1990	2.0705	2.0606	-0.48%	0.0987	0.0982	-0.48%	0.6090	0.6061	-0.48%
1991	1.6896	1.6809	-0.51%	0.0805	0.0801	-0.51%	0.4969	0.4944	-0.51%
1992	2.1143	2.0949	-0.92%	0.1007	0.0998	-0.92%	0.6218	0.6161	-0.92%
1993	3.5937	3.5478	-1.28%	0.1712	0.1690	-1.28%	1.0570	1.0435	-1.28%
1994	1.3172	1.3158	-0.11%	0.0628	0.0627	-0.11%	0.3874	0.3870	-0.11%
1995	1.5419	1.5398	-0.14%	0.0735	0.0734	-0.14%	0.4535	0.4529	-0.14%
1996	1.9837	1.9775	-0.31%	0.0945	0.0942	-0.31%	0.5834	0.5816	-0.31%
1997	1.7227	1.7217	-0.06%	0.0821	0.0820	-0.06%	0.5067	0.5064	-0.06%
1998	1.6925	1.6917	-0.05%	0.0806	0.0806	-0.05%	0.4978	0.4976	-0.05%
1999	7.7802	7.7163	-0.82%	0.3707	0.3677	-0.82%	2.2883	2.2695	-0.82%
2000	4.3325	4.3178	-0.34%	0.2064	0.2057	-0.34%	1.2743	1.2699	-0.34%
2001	2.4171	2.4147	-0.10%	0.1152	0.1151	-0.10%	0.7109	0.7102	-0.10%
2002	3.5233	3.5148	-0.24%	0.1679	0.1675	-0.24%	1.0363	1.0338	-0.24%
2003	6.2148	6.1923	-0.36%	0.2961	0.2950	-0.36%	1.8279	1.8213	-0.36%
2004	2.7884	2.7865	-0.07%	0.1329	0.1328	-0.07%	0.8201	0.8195	-0.07%
2005	4.7217	4.7148	-0.15%	0.2250	0.2246	-0.15%	1.3887	1.3867	-0.15%
2006	3.2278	3.2261	-0.05%	0.1538	0.1537	-0.05%	0.9494	0.9488	-0.05%
2007	4.6689	4.6625	-0.14%	0.2225	0.2222	-0.14%	1.3732	1.3713	-0.14%
2008	3.4427	3.4417	-0.03%	0.1640	0.1640	-0.03%	1.0126	1.0123	-0.03%
2009	4.5006	4.4972	-0.07%	0.2144	0.2143	-0.07%	1.3237	1.3227	-0.07%
2010	3.9187	3.9175	-0.03%	0.1867	0.1867	-0.03%	1.1526	1.1522	-0.03%
2011	4.3974	4.3949	-0.06%	0.2095	0.2094	-0.06%	1.2934	1.2926	-0.06%
2012	6.7754	6.7649	-0.16%	0.3228	0.3223	-0.16%	1.9928	1.9897	-0.16%
2013	2.7408	2.7391	-0.06%	0.1306	0.1305	-0.06%	0.8061	0.8056	-0.06%
2014	4.4521	4.4508	-0.03%	0.2121	0.2121	-0.03%	1.3094	1.3091	-0.03%
2015	4.7520	4.7494	-0.05%	0.2264	0.2263	-0.05%	1.3976	1.3969	-0.05%
2016	4.1360	4.1347	-0.03%	0.1971	0.1970	-0.03%	1.2165	1.2161	-0.03%
2017	4.4118	4.4097	-0.05%	0.2102	0.2101	-0.05%	1.2976	1.2970	-0.05%
2018	4.4370	4.4352	-0.04%	0.2114	0.2113	-0.04%	0.0013	0.0013	-0.04%

YEAR	PAHs [t]			HCB [kg]			PCB [kg]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.1200	0.1194	-0.48%	0.0107	0.0107	-0.48%	0.0731	0.0727	-0.48%
1991	0.0979	0.0974	-0.51%	0.0087	0.0087	-0.51%	0.0596	0.0593	-0.51%
1992	0.1225	0.1214	-0.92%	0.0109	0.0108	-0.92%	0.0746	0.0739	-0.92%
1993	0.2082	0.2056	-1.28%	0.0186	0.0184	-1.28%	0.1268	0.1252	-1.28%
1994	0.0763	0.0762	-0.11%	0.0068	0.0068	-0.11%	0.0465	0.0464	-0.11%
1995	0.0893	0.0892	-0.14%	0.0080	0.0080	-0.14%	0.0544	0.0543	-0.14%
1996	0.1149	0.1146	-0.31%	0.0103	0.0102	-0.31%	0.0700	0.0698	-0.31%
1997	0.0998	0.0998	-0.06%	0.0089	0.0089	-0.06%	0.0608	0.0608	-0.06%

YEAR	PAHs [t]			HCB [kg]			PCB [kg]		
	P	R	Change	P	R	Change	P	R	Change
1998	0.0981	0.0980	-0.05%	0.0088	0.0088	-0.05%	0.0597	0.0597	-0.05%
1999	0.4508	0.4471	-0.82%	0.0403	0.0399	-0.82%	0.2746	0.2723	-0.82%
2000	0.2510	0.2502	-0.34%	0.0224	0.0224	-0.34%	0.1529	0.1524	-0.34%
2001	0.1400	0.1399	-0.10%	0.0125	0.0125	-0.10%	0.0853	0.0852	-0.10%
2002	0.2041	0.2037	-0.24%	0.0182	0.0182	-0.24%	0.1244	0.1241	-0.24%
2003	0.3601	0.3588	-0.36%	0.0322	0.0321	-0.36%	0.2193	0.2186	-0.36%
2004	0.1616	0.1615	-0.07%	0.0144	0.0144	-0.07%	0.0984	0.0983	-0.07%
2005	0.2736	0.2732	-0.15%	0.0244	0.0244	-0.15%	0.1666	0.1664	-0.15%
2006	0.1870	0.1869	-0.05%	0.0167	0.0167	-0.05%	0.1139	0.1139	-0.05%
2007	0.2705	0.2702	-0.14%	0.0242	0.0241	-0.14%	0.1648	0.1646	-0.14%
2008	0.1995	0.1994	-0.03%	0.0178	0.0178	-0.03%	0.1215	0.1215	-0.03%
2009	0.2608	0.2606	-0.07%	0.0233	0.0233	-0.07%	0.1588	0.1587	-0.07%
2010	0.2271	0.2270	-0.03%	0.0203	0.0203	-0.03%	0.1383	0.1383	-0.03%
2011	0.2548	0.2546	-0.06%	0.0228	0.0228	-0.06%	0.1552	0.1551	-0.06%
2012	0.3926	0.3920	-0.16%	0.0351	0.0350	-0.16%	0.2391	0.2388	-0.16%
2013	0.1588	0.1587	-0.06%	0.0142	0.0142	-0.06%	0.0967	0.0967	-0.06%
2014	0.2580	0.2579	-0.03%	0.0230	0.0230	-0.03%	0.1571	0.1571	-0.03%
2015	0.2753	0.2752	-0.05%	0.0246	0.0246	-0.05%	0.1677	0.1676	-0.05%
2016	0.2396	0.2396	-0.03%	0.0214	0.0214	-0.03%	0.1460	0.1459	-0.03%
2017	0.2556	0.2555	-0.05%	0.0228	0.0228	-0.05%	0.1557	0.1556	-0.05%
2018	0.2571	0.2570	-0.04%	0.0230	0.0230	-0.04%	0.1566	0.1565	-0.04%

P-Previous
R-Refined

7.4 OTHER NATURAL EMISSIONS (NFR 11C)

7.4.1 OVERVIEW OF THE CATEGORY

No other natural emissions occur in the Slovak Republic, therefore notation key NO was used.

CHAPTER 8: RECALCULATIONS AND IMPROVEMENTS

Last update: 15.3.2021

8.1 OVERVIEW BY GASES

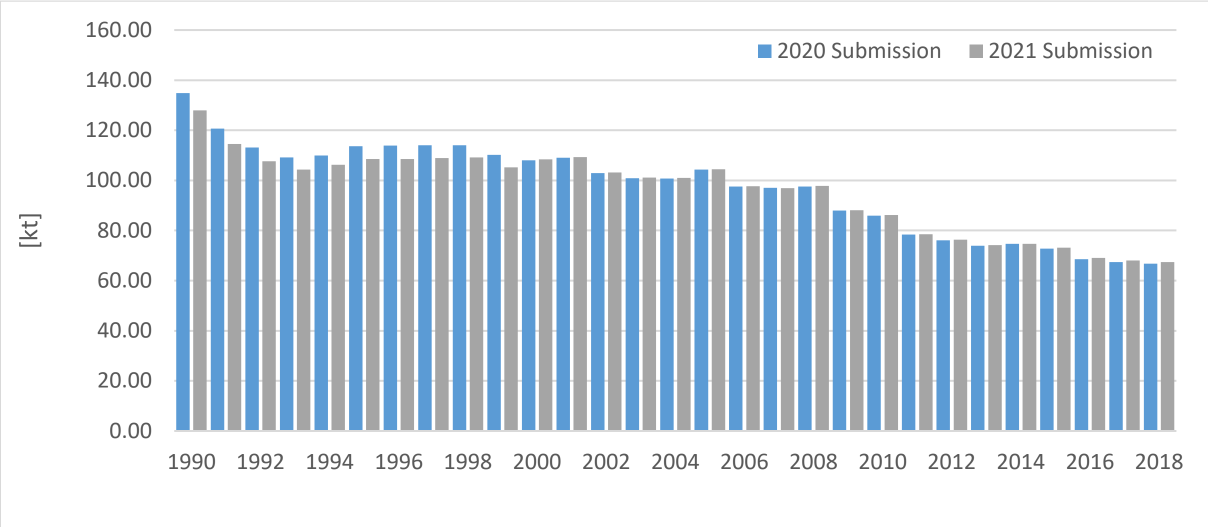
Sector specific-recalculations are described within each of the relevant chapters. These chapters should be referred to for details of recalculations and method changes. This chapter summarises the impact of these changes on the emissions totals of final versions of the submissions and highlights the largest changes for each pollutant.

8.1.1 NOx (as NO_2)

The impact of recalculations on NOx emission total in this submission is shown in ***Figure 8.1***.

Main changes were made in the Energy sector. Historical data were recalculated using a weighted average of the implied emission factors form the period 2000-2004.

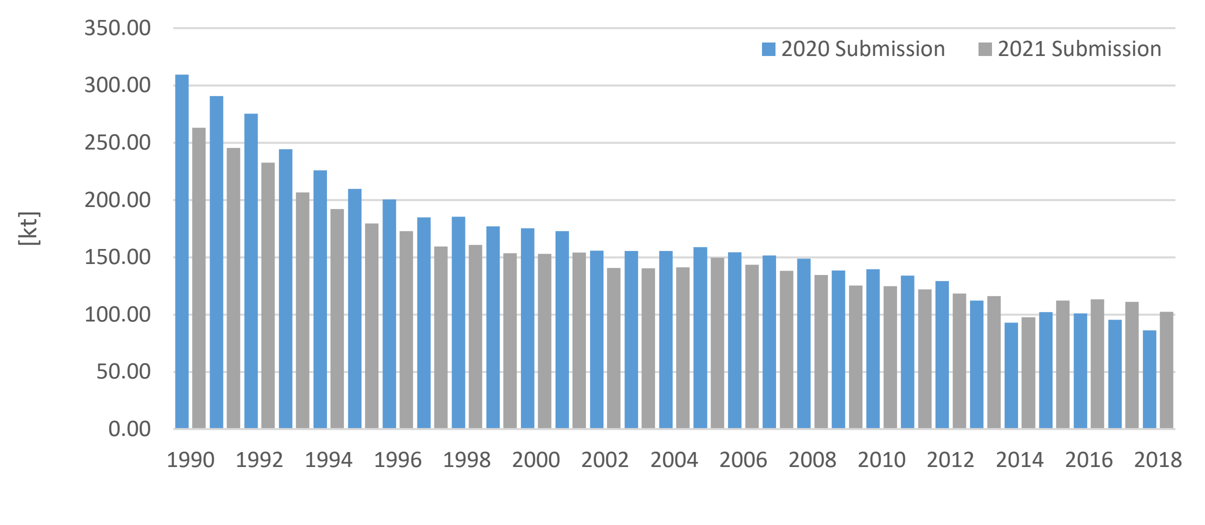
Figure 8.1: *Comparison of NOx emission total between 2020 final submission and 2021 final submission*



8.1.2 NMVOC

Methodology for residential heating (NFR 1A4bi) was improved due to new data obtained during the second statistical survey among households. Besides, the emission factor for NMVOC was changed as the EF used in the submission 2020 was for the total organic compound. Database error was eliminated and it caused slight changes in emissions of NMVOC (***Figure 8.2***).

Figure 8.2: *Comparison of NMVOC emission total between 2020 final submission and 2021 final submission*

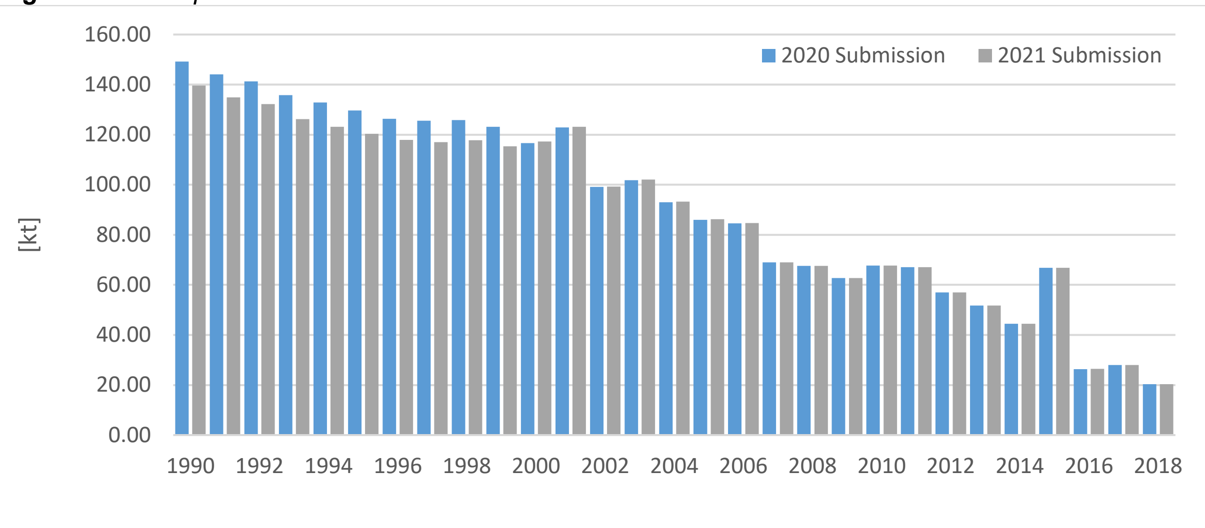


8.1.3 SOx (as SO_2)

The impact of recalculations on SOx emission total in this submission is shown in ***Figure 8.3***.

Main changes were made in the Energy sector. Historical data were recalculated using a weighted average of the implied emission factors form the period 2000-2004.

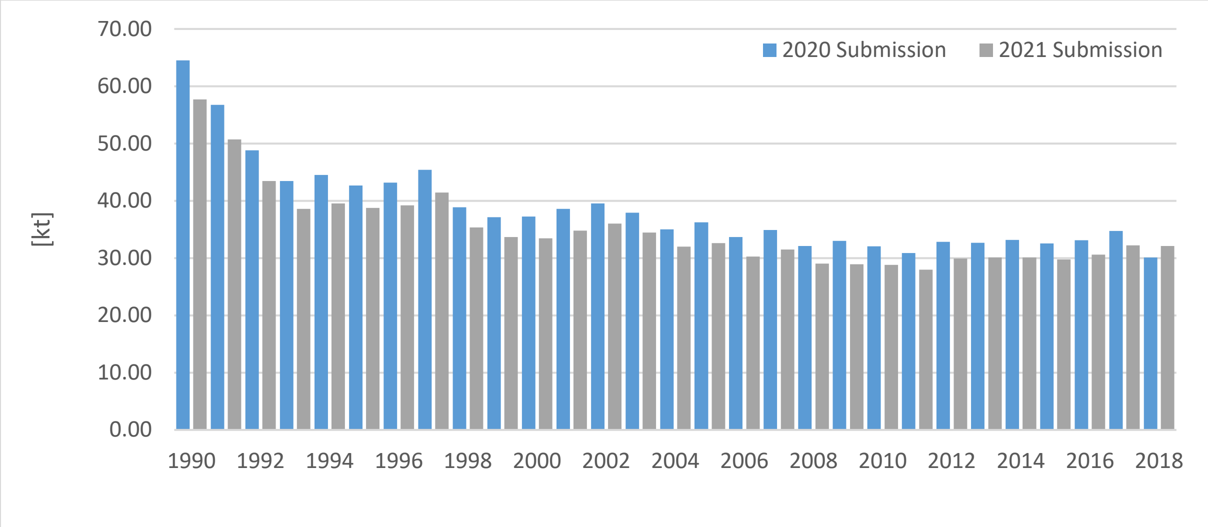
Figure 8.3: *Comparison of SOx emission total between 2020 final submission and 2021 final submission*



8.1.4 NH_3

Emissions from the sector Agriculture were recalculated following EMEP/EEA GB_{2019}. Several errors and double-counting were eliminated.

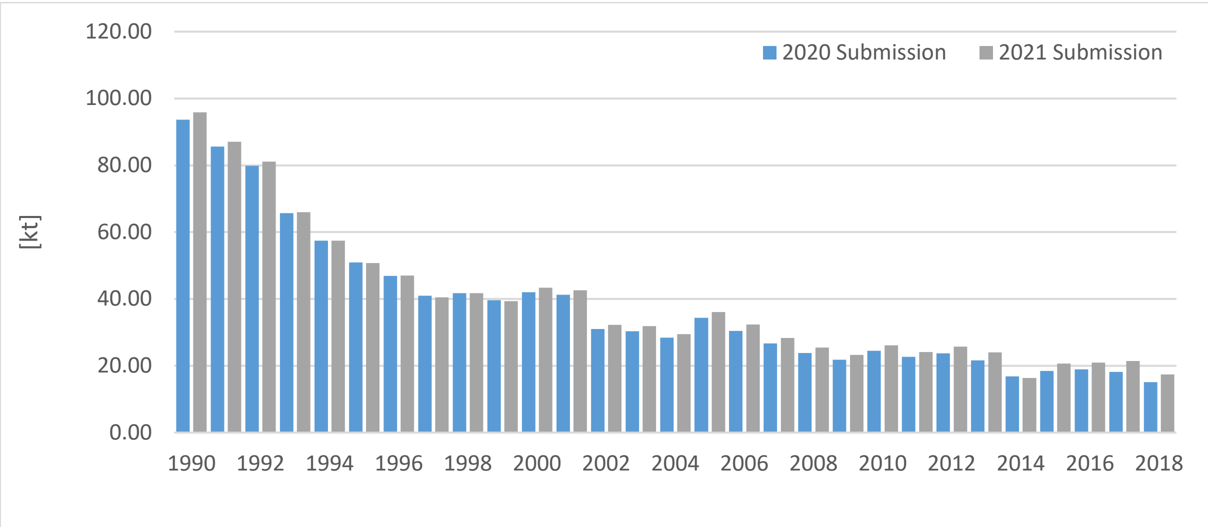
Figure 8.4: *Comparison of NH_3 emission total between 2020 final submission and 2021 final submission*



8.1.5 $PM_{2.5}$

Methodology for residential heating (NFR 1A4bi) was improved due to new data obtained during the second statistical survey among households. An overview of the changes is shown in ***Figure 8.5***.

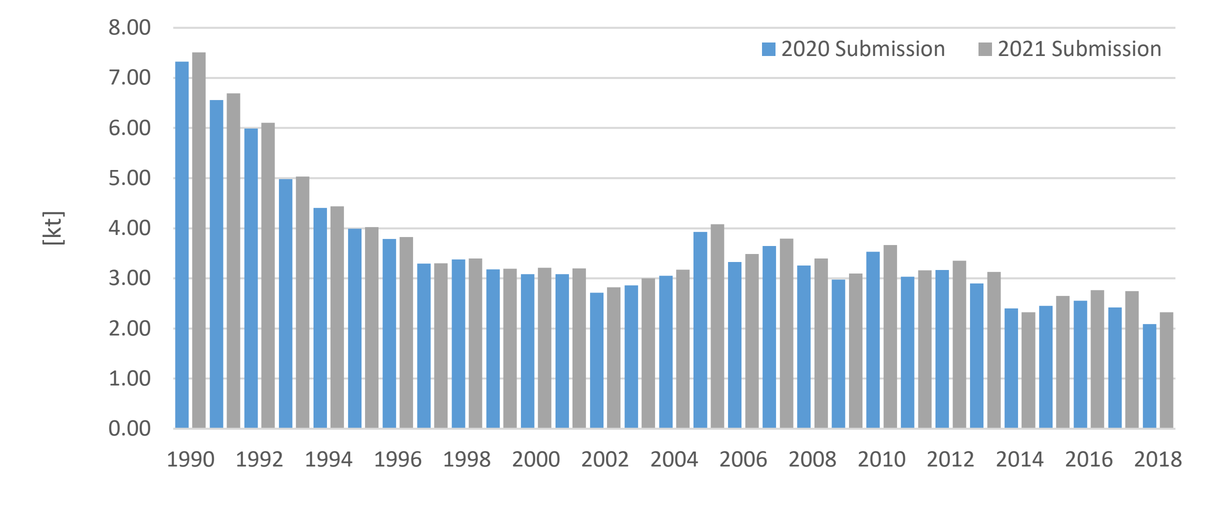
Figure 8.5: *Comparison of $PM_{2.5}$ emission total between 2020 final submission and 2021 final submission*



8.1.6 TSP, PM_{10}, BC

Methodology for residential heating (NFR 1A4bi) was improved due to new data obtained during the second statistical survey among households. An overview of the changes is shown in ***Figure 8.6***.

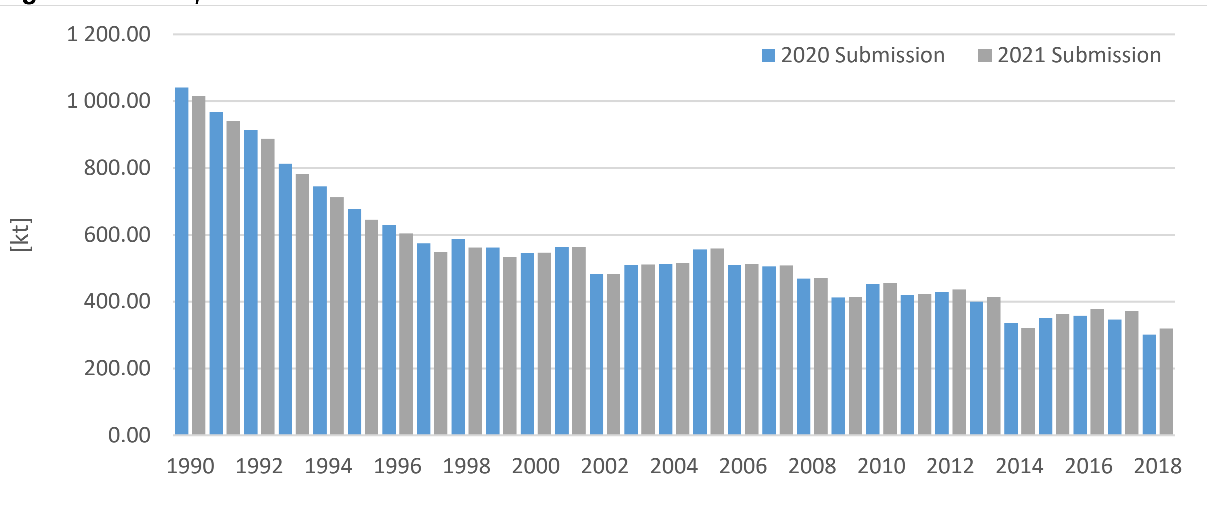
Figure 8.6: *Comparison of BC emission total between 2020 final submission and 2021 final submission*



8.1.7 CO

Methodology for residential heating (NFR 1A4bi) was improved due to new data obtained during the second statistical survey among households. Historical data were recalculated using a weighted average of implied emission factors for the period 2000-2004. An overview of the changes is shown in ***Figure 8.7***.

Figure 8.7: *Comparison of CO emission total between 2020 final submission and 2021 final submission*



8.1.8 Priority heavy metals (Pb, Cd, Hg)

Improvement of methodology for several categories in the sector Energy and Industry caused significant changes in emissions (***Figure 8.8*** – ***Figure 8.10***).

Figure 8.8: *Comparison of Pb emission total between 2020 final submission and 2021 final submission*

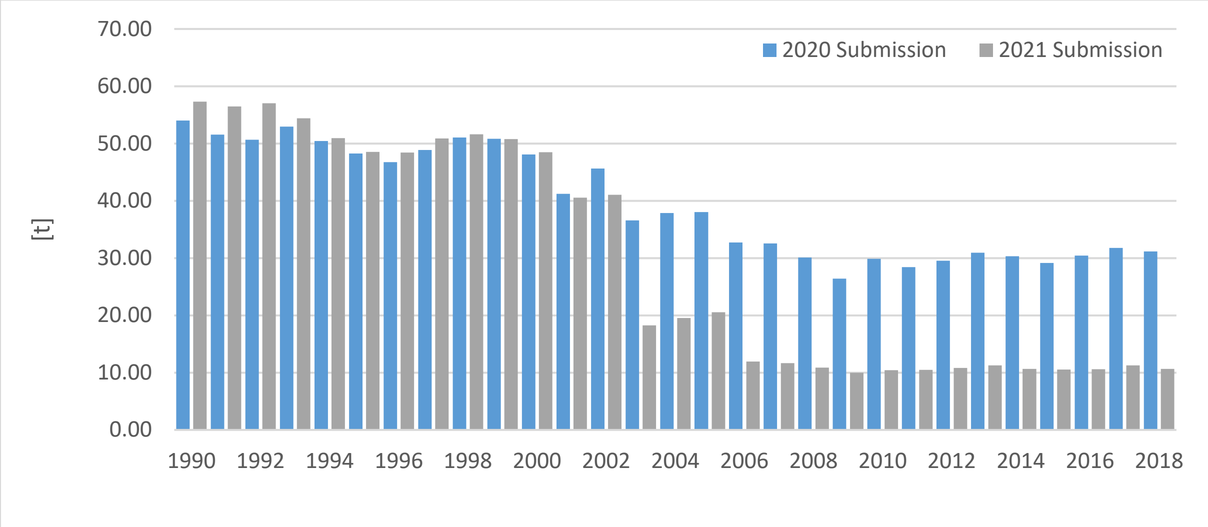


Figure 8.9: *Comparison of Cd emission total between 2020 final submission and 2021 final submission*

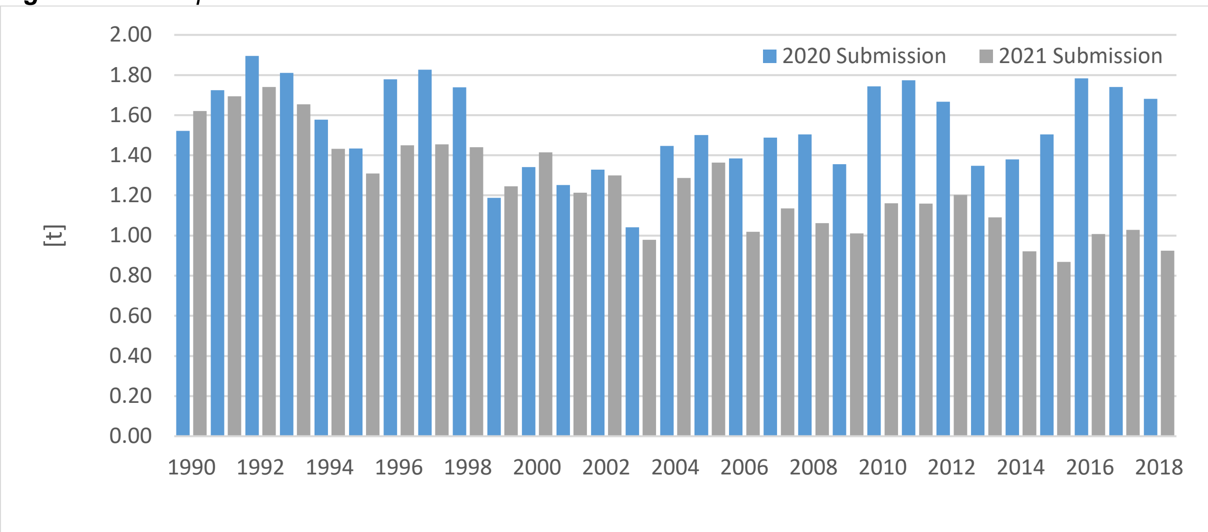
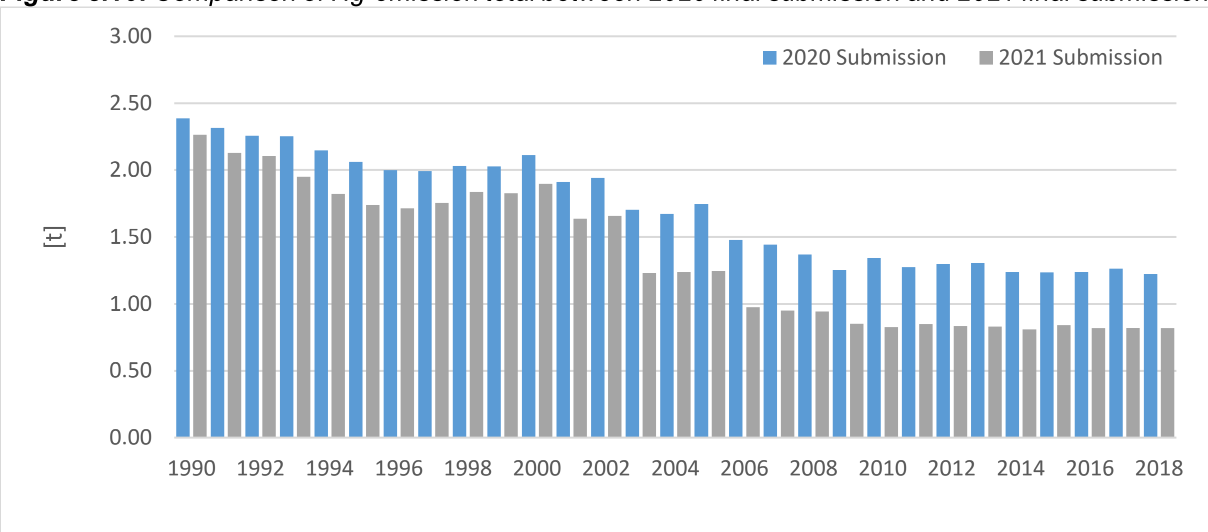


Figure 8.10: *Comparison of Hg emission total between 2020 final submission and 2021 final submission*



8.1.9 POPs

Recalculations were made due to the improvement of the methodology for several categories and calculations of historical years.

***Figure 8.11:** Comparison of PCDD/F emission total between 2020 final submission and 2021 final submission*

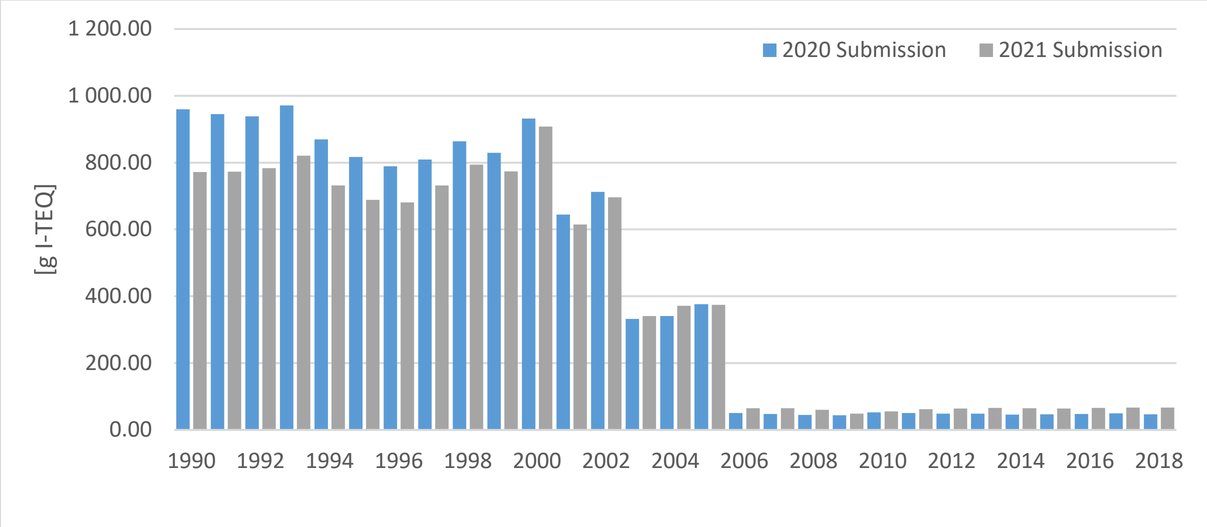


***Figure 8.12:** Comparison of PAHs emission total between 2020 final submission and 2021 final submission*

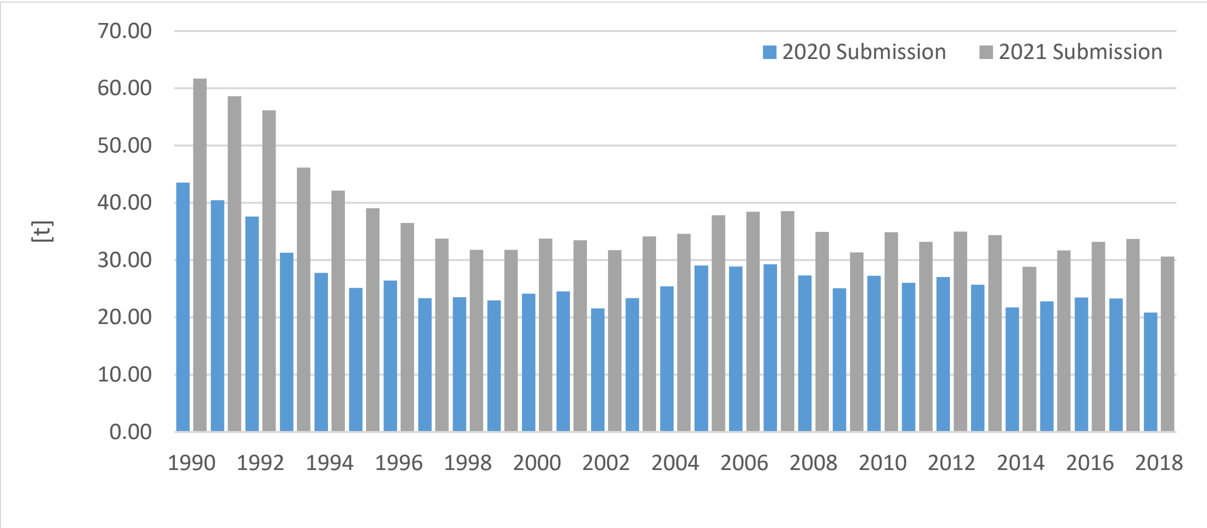


Figure 8.13: *Comparison of HCB emission total between 2020 final submission and 2021 final submission*

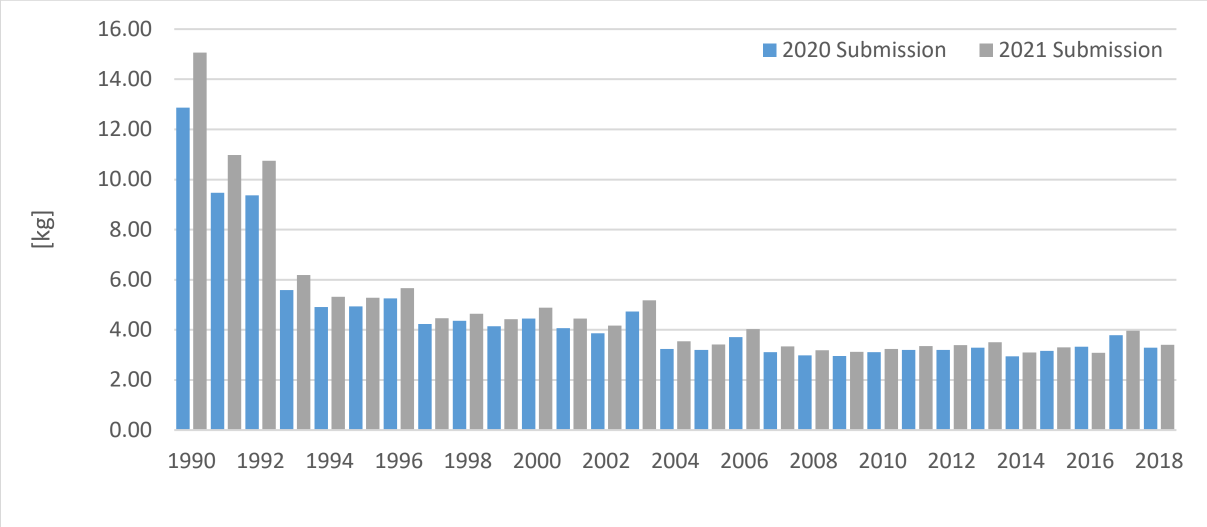
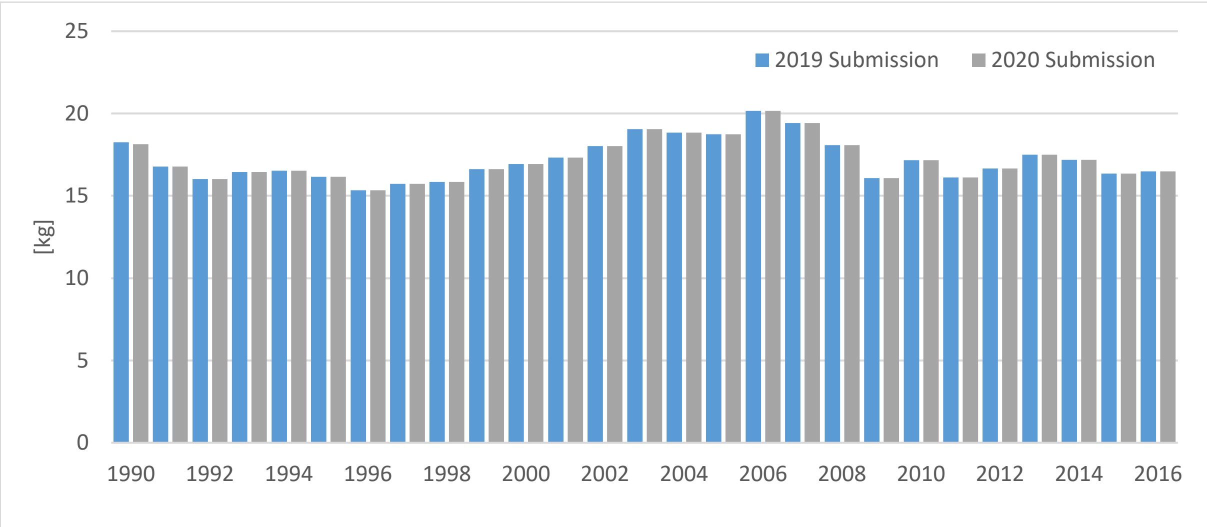


Figure 8.14: *Comparison of PCBs emission total between 2019 final submission and 2020 final submission*



8.2 RECALCULATIONS BETWEEN 1ST AND FINAL VERSION OF NATIONAL INVENTORY

Some calculation error corrections have occurred after submitting the first version of the inventory. These changes are shown in ***Table 8.15****-* ***Table 8.17***.

Table 8.15: *Recalculations between 1st and final version of national inventory 2021 – main pollutants*

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
NMVOC			
1990	263.04	263.14	0.04%
1991	245.33	245.43	0.04%
1992	232.44	232.54	0.04%
1993	206.40	206.51	0.05%
1994	191.91	191.97	0.03%
1995	179.49	179.55	0.03%
1996	172.73	172.79	0.03%
1997	159.39	159.45	0.03%
1998	160.63	160.69	0.04%
1999	153.39	153.45	0.04%
2000	152.86	152.92	0.04%
2001	153.97	154.04	0.04%
2002	140.66	140.73	0.05%
2003	140.32	140.39	0.05%
2004	141.22	141.29	0.05%
2005	149.67	149.74	0.05%
2006	143.35	143.41	0.04%
2007	138.02	138.08	0.04%
2008	134.48	134.53	0.04%
2009	125.16	125.21	0.04%
2010	124.61	124.66	0.04%
2011	122.03	122.08	0.05%
2012	118.23	118.29	0.05%
2013	116.09	116.15	0.05%
2014	97.70	97.75	0.05%
2015	112.03	112.08	0.05%
2016	113.24	113.28	0.04%
2017	110.89	110.94	0.04%
2018	102.48	102.53	0.05%
2019	99.48	99.53	0.05%
SOx			
1990	139.68	139.68	0.001%
1991	134.92	134.92	0.001%
1992	132.19	132.19	0.001%
1993	126.25	126.25	0.001%
1994	123.13	123.13	0.001%
1995	120.35	120.35	0.001%
1996	117.86	117.86	0.001%
1997	117.00	117.00	0.001%
1998	117.78	117.78	0.001%
1999	115.38	115.38	0.001%

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
2000	117.29	117.30	0.001%
2001	123.13	123.13	0.001%
2002	99.30	99.31	0.001%
2003	102.08	102.08	0.001%
2004	93.30	93.30	0.002%
2005	86.22	86.22	0.002%
2006	84.74	84.74	0.002%
2007	68.95	68.95	0.002%
2008	67.58	67.58	0.002%
2009	62.72	62.72	0.002%
2010	67.71	67.71	0.002%
2011	67.04	67.04	0.002%
2012	57.01	57.01	0.002%
2013	51.75	51.75	0.002%
2014	44.42	44.42	0.003%
2015	66.79	66.79	0.002%
2016	26.42	26.42	0.005%
2017	28.04	28.04	0.004%
2018	20.39	20.39	0.006%
2019	15.70	15.70	0.007%
$PM_{2.5}$			
1990	95.82	95.82	0.000%
1991	87.03	87.03	0.000%
1992	81.11	81.11	0.001%
1993	65.99	65.99	0.001%
1994	57.41	57.41	0.001%
1995	50.78	50.78	0.002%
1996	47.04	47.04	0.002%
1997	40.53	40.53	0.002%
1998	41.71	41.72	0.003%
1999	39.38	39.38	0.004%
2000	43.37	43.37	0.001%
2001	42.56	42.56	0.004%
2002	32.22	32.23	0.007%
2003	31.84	31.85	0.006%
2004	29.48	29.48	0.007%
2005	36.11	36.11	0.006%
2006	32.32	32.33	0.005%
2007	28.36	28.36	0.005%
2008	25.45	25.45	0.005%
2009	23.25	23.25	0.006%
2010	26.09	26.09	0.005%
2011	24.11	24.12	0.006%
2012	25.71	25.71	0.005%
2013	24.04	24.05	0.007%
2014	16.36	16.36	0.011%
2015	20.70	20.70	0.010%
2016	20.95	20.95	0.008%
2017	21.40	21.40	0.009%
2018	17.39	17.39	0.012%

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
2019	17.82	17.83	0.009%
PM_{10}			
1990	106.43	106.43	0.001%
1991	97.11	97.11	0.002%
1992	90.60	90.60	0.002%
1993	75.11	75.12	0.003%
1994	66.62	66.62	0.005%
1995	59.96	59.96	0.006%
1996	57.21	57.22	0.008%
1997	49.42	49.42	0.008%
1998	52.26	52.26	0.010%
1999	48.41	48.41	0.013%
2000	52.79	52.79	0.003%
2001	51.81	51.82	0.012%
2002	41.43	41.44	0.021%
2003	40.61	40.61	0.018%
2004	37.77	37.77	0.022%
2005	44.05	44.06	0.019%
2006	39.98	39.99	0.016%
2007	35.27	35.27	0.015%
2008	32.23	32.24	0.015%
2009	29.78	29.79	0.019%
2010	32.00	32.01	0.018%
2011	29.82	29.82	0.020%
2012	31.26	31.26	0.016%
2013	29.68	29.69	0.022%
2014	21.72	21.73	0.033%
2015	27.63	27.64	0.029%
2016	26.39	26.39	0.026%
2017	27.15	27.16	0.029%
2018	22.58	22.59	0.036%
2019	23.21	23.21	0.027%
TSP			
1990	134.48	134.48	0.003%
1991	122.51	122.51	0.003%
1992	113.58	113.59	0.005%
1993	96.74	96.74	0.006%
1994	87.24	87.25	0.009%
1995	79.73	79.74	0.011%
1996	78.88	78.89	0.014%
1997	67.67	67.68	0.014%
1998	74.60	74.61	0.017%
1999	66.96	66.98	0.023%
2000	73.32	73.32	0.006%
2001	72.01	72.03	0.022%
2002	61.35	61.37	0.036%
2003	58.35	58.37	0.031%
2004	52.12	52.14	0.040%
2005	60.38	60.40	0.035%
2006	56.09	56.11	0.029%

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
2007	46.69	46.70	0.029%
2008	42.93	42.94	0.029%
2009	39.90	39.91	0.035%
2010	41.61	41.63	0.034%
2011	38.98	38.99	0.038%
2012	39.50	39.51	0.031%
2013	38.80	38.81	0.042%
2014	30.24	30.26	0.060%
2015	40.12	40.14	0.049%
2016	34.58	34.60	0.050%
2017	36.74	36.76	0.054%
2018	30.17	30.19	0.066%
2019	30.77	30.79	0.065%

Table 8.16: *Recalculations between 1st and final version of national inventory 2021 – heavy metals*

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
Pb			
1990	57.26	57.29	0.055%
1991	56.43	56.46	0.046%
1992	57.01	57.04	0.039%
1993	54.40	54.42	0.040%
1994	50.90	50.92	0.048%
1995	48.53	48.55	0.054%
1996	48.43	48.45	0.055%
1997	50.85	50.87	0.053%
1998	51.60	51.63	0.054%
1999	50.76	50.79	0.054%
2000	48.43	48.45	0.057%
2001	40.55	40.58	0.069%
2002	41.02	41.05	0.070%
2003	18.20	18.23	0.158%
2004	19.49	19.51	0.149%
2005	20.53	20.56	0.139%
2006	11.91	11.94	0.241%
2007	11.64	11.67	0.261%
2008	10.83	10.86	0.275%
2009	9.94	9.97	0.292%
2010	10.38	10.41	0.268%
2011	10.46	10.49	0.292%
2012	10.79	10.81	0.255%
2013	11.23	11.26	0.266%
2014	10.62	10.64	0.251%
2015	10.49	10.52	0.289%
2016	10.58	10.61	0.276%
2017	11.24	11.27	0.252%
2018	10.63	10.66	0.262%
2019	9.29	9.31	0.280%
Cd			
1990	1.59	1.62	1.995%
1991	1.67	1.69	1.547%

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
1992	1.72	1.74	1.298%
1993	1.63	1.65	1.336%
1994	1.41	1.43	1.741%
1995	1.28	1.31	2.053%
1996	1.42	1.45	1.880%
1997	1.43	1.45	1.901%
1998	1.41	1.44	1.967%
1999	1.22	1.25	2.270%
2000	1.39	1.42	1.998%
2001	1.19	1.21	2.363%
2002	1.27	1.30	2.252%
2003	0.95	0.98	3.033%
2004	1.26	1.29	2.314%
2005	1.34	1.36	2.136%
2006	0.99	1.02	2.903%
2007	1.11	1.14	2.745%
2008	1.03	1.06	2.885%
2009	0.98	1.01	2.958%
2010	1.13	1.16	2.453%
2011	1.13	1.16	2.705%
2012	1.18	1.20	2.341%
2013	1.06	1.09	2.820%
2014	0.90	0.92	2.970%
2015	0.84	0.87	3.622%
2016	0.98	1.01	2.990%
2017	1.00	1.03	2.830%
2018	0.90	0.92	3.099%
2019	0.87	0.90	2.979%
Hg			
1990	2.23	2.26	1.419%
1991	2.10	2.13	1.227%
1992	2.08	2.10	1.072%
1993	1.93	1.95	1.131%
1994	1.80	1.82	1.364%
1995	1.71	1.74	1.538%
1996	1.69	1.71	1.586%
1997	1.73	1.76	1.570%
1998	1.81	1.84	1.535%
1999	1.80	1.83	1.539%
2000	1.87	1.90	1.482%
2001	1.61	1.64	1.741%
2002	1.63	1.66	1.755%
2003	1.20	1.23	2.396%
2004	1.21	1.24	2.408%
2005	1.22	1.25	2.343%
2006	0.95	0.97	3.038%
2007	0.92	0.95	3.303%
2008	0.91	0.94	3.265%
2009	0.82	0.85	3.527%
2010	0.80	0.82	3.486%

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
2011	0.82	0.85	3.730%
2012	0.81	0.83	3.412%
2013	0.80	0.83	3.737%
2014	0.78	0.81	3.399%
2015	0.81	0.84	3.752%
2016	0.79	0.82	3.711%
2017	0.79	0.82	3.576%
2018	0.79	0.82	3.523%
2019	0.76	0.79	3.428%
As			
1990	3.60	3.63	0.881%
1991	3.25	3.28	0.794%
1992	3.04	3.07	0.733%
1993	2.70	2.73	0.806%
1994	2.41	2.43	1.018%
1995	2.19	2.22	1.200%
1996	2.17	2.20	1.234%
1997	2.15	2.18	1.263%
1998	2.17	2.19	1.281%
1999	2.06	2.08	1.345%
2000	2.15	2.18	1.290%
2001	2.12	2.15	1.321%
2002	1.95	1.98	1.467%
2003	1.71	1.74	1.688%
2004	1.69	1.72	1.720%
2005	1.74	1.76	1.644%
2006	1.53	1.55	1.883%
2007	1.44	1.47	2.108%
2008	1.40	1.43	2.125%
2009	1.26	1.29	2.302%
2010	1.37	1.40	2.025%
2011	1.35	1.38	2.267%
2012	1.32	1.35	2.077%
2013	1.30	1.33	2.300%
2014	1.23	1.26	2.157%
2015	1.27	1.30	2.383%
2016	1.24	1.27	2.349%
2017	1.27	1.30	2.223%
2018	1.19	1.22	2.337%
2019	1.02	1.04	2.559%
Cr			
1990	6.39	6.42	0.496%
1991	6.13	6.16	0.421%
1992	5.99	6.01	0.372%
1993	5.24	5.26	0.416%
1994	4.68	4.70	0.524%
1995	4.21	4.24	0.626%
1996	4.51	4.53	0.594%
1997	4.36	4.38	0.623%

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
1998	4.15	4.18	0.669%
1999	3.36	3.39	0.823%
2000	3.48	3.51	0.796%
2001	3.80	3.83	0.738%
2002	3.10	3.13	0.922%
2003	3.14	3.17	0.918%
2004	3.78	3.81	0.770%
2005	3.97	4.00	0.718%
2006	4.13	4.15	0.697%
2007	4.28	4.31	0.709%
2008	4.19	4.22	0.710%
2009	3.82	3.85	0.760%
2010	4.51	4.54	0.616%
2011	4.51	4.54	0.677%
2012	4.63	4.66	0.594%
2013	3.98	4.01	0.751%
2014	3.74	3.76	0.712%
2015	4.07	4.10	0.746%
2016	4.51	4.54	0.648%
2017	4.53	4.56	0.625%
2018	4.31	4.33	0.646%
2019	4.39	4.42	0.593%
Cu			
1990	11.96	11.99	0.265%
1991	11.07	11.10	0.233%
1992	10.93	10.95	0.204%
1993	9.79	9.81	0.223%
1994	9.19	9.21	0.267%
1995	8.76	8.79	0.301%
1996	9.52	9.55	0.281%
1997	9.44	9.47	0.287%
1998	8.93	8.96	0.311%
1999	7.43	7.46	0.372%
2000	6.92	6.95	0.401%
2001	7.78	7.81	0.360%
2002	7.17	7.20	0.399%
2003	6.75	6.78	0.427%
2004	7.51	7.54	0.388%
2005	8.80	8.83	0.324%
2006	8.44	8.46	0.341%
2007	9.33	9.36	0.325%
2008	9.46	9.49	0.315%
2009	8.49	8.52	0.342%
2010	9.60	9.63	0.289%
2011	9.62	9.65	0.317%
2012	10.07	10.10	0.273%
2013	8.93	8.96	0.335%
2014	9.34	9.37	0.285%
2015	10.64	10.67	0.285%

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
2016	11.17	11.20	0.262%
2017	11.36	11.39	0.249%
2018	9.39	9.42	0.296%
2019	9.71	9.74	0.268%
Ni			
1990	7.38	7.41	0.430%
1991	6.44	6.46	0.401%
1992	5.77	5.79	0.386%
1993	4.81	4.83	0.454%
1994	4.18	4.21	0.586%
1995	3.85	3.88	0.684%
1996	3.57	3.60	0.749%
1997	3.18	3.20	0.855%
1998	3.07	3.10	0.905%
1999	2.65	2.67	1.045%
2000	2.55	2.58	1.088%
2001	2.87	2.89	0.977%
2002	2.34	2.37	1.223%
2003	2.03	2.06	1.418%
2004	1.90	1.93	1.530%
2005	1.90	1.93	1.501%
2006	2.13	2.16	1.351%
2007	2.05	2.08	1.479%
2008	2.03	2.06	1.470%
2009	1.84	1.87	1.574%
2010	1.90	1.93	1.464%
2011	1.87	1.90	1.633%
2012	1.70	1.73	1.617%
2013	1.72	1.75	1.738%
2014	1.61	1.64	1.651%
2015	1.74	1.77	1.742%
2016	1.68	1.71	1.738%
2017	1.68	1.71	1.686%
2018	1.62	1.65	1.719%
2019	1.46	1.49	1.782%
Se			
1990	5.28	5.31	0.600%
1991	4.42	4.44	0.584%
1992	3.79	3.81	0.589%
1993	3.21	3.23	0.679%
1994	2.83	2.86	0.865%
1995	2.63	2.65	1.002%
1996	2.59	2.62	1.033%
1997	2.53	2.55	1.074%
1998	2.58	2.61	1.077%
1999	2.56	2.58	1.082%
2000	2.62	2.65	1.058%
2001	2.98	3.01	0.941%
2002	2.73	2.76	1.048%

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
2003	2.83	2.86	1.019%
2004	2.68	2.71	1.085%
2005	2.69	2.72	1.060%
2006	2.58	2.61	1.113%
2007	2.45	2.48	1.237%
2008	2.55	2.58	1.168%
2009	2.27	2.30	1.281%
2010	2.33	2.36	1.192%
2011	2.32	2.35	1.314%
2012	2.21	2.24	1.243%
2013	2.11	2.14	1.420%
2014	1.95	1.97	1.367%
2015	2.05	2.08	1.478%
2016	1.95	1.98	1.501%
2017	1.97	2.00	1.438%
2018	1.83	1.86	1.517%
2019	1.58	1.60	1.649%
Zn			
1990	38.31	38.34	0.083%
1991	35.00	35.03	0.074%
1992	32.86	32.88	0.068%
1993	32.13	32.15	0.068%
1994	31.93	31.96	0.077%
1995	31.09	31.12	0.085%
1996	30.59	30.61	0.087%
1997	30.98	31.01	0.088%
1998	31.79	31.82	0.087%
1999	31.93	31.95	0.087%
2000	33.26	33.29	0.083%
2001	34.36	34.39	0.082%
2002	32.24	32.27	0.089%
2003	33.30	33.33	0.087%
2004	42.52	42.55	0.068%
2005	39.96	39.99	0.071%
2006	33.49	33.52	0.086%
2007	36.13	36.16	0.084%
2008	35.59	35.62	0.084%
2009	34.67	34.70	0.084%
2010	37.69	37.72	0.074%
2011	37.70	37.73	0.081%
2012	39.86	39.89	0.069%
2013	40.25	40.28	0.074%
2014	36.73	36.76	0.072%
2015	33.71	33.74	0.090%
2016	38.52	38.55	0.076%
2017	39.91	39.94	0.071%
2018	38.01	38.04	0.073%
2019	36.74	36.77	0.071%

Table 8.17: *Recalculations between 1st and final version of national inventory 2021 – POPs*

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
HCB			
1990	1.79	15.06	742.752%
1991	1.62	10.97	577.234%
1992	1.51	10.75	613.780%
1993	1.40	6.19	342.785%
1994	1.28	5.32	316.062%
1995	1.21	5.29	338.075%
1996	1.20	5.67	371.919%
1997	1.23	4.47	264.135%
1998	1.26	4.64	269.492%
1999	1.26	4.43	251.143%
2000	1.38	4.89	254.712%
2001	1.25	4.46	255.298%
2002	1.27	4.18	228.134%
2003	1.31	5.18	297.076%
2004	1.43	3.54	147.246%
2005	1.35	3.41	153.142%
2006	1.24	4.02	225.856%
2007	1.17	3.33	184.751%
2008	1.14	3.18	179.813%
2009	1.07	3.12	190.540%
2010	1.11	3.24	191.337%
2011	1.20	3.35	178.947%
2012	1.06	3.40	221.203%
2013	1.06	3.50	229.019%
2014	1.09	3.10	183.857%
2015	1.02	3.30	225.269%
2016	1.05	3.08	194.202%
2017	1.08	3.97	266.705%
2018	1.09	3.40	212.639%
2019	1.01	3.37	232.480%
PCBs			
1990	27.22	27.87	2.416%
1991	26.44	27.01	2.177%
1992	26.38	26.91	2.026%
1993	24.38	24.77	1.616%
1994	24.44	24.76	1.307%
1995	23.98	24.24	1.096%
1996	22.48	22.71	1.004%
1997	23.48	23.65	0.742%
1998	22.60	22.78	0.806%
1999	23.79	23.96	0.686%
2000	24.55	24.72	0.721%
2001	24.35	24.52	0.678%
2002	26.22	26.33	0.402%
2003	27.58	27.69	0.411%
2004	27.24	27.34	0.367%
2005	26.81	26.92	0.420%
2006	23.21	23.33	0.494%
2007	22.70	22.81	0.475%
2008	20.83	20.93	0.469%

YEAR/POLLUTANT	2021_V1	2021_V2	CHANGE %
2009	18.13	18.22	0.497%
2010	19.49	19.59	0.524%
2011	18.32	18.41	0.531%
2012	19.20	19.31	0.552%
2013	20.30	20.40	0.500%
2014	20.77	20.83	0.328%
2015	19.76	19.85	0.448%
2016	20.27	20.38	0.513%
2017	21.05	21.16	0.490%
2018	21.41	21.49	0.388%
2019	17.64	17.72	0.490%

CHAPTER 9: PROJECTIONS OF EMISSIONS

Last Update: 15.3.2021

The complexity and dynamic changes of the economic development in recent years have significantly complicated the preparation of projections of air pollutant emissions, particularly concerning continual changes of estimated development of macro-economic indicators for the near future. Comprehensiveness is a very important part of projections calculation and therefore a joint GHG and air pollutant emission projections were used. The modelling of emission projections was provided consistent with the GHG emission projections reported on 15th March 2021 under Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on Energy Union Governance and Climate Action. Actualized emissions projections of air pollutant were prepared in line with national air pollution control programmes.

The year 2018 was determined as the base year for modelling of emissions projections for the actualized scenario for which verified data sets were available from the national emission inventory reported in March 2021. Actualization was based on efforts to improve the methodology. Changes were driven by the new data and information about future development and also by changes in methodology. Important changes were also applied to the base of updated policies and measures or new information from stakeholders.

Table 9.1*: Main parameters applied in emission projections*

ITEM	UNITS	2015	2020	2025	2030	2035	2040
Gross domestic product: Constant prices	EUR million	76 734	89 328	102 290	117 033	127 854	134 921
Population	1000 People	5 447	5 450	5 462	5 430	5 364	5 281
EU ETS carbon price	EUR/EUA	7.5	15.0	22.5	33.5	42.0	50.0
International coal import prices	EUR/MWh	2.0	1.8	2.7	2.9	13.5	14.1
International oil import prices	EUR/MWh	8.3	6.6	11.8	14	61.0	64.6
International gas import prices	EUR/MWh	6.7	3.5	5.7	6	37.8	39.1

Even use of a wide range of input data and improvement of methodological approach at activity projection in relevant sectors, the results are influenced by the uncertainties of future development, preferably in the case of the macro-economic data and elasticity of the final energy consumption. These uncertainties are predominantly related to the process of economic transformation and privatization and historical data can be hardly used for future development extrapolation. The emission projections from the Energy sector will be influenced by the main pollutant and GHG emission caps in the new EU ETS regime. The decision 406/2009/EC on effort sharing in the sectors not included in the emission trading plays the important role.

9.1 TOOLS AND METHODS

The general approach in emissions projections calculation is based on the use of the same methodology as in the emission inventory with projected parameters, as much as possible. There were some changes in methodology. The intention is to create a methodology that is best suited for the estimation of emission projections.

The emission modelling was prepared by software model TIMES + model CPS - *Compact PRIMES for Slovakia* (energy + industry)[1],[2] software COPERT (transport)[3],[4] as well as the specific calculations in MS EXCEL environment (energy, agriculture, waste, industry).

Energy and Industry

Model MESSAGE used in previous years was replaced and not used anymore. The new methodology in the energy sector should be based on the combination of the model TIMES with the CPS model. But for this version of emission projections reporting was model TIMES not fully set and used only for the power generation sector.

TIMES - (The Integrated MARKAL-EFOM System) model generator was developed as part of the IEA-ETSAP's methodology for energy scenarios to conduct in-depth energy and environmental analyses (Loulou et al., 2004). The TIMES model generator combines two different, and complementary approaches to modelling energy: a technical engineering approach and an economic approach. In a nutshell, TIMES is used for, "the exploration of possible energy futures based on contrasted scenarios" (Loulou et al., 2005).

CPS – COMPACT PRIMES for SLOVAKIA is a mathematical system implemented in the General Algebraic Modelling System (GAMS), a high-level modelling tool for mathematical programming. CPS is designed to support energy strategy making including assessment of policy instruments, energy demand and supply planning and evaluation of climate change mitigation policies. The model includes key energy sector metrics at a detailed level: demand for energy by sector and fuel, modelling of energy efficiency possibilities, capacities of technologies, power generation mix, cogeneration and other energy supply technologies, fuel prices and system costs, investment by sector and energy-related CO_2 emissions.

An energy model for Slovakia captures the details of energy supply and demand that are critical to designing a low carbon path. A country-level energy model named the Compact-PRIMES for Slovakia (CPS), provides a bottom-up technology-rich analysis of the key elements of the energy sector and has been designed to evaluate low carbon options for the energy sector. The CPS model is a single-country partial equilibrium model of the energy sector, which balances energy supply and demand. As a hybrid model with technology and engineering detail together with micro-and macroeconomic interactions and dynamics, the CPS' sectoral decisions consider technology and costs. Electricity and heat supply and biomass supply are captured on the supply side while energy demand modelling includes separate treatment of the industrial sector (and 10 subsectors), transport, and other demand. The design of the CPS model is appropriate for the quantification of long-term energy planning and policies reducing energy-related greenhouse gas emissions.

Also, the macroeconomic model, named the ENVISAGE-Slovakia applied general equilibrium (Slovak-CGE) model, has been customized to reflect the particular features of the Slovak economy. A macroeconomic model for Slovakia complements the energy model, using the detailed energy system results from the CPS model and assessing economy-wide impacts. Importantly, demand for energy

[1] https://iea-etsap.org/index.php/etsap-tools/model-generators/times
[2] https://iea-etsap.org/index.php/documentation
[3] https://www.emisia.com/utilities/copert/documentation/

commodities across households and firms is price sensitive, and various electricity generation options are captured. Emissions are explicitly modelled. A variety of mitigation policies can be analysed using the Slovak-CGE model. By comparison with the CPS energy model, the Slovak-CGE model aims to simulate the broader economic effects of moving towards a low carbon economy.

The detailed description is provided in the Final Project Report here[4]

The modelling of emission projections in the Energy sector was based on sectoral trends and development from the CPS model and actualization was made by taking into account results of model TIMES in the category public electricity and heat production. Emission from households combustion was modelled separately in MS Excel factsheet model, where was taken into account improving efficiency, equipment status and structure and good practice.

Transport

COPERT is the EU standard vehicle emissions calculator. It uses vehicle population, mileage, speed and other data such as ambient temperature and calculates emissions and energy consumption for a specific country or region. Also, COPERT is a technologically advanced, transparent and internationally recognised research tool.

Methodology, key assumptions and trends: The fleet database for emission projections consists of two main parts. The historical time series, which is based on the Information System of Vehicle Registration of the Police Presidium of the Slovak Republic (IS EVO) and future modelled estimates of the development of the vehicle fleet. The data of the historical time series are prepared annually for the needs of emission inventories of Slovakia according to COPERT (version 5) model. The development of the time series until 2050 is projected according to the methodology based on the Sybil model and calculated in COPERT.

Estimates up to 2050 are made on the knowledge of historical time-series, newly registered vehicles, annually scrapped vehicles and the survival rate of vehicles within individual vehicle segments. The assumption is that there will be no vehicle older than 30 years. Thanks to these data, it is possible to create a general matrix of the age structure of the vehicle fleet and apply and adapt it to any development of the vehicle fleet within Slovakia. Creating an age structure for each year until 2050 is the most important part of model preparation.

The basic development of the vehicle fleet according to the methodology mentioned above forms a baseline for the WEM scenario. If the baseline is applied directly to the calculation of the model, can be obtained projections for the emission with existing measures (WEM scenario). The baseline for the WEM scenario is shown in figure 1. The total of the vehicle fleet is not changing in the WAM, but only the technological structure according to implemented measures.

Methodology: The methodology for the calculation of the projections is based on COPERT calculation. The most important data for calculations are:

1. Development of the national vehicle fleet
2. Development of annual mileage for each vehicle category
3. Technology changes
4. Science-based expert judgment of new technology emission factors

The calculation itself is done by the model COPERT through CLI (Command-line interface), which allows introducing into the model any new vehicle category and technology. It is necessary to implement all the basic data for these categories as emission factors, energy consumption and circulation data. After input, the model calculates the consumption and emissions the same way as for the emission inventories. The outcome emissions are afterwards recalculated by the technological efficiency factor.

This factor indicates the technological evolution of vehicles until 2050. This factor also reduces the emission factor as required by legislation.

Agriculture

Activity data: Research Institute of Agriculture and Food Economics in Bratislava prepared parameters for emission projections in the exponential balancing model - SAS 9.3 for the period 2018–2040 (NPPC-VÚEPP) (NPPC, 2017). Projections of input parameters such as livestock numbers and amounts of applied organic and mineral fertilizers were subsequently calculated at the Slovak Hydrometeorological Institute (SHMÚ) by 2050 using the exponential balancing function MS Excel, in the Forecast tool.

The principle of exponential smoothing is based on adaptive methods for time series parameters projections—the projections of parameters made according to exponential smoothing. Exponential smoothing is the weighted average of the past data, with the recent data points given more weight than earlier data points. The weights decay exponentially towards the earlier data points (NPPC, 2017).

The whole model of calculating emissions from livestock breeding is based on regional differences, which means that the input parameters and stocks of animals had to be re-modelled at the level of smaller territorial units - regions. Projections of the number of livestock, which were delivered to NPPC-VÚEPP only at the level of the Slovak summary, were distributed by the SHMÚ to the regional level and only after this re-division were they implemented into the calculations of emission projections.

At the time of preparation of projections of emissions from agriculture, there was no national strategic document, except for a case study prepared by the NPPC-VÚEPP, which would model the development of livestock numbers and consumption of fertilizers in the Slovak Republic.

Emission calculation: The Slovak Hydrometeorological Institute compiles annually emissions balance and uses emission factors according to the EMEP/EEA GB_{2019}.

The NH_3, NOx emission projections were estimated according to the EMEP/EEA GB_{2019} Guidebook methodologies, the Slovak Republic did not use the specific model for forecasting emissions. NH_3, NOx emission projections were modelled following the Tier 2 approach based on analysing the nitrogen cycle. The algorithm in the system Python was developed, which is an automated version of the N-Tool, developed following the methodology EMEP/EEA GB_{2019}. The nitrogen flow as an available national parameter was taken into account for more accurate emissions estimations. During the preparation of projected emissions of ammonia were considered the same input data and policies and measures, as in the preparation of projected emissions of N_2O. Emissions of NOx and NH_3 from manure storage and application were estimated taking into account the abatements requirements to reduce emissions from livestock farms.

PM_{10}, $PM_{2.5}$, emissions from manure management and agricultural soils were calculated using the default Tier 1 emissions factors for each category of farm animals. The same emissions factors were used for all years. Estimation of NMVOC was completed by the available parameters time of housing feeding situation – the amount of silage in the ration and gross feed intake. Dairy cattle and non-dairy cattle have been calculated using Tier 2 methodology by EMEP/EEA GB_{2019}. NMVOC emissions from other animal categories were calculated using the Tier 1 methodology and emission factors outlined in the EMEP/EEA GB_{2019}. NMVOC emissions from Agricultural soils were calculated using the Tier 1 methodology and emission factors outlined in EMEP/EEA GB_{2019}.

Waste

MUNICIPAL WASTE MODEL

The waste amounts model is derived from statistical data on municipal waste published by ŠÚ SR and waste composition analysis published by Benešová[5]. Total generated waste is estimated from demographic projections and waste per capita. Generated waste is divided into mixed municipal waste, a group of separately collected fractions covered by waste composition analysis and a group of other separately collected fractions not covered by waste composition analysis. The same division is applied for landfilled waste. Total landfilled waste is estimated as a difference between total generated waste and the sum of recovered waste as material and incinerated. The model uses amounts of separated fractions as input variables, from which is estimated the amount of mixed/residual waste and also changes in waste composition.

9.2 KEY CHANGES IN UPDATED PROJECTIONS

Residential heating – Probably the most crucial sector cover most of the $PM_{2.5}$ emissions and a considerable amount of NOx and NMVOC emissions. New information was obtained from the second questionnaire survey, new implemented and planned measures. Based on this information datasets were improved together with estimations of natural improvement in the structure of households, heating equipment was implemented. Compared to the last submission these scenarios was included measures that would force improving energy efficiency, equipment changes and improvement of good practises in households heating.

Energy efficiency – Energy efficiency was taken into account based on data from the CPS model

Transport – Actualization based on new methodology with model COPERT using new assumptions and data from the CPS model.

Industry – Changes in the Industry was driven by the trend of historical emission in the last years and assumed slow technology improvement, new estimated sectoral demand from CPS and based on information from producers.

Energy – Actualization was similar to in the industry sector. However, there is a significant decrease in emission caused by planned measures by key producers. Significant impact has planned phase-out of fossil fuel power plants and fuel switch to natural gas, RES and biomass.

Agriculture – Changes were driven by the improvement of methodology

The most important improvement WAM scenario was included in 2021. Published policies and measures after 2018 from the national strategies were considered in the **WAM** scenario. The list of applied policies and measures were taken at the National Air Pollution Control Program[6] and the Low-carbon Development Strategy of the Slovak Republic[7].

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[5] Benešová, Kotoulova, Černík: Základní charakteristiky komunálních odpadů http://www.mnisek.cz/e_download.php?file=data/editor/234cs_2.pdf&original=STANOVEN%C3%8D+PRODUKCE+ODPAD%C5%AE-P%C5%98%C3%8DLOHA.pdf

[6] **MŽP SR. 2020.**The National Air Pollution Control Program.

[7] **MŽP SR,2019.** *Low-Carbon Development Strategy of the Slovak Republic until 2030 with a View to 2050*

9.3 POLICIES AND MEASURES

Projections of air pollutant emissions were prepared for the years 2020-2050 within the following scenarios:

With measures scenario (WEM) – projections reflect all measures implemented or adopted before the date of preparation of the projections (31 December 2020).

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.

List of Policies and measures which have been taken into account in the scenario with measures (WEM):

ENERGY

Integrated National Energy and Climate Plan of Slovakia (NECP)

Energy efficiency improvement

National Renewable Energy Action Plan - Impact renewable energy sources in heat and electricity generation. Increase of the share of electricity production from renewable energy sources in the power system. Increase biomass consumption for electricity and heat production.

Emission trading, the new allocation - The ETS stimulates the use of the biomass in the fuel mix of energy units

Specific emissions limits and specific technical conditions for MCP and LCP - Setting limits on concentration for specific air pollutant for particular combustion plants.

National Emission Reduction Program (NAPCP) – sectoral measures in from NAPCP:

Support for the replacement of old solid fuel boilers with low-emission ones - Replacement of old non-ecological solid fuel boilers with new ones, low-emission and more energy-efficient boilers in Households.

The transition of households using solid fuel for heating to another low-emission heat source (eg natural gas) - The aim of the measure is to support the transition to low-emission methods of household heating. The measure assumes that households currently using solid fuel will be connected to a low-emission heat source.

Awareness campaign and education on good practice in coal and biomass combustion - Raising people's awareness of the importance and risks of poor air quality. And also raising information on the possibilities and simple measures to improve proper heating methods, use of wood, etc.

Transformation or phase-out of fossil fuel-fired power plants - transition to low-emission fuels. Phase-out of Novaky and Vojany Coal power plants

TRANSPORT

The RED directive cap for 2020 and further - This directive is transposed to the Slovak legislation in the Act no. 309/2018, amending Act no. 309/2009 Coll. on the promotion of renewable energy sources and high-efficiency cogeneration. This measure sets the share of the biofuels in fuels.

Action plan for the development of electromobility in Slovakia - Slow rise and grants for electromobility. Temporarily rise of the numbers of new EV (PHEV, EV) in particular years. It is assumed that the increasing trend, based on their survival rate and a lifetime of EVs, will last until 2050 and no other new measures will be introduced.

National Emission Reduction Program (NAPCP)

Strategic Plan for the development of transport in Slovakia until 2030

Integrated National Energy and Climate Plan of Slovakia (NECP)

Revision and updating of the National Policy Framework for the Development of the Alternative Fuels Market

INDUSTRY

Use of BAT level technologies in Industry

Energy efficiency improvement

AGRICULTURE

The list of applied policies and measures was taken from the National Program for Reducing Pollutant Emissions (EC, 2019), from the Low Carbon Strategy of the Slovak Republic (MŽP SR, 2020) and the strategic document " Farm to Fork Strategy" (EC, 2020). The forthcoming EU food strategy aims to reduce the use of pesticides, fertilizers and antibiotics in agriculture. By 2030, the consumption of hazardous pesticides should be reduced by 50 % and the consumption of inorganic fertilizers should decrease by 20 %. Targets are set for the entire European Union, the Slovak Republic does not set binding reduction resulting from the Farm to Fork Strategy.

The Low Carbon Strategy aims to identify measures, including to achieve climate neutrality in the Slovak Republic in 2050 and to achieve a 55 % emission reduction in 2030 compared to 1990. This ambitious goal was formally defined in the last stage of the Low Carbon Strategy. Other less ambitious emission reduction scenarios (MŽP SR, 2020) were analysed in detail.

In preparing projections, measures were selected and analysed to detectable impact on the estimated emissions and their quantified impact on the greenhouse gas inventory and inventory of pollutants as possible. All other measures proposed in the Low Carbon Strategy are not implemented in the projections due to lack of measurable effect on inventory but have an impact on the whole concerning the environment.

Based on the qualification of the probable impact of mitigation measures on emission inventories, we distinguish:

1. Measures having an identifiable impact on emissions. This impact can be specifically attributed to the implementation of mitigation measures. These measures are measurable and effective, this type of measure has been used in the preparation of emission projections.

2. Measures that have an impact on emissions reported in inventories, but this impact cannot be specifically attributed to a specific mitigation measure. This includes measures that are difficult to measure and have different often synergistic ý or antagonistic effect.

3.°Measures whose impact on emissions reported in inventories is possible because emission reductions are visible. The effect of these measures depends on other factors.

4. Measures that do not have a direct impact on emissions but which may have a positive impact on farmers' behaviour or the environment in the sector.

In the context of this document were prepared two scenarios:

The **WEM** scenario is a measures scenario that includes projections of anthropogenic emissions from agricultural sources, taking into account the effects of policies and measures adopted by the end of 2020. The measures considered in the **WEM** scenario prevent NH_3 emissions by storing manure and manure more efficiently by isolating them from the environment. This measure can be found in several strategic documents, especially in the Decree of the Ministry of the Environment of the Slovak Republic no. 410/2012 Coll., Which implements certain provisions of the Air Act. The implementation of this measure has an impact on NH_3 and NOx from category 3B Manure and slurry management

The **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.

Emissions of NOx and NH_3 from manure and manure storage in the WAM scenario were modelled taking into account the measure of introducing requirements to reduce emissions from livestock farms classified as a medium source of emissions to air. This measure was proposed in the National Program for Emission Reduction (MŽP SR, 2020) and implemented into the calculation of NH_3 and NOx emissions by implementing low-emission systems for manure and manure storage. This measure has an impact on category 3B Manure and slurry management.

Another implemented measure (MŽP SR, 2020), which has an impact on NH_3 and NOx emissions in category 3B Manure and manure management, was the use of manure as a feedstock into biogas plants. The impact on reducing emissions in two main ways - reducing carbon emissions from fossil fuels through the production of energy sources and reducing direct emissions of methane and nitrous oxide from manure and sludge storage. Although anaerobic digestion does produce methane, it is captured and used in energy production, which has a positive impact on increasing the share of energy from renewable sources.

Emissions of NH_3 and NO_X from the application of inorganic nitrogen fertilizers (category 3D Agricultural soils) were modelled in the **WAM** scenario based on a measure implemented from the Low Carbon Strategy of the Slovak Republic (MŽP SR, 2020). This measure recommends the transition or legislative restriction on the application of nitrogen fertilizers to urea bases. The implementation of this measure has an impact on the reduction of NH_3 and NOx emissions, mainly due to the high volatility of ammonia from urea fertilizers. At the same time, limiting urea consumption will prevent carbon dioxide emissions. Nitrous oxide emissions are limited based on the reduction of the total consumption of inorganic fertilizers in the resulting consumption summary.

The last implemented measure was taken from the European Green Agreement and mentioned in the Farm to Fork strategy. This measure recommended a 20% reduction in inorganic fertilizers consumption by 2030. This measure has an impact on NH_3 and NOx.

The list of policies and measures that have been taken into account in the emission projections according to the individual scenarios and their effect is given in ***Table 9.2***.

Table 9.2: *List of implemented policies and measures into projections according to the scenarios*

STRATEGIC DOCUMENT LEGISLATION	SCENARIO	GAS / CATEGORY	MEASURE	EFFECT OF THE MEASURE
Code of good agricultural practice National Emission Reduction Program Low carbon strategy Decree of the Ministry of the Environment of the Slovak Republic no. 410/201 2 Coll.	WEM	NH_3, NOx- storage of manure and manure	Efficient storage of animal waste, specifical 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
National Air Pollution Control Programme	WAM	NH_3,NOx - agricultural land	Obligation to comply with measures to reduce ammonia emissions even at medium sources of pollution	synergistic
Low carbon strategy	WAM	NH_3, NOx - storage of manure and manure	Effectively process animal waste and use biogas, especially as a local energy source	synergistic
Low carbon strategy	WAM	NH_3,NOx - agricultural land	Intensification of the use of nitrogen fertilizers with stabilized nitrogen at the expense of the use of urea	synergistic
Farm to fork strategy	WAM	NH_3,NOx - agricultural land	Reduction of inorganic nitrogen fertilizers by 20 % compared to 2030	synergistic

WASTE

Act on waste introduces the emphasis on the separation of packaging's and recyclables

Waste Management Program of the Slovak Republic for 2016-2020. This document states that the previous plan for 2011-2015 did not achieve planned objectives and states that the objective for 2013 to reduce the disposal of biodegradable waste to 50% of 1995 level was not achieved, neither the objective to recycle 35% of municipal waste by 2015. The plan for the period 2021-2025 is not yet available.

The Waste Prevention Programme 2019–2025 evaluates specific targets from the programme for the period 2014 – 2018 and concludes that the majority of them were not achieved. This new WPP 2019 – 2025 defines the following quantified targets for municipal waste:

- Reduction of residual municipal waste to 50% of the 2016 level by 2025
- Reduction of biodegradable waste in residual municipal waste by 60% not later than 2025
- Reduction of landfilling to 10% of total municipal waste by 2035

It is assumed, that to achieve the targets above, the two incinerators will continually increase operation to their full capacity of 285 kt/yr (Košice 70+80kt/yr and Bratislava 135 kt/tr). Also, additional incinerators and MBT capacity of 560 kt/yr need to be developed.

In this scenario, the recovery of landfill gas is assumed from all landfills developed after 1993 because these had to establish landfill gas collection systems.

List of Policies and measures which have been taken into account in the scenario with additional measures (WAM):

ENERGY

Support for the replacement of old solid fuel boilers with low-emission ones - More effective replacement of old non-ecological solid fuel boilers with new ones

The transition of households using solid fuel for heating to another low-emission heat source (eg natural gas, heat pumps, solar energy…) - Stronger measure, which supports the transition to low-emission methods of household heating. Greater penetration of new technologies.

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 of 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. Fuel switch of all power plants from fossil solid fuels.

Further increase of Energy efficiency and use of RES – for Energy and industry

TRANSPORT

Continuity of direct support for the use of low-emission vehicles – based on the Action plan for the development of electromobility in Slovakia.

Long term financial mechanism to support the development of charging infrastructure - based on the Action plan for the development of electromobility in Slovakia.

Setting stricter requirements for regular technical inspections

Tax for purchasing ICE vehicles with high CO2 g/km - Decreasing numbers of old vehicles.

Setting stricter requirements for periodical technical controls – Stricter check on NOx emissions during the vehicle inspection.

The modal shift in passenger and freight transport - Strategic Plan for Development of the Transport Infrastructure

Introduction and promotion of Fuel cell electric vehicles (FCEV) - European Hydrogen Strategy

Information campaign

9.4 GENERAL RESULTS AND COMMITMENTS

The actualization of the emission projection led to some changes in comparison with previously reported projections. In the table below are presented national totals of air pollutant emissions and a comparison to the absolute values of emission targets.

Table 9.3: *WEM scenario emission projection trends and targets*

TOTAL EMISSIONS OF SLOVAKIA (kt)	2005	2015	2020	2025	2030	*TARGET 2020*	*TARGET 2030*
NOx	104.5	73.2	62.68	54.67	48.47	66.88	52.25
NMVOC	149.7	112.0	100.29	92.96	85.25	122.73	101.78
SOx	86.2	66.8	17.59	16.28	15.53	37.07	15.52
NH_3	32.6	29.7	33.22	33.04	33.52	27.72	22.83
$PM_{2.5}$	36.1	20.7	17.81	15.75	13.89	23.11	18.42

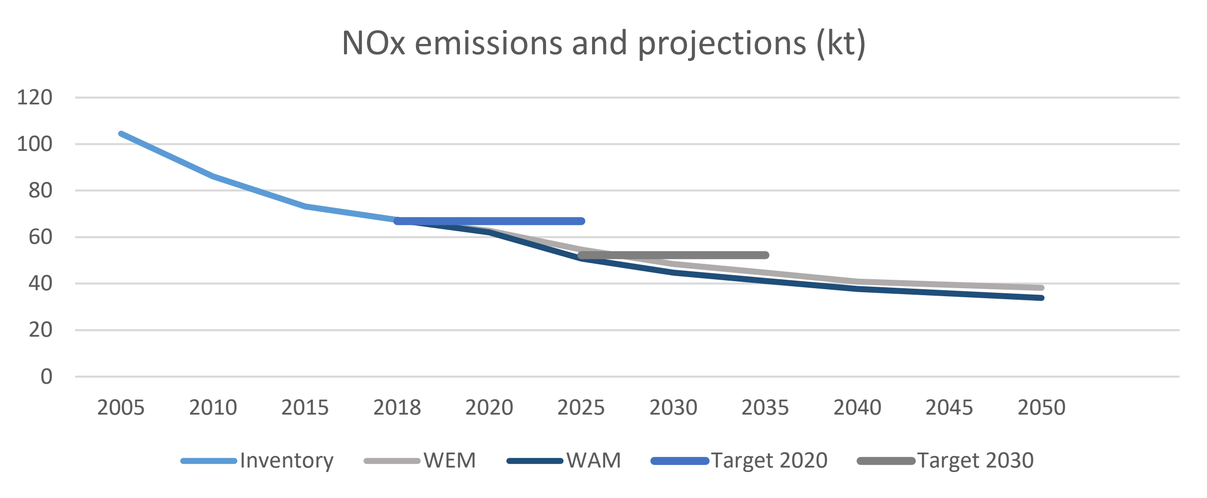
Table 9.4: *WAM scenario emission projection trends and targets*

TOTAL EMISSIONS OF SLOVAKIA (kt)	2005	2015	2020	2025	2030	*TARGET 2020*	*TARGET 2030*
NOx	104.5	73.2	62.07	50.80	44.66	66.88	52.25
NMVOC	149.7	112.0	98.39	89.01	81.60	122.73	101.78
SOx	86.2	66.8	17.48	15.71	13.70	37.07	15.52
NH_3	32.6	29.7	23.64	23.44	27.40	27.72	22.83
$PM_{2.5}$	36.1	20.7	17.67	14.96	12.49	23.11	18.42

NOx emissions

Figure 9.1 shows a general view on trends of emissions NOx and estimated emissions projections based on encountered measures. Emissions slightly decrease and achieving the 2030 target will be very tight even in WAM scenario.

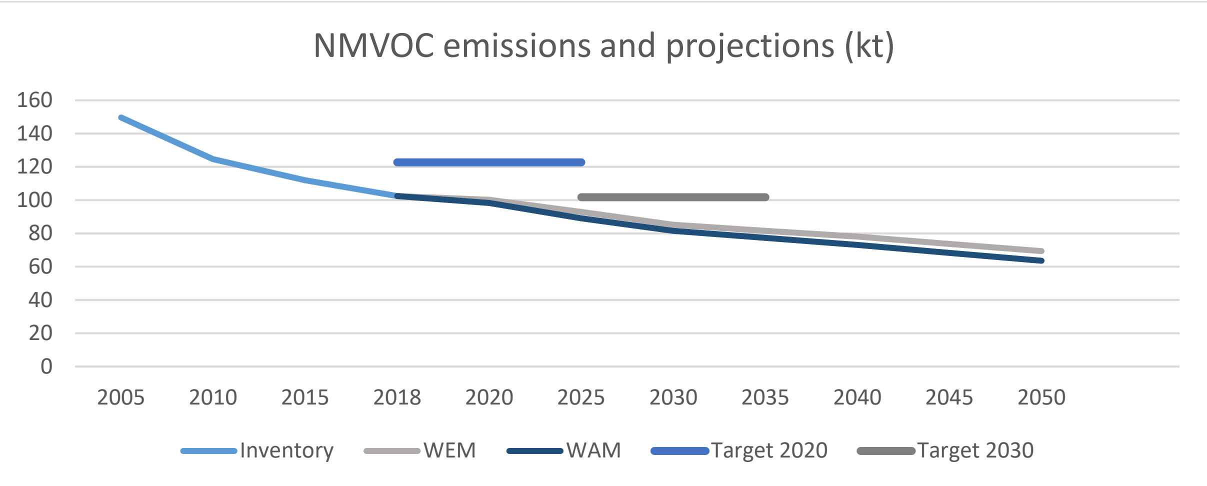
Figure 9.1: *Emission projections trends for pollutant NOx*



NMVOC emissions

Figure 9.2 shows a general view on 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 scenario.

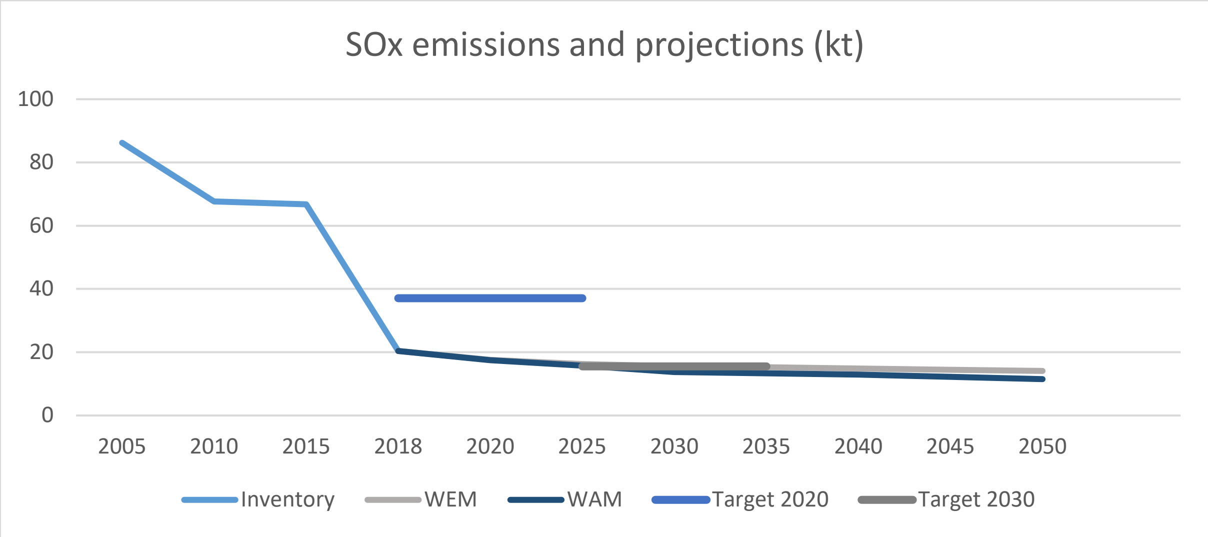
Figure 9.2: *Emission projections trends for pollutant NMVOC*



SOx emissions

Figure 9.3 shows the general view on trends of SOx emissions. After implementing strong measures in the energy sector Slovakia should achieve the 2030 target in the WAM scenario.

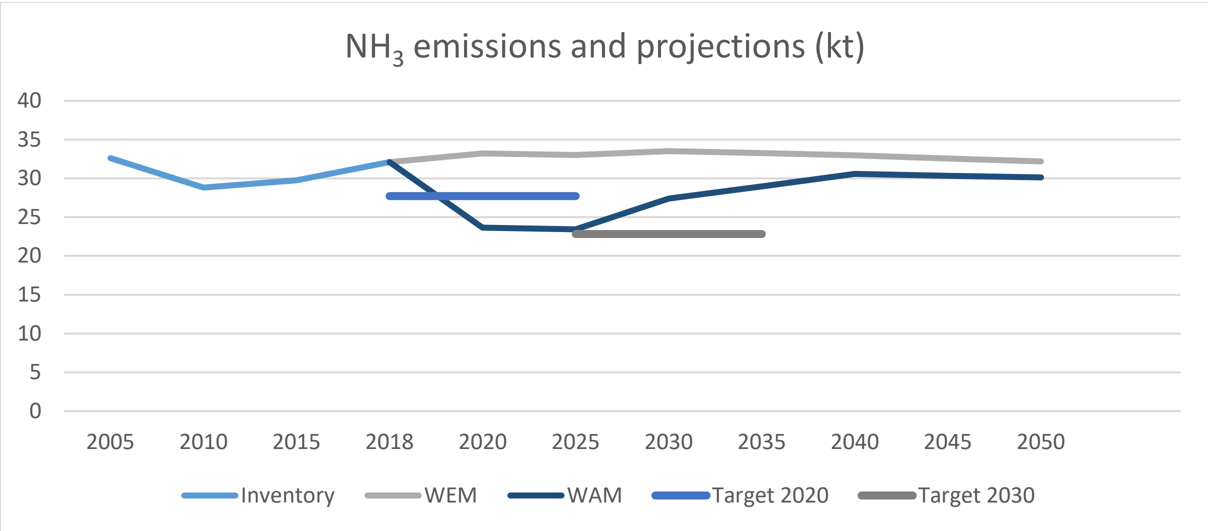
Figure 9.3: *Emission projections trends for pollutant SOx*



NH_3 emissions

Figure 9.4 shows a different trend between WEM and WAM scenario. According to the measures contained in both scenario will be very hard to achieve the 2030 target. The increase of NH_3 emissions in the WAM scenario is caused by extensive use of LNG and CNG in the Transport sector.

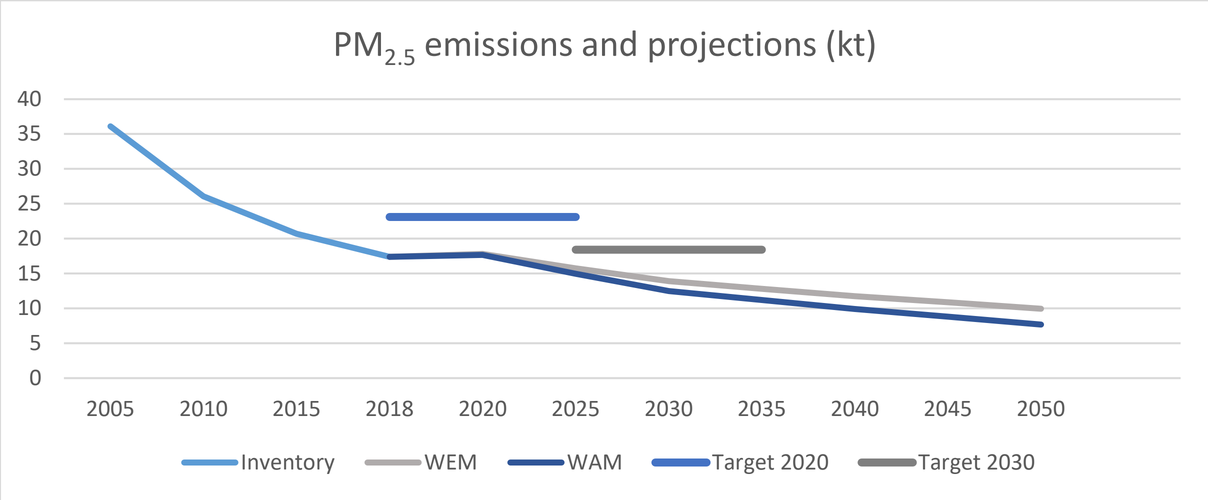
Figure 9.4: *Emission projections trends for pollutant NH_3*



$PM_{2.5}$ emissions

Figure 9.5 shows the estimated trend of $PM_{2.5}$ emissions. This is a key pollutant and the future target achievement mainly depends on development in the household and transport sector. For now, trends of emissions seems to be in the margin of target 2030.

Figure 9.5: *Emission projections trends for pollutant $PM_{2.5}$*



9.5 SECTORAL RESULTS – ENERGY

The modelling of emission projections in the Energy sector was based on sectoral trends and development from the CPS model and actualization was made by taking into account results of model TIMES in the category Public electricity and heat production (1A1a). The outputs from modelling were determined also by the reduction potential of measures to reduce emissions.

The next tables show trends of emissions for individual pollutants.

NOx emissions

Table 9.5: *NOx emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030
1A1	19.10	13.04	8.49	5.09	3.54	3.48
1A2	14.88	11.31	11.90	8.19	8.10	7.93
1A4	8.79	8.54	8.65	8.60	8.04	7.60
1A5	0.20	0.13	0.48	0.67	0.68	0.69
1B	0.00	0.00	0.00	0.00	0.00	0.00
1 Energy	**42.97**	**33.02**	**29.53**	**22.56**	**20.35**	**19.70**

WAM	2005	2010	2015	2020	2025	2030
1A1	19.10	13.04	8.49	5.09	3.52	2.67
1A2	14.88	11.31	11.90	8.13	7.16	6.74
1A4	8.79	8.54	8.65	8.59	7.84	7.49
1A5	0.20	0.13	0.48	0.67	0.68	0.69
1B	0.00	0.00	0.00	0.00	0.00	0.00
1 Energy	**42.97**	**33.02**	**29.53**	**22.49**	**19.20**	**17.59**

NMVOC emissions

Table 9.6: *NMVOC emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030
1A1	2.68	1.92	1.83	1.47	1.45	1.42
1A2	5.24	4.82	5.81	6.54	6.69	6.74
1A4	49.47	47.79	38.22	34.08	29.69	25.75
1A5	0.47	0.57	0.82	0.91	0.91	0.91

WEM	2005	2010	2015	2020	2025	2030
1B	20.71	19.69	17.66	16.94	15.38	13.43
1 Energy	**78.577**	**74.784**	**64.335**	**59.933**	**54.126**	**48.255**

WAM	2005	2010	2015	2020	2025	2030
1A1	2.68	1.92	1.83	1.48	1.46	1.43
1A2	5.24	4.82	5.81	6.43	6.48	6.54
1A4	49.47	47.79	38.22	33.95	28.39	23.11
1A5	0.47	0.57	0.82	0.91	0.92	0.92
1B	20.71	19.69	17.66	15.47	13.40	13.24
1 Energy	**78.577**	**74.784**	**64.335**	**58.243**	**50.655**	**45.244**

SO_X emissions

***Table 9.7**: SOx emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030
1A1	60.819	52.747	52.038	4.561	3.343	3.320
1A2	10.010	4.938	3.295	1.449	1.419	1.380
1A4	3.404	2.342	1.938	1.583	1.587	1.355
1A5	0.318	0.101	0.212	0.325	0.361	0.276
1B	0.000	0.000	0.000	0.000	0.000	0.000
1 Energy	74.551	60.128	57.482	7.919	6.709	6.330
WAM	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
1A1	60.819	52.747	52.038	4.561	3.269	2.153
1A2	10.010	4.938	3.295	1.444	1.194	1.097
1A4	3.404	2.342	1.938	1.563	1.587	1.134
1A5	0.318	0.101	0.212	0.326	0.361	0.276
1B	0.000	0.000	0.000	0.000	0.000	0.000
1 Energy	74.551	60.128	57.482	7.894	6.411	4.661

NH_3 emissions

***Table 9.8**: NH_3 emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030
1A1	0.077	0.032	0.047	0.031	0.030	0.029
1A2	0.015	0.018	0.035	0.062	0.063	0.063
1A4	2.064	2.092	1.629	1.536	1.360	1.196
1A5	0.004	0.002	0.002	0.002	0.002	0.002
1B	0.006	0.006	0.006	0.006	0.003	0.001
1 Energy	2.167	2.150	1.719	1.636	1.458	1.291
WAM	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
1A1	0.077	0.032	0.047	0.031	0.031	0.029
1A2	0.015	0.018	0.035	0.062	0.062	0.063
1A4	2.064	2.092	1.629	1.534	1.327	1.103
1A5	0.004	0.002	0.002	0.002	0.002	0.002
1B	0.006	0.006	0.006	0.004	0.001	0.001
1 Energy	2.167	2.150	1.719	1.633	1.423	1.197

PM$_{2.5}$ emissions

Households (1A4) are a dominant contributor to PM$_{2.5}$ emissions.

***Table 9.9**: PM$_{2,5}$ emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030
1A1	8.08	0.89	0.67	0.36	0.36	0.35
1A2	0.69	0.38	0.29	0.25	0.25	0.23
1A4	22.41	20.95	16.43	14.58	12.69	10.95
1A5	0.02	0.01	0.02	0.02	0.02	0.02
1B	0.21	0.19	0.17	0.16	0.09	0.02
1 Energy	31.41	22.43	17.58	15.38	13.40	11.58
WAM	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
1A1	8.08	0.89	0.67	0.36	0.37	0.35
1A2	0.69	0.38	0.29	0.25	0.24	0.23
1A4	22.41	20.95	16.43	14.51	12.02	9.66
1A5	0.02	0.01	0.02	0.02	0.02	0.02
1B	0.21	0.19	0.17	0.11	0.02	0.02
1 Energy	31.41	22.43	17.58	15.25	12.67	10.27

9.6 SECTORAL RESULTS – TRANSPORT

NOx emissions

***Table 9.10**: NOx emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030
1A3b road	43.281	36.844	27.568	22.209	16.358	10.998
1A3acde non-road	5.821	4.711	2.684	2.226	2.236	2.299
1A3	49.102	41.556	30.252	24.435	18.594	13.297

WAM	2005	2010	2015	2020	2025	2030
1A3b road	43.281	36.844	27.568	21.994	15.329	10.842
1A3acde non-road	5.821	4.711	2.684	2.226	2.236	2.299
1A3	49.102	41.556	30.252	24.220	17.565	13.141

NMVOC emissions

***Table 9.11**: NMVOC emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030
1A3b road	19.830	11.787	5.733	3.328	3.186	2.808
1A3acde non-road	0.395	0.357	0.397	0.159	0.163	0.169
1A3	20.225	12.144	6.130	3.487	3.349	2.977

WAM	2005	2010	2015	2020	2025	2030
1A3b road	19.830	11.787	5.733	3.346	3.108	2.681
1A3acde non-road	0.395	0.357	0.397	0.159	0.163	0.169
1A3	20.225	12.144	6.130	3.505	3.271	2.850

SOx emissions

***Table 9.12**: SOx emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030
1A3b road	0.526	0.470	0.370	0.290	0.369	0.418
1A3acde non-road	0.000	0.000	0.000	0.000	0.000	0.000
1A3	**0.526**	**0.470**	**0.371**	**0.291**	**0.369**	**0.418**

WAM	2005	2010	2015	2020	2025	2030
1A3b road	0.526	0.470	0.370	0.307	0.798	4.957
1A3acde non-road	0.000	0.000	0.000	0.000	0.000	0.000
1A3	**0.526**	**0.470**	**0.371**	**0.307**	**0.799**	**4.957**

NH_3 emissions

***Table 9.13**: NH_3 emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030
1A3b road	0.194	0.029	0.031	0.017	0.021	0.024
1A3acde non-road	0.012	0.221	0.186	0.181	0.153	0.135
1A3	0.206	0.250	0.217	0.198	0.174	0.159

WAM	2005	2010	2015	2020	2025	2030
1A3b road	0.194	0.029	0.031	0.016	0.020	0.020
1A3acde non-road	0.012	0.221	0.186	0.181	0.153	0.135
1A3	0.206	0.250	0.217	0.197	0.172	0.155

$PM_{2.5}$ emissions

***Table 9.14**: $PM_{2.5}$ emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030
1A3b road	2.241	2.178	1.423	1.155	1.066	1.047
1A3acde non road	0.048	0.098	0.083	0.054	0.055	0.056
1A3	2.289	2.276	1.506	1.209	1.121	1.103

WAM	2005	2010	2015	2020	2025	2030
1A3b road	2.241	2.178	1.423	1.137	1.011	0.960
1A3acde non road	0.048	0.098	0.083	0.054	0.055	0.056
1A3	2.289	2.276	1.506	1.192	1.066	1.016

9.7 SECTORAL RESULTS – INDUSTRY

NOx emissions

***Table 9.15**: NOx emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030
2A,B,C,H,I,J,K,L	6.701	5.907	6.483	7.642	7.706	7.699
2D, 2G	0.045	0.016	0.016	0.015	0.014	0.013
2 Industry	6.75	5.92	6.50	7.66	7.72	7.71

WAM	2005	2010	2015	2020	2025	2030
2A,B,C,H,I,J,K,L	6.701	5.907	6.483	7.555	7.532	7.441
2D, 2G	0.045	0.016	0.016	0.015	0.014	0.013

WAM	2005	2010	2015	2020	2025	2030
2 Industry	6.75	5.92	6.50	7.57	7.55	7.45

NMVOC emissions

***Table 9.16**: NMVOC emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030
2A,B,C,H,I,J,K,L	7.315	5.323	6.230	6.317	6.492	6.600
2D, 2G	31.632	22.459	25.684	23.376	21.914	20.403
2 Industry	38.95	27.78	31.91	29.69	28.41	27.00

WAM	2005	2010	2015	2020	2025	2030
2A,B,C,H,I,J,K,L	7.315	5.323	6.230	6.197	6.311	6.392
2D, 2G	31.632	22.459	25.684	23.259	21.695	20.099
2 Industry	38.95	27.78	31.91	29.46	28.01	26.49

SOx emissions

***Table 9.17**: SOx emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030
2A,B,C,H,I,J,K,L	11.430	7.303	9.055	9.437	9.356	9.010
2D, 2G	0.025	0.027	0.033	0.035	0.032	0.029
2 Industry	11.45	7.33	9.09	9.47	9.39	9.04

WAM	2005	2010	2015	2020	2025	2030
2A,B,C,H,I,J,K,L	11.430	7.303	9.055	9.351	9.090	8.850
2D, 2G	0.025	0.027	0.033	0.035	0.032	0.029
2 Industry	11.45	7.33	9.09	9.39	9.12	8.88

NH_3 emissions

***Table 9.18**: NH_3 emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030
2A,B,C,H,I,J,K,L	0.240	0.085	0.131	0.201	0.205	0.210
2D, 2G	0.103	0.037	0.035	0.035	0.032	0.029
2 Industry	0.34	0.12	0.17	0.24	0.24	0.24

WAM	2005	2010	2015	2020	2025	2030
2A,B,C,H,I,J,K,L	0.240	0.085	0.131	0.201	0.205	0.203
WAM	2005	2010	2015	2020	2025	2030
2D, 2G	0.103	0.037	0.035	0.035	0.032	0.029
2 Industry	0.34	0.12	0.17	0.24	0.24	0.23

$PM_{2.5}$ emissions

***Table 9.19**: $PM_{2.5}$ emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030
2A,B,C,H,I,J,K,L	1.296	0.713	0.949	0.636	0.649	0.654
2D, 2G	0.671	0.242	0.229	0.228	0.209	0.189
2 Industry	1.97	0.95	1.18	0.86	0.86	0.84

WAM	2005	2010	2015	2020	2025	2030
WAM	2005	2010	2015	2020	2025	2030

2A,B,C,H,I,J,K,L	1.296	0.713	0.949	0.631	0.639	0.641
2D, 2G	0.671	0.242	0.229	0.228	0.209	0.189
2 Industry	1.97	0.95	1.18	0.86	0.85	0.83

9.8 SECTORAL RESULTS – AGRICULTURE

Sector agriculture is a dominant contributor to NH_3 emissions and also a significant contributor to NOx and NMVOC emissions.

NMVOC emissions

NMVOC emission projections were prepared using the WEM scenario. The emission projections decreased mainly due to a decrease in the projected number of livestock and intensive feeding with active substances in dairy cattle, sheep and swine categories. Predictions by the WEM scenario were following the Ordinance of the Government of the Slovak Republic No 410/2012 Coll.

Figure 9.6*: Emission projections trends for pollutant NMVOC in sector Agriculture*

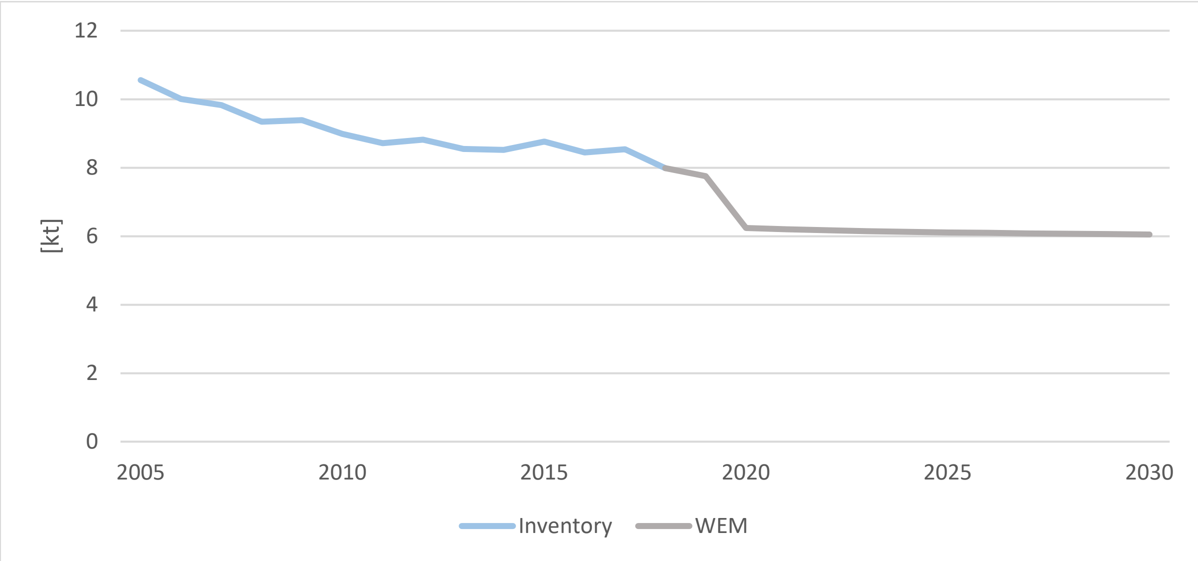


Table 9.20*: NMVOC emissions in sector Agriculture*

WEM	2005	2010	2015	2020	2025	2030	2035	2040
3B	10.438	8.861	8.629	5.792	5.629	5.554	5.258	5.225
3D	0.120	0.130	0.130	0.445	0.481	0.495	0.494	0.495
3 Agriculture	**10.558**	**8.992**	**8.759**	**6.237**	**6.110**	**6.049**	**5.752**	**5.720**

WAM	2005	2010	2015	2020	2025	2030	2035	2040
3B	10.438	8.861	8.629	5.792	5.629	5.554	5.258	5.225
3D	0.120	0.130	0.130	0.445	0.481	0.495	0.494	0.495
3 Agriculture	**10.558**	**8.992**	**8.759**	**6.237**	**6.110**	**6.049**	**5.752**	**5.720**

NH_3 emissions, NOx emissions

Sector agriculture is a dominant contributor to NH_3 emissions, approximately 90% share of the national total. The largest share of ammonia emissions was generated by 3D Agricultural soils, which produced approximately 70% of NH_3 within the sector. The key source in Agricultural Soils in the Animal manure applied to soils where were implemented abatements (Incorporation within 12, 24 hours, deep injection of manure), followed by the category Inorganic N-fertilizers representing approximately 20% of the total

NH_3 emissions, there no abatements were implemented, due to missing policies. Emissions from 3B1 Cattle, 3B3 Swine and 3B2 Sheep are key emission sources of NH_3.

Projections of NH_3 and NOx emissions from manure and manure management and agricultural soils were prepared in the WEM and WAM scenarios.

The WEM scenario is identical to the WEM scenario for NH_3 and NOx emission projections. The WEM scenario is conservative and does not envisage further measures to reduce emissions. The emission trend is relatively stable (***Figure 9.7***).

Figure 9.7*: Emission projections trends for pollutant NH_3 in sector Agriculture*

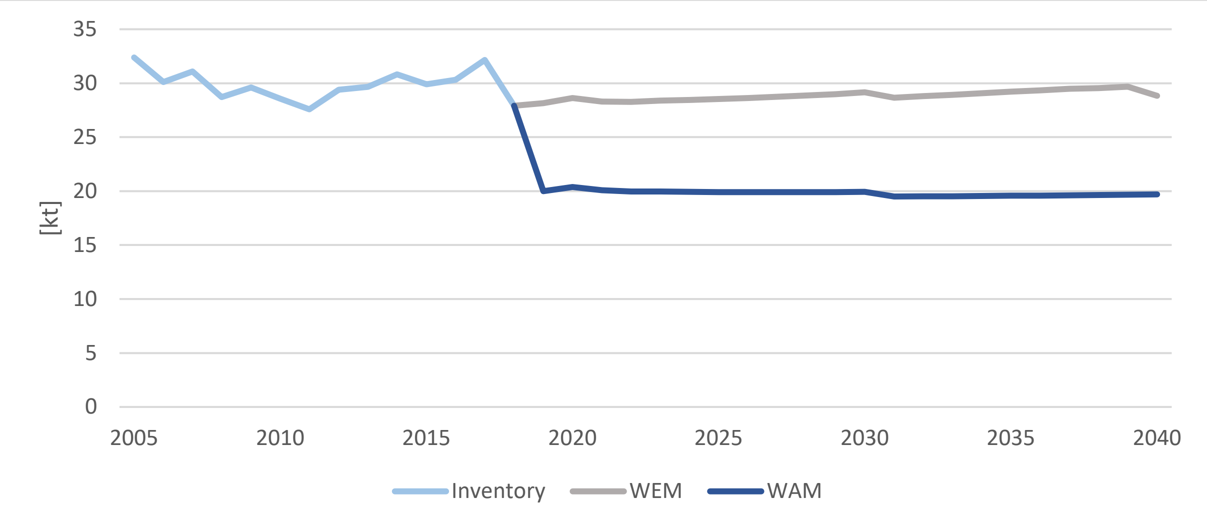


Table 9.21*: NH_3 emissions in sector Agriculture*

WEM	2005	2010	2015	2020	2025	2030	2035	2040
3B	11.42	9.73	9.45	7.17	6.86	6.83	6.72	6.64
3D	20.96	18.83	20.45	21.45	21.67	22.32	22.49	22.18
3 Agriculture	**32.38**	**28.57**	**29.90**	**28.63**	**28.53**	**29.15**	**29.20**	**28.82**

WAM	2005	2010	2015	2020	2025	2030	2035	2040
3B	11.42	9.73	9.45	6.33	6.05	6.02	5.94	5.95
3D	20.96	18.83	20.45	14.07	13.85	13.92	13.63	13.74
3 Agriculture	**32.38**	**28.57**	**29.90**	**20.39**	**19.91**	**19.94**	**19.57**	**19.69**

Agricultural NOx emissions have increased. The NOx emissions from the agricultural soils especially Inorganic N-fertilizers application is a key source of emission. The emission projections increased due to the increasing consumption of nitrogen N-fertilizers, which will be needed to replace the lack of organic nitrogen into soils due to livestock decreasing. Agriculture is an insignificant source of NOx emissions and no policies and measures are available.

Figure 9.8 *Emission projections trends for pollutant NOx in sector Agriculture*

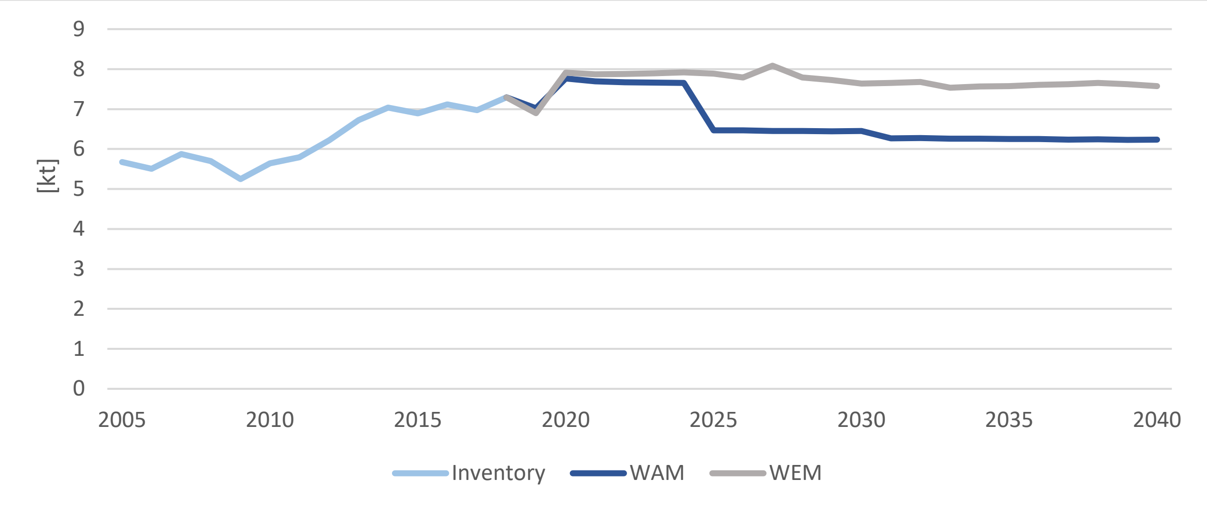


Table 9.22*: NOx emissions in sector Agriculture*

WEM	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
3B	0.176	0.150	0.146	0.099	0.096	0.096	0.09	0.09
3D	5.497	5.491	6.750	7.907	7.888	7.638	7.57	7.58
3 Agriculture	**5.673**	**5.641**	**6.896**	**8.006**	**7.984**	**7.734**	**7.67**	**7.67**

WAM	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
3B	0.176	0.150	0.146	7.745	6.451	6.429	0.00	0.00
3D	5.497	5.491	6.750	0.000	0.000	0.000	0.02	0.02
3 Agriculture	**5.673**	**5.641**	**6.896**	**7.745**	**6.451**	**6.429**	**6.45**	**6.43**

Table 9.23: *Proportion of farms (in%) used mitigation on all farms*

YEAR	**MITIGATION**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
						%				
2019	**fixed hatch or roof**	5.4	5.1	0.3	1.4	0.0	6.5	11.1	14.8	2.6
	covering the surface with peat, straw, oil or other material	1.0	1.2	1.9	0.7	1.9	0.0	0.9	2.0	0.0

A Cattle - dairy cows, **B** Cattle - other cattle, **C** Poultry - broilers, **D** Poultry - laying hens, **E** Poultry - other poultry, **F** Horses, **G** Pigs - sows, **H** Pigs - fattening, **I** Sheep

The decrease in emissions by 2040 in the WEM scenario compared to 1990 is at the level of -51.6% and compared to 2005 at the level of -7%.

The WAM scenario was prepared based on the National Air Pollution Program with the inclusion of measures from the program Introduction of requirements for the reduction of NH_3 emissions from livestock for medium farms (application of the Code of Best Agricultural Practice). The measure includes a set of techniques (Table 9.23) to reduce the release of ammonia emissions from agricultural activities during the storage of organic waste from animal production (manure, slurry). The measure aims to extend the obligation to comply with the requirements concerning the reduction of ammonia emissions from large sources to medium sources set out in the Decree of the Ministry of the Environment of the Slovak Republic No. 410/2012 Coll. The trend of NH_3 and NOx projections emissions in the WAM scenario has a decreasing and a sharp decrease is visible especially after 2019 due to implementing the measures (Figures 9.20 and 9.21). The WAM scenario contains two mitigation measures that have a synergistic effect. The implemented measure taken from the Low Carbon Strategy recommends the transition or legislative restriction on the application of urea-based nitrogen fertilizers. The implementation of this measure has an impact on the reduction of ammonia emissions, mainly due to the high volatility of ammonia from urea fertilizers. Limiting the consumption of urea also avoids NOx emissions by reducing the total consumption of inorganic fertilizers in the resulting consumption summary. Detailed information on when the legislative framework should apply was not available, so an expert estimate was used. The reduction of urea had a gradual course, which is shown in Table 9.24*.*

Table 9.24: *Limitation of urea consumption from 2025 to 2050 according to the WAM scenario*

YEAR OF IMPLEMENTATION	PERCENT OF UREA CONSUMPTION REDUCTION
2020-2025	The transition period, time to implement legislation
2026-2030	10 %
2031-2035	20 %
2036-2040	30 %
2041-2045	50 %
2046-2050	70 %

The Farm to Table strategy was also considered in the WAM scenario. The Strategy aims to reduce the use of pesticides, fertilizers, antibiotics in agriculture and mitigating the environmental and climate footprint of the European food system. Within the WAM scenario, the goal of reducing the consumption of nitrogen fertilizers by 20% by 2030 was implemented. A transitional period was implemented in the emission projections, which is in line with the transitional period for limiting urea (2020-2025). It is probable that the Slovak Republic will negotiate its percentage reduction in fertilizer consumption and will claim a transitional period, which will also be enshrined in legislation. Following the legislative process, it will be necessary to adjust the emission projections in line with the future valid state strategy.

The WAM scenario also contains the measures of increase processing of animal waste in biogas plants to produce biogas, which can be used as a local energy source. This measure included in the Low Carbon Strategy of the Slovak Republic does not contain details such as animal species, percentages of recovered waste and others that would provide measurable indicators potentially usable in the calculation of emission projections. As part of the preparation of emission projections, this information was additionally expertly estimated. For this analysis, it was considered that 10% of organic manure from cattle and pigs would be recovered in biogas plants. Cattle and pigs are key categories of animals with the highest emission recovery potential, the 10% potential was chosen as expert judgement. Biogas from stations is a promising source of renewable electricity and heat, which can be used at the local level. The decrease in emissions by 2040 in the WAM scenario compared to 1990 is at the level of -68% and then decrease by 39% compared to 2005. $PM_{2.5}$ emissions

3D sector is the main contributor to PMs emissions in Agriculture. During the preparation of PMs projections from agricultural land management, policies for forecasting of sowing areas were unavailable. Therefore, since 2018, consistent sowing areas were used except for wheat which areas were available by 2020. Agriculture is not a significant $PM_{2.5}$ emission category. After 2019, the trend has stagnated character.

Table 9.25: *$PM_{2.5}$ emissions in sector Agriculture*

WEM	2005	2010	2015	2020	2025	2030	2035	2040
3B	0.150	0.129	0.121	0.112	0.109	0.108	0.108	0.108
3D	0.143	0.124	0.128	0.080	0.086	0.089	0.088	0.091
3 Agriculture	0.293	0.253	0.249	0.191	0.195	0.197	0.196	0.198

WAM	2005	2010	2015	2020	2025	2030	2035	2040
3B	0.150	0.129	0.121	0.112	0.109	0.108	0.108	0.108
3D	0.143	0.124	0.128	0.080	0.086	0.089	0.088	0.091
3 Agriculture	0.293	0.253	0.249	0.191	0.195	0.197	0.196	0.198

9.9 SECTORAL RESULTS – WASTE

Emissions from the Waste sector have not a key impact on overall emissions. Projection emissions are estimated by simply methodology, which needs to be updated in the future.

NOx emissions

***Table 9.26**: NOx emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030
5 Waste	0.020	0.022	0.022	0.023	0.023	0.023

NMVOC emissions

***Table 9.27**: NMVOC emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030
5 Waste	1.368	0.909	0.668	0.945	0.971	0.966

SOx emissions

***Table 9.28**: SOx emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030
5 Waste	0.005	0.004	0.006	0.005	0.005	0.005

NH_3 emissions

***Table 9.29**: NH_3 emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030
5 Waste	1.213	1.074	1.077	1.067	1.073	1.075

$PM_{2.5}$ emissions

***Table 9.30**: $PM_{2.5}$ emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030
5 Waste	0.152	0.180	0.189	0.174	0.174	0.174

CHAPTER 10: LARGE POINT SOURCES

Last update: 15.3.2021

10.1 METHODOLOGICAL ISSUES

After the NECD review in 2020, the old LPS methodology was revised following the recommendations of the TERT in "Final Review Report 2020".

All LPS represent E-PRTR facilities as defined in the EMEP reporting guidelines. Only the facilities reported to the E-PRTR with pollutant releases into the air over threshold values specified in Annex II to the E-PRTR Regulation are included. If the threshold value was exceeded for at least one pollutant, the non-zero emissions of other relevant pollutants were also included in the LPS.

Facilities in E-PRTR which have non-relevant pollutants only (in the view of NECD: GHGs, some heavy metals etc.) are not included in LPS.

Some LPS have more than one GNFR. The reason is that more activities can be performed in the facilities (the main activity and also secondary activities, which have a technical connection). For example, in large farms, in addition to animal husbandry, fuel combustion (breeding hall heating) sometimes occurs - in which case the emissions are divided into GNFR C_OtherStationaryComb and K_AgriLivestock.

Two separate databases were used for LPS processing:

- National PRTR
- NEIS (detailed specification in Annex IV)

The National PRTR contains only the total emissions of the facility, therefore the source of metadata was NEIS.

NEIS has much more detailed records than National PRTR. The detailed information about the NEIS is described in IIR **ANNEX IV, Chapter A4.2 SYSTEM CHARACTERISTICS**.

The allocation of emissions into stack height categories also comes from the NEIS.

The data in the National PRTR (as well as E-PRTR) and the NEIS are consistent because the data reported to the NRZ by the operators are validated according to the NEIS.

Possible discrepancies between LPS (Annex VI) and CLRTAP data (Annex I):

<u>Heavy metals, POPs, PCDD/PCDF, HCB, PCB</u>

- Annex I: specific-sector calculation methodology for the CLRTAP report in accordance with the EMEP Guidebook
- Annex VI: various type of applied methodology (the data are based on the reporting obligation of individual operators). More information about applied quantification methodologies is written in IIR **ANNEX IV, Chapter A4.2 SYSTEM CHARACTERISTICS**.

Possible discrepancies between LPS (Annex VI) and E-PRTR data:

<u>PM_{10}</u>

- The emissions of PM_{10} are not reported in the E-PRTR. The operators are obliged to monitor only TSP emissions and not the individual fractions of PM.

Annex VI: Emissions are estimated by internal algorithm considering the amount of TSP and the type of combustion plant or technology in the NEIS central database.

CHAPTER 11: NATIONAL GRIDDED EMISSIONS DATA

Last update: 15.3.2021

11.1 OVERVIEW

Convention on Long-Range Transboundary Air Pollution obliges countries to report gridded emissions and large point sources (LPS) data. Both datasets shall be reported every four years from 2017 onwards for the year x-2.

This chapter includes basic information on data reported in the year 2017 for the year 2015.

Only data for the year 2015 is available in increased spatial resolution of the EMEP grid 0.1° x 0.1°. The data for previous years 1990, 1995, 2000, 2005, 2010 was reported in submission in the year 2012.

In order to improve the quality of reporting Slovakia planned to report all milestone years in higher spatial resolution in the next reporting in May 2021.

11.2 METHODOLOGY AND DATA SOURCES FOR GRIDDED EMISSIONS

Gridded data were reported in line with the EMEP/EEA GB_{2016}, part Spatial mapping of emissions in GNFR categories. Emissions from inventory were spatially distributed using GIS methods. Gridded emissions for 2015 is consistent with reporting in 2017. LPS data were included within the submission of the gridded data. Gridded data were based on fuel sold methodology.

Table 11.1: *Basic methodology used in each GNFR sectors*

GNFR SECTOR	THE PROXY USED FOR DISTRIBUTION OF NON-POINT SOURCES (PLEASE SPECIFY BY NFR CODE WHERE RELEVANT)
A_PublicPower	LPS and point sources which are not included in LPS. Data from National emission information system.
B_Industry	LPS data, Industry areas from Corine landcover.
C_OtherStatComb	Corine landcover - inhabited areas, information from census 2011 - type of fuel for households, data from National emission information system, LPS
D_Fugitives	Five areas were identified as sources of Fugitive emissions - manually identification, LPS, population density map for distributing of NMVOC emissions from petrol stations
E_Solvents	Population density, Corine landcover
F_RoadTransport	Information about transport intensity
G_Shipping	Information from ports, and distribution to river lines
H_Aviation	Point sources - international and inland airports
I_OtherMobile	Railroads emissions – non-electrify railroads map and information from railway depots. Forest and agricultural offroads - Corine landcover. LPS - compressor stations
J_Waste	Population density, Corine landcover, LPS
K_AgriLivestock	Corine landcover
L_AgriOther	Corine landcover

Additional information based on questions in NECD review 2020:

GNFR sector C_OtherStationaryComb

The most emissions in sector C_OtherStationaryComb comes from combustion in households for heating and hot water. Emissions from national inventory in the households sector were spatially distributed based on data from census 2011 to inhabited areas from Corine landcover. Census 2011 was the 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 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 urban areas. It also depends on the region. The share of natural gas (NG) using is higher in lowlands and in the west 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 distribution of NH_3 emissions was used tier 1 methodology recommended in EMEP guidebook chapter 7 spatial mapping. We used data from Corine land cover for arable land. And base on the area of arable land we distribute emissions to each cell.

11.3 PLANNED IMPROVEMENTS

Slovakia planned to improve methodology and completeness of reporting in the next submission of gridded data in May 2021, with a focus on the key source categories.

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ANNEXES

Last update: 15.3.2021

ANNEX I: KEY CATEGORY ANALYSIS

Table A1.1: *Level assessment of the key categories analysis of air pollutants in the Slovak Republic in 2019 (cumulative total at least 80%)*

NOx	1A3bi (17%)	1A3biii (13%)	3Da1 (8%)	1A2f (7%)	1A3bii (6%)	1A1a (6%)	1A4bi (5%)	1A4ai (4%)	2C1 (4%)	1A4cii 3%)	1A3c (3%)	1A1b (2%)	1A2gviii (2%)
SOx	2C1 (19%)	1A1a (15%)	2C3 (13%)	1A1b (12%)	2B10a (8%)	1A4bi (8%)	2C7c (4%)	1A2a (4%)					
NH_3	3Da2a (36%)	3Da1 (29%)	1A4bi (5%)	3B4gii (8%)	3B3 (4%)	3B1b (4%)							
NMVOC	1A4bi (32%)	2D3d (9%)	2D3a (6%)	1A2gviii (6%)	1B2av (5%)	1B1a (4%)	2D3e (4%)	3B1a (3%)	3B1b (3%)	2H2 (3%)			
PM_{10}	1A4bi (62%)	3Dc (10%)	2A5b (4%)	1A3bvi (3%)	1B1a (2%)								
$PM_{2.5}$	1A4bi (79%)	1A3bvi (2%)											
BC	1A4bi (63%)	1A3bi (10%)	2G (5%)	1A3biii (4%)									
CO	1A4bi (55%)	2C1 (19%)	2C3 (6%)	1A1c (5%)									
Pb	2C1 (36%)	1A2a (12%)	1A3bvi (10%)	2G (8%)	1B1b (5%)	1A1a (5%)	1A2d (5%)						
Cd	1A4bi (25%)	1A2d (23%)	1A4ai (11%)	1A2gviii (9%)	2C1 (7%)	1A1a (6%)							
Hg	1A1c (21%)	1A2f (18%)	1A1a (11%)	1A2a (9%)	1A4bi (8%)	2K (7%)	2C1 (5%)	5C1bv					
As	1A1a (38%)	2C1 (31%)	1A2f (7%)	1A1c (6%)									
Cr	2C7a (33%)	1A4bi (16%)	1A2d (8%)	1A3bvi (8%)	2C1 (7%)	1A1a (6%)	1B1b (5%)						
Cu	1A3bvi (77%)	2G (5%)											
Ni	1A1a (24%)	1A3di(ii) (11%)	1B1b (11%)	1A2f (10%)	2C1 (9%)	1A2a (7%)	1A4bi (7%)	1A3bvi (4%)					
Se	1A1a (69%)	2A3 (12%)											
Zn	1A2d (22%)	2D3i (19%)	1A4bi (12%)	1A4ai (11%)	1A2gviii (8%)	1A3bvi (8%)							
DIOX	2C1 (46%)	1A2f (12%)	1A4bi (10%)	2Cta (6%)	1B1b (6%)								
PAHs	1A4bi (36%)	2C1 (30%)	1B1b (15%)										
HCB	1A4bi (70%)	1A1a (21%)											
PCB	2C1 (77%)	1A2a (8%)											

Table A1.2: *Trend assessment of the key categories analysis of air pollutants in the Slovak Republic in 2019 (cumulative total at least 80%)*

NOx	1A3biii (27%)	1A1a (23%)	1A3c (6%)	1A2a (6%)	3Da1 (5%)	1A3ei (4%)	1A1b (3%)	1A2d (3%)	1A4bi (3%)	3Da2a (2%)
SOx	1A1a (46%)	1A4bi (22%)	1A2d (10%)	1A1b (8%)						
NH_3	3D2a (51%)	3B3 (16%)	3B1b (10%)	3Da1 (4%)						
NMVOC	1A4bi (56%)	1A3bi (8%)	3B1b (4%)	2D3e (3%)	1B1b (3%)	3B1a (3%)				
PM_{10}	1A4bi (76%)	1A1a (7%)								
$PM_{2.5}$	1A4bi (80%)									
BC	1A4bi (75%)	1A3biii (8%)								
CO	1A4bi (70%)	1A3bi (20%)								
Pb	1A1a (39%)	2C1 (32%)	1A3bi (15%)							
Cd	1A1a (48%)	2C7a (21%)	1A4bi (10%)	1A2d (6%)						
Hg	1A1a (47%)	1A4bi (19%)	2C1 (11%)	5C1biii (6%)						
As	1A1a (62%)	1A4bi (23%)								
Cr	1A4bi (36%)	2C7a (18%)	1A1a (16%)	2C1 (11%)						
Cu	1A3bvi (34%)	2C7a (14%)	1A3biii (12%)	1A3bi (8%)	1A1a (5%)					
Ni	1A1a (56%)	2C1 (13%)	1A3dii (9%)	2C7a (6%)						
Se	1A1a (92%)									
Zn	2C1 (30%)	2D3i (13%)	1A2d (10%)	1A1a (9%)	1A2gviii (8%)	1A4ai (6%)	1A3bvi (6%)			
DIOX	1A1a (86%)									
PAHs	1A4bi (64%)	1B1b (10%)	1A4aii (8%)							
HCB	1A1a (61%)	5C1biii (21%)								
PCB	2C1 (49%)	1A2d (10%)	1A3c (8%)	1A4ai (6%)	1A4bi (5%)	1A5a (4%)				

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 component of particulate matter. Green cells represent emission factors including and yellow cells excluding condensable component. Grey cells represent categories with notation keys and red cells categories are unknown of using the condensable component in emission factors of particulate matter.

***Table A2.1:** Inclusion/exclusion of the condensable component from the PM_{10} and $PM_{2.5}$ emission factors*

NFR	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

NFR	SOURCE	PM EMISSIONS: THE CONDENSABLE COMPONENT IS:		EF REFERENCE AND COMMENTS
		INCLUDED	EXCLUDED	
1A4aii	Commercial/institutional: Mobile			
1A4bi	Residential: Stationary			Unknown - Life project
1A4bii	Residential: Household and gardening (mobile)			
1A4ci	Agariculture/Forestry/Fishing: Stationary		X	Measured emissions
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	X		EEA/EMEP GB_{2016}
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_{2016}
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

NFR	SOURCE	PM EMISSIONS: THE CONDENSABLE COMPONENT IS:		EF REFERENCE AND COMMENTS
		INCLUDED	EXCLUDED	
2C7d	Storage, handling and transport of metal products (please specify in the IIR)			
2D3a	Domestic solvent use including fungicides			
2D3b	Road paving with asphalt		X	Measured emissions
2D3c	Asphalt roofing			
2D3d	Coating applications			
2D3e	Degreasing			
2D3f	Dry cleaning			
2D3g	Chemical products			
2D3h	Printing			
2D3i	Other solvent use (please specify in the IIR)			
2G	Other product use (please specify in the IIR)	X*		Schauer et al. (1998)[5]
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_{2016}
3Dd	Off-farm storage, handling and transport of bulk agricultural products			

NFR	SOURCE	PM EMISSIONS: THE CONDENSABLE COMPONENT IS:		EF REFERENCE AND COMMENTS
		INCLUDED	EXCLUDED	
3De	Cultivated crops			
3Df	Use of pesticides			
3F	Field burning of agricultural residues			
3I	Agriculture other (please specify in the IIR)			
5A	Biological treatment of waste - Solid waste disposal on land		X	
5B1	Biological treatment of waste - Composting		X	
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities			
5C1a	Municipal waste incineration			
5C1bi	Industrial waste incineration		X	US EPA (1996) [6]
5C1bii	Hazardous waste incineration			
5C1biii	Clinical waste incineration			
5C1biv	Sewage sludge incineration			
5C1bv	Cremation			Unknown
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: *Fuels, Electricity and Heat Balance in 2019 - in TJ*

	Anthracite	*Coking Coal*	*Other Bituminous Coal*	*Brown Coal and Lignite*	*Hard Coal Coke*	*Brown Coal and Peat Briquettes*	*Patent Fuel*	*Coal Tar*	*Coke Oven Gas*	*Blast Furnace Gas*	*Oxygen Steel Furnace Gas*
Primary Production	-	-	-	16 381	-	-	-	-	-	-	-
Import	4 799	68 725	20 647	5 668	6 576	747	252	-	-	-	-
Export	-	-	-	-	1 903	-	-	1 875	-	-	-
Stock Changes	-678	-935	-869	-503	-3 022	20	-	-	-	-	-
Gross Inland Consumption	**4 121**	**67 790**	**19 778**	**21 546**	**1 651**	**767**	**252**	**-1 875**	**-**	**-**	**-**
Transformation Input	**1 930**	**67 790**	**8 458**	**20 407**	**36 263**	**39**	**-**	**-**	**731**	**967**	**226**
Electricity Production - Thermal Equipment	1 930	-	8 458	20 362	-	39	-	-	731	961	209
of which: Public	1 930	-	6 797	20 340	-	39	-	-	-	-	-
Autoproducers	-	-	1 661	22	-	-	-	-	731	961	209
Nuclear Plants	-	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	53 063	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	14 727	-	-	36 263	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	45	-	-	-	-	-	6	17
Transformation Output	**-**	**-**	**-**	**-**	**39 117**	**-**	**-**	**1 875**	**10 554**	**15 514**	**2 886**
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	39 117	-	-	1 875	10 554	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	15 514	2 886
Refineries	-	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Product Transferred	-	-	-	-	-	-	-	-	-	-	-
Backflows from Petrochemical Sector	-	-	-	-	-	-	-	-	-	-	-
Consumption of the Energy Sector	**-**	**-**	**-**	**11**	**-**	**-**	**-**	**-**	**3 175**	**9 308**	**-**
Distribution Losses	**-**	**-**	**-**	**11**	**-**	**-**	**-**	**-**	**133**	**164**	**509**

1st continuation

	Anthracite	*Coking Coa l*	*Other Bituminous Coal*	*Brown Coal and Lignite*	*Hard Coal Coke*	*Brown Coal and Peat Briquettes*	*Patent Fuel*	*Coal Tar*	*Coke Oven Gas*	*Blast Furnace Gas*	*Oxygen Steel Furnace Gas*
Final Consumption	**2 191**	**-**	**11 320**	**1 117**	**4 505**	**728**	**252**	**-**	**6 515**	**5 075**	2 151
Final Non - Energy Consumption	913	-	-	-	1 147	-	-	-	-	-	-
of which: Chemical Industry	-	-	-	-	-	-	-	-	-	-	-
Final Energy Consumption	**1 278**	**-**	**11 320**	**1 117**	**3 358**	**728**	**252**	**-**	**6 515**	**5 075**	**2 151**
Industry	**1 278**	**-**	**7 921**	**413**	**2 127**	**-**	**-**	**-**	**6 515**	**5 075**	**2 151**
of which: Iron and steel	1 174	-	6 592	-	1 175	-	-	-	6 511	5 075	2 151
Non - ferrous metals	-	-	-	-	140	-	-	-	-	-	-
Chemical	-	-	-	-	-	-	-	-	-	-	-
Non - metallic minerals	104	-	1 329	11	728	-	-	-	4	-	-
Mining and quarrying	-	-	-	22	-	-	-	-	-	-	-
Food, beverages and tobacco	-	-	-	313	84	-	-	-	-	-	-
Textile and leather	-	-	-	-	-	-	-	-	-	-	-
Pulp, paper and print	-	-	-	-	-	-	-	-	-	-	-
Mach. and transport equipment	-	-	-	67	-	-	-	-	-	-	-
Not elsewhere specified	-	-	-	-	-	-	-	-	-	-	-
Transport	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Other Sectors	**-**	**-**	**3 399**	**704**	**1 231**	**728**	**252**	**-**	**-**	**-**	**-**
of which: Households	-	-	639	447	28	79	-	-	-	-	-
Agriculture	-	-	-	11	-	-	-	-	-	-	-
Commercial and public services	-	-	2 760	246	1 203	649	252	-	-	-	-

2nd continuation

	Natural Gas	*Crude Oil and NGL*	*Refinery Feedstock*	*Refinery Gas*	*LPG*	*Naphta*	*Gasoline*	*Kerosene*
Primary Production	4 315	252	6 798	-	-	-	-	-
Import	233 752	216 016	-	-	2 208	4 092	9 534	217
Export	-	210	-	-	2 898	2 068	36 817	1 429
Stock Changes	-66 986	-1 386	-	-	-138	-968	-351	0
Gross Inland Consumption	**171 081**	**214 672**	**6 798**	**-**	**-828**	**1 056**	**-27 634**	**-1 212**
Transformation Input	**34 954**	**214 672**	**29 415**	**251**	**-**	**-**	**-**	**-**
Electricity Production - Thermal Equipment	27 231	-	-	251	-	-	-	-
of which: Public	25 400	-	-	-	-	-	-	-
Autoproducers	1 831	-	-	251	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-
Refineries	-	214 672	29 415	-	-	-	-	-
Heat Production	7 723	-	-	-	-	-	-	-
Transformation Output	**-**	**-**	**-**	**13 783**	**7 544**	**18 920**	**52 413**	**3 118**
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-
Refineries	-	-	-	13 783	7 544	18 920	52 413	3 118
Heat Production	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	**-6 424**	**-**	**22 617**	**-**	**-2 208**	**-6 732**	**-**	**-**
Product Transferred	-6 424	-	13 677	-	-	-	-	-
Backflows from Petrochemical Sector	-	-	8 940	-	-2 208	-6 732	-	-
Consumption of the Energy Sector	**11 158**	**-**	**-**	**10 379**	**-**	**-**	**-**	**-**
Distribution Losses	**3 438**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

3rd continuation

	Natural Gas	*Crude Oil and NGL*	*Refinery Feedstock* [1/]	*Refinery Gas*	*LPG*	*Naphta*	*Gasoline*	*Kerosene*
Final Consumption	**115 107**	**-**	**-**	**3 153**	**4 508**	**13 244**	**24 779**	**1 906**
Final Non - Energy Consumption	**15 187**	**-**	**-**	**-**	**2 438**	**13 244**	**-**	**-**
of which: Chemical Industry	15 187	-	-	-	2 438	13 244	-	-
Final Energy Consumption	**99 920**	**-**	**-**	**3 153**	**2 070**	**-**	**24 779**	**1 906**
Industry	**35 138**	**-**	**-**	**3 153**	**138**	**-**	**88**	**-**
of which: Iron and steel	5 772	-	-	-	-	-	-	-
Non - ferrous metals	1 377	-	-	-	-	-	-	-
Chemical	5 169	-	-	3 153	-	-	-	-
Non - metallic minerals	4 561	-	-	-	46	-	-	-
Mining and quarrying	1 951	-	-	-	46	-	-	-
Food, beverages and tobacco	3 553	-	-	-	-	-	-	-
Textile and leather	471	-	-	-	-	-	-	-
Pulp, paper and print	2 624	-	-	-	-	-	-	-
Mach. and transport equipment	6 441	-	-	-	46	-	88	-
Not elsewhere specified	3 219	-	-	-	-	-	-	-
Transport	**279**	**-**	**-**	**-**	**1 472**	**-**	**24 691**	**1906**
Other Sectors	**64 503**	**-**	**-**	**-**	**460**	**-**	**-**	**-**
of which: Households	46 892	-	-	-	276	-	-	-
Agriculture	916	-	-	-	46	-	-	-
Commercial and public services	16 695	-	-	-	138	-	-	-

1/ include Additives, Oxygenates and Other Hydrocarbons

4th continuation

	Diesel Oil	*LightFuelOil*	*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	38 701	2 193	283	1 495	516	2 107	6 216	173	4 402	5 389
Export	66 032	3 452	3 314	10 585	516	496	3 890	-	-	10 568
Stock Changes	-126	244	81	-606	-	-	-	-	-140	1 221
Gross Inland Consumption	**-27 457**	**-1 015**	**-2 950**	**-9 696**	**0**	**1 611**	**2 326**	**173**	**4 262**	**-3 958**
Transformation Input	**-**	**-**	**161**	**2 788**	**-**	**-**	**-**	**-**	**-**	**-**
Electricity Production - Thermal Equipment	-	-	161	2 788	-	-	-	-	-	-
of which: Public	-	-	121	-	-	-	-	-	-	-
Autoproducers	-	-	40	2 788	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	-	-	-	-	-	-	-
Transformation Output	**112 692**	**1 543**	**3 151**	**18 463**	**-**	**-**	**-**	**-**	**1 328**	**6 231**
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	-
Refineries	112 692	1 543	3 151	18 463	-	-	-	-	1 328	6 231
Heat Production	-	-	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Product Transferred	-	-	-	-	-	-	-	-	-	-
Backflows from Petrochemical Sector	-	-	-	-	-	-	-	-	-	-
Consumption of the Energy Sector	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1 328**	**-**
Distribution Losses	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

5th continuation

	Diesel Oil	*LightFuelOil*	*Heavy Fuel Oil - Low Sulphur (<1%)*	*Heavy Fuel Oil - High Sulphur (>=1%)*	*White Spirit SBP*	*Lubricants*	*Bitumens*	*Paraffin Waxes*	*Petroleum Coke*	*Other Products*
Final Consumption	**85 235**	**528**	**40**	**5 979**	**-**	**1 611**	**2 326**	**173**	**4 262**	**2 273**
Final Non - Energy Consumption	**-**	**325**	**-**	**-**	**-**	**1 611**	**2 326**	**173**	**2 236**	**2 273**
of which: Chemical Industry	-	325	-	-	-	-	-	-	-	2 273
Final Energy Consumption	**85 235**	**203**	**40**	**5 979**	**-**	**-**	**-**	**-**	**2 026**	**-**
Industry	**674**	**-**	**40**	**5 979**	**-**	**-**	**-**	**-**	**2 026**	**-**
of which: Iron and steel	42	-	-	-	-	-	-	-	-	-
Non - ferrous metals	-	-	-	-	-	-	-	-	-	-
Chemical	-	-	-	5 979	-	-	-	-	-	-
Non - metallic minerals	42	-	-	-	-	-	-	-	2 026	-
Mining and quarrying	211	-	-	-	-	-	-	-	-	-
Food, beverages and tobacco	42	-	-	-	-	-	-	-	-	-
Textile and leather	-	-	-	-	-	-	-	-	-	-
Pulp, paper and print	-	-	40	-	-	-	-	-	-	-
Mach. and transport equipment	337	-	-	-	-	-	-	-	-	-
Not elsewhere specified	-	-	-	-	-	-	-	-	-	-
Transport	**82 203**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Other Sectors	**2 358**	**203**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
of which: Households	-	-	-	-	-	-	-	-	-	-
Agriculture	2 358	-	-	-	-	-	-	-	-	-
Commercial and public services	-	203	-	-	-	-	-	-	-	-

6th continuation

	Nuclear Heat	Solar Heat	Geo-thermal Heat	Heat	Wood and Charcoal	Municipal Solid Wastes	Biogas	Industrial Wastes	Wind energy	Hydro Energy	Solar Electricity	Electricity	Liquid Biofuels	Total
Primary Production	165 229	321	408	1 645	-	58 562	2 386	5 984	7 311	22	15 682	2 120	-	7 179
Import	-	-	-	-	74	60	-	-	401	-	-	-	48 737	4 694
Export	-	-	-	-	-	508	-	-	-	-	-	-	42 617	4 620
Stock Changes	-	-	-	-	-	61	-	-	33	-	-	-	0	0
Gross Inland Consumption	**165 229**	**321**	**408**	**1 645**	**74**	**58 175**	**2 386**	**5 984**	**7 745**	**22**	**15 682**	**2 120**	**6 120**	**7 253**
Transformation Input	**163 347**	**-**	**350**	**-**	**-**	**16 386**	**1 399**	**5 110**	**89**	**-**	**-**	**-**	**-**	**-**
Electricity Production - Thermal Equipment	-	-	12	-	-	13 941	1 198	4 988	12	-	-	-	-	-
of which: Public	-	-	-	-	-	7 319	-	1 457	-	-	-	-	-	-
Autoproducers	-	-	12	-	-	6 622	1 198	3 531	12	-	-	-	-	-
Nuclear Plants	163 347	-	-	-	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	338	-	-	2 445	201	122	77	-	-	-	-	-
Transformation Output	**-**	**-**	**-**	**-**	**29 387**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**83 764**	**-**
Electricity Production - Thermal Equipment	-	-	-	-	20 002	-	-	-	-	-	-	-	28 749	-
of which: Public	-	-	-	-	17 593	-	-	-	-	-	-	-	19 429	-
Autoproducers	-	-	-	-	2 409	-	-	-	-	-	-	-	9 320	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-	-	-	55 015	-
Coke Ovens	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	-	9 385	-	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	**-1 882**	**-2**	**-**	**-1 645**	**3 529**	**-**	**-**	**-**	**-**	**-22**	**-15 682**	**-2 120**	**17 824**	**-7 253**
Product Transferred	-1 882	-2	-	-1 645	3 529	-	-	-	-	-22	-15 682	-2 120	17 824	-7 253
Backflows from Petrochemical Sector	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Consumption of the Energy Sector	**-**	**3**	**-**	**-**	**4 151**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**10 901**	**-**
Distribution Losses	**-**	**-**	**-**	**-**	**4 281**	**25**	**-**	**-**	**-**	**-**	**-**	**-**	**6 116**	**-**

End of table

	Nuclear Heat	Solar Heat	Geo-thermal Heat	Ambient Hheat	Heat	Wood and Charcoal	Municipal Solid Wastes	Biogas	Industrial Wastes	Wind energy	Hydro Energy	Solar Electricity	Electricity	Liquid Biofuels	Total
Final Consumption	**-**	**316**	**58**	**-**	**24 558**	**41 764**	**987**	**874**	**7 656**	**-**	**-**	**-**	**90 691**	**-**	**465 882**
Final Non - Energy Consumption	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**41 873**
of which: Chemical Industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**33 467**
Final Energy Consumption	**-**	**316**	**58**	**-**	**24 558**	**41 764**	**987**	**874**	**7 656**	**-**	**-**	**-**	**90 691**	**-**	**424 009**
Industry	**-**	**-**	**-**	**-**	**2 939**	**16 905**	**-**	**10**	**7 656**	**-**	**-**	**-**	**44 087**	**-**	**144 313**
of which: Iron and steel	-	-	-	-	34	253	-	-	-	-	-	-	7 924	-	**36 703**
Non - ferrous metals	-	-	-	-	53	-	-	-	-	-	-	-	9 454	-	**11 024**
Chemical	-	-	-	-	434	3	-	-	984	-	-	-	3 395	-	**19 117**
Non - metallic minerals	-	-	-	-	183	4	-	-	6 630	-	-	-	2 977	-	**18 645**
Mining and quarrying	-	-	-	-	3	1	-	-	-	-	-	-	245	-	**2 479**
Food, beverages and tobacco	-	-	-	-	269	281	-	-	-	-	-	-	2 038	-	**6 580**
Textile and leather	-	-	-	-	34	4	-	-	-	-	-	-	436	-	**945**
Pulp, paper and print	-	-	-	-	1386	14 425	-	2	-	-	-	-	2 801	-	**21 278**
Mach. and transport equipment	-	-	-	-	421	229	-	8	42	-	-	-	10 076	-	**17 755**
Not elsewhere specified	-	-	-	-	122	1 705	-	-	-	-	-	-	4 741	-	9 787
Transport	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1 908**	**-**	112 459
Other Sectors	**-**	**316**	**58**	**-**	**21 619**	**24 859**	**987**	**864**	**-**	**-**	**-**	**-**	**44 696**	**-**	167 237
of which: Households	-	286	-	-	18 088	24 309	-	-	-	-	-	-	19 631	-	110 675
Agriculture	-	-	30	-	37	336	-	569	-	-	-	-	1 112	-	5 415
Commercial and public services	-	30	28	-	3 494	214	987	295	-	-	-	-	23 953	-	51 147

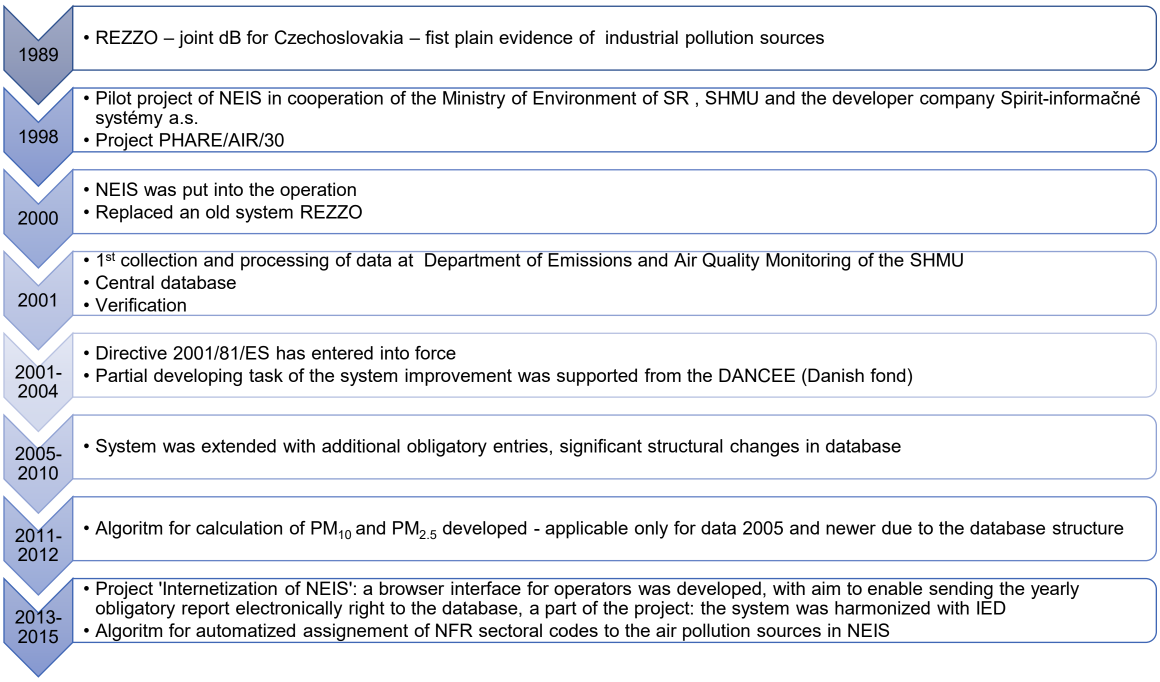
ANNEX IV: ADDITIONAL INFORMATION ON METHODOLOGY

ANNEX IV includes additional information on the methodology used in the NEIS database.

NEIS database is the National Emission Information System for air pollutants (NO_X, SOX, NMVOC, NH3, HM and TSP). Information System NEIS was established in 1998. The database was developed to fulfil the national legislation in air quality and the requirements in pollutants fees decisions (Act No 401/1998 on air pollution charges as amended). Since 2000, when the NEIS was set into operation, the emissions are directly collected consistently and verified on more levels. This database replaced an old system REZZO (Emission and Air Pollution Source Inventory). The first collection and processing of data by NEIS were realized in 2001. Department of Emissions and Biofuels of the SHMÚ is in charge of the processing of final data in the central database. The following scheme represents the formation of the database in time with important dates.

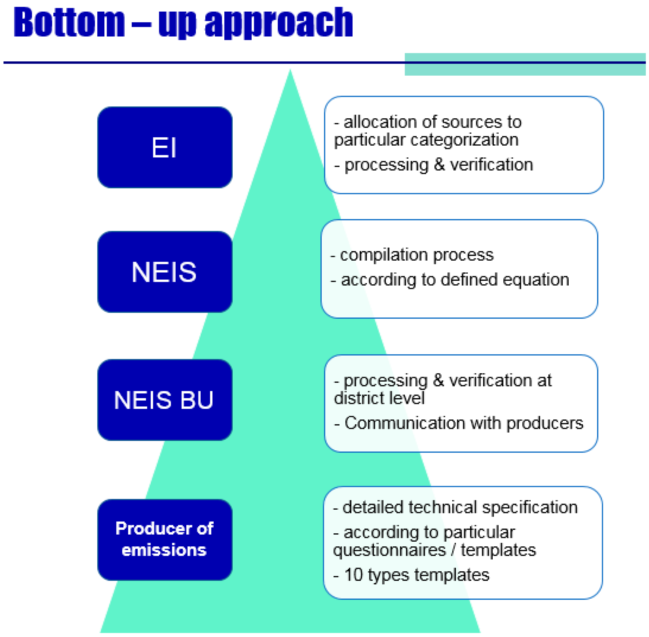
The last changes within the improvement of the NEIS were carried out from December 2013 until August 2015. Within the scope of the recent Project 'Internetization of NEIS, a browser interface was developed. The aim was to enable sending the yearly obligatory report electronically right to the database NEIS PZ WEB. The module NEIS BU on district offices is connected to this database and data is synchronized.

Figure A4.1: *Milestones in development NEIS database*



The emissions of air pollutants (NOx, SOx, NMVOC, NH_3, TSP, PMs and HM) are recorded and calculated on yearly bases in the NEIS database. The data collection of air pollutants and emission inventory preparation is performed by a standardized procedure. For the international emission inventory requirements, the bottom-up approach has been introduced for the basic pollutants

Figure A4.2: *Scheme of bottom-up approach built in database NEIS*



A4.1 DATA COLLECTION

Annual data is collected from energy and industry sources following Act on air protection No 137/2010 Coll. as amended and related regulations. The collection of annual activity data are performed through the 10 types of questionnaires (forms), where specific data is required from operators and recorded in the NEIS. In the following table is presented the complete list of forms with the name and content of surveyed data. Forms 1- 5 require identification data of operators, a sum of emissions and fees for the operator and individual sources of an operator in each district, data on calculation of fees and data on quality and parameters of combusted fuels and waste. The data has to be updated annually. Forms 6 – 10 require relatively steady data. Data is updated if the change has been made (for instance reconstruction of source, change of technology, change in source categorization and the size of source etc.).

All annual sets of input data involving fuel amounts (according to the types, and quality marks) necessary for the emission balance are obtained from the district offices using the NEIS BU module. Activity data collected in the NEIS central database are allocated according to the NFR categorization for solid, liquid, gaseous fuels, biomass and other fuels. The emissions balances of air pollutants in the range from 2000–2017 were processed in the NEIS CU module by the same way of calculation.

Table A4.1: *Overview of data forms required from operators of air pollution sources*

FORM TYPE	NAME	CONTENT
T1	Operator of the air pollution sources	Annual data on emissions and fees
T2	Air pollution source (APS)	Annual data on source - parameters
T3	Combustion parts of APS combusting fuels/waste	Annual data on emissions and fee calculation
T3a	Technological parts of APS combusting fuels/waste - direct process heating	Annual data on emissions and fee calculation
T4	Technological parts of source including surface and fugitive emissions	Annual data on emissions and conditions of fee calculation
T4a	Technological parts of source	Calculations of ammonia in livestock farming
T4b	Technological parts of source	Calculations for storage and handling of organic liquids

FORM TYPE	NAME	CONTENT
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 defined area
T8	Energy facility - combustion unit	Technical parameters
T9	Technological parts of APS	Base data on technological lines except the direct contact of flue gas with heating medium
T9a	Technological parts of APS	Facility using the organic solvents
T9b	Technological parts of APS	Refuelling gas station
T9c	Technological parts of APS	Distribution storages of gasoline
T9d	Technological parts of APS	Waste incinerations and co-incineration plants
T9e	Technological parts of APS combusting fuels/waste - direct process heating	Technological parts where flue gas is used for direct process heating and drying - technical parameters
T10	Abatement technologies	Base data for energy and technological parts of air pollution sources
-	Fuel sellers	data on fuel sold

A4.2 SYSTEM CHARACTERISTICS

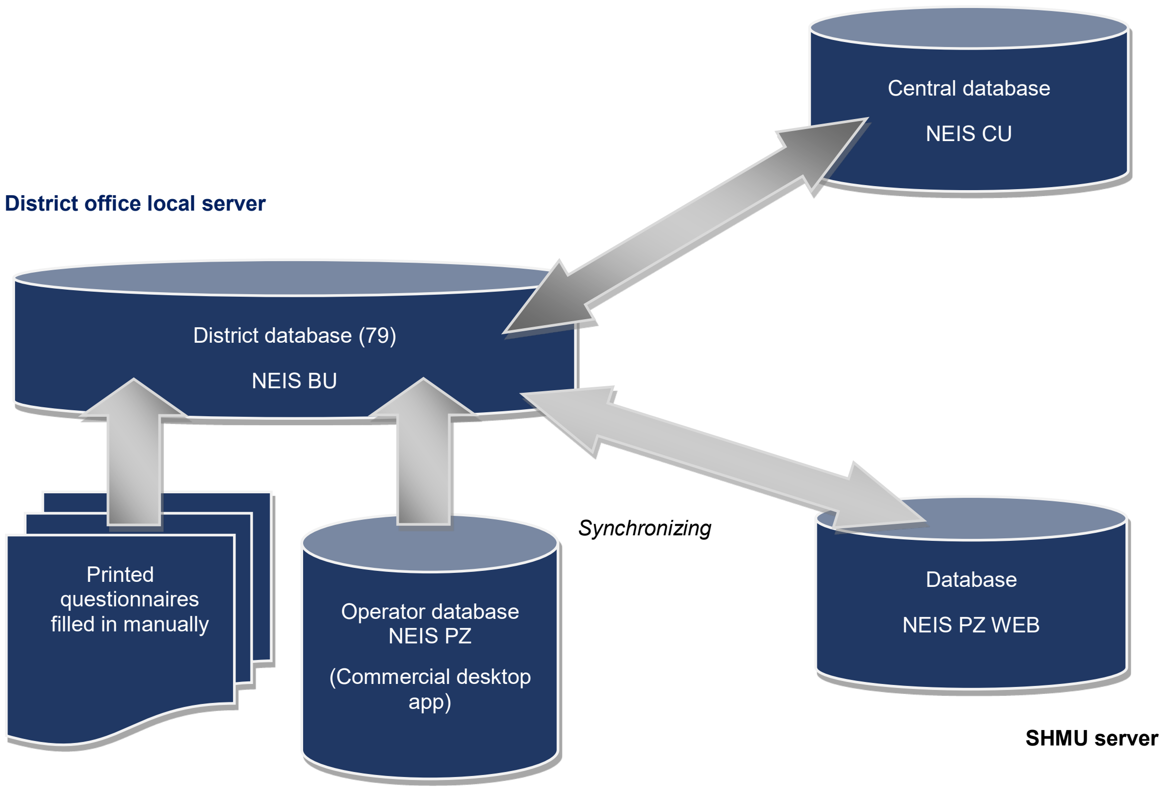
Database NEIS includes about 13000 sources of air pollution per year. The sources are categorized by activity and projected capacity as large or medium (Decree No 410/2012 Coll.) as follow:

- Large sources:
    - Technological units containing combustion plants having total rated thermal input more than 50 MW and other technological units with a capacity above the defined limit
- Medium sources:
    - Technological units containing combustion plants having total rated thermal input between 0.3 – 50 MW and other technological units with a capacity under the defined limit for the large sources but over the defined limit for the medium sources

Operators of large and medium sources are obliged to annually report specific dataset 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 on the district level.

Emissions are summarized on the level of the sources releasing pollutants into the air. The term 'source' is defined in the national Act No 137/2010 as a stationary technological unit (including storage of fuels, raw materials or products, quarries and other areas or objects), plant or activity, which is polluting or can pollute the air; delimited is as a functional and spatial complexity of all plants and activities. In some cases, this definition overlaps the definition of the 'installation' in IED, but mainly 'source' is a part of the 'installation'. Another IED term 'plant' is also mainly a part of the 'source' or identical with it.

Figure A4.3: *The scheme of the connection of individual databased in NEIS*



Each source can contain one or more combustion plant and/or one or more technology. The quantifying of the yearly emissions is executed on the plant/technology level. The applicable methods for the quantifying are enacted in Decree No 411/2012 on emission monitoring in stationary sources of air pollution:

- prescribed technical balance approach,
- explicit emission-dependence approach,
- continuous measurement,
- calculation using representative individual emission factor or representative individual mass flow,
- calculation using emission factor evaluated by periodic measurement,
- calculation using mass flow or mass concentration evaluated by periodic measurement,
- general emission-dependence approach,
- default emission factor approach[8],
- calculation using an emission-dependence approach or EF published in technical standards, directive, guidelines or another official document of a competent authority, EU and related organizations,
- other suitable approach filling given requirements,
- combination of previous approaches.

Possibly activity data is the operation hours, fuel consumption, volume of the waste gases, amount of produced energy or other relevant product.

[8] General relations, as well as default EF, are published in Bulletin of the Ministry of the Environment No 410/2012 Coll.

Due to the NFR sectoral code changes, it was necessary to recalculate the accessible timeline. Revision of all sources expected the development of the methodology for automatized re-assignment of sectoral codes to the individual sources. The accessible timeline in NEIS (2000-2019) was revised: emissions from individual air pollution sources were re-allocated according to revised sectoral codes.

Methodology for automatized re-assignment is based on the following key data:

- Air pollution source category (Decree No 410/2012 Coll.)
- SK NACE rev.2 code of the operator

The developed algorithm checks the key data, compare this with the assignment rules and due to the result executes the assignment of the relevant NFR sectoral code. The procedure is iterated for every source-record in the chosen year. It is also possible to add an exception.

- Small sources:
    - Stationary equipment – domestic heating equipment for the combustion of solid fuels and natural gas with total rated thermal input less than 0.3 MW

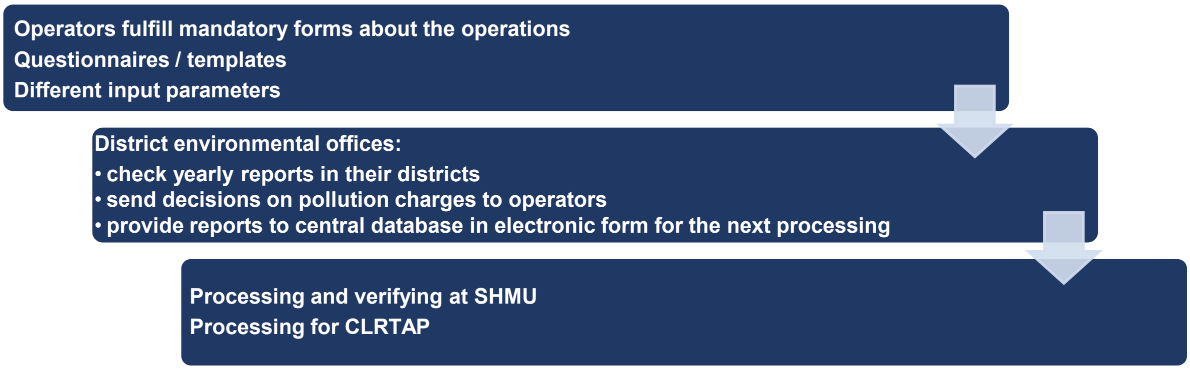
The sources below 0.3 MW (category 1A4bi – Residential: Stationary plants) are defined as small sources. These are not registered as individual point sources. The emission balance is being processed centrally (NEIS CU - central unit) and it is based on:

- Solid fossil fuels sold (data on district level) for the operator of fuel combustion plants with RTI up to 0,3 MW (households)
    - in 2001–2003 according to Decree No 144/2000
    - in 2004–2009 according to Decree No 53/2004
    - since 2010 according to Decree No 362/2010
    - Consumption of natural gas for the inhabitants and the annual market share on the gas sale in SR
    - Consumption of electric energy in the households
    - Annually specified emission factor

A4.3 DATAFLOW AND PROCESSING

According to the Act No 137/2010 Coll. as amended by the Act No 318/2012 Coll. operators of large and medium sources are obliged to annually report specific dataset about the operation. The main data is the amount of released emissions, the pollutant fee and fuel consumption. The dataset contains also the amount of various metadata. This reporting obligation since 1/2016 can be fulfilled by using the browser-interfaced tool NEIS PZ WEB, which was developed for the operators as a result of the project 'Internetization of the National emission information system'. Data from operators are collected and verified by the district offices using 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



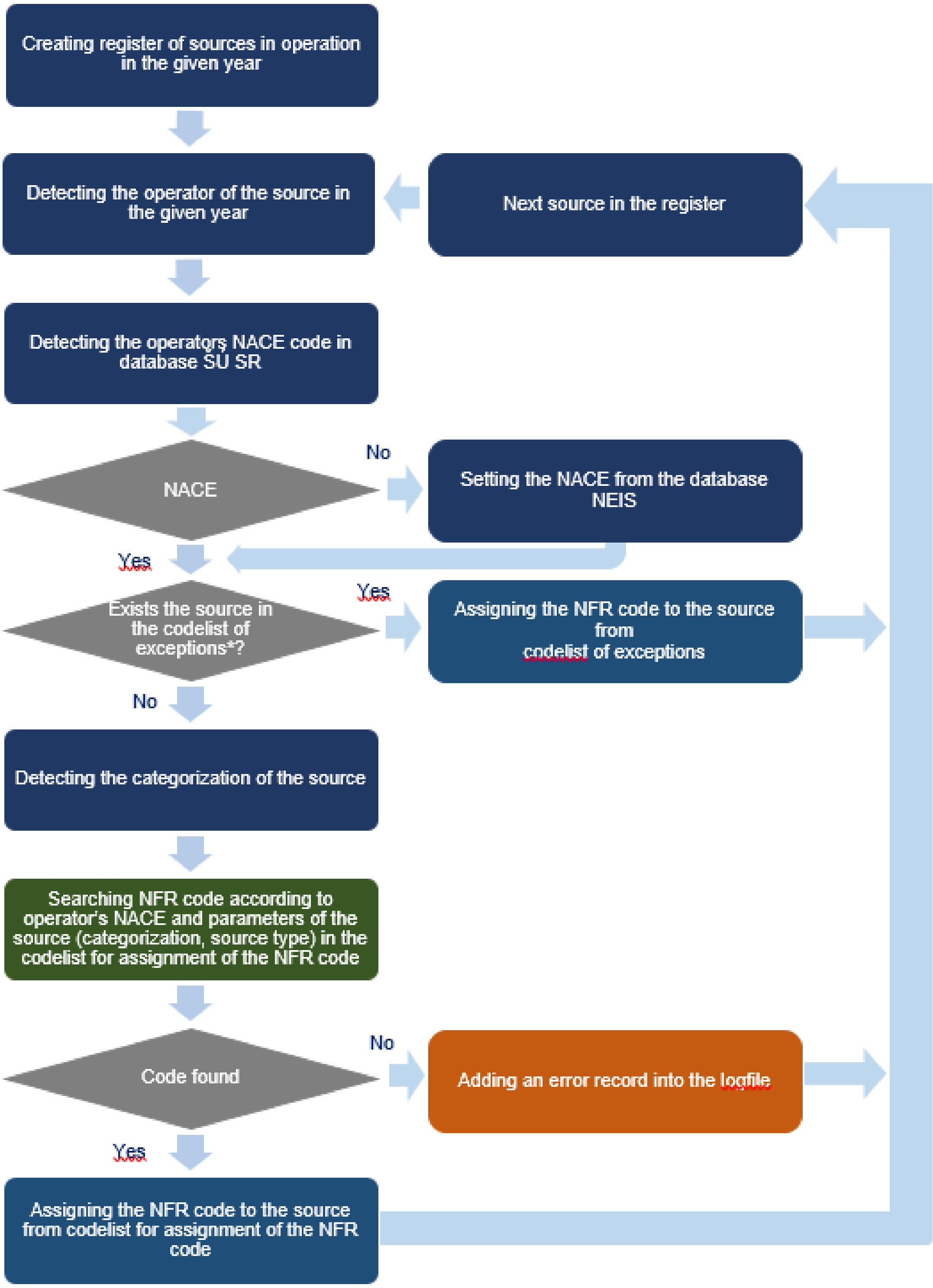
A4.4 VERIFICATION PROCESS OF NEIS DATA

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 level of districts (79 district offices responsible for the related pollution sources in the territory of individual districts). Verification is performed partly by automatized inbuilt check-up mechanisms for illogical and missing key data, and partly by the specialist for environmental issues at the district environmental offices. In cases when the data are not clear, the operator or responsible contact persons are contacted for the verification and explanation of their input data.

The second verification level is in a central database in SHMU, there is performed also the automatized verification inbuilt check-up mechanisms for illogical and missing key data, and partly by the specialist for environmental issues. In cases when the data are not clear, the operator or responsible district offices are contacted or directly the operators.

A4.5 PROCESS OF CODE MATCHING IN NEIS DATABASE

Figure A4.5: *Flowchart of code matching process*



* In the codelist of exceptions are predefined NFR codes

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 NFR is used also the specification according to NACE.

The collected data are processed to calculate definite emissions for a particular year for each source in a registry. NEIS is highly variable for the determination of emissions according to approved permission on the operation and technical condition of the installation. There are several manners for the compilation of combustion emissions.

Emission compilations for energy in NEIS:

1.	Continuous measurement
2.	Calculation using representative concentration and volume of flue gas

$$Em[t] = (1 - \eta/100) \times c[mg/m^3] \times V[th.m^{-3}] \times 10^{-6}$$

Where
η = Effectiveness of abatement technology or separator
c = concentration of air pollutant

V = quantity/volume of released waste gas3.	Calculation using representative individual mass flow and number of operating hours

$$Em[t] = (1 - \eta/100) \times q[kg/hour] \times 10^{-3}$$

Where
η = Effectiveness of abatement technology or separator
q = mass flow
t = number of operational hours for the related year

4.	Calculation using emission factor and amount of fuel

$$Em[t] = (1 - \eta/100) \times EF[kg/t] \times AD[t] \times 10^{-3}$$

$$Em[t] = (1 - \eta/100) \times EF[kg/mil.m^3] \times AD[th.m^3] \times 10^{-6}$$

Where
η = Effectiveness of abatement technology or separator
EF = Emission Factor
AD = Quantity of fuel

5.	Calculation using emission factor and amount of related quantity other than fuel

$$Em/t] = (1 - \eta/100) \times EF\ [kg/GJ \times AD\ [GJ] \times 10^{-3}$$

$$Em/t] = (1 - \eta/100) \times EF\ [kg/kWh] \times AD\ [kWh] \times 10^{-3}$$

Where
η = Effectiveness of abatement technology or separator
EF = Emission Factor
AD = Activity Data (Quantity of related Activity Data)

6.	Calculation using emission factor related to the content of AP in fuel and amount of fuel

$$Em\ /t] = (1 - \eta/100) \times EF\ [kg/t] \times AP[\%] \times AD\ [t] \times 10^{-3}$$

$$Em\ /t] = (1 - \eta/100) \times EF\ [kg/mil.m^3] \times AP[\%] \times AD\ [th.m^3] \times 10^{-6}$$

$$Em\ /t] = (1 - \eta/100) \times EF\ [kg/t] \times AP\ [mg/kg] \times AD\ [t] \times 10^{-9}$$

$$Em\ /t] = (1 - \eta/100) \times EF\ [kg/mil.m^3] \times AP\ [mg/kg] \times AD\ [th.m^3] * 10^{-12}$$

Where
η = Effectiveness of abatement technology or separator
EF = Emission Factor

AP = Content of Air Pollutant expressed as a percentage

AD = Activity Data (Quantity of related Activity Data)7.	Calculation using content of ash, sulphur or other compound in dry matter and emission factor related to content of AP in fuel and amount of fuel

$$Em\ [t]\ = (1-\eta/100)\ \times EF\ [kg/t]\ \times\ AP\ [\%\ in\ dry\ matter]\ *\ 1 - W/100\ \times\ AD\ [t]\ *\ 10^{-3}$$

Where

η = Effectiveness of abatement technology or separator
EF = Emission Factor
AP = Content of ash, sulphur or other compound in dry matter expressed as a percentage
W = humidity of the material
AD = Quantity of fuel

8.	Calculation using emission factor related to calorific value

$$Em\ [t]\ = (1-\eta/100)\ \times EF\ [kg/GJ]\ \times\ NCV\ [GJ/t]\ \times AD\ [t]\ *\ 10^{-3}$$

$$Em\ [t]\ = (1-\eta/100)\ \times\ EF\ [kg/GJ]\ \times\ NCV\ [GJ/th.m^3]\ \times\ AD\ [th.m^3]\ \times\ 10^{-3}$$

Where

η = Effectiveness of abatement technology or separator
EF = Emission Factor
NCV = Net Calorific Value
AD = Activity Data (Quantity of related Activity Data)

9.	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel

$$Em\ [t]\ = (1-\eta/100)\ \times\ EF\ [kg/GJ] \times\ AP\ [\%] \times\ NCV\ [GJ/t]\ \times\ AD\ [t]\ \times\ 10^{-3}$$

$$Em\ [t]\ = (1-\eta/100)\ \times EF\ [kg/GJ]\ \times\ AP\ [\%] \times\ NCV\ [GJ/th.m^3 \times\ AD\ [th.m^3]\ \times\ 10^{-6}$$

$$Em\ [t]\ = (1-\eta/100)\ \times EF\ [kg/GJ]\ \times\ AP\ [mg/kg]\ \times\ NCV\ [GJ/t]\ \times AD\ [t]\ \times\ 10^{-9}$$

$$Em\ [t]\ = (1-\eta/100)\ \times\ EF\ [kg/GJ]\ \times AP\ [mg/kg]\ \times NCV\ [GJ/th.m^3]\ \times AD\ [th.m^3] \times\ 10^{-12}$$

Where

η = Effectiveness of abatement technology or separator
EF = Emission Factor
AP = Content of Air Pollutant expressed as a percentage
AD = Activity Data (Quantity of related Activity Data)

10.	Calculation using content of ash and sulphur in dry matter and emission factor related to content of AP in fuel and related to calorific value and amount of fuel

$$Em\ [t]\ = \left(1-\frac{\eta}{100}\right) \times\ EF\ \left[\frac{kg}{GJ}\right] \times\ AP\ [\%] \times\ 1 - W/100\ \times\ NCV\ [GJ/t] \times AD\ [t] \times\ 10^{-3}$$

Where

η = Effectiveness of abatement technology or separator
EF = Emission Factor
AP = Content of ash and sulphur in dry matter expressed as a percentage
W = humidity of the material
AD = Quantity of fuel

99.	Other manner of determination

In data processing, is taken specific information on abatement technologies and their effectiveness in a compilation of final emissions. (**ANNEX IV, Chapter A4.7**).

A4.5.1 Calculation of particulate matters

Total Suspended Particles (TSP) emissions are provided directly by operators of individual large and medium sources on the base of measurements or more precisely by calculation (in compliance with the air protection legislation of the Slovak Republic). Emission inventory of PM_{10} and $PM_{2.5}$ for the Slovak Republic are elaborated according to the EMEP/EEA GB_{2019} and in compliance with requirements of the respective of a working group for emission inventory (UN ECE Task Force on Emission inventory) and methodology is based on IIASA's report[9].

Automated calculation of emissions PM_{10} and $PM_{2.5}$ was technically implemented in 2011[10] in db. NEIS according to the study[11]. Emissions PM_{10} and $PM_{2.5}$ were processed with certain sectoral default indicators. In respect of that on the EU level were defined emission ceiling for 2020 based on GAINS model (from IIASA) so we resolved to the methodology of calculation inventory of PM_{10} and $PM_{2.5}$. National inventory is base on the modelling of national projections

The NEIS database contains a special program that automatically calculates emissions of PM_{10} and $PM_{2.5}$. The outputs from the NEIS database are verified and performed in excel sheets. The efficiency of the installed separation of fractions is defined and then emissions of PM_{10} and $PM_{2.5}$ behind the separator were calculated. After calculations behind the separator, the calculation of total emissions PM_{10} and $PM_{2.5}$ is taken to NFR tables

Emissions are distinguished into three fractions: fine ($PM_{2.5}$), coarse (PM_{10} -$PM_{2.5}$) and big (PM>10 µm)

Final emissions are calculated: $PM_{10} = PM_{fine} + PM_{coars.}$

A4.6 ENERGY – GENERAL EMISSION FACTORS

The general emission factors are valid for emissions from combustion before the use of abatement technologies or additives. The final amount of released air pollutants demand the effectiveness of abatement or degree of DESOX after the adding of additives.

Table A4.2: *General relations and default EF published in Bulletin of the Ministry of the Environment*

FUEL	input	TZL	SO_2	NO_x as NO_2	CO	VOC	TOC
FURNACE/COMB. UNIT TYPE	**MWt**	**EF in kg/t of fuel, resp. kg/mil.m³ gaseous fuel**					
BR.COAL / LIGNITE							
Dry Bottom Boiler							
pásový rošt		$1.7.A^r$	$17.5.S^r$	3	6	0.055	0.045
pásový rošt s pohadzovačom		$4.0.A^r$	$17.5.S^r$	3	10	0.055	0.045
presuvný vratný rošt ***Combine - Dry and Wet Bottom Boiler*** rošt-olej rošt-plyn		$1,7.A^r$	$17.5.S^r$	3	6	0.055	0.045
Dry Bottom Boiler							
pevný rošt		$1.A^r$	$12.5.S^r$	3	45	7.5	6.15
Granular combined; prášok - rošt; prášok - olej; prášok - plyn							
a) stena		$7.5.A^r$	$17.5.S^r$	4	0,5	0.06	0.05
b) tangenc.		$7.5.A^r$	$17.5.S^r$	4	0,5	0.06	0.05
Fluid Combustion							
circulating layer		$3.A^r$	$12.5.S^r$	2	5	0.055	0.045
static layer		$1.6.A^r$	$12.5.S^r$	3	2.5	0.055	0.045
Cyclone combustion		$3.4.A^r$	$17.5.S^r$	6	0.5	0.06	0.049
WOOD							
		15	-	3	16	0.11	0.09
HARD COAL AND COKE							
Dry Bottom Boiler							
pásový rošt		$1.5.A^r$	$19.S_r$	5.5	3	0.055	0.045

[9] hhttp://www.iiasa.ac.at/web/home/research/researchPrograms/air/ir-02-076.pdf
[10] Správa k riešeniu úlohy „Systém pre prepočet emisií TZL na emisie PM10 a PM2.5, SPIRIT informačné systémy
[11] Návrh výpočtu tuhých znečisťujúcich látok s aerodynamickým priemerom menším ako 10 a 2.5 µm (PM_{10} a $PM_{2.5}$), Slovenský hydrometeorologický ústav v spolupráci s ECOSYS, 2008

FUEL	input	TZL	SO_2	NO_x as NO_2	CO	VOC	TOC
FURNACE/COMB. UNIT TYPE	**MWt**	**EF in kg/t of fuel, resp. kg/mil.m³ gaseous fuel**					
pásový rošt s pohadzovačom		4.A^r	19.S^r	7	2.5	0.055	0.045
presuvný vratný rošt ***Combine - Dry and Wet Bottom Boiler*** rošt-olej rošt-plyn		1.3.A^r	19.S^r	5.5	3	0.055	0.045
Dry Bottom Boiler							
pevný rošt		1.A^r	15.5.S^r	5.5	45	7.5	6.15
Granular combined; prášok - rošt; prášok - olej; prášok - plyn							
a) stena		7.5.A^r	19.S^r	9	0.5	0.06	0.05
b) tangenc.		7.5.A^r	19.S^r	9	0.5	0.06	0.05
Fluid Combustion							
circulating layer		2.2.A^r	12.5.S^r	2	5	0.055	0.045
static layer		1.6.A^r	12.5.S^r	5.5	2.5	0.055	0.045
Cyclone combustion		1.A^r	19.S^r	17	0.5	0.06	0.049
Melting		5.A^r	19.S^r	15	0.5	0.045	0.037
LIQUID AND GASEOUS FUELS							
Heavy Fuel Oil	<3	2.9	20xS	8.5	0.65	0.202	0.166
	3-100	2.9	20xS	8.5	0.65	0.146	0.120
	>100	2.9	20xS	8.5	0.65	0.131	0.170
Diesel Oil and Other Liquid Fuels	<3	0.1	20xS	8.5	0.65	0.139	0.114
	3-100	1.1	20xS	8.5	0.65	0.087	0.071
	>100	2.1	20xS	8.5	0.65	0.075	0.062
Naphtha	<3	1.42	20xS	5	0.8	0.139	0.114
	3-100	2.42	20xS	5	0.8	0.087	0.071
	>100	3.42	20xS	5	0.8	0.075	0.062
Propane - Butane		0.45	20xS (0.004)	4.7	0.8	0.132	0.108
Natural Gas	<3.5	80	9.6	1560	630	128	105
	3.5-115	80	9.6	1760	590	92	75
	>115	80	9.6	1760	590	28	23
Blast Furnace Gas	<3.5	302	2.S	1920	320	128	105
	3.5-115	290	2.S	3700	270	92	75
	>115	240	2.S	9600	270	28	23
			(150)				
Coke Oven Gas	<3.5	302	2.S	1920	320	128	105
	3.5-115	290	2.S	3700	270	92	75
	>115	240	2.S	9600	270	28	23
			(9500)				
Other Gas	<3.5	302	2.S	1920	320	128	105
	3.5-115	290	2.S	3700	270	92	75
	>115	240	2.S	9600	270	28	23
			(85)				

A^r = content of ashes in original fuel in % of weight
S^r = content of sulphur in original fuel in % of weight
S = for liquid fuels is sulphur content in % of weight
S = for gaseous fuels is sulphur content in mg/m³
S = for Propane – Butane is sulphur content in mg/100g

A4.7 ABATEMENT TECHNOLOGIES

Table A4.3: *List Abatement technologies reported to NEIS database*

TYPE OF SEPARATOR	NAME
F - textile	F - Textile hose

TYPE OF SEPARATOR	NAME
F - textile	F - Textile pocket
F - textile	F - Textile sleeve
F - textile	F - Textile chamber-cassette
F - textile	F - Textile wedge
F - textile	F - Textile non-woven felt
F - textile	F - Textile-woven with woven reinforcement
F - textile	F - Textile other
F - textile	F - Not Specified
E - electric	E - Horizontal
E - electric	E - Vertical
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

TYPE OF SEPARATOR	NAME
AD,SP - absorption and combustion	AD - adsorption of gas-fluid. Adsorbent bed
AD,SP - absorption and combustion	AD - gas-continuous adsorption moving bed ad
AD,SP - absorption and combustion	SP - Gas combustion - thermal three-stage (burner, mixer, aggravation), linear. Burner
AD,SP - absorption and combustion	SP - Combustion of gases - thermal three-stage, tunnel incinerator
AD,SP - absorption and combustion	SP - Gas Combustion - thermal three-stage, jet incinerator
AD,SP - absorption and combustion	SP - Combustion of gases - thermal in the sand bed
AD,SP - absorption and combustion	SP - Gas-catalytic combustion - solid bed (tapes, rods, bricks, pellets ...)
AD,SP - absorption and combustion	SP - Combustion of gas-catalytic-fluid bed (metals and their compounds on carriers)
DS - DESOX	DS - DESOX-lime-limestone wet scrubbing-WS
DS - DESOX	DS - DESOX - injection of lime milk into the flue gas-SDA
DS - DESOX	DS - DESOX injection of dry sorbent-DSI, additional
DS - DESOX	DS - DESOX-Wellmann-Lord with Na-WL sulphite
DS - DESOX	DS - DESOX-Walter process with ammonia-WAP
DN - DENOX	DN - DENOX-selective non-catalytic reduction - SNCR
DN - DENOX	DN - DENOX-selective catalytic reduction - SCR
DN - DENOX	RD - Reduction of gas catalytic-solid bed
DN - DENOX	RD - Reduction of catalytic-fluid gas
KMB - combine	KMB - combine-SNOX with separate cathodes, catalytic reduction of NOx, catal.ox.SO_2
KMB - combine	KMB - combine-DESONOX catalysing 1 chamber, NOx catalytic reduction, catal.ox.SO_3
KMB - combine	KMB - combine-AC-dry simultaneous adsorption on moving the activated carbon (coke) to H_2SO_4 and N_2
KMB - combine	KMB - Gas capture by condensation (also cryogenic)
KMB - combine	KMB - Gas capture and disposal not specified
BIO - biological separators	BIO - dry-biofilters
BIO - biological separators	Bio - semi-dry biofilters, with reinforcement
BIO - biological separators	BIO - wet-bioscrubbers, bioskrub

A4.8 VOC CONTENT

Table A4.4: *VOC content - scheme*

SPECIFIC CONTENT OF VOC [W%]*	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		X		
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 2018 Comprehensive Technical Review of the National Emission Inventories that might have an impact on the emission estimates as far as possible in the 2019 submission. Recommendations that have been addressed are shaded in grey in ***Table A5.1***. The remaining recommendations are mainly related to transparency and will be implemented in future submissions when resources are available.

Table A5.1: *Status of implementation of the NECD recommendations*

SERIAL NO	PRIORITY CRITERIA TCCCA[12]	PRIORITY CRITERIA KEY CATEGORY	PRIORITY CRITERIA OVER EMISSION 2%	REVIEW RECOMMENDATION	IMPLEMENTED
SK-0A-2020-0001	Accuracy	No	No	**0A National Total - National Total for the Entire Territory - Based on Fuel Sold/Fuel Used, NH_3, PM_{10}, $PM_{2.5}$, 2005:** The TERT recommends that Slovakia include the revised estimate in its 2021 IIR submission	Implemented/ANNEX I
SK-0A-2020-0002	Accuracy	No	No	**0A National Total - National Total for the Entire Territory - Based on Fuel Sold/Fuel Used, SO2, NH_3, NMVOC, $PM_{2.5}$, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, PM_{10}, CO, BC, 1990 – 2018:** The TERT recommends that Slovakia starts to compile estimates of uncertainty for the main pollutants for its next submission and develops a programme to compile uncertainties for all pollutants over the coming years that will facilitate the gathering of suitable information.	Not implemented
SK-1A1a-2018-0002	Accuracy	Yes	No	**1A1a Public Electricity and Heat Production, Hg:** The TERT recommends that Slovakia pursues the implementation of a Tier 2 methodology as soon as resources allow.	Implemented/IIR ver. 1 **Chapter 3.4.2**
SK-1A3c-2020-0001	Accuracy	Yes	Yes	**1A3c – Tier 1 method for key category:** The TERT recommends that Slovakia include the revised estimate for T2 method in its 2021 NFR and IIR submission.	Implemented/IIR ver. 1 **Chapter 3.6.5**
SK-1A4ai-2018-0001	-	Yes	No	**1A4ai Commercial/Institutional**: The TERT recommends that Slovakia ensures that its emission factors presented in Table 3.64 of the IIR are correct. TERT recommends Slovakia to use a Tier 2 method for 1A4ai	Implemented/IIR ver. 1. **Chapter 3.7.2**

[12] If is criterion TCCCA, please select option - transparency, consistency, comparability, completeness or accuracy

SERIAL NO	PRIORITY CRITERIA TCCCA[12]	PRIORITY CRITERIA KEY CATEGORY	PRIORITY CRITERIA OVER EMISSION 2%	REVIEW RECOMMENDATION	IMPLEMENTED
SK-1A4cii-2018-0001	Transparency	No	No	**1A2gvii Mobile Combustion in Manufacturing Industries and Construction, 1A4aii Commercial/Institutional:** The TERT recommends that some effort is made to separate activity for these mobile machinery sources in order to improve comparability and transparency of the Slovakia inventory. The TERT recommends that Slovakia investigates this as an improvement for the next 2019 or 2020 submissions and also corrects the duplication of description of sources in the IIR.	Implemented /IIR ver. 1 **Chapter 3.5.8, 3.7.3, 3.7.5, 3.7.7**
SK-1B2c-2020-0001	Completeness	No	No	**Reporting PAHs emissions as NE when available methodology:** The TERT recommends that Slovakia include emissions estimates in the 2021 or 2022 submission.	Not implemented
SK-2-2019-0001	-	No	No	**2C1 Industry, BaP, PCBs, HCB, Cd, Hg, Pb:** The TERT agrees with the explanation provided by Slovakia and recommends Slovakia to continue their efforts to provide a Tier 3 methodology for this sector, and to improve transparency in the IIR by providing more information on their EFs, e.g. by providing a trend of the average IEF and a comparison to the default EF and the theory behind the difference, or at least an overview of the different abatement technologies used.	To be implemented following the timetable in **ANNEX IX.**
SK-2C1-2020-0001	Accuracy	Yes	Yes	**2C1 Iron and Steel Production, Cd, PCDD/F, Hg, PAHs, Pb, PCBs, 1990, 2005, 2016, 2017:** The TERT recommends that Slovakia include the revised estimate with T2 methodology in its 2021 NFR and IIR submission.	Implemented/IIR ver. 1 **Chapter 4.6.2**
SK-2C3-2020-0001	Accuracy	Yes	Yes	**2C3 Aluminium Production, BaP, PAHs, 1990, 2005, 2016, 2017:** The TERT recommends that Slovakia include the revised estimate with T2 methodology in its 2021 NFR and IIR submission.	Implemented/IIR ver. 1 **Chapter 4.6.4**
SK-2C7a-2019-0002	Accuracy	Yes	Yes	**2C7a Copper Production, Cd, Hg, Pb, 2017:** The TERT recommends that Slovakia include the revised estimate with T2 methodology in its 2021 NFR and IIR submission.	Implemented/IIR ver. 1 **Chapter 4.6.8**
SK-2D3a-2019-0001	Accuracy	Yes	Yes	**2D3a Domestic Solvent Use including Fungicides, NMVOC, 1990-2018:** The TERT recommends that Slovakia include the revised estimate with T2 methodology in its 2021 NFR and IIR submission	Implemented/IIR ver. 1 **Chapter 4.7.1**
SK-2D3g-2018-0001	Accuracy	No	No	**2D3g Chemical Products, PAHs, 1990, 2005, 2016:** The TERT recommends that Slovakia reports PAHs from asphalt blowing in 2D3g Chemical Products in its 2021 NFR.	Implemented/IIR ver. 1 **Chapter 4.7.7**
SK-2D3h-2018-0001	Accuracy	No	No	**2D3h Printing, NMVOC, 2005, 2010, 2015:** The TERT reiterates the recommendation that Slovakia correct the data	Implemented/IIR ver.

SERIAL NO	PRIORITY CRITERIA TCCCA[12]	PRIORITY CRITERIA KEY CATEGORY	PRIORITY CRITERIA OVER EMISSION 2%	REVIEW RECOMMENDATION	IMPLEMENTED
				for the whole time series in its 2021 NFR and improves the description of the methodology applied and the Tier used in its 2021 IIR	**Chapter 4.7.8**
SK-3B1a-2020-0002	Transparency	No	No	**3B1a Manure Management - Dairy Cattle, NMVOC, 2018:** The TERT recommends Slovakia to include detailed description of activity data and parameters used for Tier2 NMVOC calculation for 3B1a (and 3B1b) in 2021 submission. Slovakia could consider aggregating the data to a national level, based on the regional data.	Implemented/IIR ver. 1 **Chapter 5.3**
SK-5A-2020-0001	Accuracy	No	Yes	**5A Biological Treatment of Waste - Solid Waste Disposal on Land, NMVOC, 1990-2018:** The TERT recommends that Slovakia estimate NMVOC emissions from 5A using a higher Tier methodology.	Implemented/IIR ver. 1 **Chapter 6.5**
SK-5C-2020-0001	Accuracy	No	Yes	**5C1 Waste Incineration, SO_2, NOX, NH_3, NMVOC, $PM_{2.5}$, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, PM_{10}, CO, BC, 1990-2018:** The TERT recommends that Slovakia investigates further, in relation with the statistical office, to understand the discrepancies between official data and data used in the inventory	Not implemented due to lack of response from the relevant authorities

ANNEX VI: IMPLEMENTATION OF MITIGATION MEASURES FOR AMMONIA EMISSIONS REDUCTION IN AGRICULTURE

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 the spreading of organic waste into the agricultural soils

A6.1 ANALYSIS OF MITIGATION MEASURES IN THE SLOVAK REPUBLIC

At present, abatements are very difficult to estimate in the condition of the Slovak Republic, due to a lack of official statistical information. The SHMÚ administers the NEIS. NEIS has information about the mitigation measures used by farmers. These data are confidential. The SHMÚ conducts the NEIS under the Act of the Ministry of the Environment of the Slovak Republic No 137/2010[13] Coll. on air and Decree of the Ministry of the Environment of the Slovak Republic No 410/2012 Coll[14]. 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 pollutions and pollution charges into the relevant district in the prescribed forms, or a portable electronic medium. NEIS has information on livestock number of animals, manure management systems and used abatements as well.

The emission from the NEIS database is not possible to fully implement into the national emission inventories due to the validity of the legislation. In addition, ammonia emissions for goats and turkeys missing entirely in the database due to a lack of law. The best practice for NH_3 estimation is the nitrogen budget. Nitrogen budget is a more complex approach, which was used during NH_3 calculation. During it, nitrogen losses are formed as nitrogen emissions (NH_3, NO, N_2O). Emissions are estimated from each breeding phase. All parameters and final implied emission factors differ during all time-series in the Slovak inventory approach. The NEIS calculates only NH_3 emissions. The Slovak Republic shall also report other nitrogen emissions (NO, N_2O). The NH_3 emissions are calculated with a default emissions factor, which is constant during all time-series in the NEIS system. Nevertheless, NEIS is a good source of additional data into the emissions inventory for quality control purposes.

[13] Act of the Ministry of the Environment of the Slovak Republic no.137/2010 Coll. Of 3 March 2010

[14] Decree of the Ministry of the Environment of the Slovak Republic no. 410/2012 Coll. of 30 November 2012 Implementing certain provisions of the Air

A6.2 METHODOLOGY ISSUE-METHOD

The SHMÚ compiles annually NH_3 balance according to the EMEP/EEA GB_{2019} using country-specific parameters and national input data from the ŠU SR[15]. The ŠU SR not dispose of official information about abatements. Therefore, in the NEIS, as mentioned above, the abatement information from farms are available.

Table A6.1: *Efficiency of abatements*

ABATEMENTS	EFFICIENCY OF ABATEMENTS
Daily spread	25%
Grounding injection	50%
Pulling spreading	90%
Storage of manure with covering	80%
Biogas station	25%
Scrubbers	90%
Storage of liquid manure with natural crust	40%
Floating LECA balls, Hexa-Covers	60%
Incorporation within 12 hours	50%
Incorporation within 24 hours	30%

The farms from the NEIS were examined analogically in the NEIS and abatements were investigated, for example spreading after 12 and 24 hours, storage for liquid and solid manure from the different livestock species. The results of the research were a list of abatements applied to the emission balance. ***Table A6.2*** and ***A6.3*** provides a share of the abatements per farm. There were calculated for a better interpretation and usability in the NH_3 calculations. NH_3 emissions from Sector 3 Agriculture are estimated according to the EMEP/EEA GB_{2016} as Tier 2 approach for cattle, sheep, goats, swine 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 2006 GL methodology. After emission calculations, emissions were multiplied with abatement share:

$$\mathrm{Emissions}_{\mathrm{NH_3\ without\ abatements}} = \mathrm{E} * \mathrm{P}_{\mathrm{abatements}}$$

$$\mathrm{Emissions}_{\mathrm{NH_3 with\ abatement}} = \mathrm{Emissions}_{\mathrm{NH_3 without\ abatement}} - (\mathrm{Emissions}_{\mathrm{NH_3 without\ abatement}} * \mathrm{K}_{\mathrm{reduction}})$$

Where: $\mathbf{Emissions}_{\mathbf{NH3\_with}\ \mathrm{abatements}}$= emissions after application of abetments v Gg, $\mathbf{K}_{\mathbf{reduction}}$= abatement efficiency $\mathrm{Emissions}_{\mathrm{NH3\_without\ abatements}}$ = emissions before application of abetments v Gg, **E**=Emissions in Gg $\mathbf{P}_{\mathbf{abatements}}$= share of abatement

A6.3 FUTURE PLANS

Implementation of mitigation measures was removed from the inventory in the 2020 submission. We plan to implement a more sophisticated estimation system at the district-level. We start cooperation with the Air Quality Monitoring Department in the Slovak Hydrometeorological Institute for this purpose. The base of calculation will be activity data on animal manure management systems (NEIS), abatements (NEIS), and animal performance data (The NPPC-VÚŽV). Final emissions base on a bottom-up approach will be implemented in Air quality modelling (***Figure A6.1***). This is the long-term plan for our inventory. We plan to finalise this work after the 2022 submission. ***Table A6.2*** presented a long-term plan for implementation.

Figure A6.1: *The description of individual subprograms and way of the usage area presented in the following subsections – Schema of the emPY software*[16]

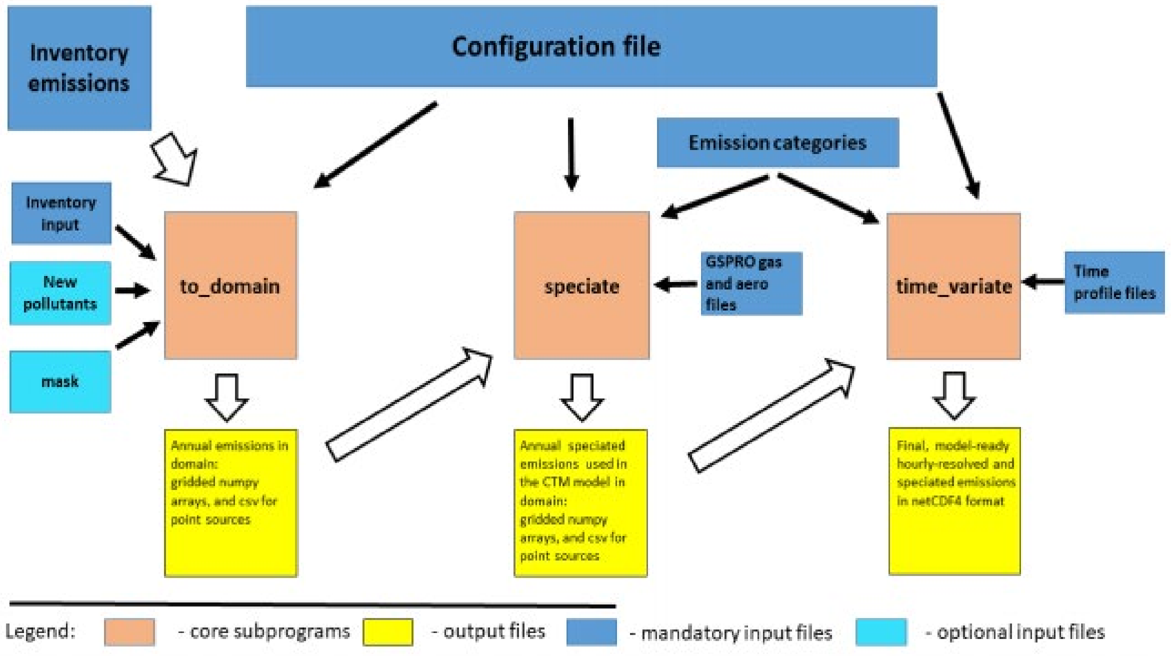


Table A6.2: Long-term plan for implementation

TIME SCHEDULE	DESCRIPTION	STATUS OF IMPLEMENTATION
Submission 2020	Automation of nitrogen emission model in the Python according to the EMEP/EEA GB_{2016}	Implemented
Submission 2021	Dissemination of activity data on district level where possible	Implemented
Submission 2022	Implementation of mitigation measures	Will be implemented
Submission 2022	Data conversion on grid data and quality control	Will be implemented
Submission 2022	Finalisation a presentation of data	Will be implemented

[16] Štefánik D.http://www.shmu.sk/File/KMO/StefanikD_Simple_software_for_preparation_of_CTM_emission_inputs_emPY.pdf

Table A6.3: *Distribution of applied abatements in 2016*

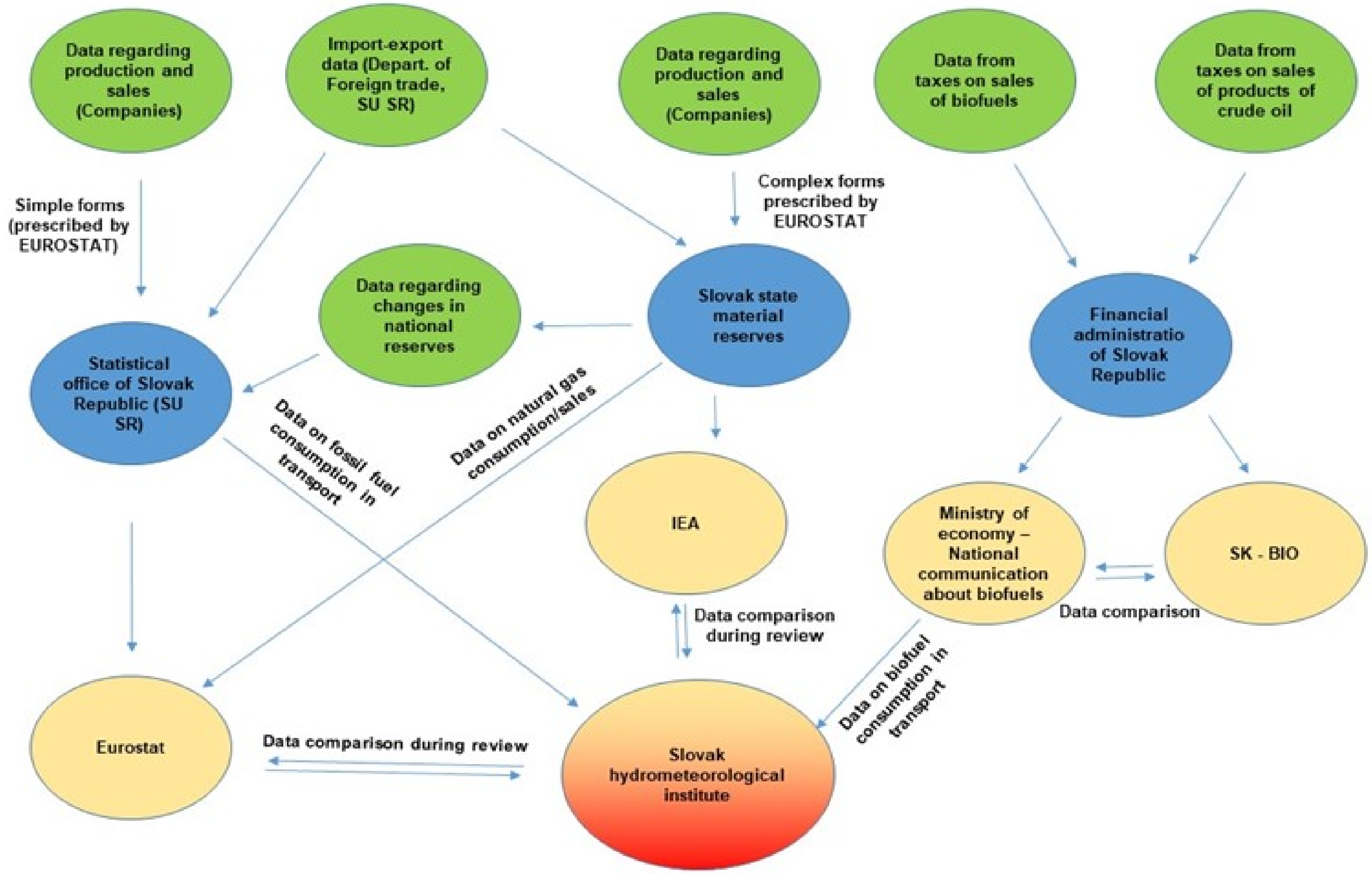
ABATEMENTS	DAIRY CATTLE	NON-DAIRY CATLE	SHEEP	BREEDING SWINE	MARKET SWINE	HORSES	LAYING HENS	BROILERS	TURKEYS
Biogas station	0.11%	0.07%	0.00%	0.00%	0.18%	0.00%	0.00%	0.00%	0.00%
Additives in the feeding ration	0.06%	0.25%	0.00%	0.88%	0.90%	0.00%	0.37%	0.57%	0.00%
Storage of manure with covering	14.69%	13.12%	7.14%	10.59%	9.14%	22.58%	2.61%	3.41%	10.71%
Storage covering with nature products (straw, sawdust)	0.23%	0.11%	0.00%	0.59%	0.18%	0.00%	8.58%	0.57%	0.00%
Storage of liquid manure with crust	5.95%	6.18%	3.90%	5.59%	7.35%	0.00%	5.22%	17.05%	5.36%
Floating LECA balls, Hexa-Covers	0.23%	0.25%	0.00%	1.18%	1.61%	0.00%	0.00%	0.00%	0.00%
Sold manure	0.97%	0.40%	0.00%	1.18%	1.25%	0.00%	0.00%	0.00%	0.00%
No measures	1.32%	2.01%	4.55%	2.94%	3.05%	3.23%	2.24%	2.84%	8.93%
Other mitigation measures	2.00%	1.15%	0.65%	2.06%	2.51%	0.00%	0.00%	0.00%	0.00%
Free spreading	5.49%	5.14%	0.00%	10.88%	13.26%	0.00%	1.49%	0.28%	0.00%
Incorporation within 24 hours	0.97%	1.22%	0.00%	1.18%	1.61%	0.00%	0.75%	1.70%	1.79%
Incorporation within 12 hours	1.09%	1.33%	1.95%	3.82%	3.58%	3.23%	49.25%	34.66%	37.50%
Deep injection	0.63%	0.29%	1.95%	8.53%	8.42%	0.00%	10.07%	0.00%	1.79%
Grounding injection	1.83%	2.09%	5.19%	1.47%	1.25%	3.23%	0.75%	1.42%	3.57%
Pulling spreading	0.17%	0.18%	0.00%	0.59%	0.54%	0.00%	0.00%	0.28%	0.00%
Sold manure	11.95%	12.33%	0.00%	12.35%	8.06%	3.23%	0.75%	1.99%	1.79%
No measures	0.80%	0.65%	0.00%	1.18%	1.61%	0.00%	0.00%	0.00%	0.00%
Other mitigation measures	16.87%	17.01%	20.78%	17.06%	15.05%	25.81%	4.10%	5.11%	3.57%
Scrubbers	7.03%	7.01%	7.14%	4.41%	3.94%	9.68%	0.75%	1.70%	0.00%
Daily spread	15.49%	17.51%	44.16%	7.94%	10.39%	29.03%	9.70%	23.01%	16.07%
No measures	12.12%	11.69%	2.60%	5.59%	6.09%	0.00%	3.36%	5.40%	8.93%

Table A6.4: *Distribution of applied abatements in 2017*

ABATEMENTS	DAIRY CATTLE	NON-DAIRY CATTLE	SHEEP	BREEDING SWINE	MARKET SWINE	HORSES	LAYING HENS	BROILERS	TURKEYS
Biogas station	0.12%	0.07%	0.00%	0.00%	0.21%	0.00%	0.00%	0.00%	0.00%
Additives in the feeding ration	0.00%	0.18%	0.00%	1.04%	0.83%	0.00%	0.37%	0.57%	0.00%
Storage of manure with covering	14.98%	12.87%	7.41%	9.34%	8.47%	16.00%	2.61%	3.41%	10.71%
Storage covering with nature products (straw, sawdust)	0.12%	0.07%	0.00%	0.69%	0.21%	0.00%	8.58%	0.57%	0.00%
Storage of liquid manure with crust	6.14%	6.56%	3.09%	3.81%	4.96%	4.00%	5.22%	17.05%	5.36%
Floating LECA balls, Hexa-Covers	0.23%	0.26%	0.00%	1.38%	1.24%	0.00%	0.00%	0.00%	0.00%
Sold manure	1.11%	0.41%	0.00%	1.38%	1.45%	0.00%	0.00%	0.00%	0.00%
No measures	1.29%	2.21%	4.94%	3.46%	3.10%	4.00%	2.24%	2.84%	8.93%
Other mitigation measures	1.87%	1.18%	0.62%	2.08%	2.27%	0.00%	0.00%	0.00%	0.00%
Free spreading	5.38%	4.94%	0.00%	10.38%	13.22%	0.00%	1.49%	0.28%	0.00%
Incorporation within 24 hours	0.99%	1.18%	0.00%	1.04%	1.45%	0.00%	0.75%	1.70%	1.79%
Incorporation within 12 hours	1.35%	1.44%	1.85%	5.19%	4.75%	4.00%	49.25%	34.66%	37.50%
Deep injection	0.53%	0.22%	1.85%	9.00%	9.30%	0.00%	10.07%	0.00%	1.79%
Grounding injection	1.87%	2.10%	6.17%	1.04%	1.24%	4.00%	0.75%	1.42%	3.57%
Pulling spreading	0.23%	0.18%	0.00%	0.69%	0.62%	0.00%	0.00%	0.28%	0.00%
Sold manure	12.23%	12.43%	0.62%	12.80%	8.26%	4.00%	0.75%	1.99%	1.79%
No measures	0.82%	0.63%	0.00%	1.38%	2.07%	0.00%	0.00%	0.00%	0.00%
Other mitigation measures	15.92%	16.15%	19.75%	16.26%	14.46%	20.00%	4.10%	5.11%	3.57%
Scrubbers	7.67%	7.52%	8.02%	4.50%	3.93%	12.00%	0.75%	1.70%	0.00%
Daily spread	15.27%	17.74%	42.59%	8.65%	11.57%	32.00%	9.70%	23.01%	16.07%
No measures	11.88%	11.65%	3.09%	5.88%	6.40%	0.00%	3.36%	5.40%	8.93%

ANNEX VII: DATA FLOW OF FUELS

Figure A7.1: *Flowchart of data reporting and utilisation (green – original data, blue – primary users, yellow – secondary users, red – tertiary users)*



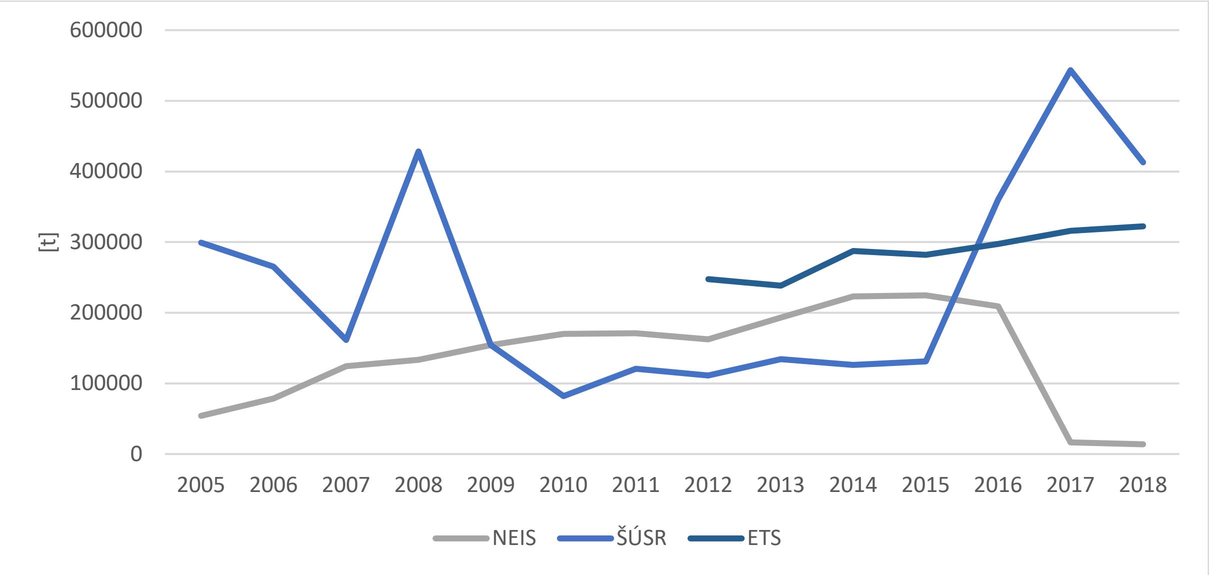
ANNEX VIII: JUSTIFICATION OF THE ACTIVITY DATA SOURCE FOR WASTE INCINERATION

In the previous submission, activity data for industrial and clinical waste incineration were used from the yearbook Waste in the Slovak Republic. These data are collected by the Slovak Ministry of Environment (MoE SR) on a yearly basis. According to information provided by MoE 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 the 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.

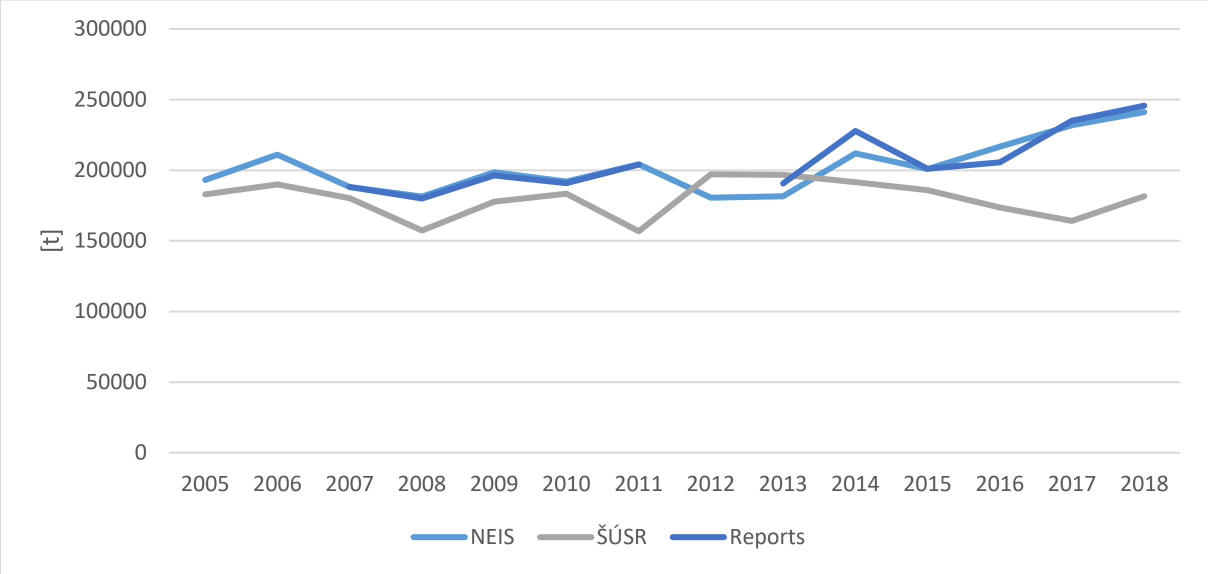
By comparison of the statistical, NEIS and ETS data for incineration of waste with energy recovery (co-incineration in cement and lime production plants), significant differences were recorded. The amounts of industrial waste incinerated according to statistical data are much higher compared to ETS or waste data. ETS (available since 2012) and NEIS data are similar in trend and absolute amounts (see ***Figure A8.1***). This can be caused by a different definition of waste in national legislation or the same waste can be recorded more than once after some sort of pre-treatment (for example sterilisation) under another waste catalogue number. The NEIS database also contains sources that are not obliged to report to ETS which can cause slight differences between the data.

Figure A8.1: *Comparison of data of industrial waste incinerated (with energy recovery) from ŠÚ SR, NEIS database and ETS*



There are two Municipal waste incineration plants – OLO in Bratislava and KOSIT in Košice. These plants report data about burned waste to the Statistical Office of the Slovak Republic, the NEIS database and also in their yearly reports of operation. Comparing these three sources, data from reports and NEIS shows more similarity than the data from national statistics (see ***Figure A8.2***).

Figure A8.2: *Comparison of data of municipal waste incinerated (with energy recovery) from ŠÚ SR and NEIS database*



Comparison of the data from the NEIS database and national statistics for IWI (without energy recovery) and CWI (without energy recovery) is shown in the following *Figures A8.3 and A8.4.*

The figures below show a significant difference in amounts of incinerated clinical and industrial waste. For clinical waste, in national statistics also veterinary waste is included.

Figure A8.3: *Comparison of data of industrial waste incinerated (without energy recovery) from ŠÚ SR and NEIS database*

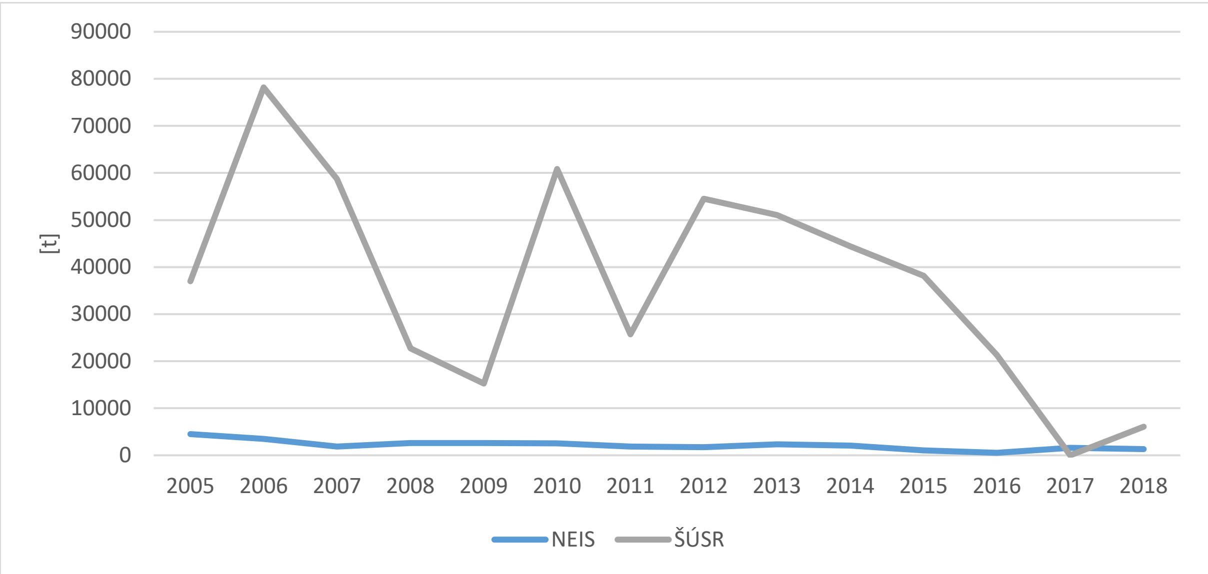
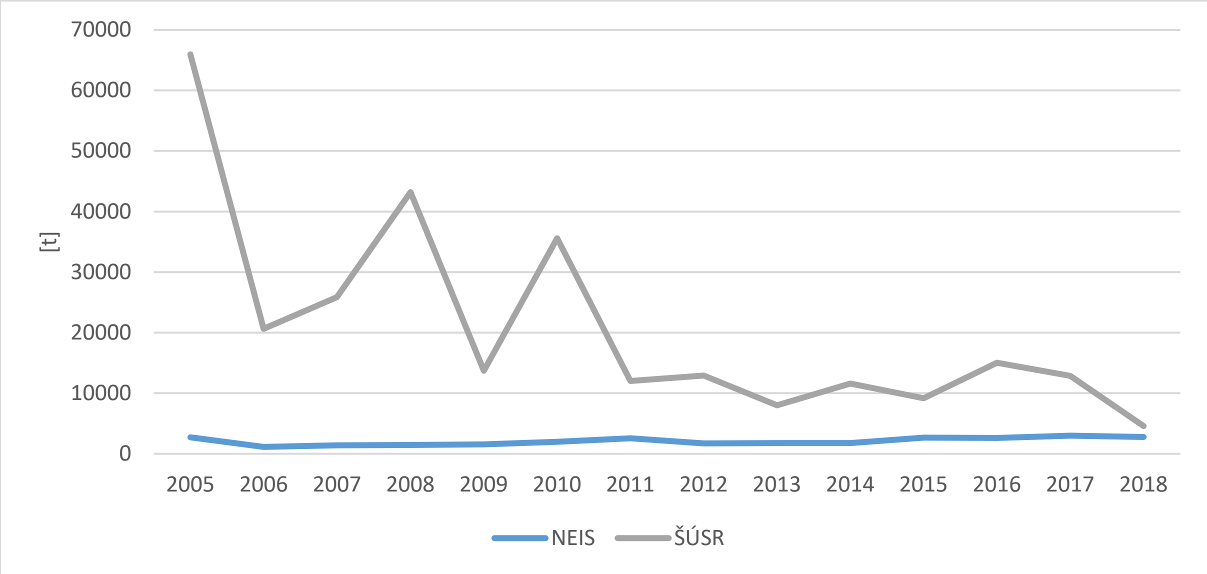


Figure A8.4: *Comparison of data of clinical waste incinerated (without energy recovery) from ŠÚ SR and NEIS database*



For the sake of consistency of using one source of activity data for all waste incineration plants, it was considered to use activity data from the NEIS database, as they are comparable with other sources of data as well as they are regularly checked in.

ANNEX IX: TIMETABLE FOR METHODOLOGY IMPROVEMENT OF REPORTING OG HEAVY METALS AND PERSISTENT ORGANIC POLLUTANTS IN SECTORS INDUSTRY AND ENERGY

TASK	OUTCOME	TIME SCHEDULE	STATUS OF IMPLEMENTATION
Application of Tier 1 methodology	Emissions reported using Tier 1	Submission 2020	**Implemented**
Key category analysis	Identification of key categories of HMs, POPs	Submission 2020	**Implemented**
Analysis of available methodology and emission data for key categories	List of categories possible to improve	Submission 2021	**Implemented**
Improvement of priority categories to Tier 2	Emissions of priority key categories reported using Tier 2	Submission 2021/2022	**To be implemented**
Further analysis of available sources of methodology/Activity data	Emissions of non-priority key categories using Tier 2	Submission 2022/2023	**To be implemented**