SLOVAK REPUBLIC

INFORMATIVE INVENTORY REPORT 2020

Submission under the LRTAP Convention and under the NEC Directive

MINISTERSTVO ŽIVOTNÉHO PROSTREDIA SLOVENSKEJ REPUBLIKY

Slovak Hydrometeorological Institute

Ministry of Environment of the Slovak Republic

Bratislava, March 13, 2020

PREFACE

TITLE OF REPORT	INFORMATIVE INVENTORY REPORT 2018. SLOVAK REPUBLIC. AIR POLLUTANT EMISSIONS 1990-2017.
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The Slovak Republic Informative Inventory Report (SK IIR) is an official document accompanying the emission inventory submission of the Slovak Republic under the Convention on Long-Range Transboundary Air Pollution (LRTAP Convention). Since the Directive (EU) 2016/2284[1] on the reduction of national emissions of certain atmospheric pollutants (NECD) was adopted, this report represents also the official document as required in the new NEC Directive.

SK IIR is annually prepared by the Slovak Hydrometeorological Institute (SHMÚ) at 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 common template for LRTAP Convention submission and NECD. The report brings sufficiently detailed information that allows transparent view onto 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: 13.3.2020

ES.1 BACKROUND 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 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 2019 Recommendations.

Significant changes were also done in sector Fuel Combustion, where the net caloric value of fuels was reconsidered and several fuels were reallocated to another fuel type in comply with IPCC 2006 Guidelines. This action caused significant changes in the emissions for historical years as these are not obtained from the NEIS database, but calculated using fuel consumption in the category.

In the transport sector, new factors for fuel consumption distribution was introduced. This correction factor is used to calculate the modified fuel consumption and respective CO_2 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.

The emission of mobile machinery used in agriculture was separated from other non-road mobile machinery (categories **1A2gvii**, **1A4aii** and **1A4bii**). It was according to recommendation ***SK-1A4cii-2018-0001***.

In the sector Industry processes and product use, activity data was changed in complying with GHG inventory. Combustion emissions from the category **2A1**, **2A2**, **2A3** and **2H1** were allocated to the relevant energy categories.

In sector Agriculture, **HCB** from pesticides was implemented into the inventory based on EMEP/EEA GB_{2019}. The Tier 2 approach from the Inorganic N-fertilizers was implemented, NH_3 emissions were recalculated in all time-series.

Nitrogen excretion rate for dairy, non-dairy cattle was developed based on annual nitrogen feeding requirements. Nitrogen excretion rate for pigs' category was corrected. Recalculation of categories has an impact on NOx and NH_3 emissions over the entire time series.

NMVOC was changed compared to last year in dairy cattle and non-dairy cattle, based on a change in enteric fermentation. The proportion of silage in feed and the energy value of feed changed, other categories unchanged.

Abatements technics were removed from NH_3, a much more sophisticated system needs to be developed to implement them please see **ANNEX VI**.

In sector waste, the methodology for the category **5C1biii** Clinical waste incineration was improved by obtaining new information.

Activity data for waste incineration with and without energy recovery was reconsidered after comparing to other data sources. The NEIS database was used as the AD source instead of national statistics. This changes caused recalculations in the category **1A1a**, **1Agviii** and **5C1bi**.

Methodology for the Municipal solid waste incinerated with energy recovery allocated in the category **1A1a** (for heavy metals and POPs) was moved to the Tier 2 level.

A general model of IIR from the sectoral point of view was introduced and implemented in 2016 in comparison to the older SK IIRs, where the pollutant approach was used. In the internal preparation system of the LRTAP Convention emission inventory process, the responsibility was partly adapted correspondingly to the sectoral division. In the past, internal and external experts were in charge of a particular pollutant or pollutants emissions across all categories. According to new circumstances, sectoral liability diversification was set. The current list of team members and their roles is shown in ***Chapter 1.2***.

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;
- detailed description of emission trends and key drivers for each category;
- description and more detail explanation of methodology, level of method used, activity data and emission factors used in each category;
- 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 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 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/PCDF, PAHs, HCB, PCBs).

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

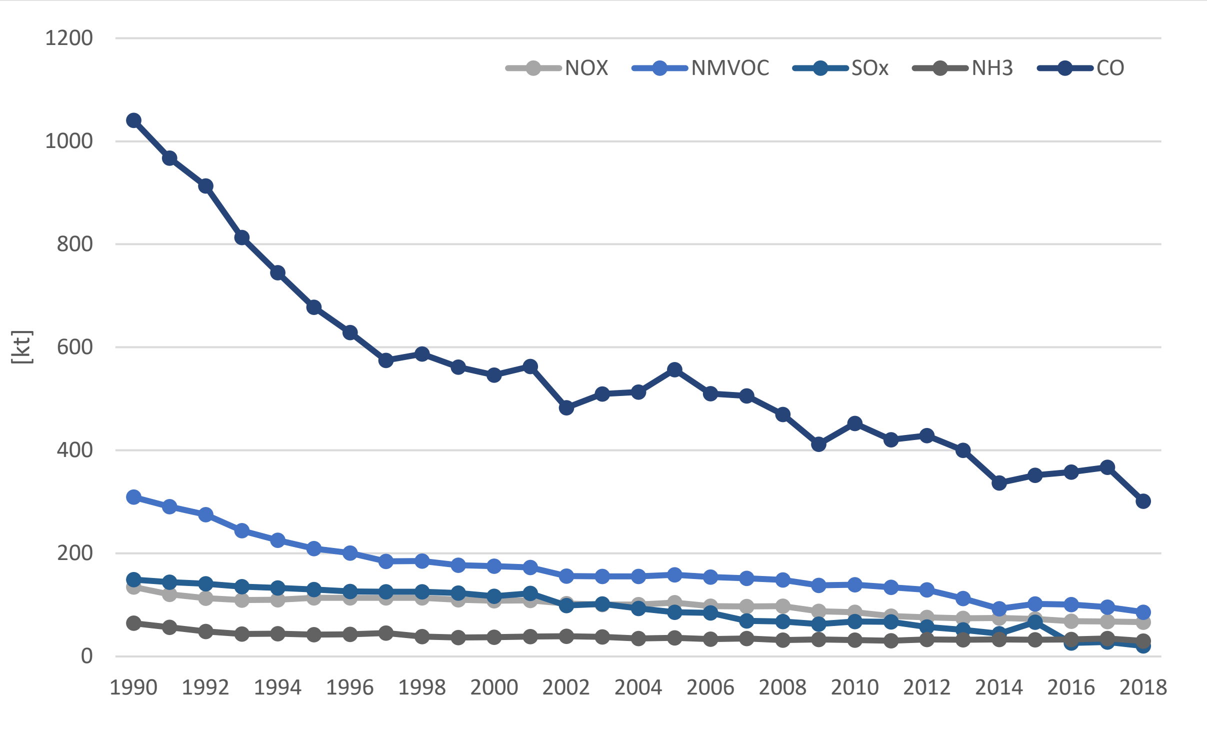


Figure ES.2: *Overall emission trends of the Particulate matter*

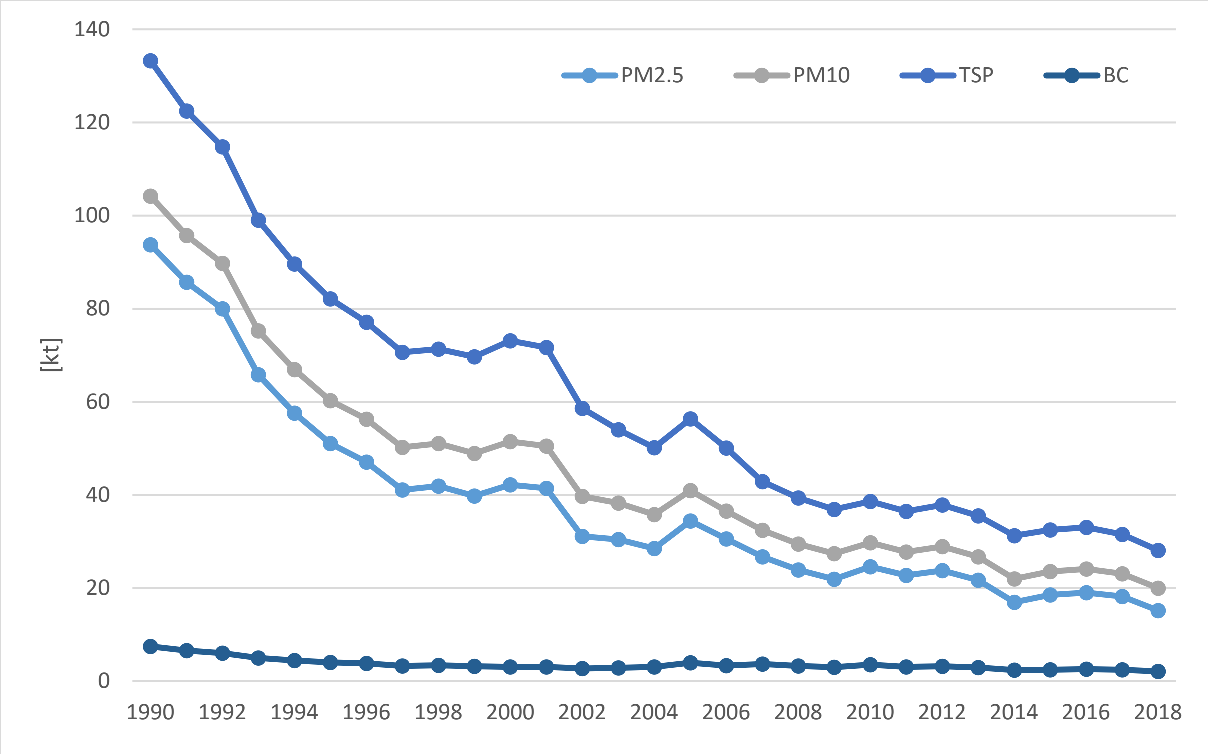


Table ES.3: *Overall emission trends of the Priority heavy metals*

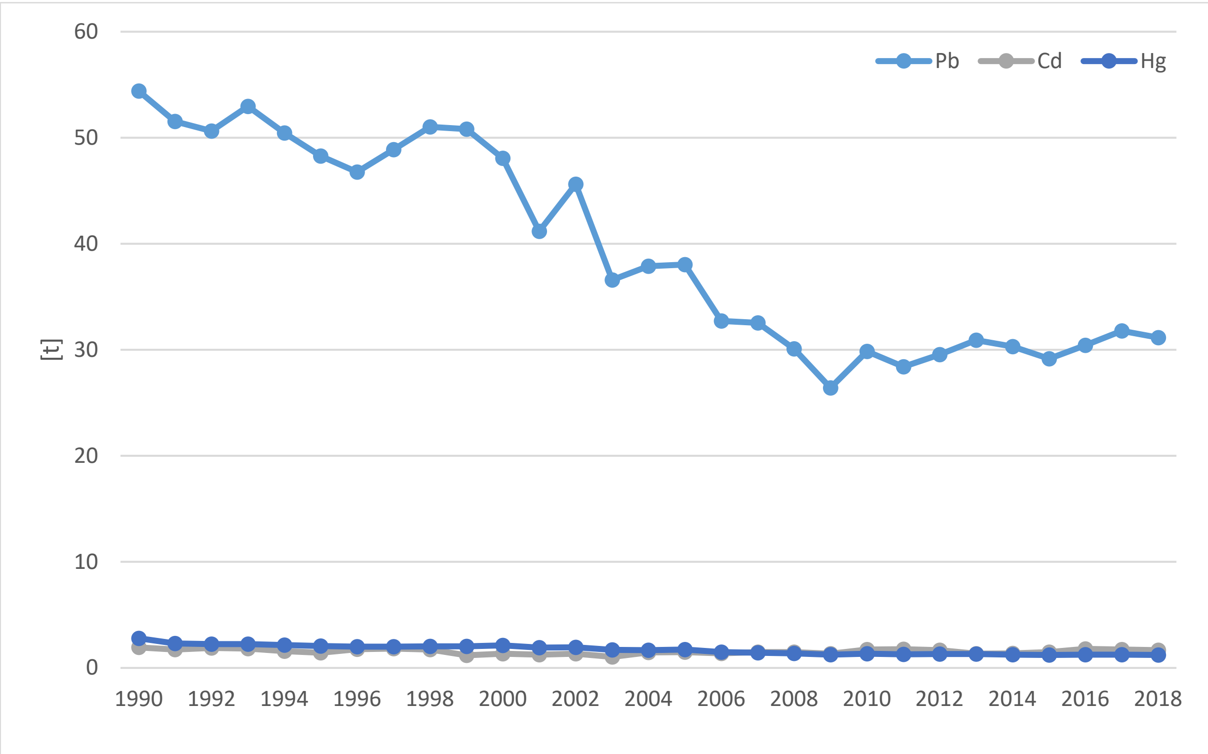
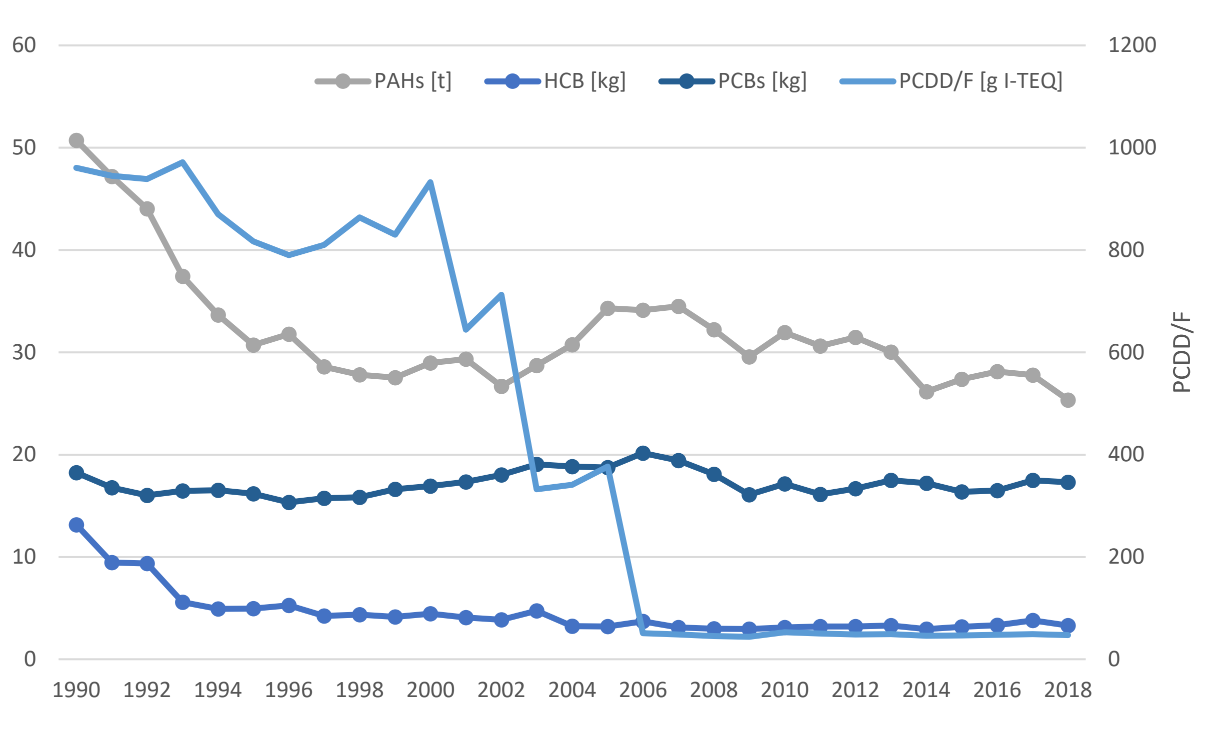


Table ES.4: *Overall emission trend of the Persistent organic pollutants*



ES.5 OVERVIEW OF RECALCULATIONS

Most of the recalculations realized in the 2020 submission were connected with re-categorisation of fuels in the energy sector, which led to significant changes especially in historical years. Emissions are calculated according to fuel consumption and do not originate from the NEIS database as the data for the period 2000-2018.

Country-specific emission factors for heavy metals and POPs were replaced with the EMEP/EEA GB_{2019} methodology which led to significant changes in emissions.

Several recalculations were made in Agriculture and Waste sector according to the follow up recommendations from the previous review process 2018.

Table ES.1 provide an overview of recalculations in the 2020 submission. More detailed data can be found in the particular chapters of this report.

Table *ES.1:* *Main recalculations and their explanation, % difference for year 2017, 2015, 2010, 2005, 2000 and 1990 between the 2019 and 2020 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)	-15%	1%	1%	1%	1%	3%	kt	Main changes were made in Energy sector. Categorisation of fuels was changed to be in comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in relation of trends in GHG and statistics.
NMVOC	1%	4%	5%	5%	5%	7%	kt	Significant recalculation due to reconsideration of the activity data of the category 1B2b.
SOx (as SO_2)	-38%	0%	0%	0%	0%	4%	kt	Main changes were made in Energy sector. Categorisation of fuels was changed to be in comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in relation of trends in GHG and statistics.
NH_3	-15%	-11%	-4%	-2%	1%	31%	kt	Change of NEX rate in calculation caused change of the NH_3 emissions.
$PM_{2.5}$	-6%	2%	0%	0%	0%	0%	kt	Main changes were made in Energy sector. Categorisation of fuels was changed to be in comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in relation of trends in GHG and statistics.
PM_{10}	-8%	2%	0%	0%	0%	0%	kt	Main changes were made in Energy sector. Categorisation of fuels was changed to be in comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in relation of trends in GHG and statistics.
TSP	-13%	0%	0%	0%	0%	0%	kt	Main changes were made in Energy sector. Categorisation of fuels was changed to be in comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in relation of trends in GHG and statistics.
BC	1%	4%	7%	4%	3%	4%	kt	Recalculation due to error correction in the category 1A1c.
CO	-8%	0%	0%	0%	-5%	-5%	kt	Main changes were made in Energy sector. Categorisation of fuels was changed to be in comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in relation of trends in GHG and statistics.

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	-18%	7%	-29%	-17%	-22%	-27%	t	Outdated country-specific emission factors for calculation of heavy metals were replaced by the EMEP/EEA GB_{2019} methodology.
Cd	-82%	-80%	-74%	82%	53%	43%	t	Outdated country-specific emission factors for calculation of heavy metals were replaced by the EMEP/EEA GB_{2019} methodology.
Hg	-87%	-53%	-39%	12%	6%	1%	t	Outdated country-specific emission factors for calculation of heavy metals were replaced by the EMEP/EEA GB_{2019} methodology.
PCDD/PCDF	157%	392%	250%	27%	7%	-34%	g I-TEQ	Change due to Tier 2 methodology for the MSW incineration with energy recovery (allocated in the category 1A1a).
PAHs	412%	525%	575%	641%	511%	474%	t	Recalculation due to replacement of country-specific emission factors for the EMEP/EEA GB_{2019} methodology and error correction in the category 1A4bi.
HCB	246%	55%	19%	101%	72%	10%	kg	Recalculation due to replacement of country-specific emission factors for the EMEP/EEA GB_{2019} methodology and error correction in the category 1A4bi.
PCBs	-29%	-4%	25%	75%	45%	10%	kg	Recalculation due to replacement of country-specific emission factors for the EMEP/EEA GB_{2019} methodology and error correction in the category 1A4bi.

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 the most of the categories in sectors energy and industry, this cannot be done in 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 of 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.

Next important improvement planned for the next period is to develop a new methodology for heavy metals, with priority to key categories due to insufficient tier of the methodology used nowadays. Similarly, higher tier methodology development is planned for the estimation of POPs emission.

Due to lack of activity data, technology and abatement technology used in the Slovak Republic (especially for the historical data in the period 1990-2004), as well as the lack of capacity, this improvement will not be possible to complete in the next submissions.

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 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: 13.3.2020

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 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 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), 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 1991 (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 ensure 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.

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[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 Ivana Bellušová Michaela Câmpian Zuzana Jonáček	SHMÚ	monika.jalsovska@shmu.sk michaela.campian@shmu.sk zuzana.jonacek@shmu.sk
Transport	Ján Horváth	SHMÚ	jan.horvath@shmu.sk
IPPU	Ivana Bellušová Michaela Câmpian Zuzana Jonáček Ľubomír Polakovič Lýdia Pokorná	SHMÚ VUIS - CESTY VURUP	 michaela.campian@shmu.sk zuzana.jonacek@shmu.sk
Agriculture	Kristína Tonhauzer Zuzana Palkovičová Vojtech Brestenský	SHMÚ NPPC NPPC	kristina.tonhauzer@shmu.sk
Waste	Zuzana Jonáček	SHMÚ	zuzana.jonacek@shmu.sk
Projections	Marcel Zemko Kristína Tonhauzer Jiří Balajka	SHMÚ Senior consultant	marcel.zemko@shmu.sk kristina.tonhauzer@shmu.sk
QA/QC	Lenka Zetochová	SHMÚ	lenka.zetochova@shmu.sk

On the base of the official Agreement between the MŽP SR[20] and 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.

[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/

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

- ensure the cooperation with institutions, experts and necessary background studies or papers
- ensure the processing and verification of data in the NEIS database
- ensure the technical preparation and compilation of data
- ensure the processing of data from the Statistical Office
- preparation of the LRTAP Convention reporting template
- annual update of the SK IIR
- submission of 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 (EU) No 525/2013 an Implementing Regulation (EU) No 749/2014.

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 2001 and 2018[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 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 in order 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 the operation, the emissions are directly collected in a consistent way and verified on more levels. This database replaced an old system REZZO (Inventory of Emissions and Air Pollution Sources).

[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

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, liquid, gaseous fuels, biomass and other fuels. The emissions balances of air pollutants in the range from 2000–2018 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). 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.

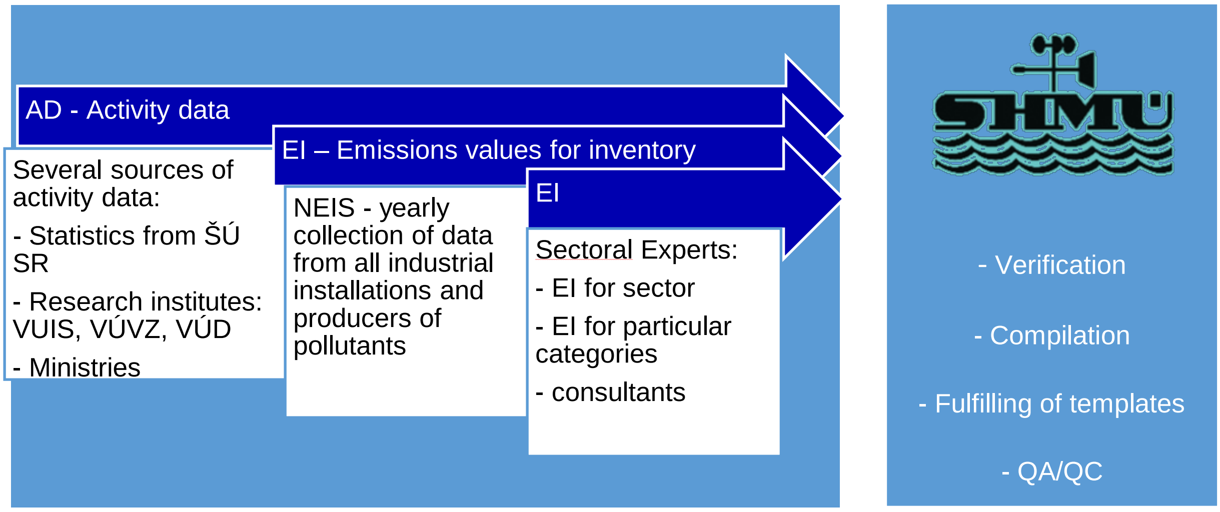
The MŽP SR has mandated the SHMÚ to ensure communication with the producers to collect the necessary data, which they are not obliged to provide to the NEIS.

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 the 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

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

for one or a number of air pollutants in a country's national inventory of air pollutants in terms of the absolute level, the trend, or the uncertainty in emissions.

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

Purpose of key category analysis:

- **Regular update**: Making sure the methods, data flows and country-specific emission factors are kept up to date and available for important regular estimate updates.
- **More focussed checking and review**: Making sure that specific QA/QC activities are implemented for *key categories*. It is *good practice* to give additional attention to *key categories* with respect to quality assurance and quality control (QA/QC)
- **Improving the accuracy of estimates and reducing overall uncertainty** using higher-tiered methods. For most sources/sinks, higher Tier methods are suggested for key categories. In some cases, inventory compilers may be unable to adopt a higher tier method due to 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

Used methodology for identification of key categories: Approach 1

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

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

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

Equation 1.1: *Level assessment*

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

Where:

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

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

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

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

Equation 1.2: *Trend assessment*

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

Where:

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

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

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

The presented key category analysis was performed with data for air emissions of the submission 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 %*

NFR14	NOx		SOx		NH_3		NMVOC		$PM_{2.5}$		PM_{10}		CO		BC		Pb		Cd		Hg		DIOX		PAHs		HCB		PCB	
	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	5	24	22	46						7		7						50		42	8	40		68			23			
1A1b	2	3	10	7																										
1A1c																					15									
1A2a	4	3	7														4				7		4		7				9	
1A2d		3		10															13	7										14
1A2f	6																													
1A2gviii																							7							
1A3bi	16						3	6	3	79	2		8	18	16			20												
1A3bii	5														7															
1A3biii	17	22													7	8														
1A3bv							2																							
1A3bvi									2		3																			
1A3bvii											2																			
1A3c	2	6																												12
1A3di(ii)																														
1A3dii																														
1A3ei		7																												
1A4ai	4								2		2																			8
1A4bi	4	3		21			37	58	74		58	75	42	71	53	77			10	6	10	14	10		42	81	58	93		9
1A4cii	3																													
1B1a							5																							
1B1b																							10							
1B2b							8																							
2A3																														
2A5b											4																			
2B10b			7																											

NFR14	NOx		SOx		NH_3		NMVOC		$PM_{2.5}$		PM_{10}		CO		BC		Pb		Cd		Hg		DIOX		PAHs		HCB		PCB	
	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
2C1	5		22										30				74	14	6		41		32		12				73	38
2C2		4																												
2C3																									23					
2C7a																	5		51	28										
2C7c			14										6																	
2D3a							8																							
2D3d							13	5																						
2D3e							3																							
2D3g								6																						
2D3h								5																						
2D3i																														
2G																														
3B1a					5		2																							
3B1b					5	13																								
3B3						14																								
3B4gi					8																									
3B4gii					5																									
3Da1	8	5			15	9																								
3Da2a					44	46																								
3Dc											10																			
5C1biii																						26	17	30						
5E																							4							

- POP: PAH, PCDD/F, HCB, PCBs

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	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	5	24	22	46						7		7						50		42	8	40		68			23			
1A1b	2	3	10	7																										
1A1c																					15									
1A2a	4	3	7														4				7		4		7				9	
1A2d		3		10															13	7										14
1A2f	6																													
1A2gviii																							7							
1A3bi	16						3	6	3	79	2		8	18	16			20												
1A3bii	5														7															
1A3biii	17	22													7	8														
1A3bv							2																							
1A3bvi									2		3																			
1A3bvii											2																			
1A3c	2	6																												12
1A3di(ii)																														
1A3dii																														
1A3ei		7																												
1A4ai	4								2		2																			8
1A4bi	4	3		21			37	58	74		58	75	42	71	53	77			10	6	10	14	10		42	81	58	93		9
1A4cii	3																													
1B1a							5																							
1B1b																							10							
1B2b							8																							
2A3																														
2A5b											4																			
2B10b			7																											

NFR14	NOx		SOx		NH_3		NMVOC		$PM_{2.5}$		PM_{10}		CO		BC		Pb		Cd		Hg		DIOX		PAHs		HCB		PCB	
	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
2C1	5		22										30				74	14	6		41		32		12				73	38
2C2		4																												
2C3																									23					
2C7a																	5		51	28										
2C7c			14										6																	
2D3a							8																							
2D3d							13	5																						
2D3e							3																							
2D3g								6																						
2D3h								5																						
2D3i																														
2G																														
3B1a					5		2																							
3B1b					5	13																								
3B3						14																								
3B4gi					8																									
3B4gii					5																									
3Da1	8	5			15	9																								
3Da2a					44	46																								
3Dc											10																			
5C1biii																						26	17	30						
5E																							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 December 2020, 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 on a regular basis to ensure close cooperation and improvement of our inventories as both countries have a common history and political and socio-economical settings.

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.

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 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 the sufficient level.

1.7 GENERAL UNCERTIANTY EVALUATION

Uncertainty analysis was not provided in the past due to the insufficient capacities and unavailable data. Nevertheless, this important issue was involved in the improvement plan as the item with the 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 the 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 ASSESMENT 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 (2020). 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 2020 submission for 1990–2018.

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	1990-2018		
1A1b			HMs, PCDD/F	1990-2018
1A2a	BC	1990-2018		
1A2b	BC	1990-2018		
	HCB, PCBs	1990-2002, 2008-2018		
1A2c	BC	1990-2018		
1A2d	BC	1990-2018		
1A2e	BC	1990-2018		
1A2f			BC	1990-2018
1A2gvii	PCDD/F, B(k)F, I()P, HCB, PCBs	2014-2018	MPs, PMs, Pb, Cd, Cr, Cu, Ni, Se, POPs	1990-2013
1A2gviii	BC	1990-2018		
1A3ai(i)	NH_3, HMs, PCDD/F, PAHs	1990-2018		
1A3aii(i)	NH_3, HMs, PCDD/F, PAHs	1990-2018		
1A3bii				
2A3	PCDD/F, PAHs, HCB	1990-2018	MPs	1990-2018
2A5c			$PM_{2.5}$, PM_{10}, TSP	1990-2018
2A6	BC	1990-2018		
2B5	BC, HMs, POPs	1990-2018		
2B6				
2B7				
2B10a	HMs, POPs	1990-2018		
2B10b	BC			
2C1	B(a)P, B(b)F, B(k)F, I()P	1990-2018		
2C2	HMs, PCDD/F, PAHS	1990-2018		
2C3	HMs, PCDD/F, HCB, PCBs	1990-2018	MPs, PMs	1990-2018
2C4	BC, HMs, POPs	1990-2018		
2C5	NH_3, BC, Cr, Cu, Ni, Se, PAHs, HCB	2011-2018		
2C6	NOx, NMVOC, NH_3, BC, CO, As, Cr, Cu, Ni, Se, PAHs, HCB	1990-2018		
2C7a	Se, Zn, PAHs, HCB	1990-2018	MPs, PMs	1990-2018
2C7c	HMs, POPs	1990-2018		
2C7d			All Pollutants	1990-2018
2D3a	$PM_{2.5}$	1990-2018		

NFR	NOT ESTIMATED	YEARS	INCLUDED ELSEWHERE	YEARS
2D3b	NOx, SOx, CO, PAHs, HCB	1990-2018		
2D3c	NOx, Pb, Cd, Hg, PCDD/F, PAHs, HCB	1990-2018		
2D3e	$PM_{2.5}$	1990-2018		
2D3f	$PM_{2.5}$	1990-2018		
2D3g	NOx, SOx, NH_3, PMs, CO, HMs, POPS	1990-2018		
2D3h	$PM_{2.5}$, BC	1990-2018		
2G	Se, HCb, PCBs	1990-2018		
2H1	NH_3, PAHs, HCB	1990-2018	NOx, NMVOC, SOx, CO	1990-2018
2H2	PMs	1990-2018		
2H3	BC	1990-2018		
2I	BC	1990-2018		
2K	Pb, Cd, AHMs, HCB	1990-2018		
3Da2a			NMVOC	1990-2018
3Da3			NMVOC	1990-2018
3Da4	NH_3	1990-2018		
5A	NH_3, CO, Hg	1990-2018		
5B1	NOx, NMVOC, SOx, PMs, CO	1990-2018		
5B2	NOx, NMVOC, SOx, PMs, CO, PHMs, Cr, Zn, POPs	1990-2018		
5C1bi	NH_3, Cr, Cu, Se, Zn, B(a)P, B(b)F, B(k)F, I()P	1990-2018		
5C1biii	NH_3, $PM_{2.5}$, PM_{10}, Se, Zn, B(a)P, B(b)F, B(k)F, I()P	1990-2018		
5C1bv	BC	1990-2018		
5D1	PMs, HMS	1990-2018		

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	1990-2018		
1A2a			NH_3	1990-2015,2017,2018
1A2b			NH_3	1990-2018
1A2c			NH_3	1990-2018
1A2d			NH_3	1990-2006
1A2f			NH_3	1990-1999,20006-2011
1A2gvii	Hg, As	1990-2018		
1A3ai(i)	HCB, PCBs	1990-2018		
1A3aii(i)	HCB, PCBs	1990-2018		
1A3bv	NOx, SOx, PMs, CO, PHMs, As, Cr, Cu, Ni, Se, I()P, HCB			
1A3bvi	NOx, NMVOC, SOx, NH_3, BC			
1A3bvii	NOx NMVOC, SOx, NH_3, BC, Zn, HCB			
2B2	NMVOC, SOx, PMs, HMs, POPs	1990-2018		
2B3			All pollutants	1990-2018
2B5	NH_3	1990-2018	All pollutants	1990-1992
2B6			All pollutants	1990-2018
2B7			All pollutants	1990-2018

NFR	NOT APPLICABLE	YEARS	NOT OCCURRING	YEARS
2B10b	HMs, POPs	1990-2018	NH_3	2006-2018
2C2	HCB, PCBs	1990-2018	NH_3	2004-2009
2C5			All Pollutants	1990-2010
2C6			SOx, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, Zn, PCDD/F, PCBs	2015-2018
2C7b			All Pollutants	1990-2018
2D3a	NOx, SOx, NH_3, PM10, TSP, BC, CO, Pb, CD, AHMs, POPs	1990-2018		
2D3c	Sox, NH_3, AHMs, PCBs	1990-2018		
2D3d	NOx, SOx, NH_3, PMs, CO, HMs, POPs	1990-2018		
2D3e	NOx, SOx, NH_3, PM_{10}, TSP, BC, CO, HMs, POPs	1990-2018		
2D3f	NOx, SOx, NH_3, PM_{10}, TSP, BC, CO, HMs, POPs	1990-2018		
2D3h	NOx, SOx, NH_3, PM_{10}, TSP, CO, HMs, POPs	1990-2018		
2D3i	NOx, NH_3, PMs, CO, POPs	1990-2018		
2H1	HMs, PCDD/F, PCBs	1990-2018		
2H2	NOx, SOx, NH_3, HMs, PCDD/F, PCBs	1990-2018		
2H3	HMs, POPs	1990-2018		
2I	HMs, POPs	1990-2018	NH_3	2011-2013
2J			All Pollutants	1990-2018
2K	MPs, PMs	1990-2018		
2L			All Pollutants	1990-2018
3B1a	SOx, BC, CO, HMs, POPs	1990-2018		
3B1b	SOx, BC, CO, HMs, POPs	1990-2018		
3B2	SOx, BC, CO, HMs, POPs	1990-2018		
3B3	SOx, BC, CO, HMs, POPs	1990-2018		
3B4a			All Pollutants	1990-2018
3B4d	SOx, BC, CO, HMs, POPs	1990-2018		
3B4e	SOx, BC, CO, HMs, POPs	1990-2018		
3B4f			All Pollutants	1990-2018
3B4gi	SOx, BC, CO, HMs, POPs	1990-2018		
3B4gii	SOx, BC, CO, HMs, POPs	1990-2018		
3B4giii	SOx, BC, CO, HMs, POPs	1990-2018		
3B4giv	SOx, BC, CO, HMs, POPs	1990-2018		
3B4h	All Pollutants	1990-2018		
3Da1	NMVOC, SOx, TSP, BC, CO, HMs, POPs	1990-2018	$PM_{2.5}$, PM_{10}	1990-2018
3Da2a	SOx, PMs, HMs, POPs	1990-2018		
3Da2b	NMVOC, SOx, TSP, BC, CO, HMs, POPs	1990-2018	NOx, NH_3	2015-2018
3Da2c	NMVOC, SOx, TSP, BC, CO, HMs, POPs	1990-2018		
3Da3	SOx, TSP, BC, CO, HMs, POPs	1990-2018		
3Da4	NOx, NMVOC, SOx, PMs, HMs, POPs	1990-2018		
3Db	NOx, NMVOC, SOx, PMs, HMs, POPs	1990-2018	NH_3	1990-2018
3Dc	MPs, BC, HMs, POPs	1990-2018		
3Dd	All Pollutants	1990-2018		
3De	NOx, SOx, PMs, HMs, POPs	1990-2018	NH_3	1990-2018
3Df	MPs, PMs, HMs, PCDD/F, PAHs, PCBs	1990-2018		
3F			All Pollutants	1990-2018
3I	All Pollutants	1990-2018		
5A	NOx, SOx, BC, Pb, Cd, AHMs, POPs	1990-2018		
5B1	HMs, POPs	1990-2018		

NFR	NOT APPLICABLE	YEARS	NOT OCCURRING	YEARS
5B2	As, Cu, Ni, Se	1990-2018	NH_3	1990-2000
5C1a			All Pollutants	1990-2018
5C1bii			All Pollutants	1990-2018
5C1biii			Pb	2007-2008
5C1biv			All Pollutants	1990-2018
5C1bv	NH_3	1990-2018		
5C1bvi			All Pollutants	1990-2018
5C2			All Pollutants	1990-2018
5D1	NOx, SOx, CO, POPs	1990-2018		
5D2	NOx, SOx, CO, POPs	1990-2018		
5D3			All Pollutants	1990-2018
5E	NH_3	1990-2018		
6A			All Pollutants	1990-2018

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: 13.3.2020

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 air pollutants separately and provides explanations of the main changes in the time series.

2.1 TRENDS IN EMISSIONS OF NECD POLLUTANTS

In Europe, the 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.

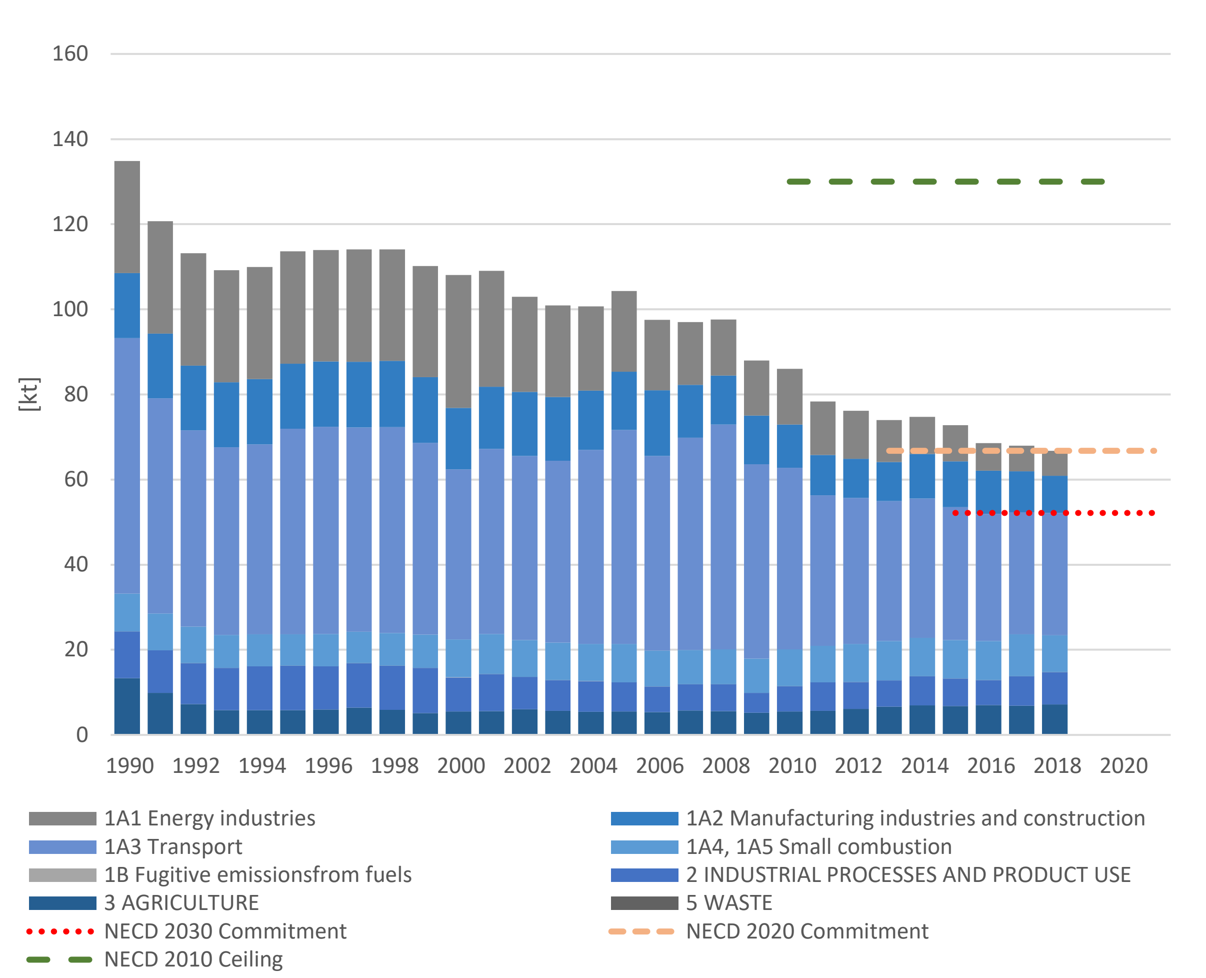
The Directive 2001/81/EC on National emissions ceilings (NEC Directive) sets limit values of emissions of **sulphur dioxide** (SO_2), **nitrogen oxides** (NOx), **volatile organic compounds** (VOCs) and **ammonia** (NH_3).

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 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 36% 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 through 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.

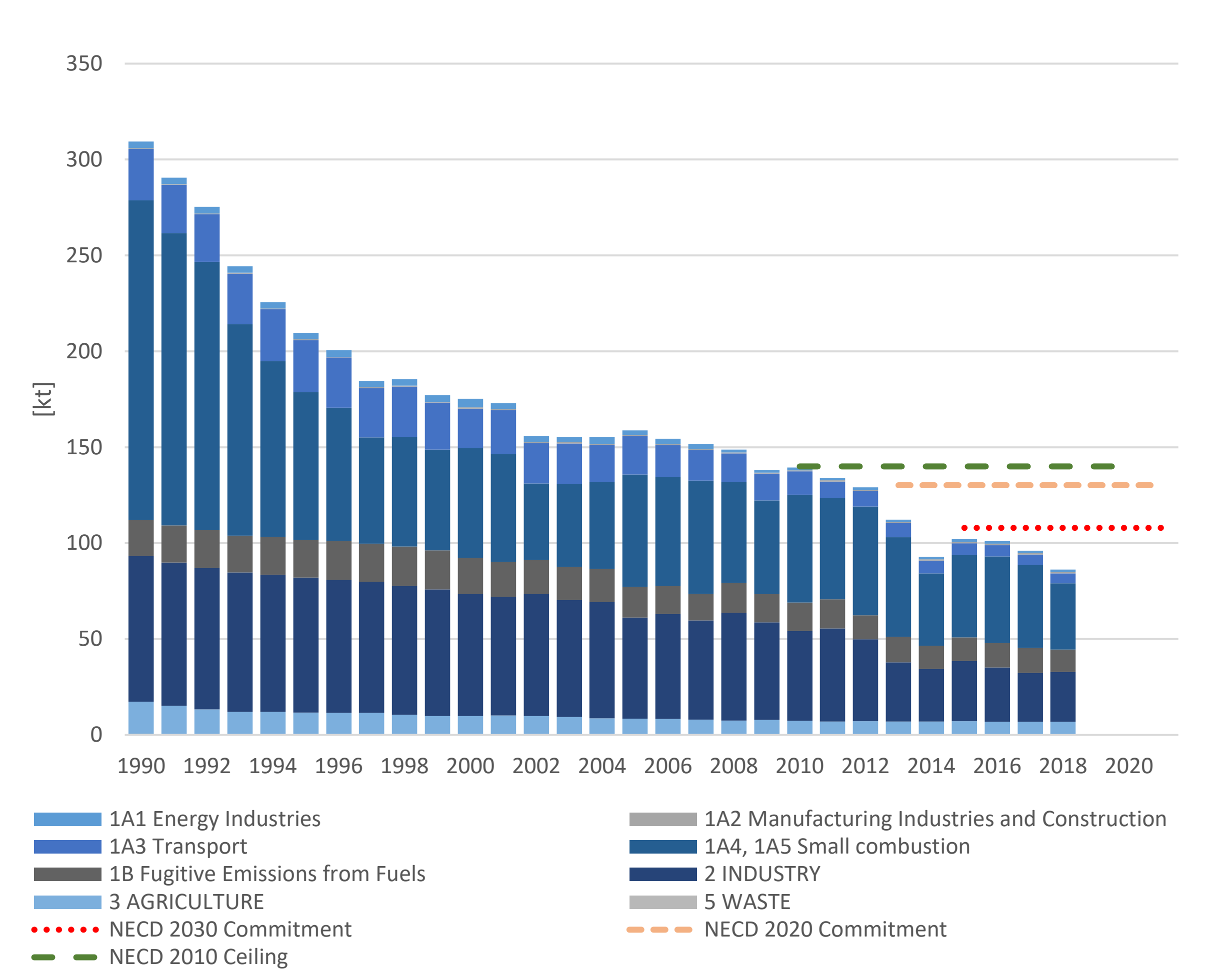
Figure 2.1: *Total NOx Emissions by Sectors*



2.1.2 TRENDS IN EMISSIONS OF NMVOC

Emissions of NMVOC have a decreasing trend in 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 2018. 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 of 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

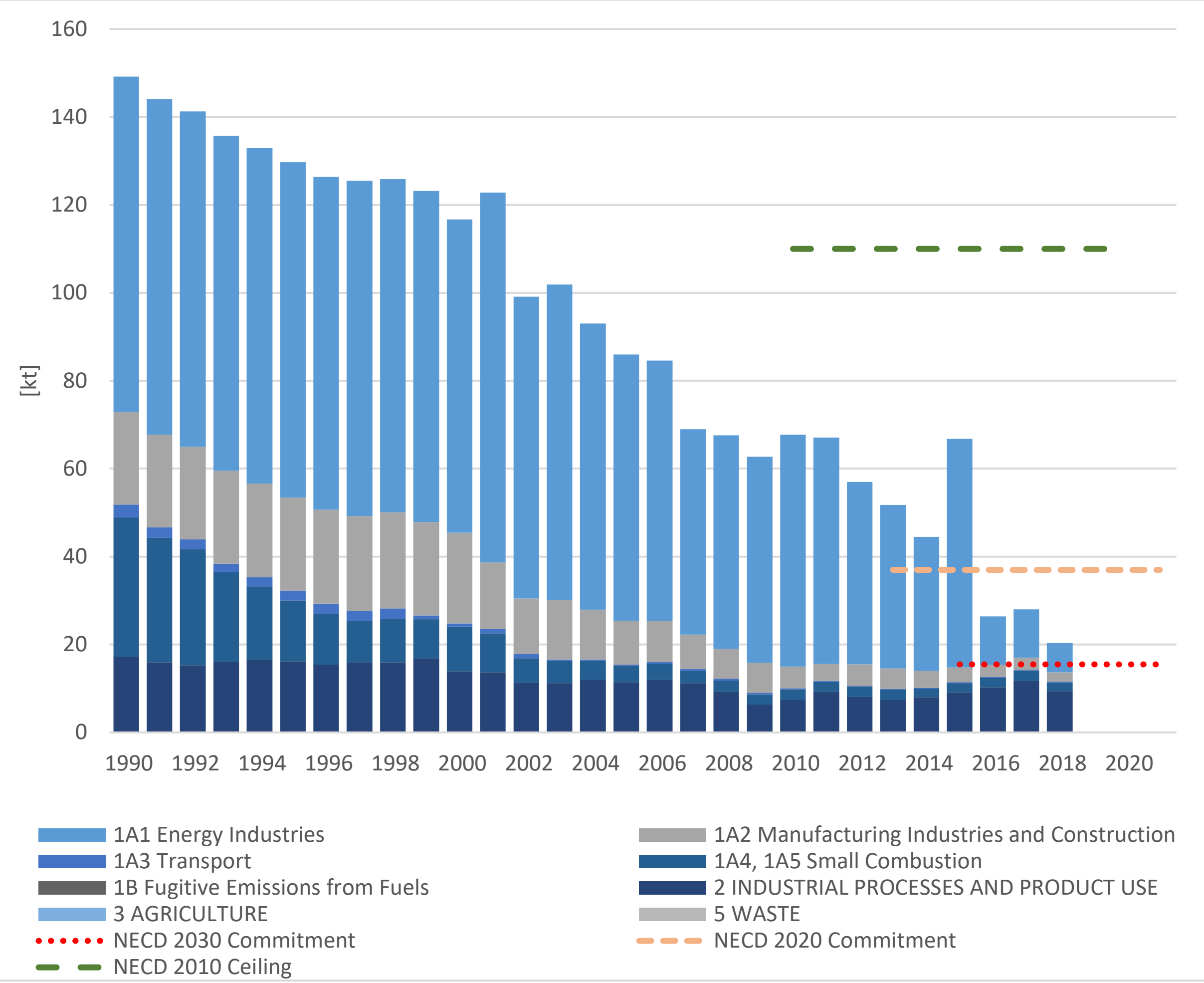
The trends of SOx emission decrease until 2014 continually. Since 1990 SOx emissions have noticed the significant decrease due to strict air protective legislative. Downward trend relates also to the composition of fuel used in all sectors and related legislative limitations.

In 2015, 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 burnt twice the amount of brown coal than 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 time 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*



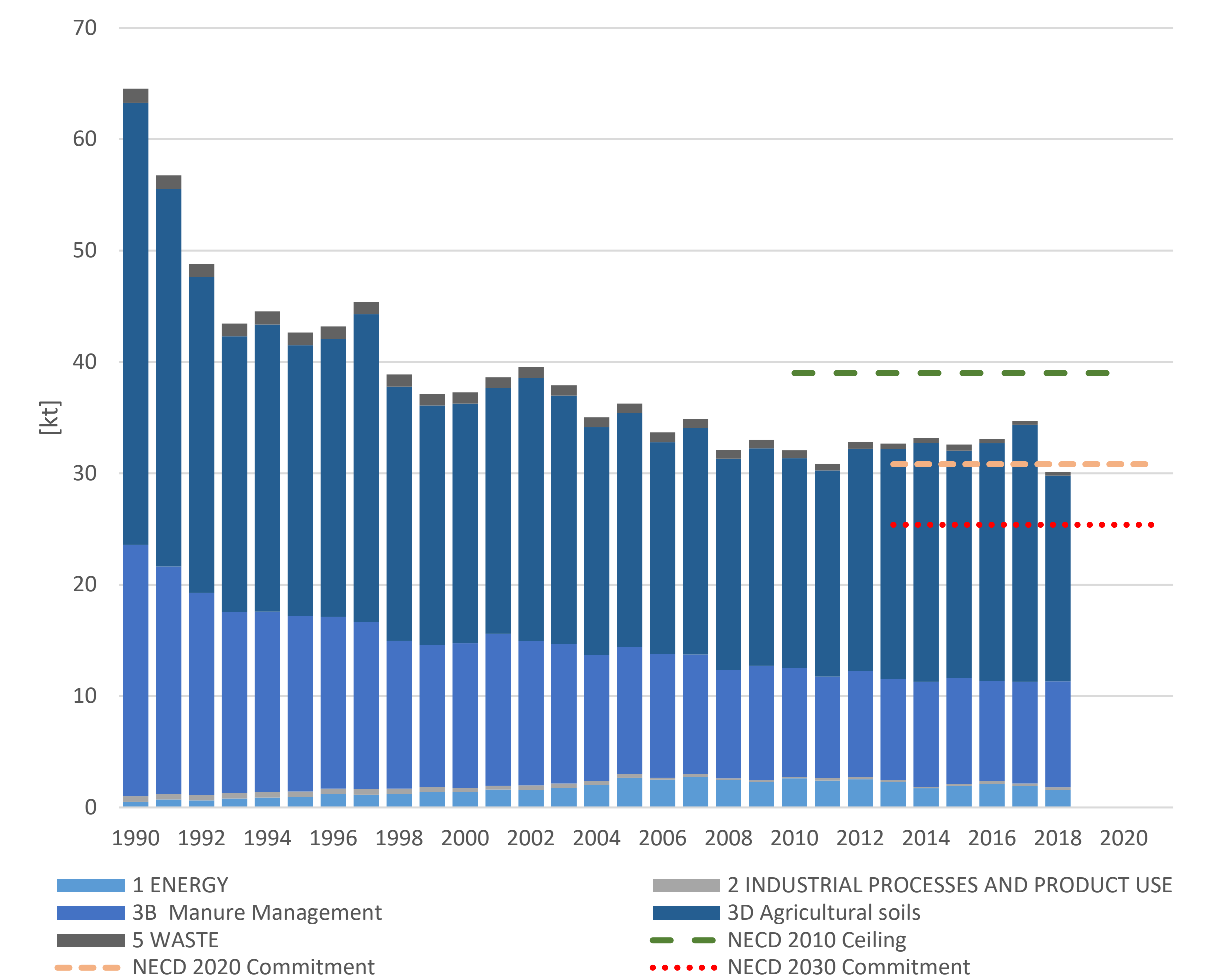
2.1.4 TRENDS IN EMISSIONS OF NH_3

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 of number of animals and application of the inorganic N-fertilized into soils (***Figure 2.4***). A decrease in 2017 is a result of the change of the fertilizers structure.

Animal manure applied to soils is the key category, which emitted more than 34% of all ammonia in the Slovak republic in the year 2018. This category is the main polluter in the whole time-series.

As shown in ***Figure 2.4***, the Slovak Republic fulfils both 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*



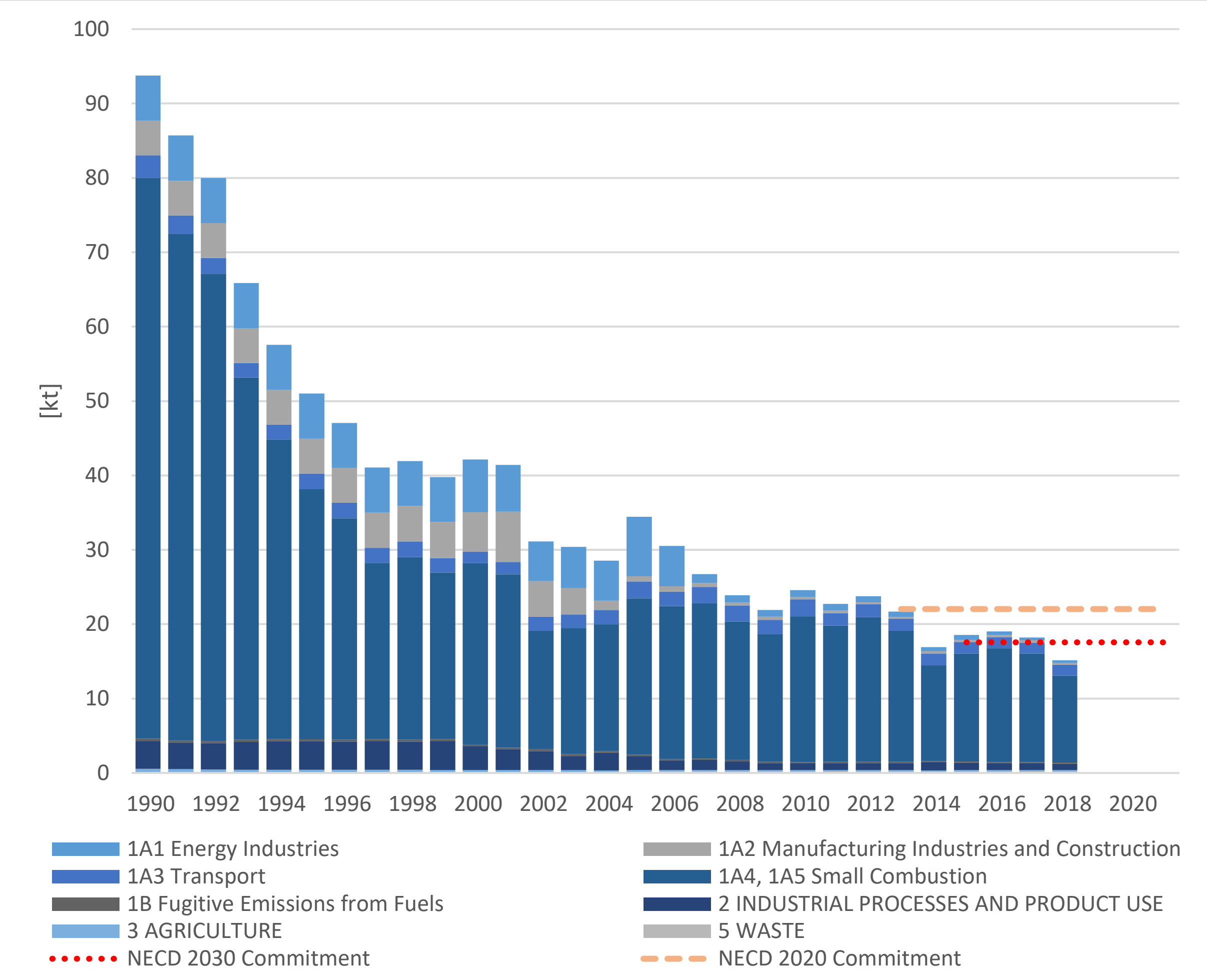
2.1.5 TRENDS IN EMISSIONS OF $PM_{2.5}$

Emission trend of $PM_{2.5}$ is significantly affected by the emission trend of the category Residential heating. This category produced more than 74% of total $PM_{2.5}$ emission in the Slovak Republic in the year 2018. 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.

Highest decrease of emissions was occurred in the period 1990-2000, since then, emissions are moderately fluctuating according to conditions connected with 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 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*

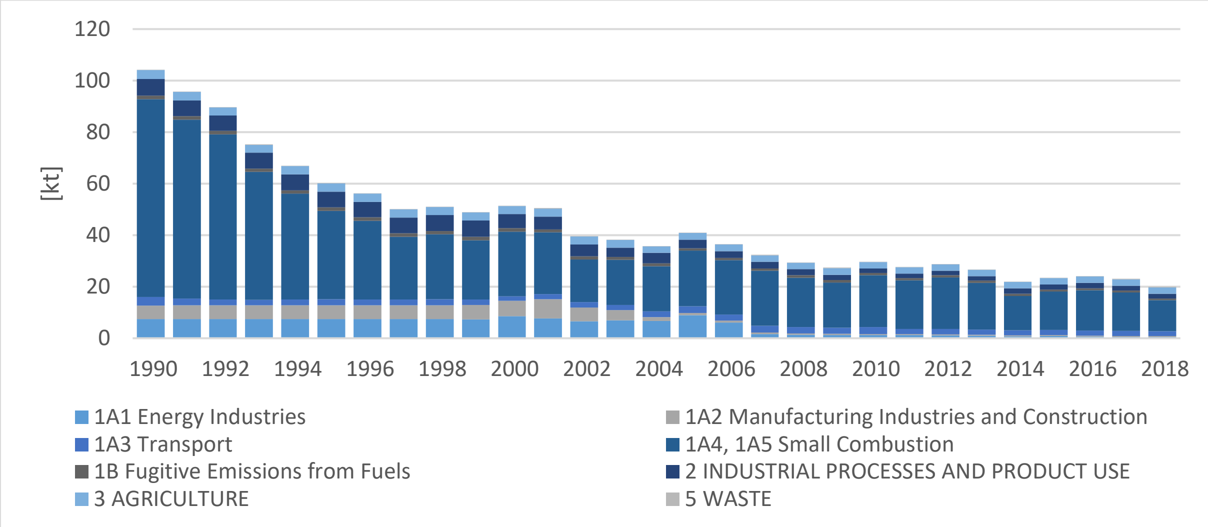


Figure 2.7: *Total BC Emissions by Sectors*

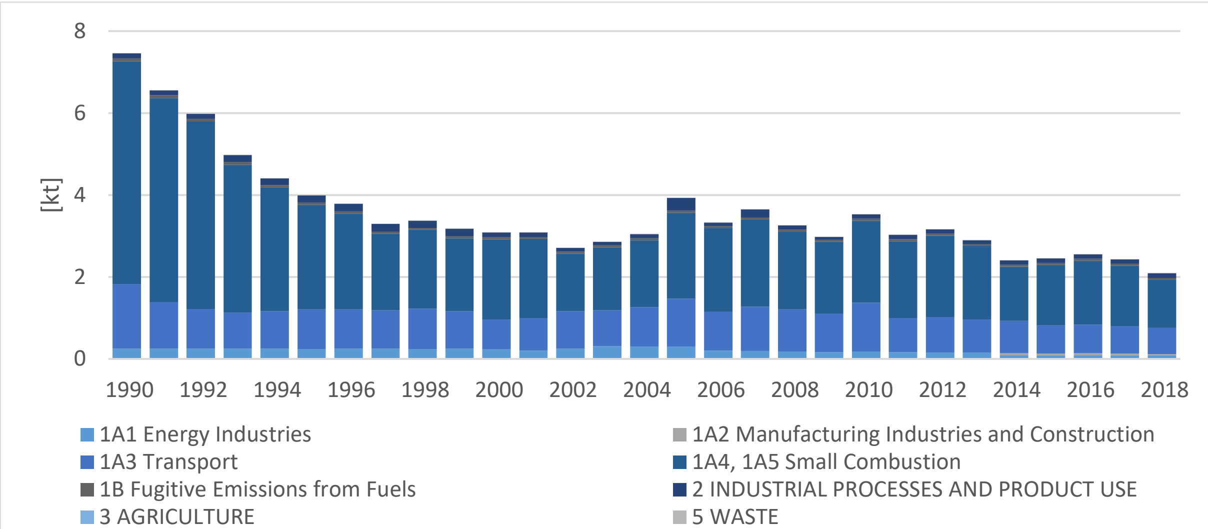
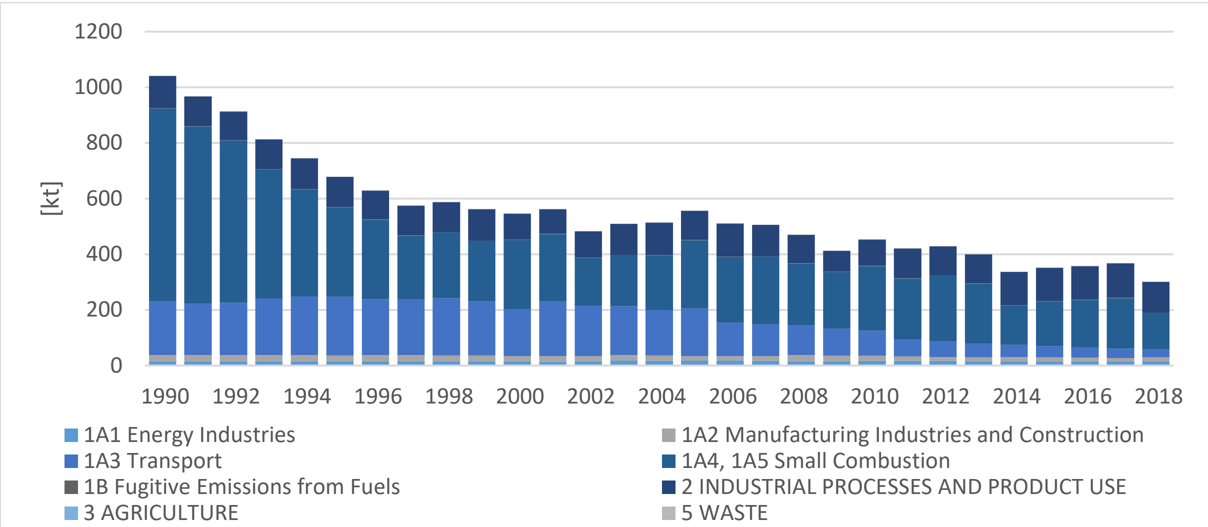


Figure 2.8: *Total CO Emissions by Sectors*



2.3 TRENDS IN EMISSIONS OF HEAVY METALS

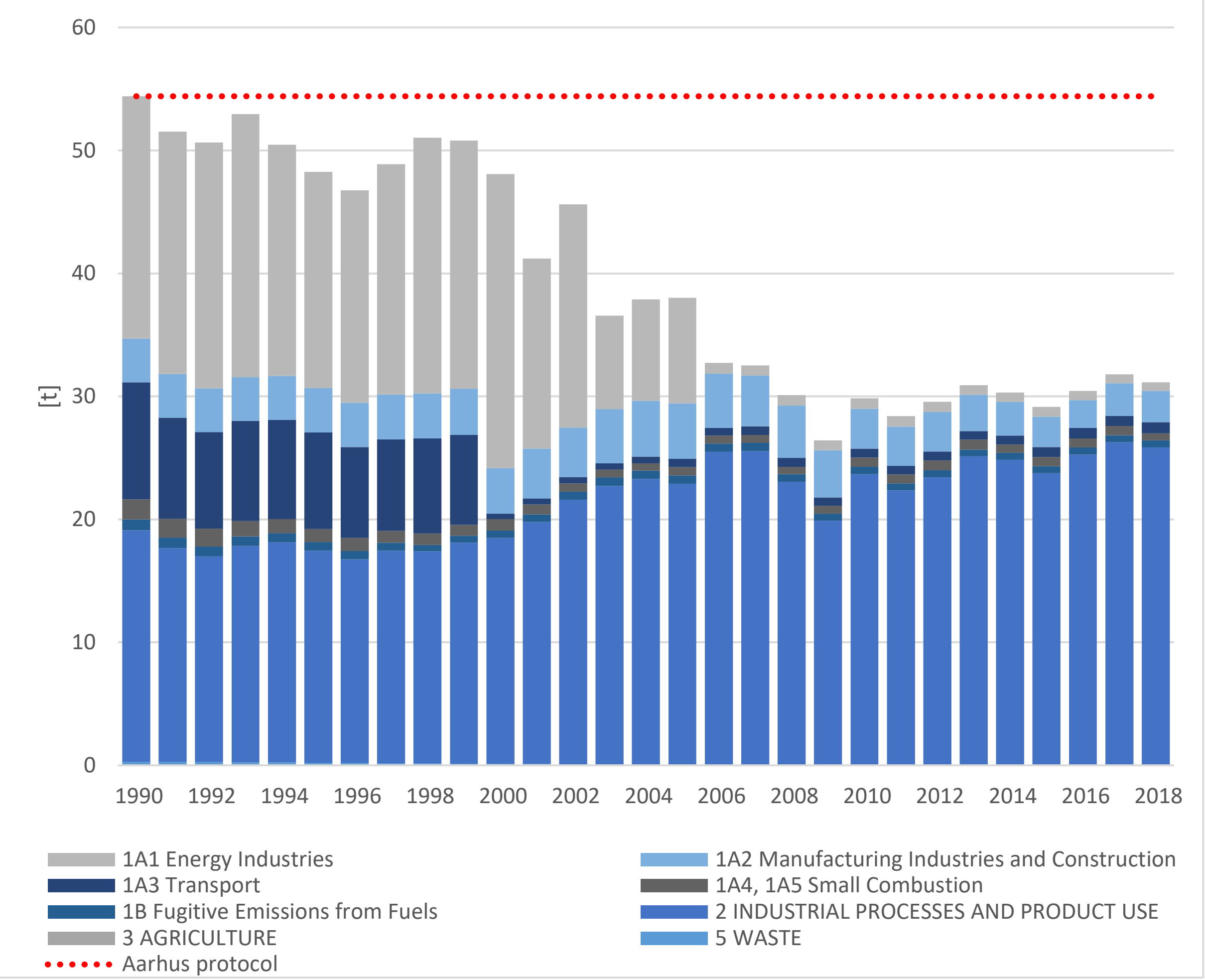
2.3.1 TRENDS IN EMISSIONS OF Pb

In general, the pollutant has moderately fluctuating trend. In the year 2001, emissions dropped due to the end of the use of leaded petrol in transport activities. Next significant decrease occurred in 2007 due to stricter legislation and emission limits for large sources. 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*

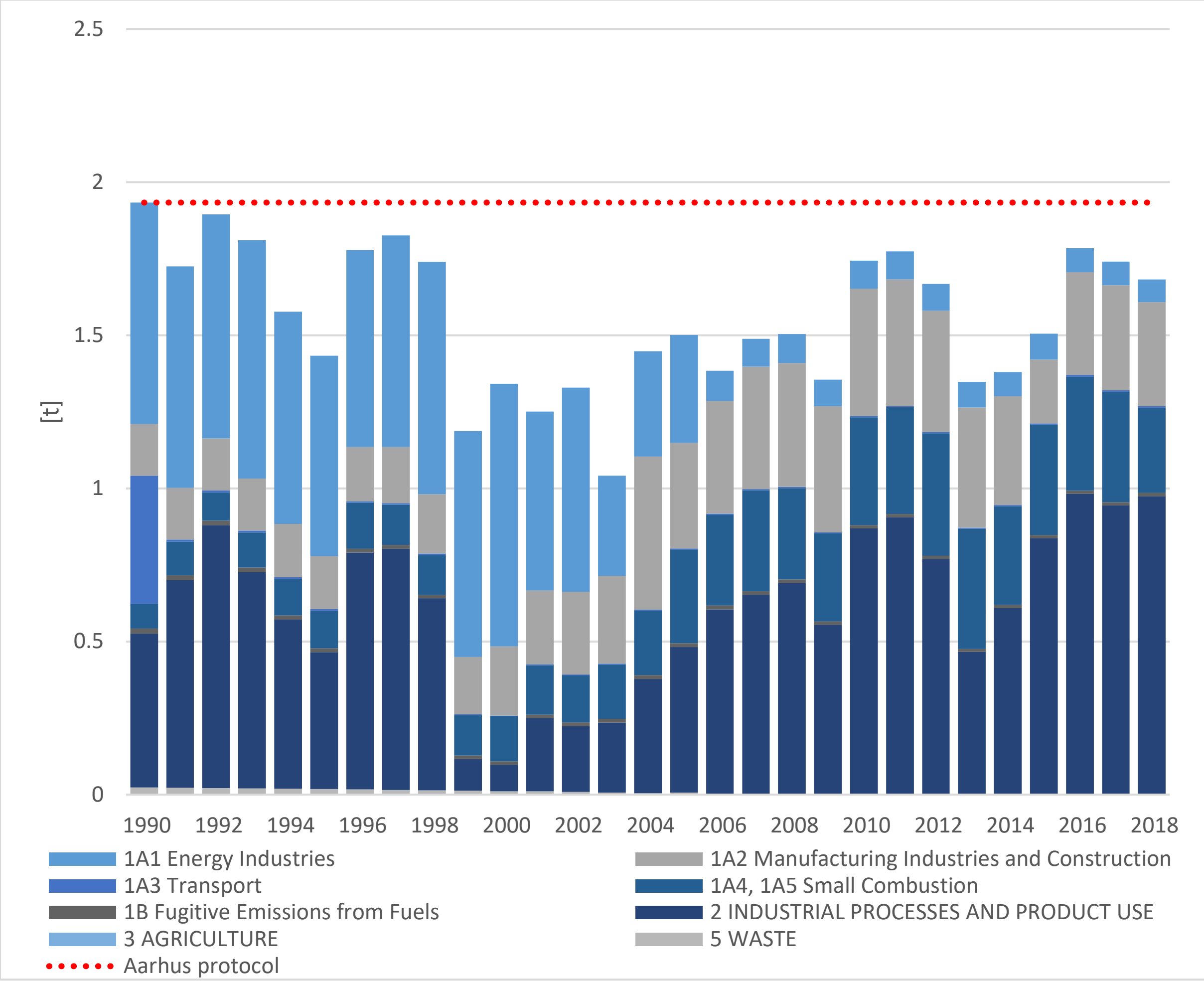


2.3.2 TRENDS IN EMISSIONS OF Cd

As shown in the ***Figure 2.10*** emissions of Cd has a fluctuating trend since 1990. The largest decline occurred in 1999 when the largest copper mining company ceased its operation.

There were no exceedances of Aarhus protocols of CLRTAP.

Figure 2.10: Total Cd Emissions by Sources



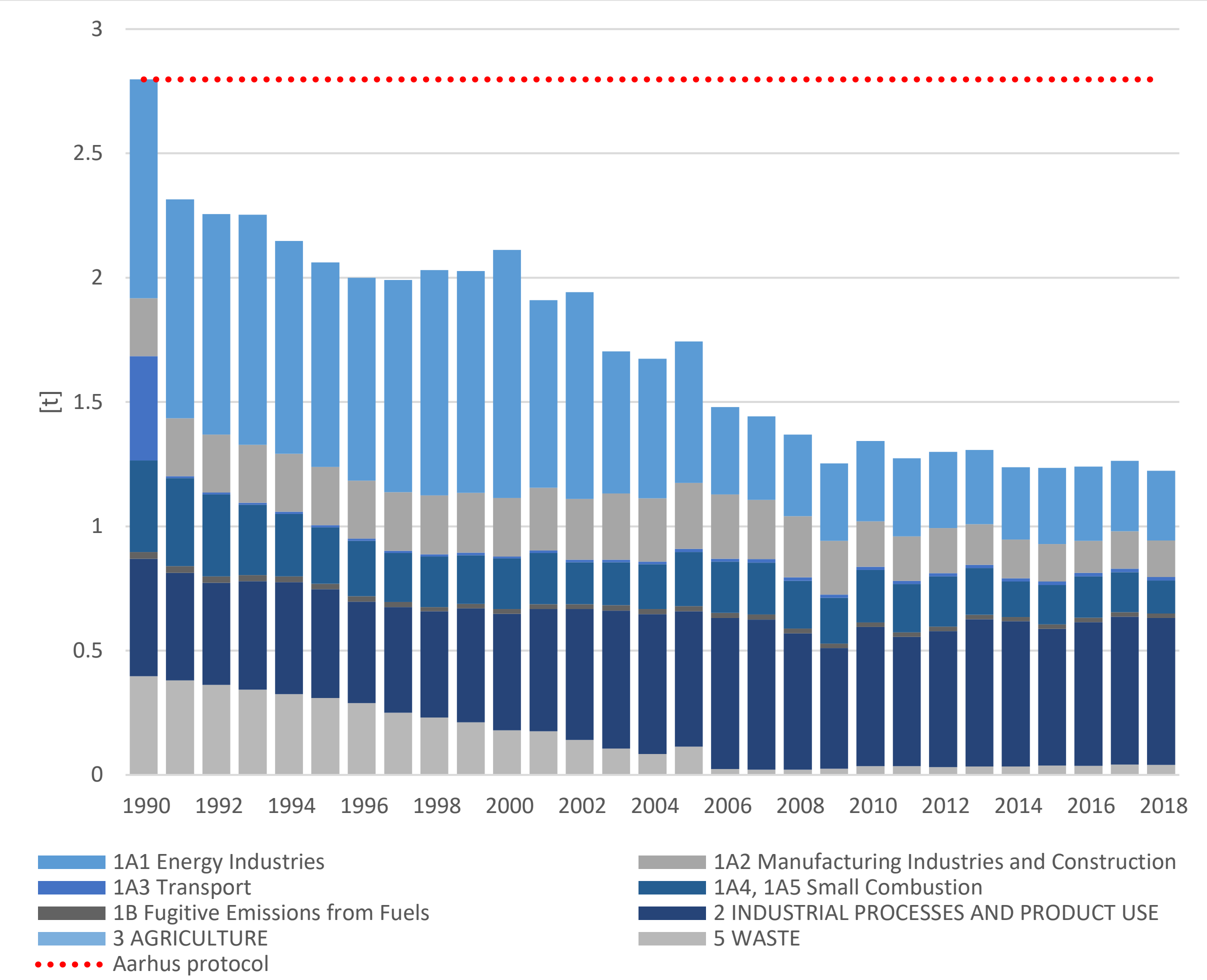
2.3.3 TRENDS IN Hg EMISSIONS

Emissions trend of Hg is decreasing in general (***Figure 2.11***). Since 2009, the emission trend remains stable.

From 1990-2002, the main contributor to emissions of Hg was Energy production, since then, it is Iron and Steel production.

No exceedances of Aarhus protocol were recorded.

Figure 2.11: Total Hg Emissions by Sources



2.4 TREND IN EMISSION OF POPS

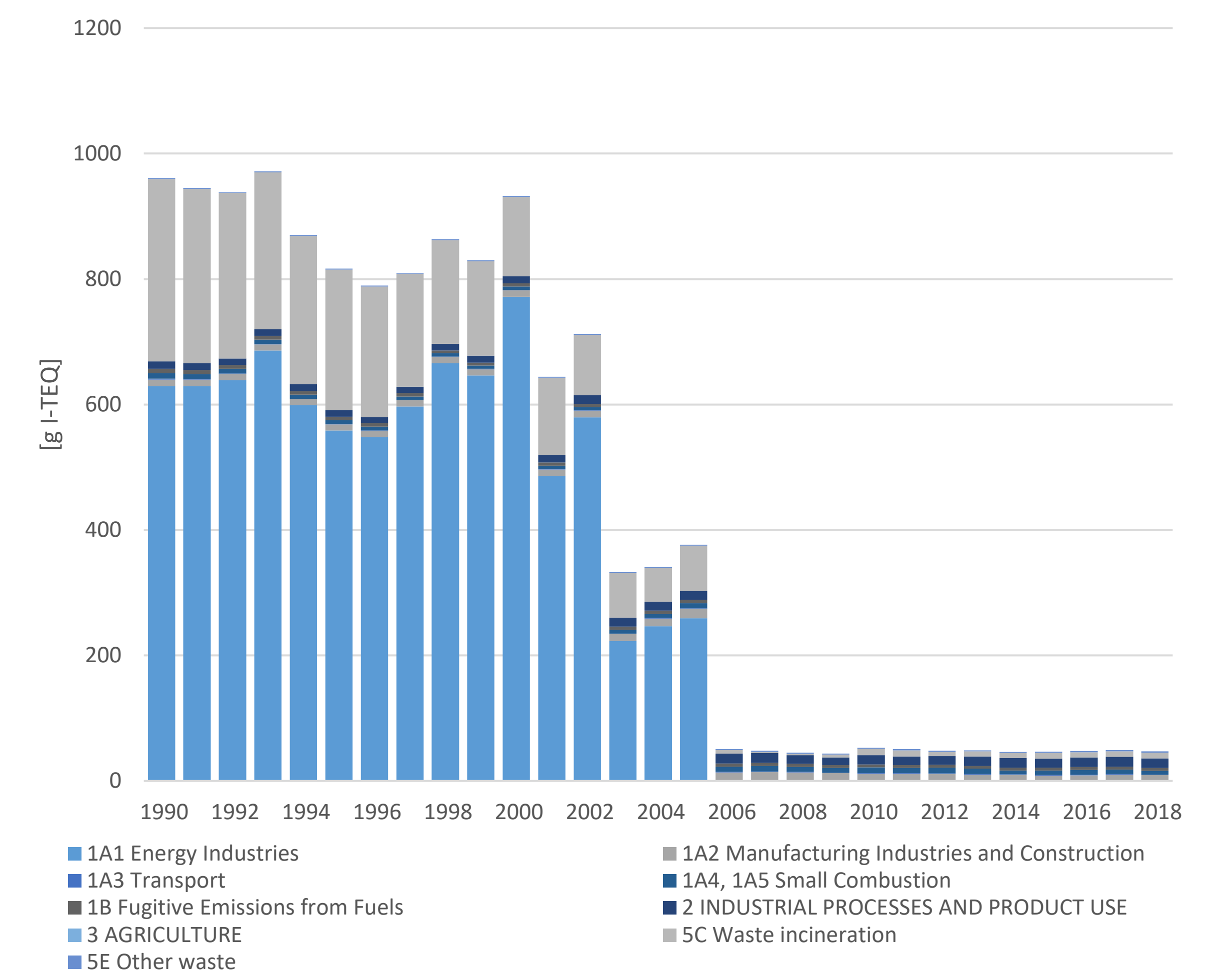
Emission inventory of POPs (PCB, DIOX, PAH - benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene and ideno(1,2,3-cd)pyrene) for the Slovak Republic is elaborated according to EMEP/EEA Air Pollution Emission Inventory Guidebook 2019 and in comply with requirements of the respective of working group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

2.4.1 TRENDS IN EMISSIONS OF PCDD/PCDF

Emissions of PCDD/F dropped in 1999 due to technological improvement of facilities which combust industrial waste as a fuel to produce energy (***Figure 2.12***). The moderate increase in 2005 was a result of that many facilities did not comply with the stricter emission limits that came into force in 2006 and therefore used the last year of their operation to burn more waste and subsequently decrease in 2006 followed. Since then 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.

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

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

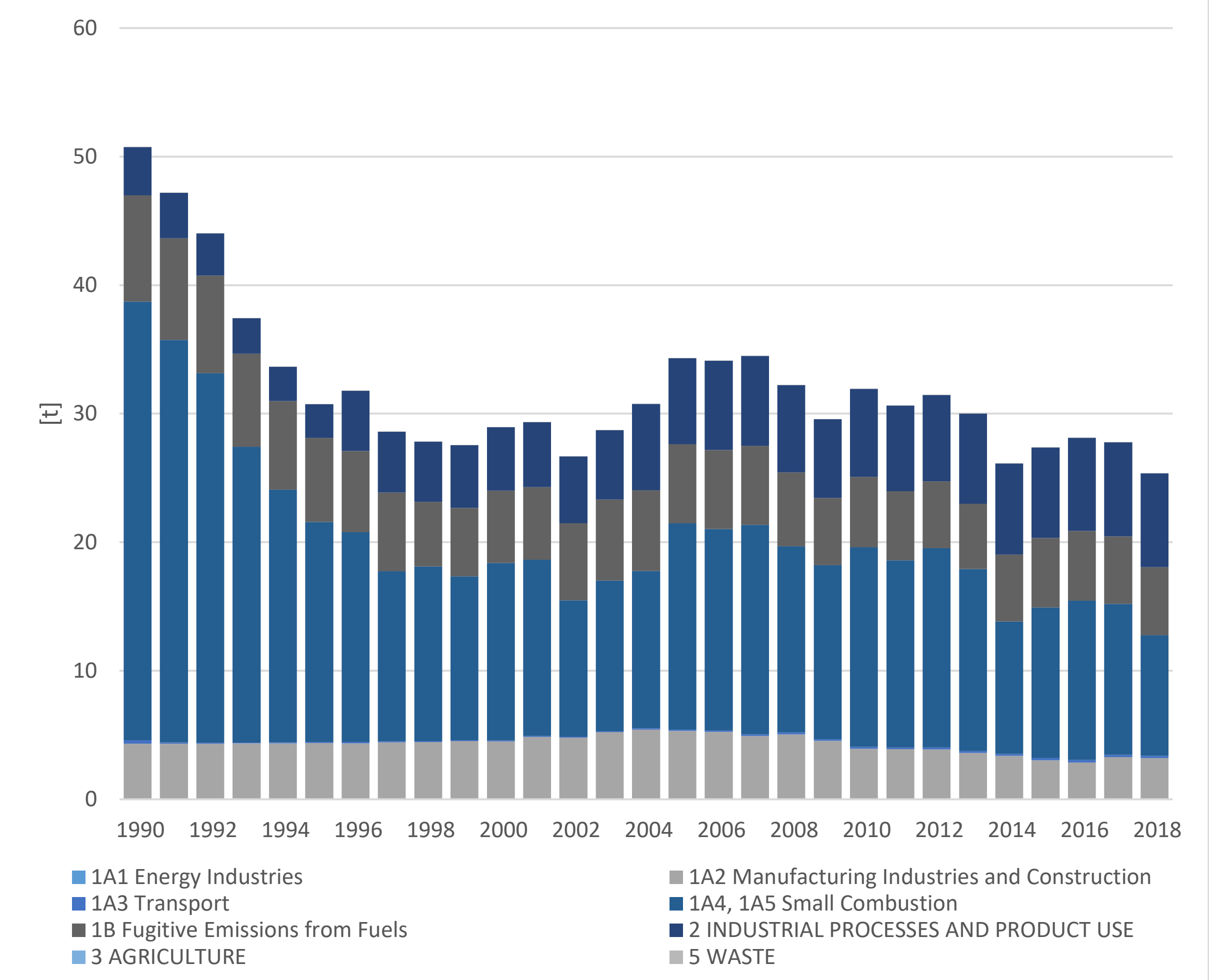


2.4.2 TRENDS IN EMISSIONS OF PAHS

The decreasing trend of PAHS emission is the most intensive in the period 1990-2000. Since then these emissions fluctuating slightly and in the last years, a slight increase was recorded. (***Figure 2.13***).

More than 50% of the emission of PAHs originated in the sector of households (35%) and metal production (29%) in 2018.

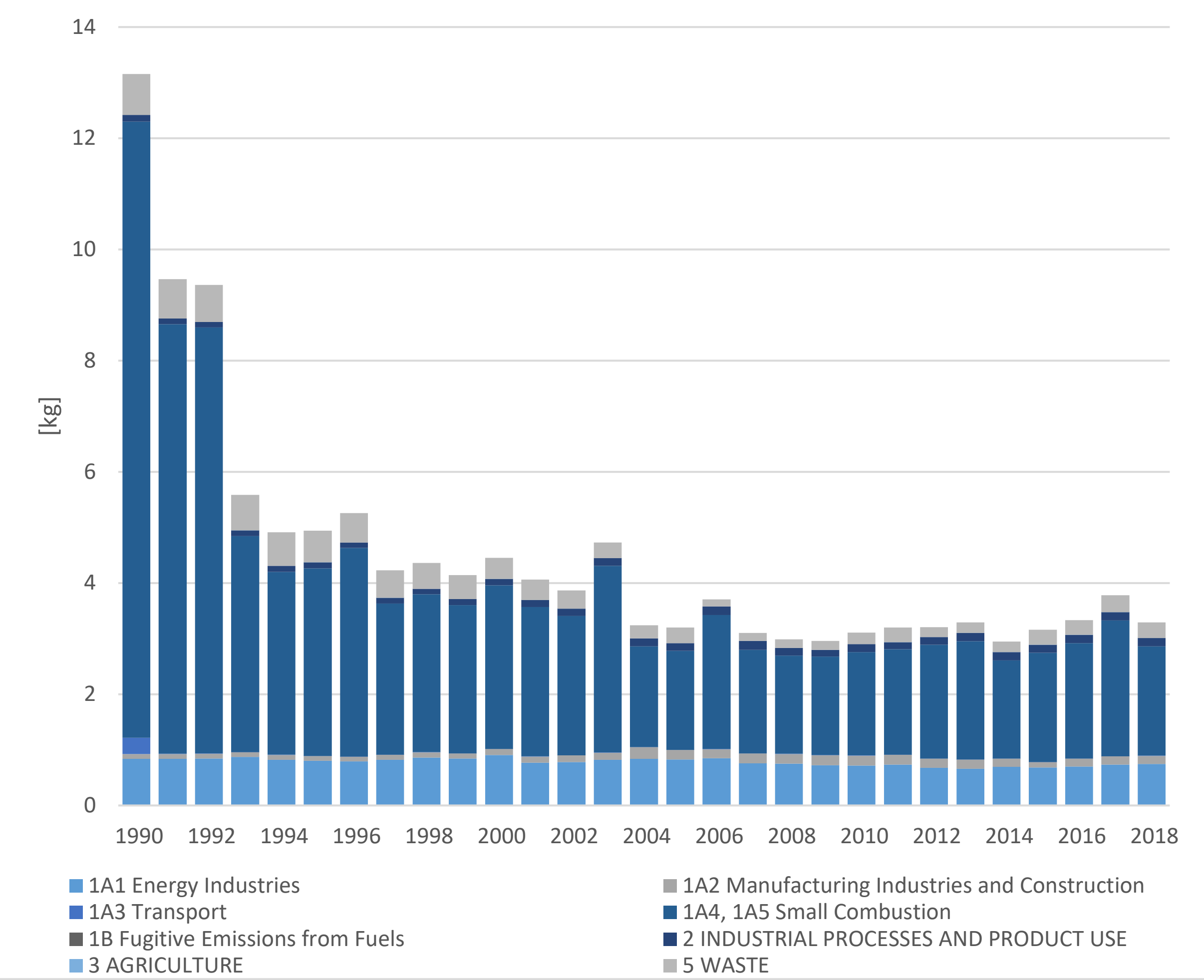
Figure 2.13: *Total PAHs Emissions by Sectors*



2.4.3 TRENDS IN HCB EMISSIONS

Emissions of HCB are connected to households heating. ***Figure 2.14*** shows in general declining trend since 1990, although since 1993 trend is rather fluctuating. It is a result of the amount of fuels and its quality in the sector of households.

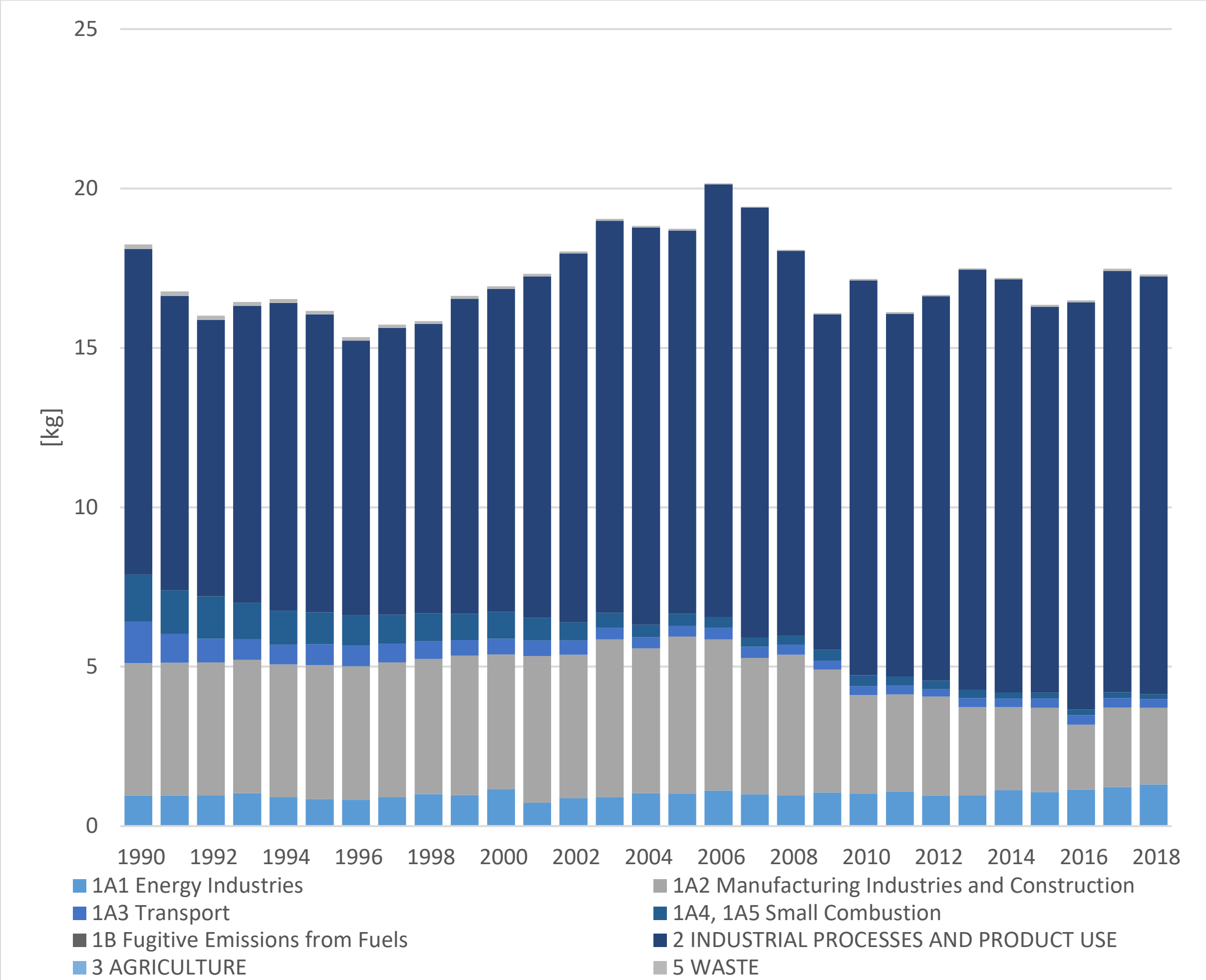
Figure 2.14: *Total HCB Emissions by Sectors*



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 emission of PCBs and its share on total emissions in 2018 was 73%. (***Figure 2.15***).

Figure 2.15: *Total PCBs Emissions by Sectors*



CHAPTER 3: ENERGY (NFR 1)

Last update: 13.3.2020

3.1 OVERVIEW OF THE SECTOR ENERGY

The emissions covered by energy sector originate from fuel combustion (NFR 1A1, 1A2, 1A3, 1A4 and 1A5) and fugitive emissions (NFR 1B).

The data sources

a/ NEIS database of stationary large and medium sources providing facility data for nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOC) sulphur oxides (SO_X), ammonia (NH_3), total suspended particles (TSP, PM_{10} and $PM_{2.5}$ are consequently compiled) and carbon monoxide (CO). All data that comes from the database is considered as T3 methodology. In the year 2018, the system contained 13 774 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 3.8.4 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 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 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, tie or notation key used in energy sector*

NFR		METHODOLOGY / TIER					
	LONGNAME OF CATEGORY	NO_X, NMVOC, SO_X, CO	NH_3	$PM_{2.5}$, PM_{10}, TSP	BC	HM	POPS
	Energy industries						
1A1a	Public electricity and heat production	T3	T3, NO	T3	NK	T1	T1
1A1b	Petroleum refining	T3	T3	T3	T1	NK	T1
1A1c	Manufacture of solid fuels and other energy industries	T3	T3	T3	T1	T1	T1
	Stationary combustion in manufacturing and construction						
1A2a	Iron and steel	T3	T3, NO	T3	NK	T1	T1
1A2b	Non-ferrous metals	T3	NO	T3	NK	T1	T1, NK
1A2c	Chemicals	T3	NO	T3	NK	T1	T1, NK
1A2d	Pulp, Paper and Print	T3	T3,NO	T3	NK	T1	T1, NK
1A2e	Food processing, beverages and tobacco	T3	T3	T3	NK	T1	T1, NK

NFR	LONGNAME OF CATEGORY	METHODOLOGY / TIER					
		NOx, NMVOC, SOx, CO	NH_3	$PM_{2.5}$, PM_{10}, TSP	BC	HM	POPS
1A2f	Non-metallic minerals	T3	NO	T3	NK	T1	T1, NK
1A2gvii	Mobile Combustion	NK	NK	NK	NK	NK	NK
1A2gviii	Other	T3	T3	T3	NK	T1	T1, NK
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	T3	NK	T1	T1
1A4aii	Commercial/institutional: Mobile	NK	NK	NK	NK	NK	NK
1A4bi	Residential: Stationary	T2, T1	NK	T3	NK	T1	T2
1A4bii	Residential: Household and gardening	NK	NK	NK	NK	NK	NK
1A4ci	Agri./Forest./Fish.: Stationary	T3	NK	T3	NK	T1	T1
1A4cii	Agri./Forest./Fish.: Off-road vehicles and other machinery	T3	T3	T3	T3	T3, NK	T3, NK
1A4ciii	Agri./Forest./Fish.: National fishing	NO	NO	NO	NO	NO	NO
Non-road mobile machinery							
1A5a	Other stationary (including military)	T3	T3	T3	NK	T1	NK
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	NO	NO	NO	NO	NO	NO
1B2ai	from oil: Exploration, production, transport	T1+T3, 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

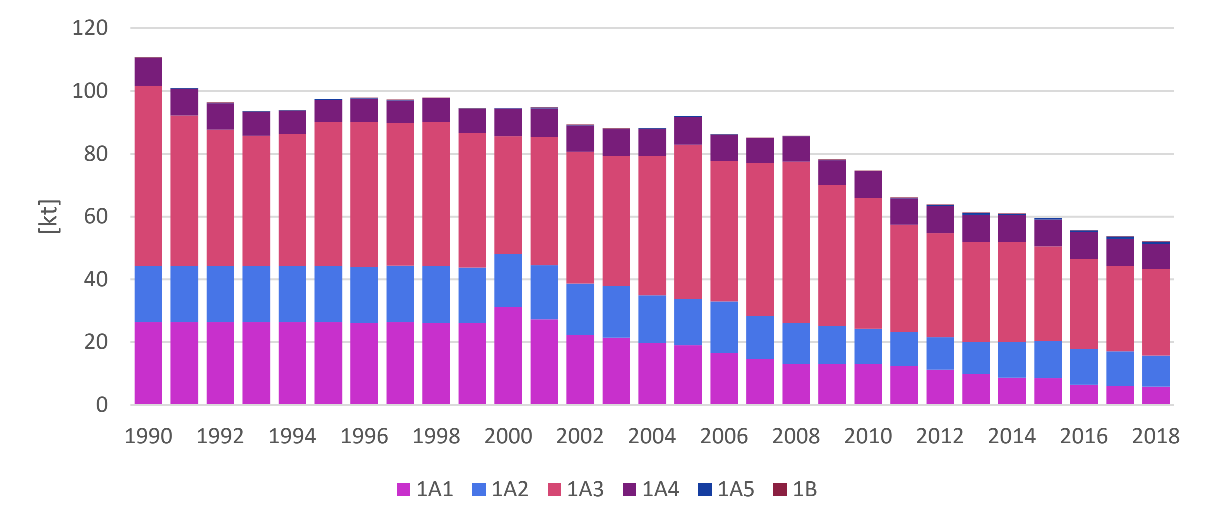
3.2 TRENDS IN THE SECTOR ENERGY

From figures 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 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).

Categories of the Energy sector are key categories for the most of the main pollutants, heavy metals and POPs. The most significant categories are 1A1a (key category for NOx, SOx, $PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Ni, Se, PCDD/F, HCB) and 1A4bi (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). Figures below show share of categories on emissions of particular pollutants (Figure 3.1-3.12).

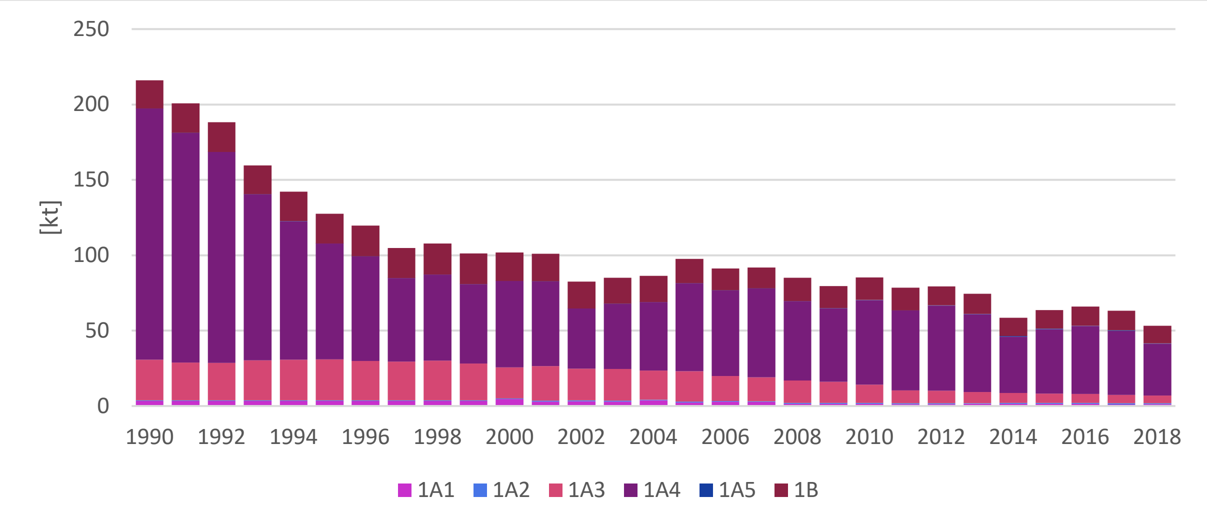
Transport categories are the main contributor to NOx emissions, especially category 1A3biii: Heavy-duty vehicles with share of 36% and 1A3bi: Passenger cars with share 34% of emissions in 2018. Emissions in this categories decrease slowly.

Figure 3.1: *The overall trend in NOx emissions by categories of Energy sector*



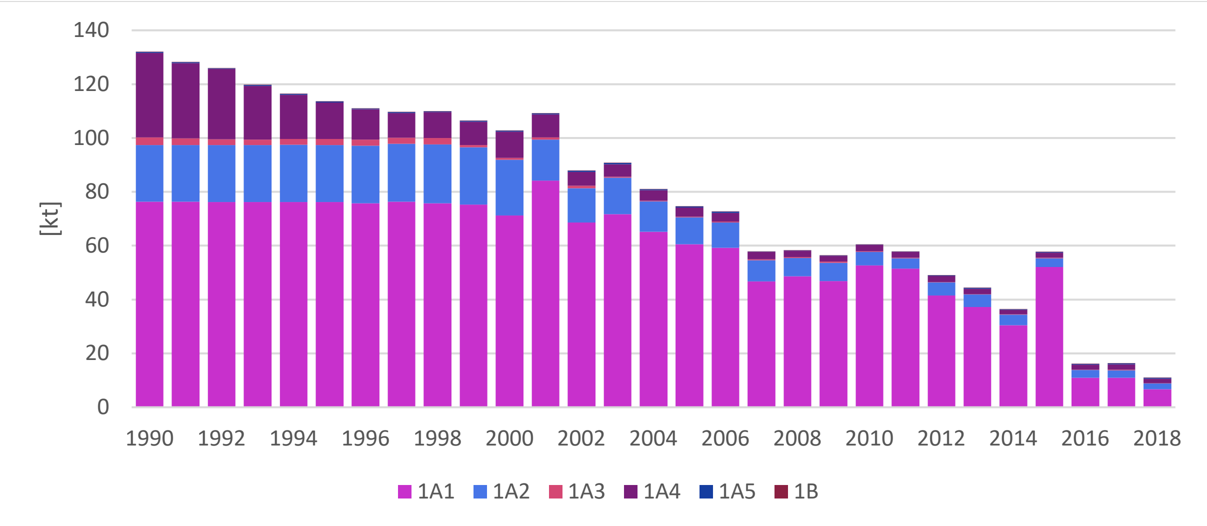
Emissions of NMVOC are emitted mostly by the category 1A4bi: Residential: Stationary. In 2018, it was 67% of all NMVOC emissions in the Energy sector and about 37% of the total emissions of this pollutant. Emission is relatively stable, with only slight fluctuation since 2005 (***Figure 3.2***).

Figure 3.2: The overall trend in NMVOC emissions by categories of Energy sector



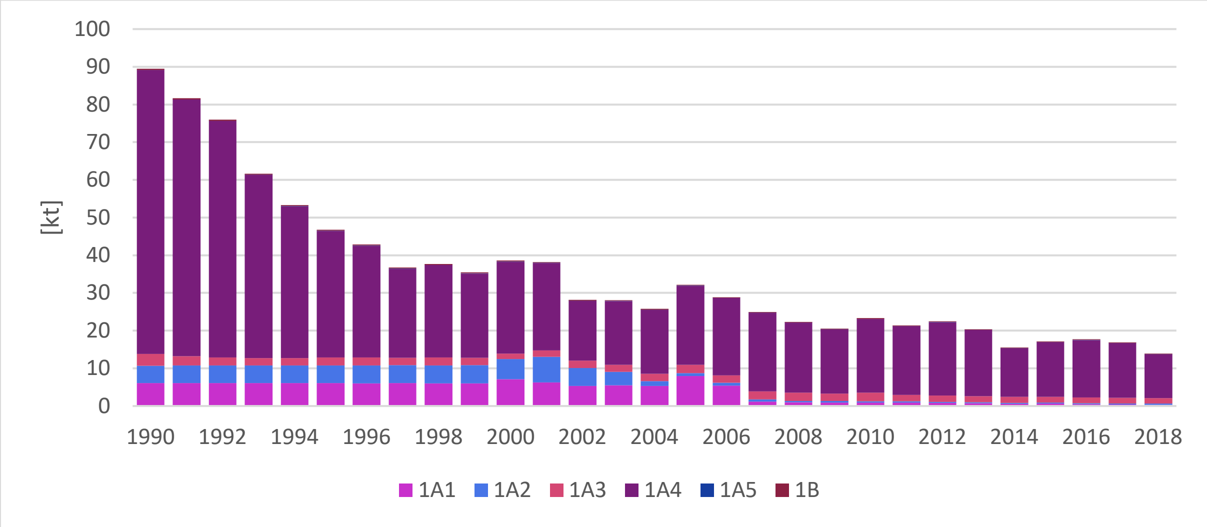
SOx emissions are mainly emitted by the category 1A1a (42% in 2018). This category shows an overall decreasing trend except the year 2015. Increase in 2015 and drop in 2016 was caused by the one source of Slovak power plants. This increase was in ENO A K1, K2- granul. boiler: higher deployment of not 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 (***Figure 3.3***).

Figure 3.3: The overall trend in SOx emissions by categories of Energy sector



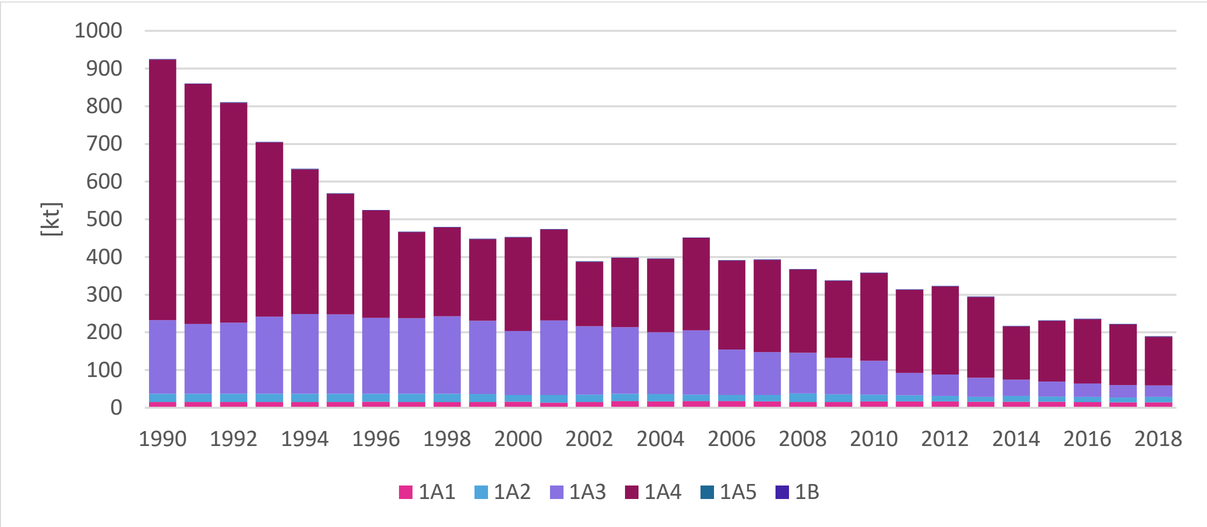
Residential heating is the main contributor to emissions of $PM_{2.5}$, PM_{10} and TSP. From ***Figure 3.4*** is clear that emissions of $PM_{2.5}$ (the trend for PM_{10} and TSP is very similar) show a decreasing trend since 1990 although since 2005 emissions in this category are relatively stable. In 2018 this category contributed by 74% of total emissions of $PM_{2.5}$.

Figure 3.4: *The overall trend in $PM_{2.5}$ emissions by categories of Energy sector*



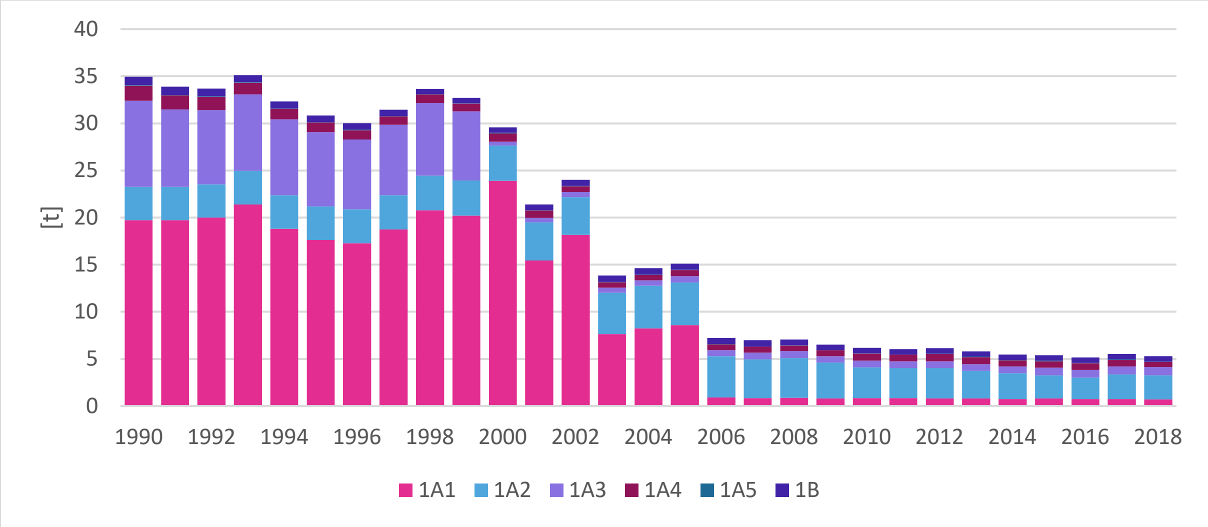
CO emissions are emitted mostly by residential heating and road transport. Emissions show an overall decreasing trend (***Figure 3.5***).

Figure 3.5: *The overall trend in CO emissions by categories of Energy sector*



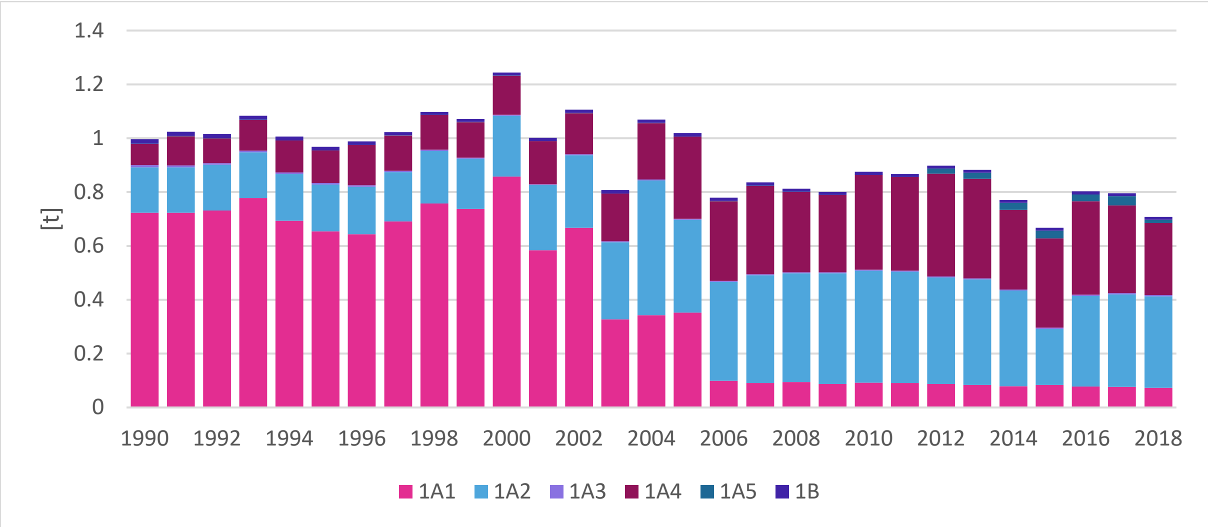
Until 2005, the main contributor to emissions of Pb was the incineration of municipal waste with energy recovery allocated in the category 1A1a. Reconstruction of both MSW incineration plants led to a significant decrease in emissions. Decrease of Pb emission from road transport in 2000 was caused by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

Figure 3.6: The overall trend in Pb emissions by categories of Energy sector



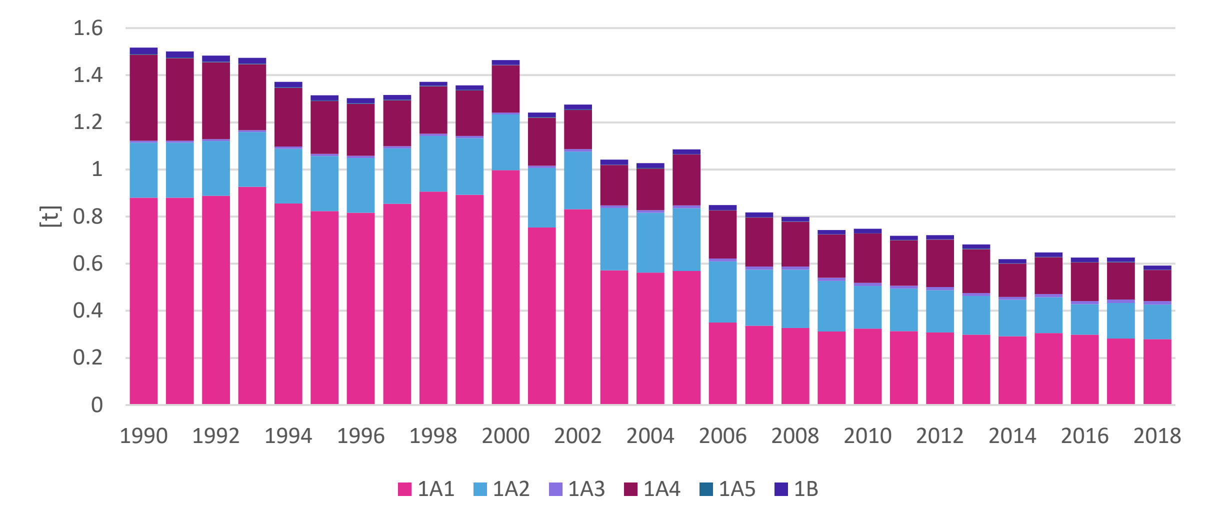
Emissions of Cd decreased only slightly in this sector since 1990. Similar to Pb emissions, MSW incineration plants contributed significantly to its emissions until 2005. Since then, combustion activities in iron and steel production and households heating have become important (***Figure 3.7***).

Figure 3.7: The overall trend in Cd emissions by categories of Energy sector



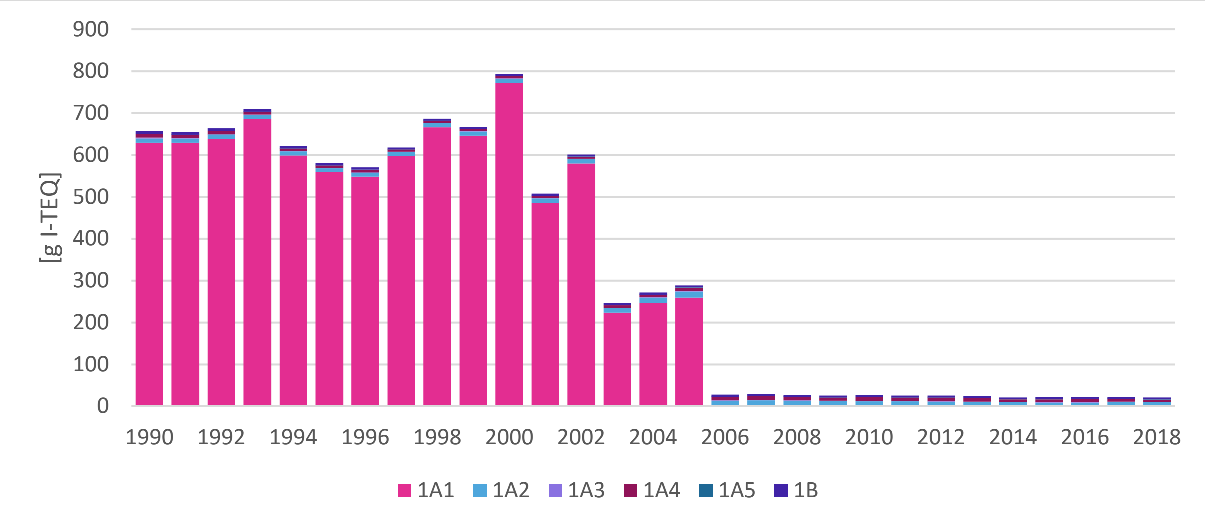
Emissions of Hg are mostly influenced by the incineration of MSW. Decrease in 2006 due to reconstruction was not as significant as by emissions of Pb or Cd (***Figure 3.8***).

Figure 3.8: *The overall trend in Hg emissions by categories of Energy sector*



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 (***Figure 3.9***).

Figure 3.9: *The overall trend in PCDD/F emissions by categories of Energy sector*



PAHs and HCB emissions are emitted mostly by residential heating. Emission trend of this pollutants is slightly decreasing in the Energy sector since 2005 (***Figure 3.10, Figure 3.11***).

Figure 3.10: *The overall trend in PAHs emissions by categories of Energy sector*

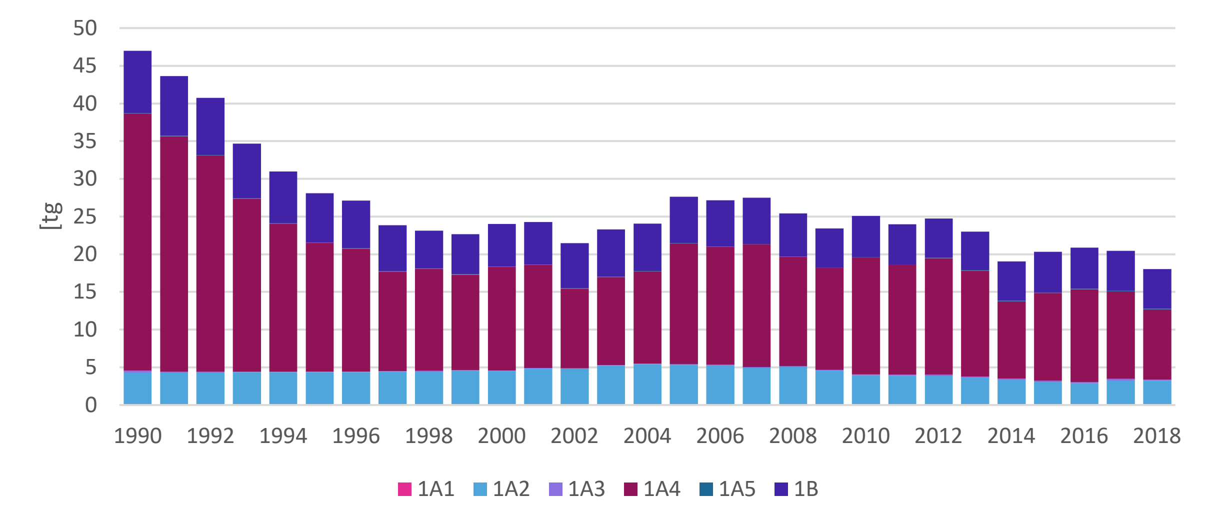
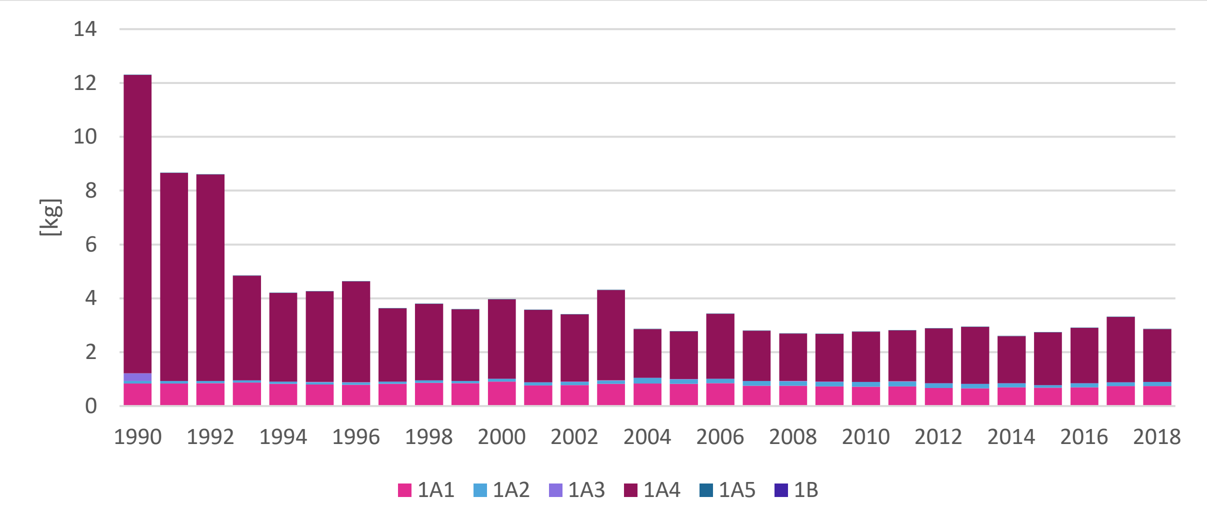
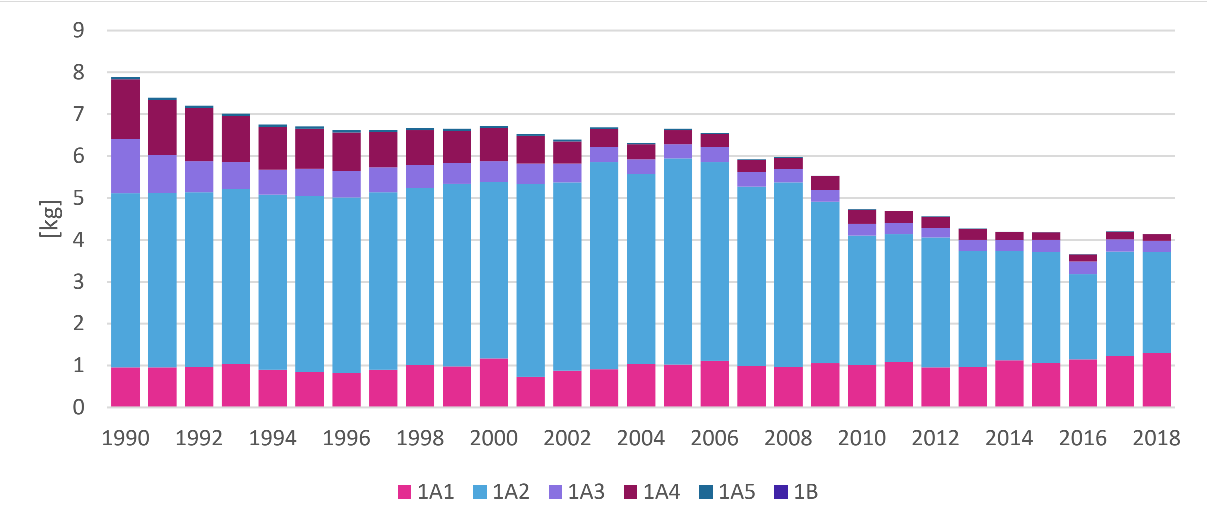


Figure 3.11: *The overall trend in HCB emissions by categories of Energy sector*



Category 1A2a is the main contributor to emissions of PCBs in whole time-series (***Figure 3.12***). In 2018, 41% of emissions of PCBs was emitted by this category in the sector Energy.

Figure 3.12: *The overall trend in HCB emissions by categories of Energy sector*



3.3 RECALCULATIONS, IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

Energy 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 previous submission was assumed as outdated and impossible to further improvements. Therefore, all categories were recalculated using EMEP/EEA GB_{2019} emission factors on Tier 1 level. This step will be followed by an improvement of the methodology of all key categories to a higher level. Due to lack of capacity, the next step will be provided in the next submission.

Further development of the methodology for HMs and POPs is planned for the next submission. In this submission, the main aim was to identify key categories. In the next step, it is planned to analyse the availability of activity data and methodology to improve key categories to Tier 2.

Combustion emissions were removed from industry categories 2A1, 2A2, 2A3 and 2H1 and allocated to the particular energy categories, which caused a significant decrease in the industrial sector and an increase in the sector energy. There is planned detailed analysis of the allocation of sources to the NFR categories across the whole NEIS database in the next period, as it was already identified that some sources might be allocated incorrectly within the database.

Also, emission factors for main pollutants were changed due to change for the period 1990-1999 (1990-2004 for $PM_{2.5}$ and PM_{10}) due to re-categorisation of fuels.

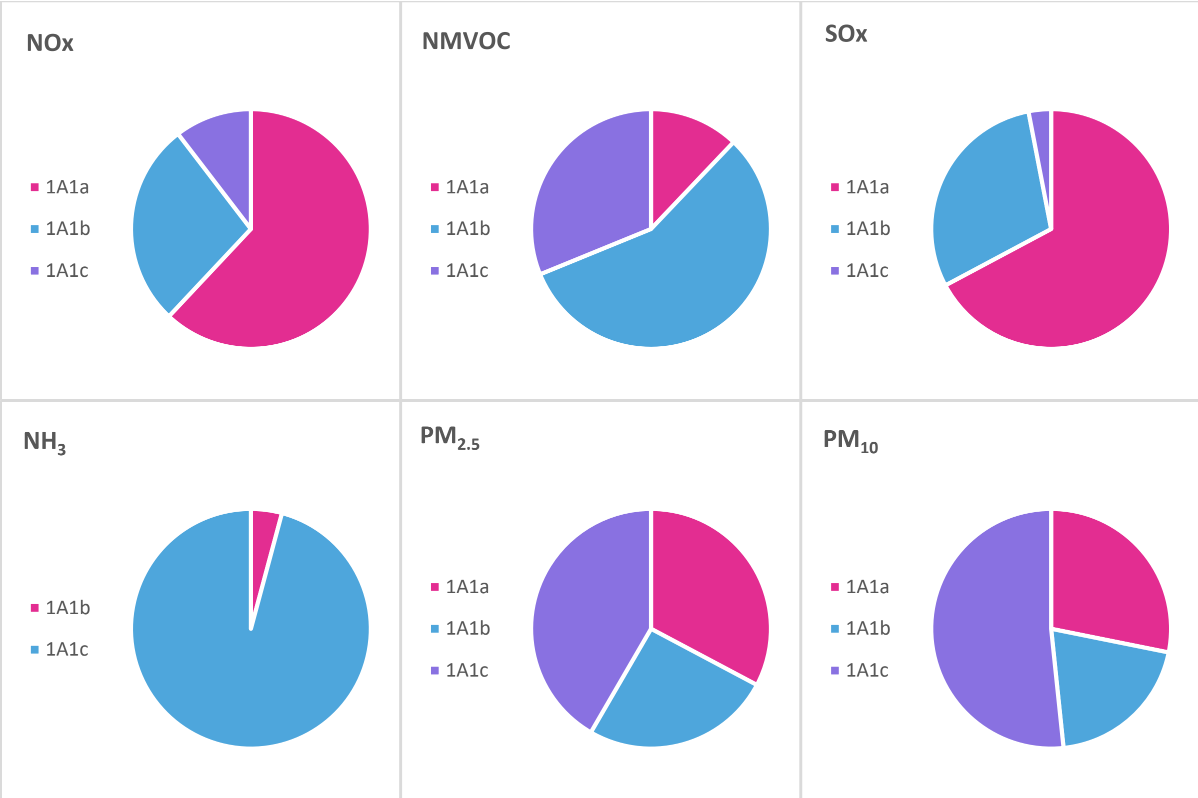
3.4 ENERGY INDUSTRIES (NFR 1A1)

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. 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 3.13***.

Figure 3.13: *Share of emissions of main polluatnts in 1A1 in 2018*



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. List of activities included in this category is in ***Table 3.2***.

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.

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.

Table 3. 2: *Activities according to national categorization included in 1A1a*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW *+ specification according to NACE: LARGE SOURCES 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*

From emission data is visible increase in 2015 and drop in 2016, the most significant in SO_X. This annual fluctuation is caused by the one source of Slovak power plants. This increase was in ENO A K1, K2-granul. 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 be in compliance with national legislation, so the expected significant reduction in SO_X emissions was visible in 2016 emissions. The decline was continuing during 2018 (***Figure 3.14***).

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

Figure 3.14: *Trends of emissions of main pollutants in the category 1A1a*

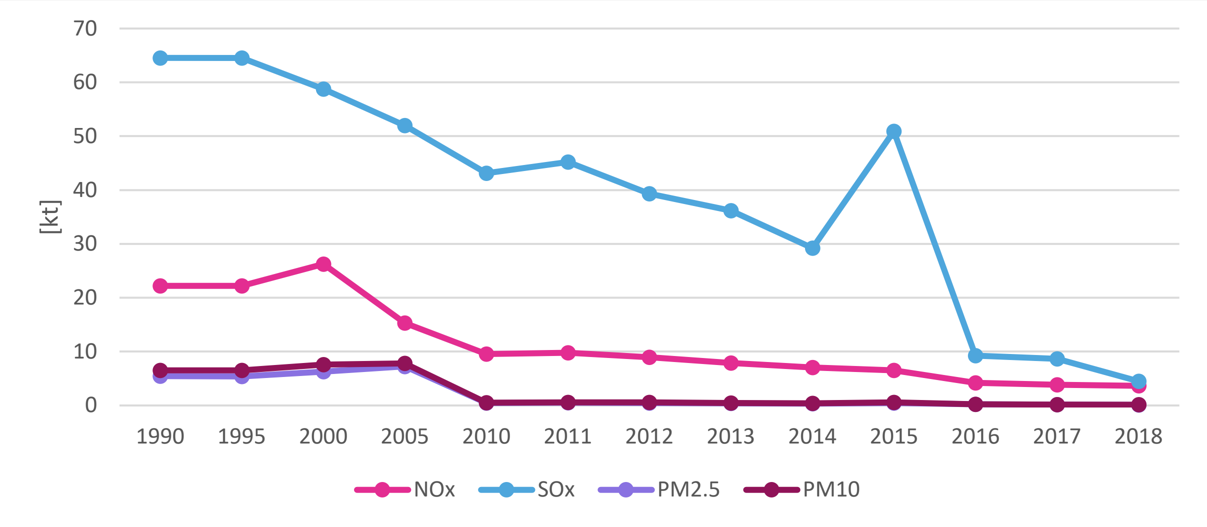


Figure 3.15: *Trends in emissions of heavy metals in 1A1a*

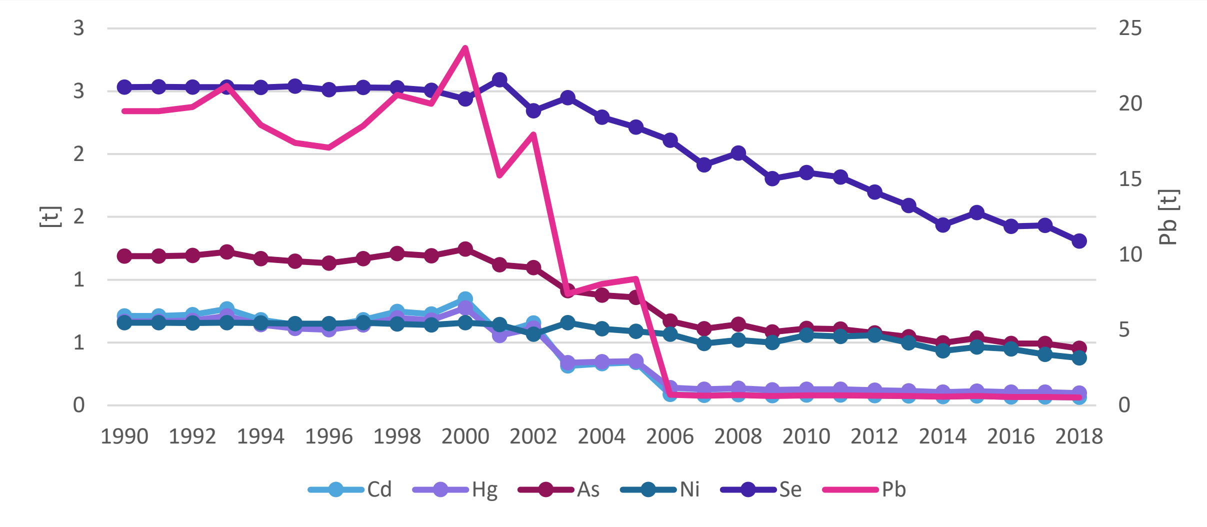
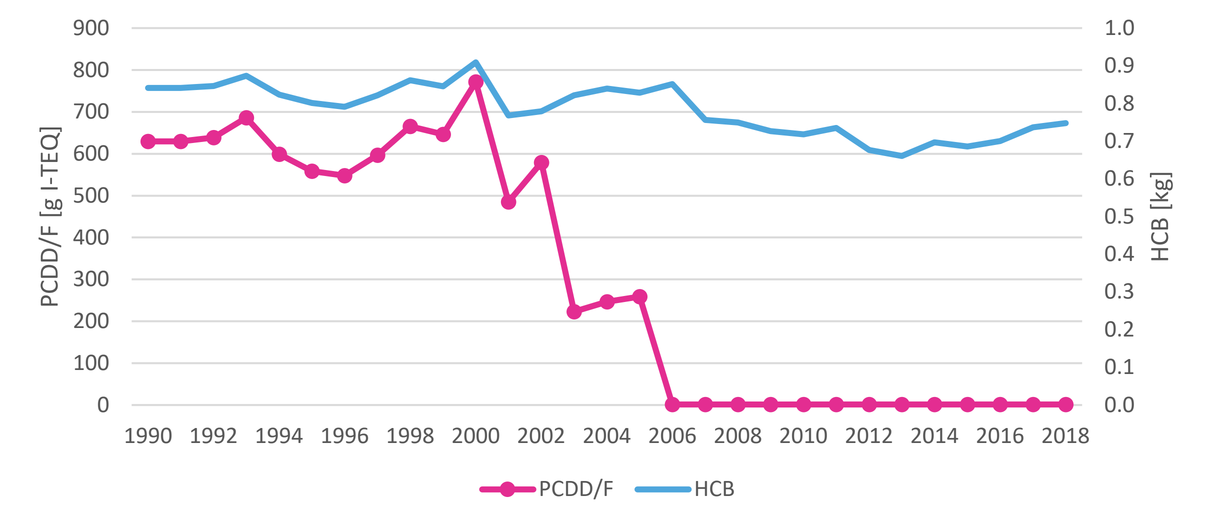


Figure 3.16: *Trends in emissions of POPs in 1A1a*



The emission data of air pollutants are presented in ***Table 3.3***. Emissions originating from MSW incineration with energy utilisation are described in **Chapter 6.7.1**. This table represents fuels allocated to the fuel type for calculations (following Table 3-1 of EMEP/EEA GB2019, Part energy industries). Fuels in the template are allocated following principle from IPCC 2006 Guidelines.

Table 3.3: *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	22.2039	0.1808	64.5489	NO	5.4252	6.5123	8.6383	2.8324
1995	22.1882	0.1807	64.5032	NO	5.4214	6.5077	8.6322	2.8304
2000	26.2635	0.1682	58.7914	NO	6.3131	7.5781	10.0520	2.6245
2005	15.2939	0.1533	51.9929	NO	7.2630	7.8104	11.7351	2.3062
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	0.1505	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
1990/2018	**-84%**	**-20%**	**-93%**	**-**	**-98%**	**-98%**	**-98%**	**-44%**
2017/2018	**-6%**	**-4%**	**-48%**	**-**	**-22%**	**-24%**	**-26%**	**-11%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	19.5124	0.7117	0.6673	1.1878	0.5410	0.3090	0.6567	2.5336	1.1540
1995	17.4069	0.6430	0.6109	1.1462	0.5384	0.3075	0.6512	2.5391	1.1361
2000	23.7036	0.8460	0.7746	1.2440	0.5292	0.3135	0.6577	2.4379	1.1824
2005	8.3952	0.3409	0.3522	0.8601	0.4595	0.3124	0.5880	2.2145	1.0779
2010	0.6701	0.0816	0.1290	0.6125	0.3975	0.2046	0.5590	1.8528	1.0968
2011	0.6691	0.0812	0.1284	0.6067	0.3950	0.2040	0.5482	1.8179	1.1573
2012	0.6475	0.0777	0.1210	0.5767	0.3787	0.2260	0.5580	1.6965	1.3192
2013	0.6225	0.0742	0.1146	0.5468	0.3617	0.2240	0.4969	1.5890	1.3614
2014	0.5752	0.0687	0.1050	0.4980	0.3321	0.2190	0.4335	1.4335	1.3489
2015	0.6180	0.0733	0.1122	0.5347	0.3565	0.2180	0.4645	1.5350	1.4206
2016	0.5667	0.0680	0.1043	0.4927	0.3279	0.2078	0.4483	1.4238	1.2913

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2017	0.5607	0.0677	0.1045	0.4910	0.3258	0.2121	0.4048	1.4324	1.2368
2018	0.5241	0.0633	0.0972	0.4533	0.3027	0.2179	0.3772	1.3061	1.2670
1990/2018	**-97%**	**-91%**	**-85%**	**-62%**	**-44%**	**-29%**	**-43%**	**-48%**	**10%**
2017/2018	**-7%**	**-7%**	**-7%**	**-8%**	**-7%**	**3%**	**-7%**	**-9%**	**2%**

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	629.3619	0.0009	0.0033	0.0027	0.0002	0.0070	0.8412	0.9522
1995	558.4448	0.0008	0.0032	0.0026	0.0002	0.0068	0.8017	0.8448
2000	771.4643	0.0010	0.0033	0.0027	0.0002	0.0072	0.9092	1.1674
2005	258.9232	0.0009	0.0031	0.0025	0.0001	0.0066	0.8285	1.0241
2010	1.2838	0.0009	0.0024	0.0020	0.0001	0.0054	0.7183	1.0174
2011	1.3386	0.0009	0.0024	0.0020	0.0001	0.0055	0.7353	1.0821
2012	1.2792	0.0008	0.0022	0.0019	0.0001	0.0050	0.6767	0.9571
2013	1.2770	0.0008	0.0021	0.0018	0.0001	0.0048	0.6607	0.9622
2014	1.3500	0.0009	0.0021	0.0018	0.0001	0.0048	0.6967	1.1232
2015	1.3476	0.0009	0.0021	0.0018	0.0001	0.0048	0.6862	1.0641
2016	1.3464	0.0010	0.0021	0.0017	0.0001	0.0049	0.7007	1.1478
2017	1.3907	0.0010	0.0022	0.0018	0.0001	0.0051	0.7365	1.2292
2018	1.4259	0.0011	0.0021	0.0018	0.0001	0.0051	0.7476	1.3019
1990/2018	**-100%**	**27%**	**-36%**	**-33%**	**-51%**	**-27%**	**-11%**	**37%**
2017/2018	**3%**	**5%**	**-2%**	**-2%**	**-6%**	**-1%**	**2%**	**6%**

Overview of activity data (energy consumption) for this source category is in ***Table 3.4*** below. Incineration of MSW is included in biomass (biomass fraction) or other fuels (non-biomass fraction).

Table 3.4: *Overview of activity data in the category 1A1a*

YEAR	HEAVY FUEL OIL [TJ NCV]	GAS OIL [TJ NCV]	HARD COAL [TJ NCV]	BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	359.12	NO	32129.75	39807.14	38537.63	NO	1435.49
1995	342.15	NO	32178.40	39910.52	38412.06	NO	918.67
2000	425.20	NO	32463.38	37497.66	36470.19	NO	2446.32
2005	391.44	NO	34369.01	31568.70	26349.33	77.70	1700.25
2010	471.06	0.02	14533.05	33605.57	20379.21	2385.28	1715.50
2011	430.15	0.59	13155.10	33517.28	25678.60	2869.79	1851.52
2012	521.71	0.72	13738.47	30499.86	23105.77	3841.03	1638.18
2013	342.01	1.38	12334.77	28822.00	19590.90	4388.67	1927.90
2014	209.29	0.99	11578.07	25748.09	12493.29	4567.79	2269.31
2015	223.82	1.70	9934.16	28834.91	13861.01	4995.70	2119.13
2016	290.70	0.85	10841.14	25912.50	13278.96	4271.98	2268.61
2017	131.37	1.06	12595.54	25219.99	13711.18	3875.10	2417.97
2018	112.14	0.44	12956.87	22218.94	14604.47	4138.96	2531.12
1990/2018	**-69%**	**-**	**-60%**	**-44%**	**-62%**	**-**	**76%**
2017/2018	**-15%**	**-59%**	**3%**	**-12%**	**7%**	**7%**	**5%**

3.4.2.2 Methodological issues

Emission data is compiled in the NEIS as presented in **ANNEX IV, Chapter A4.5**, therefore the individual specific EF could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of Ministry of Environment are presented in **ANNEX IV, Chapter A4.6.** For detailed methodology please see **ANNEX IV**. The following ***Table 3.5*** presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.

PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS. The shares were calculated for PMs in available years from 2005 to 2018. Their average was used for calculations of historical data due to the absence of historical data in the NEIS database. Emissions of NH_3 are recorded only for last two year. Emission presence is linked with the usage of DENOX abatements technologies.

Table 3.5: *The overview of share of used calculation type for category 1A1a in the NEIS*

1A1A	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	30%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	13%
4	Calculation using emission factor and amount of fuel	18%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0.1%
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	38%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

Emission factors used for reconstruction of historical years 1990–1999 (1990-2004 for $PM_{2.5}$, PM_{10} and BC) were calculated using average IEF for each pollutant for the period 2000-2015 (***Table 3.6***).

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%	325.64

Heavy metals and POPs were calculated using Tier 1 emission factors from EMEP/EEA GB_{2019}. Emission factors and methodology for incineration of MSW are described in **Chapter 6.7.1**.

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

T1	UNIT	HARD COAL	BROWN COAL	GASEOUS FUELS	HEAVY FUEL OIL	GAS OIL	BIOMASS
Pb	[mg/GJ]	7.3	15	0.0015	4.56	4.07	20.6
Cd	[mg/GJ]	0.9	1.8	0.00025	1.2	1.36	1.76
Hg	[mg/GJ]	1.4	2.9	0.1	0.341	1.36	1.51
As	[mg/GJ]	7.1	14.2	0.12	3.98	1.81	9.46
Cr	[mg/GJ]	4.5	9.1	0.00076	2.55	1.36	9.03
Cu	[mg/GJ]	7.8	1	0.000076	5.31	2.72	21.1
Ni	[mg/GJ]	4.9	9.7	0.00051	255	1.36	14.2
Se	[mg/GJ]	23	45	0.0112	2.06	6.79	1.2
Zn	[mg/GJ]	19	8.8	0.0015	87.8	1.81	181
PCDD/F	[ng/GJ]	10	10	0.5	2.5	0.5	50
B(a)P	[µg/GJ]	0.7	1.3	0.56	-	-	1.12
B(b)F	[µg/GJ]	37	37	0.84	4.5	-	0.043
B(k)F	[µg/GJ]	29	29	0.84	4.5	-	0.0155
I()P	[µg/GJ]	1.1	2.1	0.84	6.92	6.92	0.0374
PAHs	[µg/GJ]	67.8	69.4	3.08	15.92	6.92	1.2159
HCB	[µg/GJ]	6.7	6.7	-	-	-	5
PCBs	[ng/GJ]	3.3	3.3	-	-	-	3.5

3.4.2.3 Completeness

Emissions are well covered.

3.4.2.4 Source-specific recalculations

Recalculations in this submission were done to improve data quality and transparency. Recalculations in this submission were done due to change of categorisation of fuels and change of approach toward the calculation of HMs and POPs emission, where EMEP/EEA GB_{2019} EF instead of CS EF were used. 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 3.8*** shows the change in the data between final submission 2019 and this submission.

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	30.9204	22.2039	-28%	0.2518	0.1808	-28%	89.8885	64.5489	-28%
1991	26.3072	22.2174	-16%	0.2142	0.1809	-16%	76.4775	64.5881	-16%
1992	23.3038	22.1838	-5%	0.1898	0.1807	-5%	67.7464	64.4906	-5%
1993	21.1351	22.1878	5%	0.1721	0.1807	5%	61.4417	64.5020	5%
1994	19.0794	22.1779	16%	0.1554	0.1806	16%	55.4657	64.4734	16%
1995	18.7193	22.1882	19%	0.1524	0.1807	19%	54.4188	64.5032	19%
1996	18.7030	22.0180	18%	0.1523	0.1793	18%	54.3716	64.0086	18%
1997	18.5161	22.1882	20%	0.1508	0.1807	20%	53.8280	64.5032	20%
1998	18.6071	21.9893	18%	0.1515	0.1791	18%	54.0926	63.9251	18%
1999	19.0051	21.8991	15%	0.1548	0.1783	15%	55.2498	63.6629	15%

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	7.5550	5.4252	-28%	9.0688	6.5123	-28%	12.0294	8.6383	-28%	3.9443	2.8324	-28%
1991	6.4278	5.4285	-16%	7.7157	6.5162	-16%	10.2346	8.6435	-16%	3.3558	2.8341	-16%
1992	5.6940	5.4203	-5%	6.8349	6.5064	-5%	9.0662	8.6305	-5%	2.9727	2.8298	-5%
1993	5.1641	5.4213	5%	6.1988	6.5075	5%	8.2225	8.6320	5%	2.6960	2.8303	5%
1994	4.6618	5.4189	16%	5.5959	6.5047	16%	7.4227	8.6282	16%	2.4338	2.8291	16%
1995	4.5738	5.4214	19%	5.4903	6.5077	19%	7.2826	8.6322	19%	2.3879	2.8304	19%
1996	4.5698	5.3798	18%	5.4855	6.4578	18%	7.2763	8.5660	18%	2.3858	2.8087	18%
1997	4.5241	5.4214	20%	5.4307	6.5077	20%	7.2036	8.6322	20%	2.3620	2.8304	20%
1998	4.5464	5.3728	18%	5.4573	6.4493	18%	7.2390	8.5548	18%	2.3736	2.8050	18%
1999	4.6436	5.3508	15%	5.5741	6.4229	15%	7.3938	8.5197	15%	2.4243	2.7935	15%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.9397	19.5124	1976%	0.1212	0.7117	487%	0.1788	0.6673	273%	0.9038	1.1878	31%
1991	0.7836	19.5132	2390%	0.1008	0.7118	606%	0.1498	0.6674	346%	0.7527	1.1885	58%
1992	0.6620	19.7868	2889%	0.0847	0.7206	750%	0.1276	0.6747	429%	0.6354	1.1932	88%
1993	0.5716	21.1884	3607%	0.0727	0.7664	954%	0.1113	0.7123	540%	0.5477	1.2217	123%
1994	0.5060	18.5998	3576%	0.0640	0.6817	966%	0.0990	0.6425	549%	0.4854	1.1679	141%
1995	0.4641	17.4069	3651%	0.0583	0.6430	1003%	0.0918	0.6109	566%	0.4461	1.1462	157%
1996	0.4558	17.0819	3648%	0.0568	0.6316	1011%	0.0906	0.6006	563%	0.4386	1.1309	158%
1997	0.4432	18.5443	4084%	0.0549	0.6799	1137%	0.0887	0.6410	623%	0.4261	1.1664	174%
1998	0.4428	20.5913	4551%	0.0546	0.7467	1267%	0.0890	0.6959	682%	0.4249	1.2078	184%
1999	0.4559	19.9973	4287%	0.0561	0.7267	1195%	0.0916	0.6788	641%	0.4381	1.1893	171%
2000	0.5248	23.7036	4417%	0.0644	0.8460	1213%	0.1057	0.7746	633%	0.5041	1.2440	147%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2001	0.5446	15.2542	2701%	0.0670	0.5741	757%	0.1090	0.5558	410%	0.5274	1.1181	112%
2002	0.4985	17.9653	3504%	0.0612	0.6554	971%	0.1001	0.6147	514%	0.4809	1.0960	128%
2003	0.5331	7.4008	1288%	0.0656	0.3150	380%	0.1065	0.3386	218%	0.5140	0.9124	78%
2004	0.5038	8.0494	1498%	0.0619	0.3319	436%	0.1009	0.3479	245%	0.4838	0.8778	81%
2005	0.4941	8.3952	1599%	0.0607	0.3409	462%	0.0985	0.3522	257%	0.4733	0.8601	82%
2006	0.4834	0.7048	46%	0.0593	0.0880	48%	0.0956	0.1413	48%	0.4602	0.6702	46%
2007	0.4316	0.6435	49%	0.0526	0.0800	52%	0.0849	0.1284	51%	0.4082	0.6095	49%
2008	0.4328	0.6853	58%	0.0529	0.0845	60%	0.0851	0.1352	59%	0.4116	0.6444	57%
2009	0.3866	0.6258	62%	0.0466	0.0773	66%	0.0747	0.1238	66%	0.3573	0.5840	63%
2010	0.4034	0.6701	66%	0.0481	0.0816	70%	0.0759	0.1290	70%	0.3642	0.6125	68%
2011	0.3960	0.6691	69%	0.0470	0.0812	73%	0.0747	0.1284	72%	0.3559	0.6067	70%
2012	0.4142	0.6475	56%	0.0480	0.0777	62%	0.0734	0.1210	65%	0.3552	0.5767	62%
2013	0.4025	0.6225	55%	0.0460	0.0742	61%	0.0696	0.1146	65%	0.3378	0.5468	62%
2014	0.3783	0.5752	52%	0.0427	0.0687	61%	0.0640	0.1050	64%	0.3112	0.4980	60%
2015	0.3980	0.6180	55%	0.0427	0.0733	72%	0.0640	0.1122	75%	0.3112	0.5347	72%
2016	0.3690	0.5667	54%	0.0418	0.0680	62%	0.0630	0.1043	65%	0.3047	0.4927	62%
2017	0.3690	0.5607	52%	0.0418	0.0677	62%	0.0630	0.1045	66%	0.3047	0.4910	61%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.5736	0.5410	-6%	0.9998	0.3090	-69%	2.9215	0.6567	-78%
1991	0.4778	0.5415	13%	0.8321	0.3090	-63%	2.3330	0.6565	-72%
1992	0.4033	0.5414	34%	0.7014	0.3093	-56%	1.8438	0.6556	-64%
1993	0.3477	0.5436	56%	0.6037	0.3105	-49%	1.4451	0.6585	-54%
1994	0.3079	0.5387	75%	0.5341	0.3079	-42%	1.1269	0.6549	-42%
1995	0.2826	0.5384	91%	0.4895	0.3075	-37%	0.8813	0.6512	-26%
1996	0.2777	0.5322	92%	0.4805	0.3060	-36%	0.7085	0.6490	-8%
1997	0.2698	0.5384	100%	0.4662	0.3079	-34%	0.5767	0.6573	14%
1998	0.2692	0.5415	101%	0.4647	0.3111	-33%	0.4904	0.6467	32%
1999	0.2775	0.5365	93%	0.4789	0.3057	-36%	0.4447	0.6411	44%
2000	0.3194	0.5292	66%	0.5508	0.3135	-43%	0.4572	0.6577	44%
2001	0.3331	0.5451	64%	0.5756	0.3078	-47%	0.4348	0.6432	48%
2002	0.3042	0.4998	64%	0.5251	0.2907	-45%	0.3762	0.5668	51%
2003	0.3253	0.5040	55%	0.5619	0.3198	-43%	0.4753	0.6574	38%
2004	0.3067	0.4745	55%	0.5295	0.3061	-42%	0.4385	0.6089	39%
2005	0.3009	0.4595	53%	0.5192	0.3124	-40%	0.3279	0.5880	79%
2006	0.2936	0.4275	46%	0.5074	0.3140	-38%	0.3206	0.5657	76%
2007	0.2611	0.3894	49%	0.4522	0.2659	-41%	0.2863	0.4910	71%
2008	0.2627	0.4130	57%	0.4547	0.2561	-44%	0.2875	0.5200	81%
2009	0.2309	0.3755	63%	0.4036	0.1937	-52%	0.2563	0.5003	95%
2010	0.2380	0.3975	67%	0.4206	0.2046	-51%	0.2676	0.5590	109%
2011	0.2328	0.3950	70%	0.4124	0.2040	-51%	0.2627	0.5482	109%
2012	0.2378	0.3787	59%	0.4311	0.2260	-48%	0.2757	0.5580	102%
2013	0.2286	0.3617	58%	0.4178	0.2240	-46%	0.2683	0.4969	85%
2014	0.2128	0.3321	56%	0.3911	0.2190	-44%	0.2521	0.4335	72%
2015	0.2128	0.3565	68%	0.3911	0.2180	-44%	0.2521	0.4645	84%
2016	0.2079	0.3279	58%	0.3810	0.2078	-45%	0.2454	0.4483	83%
2017	0.2079	0.3258	57%	0.3810	0.2121	-44%	0.2454	0.4048	65%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	2.8198	2.5336	-10%	3.1155	1.1540	-63%
1991	2.3514	2.5359	8%	2.5633	1.1541	-55%
1992	1.9879	2.5331	27%	2.1238	1.1559	-46%
1993	1.7175	2.5319	47%	1.7852	1.1682	-35%
1994	1.5280	2.5299	66%	1.5345	1.1450	-25%
1995	1.4086	2.5391	80%	1.3612	1.1361	-17%
1996	1.3911	2.5113	81%	1.2896	1.1279	-13%
1997	1.3553	2.5289	87%	1.2181	1.1451	-6%
1998	1.3549	2.5273	87%	1.1887	1.1616	-2%
1999	1.3997	2.5070	79%	1.2071	1.1436	-5%
2000	1.6128	2.4379	51%	1.3722	1.1824	-14%
2001	1.6901	2.5923	53%	1.4222	1.1247	-21%
2002	1.5419	2.3433	52%	1.2909	1.0642	-18%
2003	1.6461	2.4480	49%	1.4030	1.1136	-21%
2004	1.5482	2.2920	48%	1.3242	1.0735	-19%
2005	1.5198	2.2145	46%	1.2608	1.0779	-15%
2006	1.4746	2.1104	43%	1.2504	1.0489	-16%
2007	1.3024	1.9130	47%	1.1444	0.9327	-18%
2008	1.3171	2.0082	52%	1.1362	0.9905	-13%
2009	1.1166	1.8044	62%	1.1136	0.8747	-21%
2010	1.1128	1.8528	66%	1.2642	1.0968	-13%
2011	1.0793	1.8179	68%	1.2659	1.1573	-9%
2012	1.0254	1.6965	65%	1.5406	1.3192	-14%
2013	0.9548	1.5890	66%	1.5808	1.3614	-14%
2014	0.8667	1.4335	65%	1.5404	1.3489	-12%
2015	0.8667	1.5350	77%	1.5404	1.4206	-8%
2016	0.8535	1.4238	67%	1.4762	1.2913	-13%
2017	0.8535	1.4324	68%	1.4762	1.2368	-16%

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	15.0711	629.3619	4076%	0.0149	0.0070	-53%	0.8868	0.8412	-5%	2.6963	0.9522	-65%
1991	14.3197	629.3624	4295%	0.0132	0.0070	-47%	0.8271	0.8415	2%	2.4116	0.9522	-61%
1992	13.9122	638.6025	4490%	0.0118	0.0070	-41%	0.7895	0.8464	7%	2.2103	0.9661	-56%
1993	14.2884	685.7866	4700%	0.0111	0.0071	-36%	0.7957	0.8732	10%	2.1249	1.0376	-51%
1994	12.6283	598.6860	4641%	0.0092	0.0069	-25%	0.7041	0.8230	17%	1.9001	0.9057	-52%
1995	11.9423	558.4448	4576%	0.0080	0.0068	-16%	0.6663	0.8017	20%	1.8180	0.8448	-54%
1996	11.6965	547.8076	4583%	0.0073	0.0067	-8%	0.6504	0.7911	22%	1.7680	0.8287	-53%
1997	12.4914	596.8294	4678%	0.0074	0.0068	-7%	0.6886	0.8218	19%	1.8309	0.9029	-51%
1998	13.7032	665.7495	4758%	0.0078	0.0071	-9%	0.7502	0.8617	15%	1.9568	1.0073	-49%
1999	13.8232	645.9715	4573%	0.0074	0.0069	-6%	0.7653	0.8454	10%	2.0765	0.9773	-53%
2000	16.0248	771.4643	4714%	0.0086	0.0072	-16%	0.8784	0.9092	4%	2.3102	1.1674	-49%
2001	11.7996	485.4207	4014%	0.0060	0.0066	10%	0.6651	0.7685	16%	1.9119	0.7342	-62%
2002	12.9355	579.3787	4379%	0.0069	0.0064	-7%	0.7174	0.7791	9%	1.9633	0.8765	-55%
2003	9.5208	222.9209	2241%	0.0070	0.0068	-2%	0.5643	0.8220	46%	2.1460	0.9102	-58%
2004	10.1441	246.4400	2329%	0.0078	0.0068	-13%	0.5993	0.8393	40%	2.2876	1.0311	-55%
2005	9.7711	258.9232	2550%	0.0076	0.0066	-13%	0.5764	0.8285	44%	2.2033	1.0241	-54%
2006	3.0148	1.3996	-54%	0.0085	0.0067	-22%	0.2499	0.8515	241%	2.2457	1.1184	-50%
2007	2.8390	1.2516	-56%	0.0087	0.0059	-32%	0.2250	0.7565	236%	1.9994	0.9971	-50%

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	3.1118	1.2571	-60%	0.0075	0.0059	-21%	0.2237	0.7497	235%	1.7393	0.9614	-45%
2009	3.1314	1.2413	-60%	0.0113	0.0055	-51%	0.2055	0.7263	253%	1.6006	1.0523	-34%
2010	3.3423	1.2838	-62%	0.0156	0.0054	-65%	0.2097	0.7183	243%	1.5667	1.0174	-35%
2011	3.4496	1.3386	-61%	0.0161	0.0055	-66%	0.2137	0.7353	244%	1.5719	1.0821	-31%
2012	3.3442	1.2792	-62%	0.0219	0.0050	-77%	0.2086	0.6767	224%	1.4971	0.9571	-36%
2013	3.2795	1.2770	-61%	0.0243	0.0048	-80%	0.2016	0.6607	228%	1.4774	0.9622	-35%
2014	2.9787	1.3500	-55%	0.0254	0.0048	-81%	0.1856	0.6967	275%	1.4968	1.1232	-25%
2015	3.1022	1.3476	-57%	0.0259	0.0048	-81%	0.1882	0.6862	265%	1.4872	1.0641	-28%
2016	2.8571	1.3464	-53%	0.0236	0.0049	-79%	0.1799	0.7007	290%	1.5333	1.1478	-25%
2017	2.8571	1.3907	-51%	0.0219	0.0051	-77%	0.1797	0.7365	310%	1.5895	1.2292	-23%

P-Previous
R-Refined
C-Changed

3.4.3 PETROLEUM REFINING (NFR 1A1b)

3.4.3.1 Overview

This activity covers emissions released from production and combustion processes within a refinery. Combustion processes include the heating of crude and petroleum products without contact between flame and products.

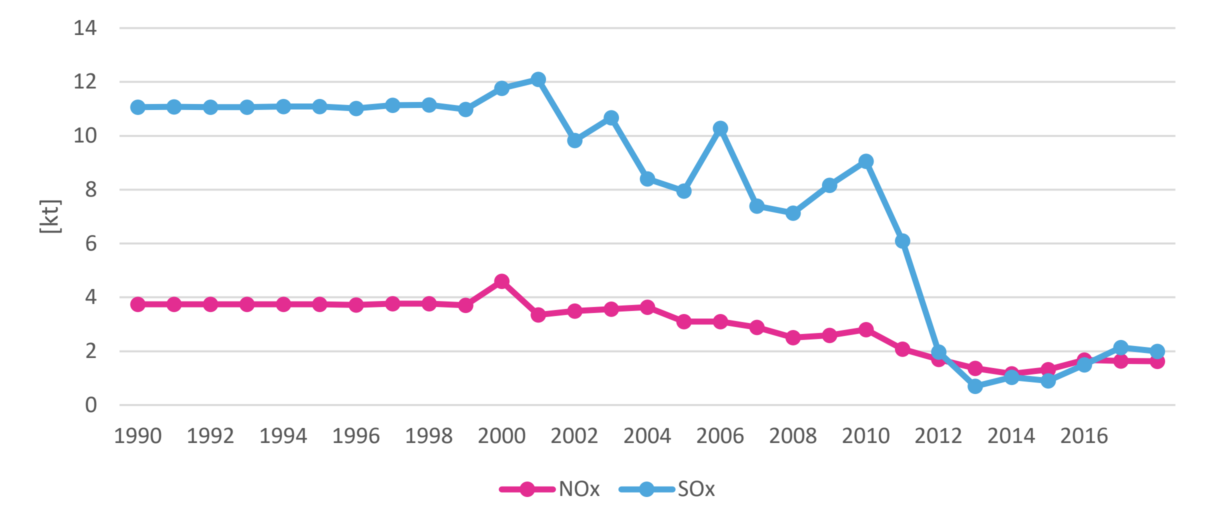
The emissions from the refineries are allocated in 1A1b. Refineries process crude oil into a variety of hydrocarbon products. The biggest refinery SLOVNAFT Plc is the only petroleum refining company operating in Slovakia, processing approximately 5.7 million tons of crude oil a year. The company is the most important supplier of petrol and diesel fuels in Slovakia. Emissions from the petroleum refining, classified by the code 1A1b, concern all combustion activities required to support the refining of petroleum products. This category is key for NOx and SOx (***Figure 3.17***). Decrease of emissions of SOx after 2010 was caused by the economic situation of Slovak biggest refinery Slovnaft.

Activities included in this category are listed in ***Table 3.9***.

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

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
1.1. Technological units containing combustion plants, including gas turbines and stationary piston engines, with an installed total rated thermal input in MW *+ specification according to NACE: LARGE SOURCES 19*
4.3. Refineries (combustion)

Figure 3.17: *Trends of emissions on NOx and SOx in the category 1A1b*



The emission data of air pollutants in ***Table 3.10*** are calculated in Tier 3 level.

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	3.7392	1.9625	11.0653	0.0228	0.2271	0.2480	0.2491	0.0418	0.4888
1995	3.7454	1.9657	11.0834	0.0228	0.2274	0.2484	0.2495	0.0418	0.4896
2000	4.5934	2.5246	11.7684	0.0245	0.4774	0.5214	0.5236	0.0878	0.7344
2005	3.0979	1.1599	7.9456	0.0127	0.1620	0.1809	0.1818	0.0298	0.2640
2010	2.8049	0.9750	9.0571	0.0013	0.1499	0.1594	0.1599	0.0276	0.1739
2011	2.0821	0.8496	6.0977	0.0028	0.1042	0.1103	0.1106	0.0192	0.1777
2012	1.6956	0.8607	1.9747	0.0006	0.0811	0.0880	0.0883	0.0149	0.1004
2013	1.3691	0.8913	0.6964	0.0053	0.0833	0.0906	0.0910	0.0153	0.1069
2014	1.1610	0.8803	1.0276	0.0023	0.0454	0.0492	0.0494	0.0084	0.1023
2015	1.3137	0.9211	0.8987	0.0014	0.0444	0.0487	0.0489	0.0082	0.1131
2016	1.6777	0.8200	1.4927	0.0152	0.0689	0.0745	0.0748	0.0127	0.0630
2017	1.6435	0.5564	2.1348	0.0165	0.0801	0.0869	0.0884	0.0147	0.0619
2018	1.6257	0.6746	1.9917	0.0013	0.0912	0.0976	0.0980	0.0168	0.0548
1990/2018	**-57%**	**-66%**	**-82%**	**-94%**	**-60%**	**-61%**	**-61%**	**-60%**	**-89%**
2017/2018	**-1%**	**21%**	**-7%**	**-92%**	**14%**	**12%**	**11%**	**14%**	**-11%**

YEAR	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	HCB [g]	PCBs [kg]
1990	2E-05	1E-04	1E-04	1E-04	4E-04	7E-06
1995	2E-05	1E-04	1E-04	1E-04	4E-04	7E-06
2000	2E-05	1E-04	1E-04	1E-04	4E-04	8E-06
2005	2E-05	2E-04	1E-04	1E-04	4E-04	1E-05
2010	2E-05	1E-04	1E-04	1E-04	4E-04	9E-06
2011	1E-05	1E-04	1E-04	9E-05	3E-04	1E-05
2012	1E-05	1E-04	1E-04	8E-05	3E-04	1E-05
2013	1E-05	1E-04	1E-04	7E-05	3E-04	1E-05
2014	1E-05	9E-05	8E-05	6E-05	2E-04	9E-06
2015	1E-05	1E-04	1E-04	7E-05	3E-04	1E-05
2016	1E-05	1E-04	1E-04	8E-05	3E-04	1E-05
2017	1E-05	1E-04	1E-04	7E-05	3E-04	1E-05
2018	1E-05	1E-04	1E-04	8E-05	3E-04	1E-05
1990/2018	**-29%**	**-8%**	**-13%**	**-40%**	**-21%**	**66%**

YEAR	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	HCB [g]	PCBs [kg]
2017/2018	**-4%**	**-3%**	**-2%**	**4%**	**-1%**	**-8%**

Overview of activity data (energy consumption) for this source category is in ***Table 3.11*** below. This table represents fuels allocated to the fuel type for calculations (following Table 4-1 of EMEP/EEA GB_{2019}, Part Energy industries). Fuels in the template are allocated following principle from IPCC 2006 Guidelines.

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

YEAR	HEAVY FUEL OIL [TJ NCV]	NATURAL GAS [TJ NCV]	HARD COAL [TJ NCV]	RAFINERY GAS [TJ NCV]
1990	15619.72	10467.17	1069.06	13375.77
1995	15486.80	10229.82	1106.24	13774.09
2000	15714.51	8842.78	1197.97	14769.37
2005	14087.95	6438.24	1958.62	15048.35
2010	11654.06	5739.70	1282.94	19826.71
2011	10694.89	4299.62	1551.69	14952.78
2012	9735.06	4176.78	1483.57	13622.38
2013	8618.21	5734.39	1833.24	10825.31
2014	6293.18	5175.42	1278.42	9384.75
2015	8012.11	4984.15	1893.66	11609.36
2016	9285.59	4939.10	1727.90	11131.94
2017	8666.52	5134.41	1925.76	10799.22
2018	9169.71	4543.17	1776.06	10776.10
1990/2018	**-41%**	**-57%**	**66%**	**-19%**
2017/2018	**6%**	**-12%**	**-8%**	**0%**

3.4.3.2 Methodological issues

Emission data is compiled in the NEIS as presented in **ANNEX IV, Chapter A4.5**, therefore the individual specific EF could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of Ministry of Environment are presented in **ANNEX IV, Chapter A4.6.** For detailed methodology please see **ANNEX IV**. The following ***Table 3.12*** presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.

Table 3.12: *The overview of share of used calculation type for category 1A1b in NEIS*

1A1b	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	70%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	20%
4	Calculation using emission factor and amount of fuel	1%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0.01%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	9%

Historical data 1990-1999 are not covered by NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***Table 3.13***). HMs and DIOX emissions are allocated in the category 1B2aiv because if using of Tier 1 approach adopted for the process emissions, combustion emissions are already covered and should not be reported again in Chapter 1A1b since this would lead to double counting. This action was taken due to recommendation No ***SK-1A1b-2018-0001***. POPs are balanced using emission factors from EMEP/EEA GB_{2019}.

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

	NOx [g/tGJ]	NMVOC [g/tGJ]	SOx [g/tGJ]	NH_3 [g/tGJ]	TSP [g/tGJG	$PM_{2.5}$ [% 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 GB2019 EF

PMs are provided in the percentage share of PMs from TSP due to the integrated way of compilation in the NEIS. The shares were calculated for PMs in available years from 2005 to 2017. The average was used for calculations of historical data due to the absence of historical data in the NEIS database.

The emission factor of POPs from EMEP/EEA GB_{2019} are displayed in ***Table 3.14***.

Table 3.14: *Emission factor for POPs in 1A1b*

T1	UNIT	HEAVY FUEL OIL	NATURAL GAS	HARD COAL	REFINERY GAS
B(a)P	µg/GJ	-	0.56	0.7	0.669
B(b)F	µg/GJ	4.5	0.84	37	1.14
B(k)F	µg/GJ	4.5	0.84	29	0.631
I()P	µg/GJ	6.92	0.84	1.1	0.631
PAHs	µg/GJ	15.92	3.08	67.8	3.071
HCB	ng WHO-TEQ/GJ	-	-	6.7	-
PCBs	ng WHO-TEQ/GJ	-	-	3.3	-

3.4.3.3 Completeness

Emissions are well covered.

3.4.3.4 Source-specific recalculations

Recalculations in this submission were done due to change of categorisation of fuels and change of approach toward the calculation of HMs and POPs emission, where EMEP/EEA GB_{2019} EF instead of CS EF were used (***Table 3.15***). 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. Following recommendation No ***SK-1A1b-2019-0001***, emission factors for PAHs were changed to EF from EMEP/EEA GB_{2019}.

Table 3.15: *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	4.6169	3.7392	-19%	2.4232	1.9625	-19%	13.6626	11.0653	-19%	0.0281	0.0228	-19%
1991	3.8308	3.7426	-2%	2.0106	1.9643	-2%	11.3362	11.0753	-2%	0.0233	0.0228	-2%
1992	3.3086	3.7380	13%	1.7365	1.9619	13%	9.7909	11.0617	13%	0.0202	0.0228	13%
1993	3.2821	3.7377	14%	1.7226	1.9617	14%	9.7126	11.0607	14%	0.0200	0.0228	14%
1994	3.6388	3.7474	3%	1.9098	1.9668	3%	10.7680	11.0895	3%	0.0222	0.0228	3%
1995	3.6262	3.7454	3%	1.9032	1.9657	3%	10.7308	11.0834	3%	0.0221	0.0228	3%
1996	3.7573	3.7238	-1%	1.9720	1.9544	-1%	11.1188	11.0197	-1%	0.0229	0.0227	-1%
1997	3.7212	3.7632	1%	1.9530	1.9751	1%	11.0118	11.1361	1%	0.0227	0.0229	1%
1998	3.6339	3.7683	4%	1.9073	1.9778	4%	10.7537	11.1512	4%	0.0221	0.0230	4%
1999	3.6584	3.7098	1%	1.9201	1.9471	1%	10.8260	10.9783	1%	0.0223	0.0226	1%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.2804	0.2271	-19%	0.3062	0.2480	-19%	0.3075	0.2491	-19%
1991	0.2326	0.2273	-2%	0.2541	0.2482	-2%	0.2551	0.2493	-2%
1992	0.2009	0.2270	13%	0.2194	0.2479	13%	0.2204	0.2490	13%
1993	0.1993	0.2270	14%	0.2177	0.2479	14%	0.2186	0.2489	14%
1994	0.2210	0.2276	3%	0.2413	0.2485	3%	0.2424	0.2496	3%
1995	0.2202	0.2274	3%	0.2405	0.2484	3%	0.2415	0.2495	3%
1996	0.2282	0.2261	-1%	0.2492	0.2470	-1%	0.2503	0.2480	-1%
1997	0.2260	0.2285	1%	0.2468	0.2496	1%	0.2478	0.2506	1%
1998	0.2207	0.2288	4%	0.2410	0.2499	4%	0.2420	0.2510	4%
1999	0.2222	0.2253	1%	0.2426	0.2461	1%	0.2437	0.2471	1%

YEAR	BC [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0516	0.0418	-19%	0.6035	0.4888	-19%
1991	0.0428	0.0418	-2%	0.5007	0.4892	-2%
1992	0.0370	0.0418	13%	0.4325	0.4886	13%
1993	0.0367	0.0418	14%	0.4290	0.4886	14%
1994	0.0407	0.0419	3%	0.4756	0.4898	3%
1995	0.0405	0.0418	3%	0.4740	0.4896	3%
1996	0.0420	0.0416	-1%	0.4911	0.4868	-1%
1997	0.0416	0.0420	1%	0.4864	0.4919	1%
1998	0.0406	0.0421	4%	0.4750	0.4926	4%
1999	0.0409	0.0415	1%	0.4782	0.4849	1%

YEAR	PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.3945	0.0004	-100%	0.0072	7E-06	-100%	0.0035	4E-06	-100%
1991	0.3945	0.0004	-100%	0.0072	7E-06	-100%	0.0035	4E-06	-100%
1992	0.3946	0.0004	-100%	0.0072	7E-06	-100%	0.0036	4E-06	-100%
1993	0.3948	0.0004	-100%	0.0072	7E-06	-100%	0.0036	4E-06	-100%
1994	0.3952	0.0004	-100%	0.0072	7E-06	-100%	0.0036	4E-06	-100%
1995	0.3954	0.0004	-100%	0.0074	7E-06	-100%	0.0037	4E-06	-100%
1996	0.3961	0.0004	-100%	0.0074	7E-06	-100%	0.0037	4E-06	-100%
1997	0.3970	0.0004	-100%	0.0075	7E-06	-100%	0.0037	4E-06	-100%
1998	0.3986	0.0004	-100%	0.0079	8E-06	-100%	0.0039	4E-06	-100%
1999	0.3990	0.0004	-100%	0.0083	8E-06	-100%	0.0041	4E-06	-100%
2000	0.4040	0.0004	-100%	0.0080	8E-06	-100%	0.0040	4E-06	-100%
2001	0.4067	0.0004	-100%	0.0094	9E-06	-100%	0.0046	5E-06	-100%
2002	0.4129	0.0004	-100%	0.0109	1E-05	-100%	0.0054	5E-06	-100%
2003	0.4189	0.0004	-100%	0.0109	1E-05	-100%	0.0054	5E-06	-100%
2004	0.4431	0.0004	-100%	0.0122	1E-05	-100%	0.0060	6E-06	-100%
2005	0.4231	0.0004	-100%	0.0131	1E-05	-100%	0.0065	6E-06	-100%
2006	0.4038	0.0004	-100%	0.0117	1E-05	-100%	0.0057	6E-06	-100%
2007	0.4196	0.0004	-100%	0.0145	1E-05	-100%	0.0072	7E-06	-100%
2008	0.3687	0.0004	-100%	0.0100	1E-05	-100%	0.0049	5E-06	-100%
2009	0.3645	0.0004	-100%	0.0102	1E-05	-100%	0.0050	5E-06	-100%
2010	0.3511	0.0004	-100%	0.0086	9E-06	-100%	0.0042	4E-06	-100%
2011	0.3346	0.0003	-100%	0.0104	1E-05	-100%	0.0051	5E-06	-100%
2012	0.3103	0.0003	-100%	0.0099	1E-05	-100%	0.0049	5E-06	-100%

YEAR	PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2013	0.3124	0.0003	-100%	0.0123	1E-05	-100%	0.0060	6E-06	-100%
2014	0.2316	0.0002	-100%	0.0086	9E-06	-100%	0.0042	4E-06	-100%
2015	0.3069	0.0003	-100%	0.0127	1E-05	-100%	0.0062	6E-06	-100%
2016	0.3144	0.0003	-100%	0.0116	1E-05	-100%	0.0057	6E-06	-100%
2017	0.3175	0.0003	-100%	0.0129	1E-05	-100%	0.0064	6E-06	-100%

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. The category covers the activities included in 1A1c is shown in ***Table 16***. The trend of emissions is presented in ***Table 3.17***. This category is key for emissions of Hg (***Figure 3.18).***

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

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

Figure 3.18: *Trends of Hg emissions in the category 1A1c*

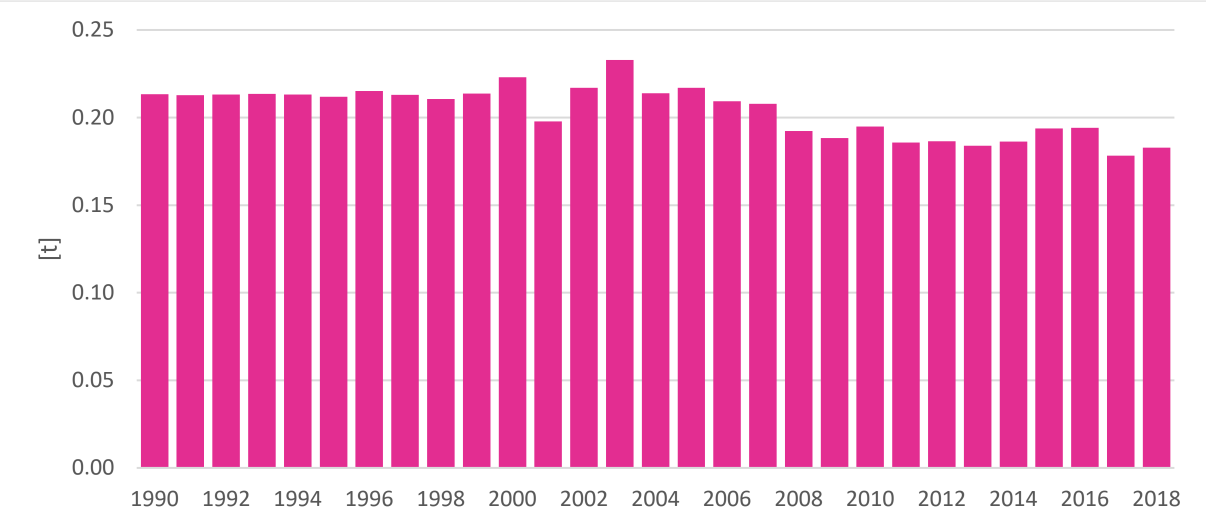


Table 3.17: *Overview of emissions in the category 1A1c*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt	CO [kt]]
1990	0.4314	1.2529	0.6911	0.0888	0.4271	0.7187	1.0789	0.2050	12.2991
1995	0.4285	1.2445	0.6865	0.0882	0.4242	0.7140	1.0717	0.2036	12.2173
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

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt	CO [kt]]
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
1990/2018	**42%**	**-70%**	**-71%**	**-67%**	**-65%**	**-65%**	**-65%**	**-65%**	**5%**
2017/2018	**17%**	**-10%**	**14%**	**-4%**	**2%**	**2%**	**2%**	**2%**	**3%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.1991	0.0114	0.2133	0.0782	0.0405	0.1777	0.0370	0.0206	0.3270
1995	0.1977	0.0113	0.2119	0.0777	0.0403	0.1765	0.0367	0.0205	0.3249
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
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
1990/2018	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**
2017/2018	**3%**	**3%**	**3%**	**3%**	**3%**	**3%**	**3%**	**3%**	**3%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]
1990	0.1848	0.0021	2E-05	7E-06	7E-06	0.0021
1995	0.1836	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
1990/2018	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**	**-14%**
2017/2018	**3%**	**3%**	**3%**	**3%**	**3%**	**3%**

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

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

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	NO	7109.30	NO	NO	NO
1995	NO	7061.99	NO	NO	NO
2000	NO	7431.88	0.93	NO	NO
2005	NO	7231.65	1.85	NO	NO

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
2010	0.09	6491.11	3.43	NO	NO
2011	0.08	6187.55	1.76	NO	NO
2012	0.10	6211.97	2.46	NO	NO
2013	0.07	6130.61	2.48	NO	NO
2014	0.09	6209.12	1.29	NO	NO
2015	0.10	6456.99	1.23	NO	NO
2016	0.13	6471.44	1.33	NO	NO
2017	0.05	5934.80	6.83	NO	NO
2018	0.10	6087.14	6.82	NO	NO
1990/2018	**-**	**-14%**	**-**	**-**	**-**
2017/2018	**91%**	**3%**	**0%**	**-**	**-**

3.4.4.2 Methodological issues

Emission data is compiled in the NEIS as presented in **ANNEX IV, Chapter A4.5**, therefore the individual specific F could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of Ministry of Environment are presented in **ANNEX IV, Chapter A4.6.** For detailed methodology please see **ANNEX IV**. The following ***Table 3.19*** presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.

Table 3.19: *The overview of share of used calculation type for category 1A1c in NEIS*

1A1c	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	94%
3	Calculation using representative individual mass flow and number of operating hours	0.4%
4	Calculation using emission factor and amount of fuel	1%
5	Calculation using emission factor and amount of related quantity other than fuel	2%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	3%

Historical data 1990-1999 are not covered by NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***Table 3.20***).

Table 3.20: *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 GB2019 EF

HMs and POPs were balanced using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.21***).

Table 3.21: Emission factor 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/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 to improve data quality and transparency. Recalculations in this submission were done due to change of categorisation of fuels and change of approach toward the calculation of HMs and POPs emission, where EMEP/EEA GB_{2019} EF instead of CS EF were used. 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 3.22*** shows the change in the data between final submission 2019 and this submission.

Table 3.22: Previous and refined emissions in the category 1A1c

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.4303	0.4314	0%	1.2497	1.2529	0%	0.6894	0.6911	0%	0.0886	0.0888	0%
1991	0.4291	0.4305	0%	1.2461	1.2503	0%	0.6874	0.6897	0%	0.0884	0.0886	0%
1992	0.4278	0.4310	1%	1.2426	1.2519	1%	0.6854	0.6906	1%	0.0881	0.0888	1%
1993	0.4266	0.4318	1%	1.2390	1.2543	1%	0.6835	0.6919	1%	0.0878	0.0889	1%
1994	0.4254	0.4310	1%	1.2354	1.2517	1%	0.6815	0.6905	1%	0.0876	0.0887	1%
1995	0.4241	0.4285	1%	1.2318	1.2445	1%	0.6795	0.6865	1%	0.0873	0.0882	1%
1996	0.4229	0.4353	3%	1.2283	1.2642	3%	0.6775	0.6974	3%	0.0871	0.0896	3%
1997	0.4217	0.4308	2%	1.2247	1.2513	2%	0.6756	0.6903	2%	0.0868	0.0887	2%
1998	0.4204	0.4259	1%	1.2211	1.2371	1%	0.6736	0.6824	1%	0.0866	0.0877	1%
1999	0.4192	0.4321	3%	1.2175	1.2550	3%	0.6716	0.6923	3%	0.0863	0.0890	3%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.4260	0.4271	0%	0.7169	0.7187	0%	1.0762	1.0789	0%
1991	0.4248	0.4262	0%	0.7149	0.7173	0%	1.0731	1.0767	0%
1992	0.4235	0.4267	1%	0.7128	0.7182	1%	1.0700	1.0781	1%
1993	0.4223	0.4275	1%	0.7108	0.7195	1%	1.0670	1.0801	1%
1994	0.4211	0.4267	1%	0.7087	0.7180	1%	1.0639	1.0779	1%
1995	0.4199	0.4242	1%	0.7067	0.7140	1%	1.0608	1.0717	1%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1996	0.4187	0.4309	3%	0.7046	0.7252	3%	1.0577	1.0887	3%
1997	0.4175	0.4265	2%	0.7026	0.7179	2%	1.0546	1.0776	2%
1998	0.4162	0.4217	1%	0.7005	0.7097	1%	1.0516	1.0653	1%
1999	0.4150	0.4278	3%	0.6985	0.7200	3%	1.0485	1.0808	3%

YEAR	BC [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0020	0.2050	0.4260	12.2682	12.2991	0%
1991	0.0020	0.2046	0.4248	12.2331	12.2739	0%
1992	0.0020	0.2048	0.4235	12.1980	12.2892	1%
1993	0.0020	0.2052	0.4223	12.1628	12.3127	1%
1994	0.0020	0.2048	0.4211	12.1277	12.2874	1%
1995	0.0020	0.2036	0.4199	12.0926	12.2173	1%
1996	0.0020	0.2068	0.4187	12.0575	12.4105	3%
1997	0.0020	0.2047	0.4175	12.0224	12.2841	2%
1998	0.0020	0.2024	0.4162	11.9872	12.1439	1%
1999	0.0020	0.2053	0.4150	11.9521	12.3202	3%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.9503	0.1991	-79%	0.0128	0.0114	-11%	0.0560	0.2133	281%	0.0284	0.0782	176%
1991	0.9475	0.1987	-79%	0.0127	0.0114	-11%	0.0559	0.2128	281%	0.0283	0.0780	176%
1992	0.9448	0.1989	-79%	0.0127	0.0114	-10%	0.0557	0.2131	283%	0.0282	0.0781	177%
1993	0.9421	0.1993	-79%	0.0127	0.0114	-10%	0.0555	0.2135	284%	0.0281	0.0783	178%
1994	0.9394	0.1989	-79%	0.0126	0.0114	-10%	0.0554	0.2131	285%	0.0280	0.0781	179%
1995	0.9366	0.1977	-79%	0.0126	0.0113	-10%	0.0552	0.2119	284%	0.0280	0.0777	178%
1996	0.9339	0.2009	-78%	0.0125	0.0115	-9%	0.0551	0.2152	291%	0.0279	0.0789	183%
1997	0.9312	0.1988	-79%	0.0125	0.0114	-9%	0.0549	0.2130	288%	0.0278	0.0781	181%
1998	0.9285	0.1965	-79%	0.0125	0.0112	-10%	0.0547	0.2106	285%	0.0277	0.0772	179%
1999	0.9258	0.1994	-78%	0.0124	0.0114	-8%	0.0546	0.2136	291%	0.0276	0.0783	183%
2000	0.9960	0.2081	-79%	0.0134	0.0119	-11%	0.0587	0.2230	280%	0.0297	0.0818	175%
2001	0.8837	0.1846	-79%	0.0119	0.0106	-11%	0.0521	0.1978	280%	0.0264	0.0725	175%
2002	0.9690	0.2025	-79%	0.0130	0.0116	-11%	0.0571	0.2169	280%	0.0289	0.0795	175%
2003	1.0404	0.2174	-79%	0.0140	0.0124	-11%	0.0613	0.2329	280%	0.0311	0.0854	175%
2004	0.9553	0.1996	-79%	0.0128	0.0114	-11%	0.0563	0.2139	280%	0.0285	0.0784	175%
2005	0.9693	0.2025	-79%	0.0130	0.0116	-11%	0.0571	0.2170	280%	0.0289	0.0796	175%
2006	0.9349	0.1954	-79%	0.0126	0.0112	-11%	0.0551	0.2093	280%	0.0279	0.0767	175%
2007	0.9287	0.1941	-79%	0.0125	0.0111	-11%	0.0548	0.2079	280%	0.0277	0.0762	175%
2008	0.8592	0.1794	-79%	0.0115	0.0103	-11%	0.0507	0.1923	280%	0.0256	0.0705	175%
2009	0.8416	0.1758	-79%	0.0113	0.0100	-11%	0.0496	0.1883	280%	0.0251	0.0690	175%
2010	0.8708	0.1818	-79%	0.0117	0.0104	-11%	0.0513	0.1948	280%	0.0260	0.0714	175%
2011	0.8299	0.1733	-79%	0.0111	0.0099	-11%	0.0489	0.1857	280%	0.0248	0.0681	175%
2012	0.8332	0.1740	-79%	0.0112	0.0099	-11%	0.0491	0.1864	280%	0.0249	0.0684	175%
2013	0.8223	0.1717	-79%	0.0110	0.0098	-11%	0.0485	0.1840	280%	0.0245	0.0675	175%
2014	0.8325	0.1739	-79%	0.0112	0.0099	-11%	0.0491	0.1863	280%	0.0249	0.0683	175%
2015	0.8657	0.1808	-79%	0.0116	0.0103	-11%	0.0510	0.1937	280%	0.0258	0.0710	175%
2016	0.8679	0.1812	-79%	0.0117	0.0104	-11%	0.0512	0.1942	280%	0.0259	0.0712	175%
2017	0.7967	0.1664	-79%	0.0107	0.0095	-11%	0.0470	0.1783	279%	0.0238	0.0654	175%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0957	0.0405	-58%	0.1241	0.1777	43%	0.0922	0.0370	-60%
1991	0.0955	0.0404	-58%	0.1237	0.1774	43%	0.0919	0.0369	-60%
1992	0.0952	0.0405	-57%	0.1234	0.1776	44%	0.0917	0.0369	-60%
1993	0.0949	0.0406	-57%	0.1230	0.1779	45%	0.0914	0.0370	-60%
1994	0.0946	0.0405	-57%	0.1227	0.1776	45%	0.0911	0.0369	-59%
1995	0.0944	0.0403	-57%	0.1223	0.1765	44%	0.0909	0.0367	-60%
1996	0.0941	0.0409	-57%	0.1220	0.1793	47%	0.0906	0.0373	-59%
1997	0.0938	0.0405	-57%	0.1216	0.1775	46%	0.0903	0.0369	-59%
1998	0.0935	0.0400	-57%	0.1213	0.1755	45%	0.0901	0.0365	-59%
1999	0.0933	0.0406	-56%	0.1209	0.1780	47%	0.0898	0.0370	-59%
2000	0.1003	0.0424	-58%	0.1301	0.1858	43%	0.0966	0.0387	-60%
2001	0.0890	0.0376	-58%	0.1154	0.1649	43%	0.0857	0.0343	-60%
2002	0.0976	0.0412	-58%	0.1265	0.1808	43%	0.0940	0.0376	-60%
2003	0.1048	0.0443	-58%	0.1359	0.1941	43%	0.1009	0.0404	-60%
2004	0.0962	0.0406	-58%	0.1248	0.1782	43%	0.0927	0.0371	-60%
2005	0.0977	0.0412	-58%	0.1266	0.1808	43%	0.0940	0.0376	-60%
2006	0.0942	0.0398	-58%	0.1221	0.1744	43%	0.0907	0.0363	-60%
2007	0.0936	0.0395	-58%	0.1213	0.1733	43%	0.0901	0.0360	-60%
2008	0.0866	0.0365	-58%	0.1122	0.1602	43%	0.0834	0.0333	-60%
2009	0.0848	0.0358	-58%	0.1099	0.1569	43%	0.0816	0.0326	-60%
2010	0.0877	0.0370	-58%	0.1137	0.1624	43%	0.0845	0.0338	-60%
2011	0.0836	0.0353	-58%	0.1084	0.1547	43%	0.0805	0.0322	-60%
2012	0.0839	0.0354	-58%	0.1088	0.1554	43%	0.0808	0.0323	-60%
2013	0.0828	0.0350	-58%	0.1074	0.1533	43%	0.0798	0.0319	-60%
2014	0.0839	0.0354	-58%	0.1087	0.1553	43%	0.0808	0.0323	-60%
2015	0.0872	0.0368	-58%	0.1131	0.1615	43%	0.0840	0.0336	-60%
2016	0.0874	0.0369	-58%	0.1133	0.1618	43%	0.0842	0.0337	-60%
2017	0.0803	0.0339	-58%	0.1040	0.1485	43%	0.0773	0.0309	-60%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0128	0.0206	62%	1.4183	0.3270	-77%
1991	0.0127	0.0206	62%	1.4142	0.3264	-77%
1992	0.0127	0.0206	62%	1.4102	0.3268	-77%
1993	0.0127	0.0206	63%	1.4061	0.3274	-77%
1994	0.0126	0.0206	63%	1.4020	0.3267	-77%
1995	0.0126	0.0205	63%	1.3980	0.3249	-77%
1996	0.0125	0.0208	66%	1.3939	0.3300	-76%
1997	0.0125	0.0206	65%	1.3899	0.3266	-76%
1998	0.0125	0.0204	63%	1.3858	0.3229	-77%
1999	0.0124	0.0207	66%	1.3817	0.3276	-76%
2000	0.0134	0.0216	61%	1.4866	0.3419	-77%
2001	0.0119	0.0191	61%	1.3189	0.3034	-77%
2002	0.0130	0.0210	61%	1.4463	0.3326	-77%
2003	0.0140	0.0225	61%	1.5528	0.3571	-77%
2004	0.0128	0.0207	61%	1.4258	0.3279	-77%
2005	0.0130	0.0210	61%	1.4467	0.3327	-77%
2006	0.0126	0.0202	61%	1.3954	0.3209	-77%
2007	0.0125	0.0201	61%	1.3861	0.3188	-77%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
2008	0.0115	0.0186	61%	1.2824	0.2948	-77%
2009	0.0113	0.0182	61%	1.2561	0.2887	-77%
2010	0.0117	0.0188	61%	1.2997	0.2988	-77%
2011	0.0111	0.0179	61%	1.2387	0.2847	-77%
2012	0.0112	0.0180	61%	1.2437	0.2859	-77%
2013	0.0110	0.0178	61%	1.2273	0.2821	-77%
2014	0.0112	0.0180	61%	1.2425	0.2857	-77%
2015	0.0116	0.0187	61%	1.2921	0.2971	-77%
2016	0.0117	0.0188	61%	1.2954	0.2978	-77%
2017	0.0107	0.0172	61%	1.1891	0.2733	-77%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.1844	0.1848	0%	0.0021	0.0021	0%
1991	0.1838	0.1845	0%	0.0021	0.0021	0%
1992	0.1833	0.1847	1%	0.0021	0.0021	1%
1993	0.1828	0.1850	1%	0.0021	0.0021	1%
1994	0.1823	0.1847	1%	0.0021	0.0021	1%
1995	0.1817	0.1836	1%	0.0021	0.0021	1%
1996	0.1812	0.1865	3%	0.0021	0.0021	3%
1997	0.1807	0.1846	2%	0.0021	0.0021	2%
1998	0.1802	0.1825	1%	0.0020	0.0021	1%
1999	0.1796	0.1852	3%	0.0020	0.0021	3%
2000	0.1933	0.1933	-	0.0022	0.0022	-
2001	0.1715	0.1715	-	0.0019	0.0019	-
2002	0.1880	0.1880	-	0.0021	0.0021	-
2003	0.2019	0.2019	-	0.0023	0.0023	-
2004	0.1854	0.1854	-	0.0021	0.0021	-
2005	0.1881	0.1881	-	0.0021	0.0021	-
2006	0.1814	0.1814	-	0.0021	0.0021	-
2007	0.1802	0.1802	-	0.0020	0.0020	-
2008	0.1667	0.1666	0%	0.0019	0.0019	0%
2009	0.1633	0.1632	0%	0.0019	0.0019	0%
2010	0.1690	0.1689	0%	0.0019	0.0019	0%
2011	0.1610	0.1609	0%	0.0018	0.0018	0%
2012	0.1617	0.1616	0%	0.0018	0.0018	0%
2013	0.1596	0.1595	0%	0.0018	0.0018	0%
2014	0.1615	0.1615	0%	0.0018	0.0018	0%
2015	0.1680	0.1679	0%	0.0019	0.0019	0%
2016	0.1684	0.1683	0%	0.0019	0.0019	0%
2017	0.1546	0.1545	0%	0.0018	0.0018	0%

P- Previous
R - Refined

3.5 MANUFACTURING INDUSTRIES AND CONSTRUCTION (NFR 1A2)

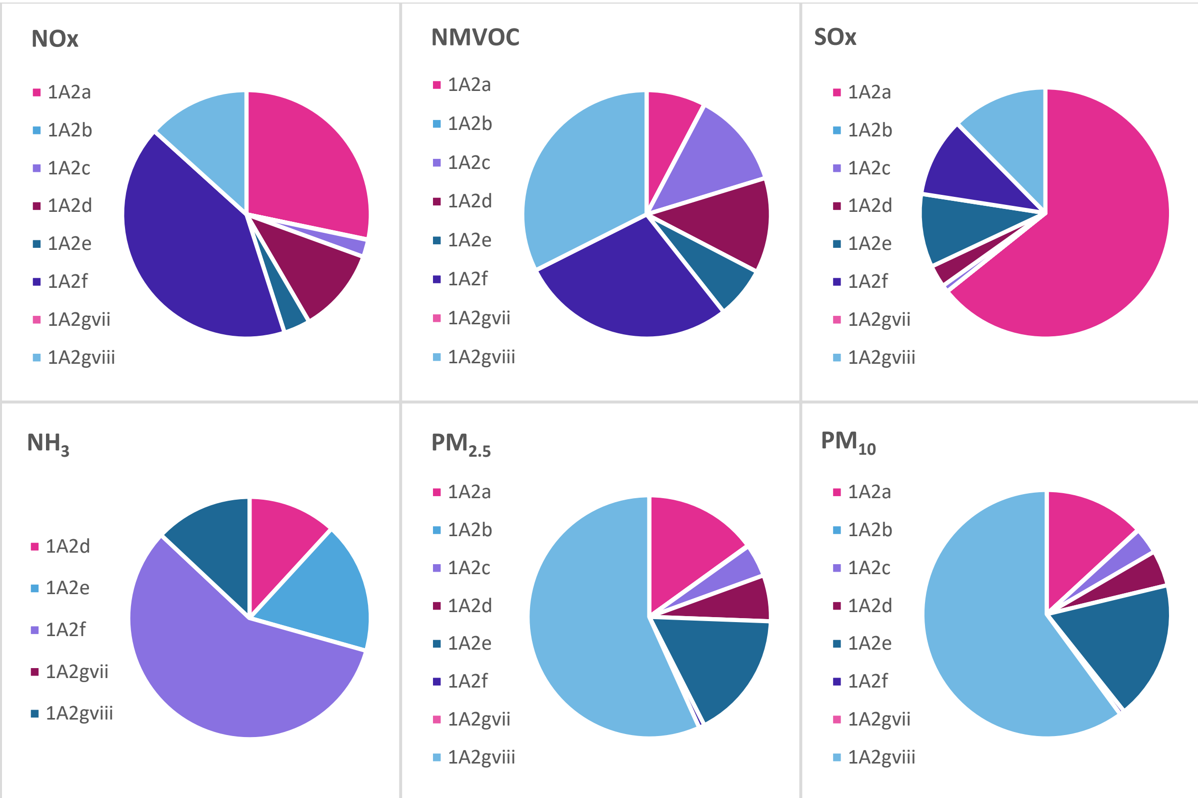
3.5.1 OVERVIEW

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 a substantial contributors to most of the air pollutants. Category 1A2a, 1A2f and 1A2gviii are key categories for various air pollutants. (***Figure 3.19***).

Figure 3.19*: Share of emissions of main pollutants in 1A2 in 2018*



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 25 508,6 TJ in 2018. Emissions of main pollutants are calculated using Tier 3 method – facility data from the operator. The overview of trends of emissions for which is this category key is presented in the following ***Figures 3.20-3.22***. 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.

The sources included in 1A2a is shown in ***Table 3.23***. Data of fuel consumption is in the registry of NEIS since 2000.

Table 3.23: *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

Figure 3.20: *Trends of SOx and NOx emissions in the category 1A2a*

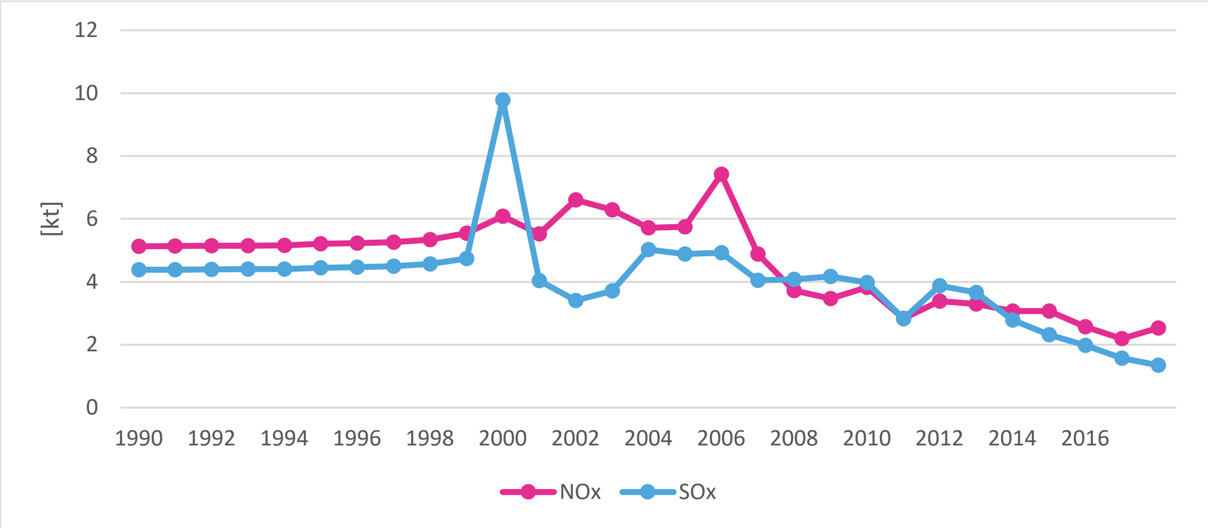


Figure 3.21: *Trends of Pb and Hg emissions in the category 1A2a*

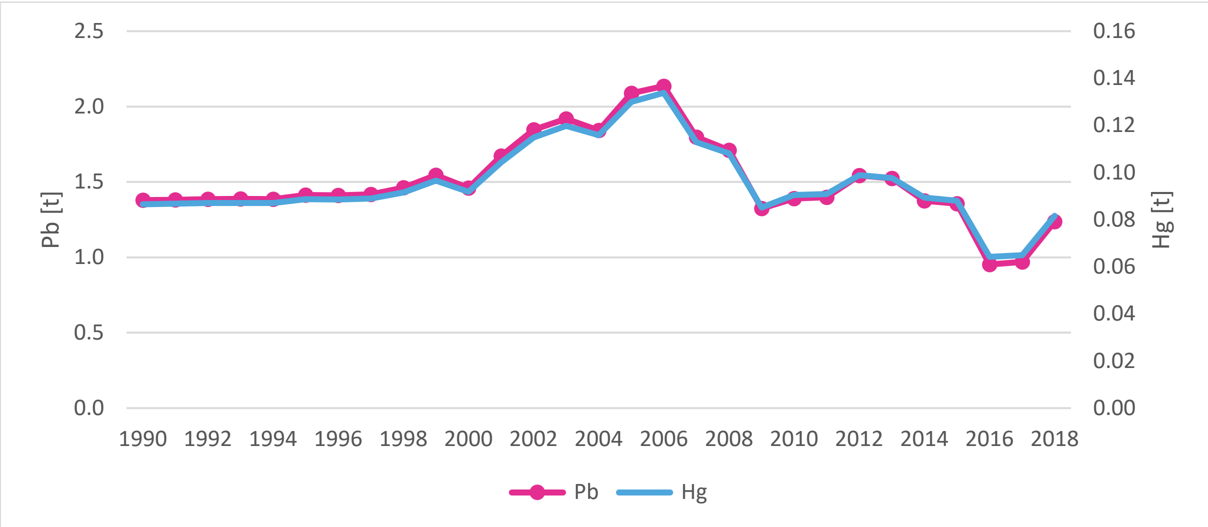
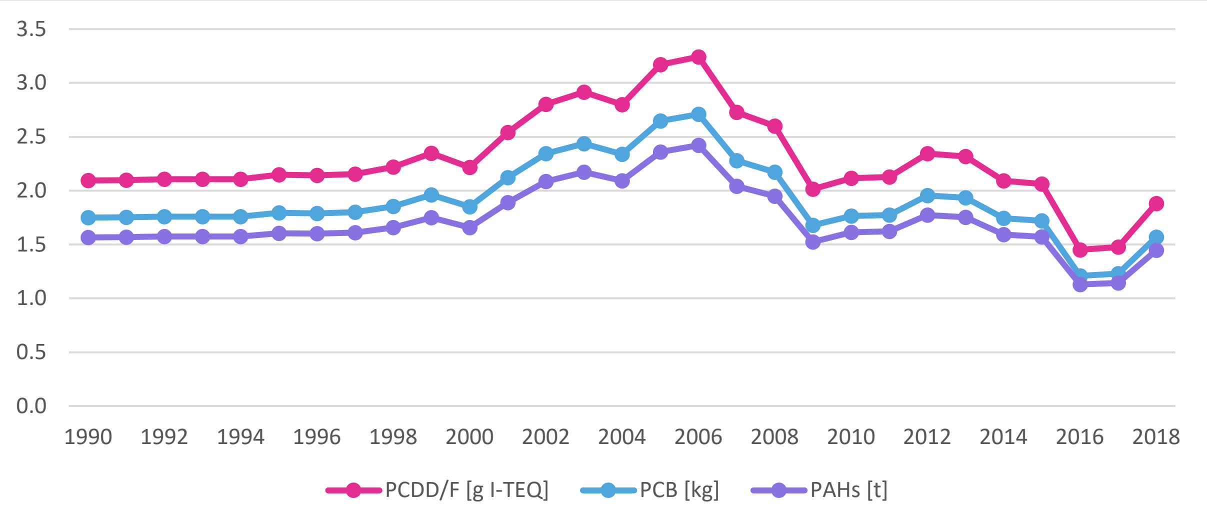


Figure 3.22: *Trends of PCDD/F and PCBs emissions in the category 1A2a*



Overview of emissions in this category is shown in ***Table 3.24***.

Table 3.24 *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
1990/2018	**-51%**	**31%**	**-69%**	**-**	**-99%**	**-99%**	**-99%**	**-26%**
2017/2018	**16%**	**40%**	**-14%**	**-**	**16%**	**12%**	**13%**	**-3%**

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
1990/2018	**-10%**	**-10%**	**-6%**	**-9%**	**-10%**	**-10%**	**-10%**	**-8%**	**-10%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2017/2018	**3%**	**3%**	**3%**	**3%**	**3%**	**3%**	**3%**	**3%**	**3%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	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
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
1990/2018	**-10%**	**-9%**	**-7%**	**-7%**	**-6%**	**-8%**	**-10%**	**-10%**
2017/2018	**28%**	**27%**	**26%**	**26%**	**26%**	**26%**	**28%**	**28%**

Overview of the activity data (energy consumption) for this source category is in ***Table 3.25*** below. This table represents fuels allocated to the fuel type for calculations (following Table 3-1 of EMEP/EEA GB2019, Part Manufacturing industries and construction (combustion)). Fuels in the template are allocated following principle prom IPCC 2006 Guidelines.

Table 3.25: *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	10285.94	9788.62	NO	NO
1995	5.97	10550.17	9830.02	NO	NO
2000	5.50	10893.22	10683.83	NO	NO
2005	NO	15580.02	12829.85	NO	NO
2010	0.35	10378.72	15769.87	NO	NO
2011	1.55	10439.54	15643.75	NO	NO
2012	15.94	11506.10	14903.77	NO	NO
2013	0.24	11372.90	14495.03	NO	NO
2014	0.22	10259.16	15429.17	NO	NO
2015	0.09	10123.57	14928.30	NO	NO
2016	0.05	7109.10	14883.16	NO	NO
2017	2.67	7232.08	14510.80	NO	NO
2018	1.05	9227.45	16280.09	NO	NO
1990/2018	**-82%**	**-10%**	**66%**	**-**	**-**
2017/2018	**-61%**	**28%**	**12%**	**-**	**-**

3.5.2.2 Methodological issues

Emission data is compiled in the NEIS. For detailed methodology please see **ANNEX IV**.

Table 3.26: *The overview of share of used calculation type for category 1A2a in NEIS*

1A2a	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	95%
2	Calculation using representative concentration and volume of flue gas	0.004%
3	Calculation using representative individual mass flow and number of operating hours	1%

1A2a	TYPE OF EMISSION COMPILATION/CALCULATION	%
4	Calculation using emission factor and amount of fuel	4%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

Historical data 1990-1999 are not covered by NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***Table 3.27***).

Table 3.27: *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 were balanced using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.28***).

Table 3.28: *Emission factor 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
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/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

Recalculations in this submission were done to improve data quality and transparency. Recalculations in this submission were done due to change of categorisation of fuels and change of approach toward the calculation of HMs and POPs emission, where EMEP/EEA GB_{2019} EF instead of CS EF were used. 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 3.29*** shows the change in the data between final submission 2019 and this submission.

Table 3.29: Previous and refined emissions in the category 1A2a

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	5.8695	5.1282	-13%	0.0415	0.0362	-13%	5.0168	4.3832	-13%
1991	5.8030	5.1345	-12%	0.0410	0.0363	-12%	4.9600	4.3886	-12%
1992	5.7944	5.1451	-11%	0.0409	0.0363	-11%	4.9526	4.3977	-11%
1993	5.8472	5.1535	-12%	0.0413	0.0364	-12%	4.9977	4.4048	-12%
1994	5.9006	5.1578	-13%	0.0417	0.0364	-13%	5.0434	4.4085	-13%
1995	5.9546	5.2063	-13%	0.0421	0.0368	-13%	5.0895	4.4499	-13%
1996	6.0091	5.2277	-13%	0.0424	0.0369	-13%	5.1361	4.4683	-13%
1997	6.0650	5.2568	-13%	0.0428	0.0371	-13%	5.1839	4.4931	-13%
1998	6.1194	5.3463	-13%	0.0432	0.0378	-13%	5.2304	4.5696	-13%
1999	6.1750	5.5421	-10%	0.0436	0.0391	-10%	5.2779	4.7369	-10%

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	4.1852	3.6566	-13%	4.4883	3.9214	-13%	5.1947	4.5386	-13%	0.4810	0.4202	-13%
1991	4.1378	3.6611	-12%	4.4375	3.9262	-12%	5.1358	4.5441	-12%	0.4755	0.4207	-12%
1992	4.1317	3.6687	-11%	4.4309	3.9344	-11%	5.1282	4.5536	-11%	0.4748	0.4216	-11%
1993	4.1693	3.6747	-12%	4.4712	3.9408	-12%	5.1749	4.5610	-12%	0.4791	0.4223	-12%
1994	4.2074	3.6778	-13%	4.5121	3.9441	-13%	5.2222	4.5648	-13%	0.4835	0.4227	-13%
1995	4.2459	3.7123	-13%	4.5534	3.9811	-13%	5.2700	4.6077	-13%	0.4879	0.4266	-13%
1996	4.2848	3.7276	-13%	4.5950	3.9975	-13%	5.3182	4.6267	-13%	0.4924	0.4284	-13%
1997	4.3247	3.7484	-13%	4.6378	4.0198	-13%	5.3677	4.6524	-13%	0.4970	0.4308	-13%
1998	4.3634	3.8121	-13%	4.6793	4.0882	-13%	5.4158	4.7316	-13%	0.5014	0.4381	-13%
1999	4.4031	3.9517	-10%	4.7219	4.2379	-10%	5.4650	4.9049	-10%	0.5060	0.4541	-10%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	27.1389	1.3784	-95%	0.2082	0.0185	-91%	3.8121	0.0865	-98%	1.3344	0.0421	-97%
1991	25.0558	1.3820	-94%	0.1906	0.0186	-90%	3.4683	0.0868	-97%	1.2138	0.0422	-97%
1992	22.9726	1.3863	-94%	0.1729	0.0186	-89%	3.1245	0.0870	-97%	1.0932	0.0424	-96%
1993	22.8026	1.3873	-94%	0.1830	0.0186	-90%	2.7489	0.0871	-97%	0.9475	0.0424	-96%
1994	22.6326	1.3869	-94%	0.1931	0.0186	-90%	2.3733	0.0871	-96%	0.8018	0.0424	-95%
1995	22.1671	1.4138	-94%	0.1862	0.0190	-90%	2.4115	0.0887	-96%	0.8193	0.0432	-95%
1996	22.9921	1.4103	-94%	0.1716	0.0190	-89%	2.4113	0.0885	-96%	0.8279	0.0431	-95%
1997	24.0962	1.4181	-94%	0.1800	0.0191	-89%	2.4243	0.0890	-96%	0.8292	0.0433	-95%
1998	21.9346	1.4620	-93%	0.1617	0.0196	-88%	2.6740	0.0916	-97%	0.9302	0.0446	-95%
1999	23.3402	1.5457	-93%	0.1750	0.0208	-88%	2.7139	0.0966	-96%	0.9392	0.0472	-95%
2000	24.5201	1.4598	-94%	0.1854	0.0196	-89%	3.3236	0.0918	-97%	1.1621	0.0446	-96%
2001	24.9628	1.6727	-93%	0.1904	0.0225	-88%	2.5574	0.1043	-96%	0.8740	0.0510	-94%
2002	23.7699	1.8467	-92%	0.2047	0.0248	-88%	2.0020	0.1149	-94%	0.6580	0.0562	-91%
2003	25.3766	1.9196	-92%	0.2251	0.0258	-89%	1.4716	0.1198	-92%	0.4507	0.0585	-87%
2004	24.9513	1.8428	-93%	0.2180	0.0248	-89%	1.8629	0.1158	-94%	0.6001	0.0563	-91%
2005	23.8354	2.0879	-91%	0.2128	0.0281	-87%	1.6119	0.1300	-92%	0.5083	0.0636	-87%
2006	24.2236	2.1358	-91%	0.2380	0.0287	-88%	2.1570	0.1338	-94%	0.6983	0.0652	-91%
2007	11.8016	1.7969	-85%	0.2300	0.0241	-90%	1.7684	0.1128	-94%	0.5420	0.0549	-90%
2008	10.8711	1.7113	-84%	0.2034	0.0230	-89%	1.9641	0.1081	-94%	0.6288	0.0524	-92%
2009	6.8641	1.3243	-81%	0.1708	0.0178	-90%	0.3543	0.0851	-76%	0.0438	0.0408	-7%
2010	8.8046	1.3909	-84%	0.2070	0.0187	-91%	0.4353	0.0905	-79%	0.0556	0.0431	-22%
2011	10.3342	1.3991	-86%	0.1924	0.0188	-90%	0.4309	0.0909	-79%	0.0626	0.0433	-31%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2012	11.1159	1.5420	-86%	0.2026	0.0207	-90%	0.4566	0.0989	-78%	0.0671	0.0475	-29%
2013	10.8342	1.5241	-86%	0.2076	0.0205	-90%	0.4610	0.0977	-79%	0.0659	0.0469	-29%
2014	13.3995	1.3749	-90%	0.2237	0.0185	-92%	0.5179	0.0894	-83%	0.0798	0.0426	-47%
2015	13.2181	1.3567	-90%	0.2168	0.0182	-92%	0.5048	0.0880	-83%	0.0785	0.0420	-47%
2016	13.1293	0.9528	-93%	0.2301	0.0128	-94%	0.5248	0.0642	-88%	0.0788	0.0299	-62%
2017	13.2895	0.9693	-93%	0.2888	0.0130	-95%	0.6197	0.0650	-90%	0.0827	0.0304	-63%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	1.0028	0.1390	-86%	8.9511	0.1800	-98%	3.7291	0.1338	-96%
1991	0.9178	0.1394	-85%	8.2637	0.1805	-98%	3.4162	0.1342	-96%
1992	0.8328	0.1398	-83%	7.5764	0.1811	-98%	3.1034	0.1346	-96%
1993	0.8808	0.1399	-84%	7.5222	0.1812	-98%	3.2607	0.1347	-96%
1994	0.9288	0.1398	-85%	7.4680	0.1811	-98%	3.4180	0.1347	-96%
1995	0.8957	0.1426	-84%	7.3139	0.1847	-97%	3.3011	0.1373	-96%
1996	0.8267	0.1422	-83%	7.5826	0.1842	-98%	3.0833	0.1369	-96%
1997	0.8673	0.1430	-84%	7.9467	0.1852	-98%	3.2343	0.1377	-96%
1998	0.7791	0.1474	-81%	7.2335	0.1909	-97%	2.9096	0.1420	-95%
1999	0.8430	0.1558	-82%	7.6975	0.2019	-97%	3.1425	0.1501	-95%
2000	0.8929	0.1472	-84%	8.0869	0.1907	-98%	3.3257	0.1418	-96%
2001	0.9170	0.1686	-82%	8.2331	0.2185	-97%	3.4123	0.1624	-95%
2002	0.9847	0.1862	-81%	7.8436	0.2412	-97%	3.6204	0.1793	-95%
2003	1.0822	0.1935	-82%	8.3748	0.2507	-97%	3.9681	0.1864	-95%
2004	1.0482	0.1858	-82%	8.2339	0.2407	-97%	3.8489	0.1789	-95%
2005	1.0230	0.2105	-79%	7.8664	0.2727	-97%	3.7489	0.2027	-95%
2006	1.1434	0.2154	-81%	7.9981	0.2789	-97%	4.1553	0.2074	-95%
2007	1.0844	0.1812	-83%	0.1902	0.2347	23%	3.7343	0.1745	-95%
2008	0.9587	0.1726	-82%	0.1721	0.2235	30%	3.3061	0.1662	-95%
2009	0.8068	0.1336	-83%	0.1241	0.1730	39%	2.7582	0.1286	-95%
2010	0.9774	0.1403	-86%	0.1548	0.1817	17%	3.3466	0.1351	-96%
2011	0.9068	0.1411	-84%	0.1633	0.1827	12%	3.1273	0.1359	-96%
2012	0.9548	0.1555	-84%	0.1741	0.2014	16%	3.2957	0.1498	-95%
2013	0.9785	0.1537	-84%	0.1733	0.1991	15%	3.3715	0.1480	-96%
2014	1.0533	0.1387	-87%	0.2024	0.1796	-11%	3.6476	0.1336	-96%
2015	1.0206	0.1369	-87%	0.1982	0.1772	-11%	3.5368	0.1318	-96%
2016	1.0840	0.0962	-91%	0.2022	0.1244	-38%	3.7467	0.0926	-98%
2017	1.3630	0.0978	-93%	0.2251	0.1266	-44%	4.6774	0.0942	-98%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	1.2935	0.0191	-99%	21.7602	2.0645	-91%
1991	1.1939	0.0191	-98%	20.0237	2.0699	-90%
1992	1.0943	0.0192	-98%	18.2873	2.0762	-89%
1993	1.0882	0.0192	-98%	18.5996	2.0778	-89%
1994	1.0821	0.0192	-98%	18.9120	2.0772	-89%
1995	1.0593	0.0196	-98%	18.4072	2.1174	-88%
1996	1.0950	0.0195	-98%	18.2465	2.1121	-88%
1997	1.1476	0.0196	-98%	19.1300	2.1239	-89%
1998	1.0443	0.0202	-98%	17.3280	2.1894	-87%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1999	1.1117	0.0214	-98%	18.5539	2.3145	-88%
2000	1.1682	0.0202	-98%	19.5521	2.1866	-89%
2001	1.1896	0.0231	-98%	19.9710	2.5043	-87%
2002	1.1368	0.0254	-98%	19.9384	2.7645	-86%
2003	1.2148	0.0265	-98%	21.5417	2.8738	-87%
2004	1.1939	0.0255	-98%	21.0497	2.7599	-87%
2005	1.1413	0.0288	-97%	20.2874	3.1254	-85%
2006	1.1637	0.0295	-97%	21.4755	3.1983	-85%
2007	0.1108	0.0249	-78%	8.7898	2.6910	-69%
2008	0.1004	0.0238	-76%	7.7619	2.5638	-67%
2009	0.0718	0.0185	-74%	6.5798	1.9863	-70%
2010	0.0897	0.0196	-78%	7.9610	2.0873	-74%
2011	0.0952	0.0197	-79%	7.3399	2.0994	-71%
2012	0.1016	0.0216	-79%	7.7243	2.3126	-70%
2013	0.1010	0.0213	-79%	7.9273	2.2852	-71%
2014	0.1183	0.0194	-84%	8.4973	2.0631	-76%
2015	0.1159	0.0191	-84%	8.2285	2.0356	-75%
2016	0.1181	0.0137	-88%	8.7582	1.4327	-84%
2017	0.1307	0.0139	-89%	11.0801	1.4571	-87%

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	74.8873	2.0931	-97%	0.1272	1.5648	1130%	0.1827	0.0064	-97%	7.5875	1.7486	-77%
1991	71.1814	2.0986	-97%	0.1227	1.5687	1178%	0.1737	0.0064	-96%	7.2132	1.7532	-76%
1992	67.4814	2.1051	-97%	0.1192	1.5735	1220%	0.1646	0.0064	-96%	6.8407	1.7586	-74%
1993	63.7813	2.1066	-97%	0.1157	1.5747	1261%	0.1556	0.0064	-96%	6.4681	1.7599	-73%
1994	60.0813	2.1060	-96%	0.1122	1.5744	1304%	0.1465	0.0064	-96%	6.0956	1.7593	-71%
1995	56.3579	2.1468	-96%	0.1047	1.6038	1432%	0.1375	0.0065	-95%	5.7161	1.7935	-69%
1996	58.2557	2.1415	-96%	0.1053	1.6005	1420%	0.1422	0.0065	-95%	5.9033	1.7890	-70%
1997	60.1534	2.1534	-96%	0.1058	1.6094	1421%	0.1469	0.0066	-96%	6.0905	1.7989	-70%
1998	57.7822	2.2198	-96%	0.0984	1.6576	1584%	0.1413	0.0068	-95%	5.8418	1.8546	-68%
1999	60.5906	2.3468	-96%	0.1048	1.7500	1569%	0.1482	0.0072	-95%	6.1270	1.9609	-68%
2000	66.7172	2.2169	-97%	0.1134	1.6590	1363%	0.1633	0.0068	-96%	6.7421	1.8518	-73%
2001	62.4973	2.5392	-96%	0.1111	1.8908	1602%	0.1529	0.0077	-95%	6.3216	2.1219	-66%
2002	41.8610	2.8032	-93%	0.1084	2.0847	1822%	0.1326	0.0085	-94%	5.5058	2.3427	-57%
2003	27.6589	2.9142	-89%	0.1115	2.1709	1847%	0.1243	0.0089	-93%	5.1816	2.4351	-53%
2004	12.3559	2.7984	-77%	0.1103	2.0930	1798%	0.1268	0.0085	-93%	5.2826	2.3377	-56%
2005	11.7210	3.1694	-73%	0.1064	2.3584	2117%	0.1201	0.0097	-92%	5.0074	2.6486	-47%
2006	11.8472	3.2430	-73%	0.1145	2.4215	2014%	0.1207	0.0099	-92%	5.0511	2.7094	-46%
2007	11.1853	2.7286	-76%	0.1097	2.0399	1759%	0.1138	0.0083	-93%	4.7658	2.2794	-52%
2008	10.1566	2.5993	-74%	0.0978	1.9495	1892%	0.1033	0.0079	-92%	4.3245	2.1709	-50%
2009	6.1678	2.0129	-67%	0.0739	1.5247	1964%	0.0618	0.0061	-90%	2.6154	1.6800	-36%
2010	7.8942	2.1151	-73%	0.0910	1.6130	1673%	0.0794	0.0064	-92%	3.3507	1.7644	-47%
2011	9.2039	2.1274	-77%	0.0910	1.6212	1682%	0.0934	0.0065	-93%	3.9174	1.7747	-55%
2012	9.8763	2.3435	-76%	0.0965	1.7736	1738%	0.1005	0.0071	-93%	4.2088	1.9560	-54%
2013	9.6504	2.3162	-76%	0.0972	1.7513	1701%	0.0979	0.0071	-93%	4.1076	1.9334	-53%
2014	11.8862	2.0906	-82%	0.1099	1.5935	1350%	0.1213	0.0064	-95%	5.0684	1.7441	-66%
2015	11.7075	2.0628	-82%	0.1072	1.5707	1365%	0.1197	0.0063	-95%	4.9961	1.7210	-66%
2016	11.6369	1.4509	-88%	0.1111	1.1285	916%	0.1188	0.0044	-96%	4.9651	1.2085	-76%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2017	11.7637	1.4757	-87%	0.1136	1.1444	908%	0.1199	0.0045	-96%	5.0163	1.2295	-75%

P-Previous
R-Refined

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. The emissions trends are presented in the following figures with distinguishing on air pollutants and heavy metals because of the different scale reported emissions. The category covers the combustion activities of sources defined in ***Table 3.30*** below in compliance with the definitions of sources in national legislations.

Table 3.30: *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

Overview of the emissions is shown in ***Table 3.31***. Emissions in this category show an overall increasing trend due to the increase of activity within this category.

Table 3.31 *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
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
1990/2018	**33%**	**331%**	**-80%**	**7%**	**8%**	**-4%**	**52%**
2017/2018	**6%**	**6%**	**6%**	**6%**	**6%**	**6%**	**6%**

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

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
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
1990/2018	**50%**	**50%**	**50%**	**50%**	**50%**	**51%**	**50%**	**50%**	**50%**
2017/2018	**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	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
1990/2018	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**-**	**-**
2017/2018	**6%**	**6%**	**6%**	**6%**	**6%**	**6%**	**-**	**-**

Overview of the activity data (energy consumption) for this source category is in ***Table 3.32*** below. This table represents fuels allocated to the fuel type for the calculations (following Table 3-1 of EMEP/EEA GB_{2019}, Part Manufacturing industries and construction (combustion)). Fuels in the template are allocated following principle from IPCC 2006 Guidelines.

Table 3.32: *Overview of activity data in the category 1A2b*

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	NO	NO	82.27	NO	NO
1995	NO	NO	92.15	NO	NO
2000	NO	NO	50.36	NO	NO
2005	NO	0.48	74.88	NO	NO
2010	NO	NO	76.40	NO	NO
2011	NO	NO	81.65	NO	NO
2012	NO	NO	83.09	NO	NO
2013	0.01	NO	102.13	NO	NO
2014	0.01	NO	61.46	NO	NO
2015	0.01	NO	97.30	NO	NO
2016	0.01	NO	99.67	NO	NO
2017	0.01	NO	116.37	NO	NO
2018	0.01	NO	123.28	NO	NO
1990/2018	**-**	**-**	**50%**	**-**	**-**

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
2017/2018	12%	-	6%	-	-

3.5.3.2 Methodological issues

Emission data is compiled in the NEIS. For detailed methodology please see **ANNEX IV**. Sources report emission to the NEIS database using us emission factor and amount of fuel (***Table 3.33***).

Table 3.33: *The overview of share of used calculation type for category 1A2b in NEIS*

1A2b	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	0%
4	Calculation using emission factor and amount of fuel	100%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

Historical data 1990-1999 are not covered by NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***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	48.12	0.90	1.92	3.41	78%	85%	16.93

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

Table 3.35: *Emission factor 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/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

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
PCBs	[µg/GJ]	-	170	-	0.06

3.5.3.3 Completeness

POPs (except HCB and PCBs) are reported as NE in the period 1990-2002 and 2008-2018 because EMEP/EEA GB2019 do not provide EF for gaseous and liquid fuels for these pollutants.

3.5.3.4 Source-specific recalculations

Recalculations in this submission were done to improve data quality and transparency. Recalculations in this submission were done due to change of categorisation of fuels and change of approach toward the calculation of HMs and POPs emission, where EMEP/EEA GB_{2019} EF instead of CS EF were used. 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 3.36*** shows the change in the data between final submission 2019 and this submission. Recommendation No ***SK-1A2b-2019-0001*** was implemented.

Table 3.36: *Previous and refined emissions in the category 1A2b*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0159	0.0040	-75%	0.0003	0.0001	-75%	0.0006	0.0002	-75%
1991	0.0119	0.0040	-66%	0.0002	0.0001	-66%	0.0005	0.0002	-66%
1992	0.0088	0.0041	-54%	0.0002	0.0001	-54%	0.0004	0.0002	-54%
1993	0.0065	0.0040	-38%	0.0001	0.0001	-38%	0.0003	0.0002	-38%
1994	0.0048	0.0040	-18%	0.0001	0.0001	-18%	0.0002	0.0002	-18%
1995	0.0038	0.0044	17%	0.0001	0.0001	17%	0.0002	0.0002	17%
1996	0.0033	0.0039	19%	0.0001	0.0001	19%	0.0001	0.0002	19%
1997	0.0031	0.0041	32%	0.0001	0.0001	32%	0.0001	0.0002	32%
1998	0.0033	0.0048	45%	0.0001	0.0001	45%	0.0001	0.0002	45%
1999	0.0036	0.0053	45%	0.0001	0.0001	45%	0.0001	0.0002	45%

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	0.0009	0.0002	-75%	0.0010	0.0002	-75%	0.0011	0.0003	-75%	0.0056	0.0014	-75%
1991	0.0007	0.0002	-66%	0.0007	0.0002	-66%	0.0008	0.0003	-66%	0.0042	0.0014	-66%
1992	0.0005	0.0002	-54%	0.0005	0.0002	-54%	0.0006	0.0003	-54%	0.0031	0.0014	-54%
1993	0.0004	0.0002	-38%	0.0004	0.0002	-38%	0.0005	0.0003	-38%	0.0023	0.0014	-38%
1994	0.0003	0.0002	-18%	0.0003	0.0002	-18%	0.0003	0.0003	-18%	0.0017	0.0014	-18%
1995	0.0002	0.0002	17%	0.0002	0.0003	17%	0.0003	0.0003	17%	0.0013	0.0016	17%
1996	0.0002	0.0002	19%	0.0002	0.0002	19%	0.0002	0.0003	19%	0.0011	0.0014	19%
1997	0.0002	0.0002	32%	0.0002	0.0002	32%	0.0002	0.0003	32%	0.0011	0.0014	32%
1998	0.0002	0.0003	45%	0.0002	0.0003	45%	0.0002	0.0003	45%	0.0012	0.0017	45%
1999	0.0002	0.0003	45%	0.0002	0.0003	45%	0.0003	0.0004	45%	0.0013	0.0019	45%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	4E-06	9E-07	-75%	3E-07	7E-08	-75%	2E-04	4E-05	-75%	3E-05	8E-06	-75%
1991	3E-06	9E-07	-66%	2E-07	8E-08	-66%	1E-04	5E-05	-66%	2E-05	8E-06	-66%
1992	2E-06	9E-07	-54%	2E-07	8E-08	-54%	1E-04	5E-05	-54%	2E-05	8E-06	-54%
1993	1E-06	9E-07	-38%	1E-07	7E-08	-38%	7E-05	4E-05	-38%	1E-05	8E-06	-38%
1994	1E-06	9E-07	-18%	9E-08	7E-08	-18%	5E-05	4E-05	-18%	1E-05	8E-06	-18%
1995	9E-07	1E-06	17%	7E-08	8E-08	17%	4E-05	5E-05	17%	8E-06	9E-06	17%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1996	7E-07	9E-07	19%	6E-08	7E-08	19%	4E-05	4E-05	19%	7E-06	8E-06	19%
1997	7E-07	9E-07	32%	6E-08	8E-08	32%	3E-05	5E-05	32%	6E-06	9E-06	32%
1998	7E-07	1E-06	45%	6E-08	9E-08	45%	4E-05	5E-05	45%	7E-06	1E-05	45%
1999	8E-07	1E-06	45%	7E-08	1E-07	45%	4E-05	6E-05	45%	8E-06	1E-05	45%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	4E-06	1E-06	-75%	9E-07	2E-07	-75%	4E-06	1E-06	-75%
1991	3E-06	1E-06	-66%	6E-07	2E-07	-66%	3E-06	1E-06	-66%
1992	2E-06	1E-06	-54%	5E-07	2E-07	-54%	2E-06	1E-06	-54%
1993	2E-06	1E-06	-38%	4E-07	2E-07	-38%	2E-06	1E-06	-38%
1994	1E-06	1E-06	-18%	3E-07	2E-07	-18%	1E-06	1E-06	-18%
1995	1E-06	1E-06	17%	2E-07	2E-07	17%	1E-06	1E-06	17%
1996	9E-07	1E-06	19%	2E-07	2E-07	19%	9E-07	1E-06	19%
1997	8E-07	1E-06	32%	2E-07	2E-07	32%	8E-07	1E-06	32%
1998	9E-07	1E-06	45%	2E-07	3E-07	45%	9E-07	1E-06	45%
1999	1E-06	1E-06	45%	2E-07	3E-07	45%	1E-06	1E-06	45%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	2E-05	5E-06	-75%	2E-04	6E-05	-75%
1991	1E-05	5E-06	-66%	2E-04	6E-05	-66%
1992	1E-05	5E-06	-54%	1E-04	6E-05	-54%
1993	8E-06	5E-06	-38%	1E-04	6E-05	-38%
1994	6E-06	5E-06	-18%	7E-05	6E-05	-18%
1995	5E-06	5E-06	17%	6E-05	7E-05	17%
1996	4E-06	5E-06	19%	5E-05	6E-05	19%
1997	4E-06	5E-06	32%	5E-05	6E-05	32%
1998	4E-06	6E-06	45%	5E-05	7E-05	45%
1999	4E-06	6E-06	45%	6E-05	8E-05	45%

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	0.2276	4E-05	-100%	NE	5E-04	-	0.1775	NE	-	0.0118	NE	-
1991	0.2873	4E-05	-100%	NE	5E-04	-	0.2241	NE	-	0.0149	NE	-
1992	0.3470	4E-05	-100%	NE	5E-04	-	0.2707	NE	-	0.0180	NE	-
1993	0.3121	4E-05	-100%	NE	5E-04	-	0.2434	NE	-	0.0162	NE	-
1994	0.2730	4E-05	-100%	NE	5E-04	-	0.2129	NE	-	0.0142	NE	-
1995	0.2277	5E-05	-100%	NE	5E-04	-	0.1776	NE	-	0.0118	NE	-
1996	0.2524	4E-05	-100%	NE	5E-04	-	0.1969	NE	-	0.0131	NE	-
1997	0.5653	4E-05	-100%	9E-06	5E-04	5145%	0.2162	NE	-	0.0624	NE	-
1998	0.5304	5E-05	-100%	9E-06	6E-04	5990%	0.1890	NE	-	0.0606	NE	-
1999	0.4913	6E-05	-100%	9E-06	6E-04	6658%	0.1585	NE	-	0.0585	NE	-
2000	1.0647	3E-05	-100%	3E-05	3E-04	894%	0.1280	NE	-	0.1585	NE	-
2001	1.1196	8E-05	-100%	3E-05	9E-04	2732%	0.0975	NE	-	0.1721	NE	-
2002	1.0297	7E-05	-100%	3E-05	8E-04	2563%	0.0716	NE	-	0.1610	NE	-
2003	1.1092	2E-04	-100%	3E-05	7E-04	2152%	0.1405	6E-07	-100%	0.1641	0.0002	-100%
2004	1.2953	1E-04	-100%	3E-05	4E-04	1206%	0.2544	3E-07	-100%	0.1783	0.0001	-100%
2005	1.2640	1E-04	-100%	2E-05	5E-04	1961%	0.3999	3E-07	-100%	0.1518	0.0001	-100%
2006	1.0253	1E-04	-100%	1E-05	6E-04	4332%	0.4899	2E-07	-100%	0.0988	0.0001	-100%

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	1.0743	2E-04	-100%	5E-06	7E-04	13953%	0.7119	3E-07	-100%	0.0744	0.0001	-100%
2008	1.3176	5E-05	-100%	2E-05	6E-04	3310%	0.6169	NE	-	0.1288	NE	-
2009	0.7233	4E-05	-100%	8E-06	5E-04	5778%	0.3774	NE	-	0.0650	NE	-
2010	0.6970	4E-05	-100%	8E-06	4E-04	5182%	0.3432	NE	-	0.0657	NE	-
2011	1.0332	4E-05	-100%	1E-05	5E-04	4167%	0.5407	NE	-	0.0927	NE	-
2012	0.6775	4E-05	-100%	7E-06	5E-04	7297%	0.3728	NE	-	0.0581	NE	-
2013	0.7148	5E-05	-100%	1E-05	6E-04	4857%	0.2719	NE	-	0.0791	NE	-
2014	0.8284	3E-05	-100%	1E-05	4E-04	3523%	0.4109	NE	-	0.0776	NE	-
2015	0.8609	5E-05	-100%	8E-06	6E-04	7098%	0.4840	NE	-	0.0723	NE	-
2016	1.0910	5E-05	-100%	7E-06	6E-04	8320%	0.6868	NE	-	0.0808	NE	-
2017	1.0835	6E-05	-100%	6E-06	7E-04	11116%	0.7013	NE	-	0.0775	NE	-

P-Previous
R-Refined

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. The total volume of fuels expressed in energy units allocated in this subcategory was 4 157.68 TJ in 2018.

Activities are included in 1A2c according to national categorization (***Table 3.37***).

Table 3.37: *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

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

Table 3.38 *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	0.3467	0.0180	0.2114	0.0150	0.0222	0.0330	0.0904
1995	0.3463	0.0180	0.2111	0.0149	0.0222	0.0330	0.0903
2000	0.3297	0.0181	0.1810	0.0203	0.0302	0.0448	0.1027
2005	0.2305	0.0078	0.0486	0.0118	0.0122	0.0147	0.0382
2010	0.1781	0.0088	0.0081	0.0104	0.0116	0.0149	0.0576
2011	0.1811	0.0087	0.0124	0.0107	0.0117	0.0151	0.0568
2012	0.1929	0.0179	0.0114	0.0109	0.0118	0.0151	0.0580
2013	0.1865	0.0180	0.0116	0.0104	0.0112	0.0139	0.0565
2014	0.1947	0.0446	0.0123	0.0089	0.0093	0.0096	0.0570
2015	0.2058	0.0477	0.0137	0.0094	0.0097	0.0100	0.0717
2016	0.2010	0.0609	0.0145	0.0105	0.0110	0.0115	0.0694
2017	0.2009	0.0710	0.0271	0.0108	0.0113	0.0119	0.0644
2018	0.2004	0.0772	0.0187	0.0100	0.0104	0.0108	0.0615
1990/2018	-42%	328%	-91%	-33%	-53%	-67%	-32%

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]]
2017/2018	0%	9%	-31%	-7%	-8%	-9%	-5%

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0038	6E-05	0.0034	0.0007	0.0006	6E-04	0.0004	0.0004	0.0249
1995	0.0036	6E-05	0.0033	0.0007	0.0005	6E-04	0.0004	0.0004	0.0244
2000	0.0034	5E-05	0.0031	0.0006	0.0005	6E-04	0.0004	0.0004	0.0266
2005	0.0006	1E-05	0.0018	0.0004	0.0002	2E-04	0.0001	0.0002	0.0151
2010	0.0009	6E-05	0.0020	0.0004	0.0002	1E-04	0.0001	0.0002	0.0058
2011	0.0008	6E-05	0.0021	0.0004	0.0002	1E-04	0.0001	0.0002	0.0057
2012	0.0007	6E-05	0.0021	0.0004	0.0002	1E-04	0.0001	0.0002	0.0056
2013	0.0006	6E-05	0.0021	0.0004	0.0002	9E-05	0.0001	0.0002	0.0054
2014	0.0002	3E-05	0.0022	0.0004	0.0001	3E-05	0.0001	0.0002	0.0042
2015	0.0001	3E-05	0.0024	0.0004	0.0001	3E-05	0.0001	0.0003	0.0043
2016	0.0002	5E-05	0.0023	0.0004	0.0001	4E-05	0.0001	0.0003	0.0052
2017	0.0002	6E-05	0.0023	0.0004	0.0002	4E-05	0.0001	0.0002	0.0052
2018	0.0001	4E-05	0.0022	0.0004	0.0001	3E-05	0.0001	0.0002	0.0046
1990/2018	**-96%**	**-29%**	**-33%**	**-40%**	**-78%**	**-95%**	**-86%**	**-45%**	**-82%**
2017/2018	**-31%**	**-27%**	**-2%**	**-2%**	**-20%**	**-26%**	**-10%**	**-2%**	**-13%**

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	0.0093	0.0064	0.0260	0.0078	0.0075	0.0476	2E-05	5E-03
1995	0.0090	0.0063	0.0258	0.0078	0.0074	0.0473	2E-05	4E-03
2000	0.0086	0.0060	0.0257	0.0073	0.0070	0.0460	2E-05	4E-03
2005	0.0031	0.0033	0.0159	0.0044	0.0042	0.0278	2E-06	7E-04
2010	0.0034	0.0029	0.0111	0.0042	0.0041	0.0223	2E-05	9E-04
2011	0.0033	0.0030	0.0113	0.0043	0.0042	0.0227	2E-05	8E-04
2012	0.0032	0.0030	0.0114	0.0043	0.0042	0.0230	2E-05	7E-04
2013	0.0031	0.0030	0.0116	0.0044	0.0043	0.0233	2E-05	6E-04
2014	0.0024	0.0029	0.0117	0.0044	0.0043	0.0234	1E-05	1E-04
2015	0.0026	0.0032	0.0129	0.0049	0.0048	0.0258	1E-05	5E-05
2016	0.0027	0.0032	0.0127	0.0048	0.0047	0.0253	2E-05	4E-05
2017	0.0027	0.0031	0.0124	0.0047	0.0046	0.0248	2E-05	7E-05
2018	0.0025	0.0030	0.0121	0.0046	0.0045	0.0242	1E-05	3E-05
1990/2018	**-73%**	**-52%**	**-53%**	**-41%**	**-40%**	**-49%**	**-16%**	**-99%**
2017/2018	**-8%**	**-3%**	**-2%**	**-2%**	**-2%**	**-2%**	**-29%**	**-60%**

Overview of the activity data (energy consumption) for this source category is in ***Table 3.39*** below. This table represents fuels allocated to the fuel type for the calculations (following Table 3-1 of EMEP/EEA GB_{2019}, Part Manufacturing industries and construction (combustion)). Fuels in the template are allocated following principle from IPCC 2006 Guidelines.

Table 3.39: *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	523.07	27.66	5701.68	NO	NO
1995	517.04	26.28	5702.38	NO	NO
2000	617.35	24.84	5156.03	NO	NO
2005	411.38	4.01	3271.67	NO	NO
2010	0.02	5.58	3685.37	3.90	NO
2011	0.03	4.55	3776.18	3.90	NO
2012	0.04	4.30	3836.81	3.73	NO

YEAR	LIQUID FUELS [TJ NCV]	SOLID FUELS [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
2013	0.14	3.53	3913.02	3.49	NO
2014	0.10	0.58	4006.03	2.17	NO
2015	0.03	0.28	4434.53	2.04	NO
2016	0.05	0.24	4338.43	3.88	NO
2017	0.08	0.42	4238.79	3.99	NO
2018	1.51	0.17	4153.15	2.85	NO
1990/2018	**-100%**	**-99%**	**-27%**	**-**	**-**
2017/2018	**1708%**	**-60%**	**-2%**	**-29%**	**-**

3.5.4.2 Methodological issues

Emission data is compiled in the NEIS. Detailed methodology is descripted **ANNEX IV**.

***Table 3.40:** The overview of share of used calculation type for category 1A2c in NEIS*

1A2c	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	11%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	16%
4	Calculation using emission factor and amount of fuel	72%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0.03%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

The emissions were balanced in comply with general EF of the Bulletin of Ministry of Environment. These emissions factors are presented in **ANNEX IV, Chapter A4.6**.

Historical data 1990-1999 are not covered by NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***Table 3.41***).

***Table 3.41:** 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 were balanced using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.42***).

***Table 3.42:** Emission factor 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

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
PCDD/F	[ng/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 to improve data quality and transparency. Recalculations in this submission were done due to change of categorisation of fuels and change of approach toward the calculation of HMs and POPs emission, where EMEP/EEA GB_{2019} EF instead of CS EF were used. 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 3.43*** shows the change in the data between final submission 2019 and this submission.

Table 3.43: *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	0.3837	0.3467	-10%	0.0200	0.0180	-10%	0.2339	0.2114	-10%
1991	0.3772	0.3468	-8%	0.0196	0.0181	-8%	0.2299	0.2114	-8%
1992	0.3629	0.3466	-5%	0.0189	0.0180	-5%	0.2212	0.2113	-5%
1993	0.3538	0.3462	-2%	0.0184	0.0180	-2%	0.2157	0.2111	-2%
1994	0.3514	0.3450	-2%	0.0183	0.0180	-2%	0.2142	0.2103	-2%
1995	0.3391	0.3463	2%	0.0177	0.0180	2%	0.2067	0.2111	2%
1996	0.3301	0.3431	4%	0.0172	0.0179	4%	0.2012	0.2092	4%
1997	0.3197	0.3420	7%	0.0166	0.0178	7%	0.1949	0.2085	7%
1998	0.3038	0.3397	12%	0.0158	0.0177	12%	0.1852	0.2071	12%
1999	0.2962	0.3423	16%	0.0154	0.0178	16%	0.1806	0.2086	16%

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	0.0000	0.0150	90358810%	0.0000	0.0222	90358810%	0.0366	0.0330	-10%	0.1001	0.0904	-10%
1991	0.0163	0.0150	-8%	0.0242	0.0222	-8%	0.0360	0.0331	-8%	0.0984	0.0904	-8%
1992	0.0157	0.0150	-5%	0.0233	0.0222	-5%	0.0346	0.0330	-5%	0.0947	0.0904	-5%
1993	0.0153	0.0149	-2%	0.0227	0.0222	-2%	0.0337	0.0330	-2%	0.0923	0.0903	-2%
1994	0.0152	0.0149	-2%	0.0225	0.0221	-2%	0.0335	0.0329	-2%	0.0916	0.0900	-2%
1995	0.0146	0.0149	2%	0.0217	0.0222	2%	0.0323	0.0330	2%	0.0884	0.0903	2%
1996	0.0142	0.0148	4%	0.0212	0.0220	4%	0.0315	0.0327	4%	0.0861	0.0895	4%
1997	0.0138	0.0148	7%	0.0205	0.0219	7%	0.0305	0.0326	7%	0.0834	0.0892	7%
1998	0.0131	0.0147	12%	0.0195	0.0218	12%	0.0290	0.0324	12%	0.0792	0.0886	12%
1999	0.0128	0.0148	16%	0.0190	0.0219	16%	0.0282	0.0326	16%	0.0773	0.0893	16%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0058	0.0038	-35%	8E-05	6E-05	-30%	0.0040	0.0034	-15%	0.0008	0.0007	-17%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1991	0.0072	0.0038	-47%	1E-04	6E-05	-42%	0.0039	0.0034	-15%	0.0009	0.0007	-19%
1992	0.0079	0.0038	-52%	1E-04	6E-05	-48%	0.0039	0.0034	-14%	0.0009	0.0007	-20%
1993	0.0082	0.0038	-54%	1E-04	6E-05	-50%	0.0038	0.0034	-12%	0.0009	0.0007	-19%
1994	0.0083	0.0038	-55%	1E-04	6E-05	-50%	0.0037	0.0033	-11%	0.0008	0.0007	-18%
1995	0.0079	0.0036	-54%	1E-04	6E-05	-49%	0.0036	0.0033	-7%	0.0008	0.0007	-15%
1996	0.0073	0.0037	-50%	1E-04	6E-05	-44%	0.0035	0.0033	-5%	0.0008	0.0007	-12%
1997	0.0064	0.0036	-43%	9E-05	6E-05	-38%	0.0033	0.0033	-1%	0.0007	0.0007	-7%
1998	0.0054	0.0033	-39%	8E-05	5E-05	-33%	0.0032	0.0033	3%	0.0007	0.0007	-3%
1999	0.0045	0.0030	-33%	6E-05	5E-05	-24%	0.0030	0.0033	8%	0.0006	0.0007	3%
2000	0.0039	0.0034	-11%	5E-05	5E-05	-	0.0031	0.0031	-	0.0006	0.0006	-
2001	0.0026	0.0023	-12%	4E-05	4E-05	0%	0.0032	0.0032	0%	0.0006	0.0006	0%
2002	0.0017	0.0012	-28%	2E-05	2E-05	0%	0.0029	0.0029	0%	0.0006	0.0006	0%
2003	0.0022	0.0017	-24%	3E-05	3E-05	0%	0.0027	0.0027	0%	0.0005	0.0005	0%
2004	0.0014	0.0010	-31%	2E-05	2E-05	0%	0.0021	0.0021	0%	0.0004	0.0004	0%
2005	0.0009	0.0006	-33%	1E-05	1E-05	0%	0.0018	0.0018	0%	0.0004	0.0004	0%
2006	0.0005	0.0005	-8%	9E-06	9E-06	0%	0.0015	0.0015	0%	0.0003	0.0003	0%
2007	0.0005	0.0005	0%	8E-06	8E-06	0%	0.0013	0.0013	0%	0.0002	0.0002	0%
2008	0.0005	0.0006	7%	9E-06	5E-05	432%	0.0015	0.0015	0%	0.0003	0.0003	0%
2009	0.0008	0.0008	10%	1E-05	6E-05	401%	0.0019	0.0019	0%	0.0004	0.0004	0%
2010	0.0008	0.0009	13%	1E-05	6E-05	379%	0.0020	0.0020	0%	0.0004	0.0004	0%
2011	0.0007	0.0008	16%	1E-05	6E-05	438%	0.0021	0.0021	0%	0.0004	0.0004	0%
2012	0.0006	0.0007	14%	1E-05	6E-05	430%	0.0021	0.0021	0%	0.0004	0.0004	0%
2013	0.0005	0.0006	16%	1E-05	6E-05	456%	0.0021	0.0021	0%	0.0004	0.0004	0%
2014	0.0001	0.0002	35%	5E-06	3E-05	596%	0.0022	0.0022	0%	0.0004	0.0004	0%
2015	0.0001	0.0001	53%	5E-06	3E-05	583%	0.0024	0.0024	0%	0.0004	0.0004	0%
2016	0.0001	0.0002	125%	4E-06	5E-05	1161%	0.0023	0.0023	0%	0.0004	0.0004	0%
2017	0.0001	0.0002	103%	5E-06	6E-05	1132%	0.0023	0.0023	0%	0.0004	0.0004	0%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0007	0.0006	-20%	8E-04	6E-04	-23%	0.0006	0.0004	-31%
1991	0.0008	0.0005	-34%	1E-03	6E-04	-37%	0.0008	0.0004	-42%
1992	0.0009	0.0005	-38%	1E-03	6E-04	-42%	0.0008	0.0004	-48%
1993	0.0009	0.0005	-40%	1E-03	6E-04	-44%	0.0009	0.0004	-49%
1994	0.0009	0.0005	-42%	1E-03	6E-04	-46%	0.0009	0.0004	-49%
1995	0.0009	0.0005	-40%	1E-03	6E-04	-45%	0.0008	0.0004	-48%
1996	0.0008	0.0005	-35%	1E-03	6E-04	-39%	0.0008	0.0004	-44%
1997	0.0007	0.0005	-28%	9E-04	6E-04	-33%	0.0007	0.0004	-37%
1998	0.0006	0.0005	-21%	7E-04	5E-04	-26%	0.0006	0.0004	-33%
1999	0.0005	0.0005	-12%	6E-04	5E-04	-16%	0.0005	0.0004	-25%
2000	0.0005	0.0005	-	6E-04	6E-04	-	0.0004	0.0004	-
2001	0.0004	0.0004	0%	4E-04	4E-04	0%	0.0003	0.0003	0%
2002	0.0003	0.0003	0%	3E-04	3E-04	0%	0.0002	0.0002	0%
2003	0.0004	0.0004	0%	4E-04	4E-04	0%	0.0002	0.0002	0%
2004	0.0003	0.0003	0%	3E-04	3E-04	0%	0.0001	0.0001	0%
2005	0.0002	0.0002	0%	2E-04	2E-04	0%	0.0001	0.0001	0%
2006	0.0001	0.0001	0%	8E-05	8E-05	-1%	0.0001	0.0001	0%
2007	0.0001	0.0001	0%	6E-05	6E-05	-1%	0.0001	0.0001	0%
2008	0.0001	0.0002	72%	8E-05	1E-04	22%	0.0001	0.0001	7%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2009	0.0001	0.0002	74%	1E-04	1E-04	21%	0.0001	0.0001	7%
2010	0.0001	0.0002	72%	1E-04	1E-04	22%	0.0001	0.0001	6%
2011	0.0001	0.0002	81%	9E-05	1E-04	26%	0.0001	0.0001	7%
2012	0.0001	0.0002	75%	9E-05	1E-04	22%	0.0001	0.0001	7%
2013	0.0001	0.0002	77%	7E-05	9E-05	24%	0.0001	0.0001	7%
2014	0.0001	0.0001	76%	2E-05	3E-05	42%	0.0001	0.0001	7%
2015	0.0001	0.0001	72%	2E-05	3E-05	59%	0.0001	0.0001	7%
2016	0.0001	0.0001	147%	2E-05	4E-05	141%	0.0001	0.0001	13%
2017	0.0001	0.0002	150%	2E-05	4E-05	128%	0.0001	0.0001	13%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0005	0.0004	-10%	0.0193	0.0249	29%
1991	0.0005	0.0004	-12%	0.0222	0.0247	11%
1992	0.0005	0.0004	-10%	0.0206	0.0248	21%
1993	0.0005	0.0004	-9%	0.0210	0.0249	18%
1994	0.0005	0.0004	-10%	0.0247	0.0248	0%
1995	0.0005	0.0004	-7%	0.0228	0.0244	7%
1996	0.0005	0.0004	-4%	0.0224	0.0252	13%
1997	0.0004	0.0004	1%	0.0211	0.0246	17%
1998	0.0004	0.0004	7%	0.0167	0.0238	42%
1999	0.0004	0.0004	13%	0.0168	0.0245	46%
2000	0.0004	0.0004	-	0.0266	0.0266	-
2001	0.0004	0.0004	0%	0.0201	0.0201	0%
2002	0.0004	0.0004	0%	0.0239	0.0238	0%
2003	0.0004	0.0004	0%	0.0278	0.0277	0%
2004	0.0003	0.0003	0%	0.0215	0.0214	0%
2005	0.0002	0.0002	0%	0.0152	0.0151	0%
2006	0.0002	0.0002	0%	0.0044	0.0044	-1%
2007	0.0001	0.0001	0%	0.0024	0.0024	-2%
2008	0.0002	0.0002	1%	0.0045	0.0060	32%
2009	0.0002	0.0002	1%	0.0046	0.0065	43%
2010	0.0002	0.0002	1%	0.0038	0.0058	51%
2011	0.0002	0.0002	1%	0.0037	0.0057	53%
2012	0.0002	0.0002	0%	0.0041	0.0056	37%
2013	0.0002	0.0002	0%	0.0040	0.0054	35%
2014	0.0002	0.0002	0%	0.0034	0.0042	21%
2015	0.0003	0.0003	0%	0.0035	0.0043	24%
2016	0.0003	0.0003	1%	0.0033	0.0052	58%
2017	0.0002	0.0002	1%	0.0032	0.0052	63%

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	0.0122	0.0093	-24%	0.0490	0.0476	-3%	3E-05	2E-05	-34%	0.0071	0.0047	-34%
1991	0.0142	0.0093	-35%	0.0503	0.0476	-5%	3E-05	2E-05	-47%	0.0088	0.0047	-47%
1992	0.0151	0.0092	-39%	0.0482	0.0476	-1%	4E-05	2E-05	-52%	0.0097	0.0046	-52%
1993	0.0156	0.0093	-41%	0.0477	0.0476	0%	4E-05	2E-05	-54%	0.0102	0.0047	-54%
1994	0.0156	0.0092	-41%	0.0493	0.0474	-4%	4E-05	2E-05	-54%	0.0101	0.0046	-54%
1995	0.0149	0.0090	-39%	0.0470	0.0473	1%	4E-05	2E-05	-54%	0.0096	0.0045	-54%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1996	0.0139	0.0091	-35%	0.0457	0.0474	4%	3E-05	2E-05	-49%	0.0089	0.0045	-49%
1997	0.0126	0.0090	-28%	0.0438	0.0470	7%	3E-05	2E-05	-43%	0.0078	0.0045	-43%
1998	0.0109	0.0085	-22%	0.0398	0.0463	16%	2E-05	1E-05	-39%	0.0066	0.0041	-39%
1999	0.0094	0.0081	-14%	0.0388	0.0468	21%	2E-05	1E-05	-31%	0.0054	0.0037	-31%
2000	0.0086	0.0086	-	0.0460	0.0460	-	2E-05	2E-05	-	0.0042	0.0042	-
2001	0.0068	0.0068	0%	0.0434	0.0433	0%	1E-05	1E-05	-	0.0028	0.0028	-
2002	0.0052	0.0052	0%	0.0432	0.0432	0%	5E-06	5E-06	-	0.0014	0.0014	-
2003	0.0059	0.0059	0%	0.0442	0.0442	0%	7E-06	7E-06	-	0.0020	0.0020	-
2004	0.0041	0.0041	0%	0.0339	0.0339	0%	4E-06	4E-06	-	0.0011	0.0011	-
2005	0.0031	0.0031	0%	0.0279	0.0278	0%	2E-06	2E-06	-	0.0007	0.0007	-
2006	0.0022	0.0022	0%	0.0175	0.0174	0%	2E-06	2E-06	-	0.0006	0.0006	-
2007	0.0019	0.0019	0%	0.0142	0.0142	0%	2E-06	2E-06	-	0.0006	0.0006	-
2008	0.0022	0.0025	13%	0.0180	0.0181	0%	2E-06	2E-05	718%	0.0006	0.0006	0%
2009	0.0029	0.0033	14%	0.0212	0.0213	1%	3E-06	2E-05	605%	0.0009	0.0009	0%
2010	0.0031	0.0034	13%	0.0222	0.0223	1%	3E-06	2E-05	564%	0.0009	0.0009	0%
2011	0.0029	0.0033	13%	0.0226	0.0227	1%	3E-06	2E-05	692%	0.0008	0.0008	0%
2012	0.0029	0.0032	13%	0.0231	0.0230	0%	3E-06	2E-05	699%	0.0007	0.0007	0%
2013	0.0028	0.0031	12%	0.0234	0.0233	0%	2E-06	2E-05	798%	0.0006	0.0006	0%
2014	0.0022	0.0024	9%	0.0235	0.0234	-1%	4E-07	1E-05	3015%	0.0001	0.0001	0%
2015	0.0024	0.0026	8%	0.0259	0.0258	0%	2E-07	1E-05	5858%	0.0000	0.0000	0%
2016	0.0023	0.0027	17%	0.0252	0.0253	0%	1E-07	2E-05	13241%	0.0000	0.0000	1%
2017	0.0023	0.0027	17%	0.0247	0.0248	1%	3E-07	2E-05	7621%	0.0001	0.0001	0%

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.

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 in 2015, the same source used 2x less biomass fuel. Decrease of emissions of PCBs in 2010 is connected with a significant reduction in the use of solid fuels in this category.

Figure 3.23: Trends of NOx and SOx emissions in the category 1A2d

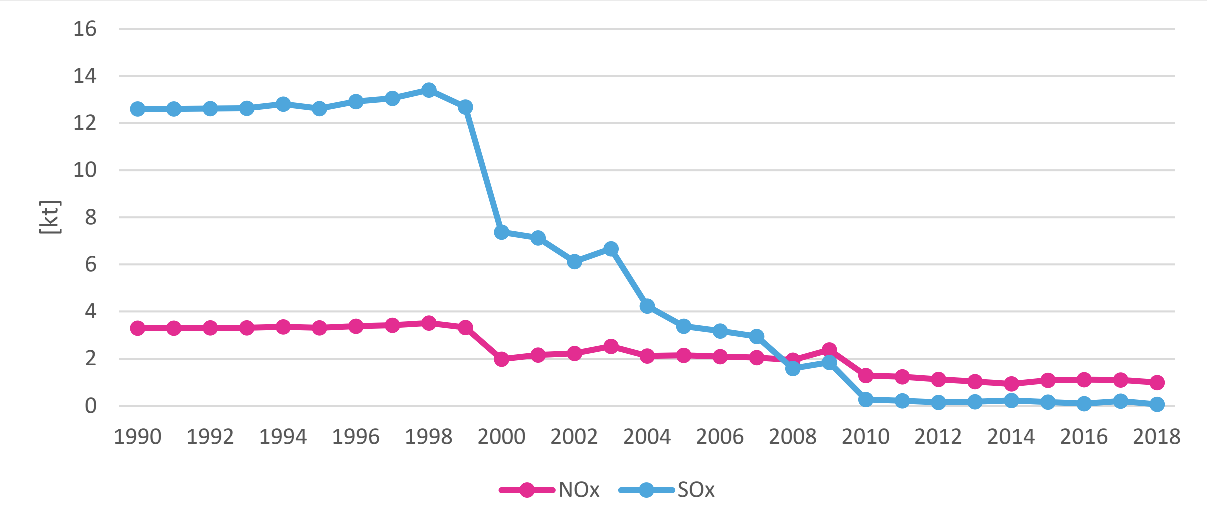


Figure 3.24: Trends of Cd and Zn emissions in the category 1A2d

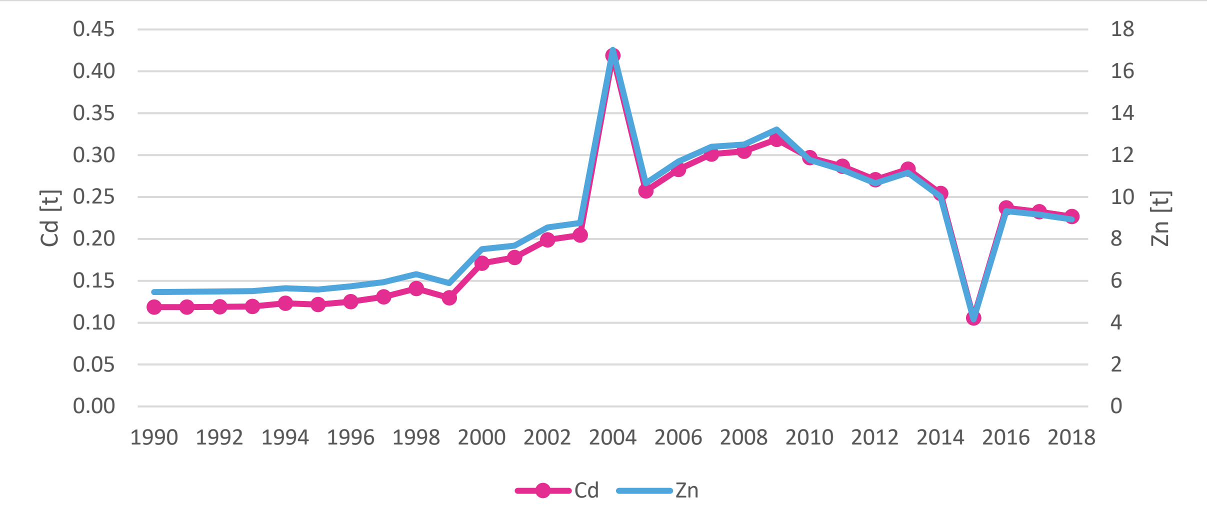
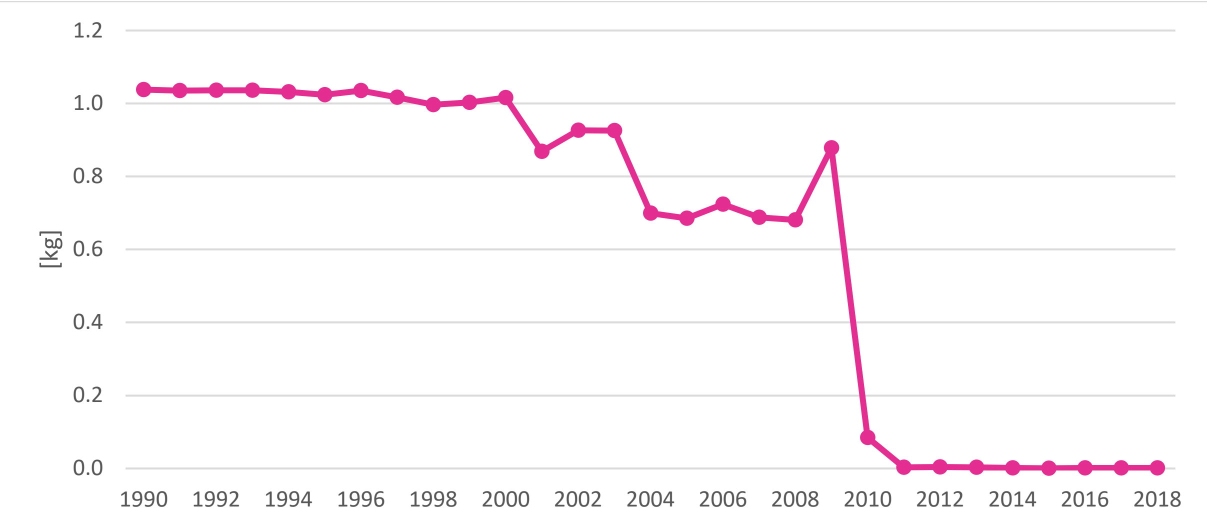


Figure 3.25: Trends of PCBs emissions in the category 1A2d



Overview of the emissions is shown in ***Table 3.44***. Emissions in this category show overall increasing trend due to an increase of activity within this category.

Table 3.44 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	5.5380
1995	3.3055	0.0321	12.6132	NO	0.1983	0.2240	0.2986	5.5393
2000	1.9772	0.1984	7.3805	NO	0.1261	0.1425	0.1899	5.1912
2005	2.1433	0.1611	3.3816	NO	0.0748	0.0887	0.1205	3.4881
2010	1.2829	0.0725	0.2672	0.0039	0.0245	0.0279	0.0424	1.9828
2011	1.2395	0.0679	0.2202	0.0038	0.0281	0.0315	0.0472	2.3147
2012	1.1296	0.0707	0.1503	0.0029	0.0253	0.0292	0.0487	2.0773
2013	1.0277	0.0253	0.1800	0.0029	0.0220	0.0254	0.0411	2.1118
2014	0.9283	0.0264	0.2292	0.0026	0.0164	0.0164	0.0164	1.9891
2015	1.0847	0.0364	0.1637	0.0001	0.0127	0.0134	0.0148	2.6371
2016	1.1150	0.0462	0.0969	0.0031	0.0181	0.0181	0.0181	2.9958
2017	1.0995	0.0749	0.2004	0.0072	0.0120	0.0121	0.0122	1.6415
2018	0.9907	0.0763	0.0596	0.0079	0.0142	0.0142	0.0142	1.4044
1990/2018	**-70%**	**138%**	**-100%**	**-**	**-93%**	**-94%**	**-95%**	**-75%**
2017/2018	**-10%**	**2%**	**-70%**	**9%**	**18%**	**17%**	**16%**	**-14%**

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	0.5281	0.2542	0.0118	0.0039	0.4498	0.1173	0.0391	0.0099	10.0145
2015	0.2191	0.1055	0.0061	0.0018	0.1866	0.0487	0.0163	0.0042	4.1562
2016	0.4921	0.2369	0.0112	0.0036	0.4192	0.1094	0.0365	0.0092	9.3329
2017	0.4828	0.2324	0.0108	0.0035	0.4113	0.1073	0.0358	0.0090	9.1557
2018	0.4711	0.2268	0.0106	0.0035	0.4013	0.1047	0.0349	0.0088	8.9347
1990/2018	**-55%**	**92%**	**-81%**	**-87%**	**47%**	**-33%**	**-64%**	**-43%**	**63%**
2017/2018	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**

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	1.9566	0.1967	0.3176	0.0996	0.0800	0.6940	0.0978	0.0012
2015	0.8128	0.0832	0.1379	0.0436	0.0355	0.3002	0.0406	0.0005
2016	1.8235	0.1836	0.2969	0.0931	0.0749	0.6484	0.0911	0.0011
2017	1.7888	0.1799	0.2905	0.0911	0.0732	0.6346	0.0894	0.0011
2018	1.7457	0.1756	0.2838	0.0890	0.0715	0.6200	0.0872	0.0010
1990/2018	**-16%**	**-52%**	**-44%**	**-53%**	**-53%**	**-49%**	**93%**	**-100%**

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]
2017/2018	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**

Overview of the activity data (energy consumption) for this source category is in ***Table 3.45*** below. This table represents fuels allocated to the fuel type for the calculations (following Table 3-1 of EMEP/EEA GB_{2019}, Part Manufacturing industries and construction (combustion)). Fuels in the template are allocated following principle prom IPCC 2006 Guidelines.

Table 3.45: *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	427.29	6103.22	3753.93	8263.96	NO
1995	426.21	6021.67	3596.48	8508.41	NO
2000	373.34	5972.66	3699.16	12318.58	NO
2005	50.66	4026.33	1812.59	19231.71	NO
2010	0.58	491.85	3812.27	22782.67	NO
2011	0.02	9.27	3678.24	22055.05	NO
2012	0.10	14.06	3274.47	20817.50	NO
2013	0.00	10.93	1720.58	21792.53	NO
2014	0.00	NO	1630.26	19557.29	34.71
2015	0.00	NO	2800.74	8113.57	34.56
2016	0.00	NO	1818.44	18225.71	0.00
2017	0.03	NO	1513.36	17880.11	19.78
2018	0.03	NO	1611.15	17448.33	23.75
1990/2018	**-100%**	**-**	**-57%**	**111%**	**-**
2017/2018	**-6%**	**-**	**6%**	**-2%**	**20%**

3.5.5.2 Methodological issues

The category represents the emissions from the activities included in ***Table 3.46***. Emissions combustion processes were reallocated from 2H1 into this category following the EMEP/EEA GB_{2019}.

Table 3.46: *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	

Table 3.47: *The overview of share of used calculation type for category 1A2d in NEIS*

1A2d	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	91%
2	Calculation using representative concentration and volume of flue gas	0.39%
3	Calculation using representative individual mass flow and number of operating hours	0%
4	Calculation using emission factor and amount of fuel	9%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

The emissions were balanced in comply with general EF of the Bulletin of Ministry of Environment. These emissions factors are presented in **ANNEX IV, Chapter A4.6**.

Historical data 1990-1999 are not covered by the NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***Table 3.48***).

Table 3.48: *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 were balanced using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.49***).

Table 3.49: *Emission factor 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/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

3.5.5.3 Completeness

Emissions are well covered.

3.5.5.4 Source-specific recalculations

In this submission, combustion emissions (NOx, NMVOC, SOx and CO) from the category 2H1 were reallocated to this category which caused significant changes. This change was done because most of these emissions originate during the combustion processes. PMs emissions were assumed as mostly process emissions, therefore, they were not reallocated.

Also, recalculations were done due to change of categorisation of fuels and change of approach toward the calculation of HMs and POPs emission, where EMEP/EEA GB2019 EF instead of CS EF were used. 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 3.50*** shows change in the data between final submission 2019 and this submission.

Table 3.50: *Previous and refined emissions in the category 1A2d*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	4.2808	3.3048	-23%	0.0416	0.0321	-23%	16.3347	12.6102	-23%
1991	3.9328	3.3022	-16%	0.0382	0.0321	-16%	15.0067	12.6004	-16%
1992	3.6270	3.3060	-9%	0.0353	0.0321	-9%	13.8399	12.6151	-9%
1993	3.3591	3.3107	-1%	0.0327	0.0322	-1%	12.8176	12.6330	-1%
1994	3.1252	3.3568	7%	0.0304	0.0326	7%	11.9251	12.8089	7%
1995	2.9216	3.3055	13%	0.0284	0.0321	13%	11.1480	12.6132	13%
1996	2.7443	3.3855	23%	0.0267	0.0329	23%	10.4717	12.9183	23%
1997	2.6026	3.4212	31%	0.0253	0.0333	31%	9.9310	13.0544	31%
1998	2.4540	3.5134	43%	0.0239	0.0342	43%	9.3640	13.4063	43%
1999	2.3334	3.3247	42%	0.0227	0.0323	42%	8.9036	12.6863	42%
2000	1.4376	1.9772	38%	0.0178	0.1984	1012%	7.0795	7.3805	4%
2001	1.6065	2.1620	35%	0.0157	0.2143	1266%	6.7486	7.1363	6%
2002	1.7107	2.2267	30%	0.0161	0.2242	1289%	5.7567	6.1229	6%
2003	2.0154	2.5265	25%	0.0161	0.2453	1419%	6.2485	6.6704	7%
2004	1.5599	2.1160	36%	0.0139	0.2127	1436%	4.1670	4.2384	2%
2005	1.5095	2.1433	42%	0.0139	0.1611	1062%	3.2751	3.3816	3%
2006	1.4769	2.0913	42%	0.0161	0.1559	865%	3.1220	3.1730	2%
2007	1.4125	2.0517	45%	0.0154	0.1074	596%	2.7524	2.9457	7%
2008	1.2832	1.9465	52%	0.0158	0.1996	1162%	1.3700	1.5826	16%
2009	1.7297	2.3778	37%	0.0186	0.1859	897%	1.6450	1.8469	12%
2010	0.6664	1.2829	92%	0.0035	0.0725	1971%	0.2220	0.2672	20%
2011	0.6077	1.2395	104%	0.0026	0.0679	2530%	0.1419	0.2202	55%
2012	0.5372	1.1296	110%	0.0023	0.0707	2993%	0.0986	0.1503	52%
2013	0.3889	1.0277	164%	0.0011	0.0253	2286%	0.1068	0.1800	68%
2014	0.3214	0.9283	189%	0.0009	0.0264	2937%	0.1322	0.2292	73%
2015	0.3493	1.0847	211%	0.0010	0.0364	3665%	0.0402	0.1637	308%
2016	0.3610	1.1150	209%	0.0011	0.0462	4047%	0.0475	0.0969	104%
2017	0.3160	1.0995	248%	0.0271	0.0749	176%	0.0439	0.2004	356%

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	0.2569	0.1983	-23%	0.2901	0.2240	-23%	0.3867	0.2985	-23%	7.1737	5.5380	-23%
1991	0.2360	0.1981	-16%	0.2665	0.2238	-16%	0.3552	0.2983	-16%	6.5905	5.5337	-16%
1992	0.2176	0.1984	-9%	0.2458	0.2241	-9%	0.3276	0.2986	-9%	6.0781	5.5401	-9%
1993	0.2016	0.1987	-1%	0.2277	0.2244	-1%	0.3034	0.2990	-1%	5.6291	5.5480	-1%
1994	0.1875	0.2014	7%	0.2118	0.2275	7%	0.2823	0.3032	7%	5.2371	5.6252	7%
1995	0.1753	0.1983	13%	0.1980	0.2240	13%	0.2639	0.2986	13%	4.8958	5.5393	13%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1996	0.1647	0.2031	23%	0.1860	0.2294	23%	0.2479	0.3058	23%	4.5989	5.6733	23%
1997	0.1562	0.2053	31%	0.1764	0.2319	31%	0.2351	0.3090	31%	4.3614	5.7331	31%
1998	0.1472	0.2108	43%	0.1663	0.2381	43%	0.2217	0.3173	43%	4.1124	5.8876	43%
1999	0.1400	0.1995	42%	0.1581	0.2253	42%	0.2108	0.3003	42%	3.9102	5.5714	42%
2000	0.1261	0.1261	-	0.1425	0.1425	-	0.1899	0.1899	-	3.0044	5.1912	73%
2001	0.0963	0.0963	-	0.1088	0.1088	-	0.1450	0.1450	-	3.4381	5.6918	66%
2002	0.0875	0.0875	-	0.0989	0.0989	-	0.1318	0.1318	-	2.6816	4.9523	85%
2003	0.0962	0.0962	-	0.1087	0.1087	-	0.1449	0.1449	-	2.2212	4.3778	97%
2004	0.0825	0.0825	-	0.0932	0.0932	-	0.1242	0.1242	-	2.5729	4.2331	65%
2005	0.0748	0.0748	-	0.0887	0.0887	-	0.1205	0.1205	-	2.1214	3.4881	64%
2006	0.0628	0.0628	-	0.0758	0.0758	-	0.1032	0.1032	-	2.2065	3.5090	59%
2007	0.0543	0.0543	-	0.0626	0.0626	-	0.0808	0.0808	-	2.2202	3.0179	36%
2008	0.0465	0.0465	-	0.0552	0.0552	-	0.0732	0.0732	-	1.6864	3.6452	116%
2009	0.0971	0.0971	-	0.1140	0.1140	-	0.1412	0.1412	-	1.3887	2.0376	47%
2010	0.0245	0.0245	-	0.0279	0.0279	-	0.0424	0.0424	-	1.8490	1.9828	7%
2011	0.0281	0.0281	-	0.0315	0.0315	-	0.0472	0.0472	-	2.0261	2.3147	14%
2012	0.0253	0.0253	-	0.0292	0.0292	-	0.0487	0.0487	-	1.7744	2.0773	17%
2013	0.0220	0.0220	-	0.0254	0.0254	-	0.0411	0.0411	-	1.8269	2.1118	16%
2014	0.0164	0.0164	-	0.0164	0.0164	-	0.0164	0.0164	-	1.6507	1.9891	21%
2015	0.0127	0.0127	-	0.0134	0.0134	-	0.0148	0.0148	-	0.0959	2.6371	2649%
2016	0.0181	0.0181	-	0.0181	0.0181	-	0.0181	0.0181	-	0.1200	2.9958	2396%
2017	0.0120	0.0120	-	0.0121	0.0121	-	0.0122	0.0122	-	0.1074	1.6415	1428%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	2.5695	1.0410	-59%	0.0460	0.1184	157%	0.1511	0.0549	-64%	0.0762	0.0264	-65%
1991	2.3321	1.0396	-55%	0.0428	0.1187	177%	0.1371	0.0548	-60%	0.0692	0.0263	-62%
1992	2.1205	1.0406	-51%	0.0400	0.1190	197%	0.1247	0.0548	-56%	0.0628	0.0263	-58%
1993	1.9320	1.0417	-46%	0.0375	0.1194	218%	0.1136	0.0549	-52%	0.0572	0.0263	-54%
1994	1.7641	1.0460	-41%	0.0352	0.1232	249%	0.1038	0.0548	-47%	0.0522	0.0263	-50%
1995	1.6144	1.0367	-36%	0.0332	0.1215	265%	0.0950	0.0543	-43%	0.0478	0.0261	-45%
1996	1.4807	1.0532	-29%	0.0314	0.1252	298%	0.0871	0.0551	-37%	0.0438	0.0264	-40%
1997	1.3605	1.0506	-23%	0.0298	0.1308	339%	0.0801	0.0544	-32%	0.0402	0.0260	-35%
1998	1.2514	1.0558	-16%	0.0283	0.1409	397%	0.0737	0.0538	-27%	0.0370	0.0257	-30%
1999	1.1512	1.0373	-10%	0.0270	0.1297	381%	0.0678	0.0535	-21%	0.0340	0.0256	-25%
2000	0.8105	1.1330	40%	0.0156	0.1709	995%	0.0491	0.0561	14%	0.0243	0.0266	10%
2001	0.6945	1.0347	49%	0.0141	0.1779	1162%	0.0415	0.0489	18%	0.0207	0.0231	12%
2002	0.7397	1.1223	52%	0.0147	0.1990	1252%	0.0443	0.0525	19%	0.0220	0.0248	12%
2003	0.7390	1.1334	53%	0.0146	0.2045	1303%	0.0440	0.0525	19%	0.0220	0.0248	13%
2004	0.5610	1.4044	150%	0.0127	0.4188	3206%	0.0335	0.0513	53%	0.0167	0.0226	36%
2005	0.5478	1.0588	93%	0.0112	0.2573	2188%	0.0326	0.0436	34%	0.0163	0.0199	23%
2006	0.5767	1.1410	98%	0.0112	0.2828	2436%	0.0354	0.0474	34%	0.0174	0.0214	23%
2007	0.5487	1.1522	110%	0.0108	0.3013	2701%	0.0339	0.0468	38%	0.0166	0.0209	26%
2008	0.5429	1.1536	113%	1E-02	0.3045	2813%	0.0335	0.0466	39%	0.0164	0.0208	27%
2009	0.6989	1.3340	91%	9E-04	0.3189	2336%	0.0426	0.0562	32%	0.0210	0.0255	22%
2010	0.0659	0.6811	933%	2E-05	0.2971	33346%	0.0056	0.0187	234%	0.0023	0.0067	192%
2011	0.0013	0.5968	46678%	3E-05	0.2867	1472996%	0.0017	0.0144	726%	0.0003	0.0046	1226%
2012	0.0019	0.5640	29365%	4E-05	0.2707	974556%	0.0016	0.0135	752%	0.0003	0.0043	1215%
2013	0.0015	0.5899	38961%	4E-05	0.2833	772104%	0.0007	0.0132	1733%	0.0002	0.0044	2600%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2014	0.0001	0.5281	519867%	6E-05	0.2542	569805%	0.0005	0.0118	2140%	0.0001	0.0039	3853%
2015	0.0001	0.2191	175305%	4E-05	0.1055	190333%	0.0006	0.0061	933%	0.0001	0.0018	1573%
2016	0.0001	0.4921	485019%	3E-02	0.2369	547627%	0.0007	0.0112	1527%	0.0001	0.0036	2755%
2017	0.0562	0.4828	759%	1E-02	0.2324	759%	0.0016	0.0108	557%	0.0005	0.0035	632%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.2775	0.2726	-2%	0.3380	0.1565	-54%	0.2486	0.0959	-61%
1991	0.2536	0.2730	8%	0.3069	0.1564	-49%	0.2256	0.0958	-58%
1992	0.2323	0.2735	18%	0.2793	0.1566	-44%	0.2051	0.0959	-53%
1993	0.2133	0.2741	29%	0.2546	0.1568	-38%	0.1868	0.0959	-49%
1994	0.1963	0.2806	43%	0.2327	0.1581	-32%	0.1706	0.0962	-44%
1995	0.1812	0.2771	53%	0.2131	0.1565	-27%	0.1561	0.0953	-39%
1996	0.1678	0.2845	70%	0.1957	0.1594	-19%	0.1431	0.0968	-32%
1997	0.1556	0.2932	88%	0.1800	0.1601	-11%	0.1314	0.0962	-27%
1998	0.1446	0.3098	114%	0.1657	0.1628	-2%	0.1209	0.0963	-20%
1999	0.1345	0.2905	116%	0.1526	0.1582	4%	0.1111	0.0950	-15%
2000	0.0893	0.3641	308%	0.1068	0.1785	67%	0.0784	0.1023	30%
2001	0.0776	0.3675	373%	0.0916	0.1673	83%	0.0672	0.0924	38%
2002	0.0822	0.4083	396%	0.0976	0.1827	87%	0.0715	0.0999	40%
2003	0.0819	0.4180	410%	0.0974	0.1851	90%	0.0715	0.1007	41%
2004	0.0648	0.7833	1109%	0.0743	0.2617	252%	0.0542	0.1167	115%
2005	0.0614	0.4967	708%	0.0723	0.1859	157%	0.0530	0.0908	71%
2006	0.0636	0.5443	756%	0.0760	0.2014	165%	0.0558	0.0976	75%
2007	0.0608	0.5748	846%	0.0723	0.2064	185%	0.0531	0.0978	84%
2008	0.0598	0.5801	870%	0.0715	0.2073	190%	0.0526	0.0978	86%
2009	0.0764	0.6174	708%	0.0920	0.2332	153%	0.0677	0.1147	70%
2010	0.0067	0.5307	7843%	0.0086	0.1453	1587%	0.0064	0.0520	708%
2011	0.0002	0.5074	306824%	0.0002	0.1325	77745%	0.0002	0.0443	27454%
2012	0.0002	0.4790	212440%	0.0003	0.1252	49337%	0.0002	0.0419	19072%
2013	0.0002	0.5014	262389%	0.0002	0.1310	64847%	0.0002	0.0437	27284%
2014	0.0001	0.4498	499441%	2E-05	0.1173	516397%	2E-05	0.0391	201607%
2015	0.0001	0.1866	169076%	3E-05	0.0487	174251%	2E-05	0.0163	72425%
2016	0.0001	0.4192	460455%	2E-05	0.1094	480805%	2E-05	0.0365	158540%
2017	0.0479	0.4113	759%	0.0125	0.1073	759%	0.0042	0.0358	757%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0348	0.0154	-56%	4.3026	5.4669	27%
1991	0.0316	0.0154	-51%	3.9413	5.4772	39%
1992	0.0288	0.0154	-47%	3.6195	5.4883	52%
1993	0.0262	0.0154	-41%	3.3329	5.5022	65%
1994	0.0239	0.0155	-35%	3.0779	5.6489	84%
1995	0.0219	0.0153	-30%	2.8509	5.5756	96%
1996	0.0201	0.0156	-22%	2.6483	5.7323	116%
1997	0.0185	0.0156	-16%	2.4687	5.9385	141%
1998	0.0170	0.0158	-7%	2.3021	6.3195	175%
1999	0.0157	0.0154	-2%	2.1513	5.8853	174%
2000	0.0111	0.0172	54%	1.3886	7.5152	441%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
2001	0.0095	0.0159	67%	1.2162	7.6783	531%
2002	0.0101	0.0173	71%	1.2870	8.5520	564%
2003	0.0101	0.0174	73%	1.2790	8.7669	585%
2004	0.0077	0.0233	204%	1.0314	17.0277	1551%
2005	0.0075	0.0170	127%	0.9638	10.6547	1005%
2006	0.0080	0.0185	132%	0.9904	11.6933	1081%
2007	0.0076	0.0188	148%	0.9479	12.3935	1207%
2008	0.0075	0.0189	151%	0.9308	12.5139	1244%
2009	0.0096	0.0214	123%	1.1835	13.2294	1018%
2010	0.0011	0.0125	1069%	0.1007	11.7659	11584%
2011	0.0002	0.0113	5639%	0.0041	11.2967	274566%
2012	0.0002	0.0106	5674%	0.0048	10.6638	221509%
2013	0.0001	0.0110	12362%	0.0037	11.1612	303910%
2014	0.0001	0.0099	16856%	0.0024	10.0145	411317%
2015	0.0001	0.0042	6412%	0.0029	4.1562	141639%
2016	0.0001	0.0092	12143%	0.0026	9.3329	360808%
2017	0.0011	0.0090	726%	1.0660	9.1557	759%

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	3.9470	2.0679	-48%	2.8475	1.2143	-57%	0.0163	0.0451	176%	3.2273	1.0380	-68%
1991	3.5875	2.0673	-42%	2.5827	1.2128	-53%	0.0152	0.0452	197%	2.9264	1.0354	-65%
1992	3.2671	2.0700	-37%	2.3470	1.2140	-48%	0.0143	0.0453	218%	2.6582	1.0360	-61%
1993	2.9815	2.0732	-30%	2.1373	1.2153	-43%	0.0134	0.0455	239%	2.4191	1.0364	-57%
1994	2.7272	2.0972	-23%	1.9509	1.2214	-37%	0.0126	0.0469	272%	2.2063	1.0316	-53%
1995	2.5005	2.0757	-17%	1.7852	1.2100	-32%	0.0119	0.0463	288%	2.0165	1.0242	-49%
1996	2.2979	2.1173	-8%	1.6374	1.2301	-25%	0.0113	0.0477	322%	1.8470	1.0355	-44%
1997	2.1159	2.1396	1%	1.5064	1.2287	-18%	0.0107	0.0499	364%	1.6946	1.0169	-40%
1998	1.9506	2.1943	12%	1.3851	1.2379	-11%	0.0102	0.0538	425%	1.5563	0.9966	-36%
1999	1.7988	2.1151	18%	1.2753	1.2118	-5%	0.0098	0.0495	406%	1.4292	1.0025	-30%
2000	1.2515	2.4468	96%	0.9071	1.3357	47%	0.0056	0.0653	1072%	1.0154	1.0161	0%
2001	1.0753	2.3361	117%	0.7722	1.2232	58%	0.0051	0.0681	1247%	0.8681	0.8689	0%
2002	1.1440	2.5619	124%	0.8248	1.3295	61%	0.0053	0.0761	1346%	0.9254	0.9263	0%
2003	1.1420	2.6035	128%	0.8201	1.3402	63%	0.0052	0.0783	1401%	0.9249	0.9257	0%
2004	0.8746	3.9988	357%	0.6261	1.7242	175%	0.0046	0.1608	3415%	0.6977	0.6996	0%
2005	0.8487	2.7415	223%	0.6078	1.2749	110%	0.0040	0.0987	2346%	0.6845	0.6856	0%
2006	0.8912	2.9814	235%	0.6505	1.3874	113%	0.0040	0.1085	2625%	0.7224	0.7236	0%
2007	0.8488	3.0843	263%	0.6216	1.4095	127%	0.0038	0.1156	2907%	0.6869	0.6882	0%
2008	0.8389	3.1014	270%	0.6148	1.4114	130%	0.0037	0.1168	3032%	0.6801	0.6815	0%
2009	1.0776	3.4304	218%	0.7843	1.6127	106%	0.0047	0.1223	2524%	0.8766	0.8780	0%
2010	0.1015	2.3801	2245%	0.0905	0.8916	885%	0.0003	0.1142	37355%	0.0836	0.0850	2%
2011	0.0035	2.2093	63198%	0.0193	0.7946	4016%	6E-06	0.1103	1919444%	0.0016	0.0029	84%
2012	0.0043	2.0863	48681%	0.0179	0.7497	4081%	9E-06	0.1041	1194126%	0.0024	0.0036	52%
2013	0.0030	2.1824	73842%	0.0085	0.7743	9057%	1E-05	0.1090	843635%	0.0019	0.0032	70%
2014	0.0008	1.9566	231894%	0.0058	0.6940	11922%	2E-05	0.0978	581236%	2E-07	0.0012	581236%
2015	0.0010	0.8128	82780%	0.0064	0.3002	4579%	2E-05	0.0406	193733%	3E-07	0.0005	193733%
2016	0.0010	1.8235	185125%	0.0075	0.6484	8568%	2E-05	0.0911	562491%	2E-07	0.0011	562491%
2017	0.2085	1.7888	758%	0.0780	0.6346	713%	1E-02	0.0894	759%	1E-04	0.0011	759%

P-Previous, R-Refined

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 3.53*** were included here.

Overview of the emissions is shown in ***Table 3.51***. Emissions of main pollutants in this category shown 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 3.51 *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	0.0666	0.1063	0.1774	0.3813
2005	0.5258	0.0259	0.5047	0.0075	0.0776	0.0912	0.1167	0.2446
2010	0.3418	0.0600	0.1481	0.0094	0.0168	0.0301	0.0548	0.3559
2011	0.3358	0.0602	0.1785	0.0037	0.0153	0.0287	0.0535	0.3644
2012	0.2992	0.0572	0.1815	0.0039	0.0140	0.0256	0.0476	0.2884
2013	0.2949	0.0605	0.2061	0.0040	0.0169	0.0322	0.0576	0.2416
2014	0.2987	0.0577	0.2037	0.0040	0.0173	0.0342	0.0615	0.2626
2015	0.3406	0.0596	0.2015	0.0040	0.0202	0.0388	0.0671	0.2730
2016	0.2989	0.0407	0.1783	0.0039	0.0371	0.0514	0.0743	0.2577
2017	0.3289	0.0425	0.2551	0.0096	0.0382	0.0541	0.0794	0.2766
2018	0.3095	0.0414	0.1979	0.0117	0.0391	0.0552	0.0801	0.2651
1990/2018	**-60%**	**-20%**	**-77%**	**56%**	**-40%**	**-47%**	**-54%**	**-37%**
2017/2018	**-6%**	**-2%**	**-22%**	**22%**	**2%**	**2%**	**1%**	**-4%**

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
1990/2018	**30%**	**-10%**	**-24%**	**-1%**	**16%**	**27%**	**28%**	**-10%**	**-3%**
2017/2018	**-10%**	**-11%**	**-8%**	**-9%**	**-10%**	**-10%**	**-10%**	**-9%**	**-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	0.0996	0.0283	0.0610	0.0218	0.0191	0.1302	0.0004	0.0762
1995	0.0993	0.0282	0.0609	0.0217	0.0191	0.1298	0.0004	0.0760
2000	0.0865	0.0251	0.0559	0.0198	0.0175	0.1182	0.0004	0.0655
2005	0.0747	0.0207	0.0465	0.0156	0.0137	0.0966	0.0005	0.0549
2010	0.1005	0.0244	0.0397	0.0156	0.0131	0.0928	0.0005	0.0782
2011	0.1035	0.0255	0.0410	0.0162	0.0136	0.0964	0.0003	0.0843
2012	0.0865	0.0216	0.0355	0.0140	0.0117	0.0828	0.0003	0.0706
2013	0.0952	0.0234	0.0373	0.0147	0.0122	0.0875	0.0003	0.0782
2014	0.1132	0.0275	0.0426	0.0169	0.0140	0.1009	0.0004	0.0930
2015	0.1484	0.0354	0.0531	0.0211	0.0172	0.1268	0.0005	0.1225
2016	0.1139	0.0277	0.0430	0.0170	0.0141	0.1018	0.0004	0.0936
2017	0.1357	0.0326	0.0496	0.0196	0.0161	0.1179	0.0004	0.1118
2018	0.1220	0.0295	0.0454	0.0179	0.0147	0.1075	0.0004	0.1004
1990/2018	**22%**	**4%**	**-26%**	**-18%**	**-23%**	**-17%**	**-12%**	**32%**
2017/2018	**-10%**	**-10%**	**-8%**	**-9%**	**-8%**	**-9%**	**-11%**	**-10%**

Overview of the activity data (energy consumption) for this source category is in ***Table 3.52*** below. This table represents fuels allocated to the fuel type for the calculations (following Table 3-1 of EMEP/EEA GB_{2019}, Part Manufacturing industries and construction (combustion)). Fuels in the template are allocated following principle prom IPCC 2006 Guidelines.

Table 3.52: *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	482.78	448.38	9263.26	30.61	NO
1995	494.17	447.23	9186.23	30.61	NO
2000	483.54	385.14	8789.97	30.61	NO
2005	596.80	323.08	6103.78	51.52	NO
2010	0.01	459.72	4085.92	50.06	NO
2011	0.01	496.14	4037.58	6.61	NO
2012	11.79	415.15	3733.01	2.74	NO
2013	27.48	459.88	3365.35	0.94	NO
2014	5.58	547.16	3536.98	2.81	NO
2015	11.39	720.47	3600.02	2.47	NO
2016	19.09	550.43	3551.21	2.55	NO
2017	23.13	657.52	3603.54	3.20	NO
2018	28.43	590.46	3491.00	2.46	NO
1990/2018	**-94%**	**32%**	**-62%**	**-92%**	**-**
2017/2018	**23%**	**-10%**	**-3%**	**-23%**	**-**

3.5.6.2 Methodological issues

The 50% of emissions were balanced in comply with general EF of the Bulletin of Ministry of Environment. These emissions factors are presented in **ANNEX IV, Chapter A4.6**.

Table 3.53*: 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	

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:	SPECIFICATION FOR SOURCES
b) domestic ungulates	
c) Others (eg. 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

Table 3.54: *The overview of share of used calculation type for category 1A2e in NEIS*

1A2e	Type of emission compilation/calculation	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0.0001%
3	Calculation using representative individual mass flow and number of operating hours	29%
4	Calculation using emission factor and amount of fuel	50%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	22%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0.02%

The emissions were balanced in comply with general EF of the Bulletin of Ministry of Environment. These emissions factors are presented in **ANNEX IV, Chapter A4.6**.

Historical data 1990-1999 are not covered by the NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***Table 3.55***).

Table 3.55: *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 were balanced using Tier 1emission factors from EMEP/EEA GB_{2019} (***Table 3.56***).

Table 3.56: *Emission factor 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
Cu	[mg/GJ]	0.22	17.5	0.002600	6

T1	UNIT	LIQUID FUELS	SOLID FUELS	GASEOUS FUELS	BIOMASS
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/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

Recalculations in this submission were done to improve data quality and transparency. Recalculations in this submission were done due to change of categorisation of fuels and change of approach toward the calculation of HMs and POPs emission, where EMEP/EEA GB_{2019} EF instead of CS EF were used. 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 3.57*** shows the change in the data between final submission 2019 and this submission.

Table 3.57: *Previous and refined emissions in the category 1A2e*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	1.3424	0.7790	-42%	0.0896	0.0520	-42%	1.5047	0.8731	-42%	0.0129	0.0075	-42%
1991	1.2524	0.7785	-38%	0.0836	0.0519	-38%	1.4038	0.8727	-38%	0.0121	0.0075	-38%
1992	1.1723	0.7782	-34%	0.0782	0.0519	-34%	1.3140	0.8723	-34%	0.0113	0.0075	-34%
1993	1.1007	0.7768	-29%	0.0734	0.0518	-29%	1.2338	0.8707	-29%	0.0106	0.0075	-29%
1994	1.0366	0.7760	-25%	0.0692	0.0518	-25%	1.1619	0.8698	-25%	0.0100	0.0075	-25%
1995	0.9791	0.7739	-21%	0.0653	0.0516	-21%	1.0974	0.8674	-21%	0.0094	0.0075	-21%
1996	0.9269	0.7714	-17%	0.0618	0.0515	-17%	1.0390	0.8647	-17%	0.0089	0.0074	-17%
1997	0.9019	0.7651	-15%	0.0602	0.0510	-15%	1.0109	0.8575	-15%	0.0087	0.0074	-15%
1998	0.8350	0.7632	-9%	0.0557	0.0509	-9%	0.9359	0.8555	-9%	0.0080	0.0074	-9%
1999	0.7931	0.7498	-5%	0.0529	0.0500	-5%	0.8890	0.8405	-5%	0.0076	0.0072	-5%

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	0.1121	0.0651	-42%	0.1790	0.1039	-42%	0.2988	0.1734	-42%	0.7238	0.4200	-42%
1991	0.1046	0.0650	-38%	0.1670	0.1038	-38%	0.2788	0.1733	-38%	0.6752	0.4198	-38%
1992	0.0979	0.0650	-34%	0.1563	0.1038	-34%	0.2609	0.1732	-34%	0.6320	0.4196	-34%
1993	0.0919	0.0649	-29%	0.1468	0.1036	-29%	0.2450	0.1729	-29%	0.5934	0.4188	-29%
1994	0.0866	0.0648	-25%	0.1382	0.1035	-25%	0.2307	0.1727	-25%	0.5589	0.4184	-25%
1995	0.0818	0.0646	-21%	0.1305	0.1032	-21%	0.2179	0.1723	-21%	0.5279	0.4173	-21%
1996	0.0774	0.0644	-17%	0.1236	0.1029	-17%	0.2063	0.1717	-17%	0.4998	0.4159	-17%
1997	0.0753	0.0639	-15%	0.1202	0.1020	-15%	0.2007	0.1703	-15%	0.4862	0.4125	-15%
1998	0.0697	0.0637	-9%	0.1113	0.1018	-9%	0.1859	0.1699	-9%	0.4502	0.4115	-9%
1999	0.0662	0.0626	-5%	0.1057	0.1000	-5%	0.1765	0.1669	-5%	0.4276	0.4043	-5%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.6498	0.0611	-91%	0.0089	0.0012	-86%	0.0430	0.0086	-80%	0.0202	0.0027	-86%
1991	0.5373	0.0612	-89%	0.0072	0.0012	-83%	0.0367	0.0086	-76%	0.0169	0.0027	-84%
1992	0.4404	0.0609	-86%	0.0059	0.0012	-79%	0.0311	0.0086	-72%	0.0141	0.0027	-81%
1993	0.3581	0.0608	-83%	0.0049	0.0012	-75%	0.0264	0.0086	-67%	0.0116	0.0027	-77%
1994	0.2884	0.0607	-79%	0.0040	0.0012	-70%	0.0224	0.0086	-62%	0.0096	0.0027	-72%
1995	0.2306	0.0609	-74%	0.0032	0.0012	-62%	0.0190	0.0086	-55%	0.0079	0.0027	-65%
1996	0.1835	0.0593	-68%	0.0026	0.0012	-54%	0.0162	0.0085	-48%	0.0065	0.0027	-59%
1997	0.1463	0.0599	-59%	0.0021	0.0012	-43%	0.0139	0.0085	-39%	0.0053	0.0027	-50%
1998	0.1171	0.0594	-49%	0.0017	0.0012	-30%	0.0120	0.0084	-30%	0.0044	0.0027	-40%
1999	0.0955	0.0575	-40%	0.0014	0.0012	-17%	0.0106	0.0082	-22%	0.0038	0.0026	-31%
2000	0.0527	0.0526	0%	0.0010	0.0011	12%	0.0079	0.0079	0%	0.0024	0.0024	0%
2001	0.0599	0.0599	0%	0.0011	0.0013	23%	0.0080	0.0080	0%	0.0026	0.0026	0%
2002	0.0466	0.0466	0%	0.0009	0.0011	19%	0.0072	0.0072	0%	0.0022	0.0022	0%
2003	0.0404	0.0408	1%	0.0008	0.0012	45%	0.0064	0.0064	0%	0.0019	0.0019	0%
2004	0.0362	0.0365	1%	0.0008	0.0012	55%	0.0058	0.0059	0%	0.0018	0.0018	0%
2005	0.0443	0.0448	1%	0.0008	0.0013	51%	0.0059	0.0059	0%	0.0019	0.0019	0%
2006	0.0435	0.0441	1%	0.0008	0.0013	63%	0.0057	0.0057	0%	0.0019	0.0019	0%
2007	0.0529	0.0540	2%	0.0008	0.0014	66%	0.0059	0.0059	0%	0.0021	0.0021	0%
2008	0.0497	0.0497	0%	0.0007	0.0007	0%	0.0055	0.0055	0%	0.0020	0.0020	0%
2009	0.0527	0.0538	2%	0.0007	0.0012	70%	0.0054	0.0054	0%	0.0020	0.0020	0%
2010	0.0617	0.0630	2%	0.0008	0.0015	75%	0.0058	0.0059	0%	0.0022	0.0023	0%
2011	0.0666	0.0667	0%	0.0009	0.0010	7%	0.0061	0.0061	0%	0.0024	0.0024	0%
2012	0.0558	0.0557	0%	0.0008	0.0008	0%	0.0053	0.0053	0%	0.0020	0.0020	0%
2013	0.0617	0.0617	0%	0.0008	0.0008	0%	0.0055	0.0055	0%	0.0022	0.0022	0%
2014	0.0734	0.0734	0%	0.0010	0.0010	0%	0.0062	0.0062	0%	0.0025	0.0025	0%
2015	0.0967	0.0967	0%	0.0013	0.0013	0%	0.0076	0.0076	0%	0.0032	0.0032	0%
2016	0.0739	0.0739	0%	0.0010	0.0010	0%	0.0063	0.0063	0%	0.0026	0.0026	0%
2017	0.0883	0.0882	0%	0.0012	0.0012	0%	0.0071	0.0071	0%	0.0030	0.0030	0%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0663	0.0070	-89%	0.0854	0.0082	-90%	0.0628	0.0060	-90%
1991	0.0547	0.0070	-87%	0.0706	0.0082	-88%	0.0520	0.0060	-88%
1992	0.0448	0.0070	-84%	0.0579	0.0081	-86%	0.0426	0.0060	-86%
1993	0.0367	0.0069	-81%	0.0471	0.0081	-83%	0.0347	0.0060	-83%
1994	0.0296	0.0069	-77%	0.0379	0.0081	-79%	0.0280	0.0060	-79%
1995	0.0237	0.0070	-71%	0.0303	0.0081	-73%	0.0224	0.0060	-73%
1996	0.0189	0.0068	-64%	0.0241	0.0079	-67%	0.0178	0.0058	-67%
1997	0.0152	0.0069	-55%	0.0193	0.0080	-58%	0.0142	0.0059	-59%
1998	0.0122	0.0068	-44%	0.0154	0.0080	-48%	0.0114	0.0059	-49%
1999	0.0100	0.0066	-34%	0.0126	0.0077	-39%	0.0093	0.0057	-39%
2000	0.0059	0.0061	4%	0.0070	0.0071	1%	0.0052	0.0052	0%
2001	0.0066	0.0071	7%	0.0079	0.0081	1%	0.0059	0.0059	1%
2002	0.0054	0.0057	6%	0.0062	0.0063	1%	0.0046	0.0046	1%
2003	0.0047	0.0053	14%	0.0054	0.0056	3%	0.0040	0.0040	1%
2004	0.0042	0.0050	17%	0.0049	0.0051	4%	0.0035	0.0036	2%
2005	0.0050	0.0057	15%	0.0059	0.0061	3%	0.0043	0.0044	2%
2006	0.0049	0.0057	18%	0.0058	0.0060	4%	0.0042	0.0043	2%
2007	0.0056	0.0066	18%	0.0069	0.0072	4%	0.0052	0.0053	2%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2008	0.0051	0.0051	0%	0.0065	0.0065	0%	0.0049	0.0049	0%
2009	0.0054	0.0063	17%	0.0069	0.0071	3%	0.0052	0.0052	2%
2010	0.0063	0.0074	18%	0.0081	0.0084	4%	0.0060	0.0061	2%
2011	0.0068	0.0069	2%	0.0087	0.0087	0%	0.0065	0.0065	0%
2012	0.0057	0.0057	0%	0.0073	0.0073	0%	0.0055	0.0055	0%
2013	0.0063	0.0063	0%	0.0081	0.0081	0%	0.0060	0.0060	0%
2014	0.0075	0.0075	0%	0.0096	0.0096	0%	0.0072	0.0072	0%
2015	0.0098	0.0098	0%	0.0126	0.0126	0%	0.0094	0.0094	0%
2016	0.0075	0.0075	0%	0.0097	0.0097	0%	0.0072	0.0072	0%
2017	0.0090	0.0090	0%	0.0115	0.0115	0%	0.0086	0.0086	0%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0097	0.0014	-85%	1.1107	0.1261	-89%
1991	0.0081	0.0014	-83%	0.9105	0.1263	-86%
1992	0.0067	0.0014	-79%	0.7436	0.1260	-83%
1993	0.0056	0.0014	-75%	0.6076	0.1257	-79%
1994	0.0046	0.0014	-69%	0.4890	0.1257	-74%
1995	0.0038	0.0014	-63%	0.3913	0.1262	-68%
1996	0.0031	0.0014	-56%	0.3126	0.1235	-61%
1997	0.0026	0.0014	-47%	0.2593	0.1245	-52%
1998	0.0022	0.0014	-37%	0.2036	0.1246	-39%
1999	0.0019	0.0013	-28%	0.1691	0.1213	-28%
2000	0.0013	0.0013	0%	0.1085	0.1131	4%
2001	0.0013	0.0014	1%	0.1219	0.1314	8%
2002	0.0012	0.0012	1%	0.1040	0.1110	7%
2003	0.0010	0.0010	1%	0.0899	0.1043	16%
2004	0.0010	0.0010	2%	0.0886	0.1047	18%
2005	0.0010	0.0010	2%	0.0961	0.1128	17%
2006	0.0010	0.0010	2%	0.0931	0.1127	21%
2007	0.0010	0.0010	2%	0.0885	0.1105	25%
2008	0.0009	0.0009	0%	0.0790	0.0789	0%
2009	0.0010	0.0010	2%	0.0826	0.1028	25%
2010	0.0011	0.0011	2%	0.0956	0.1206	26%
2011	0.0011	0.0011	0%	0.1030	0.1056	2%
2012	0.0010	0.0010	0%	0.0875	0.0875	0%
2013	0.0010	0.0010	0%	0.0958	0.0957	0%
2014	0.0012	0.0012	0%	0.1136	0.1136	0%
2015	0.0015	0.0015	0%	0.1483	0.1483	0%
2016	0.0012	0.0012	0%	0.1148	0.1145	0%
2017	0.0014	0.0014	0%	0.1366	0.1364	0%

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	0.9900	0.0996	-90%	0.8475	0.1302	-85%	0.0030	0.0004	-86%	0.8192	0.0762	-91%
1991	0.8201	0.0997	-88%	0.7095	0.1303	-82%	0.0025	0.0004	-83%	0.6778	0.0764	-89%
1992	0.6735	0.0994	-85%	0.5906	0.1301	-78%	0.0021	0.0004	-79%	0.5557	0.0761	-86%
1993	0.5483	0.0991	-82%	0.4893	0.1298	-73%	0.0017	0.0004	-75%	0.4515	0.0759	-83%
1994	0.4427	0.0991	-78%	0.4041	0.1297	-68%	0.0014	0.0004	-69%	0.3636	0.0758	-79%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1995	0.3551	0.0993	-72%	0.3335	0.1298	-61%	0.0011	0.0004	-61%	0.2907	0.0760	-74%
1996	0.2838	0.0968	-66%	0.2761	0.1278	-54%	0.0009	0.0004	-53%	0.2313	0.0740	-68%
1997	0.2273	0.0978	-57%	0.2362	0.1281	-46%	0.0007	0.0004	-41%	0.1840	0.0748	-59%
1998	0.1828	0.0970	-47%	0.1947	0.1278	-34%	0.0006	0.0004	-28%	0.1474	0.0742	-50%
1999	0.1499	0.0941	-37%	0.1679	0.1247	-26%	0.0005	0.0004	-15%	0.1201	0.0717	-40%
2000	0.0856	0.0865	1%	0.1180	0.1182	0%	0.0003	0.0004	14%	0.0655	0.0655	0%
2001	0.0962	0.0981	2%	0.1252	0.1258	0%	0.0004	0.0005	25%	0.0745	0.0745	0%
2002	0.0764	0.0778	2%	0.1106	0.1110	0%	0.0003	0.0004	21%	0.0576	0.0576	0%
2003	0.0663	0.0691	4%	0.0965	0.0974	1%	0.0003	0.0004	48%	0.0498	0.0498	0%
2004	0.0596	0.0628	5%	0.0929	0.0938	1%	0.0003	0.0004	60%	0.0444	0.0444	0%
2005	0.0715	0.0747	5%	0.0955	0.0966	1%	0.0003	0.0005	56%	0.0549	0.0549	0%
2006	0.0698	0.0737	6%	0.0919	0.0932	1%	0.0003	0.0005	69%	0.0540	0.0540	0%
2007	0.0833	0.0876	5%	0.0885	0.0899	2%	0.0003	0.0005	73%	0.0666	0.0666	0%
2008	0.0778	0.0778	0%	0.0819	0.0818	0%	0.0002	0.0002	0%	0.0628	0.0628	0%
2009	0.0821	0.0861	5%	0.0824	0.0838	2%	0.0003	0.0005	79%	0.0668	0.0668	0%
2010	0.0956	0.1005	5%	0.0912	0.0928	2%	0.0003	0.0005	84%	0.0782	0.0782	0%
2011	0.1030	0.1035	0%	0.0962	0.0964	0%	0.0003	0.0003	8%	0.0843	0.0843	0%
2012	0.0865	0.0865	0%	0.0829	0.0828	0%	0.0003	0.0003	-	0.0706	0.0706	-
2013	0.0952	0.0952	0%	0.0876	0.0875	0%	0.0003	0.0003	-	0.0782	0.0782	-
2014	0.1132	0.1132	0%	0.1009	0.1009	0%	0.0004	0.0004	-	0.0930	0.0930	-
2015	0.1484	0.1484	0%	0.1268	0.1268	0%	0.0005	0.0005	-	0.1225	0.1225	-
2016	0.1139	0.1139	0%	0.1019	0.1018	0%	0.0004	0.0004	-	0.0936	0.0936	-
2017	0.1357	0.1357	0%	0.1180	0.1179	0%	0.0004	0.0004	-	0.1118	0.1118	-

P-Previous
R-Refined

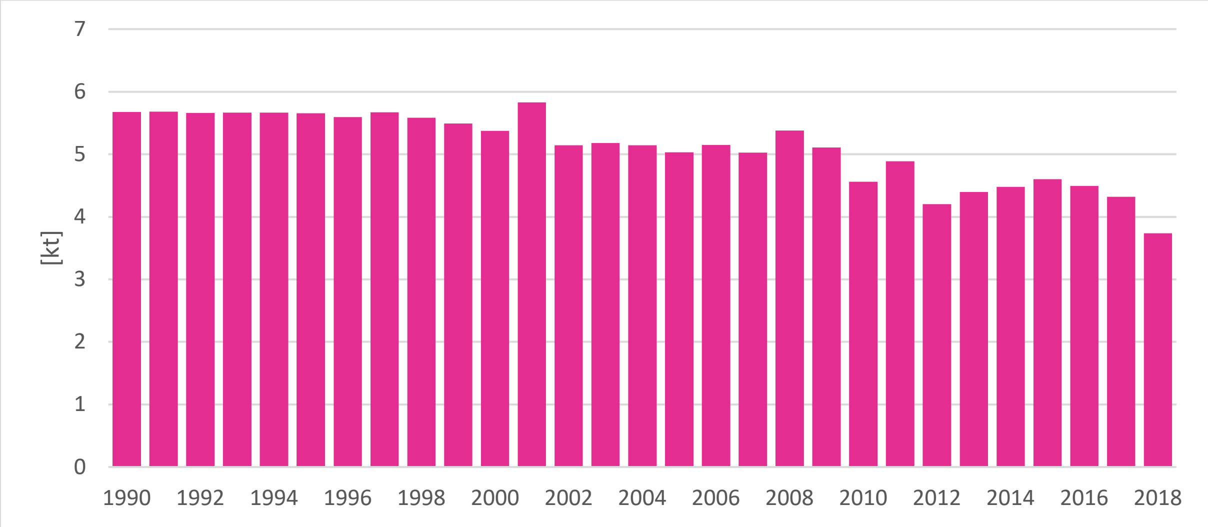
3.5.7 STATIONARY COMBUSTION IN MANUFACTURING INDUSTRIES AND CONSTRUCTION: NON-METALLIC MINERALS (NFR 1A2f)

3.5.7.1 Overview

Emissions in this category include combustion processes within the cement, lime, glass and glass wool production in the Slovak Republic. The emissions depend on fuel and process activity. Relevant pollutants are generally described for combustion: SO_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).

This category is key for emissions of NOx. A slightly decreasing trend of emissions of this pollutant is shown in ***Figure 3.26***.

Figure 3.26: *Trends of NOx emissions in the category 1A2f*



Overview of the emissions is shown in ***Table 3.58***. Emissions of air pollutants in this category show an overall decreasing trend due to stricter emission limits for these pollutants. Only emissions of Zn and HCB are increased since 1990 due to the significant increase of using biomass as a fuel within this category.

Table 3.58 *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
1995	5.6543	0.0739	0.6571	NO	0.0244	0.0344	0.0385	11.3375
2000	5.3727	0.0746	0.7341	0.0031	0.0285	0.0401	0.0449	9.0429
2005	5.0294	0.0677	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	0.1852	0.3421	0.0240	0.0024	0.0031	0.0059	7.6889
2016	4.4955	0.1752	0.3008	0.0428	0.0023	0.0026	0.0031	7.8489
2017	4.3187	0.1748	0.2779	0.0439	0.0018	0.0019	0.0020	8.8505
2018	3.7363	0.1739	0.2133	0.0384	0.0017	0.0019	0.0022	10.9896
1990/2018	**-34%**	**135%**	**-68%**	**-**	**-93%**	**-95%**	**-94%**	**-3%**
2017/2018	**-13%**	**-1%**	**-23%**	**-12%**	**-5%**	**-2%**	**14%**	**24%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.7140	0.0108	0.0485	0.0225	0.0741	0.0936	0.0694	0.0104	1.1363
1995	0.7210	0.0109	0.0489	0.0227	0.0748	0.0945	0.0700	0.0104	1.1448
2000	0.7632	0.0115	0.0507	0.0238	0.0791	0.1001	0.0741	0.0110	1.2105
2005	1.0977	0.0212	0.0691	0.0334	0.1210	0.1447	0.1063	0.0154	1.8914
2010	0.9009	0.0204	0.0549	0.0269	0.1041	0.1193	0.0870	0.0125	1.6647
2011	0.8977	0.0204	0.0547	0.0268	0.1039	0.1189	0.0867	0.0124	1.6622
2012	0.8284	0.0189	0.0502	0.0247	0.0960	0.1097	0.0800	0.0114	1.5328
2013	0.5681	0.0126	0.0355	0.0172	0.0656	0.0755	0.0549	0.0081	1.0761
2014	0.5791	0.0113	0.0362	0.0176	0.0643	0.0766	0.0561	0.0082	1.0398
2015	0.6041	0.0120	0.0376	0.0183	0.0676	0.0802	0.0585	0.0086	1.1181
2016	0.5647	0.0137	0.0356	0.0171	0.0672	0.0755	0.0545	0.0082	1.1436

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2017	0.6016	0.0142	0.0379	0.0182	0.0709	0.0803	0.0581	0.0087	1.1997
2018	0.5744	0.0156	0.0360	0.0173	0.0710	0.0770	0.0554	0.0083	1.2186
1990/2018	**-20%**	**44%**	**-26%**	**-23%**	**-4%**	**-18%**	**-20%**	**-20%**	**7%**
2017/2018	**-5%**	**10%**	**-5%**	**-5%**	**0%**	**-4%**	**-5%**	**-4%**	**2%**

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	1.0941	0.2521	0.3574	0.1404	0.1123	0.8622	0.0038	0.9024
1995	1.1045	0.2543	0.3594	0.1414	0.1131	0.8683	0.0038	0.9112
2000	1.1681	0.2681	0.3765	0.1479	0.1179	0.9103	0.0040	0.9648
2005	1.6978	0.3802	0.5148	0.2047	0.1619	1.2616	0.0075	1.3752
2010	1.4061	0.3102	0.4159	0.1649	0.1298	1.0208	0.0074	1.1204
2011	1.4015	0.3091	0.4148	0.1644	0.1294	1.0177	0.0074	1.1162
2012	1.2934	0.2846	0.3786	0.1508	0.1186	0.9326	0.0068	1.0298
2013	0.8879	0.1988	0.2836	0.1075	0.0851	0.6749	0.0046	0.7070
2014	0.8976	0.2025	0.2891	0.1094	0.0865	0.6875	0.0040	0.7250
2015	0.9384	0.2125	0.3131	0.1150	0.0911	0.7317	0.0043	0.7556
2016	0.8895	0.2000	0.2997	0.1092	0.0867	0.6956	0.0050	0.6996
2017	0.9455	0.2128	0.3173	0.1160	0.0921	0.7381	0.0051	0.7465
2018	0.9121	0.2030	0.3018	0.1106	0.0878	0.7032	0.0057	0.7071
1990/2018	**-17%**	**-19%**	**-16%**	**-21%**	**-22%**	**-18%**	**51%**	**-22%**
2017/2018	**-4%**	**-5%**	**-5%**	**-5%**	**-5%**	**-5%**	**11%**	**-5%**

Overview of the activity data (energy consumption) for this source category is in ***Table 3.59*** below. This table represents fuels allocated to the fuel type for the calculations (following Table 3-1 of EMEP/EEA GB_{2019}, Part Manufacturing industries and construction (combustion)). Fuels in the template are allocated following principle prom IPCC 2006 Guidelines.

Table 3.59: *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	5308.02	11897.64	95.99	17.10
1995	520.34	5359.76	11846.05	95.99	17.11
2000	638.78	5675.22	10711.69	95.99	20.25
2005	257.90	8089.02	9109.96	506.78	792.00
2010	275.16	6590.37	4522.16	655.05	3439.86
2011	295.77	6565.93	4513.42	658.54	3378.13
2012	86.93	6057.41	3665.36	617.42	3675.01
2013	1330.76	4158.81	4248.36	395.71	4316.48
2014	1447.69	4264.56	4050.67	277.21	5221.75
2015	2360.17	4444.44	3777.06	308.63	4982.50
2016	2406.49	4115.03	4662.13	483.15	5223.98
2017	2461.57	4390.73	4842.44	481.78	7003.06
2018	2217.91	4159.07	4674.96	623.07	5377.96
1990/2018	**281%**	**-22%**	**-61%**	**549%**	**31358%**
2017/2018	**-10%**	**-5%**	**-3%**	**29%**	**-23%**

3.5.7.2 Methodological issues

Calculations of annual emissions are performed in the NEIS. The emissions were balanced in comply with general EF of the Bulletin of Ministry of Environment. These emissions factors are presented in **ANNEX IV, Chapter A4.6**. 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 on 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 (***Table 3.60***).

Table 3.60*: 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	

The emissions were balanced in comply with general EF of the Bulletin of Ministry of Environment. These emissions factors are presented in **ANNEX IV, Chapter A4.6**.

Historical data 1990-1999 are not covered by NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***Table 3.61***).

Table 3.61: *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 were balanced using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.62***).

Table 3.62: *Emission factor for heavy metals and POPs in the category 1A2f*

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/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

3.5.7.3 Completeness

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

3.5.7.4 Source-specific recalculations

In this submission, combustion emissions (NOx, NMVOC, SOx and CO) from the category 2A1, 2A2 and 2A3 were reallocated to this category which caused significant changes. This change was done because most of these emissions originate during the combustion processes. PMs emissions were assumed as mostly process emissions, therefore, they were not reallocated.

Also, recalculations were done due to change of categorisation of fuels and change of approach toward the calculation of HMs and POPs emission, where EMEP/EEA GB_{2019} EF instead of CS EF were used. 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 3.63*** shows the change in the data between final submission 2019 and this submission.

Table 3.63: *Previous and refined emissions in the category 1A2f*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0840	5.6738	6654%	0.0063	0.0741	1082%	0.1617	0.6594	308%
1991	0.0845	5.6780	6617%	0.0063	0.0742	1076%	0.1627	0.6599	306%
1992	0.0866	5.6623	6436%	0.0065	0.0740	1044%	0.1667	0.6580	295%
1993	0.0899	5.6647	6202%	0.0067	0.0740	1003%	0.1730	0.6583	281%
1994	0.0940	5.6675	5930%	0.0070	0.0740	955%	0.1809	0.6586	264%
1995	0.0997	5.6543	5574%	0.0074	0.0739	893%	0.1918	0.6571	243%
1996	0.1050	5.5947	5228%	0.0078	0.0731	833%	0.2021	0.6502	222%
1997	0.1098	5.6709	5066%	0.0082	0.0741	804%	0.2113	0.6590	212%
1998	0.1136	5.5834	4817%	0.0085	0.0729	761%	0.2186	0.6489	197%
1999	0.1175	5.4889	4570%	0.0088	0.0717	717%	0.2262	0.6379	182%
2000	0.1070	5.3727	4921%	0.0064	0.0746	1063%	0.2456	0.7341	199%
2001	0.1129	5.8293	5064%	0.0104	0.0751	623%	0.2101	0.7345	250%
2002	0.1020	5.1429	4942%	0.0073	0.0809	1013%	0.1927	0.6241	224%
2003	0.0798	5.1787	6389%	0.0059	0.0632	969%	0.1248	0.5401	333%
2004	0.0561	5.1451	9075%	0.0021	0.0535	2397%	0.0295	0.4704	1492%
2005	0.0485	5.0294	10270%	0.0022	0.0677	2917%	0.0168	0.4997	2873%
2006	0.0395	5.1479	12922%	0.0016	0.1017	6192%	0.0173	0.3207	1751%
2007	0.0314	5.0242	15881%	0.0009	0.1278	13512%	0.0150	0.3770	2416%
2008	0.0306	5.3794	17508%	0.0008	0.1467	17247%	0.0172	0.6996	3963%
2009	0.0236	5.1099	21512%	0.0006	0.1055	16608%	0.0220	0.4676	2024%
2010	0.0214	4.5594	21227%	0.0007	0.1898	27891%	0.0121	0.3220	2553%
2011	0.0174	4.8866	27990%	0.0007	0.2473	37499%	0.0080	0.3462	4238%
2012	0.0150	4.2019	27934%	0.0006	0.1520	26413%	0.0079	0.4290	5338%
2013	0.0113	4.3940	38905%	0.0005	0.1198	24094%	0.0074	0.3624	4810%
2014	0.0093	4.4765	48107%	0.0004	0.1498	35397%	0.0068	0.3841	5548%
2015	0.0094	4.6022	48944%	0.0004	0.1852	41499%	0.0051	0.3421	6611%
2016	0.0104	4.4955	43273%	0.0006	0.1752	31507%	0.0004	0.3008	82337%
2017	0.0108	4.3187	40036%	0.0006	0.1748	30062%	0.0001	0.2779	452349%

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	0.0101	0.0245	142%	0.0143	0.0345	142%	0.0345	0.0386	12%	0.0909	11.3766	12411%
1991	0.0102	0.0245	140%	0.0144	0.0345	140%	0.0347	0.0387	11%	0.0915	11.3851	12343%
1992	0.0104	0.0245	134%	0.0147	0.0344	134%	0.0355	0.0385	8%	0.0938	11.3536	12008%
1993	0.0108	0.0245	126%	0.0153	0.0344	126%	0.0369	0.0386	5%	0.0973	11.3583	11574%
1994	0.0113	0.0245	116%	0.0160	0.0345	116%	0.0386	0.0386	0%	0.1017	11.3640	11070%
1995	0.0120	0.0244	103%	0.0169	0.0344	103%	0.0409	0.0385	-6%	0.1079	11.3375	10411%
1996	0.0127	0.0242	91%	0.0178	0.0340	91%	0.0431	0.0381	-12%	0.1137	11.2179	9770%
1997	0.0132	0.0245	85%	0.0186	0.0345	85%	0.0450	0.0386	-14%	0.1188	11.3708	9469%
1998	0.0137	0.0241	76%	0.0193	0.0339	76%	0.0466	0.0380	-18%	0.1229	11.1954	9008%
1999	0.0142	0.0237	67%	0.0200	0.0334	67%	0.0482	0.0374	-23%	0.1272	11.0059	8550%
2000	0.0132	0.0285	116%	0.0186	0.0401	116%	0.0449	0.0449	-	0.1418	9.0429	6276%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2001	0.0135	0.0292	116%	0.0190	0.0411	116%	0.0460	0.0460	-	0.1183	9.8913	8264%
2002	0.0120	0.0259	116%	0.0169	0.0364	116%	0.0408	0.0408	-	0.1080	10.7496	9851%
2003	0.0098	0.0210	116%	0.0137	0.0296	116%	0.0332	0.0332	-	0.0667	12.1598	18135%
2004	0.0049	0.0107	116%	0.0070	0.0150	116%	0.0168	0.0168	-	0.0252	11.4248	45306%
2005	0.0044	0.0044	-	0.0063	0.0063	-	0.0162	0.0162	-	0.0272	10.2890	37774%
2006	0.0040	0.0040	-	0.0059	0.0059	-	0.0169	0.0169	-	0.0248	9.6115	38626%
2007	0.0036	0.0036	-	0.0052	0.0052	-	0.0140	0.0140	-	0.0170	10.8521	63796%
2008	0.0049	0.0049	-	0.0071	0.0071	-	0.0176	0.0176	-	0.0188	16.6834	88490%
2009	0.0028	0.0028	-	0.0050	0.0050	-	0.0179	0.0179	-	0.0145	15.4858	106417%
2010	0.0029	0.0029	-	0.0045	0.0045	-	0.0124	0.0124	-	0.0125	12.8343	102544%
2011	0.0022	0.0022	-	0.0033	0.0033	-	0.0088	0.0088	-	0.0103	11.3292	110154%
2012	0.0030	0.0030	-	0.0040	0.0040	-	0.0074	0.0074	-	0.0102	9.3928	91872%
2013	0.0027	0.0027	-	0.0036	0.0036	-	0.0074	0.0074	-	0.0083	7.9731	95732%
2014	0.0024	0.0024	-	0.0032	0.0032	-	0.0067	0.0067	-	0.0073	9.7134	133499%
2015	0.0024	0.0024	-	0.0031	0.0031	-	0.0059	0.0059	-	0.0086	7.6889	89307%
2016	0.0023	0.0023	-	0.0026	0.0026	-	0.0031	0.0031	-	0.0073	7.8489	107968%
2017	0.0018	0.0018	-	0.0019	0.0019	-	0.0020	0.0020	-	0.0064	8.8505	138251%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0202	0.7140	3435%	3E-04	0.0108	3589%	0.0017	0.0485	2719%	7E-04	0.0225	3109%
1991	0.0149	0.7161	4703%	2E-04	0.0108	4795%	0.0014	0.0486	3287%	5E-04	0.0225	4017%
1992	0.0106	0.7125	6617%	2E-04	0.0108	6515%	0.0012	0.0484	3879%	4E-04	0.0224	5173%
1993	0.0072	0.7180	9863%	1E-04	0.0109	9186%	0.0011	0.0487	4515%	3E-04	0.0226	6723%
1994	0.0046	0.7198	15512%	8E-05	0.0109	13224%	0.0009	0.0488	5068%	3E-04	0.0226	8563%
1995	0.0046	0.7210	15453%	8E-05	0.0109	13247%	0.0010	0.0489	4842%	3E-04	0.0227	8296%
1996	0.0043	0.7130	16451%	8E-05	0.0108	13926%	0.0010	0.0483	4677%	3E-04	0.0224	8264%
1997	0.0035	0.7524	21214%	7E-05	0.0113	16991%	0.0010	0.0506	4940%	3E-04	0.0236	9262%
1998	0.0022	0.7243	32799%	5E-05	0.0110	22611%	0.0010	0.0489	5001%	2E-04	0.0227	10309%
1999	0.0002	0.7422	331074%	2E-05	0.0112	51958%	0.0009	0.0498	5552%	2E-04	0.0232	13856%
2000	0.0176	0.7632	4225%	3E-04	0.0115	4415%	0.0017	0.0507	2810%	7E-04	0.0238	3528%
2001	0.0180	0.8827	4817%	3E-04	0.0131	4951%	0.0017	0.0580	3219%	7E-04	0.0274	4037%
2002	0.0125	0.6681	5261%	2E-04	0.0147	7704%	0.0015	0.0444	2956%	5E-04	0.0207	4004%
2003	0.0076	1.0270	13412%	1E-04	0.0210	17305%	0.0011	0.0644	5921%	3E-04	0.0311	9025%
2004	0.0019	1.0155	53527%	4E-05	0.0208	47866%	0.0006	0.0637	9707%	2E-04	0.0308	19725%
2005	0.0020	1.0977	54618%	4E-05	0.0212	48766%	0.0007	0.0691	9237%	2E-04	0.0334	19042%
2006	0.0022	0.9623	44241%	4E-05	0.0210	48498%	0.0006	0.0610	10611%	1E-04	0.0292	19946%
2007	0.0017	0.9627	55403%	4E-05	0.0216	54985%	0.0005	0.0607	13279%	1E-04	0.0292	25006%
2008	0.0020	1.1686	57277%	7E-05	0.0254	36026%	0.0004	0.0720	17217%	1E-04	0.0351	30724%
2009	0.0023	0.9670	41386%	4E-05	0.0207	48510%	0.0004	0.0590	16012%	1E-04	0.0290	25898%
2010	0.0017	0.9009	51598%	4E-05	0.0204	50448%	0.0003	0.0549	17005%	9E-05	0.0269	29259%
2011	0.0013	0.8977	71545%	3E-05	0.0204	78164%	0.0003	0.0547	20778%	7E-05	0.0268	37258%
2012	0.0011	0.8284	75559%	4E-05	0.0189	46300%	0.0002	0.0502	22794%	6E-05	0.0247	40834%
2013	0.0010	0.5681	57612%	4E-05	0.0126	32654%	0.0002	0.0355	20540%	5E-05	0.0172	34523%
2014	0.0009	0.5791	66163%	4E-05	0.0113	30800%	0.0001	0.0362	24974%	4E-05	0.0176	41313%
2015	0.0007	0.6041	88848%	4E-05	0.0120	32888%	0.0001	0.0376	27185%	4E-05	0.0183	48762%
2016	0.0001	0.5647	558135%	3E-05	0.0137	48544%	0.0001	0.0356	28687%	2E-05	0.0171	71536%
2017	0.0001	0.6016	1057874%	3E-05	0.0142	54610%	0.0001	0.0379	29760%	2E-05	0.0182	76865%

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	7E-05	0.0769	110093%	3E-05	0.0973	279066%	4E-05	0.0721	180389%
2000	2E-03	0.0791	4245%	2E-03	0.1001	4231%	2E-03	0.0741	4193%
2001	2E-03	0.0910	4814%	2E-03	0.1155	4815%	2E-03	0.0857	4783%
2002	1E-03	0.0766	5772%	2E-03	0.0884	5310%	1E-03	0.0647	5186%
2003	8E-04	0.1151	14137%	1E-03	0.1356	13482%	7E-04	0.0994	13154%
2004	2E-04	0.1139	49189%	3E-04	0.1341	52964%	2E-04	0.0983	50483%
2005	2E-04	0.1210	50148%	3E-04	0.1447	54184%	2E-04	0.1063	51107%
2006	3E-04	0.1100	43897%	3E-04	0.1273	44237%	2E-04	0.0931	42284%
2007	2E-04	0.1110	53426%	2E-04	0.1275	55217%	2E-04	0.0931	53015%
2008	3E-04	0.1335	47489%	3E-04	0.1546	56058%	2E-04	0.1130	55848%
2009	3E-04	0.1099	42534%	3E-04	0.1279	41501%	2E-04	0.0935	40460%
2010	2E-04	0.1041	50158%	2E-04	0.1193	51457%	2E-04	0.0870	50215%
2011	1E-04	0.1039	71606%	2E-04	0.1189	71579%	1E-04	0.0867	69167%
2012	2E-04	0.0960	61638%	1E-04	0.1097	73725%	1E-04	0.0800	73814%
2013	1E-04	0.0656	45922%	1E-04	0.0755	56212%	1E-04	0.0549	56707%
2014	1E-04	0.0643	49331%	1E-04	0.0766	64035%	9E-05	0.0561	65473%
2015	1E-04	0.0676	58999%	9E-05	0.0802	84848%	7E-05	0.0585	87557%
2016	6E-05	0.0672	120485%	2E-05	0.0755	401057%	1E-05	0.0545	491986%
2017	5E-05	0.0709	145387%	1E-05	0.0803	631026%	7E-06	0.0581	831715%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	3E-04	0.0104	3033%	0.0323	1.1363	3420%
1991	3E-04	0.0104	3863%	0.0243	1.1391	4593%
1992	2E-04	0.0103	4878%	0.0178	1.1336	6278%
1993	2E-04	0.0104	6174%	0.0126	1.1420	8932%
1994	1E-04	0.0104	7612%	0.0087	1.1447	13006%
1995	1E-04	0.0104	7357%	0.0088	1.1448	12978%
1996	1E-04	0.0103	7281%	0.0083	1.1342	13631%
1997	1E-04	0.0109	8024%	0.0071	1.1921	16638%
1998	1E-04	0.0105	8676%	0.0051	1.1479	22193%
1999	1E-04	0.0107	10943%	0.0022	1.1717	53053%
2000	3E-04	0.0110	3394%	0.0281	1.2105	4210%
2001	3E-04	0.0125	3857%	0.0287	1.3728	4684%
2002	2E-04	0.0096	3821%	0.0205	1.2182	5833%
2003	2E-04	0.0144	8363%	0.0130	1.8109	13821%
2004	8E-05	0.0142	16800%	0.0044	1.7959	40840%
2005	9E-05	0.0154	16233%	0.0044	1.8914	42573%
2006	8E-05	0.0136	17548%	0.0044	1.7502	40063%
2007	6E-05	0.0135	21954%	0.0037	1.7728	48240%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
2008	6E-05	0.0162	26918%	0.0051	2.1196	41500%
2009	6E-05	0.0134	23671%	0.0043	1.7424	40795%
2010	5E-05	0.0125	26307%	0.0035	1.6647	46797%
2011	4E-05	0.0124	33262%	0.0025	1.6622	66788%
2012	3E-05	0.0114	35632%	0.0029	1.5328	53369%
2013	3E-05	0.0081	30779%	0.0026	1.0761	40901%
2014	2E-05	0.0082	36509%	0.0024	1.0398	42807%
2015	2E-05	0.0086	42550%	0.0022	1.1181	50943%
2016	1E-05	0.0082	55961%	0.0013	1.1436	85650%
2017	1E-05	0.0087	59459%	0.0012	1.1997	98627%

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	0.0312	1.0941	3407%	0.0282	0.8622	2955%	1E-04	0.0038	3614%	3E-02	0.9024	3434%
1991	0.0232	1.0972	4629%	0.0226	0.8643	3716%	8E-05	0.0038	4822%	2E-02	0.9049	4707%
1992	0.0167	1.0917	6431%	0.0182	0.8602	4615%	6E-05	0.0038	6541%	1E-02	0.9004	6634%
1993	0.0116	1.1001	9384%	0.0149	0.8661	5717%	4E-05	0.0038	9202%	9E-03	0.9074	9913%
1994	0.0077	1.1029	14217%	0.0125	0.8681	6871%	3E-05	0.0038	13207%	6E-03	0.9097	15663%
1995	0.0078	1.1045	14099%	0.0129	0.8683	6630%	3E-05	0.0038	13248%	6E-03	0.9112	15595%
1996	0.0073	1.0925	14825%	0.0130	0.8595	6531%	3E-05	0.0038	13937%	5E-03	0.9011	16613%
1997	0.0062	1.1520	18554%	0.0125	0.9018	7106%	2E-05	0.0039	16990%	4E-03	0.9510	21491%
1998	0.0042	1.1093	26357%	0.0114	0.8695	7522%	2E-05	0.0038	22561%	3E-03	0.9154	33553%
1999	0.0012	1.1362	92129%	0.0096	0.8852	9092%	8E-06	0.0039	51129%	2E-04	0.9381	441741%
2000	0.0275	1.1681	4153%	0.0270	0.9103	3269%	9E-05	0.0040	4454%	2E-02	0.9648	4223%
2001	0.0279	1.3486	4730%	0.0273	1.0325	3684%	9E-05	0.0046	4987%	2E-02	1.1164	4818%
2002	0.0196	1.0438	5215%	0.0215	0.7926	3584%	7E-05	0.0053	8014%	2E-02	0.8320	5190%
2003	0.0122	1.5938	12986%	0.0151	1.1776	7680%	4E-05	0.0075	17859%	1E-02	1.2834	13307%
2004	0.0035	1.5762	45547%	0.0080	1.1664	14478%	2E-05	0.0075	48565%	2E-03	1.2688	54255%
2005	0.0037	1.6978	45868%	0.0089	1.2616	14051%	2E-05	0.0075	49588%	2E-03	1.3752	55220%
2006	0.0038	1.5002	39766%	0.0071	1.1132	15475%	2E-05	0.0076	49716%	3E-03	1.1989	44232%
2007	0.0030	1.5035	49534%	0.0057	1.1115	19347%	1E-05	0.0078	55823%	2E-03	1.1977	55654%
2008	0.0036	1.8197	50958%	0.0055	1.3292	24060%	3E-05	0.0092	35354%	2E-03	1.4562	59133%
2009	0.0038	1.5038	39504%	0.0051	1.0934	21505%	2E-05	0.0075	49593%	3E-03	1.2057	41209%
2010	0.0029	1.4061	48009%	0.0043	1.0208	23664%	1E-05	0.0074	50851%	2E-03	1.1204	51802%
2011	0.0021	1.4015	66118%	0.0034	1.0177	29637%	9E-06	0.0074	79668%	2E-03	1.1162	71485%
2012	0.0019	1.2934	67043%	0.0029	0.9326	31723%	2E-05	0.0068	45426%	1E-03	1.0298	78340%
2013	0.0017	0.8879	51584%	0.0024	0.6749	28324%	1E-05	0.0046	31844%	1E-03	0.7070	60051%
2014	0.0015	0.8976	58631%	0.0020	0.6875	33716%	1E-05	0.0040	29647%	1E-03	0.7250	69823%
2015	0.0012	0.9384	74992%	0.0018	0.7317	39510%	1E-05	0.0043	31449%	8E-04	0.7556	96227%
2016	0.0004	0.8895	228049%	0.0014	0.6956	48627%	1E-05	0.0050	46165%	5E-05	0.6996	1344103%
2017	0.0003	0.9455	295088%	0.0014	0.7381	51134%	1E-05	0.0051	51785%	1E-07	0.7465	628998831%

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. 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 the year 2017 and were used for estimation of emissions from residential machinery the first time in 2019 inventory.

Results of the first separation of the categories 1A2gvii, 1A4aii and 1A4bii (reported together under 1A2gvii) from the category 1A4cii are in ***Table 3.64***.

Table 3.64: *Overview of emissions from mobile combustion in manufacturing (1A2gvii), commercial/institutional: mobile (1A4aii) and residential: mobile (1A4bii) for years 2014–2018*

YEAR	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	CO	BC	PRIORITY HEAVY METALS	PAH
	t							kg	
2014	1448.31	148.88	0.84	0.34	80.41	482.07	46.70	0.42	0.34
2015	1448.31	148.88	0.84	0.34	80.41	482.07	46.70	0.42	0.34
2016	1455.00	149.57	0.84	0.34	80.78	484.30	46.91	0.42	0.34
2017	1461.02	150.18	0.85	0.34	81.11	486.30	47.11	0.42	0.34
2018	929.21	95.52	0.54	0.22	51.59	309.29	29.96	0.27	0.22

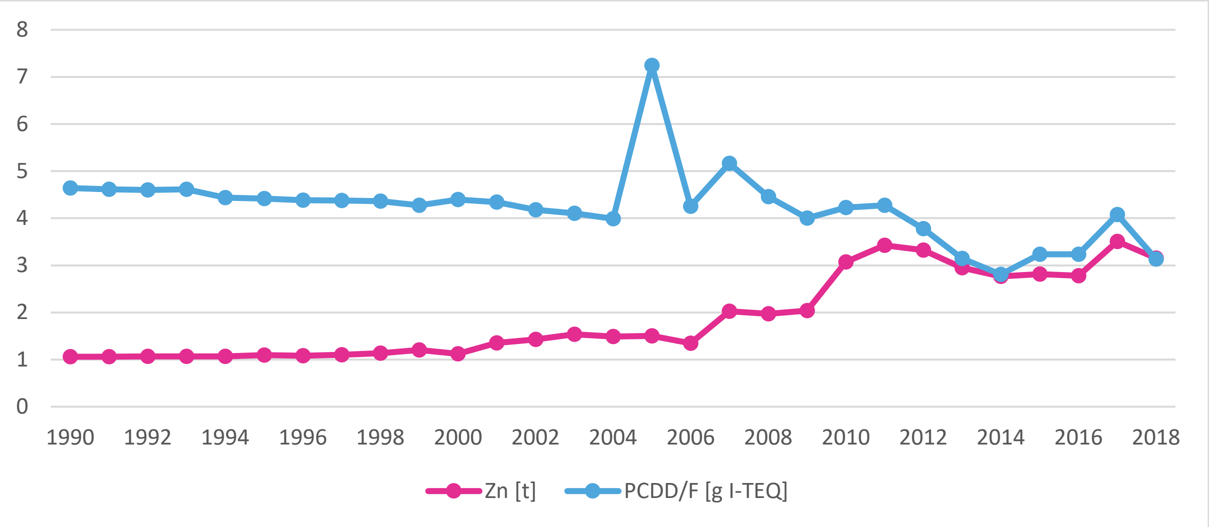
3.5.9 STATIONARY COMBUSTION IN MANUFACTURING INDUSTRIES AND CONSTRUCTION: OTHER (NFR 1A2gviii)

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. The definition of sources is provided in ***Table 3.66***.

This category is key for emissions of Zn and PCDD/F. Emission trends of these pollutants are shown in ***Figure 3.27***.

Figure 3.27: *Trends of Zn and PCDD/F emissions in the category 1A2gviii*



Overview of the emissions is shown in ***Table 3.65***. 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. Increase of HMs and PAHs in 2016 correlate with consumption of solid fuels. The overall trend of these emissions is connected with trend of biomass fuels used.

Table 3.65 *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	2.5765	0.2076	2.3573	0.0269	0.6974	0.9523	1.4637	3.6983
1995	2.5312	0.2005	2.3162	0.0264	0.6853	0.9357	1.4382	3.6338
2000	2.4920	0.2139	1.6427	0.0080	0.5624	0.7680	1.1803	3.0051
2005	1.1467	0.2087	0.6846	0.0076	0.2663	0.3539	0.6152	2.1227
2010	1.1055	0.1514	0.2113	0.0051	0.1490	0.2055	0.3074	1.8498
2011	1.1843	0.1699	0.2336	0.0072	0.1360	0.1876	0.2796	2.0268
2012	1.1140	0.1591	0.2122	0.0074	0.1529	0.2007	0.2838	1.7751
2013	0.9983	0.1637	0.2475	0.0062	0.1183	0.1649	0.2454	1.8274
2014	0.9452	0.1796	0.2380	0.0064	0.1142	0.1695	0.2671	1.6512
2015	1.1224	0.1948	0.2591	0.0066	0.1190	0.1807	0.2909	1.7673
2016	1.1837	0.2134	0.2673	0.0067	0.1271	0.1758	0.2566	1.1501
2017	1.4433	0.2387	0.4315	0.0081	0.1362	0.1866	0.2713	1.2735
2018	1.1925	0.2000	0.2594	0.0087	0.1310	0.1838	0.2717	1.2491
1990/2018	**-54%**	**-4%**	**-89%**	**-68%**	**-81%**	**-81%**	**-81%**	**-66%**
2017/2018	**-17%**	**-16%**	**-40%**	**7%**	**-4%**	**-2%**	**0%**	**-2%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.3562	0.0199	0.0305	0.0117	0.0573	0.0474	0.0343	0.0059	1.0601
1995	0.3603	0.0206	0.0305	0.0118	0.0589	0.0482	0.0346	0.0060	1.0923
2000	0.3019	0.0229	0.0256	0.0096	0.0579	0.0412	0.0288	0.0051	1.1227
2005	0.2183	0.0367	0.0152	0.0055	0.0712	0.0316	0.0200	0.0036	1.5051
2010	0.2048	0.0780	0.0098	0.0030	0.1387	0.0396	0.0165	0.0038	3.0707
2011	0.2455	0.0863	0.0116	0.0038	0.1554	0.0465	0.0200	0.0045	3.4221
2012	0.2172	0.0842	0.0102	0.0031	0.1501	0.0427	0.0173	0.0041	3.3228
2013	0.1959	0.0747	0.0097	0.0030	0.1335	0.0384	0.0157	0.0037	2.9526
2014	0.1879	0.0698	0.0092	0.0029	0.1252	0.0365	0.0151	0.0035	2.7645
2015	0.1895	0.0711	0.0096	0.0029	0.1273	0.0368	0.0152	0.0036	2.8141
2016	0.1778	0.0706	0.0093	0.0027	0.1255	0.0352	0.0141	0.0035	2.7821
2017	0.4874	0.0819	0.0270	0.0116	0.1679	0.0768	0.0438	0.0077	3.5072
2018	0.1967	0.0801	0.0096	0.0028	0.1423	0.0396	0.0155	0.0038	3.1562
1990/2018	**-45%**	**303%**	**-69%**	**-76%**	**148%**	**-17%**	**-55%**	**-35%**	**198%**
2017/2018	**-60%**	**-2%**	**-65%**	**-76%**	**-15%**	**-49%**	**-65%**	**-50%**	**-10%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	4.6383	0.1318	0.2178	0.0833	0.0697	0.5029	0.0301	0.3942
1995	4.4149	0.1332	0.2187	0.0837	0.0698	0.5056	0.0291	0.3987
2000	4.3944	0.1122	0.1901	0.0712	0.0597	0.4334	0.0303	0.3161
2005	7.2439	0.0754	0.1296	0.0461	0.0385	0.2900	0.0521	0.1579
2010	4.2269	0.0754	0.1318	0.0435	0.0362	0.2870	0.0501	0.0416

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	4.2747	0.0899	0.1522	0.0509	0.0421	0.3353	0.0530	0.0724
2012	3.7759	0.0808	0.1404	0.0464	0.0385	0.3062	0.0497	0.0429
2013	3.1437	0.0736	0.1285	0.0427	0.0356	0.2806	0.0428	0.0432
2014	2.8083	0.0704	0.1215	0.0406	0.0337	0.2663	0.0393	0.0473
2015	3.2372	0.0712	0.1250	0.0416	0.0347	0.2726	0.0422	0.0439
2016	3.2335	0.0676	0.1215	0.0401	0.0337	0.2630	0.0420	0.0301
2017	4.0750	0.1729	0.2603	0.0950	0.0767	0.6051	0.0481	0.4021
2018	3.1306	0.0747	0.1325	0.0436	0.0364	0.2873	0.0447	0.0299
1990/2018	**-33%**	**-43%**	**-39%**	**-48%**	**-48%**	**-43%**	**48%**	**-92%**
2017/2018	**-23%**	**-57%**	**-49%**	**-54%**	**-52%**	**-53%**	**-7%**	**-93%**

Overview of the activity data (energy consumption) for this source category is in ***Table 3.66*** below. This table represents fuels allocated to the fuel type for the calculations (following Table 3-1 of EMEP/EEA GB_{2019}, Part Manufacturing industries and construction (combustion)). Fuels in the template are allocated following principle prom IPCC 2006 Guidelines.

Table 3.66: *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	315.39	2318.63	20212.74	1118.20	NO
1995	307.61	2345.02	19722.79	1171.80	NO
2000	483.85	1859.07	17494.28	1414.16	NO
2005	393.97	927.89	9774.24	2541.02	11.66
2010	139.24	242.57	7332.45	5884.32	9.91
2011	102.80	423.59	7470.79	6501.87	NO
2012	106.16	250.28	7604.82	6375.29	NO
2013	73.26	252.31	7616.12	5653.20	NO
2014	68.93	276.46	6820.59	5277.84	NO
2015	115.00	256.39	7628.84	5378.81	NO
2016	115.34	175.15	8232.06	5347.14	NO
2017	142.15	2363.12	8424.52	5906.89	NO
2018	99.96	173.66	8088.59	6079.51	NO
1990/2018	**-68%**	**-93%**	**-60%**	**444%**	**-**
2017/2018	**-30%**	**-93%**	**-4%**	**3%**	**-**

3.5.9.2 Methodological issues

Main air pollutants, CO and PMs emissions were taken from the NEIS. Heavy metals and POPs emissions were balanced with T1 methodology.

For emissions calculation methodology of clinical waste incineration with energy recovery, please see **Chapter 6.7.4.2**.

Table 3.67: *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

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

Industrial waste incinerated with energy recovery is calculated using Tier 1 emissions factors from EMEP/EEA GB_{2019}. Amounts of incinerated waste, as well as emission factors for this source, are described in **Chapter 6.7.2.1** and **Chapter 6.7.2.2**.

The emissions were balanced in comply with general EF of the Bulletin of Ministry of Environment. These emissions factors are presented in **ANNEX IV, Chapter A4.6**.

Historical data 1990-1999 are not covered by NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***Table 3.68***).

Table 3.68: *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 were balanced using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 3.69***).

Table 3.69: *Emission factor 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/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 were done due to change of categorisation of fuels and change of approach toward the calculation of HMs and POPs emission, where EMEP/EEA GB_{2019} EF instead of CS EF were used. 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 3.70*** shows the change in the data between final submission 2019 and this submission.

Source of the activity data for industrial waste incinerated was changed which caused significant changes within the category. More information in **ANNEX VIII**.

Table 3.70: *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	2.1219	2.5765	21%	0.1009	0.2076	106%	1.9486	2.3573	21%	0.0222	0.0269	21%
1991	2.0130	2.5756	28%	0.0957	0.2070	116%	1.8486	2.3566	27%	0.0211	0.0269	27%
1992	1.9395	2.5615	32%	0.0923	0.2060	123%	1.7811	2.3437	32%	0.0203	0.0267	32%
1993	1.8955	2.5640	35%	0.0902	0.2065	129%	1.7407	2.3459	35%	0.0199	0.0268	35%
1994	1.8762	2.5568	36%	0.0892	0.2024	127%	1.7230	2.3397	36%	0.0197	0.0267	36%
1995	1.9253	2.5312	31%	0.0916	0.2005	119%	1.7681	2.3162	31%	0.0202	0.0264	31%
1996	1.9650	2.4914	27%	0.0935	0.1983	112%	1.8045	2.2798	26%	0.0206	0.0260	26%
1997	1.9891	2.5300	27%	0.0946	0.1998	111%	1.8266	2.3152	27%	0.0208	0.0264	27%
1998	1.9953	2.4065	21%	0.0949	0.1935	104%	1.8323	2.2018	20%	0.0209	0.0251	20%
1999	1.9932	2.3224	17%	0.0948	0.1875	98%	1.8303	2.1249	16%	0.0209	0.0242	16%
2000	2.4824	2.4920	0%	0.1321	0.2139	62%	1.6422	1.6427	0%	0.0080	0.0080	-
2001	2.6442	2.6533	0%	0.1184	0.1959	65%	2.1332	2.1337	0%	0.0367	0.0367	-
2002	1.3760	1.3849	1%	0.0625	0.1381	121%	1.6336	1.6341	0%	0.0222	0.0222	-
2003	1.3721	1.3810	1%	0.0615	0.1370	123%	1.8225	1.8229	0%	0.0157	0.0157	-
2004	1.1605	1.1692	1%	0.0510	0.1252	145%	0.8706	0.8710	0%	0.0144	0.0144	-
2005	1.1298	1.1467	1%	0.0650	0.2087	221%	0.6837	0.6846	0%	0.0076	0.0076	-
2006	1.0208	1.0306	1%	0.0893	0.1726	93%	0.3425	0.3430	0%	0.0099	0.0099	-
2007	1.2351	1.2468	1%	0.0771	0.1769	129%	0.2615	0.2622	0%	0.0062	0.0062	-
2008	1.3444	1.3544	1%	0.0854	0.1706	100%	0.2076	0.2081	0%	0.0080	0.0080	-
2009	0.8764	0.8852	1%	0.0578	0.1332	131%	0.1558	0.1563	0%	0.0079	0.0079	-
2010	1.0966	1.1055	1%	0.0756	0.1514	100%	0.2108	0.2113	0%	0.0051	0.0051	-
2011	1.1755	1.1843	1%	0.0951	0.1699	79%	0.2331	0.2336	0%	0.0072	0.0072	-
2012	1.1063	1.1140	1%	0.0939	0.1591	69%	0.2118	0.2122	0%	0.0074	0.0074	-
2013	0.9920	0.9983	1%	0.1103	0.1637	48%	0.2472	0.2475	0%	0.0062	0.0062	-
2014	0.9397	0.9452	1%	0.1326	0.1796	35%	0.2377	0.2380	0%	0.0064	0.0064	-
2015	1.1158	1.1224	1%	0.1390	0.1948	40%	0.2587	0.2591	0%	0.0066	0.0066	-
2016	1.1770	1.1837	1%	0.1572	0.2134	36%	0.2670	0.2673	0%	0.0067	0.0067	-
2017	1.4359	1.4433	1%	0.1752	0.2387	36%	0.4311	0.4315	0%	0.0081	0.0081	-

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	0.5766	0.6974	21%	0.7873	0.9523	21%	1.2101	1.4637	21%	3.0571	3.6983	21%
1991	0.5470	0.6972	27%	0.7469	0.9520	27%	1.1480	1.4632	27%	2.9002	3.6971	27%
1992	0.5270	0.6934	32%	0.7196	0.9468	32%	1.1061	1.4552	32%	2.7942	3.6768	32%
1993	0.5151	0.6940	35%	0.7033	0.9477	35%	1.0810	1.4566	35%	2.7309	3.6804	35%
1994	0.5098	0.6922	36%	0.6962	0.9452	36%	1.0700	1.4528	36%	2.7031	3.6706	36%
1995	0.5232	0.6853	31%	0.7144	0.9357	31%	1.0980	1.4382	31%	2.7739	3.6338	31%
1996	0.5339	0.6745	26%	0.7291	0.9210	26%	1.1206	1.4155	26%	2.8311	3.5766	26%
1997	0.5405	0.6850	27%	0.7380	0.9353	27%	1.1343	1.4376	27%	2.8657	3.6322	27%
1998	0.5422	0.6514	20%	0.7403	0.8895	20%	1.1379	1.3671	20%	2.8747	3.4543	20%
1999	0.5416	0.6286	16%	0.7396	0.8584	16%	1.1367	1.3194	16%	2.8716	3.3336	16%
2000	0.5623	0.5624	0%	0.7679	0.7680	0%	1.1802	1.1803	0%	3.0044	3.0051	0%
2001	0.6634	0.6634	0%	0.9059	0.9059	0%	1.3923	1.3924	0%	3.4381	3.4388	0%
2002	0.4844	0.4845	0%	0.6615	0.6616	0%	1.0167	1.0168	0%	2.6816	2.6823	0%
2003	0.4296	0.4296	0%	0.5866	0.5867	0%	0.9016	0.9017	0%	2.2212	2.2219	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
2004	0.3479	0.3480	0%	0.4751	0.4751	0%	0.7302	0.7303	0%	2.5729	2.5736	0%
2005	0.2662	0.2663	0%	0.3538	0.3539	0%	0.6150	0.6152	0%	2.1214	2.1227	0%
2006	0.2530	0.2531	0%	0.3404	0.3405	0%	0.5740	0.5741	0%	2.2065	2.2073	0%
2007	0.2774	0.2775	0%	0.3718	0.3719	0%	0.5940	0.5941	0%	2.2202	2.2212	0%
2008	0.2047	0.2047	0%	0.2647	0.2648	0%	0.3730	0.3731	0%	1.6864	1.6872	0%
2009	0.1441	0.1442	0%	0.1872	0.1872	0%	0.2757	0.2758	0%	1.3887	1.3894	0%
2010	0.1490	0.1490	0%	0.2055	0.2055	0%	0.3073	0.3074	0%	1.8490	1.8498	0%
2011	0.1360	0.1360	0%	0.1876	0.1876	0%	0.2795	0.2796	0%	2.0261	2.0268	0%
2012	0.1529	0.1529	0%	0.2006	0.2007	0%	0.2837	0.2838	0%	1.7744	1.7751	0%
2013	0.1183	0.1183	0%	0.1648	0.1649	0%	0.2453	0.2454	0%	1.8269	1.8274	0%
2014	0.1141	0.1142	0%	0.1695	0.1695	0%	0.2670	0.2671	0%	1.6507	1.6512	0%
2015	0.1190	0.1190	0%	0.1806	0.1807	0%	0.2909	0.2909	0%	1.7668	1.7673	0%
2016	0.1271	0.1271	0%	0.1757	0.1758	0%	0.2565	0.2566	0%	1.1495	1.1501	0%
2017	0.1362	0.1362	0%	0.1866	0.1866	0%	0.2713	0.2713	0%	1.2729	1.2735	0%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	1.1816	0.3562	-70%	0.0750	0.0199	-73%	0.0632	0.0305	-52%	0.0228	0.0117	-49%
1991	1.0501	0.3575	-66%	0.0697	0.0199	-71%	0.0562	0.0306	-45%	0.0194	0.0117	-40%
1992	0.9388	0.3568	-62%	0.0649	0.0200	-69%	0.0503	0.0305	-39%	0.0166	0.0117	-30%
1993	0.8456	0.3552	-58%	0.0606	0.0201	-67%	0.0455	0.0304	-33%	0.0144	0.0117	-19%
1994	0.7688	0.3541	-54%	0.0568	0.0201	-65%	0.0417	0.0303	-27%	0.0126	0.0116	-8%
1995	0.7442	0.3603	-52%	0.0538	0.0206	-62%	0.0410	0.0305	-26%	0.0124	0.0118	-5%
1996	0.7130	0.3475	-51%	0.0510	0.0207	-60%	0.0398	0.0295	-26%	0.0119	0.0113	-5%
1997	0.6734	0.3511	-48%	0.0483	0.0209	-57%	0.0381	0.0299	-22%	0.0112	0.0115	2%
1998	0.6234	0.3578	-43%	0.0457	0.0218	-52%	0.0358	0.0296	-17%	0.0102	0.0115	13%
1999	0.5610	0.3564	-36%	0.0431	0.0236	-45%	0.0327	0.0288	-12%	0.0088	0.0113	29%
2000	0.7676	0.3019	-61%	0.0443	0.0229	-48%	0.0465	0.0256	-45%	0.0156	0.0096	-38%
2001	0.8289	0.3885	-53%	0.0449	0.0267	-41%	0.0499	0.0300	-40%	0.0176	0.0120	-32%
2002	0.7802	0.3326	-57%	0.0486	0.0305	-37%	0.0428	0.0226	-47%	0.0152	0.0094	-38%
2003	0.9390	0.2720	-71%	0.0616	0.0343	-44%	0.0498	0.0198	-60%	0.0161	0.0076	-53%
2004	0.4582	0.2310	-50%	0.0294	0.0345	17%	0.0260	0.0152	-42%	0.0088	0.0060	-33%
2005	0.5252	0.2183	-58%	0.0391	0.0367	-6%	0.0295	0.0152	-49%	0.0094	0.0055	-41%
2006	0.3904	0.1217	-69%	0.0340	0.0339	0%	0.0228	0.0102	-55%	0.0063	0.0029	-54%
2007	0.2771	0.1566	-43%	0.0363	0.0515	42%	0.0174	0.0110	-37%	0.0048	0.0031	-34%
2008	0.6223	0.1475	-76%	0.0630	0.0501	-21%	0.0357	0.0131	-63%	0.0094	0.0034	-64%
2009	0.2754	0.1446	-47%	0.0397	0.0520	31%	0.0162	0.0079	-52%	0.0042	0.0023	-44%
2010	0.1833	0.2048	12%	0.0331	0.0780	136%	0.0124	0.0098	-21%	0.0031	0.0030	-5%
2011	0.2552	0.2455	-4%	0.0367	0.0863	135%	0.0160	0.0116	-27%	0.0045	0.0038	-14%
2012	0.2554	0.2172	-15%	0.0537	0.0842	57%	0.0141	0.0102	-28%	0.0038	0.0031	-19%
2013	0.2640	0.1959	-26%	0.0456	0.0747	64%	0.0153	0.0097	-37%	0.0041	0.0030	-27%
2014	0.2466	0.1879	-24%	0.0402	0.0698	74%	0.0150	0.0092	-39%	0.0039	0.0029	-25%
2015	0.2606	0.1895	-27%	0.0453	0.0711	57%	0.0156	0.0096	-38%	0.0040	0.0029	-27%
2016	0.5664	0.1778	-69%	0.0766	0.0706	-8%	0.0346	0.0093	-73%	0.0076	0.0027	-65%
2017	0.9333	0.4874	-48%	0.0956	0.0819	-14%	0.0490	0.0270	-45%	0.0146	0.0116	-21%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0637	0.0573	-10%	0.0597	0.0474	-21%	0.1221	0.0343	-72%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1991	0.0494	0.0576	17%	0.0451	0.0476	6%	0.1092	0.0344	-69%
1992	0.0375	0.0577	54%	0.0332	0.0475	43%	0.0983	0.0343	-65%
1993	0.0278	0.0576	107%	0.0237	0.0473	100%	0.0891	0.0342	-62%
1994	0.0201	0.0576	186%	0.0164	0.0473	189%	0.0814	0.0340	-58%
1995	0.0181	0.0589	226%	0.0159	0.0482	203%	0.0789	0.0346	-56%
1996	0.0158	0.0581	269%	0.0146	0.0466	219%	0.0756	0.0334	-56%
1997	0.0129	0.0589	357%	0.0123	0.0471	284%	0.0716	0.0337	-53%
1998	0.0093	0.0607	552%	0.0086	0.0481	459%	0.0665	0.0343	-48%
1999	0.0048	0.0635	1227%	0.0034	0.0484	1335%	0.0602	0.0341	-43%
2000	0.0277	0.0579	109%	0.0333	0.0412	24%	0.0801	0.0288	-64%
2001	0.0382	0.0711	86%	0.0445	0.0531	19%	0.0857	0.0370	-57%
2002	0.0384	0.0728	90%	0.0378	0.0467	24%	0.0808	0.0313	-61%
2003	0.0239	0.0742	210%	0.0268	0.0398	49%	0.0989	0.0252	-75%
2004	0.0209	0.0711	241%	0.0202	0.0346	71%	0.0476	0.0211	-56%
2005	0.0244	0.0712	192%	0.0184	0.0316	72%	0.0549	0.0200	-64%
2006	0.0157	0.0612	290%	0.0074	0.0202	175%	0.0413	0.0106	-74%
2007	0.0378	0.0917	143%	0.0126	0.0277	120%	0.0283	0.0131	-54%
2008	0.0377	0.0892	137%	0.0137	0.0266	94%	0.0657	0.0123	-81%
2009	0.0448	0.0923	106%	0.0163	0.0268	65%	0.0280	0.0118	-58%
2010	0.0457	0.1387	204%	0.0163	0.0396	144%	0.0181	0.0165	-9%
2011	0.0471	0.1554	230%	0.0191	0.0465	143%	0.0256	0.0200	-22%
2012	0.0773	0.1501	94%	0.0235	0.0427	81%	0.0245	0.0173	-29%
2013	0.0586	0.1335	128%	0.0190	0.0384	102%	0.0262	0.0157	-40%
2014	0.0506	0.1252	148%	0.0182	0.0365	101%	0.0247	0.0151	-39%
2015	0.0588	0.1273	116%	0.0194	0.0368	89%	0.0258	0.0152	-41%
2016	0.0729	0.1255	72%	0.0217	0.0352	62%	0.0582	0.0141	-76%
2017	0.0845	0.1679	99%	0.0410	0.0768	87%	0.0967	0.0438	-55%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0067	0.0059	-12%	1.1150	1.0601	-5%
1991	0.0053	0.0060	13%	0.8768	1.0640	21%
1992	0.0041	0.0059	46%	0.6776	1.0666	57%
1993	0.0031	0.0059	89%	0.5144	1.0679	108%
1994	0.0024	0.0059	143%	0.3838	1.0683	178%
1995	0.0024	0.0060	147%	0.3391	1.0923	222%
1996	0.0023	0.0058	149%	0.2927	1.0837	270%
1997	0.0021	0.0059	177%	0.2408	1.0996	357%
1998	0.0018	0.0059	233%	0.1812	1.1338	526%
1999	0.0013	0.0059	365%	0.1107	1.2025	986%
2000	0.0045	0.0051	14%	0.4549	1.1227	147%
2001	0.0056	0.0063	13%	0.6220	1.3503	117%
2002	0.0044	0.0052	16%	0.6734	1.4309	112%
2003	0.0035	0.0046	30%	0.4219	1.5344	264%
2004	0.0026	0.0038	47%	0.3826	1.4870	289%
2005	0.0024	0.0036	46%	0.4734	1.5051	218%
2006	0.0014	0.0024	79%	0.3461	1.3477	289%
2007	0.0018	0.0031	71%	0.8381	2.0258	142%
2008	0.0020	0.0032	59%	0.8379	1.9737	136%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
2009	0.0017	0.0027	62%	0.9890	2.0394	106%
2010	0.0017	0.0038	122%	1.0099	3.0707	204%
2011	0.0020	0.0045	120%	1.0240	3.4221	234%
2012	0.0024	0.0041	70%	1.7153	3.3228	94%
2013	0.0020	0.0037	87%	1.2982	2.9526	127%
2014	0.0018	0.0035	96%	1.1163	2.7645	148%
2015	0.0020	0.0036	78%	1.3060	2.8141	115%
2016	0.0023	0.0035	54%	1.6256	2.7821	71%
2017	0.0041	0.0077	89%	1.7852	3.5072	96%

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	157.1982	4.6383	-97%	0.0250	0.5029	1914%	1.7262	0.0301	-98%	5.7689	0.3942	-93%
1991	152.3605	4.6144	-97%	0.0239	0.5043	2013%	1.6710	0.0300	-98%	5.5809	0.3959	-93%
1992	147.5272	4.5975	-97%	0.0228	0.5028	2104%	1.6162	0.0300	-98%	5.3954	0.3948	-93%
1993	142.6977	4.6160	-97%	0.0218	0.5014	2199%	1.5620	0.0301	-98%	5.2120	0.3925	-92%
1994	137.8718	4.4358	-97%	0.0208	0.5006	2301%	1.5081	0.0291	-98%	5.0307	0.3919	-92%
1995	133.0555	4.4149	-97%	0.0199	0.5056	2436%	1.4554	0.0291	-98%	4.8558	0.3987	-92%
1996	128.2388	4.3826	-97%	0.0191	0.4904	2473%	1.4026	0.0291	-98%	4.6801	0.3818	-92%
1997	123.4215	4.3737	-96%	0.0182	0.4969	2626%	1.3496	0.0291	-98%	4.5031	0.3858	-91%
1998	118.6031	4.3638	-96%	0.0174	0.4963	2746%	1.2964	0.0293	-98%	4.3248	0.3926	-91%
1999	113.7835	4.2776	-96%	0.0167	0.4918	2845%	1.2430	0.0294	-98%	4.1450	0.3861	-91%
2000	29.7712	4.3944	-85%	0.0161	0.4334	2590%	1.1961	0.0303	-97%	4.0012	0.3161	-92%
2001	28.4839	4.3390	-85%	0.0156	0.5227	3253%	1.1454	0.0306	-97%	3.8283	0.4196	-89%
2002	28.9767	4.1819	-86%	0.0166	0.4214	2443%	1.1642	0.0316	-97%	3.8860	0.3368	-91%
2003	42.6456	4.1066	-90%	0.0234	0.3836	1537%	1.7118	0.0331	-98%	5.7187	0.2475	-96%
2004	17.9042	3.9880	-78%	0.0106	0.3083	2817%	0.7205	0.0328	-95%	2.4155	0.1938	-92%
2005	22.8476	7.2439	-68%	0.0138	0.2900	2005%	0.9175	0.0521	-94%	3.0672	0.1579	-95%
2006	19.9412	4.2544	-79%	0.0123	0.2014	1539%	0.7997	0.0351	-96%	2.6624	0.0509	-98%
2007	12.2275	5.1628	-58%	0.0113	0.2423	2041%	0.4919	0.0463	-91%	1.6278	0.0455	-97%
2008	32.2263	4.4580	-86%	0.0211	0.2601	1134%	1.3475	0.0418	-97%	4.3499	0.0403	-99%
2009	11.7108	4.0026	-66%	0.0119	0.2053	1623%	0.5527	0.0400	-93%	1.6373	0.0335	-98%
2010	6.3741	4.2269	-34%	0.0095	0.2870	2906%	0.3315	0.0501	-85%	0.9180	0.0416	-95%
2011	9.2115	4.2747	-54%	0.0108	0.3353	3017%	0.4451	0.0530	-88%	1.2963	0.0724	-94%
2012	8.5181	3.7759	-56%	0.0143	0.3062	2035%	0.3830	0.0497	-87%	1.1635	0.0429	-96%
2013	10.2754	3.1437	-69%	0.0141	0.2806	1884%	0.4691	0.0428	-91%	1.4148	0.0432	-97%
2014	9.6312	2.8083	-71%	0.0123	0.2663	2069%	0.4811	0.0393	-92%	1.3692	0.0473	-97%
2015	9.9864	3.2372	-68%	0.0130	0.2726	1998%	0.4685	0.0422	-91%	1.3894	0.0439	-97%
2016	27.1820	3.2335	-88%	0.0229	0.2630	1047%	1.1854	0.0420	-96%	3.7095	0.0301	-99%
2017	40.8138	4.0750	-90%	0.0297	0.6051	1938%	1.8429	0.0481	-97%	5.6664	0.4021	-93%

P-Previous
R-Refined
C-Changed

3.6 TRANSPORT (NFR 1A3)

3.6.1 OVERVIEW

The emissions from the category 1A3 Transport include subcategories Domestic aviation (1A3a), Road transportation (1A3b), Railways (1A3c), Domestic navigation (1A3d) and Pipeline transport (1A3ei). 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 the 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 52.10% (NOX) and 93.43% (SOX), although emission of ammonia has increased by 1 236%, in comparison with the base year. More information can be found below in ***Table 3.71***. Ammonia mostly comes from road transportation, exactly 99.93% of it and the rest is railways and navigation (0.07%). The emissions from road and non-road transport were calculated by using models, default methodologies and the consistent data series from 1990–2018.

Table 3.71: *Overview of the main pollutants and change to year 1900 in sector Transport in years 1990–2018*

YEAR	EMISSIONS					
	kt					
	NOx		NMVOC		SOx	
1990	57.49	0.00%	26.90	0.00%	2.88	0.00%
1995	45.81	-20.31%	27.11	0.80%	2.30	-20.14%
2000	37.41	-34.92%	20.50	-23.78%	0.73	-74.57%
2005	49.09	-14.60%	20.23	-24.80%	0.21	-92.88%
2010	41.55	-27.72%	12.14	-54.85%	0.25	-91.34%
2011	34.21	-40.49%	8.50	-68.39%	0.23	-91.87%
2012	33.15	-42.34%	8.24	-69.35%	0.10	-96.56%
2013	31.89	-44.52%	7.43	-72.39%	0.14	-95.29%
2014	31.83	-44.63%	6.63	-75.36%	0.15	-94.70%
2015	30.11	-47.62%	6.13	-77.22%	0.22	-92.47%
2016	28.65	-50.16%	5.88	-78.13%	0.19	-93.45%
2017	27.24	-52.61%	5.40	-79.93%	0.19	-93.45%
2018	27.54	-52.10%	5.15	-80.81%	0.19	-93.43%
2005-2018	**-**	**-43.91%**	**-**	**-74.47%**	**-**	**-7.81%**

YEAR	EMISSIONS					
	kt					
	NH_3		$PM_{2.5}$		CO	
1990	0.03	0%	3.08	0.00%	195.18	0.00%
1995	0.09	240%	2.12	-31.37%	210.54	7.87%
2000	0.35	1249%	1.51	-50.99%	169.32	-13.25%
2005	0.53	1932%	2.29	-25.79%	170.92	-12.43%
2010	0.47	1716%	2.28	-26.21%	89.84	-53.97%
2011	0.41	1488%	1.70	-45.03%	59.07	-69.74%
2012	0.42	1514%	1.71	-44.45%	56.71	-70.95%
2013	0.39	1418%	1.62	-47.64%	50.53	-74.11%
2014	0.36	1296%	1.60	-47.98%	43.43	-77.75%
2015	0.37	1331%	1.51	-50.90%	39.93	-79.54%
2016	0.38	1364%	1.50	-51.31%	36.06	-81.53%
2017	0.36	1288%	1.48	-52.13%	33.10	-83.04%
2018	0.35	1236%	1.46	-52.72%	30.24	-84.51%

YEAR	EMISSIONS					
	kt					
	NH_3		$PM_{2.5}$		CO	
2005-2018	**-**	**-34.25%**	**-**	**-36.28%**	**-**	**-82.31%**

YEAR	EMISSIONS					
	kt		t			
	BC		PRIORITY HMs		PAH	
1990	5.50	0.00%	9.16	0.00%	0.55	0.00%
1995	4.76	-91.71%	7.86	-14.11%	0.40	-28.54%
2000	4.27	-92.57%	0.45	-95.14%	0.42	-24.01%
2005	5.16	-91.02%	0.69	-92.50%	0.60	7.81%
2010	4.50	-92.18%	0.75	-91.81%	0.74	34.41%
2011	3.99	-93.06%	0.70	-97.38%	0.78	39.95%
2012	3.84	-93.31%	0.75	-97.22%	0.82	47.38%
2013	3.65	-93.65%	0.73	-97.30%	0.85	53.67%
2014	3.49	-93.93%	0.74	-97.24%	0.90	61.95%
2015	2.70	-95.30%	0.84	-96.88%	0.74	33.81%
2016	2.01	-96.50%	0.86	-96.82%	0.56	1.95%
2017	1.32	-97.71%	0.87	-96.76%	0.38	-31.02%
2018	0.65	-98.88%	0.90	-90.14%	0.20	-64.78%
2005-2018	**-**	**-74.46%**	**-**	**26.99%**	**-**	**-36.01%**

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. Although some results are already available and present here, the discussion between interested organisations is still ongoing. In the next sections are summarized information, gathered until now.

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 IPCC 2006 GL. The QC checks were done during the CRF and NIR 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 2014–2018:

- 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 from taxes on sales of biofuels (***Figure A7.1,*** **ANNEX VII**).[1,2]

Table 3.72: *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 Slovak Republic	Ministry of Economy
Data from taxes on sales of products of crude oil		SK - BIO[3]
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 of fuel sales on gas stations (NEIS)	Ministry of Environment (according to art.8 of Directive 98/70/EC)	European Environmental Agency

As it is shown in ***Table 3.73*** and on ***Figure 3.28***, discrepancies occurred between major data sources - providers. During discussions with the main authorities, some information was collected by the sectoral experts, which were further analysed:

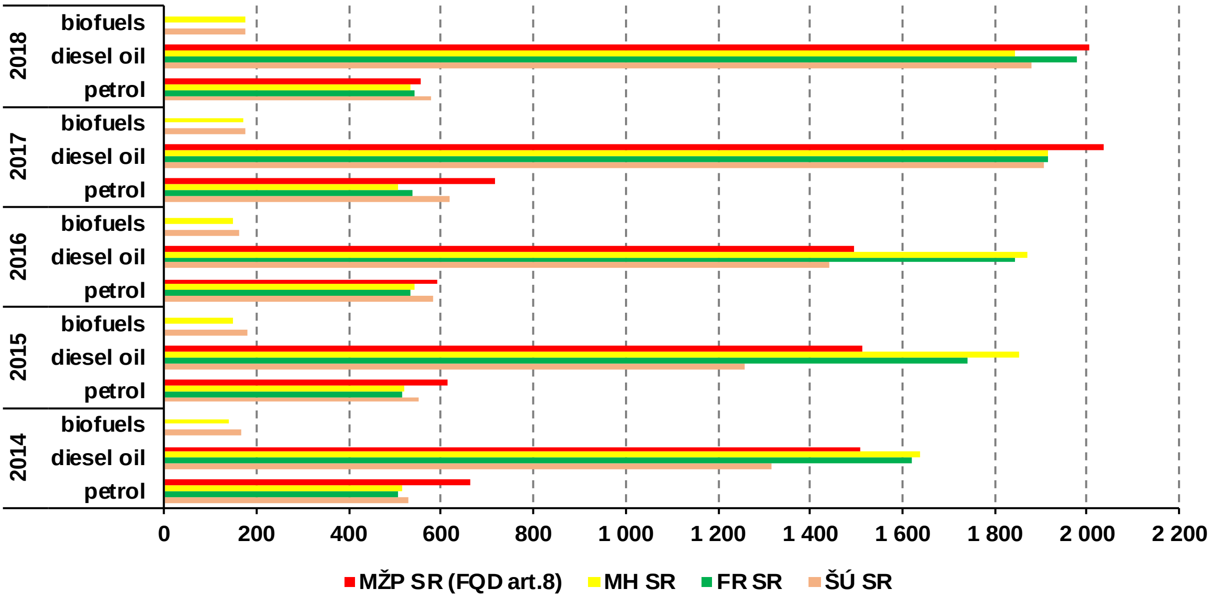
- Each authority report different data in different forms for different institutions or requirements (***Table 3.72*** and **ANNEX VII**);
- The conversion factors (e.g. density) differ throughout all data suppliers not only between authorities and companies but also for each delivered supply has own characteristics;
- Dates of collection for tax reports and reports to the ŠÚ SR differ.

Table 3.73: *Results of fuels consumption comparison according to different sources (kt)*

Source	2014			2015		
	petrol	**diesel oil**	**biofuels**	**petrol**	**diesel oil**	**biofuels**
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	-
Source	**2016**			**2017**		
	petrol	**diesel oil**	**biofuels**	**petrol**	**diesel oil**	**biofuels**
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	-
Source	**2018**					
	petrol	**diesel oil**	**biofuels**			
ŠÚ SR	579.0	1 879.0	174.0			
FR SR	544.6	1 978.2	-			
MH SR	532.7	1 841.6	178.0			
MŽP SR (FQD art.8)	555.0	2 004.6	-			

[1] 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
[2] 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/
[3] SK-BIO is the national register for biofuels and bioliquids (http://www.shmu.sk/en/?page=1684)

Figure 3.28: Results of fuels consumption comparison according to different sources (kt)



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.).[4] 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 2014–2018..

3.6.3 DOMESTIC AVIATION LTO (NFR 1A3AI) AND INTERNATIONAL AVIATION LTO (NFR 1A3aii)

3.6.3.1 Overview

These categories are not key categories. In the absence of national data on the exact numbers of domestic and international LTO cycles (only total numbers of LTO cycles is available), summary information from the EUROCONTROL database was used. The Slovak Management of Airports manages Slovak airports, except 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 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 2005–2018, EUROCONTROL data on the number of flights, fuel consumption and share of domestic and international flights were used. The emissions of NO_X, SO_X, PMs and CO were taken from EUROCONTROL file for LTO and Cruise separately (in line with NECD review 2017 recommendation No ***SK-1A3aii(ii)-0002***) and reported in Domestic and International Aviation LTO cycles (***Table 3.74***). The fuel consumption in category 1A3aii(i) decreased compared to the base year

[4] 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

1990 by 25.61%. The total consumption of jet kerosene was 10.78 TJ and the consumption of aviation gasoline was 0.23 TJ in domestic aviation LTO cycle in 2018. Since 2005, domestic aviation emissions are decreasing. This decrease and the whole category is influenced by the fact, that the Slovak Republic has no official national airlines as 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 178.38%. The total consumption of jet kerosene was 349.00 TJ and the consumption of aviation gasoline was 0.21 TJ allocated in domestic aviation LTO cycle in 2018. Since 2005, international aviation emissions are slightly increasing. Increase in fuel consumption and emissions are influenced by the arrival of low-cost airlines (Ryanair – based in Bratislava, WizzAir – based in Košice) and charter flights.

Table 3.74: *Overview of emissions from domestic and international aviation (1990–2018)*

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	0.0001	0.00021	0.00007	0.00855
2005-2018	**-66.56%**	**17.94%**	**-65.60%**	**-63.61%**	**-20.52%**
1990-2018	**-96.73%**	**-82.71%**	**-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
2005-2017	**59.56%**	**98.13%**	**32.21%**	**-1.59%**	**18.21%**
1990-2017	**9.13%**	**29.52%**	**-74.98%**	**55.57%**	**9.76%**

3.6.3.2 Methodological issues

The airport traffic in Slovakia is determined only by the origin of airlines. It means, that there is no direct information about the number of domestic and international flights in statistics. Tier 1 methodology for emission estimation in aviation, both for aviation gasoline and jet kerosene was used for time series 1990–2004. Tier 1 methodology is based on fuel sold on the airports. For this period, the only total number of LTO cycles is known, therefore 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. Real share of national and international activities for the period 2005–2018 was taken from the EUROCONTROL database directly. More data and revision is provided in ***Table 3.75***. 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 3.75: *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 this submissions for the years 1990–2004 were calculated as average EFs from available EUROCONTROL data for 2005–2017. These average emission factors (***Table 3.76***) 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_{2016}.

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 the 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 2016 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.

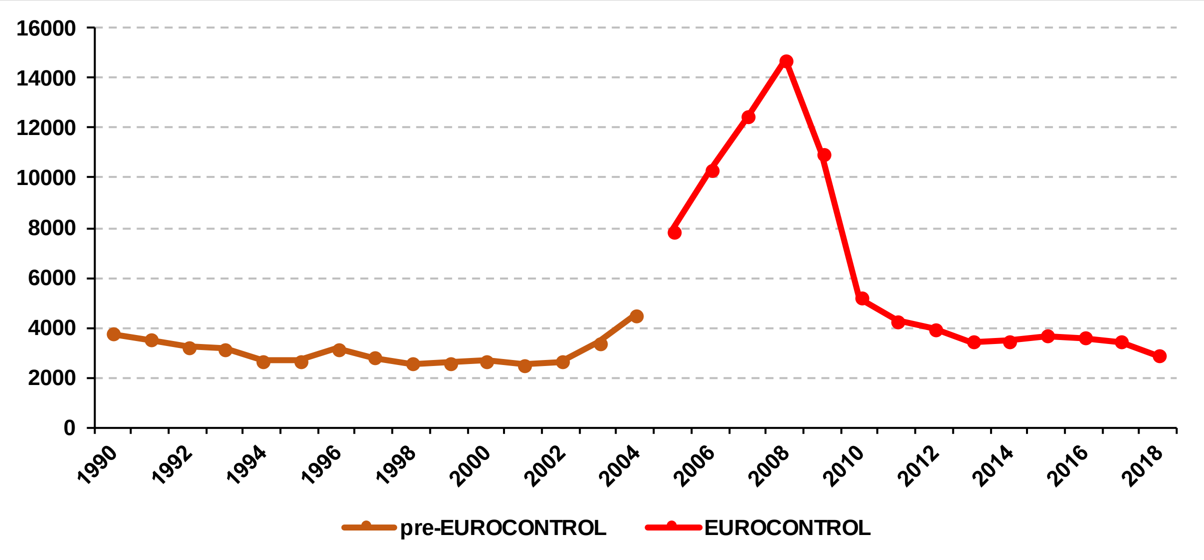
Table 3.76: *Average emission factors for the pollutants in civil aviation according to EUROCONTROL*

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

3.6.3.3 Source-specific QA/QC

Since 2011, the agreement of the European Commission (the EC) and the EUROCONTROL is in place. Based on this agreement, the annual comparison of the 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 on a regular basis, for quality check, however, this information is not possible to make publicly available. Consistency of the time-series (***Figure 3.29***) is maintained by using calculated average EFs from EUROCONTROL. The methodology is explained in **Chapter 3.6.2.1.**

Figure 3.29: Demonstration of time-series consistency between pre-EUROCONTROL methodology and EUROCONTROL methodology (in TJ)



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

3.6.3.4 Source-specific recalculations

No recalculations in this submission.

3.6.4 ROAD TRANSPORTATION (NFR 1A3b)

3.6.4.1 Overview

Short distance passenger transport is an important part of road transport. It is the most exploited type of transport in the Slovak Republic due to the high density of roads, the quality of the road network and interconnection of all municipalities. In the recent 10 years, road transport has expanded significantly in the transport of goods and persons. In 2018, the transport network included 482 km of highways, 282 km of motorways and 3 312 km of the category 1st class roads. Total roads network represented 18 059 km of the roads in the Slovak Republic[5] in 2018. Road transportation is the most important and key category within transport with the highest share of emissions and continually increasing trend in fuel consumption. There is a huge increase in emission of ammonia compared to base year – 1 287.3% (***Table 3.77***). This is caused by the expand of light commercial vehicles in category EURO 5 and onwards, which have higher EFs as vehicles in category EURO 2, 3 and 4.

Table 3.77: *Overview of emissions in road transport in years 1990–2018*

YEAR	EMISSIONS - ROAD TRANSPORT							
	kt						t	
	NO_X	NMVOC	SO_X	NH_3	$PM_{2.5}$	CO	PRIORITY HMs	PAH
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

[5] Slovak Road Database 2017; http://www.cdb.sk/en/maps-and-statistical-outputs-of-road-databank/Statistical-outputs/Lenght-of-the-road.alej

YEAR	EMISSIONS - ROAD TRANSPORT							
	kt						t	
	NO_X	NMVOC	SO_X	NH_3	$PM_{2.5}$	CO	PRIORITY HMs	PAH
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
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
2005-2018	**-41.6%**	**-75.5%**	**-82.7%**	**-34.3%**	**-38.6%**	**-82.5%**	**31.4%**	**71.6%**
1990-2018	**-42.3%**	**-81.4%**	**-98.6%**	**1287.3%**	**-51.0%**	**-84.6%**	**-90.2%**	**123.6%**

The major share of emissions belongs to passenger cars (***Table 3.78***). Most of the priority HMs (Pb, Cd and Hg) comes from tyre and brake wear abrasion. Majority of NO_x, NMVOC and CO emission are emitted in the cities (***Table 3.79***).

Table 3.78: *Overview of total emissions according to the type of vehicles in 2018*

VEHICLE CATEGORY	NOx	NMVOC	SOx	NH_3	TSP	CO	PRIORITY HMs	PAH
	kt						t	
Passenger cars	10.54	2.37	0.02	0.29	0.43	23.72	0.01	0.11
Light duty vehicles	3.56	0.24	0.00	0.02	0.18	2.07	0.00	0.02
Heavy duty vehicles and buses	11.14	0.45	0.01	0.04	0.22	3.28	0.00	0.06
Mopeds & motorcycles	0.02	0.09	0.00	0.00	0.00	0.62	0.00	0.0003
Gasoline evaporation	NA	1.71	NA	NA	NA	NA	NA	NE
Automobile tyre and brake wear abrasion	NA	NA	NA	NA	0.35	NE	0.88	NE
Automobile road abrasion	NA	NA	NA	NA	0.20	NE	NE	NE

Table 3.79: *Results from COPERT in distribution for agglomeration mode in 2018*

kt	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	CO
Urban	12.24	1.37	0.01	0.08	0.22	22.91
Rural	9.23	0.17	0.02	0.18	0.25	4.61
Highway	3.79	0.17	0.006	0.09	0.07	2.18

3.6.4.2 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 as the name of the program (methodology "COPERT"). Calculation in model COPERT 5 is based on EMEP/EEA GB_{2016} 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 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 3.80***). 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, VIN number (vehicle identification number) was used. Using MS Access, the average number of mileages was produced. Further data needed: 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 3.80: *Overview of input data used in COPERT 5 model in 2018*

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	**2 290 876**	**8 119.01**	Diesel N1-III	115 921	14 521.71
Petrol Mini	10 394	3 408.32	**HEAVY DUTY TRUCKS**	**82 289**	**23 998.42**
Petrol Small	807 097	3 458.05	Petrol >3.5 t	147	6 122.20
Petrol Medium	356 126	4 301.63	Rigid <=7,5 t	27 930	29 159.25
Petrol Large	39 759	5 242.68	Rigid 7,5 - 12 t	15 370	38 404.86
2-Stroke	157	121.58	Rigid 12 - 14 t	3 596	31 384.62

[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)
Hybrid Mini	48	2 683.81	Rigid 14 - 20 t	4 699	24 578.20
Hybrid Small	223	7 362.91	Rigid 20 - 26 t	1 308	10 727.57
Hybrid Medium	3 485	5 842.89	Rigid 26 - 28 t	49	12 811.15
Hybrid Large-SUV-Executive	1 494	6 062.34	Rigid 28 - 32 t	220	13 813.11
Diesel Mini	466	2 160.21	Rigid >32 t	145	3 089.11
Diesel Small	26 422	8 465.63	Articulated 14 - 20 t	28 825	69 894.16
Diesel Medium	808 735	11 270.43	**BUSES**	**8 767**	**30752.15**
Diesel Large-SUV-Executive	182 275	11 260.31	Urban Buses Midi <=15 t	800	37789.07
LPG Bifuel Mini	36	7 294.66	Urban Buses Standard 15 - 18 t	262	38754.22
LPG Bifuel Small	23 149	18 529.72	Urban Buses Articulated >18 t	46	11845.01
LPG Bifuel Medium	21 265	19 125.15	Coaches Standard <=18 t	49	32 186.92
LPG Large-SUV-Executive	7 908	15 663.21	Coaches Articulated >18 t	7 383	39 111.10
CNG Bifuel Small	1 138	12 246.18	CNG Buses	227	24 826.56
CNG Bifuel Medium	642	8 960.07	**L-CATEGORY**	**139 912**	**1 186.56**
CNG Large-SUV-Executive	57	8 920.34	Mopeds 2-stroke <50 cm^3	1 120	633.10
LIGHT COMMERCIAL VEHICLES	**138 416**	**8 901.44**	Mopeds 4-stroke <50 cm^3	28 602	526.71
Petrol N1- I	32 051	6 810.44	Motorcycles 2-stroke >50 cm^3	2 052	1 041.33
Petrol N1-II	11 053	7 782.36	Motorcycles 4-stroke <250 cm^3	39 572	1 091.14
Petrol N1-III	2 803	6 245.96	Motorcycles 4-stroke 250 - 750 cm^3	39 844	2 148.09
Diesel N1- I	20 231	11 982.95	Motorcycles 4-stroke >750 cm^3	28 722	1 678.97
Diesel N1-II	72 278	11 685.48			

CO_2 correction factor[8] was introduced in 2018 into the COPERT model. According to the EMEP/GB_{2019}, the CO_2 emissions of new passenger cars registered in Europe are monitored 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= $FC_{In\ use}/FC_{Sample}$

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.

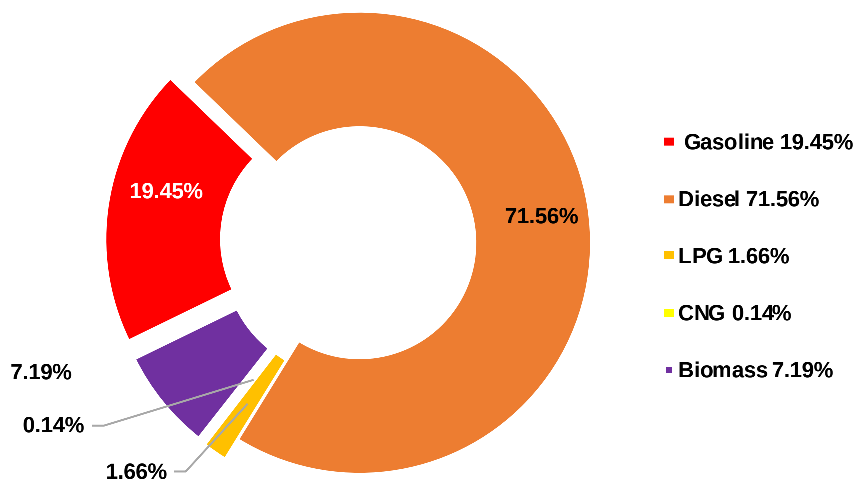
[8] https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-b-i/view, page 90
[9] https://www.eea.europa.eu/data-and-maps/data/co2-cars-emission-16

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 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 3.8.4.2**). 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 Slovak language and they are official. Share of diesel oil represents 71.56%, followed by gasoline with 19.45% share, then LPG (1.66%), CNG (0.14%) and biomass (7.19%) (***Figure 3.30***).

The blending of biomass in liquid fuels was considered and the bio-emissions are calculated since 2007 (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 the 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 3.81***). In ETBE as bio-component is considered in the calculation of total bio-components in fuel only in 47% by volume or 37% by weight. From the biomass (biodiesel) is also subtracted the 4% fossil methanol part.

Figure 3.30: *Fuels balance in road transportation in 2018*



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[10] 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.

Table 3.81: *Estimated activity data and share of biomass for the time series 2007–2018*

GASOLINE	2007	2008	2009	2010
Biomass share % (energy)	2.30%	1.23%	2.58%	2.95%
Biomass (TJ)	652.261	358.172	706.723	779.130
DIESEL OIL	**2007**	**2008**	**2009**	**2010**
Biomass share % (energy)	4.09%	4.77%	5.14%	5.28%
Biomass (TJ)	2 677.29	2 795.75	3 090.30	3 577.88
GASOLINE	**2011**	**2012**	**2013**	**2014**
Biomass share % (energy)	2.97%	2.94%	3.21%	4.03%
Biomass (TJ)	715.872	710.557	726.595	859.329
DIESEL OIL	**2011**	**2012**	**2013**	**2014**
Biomass share % (energy)	6.05%	5.79%	6.43%	5.98%
Biomass (TJ)	3 741.68	3 846.12	4 107.36	3 766.08
GASOLINE	**2015**	**2016**	**2017**	**2018**
Biomass share % (energy)	3.45%	3.20%	4.24%	4.73%
Biomass (TJ)	747.873	725.623	943.486	1 018.32
DIESEL OIL	**2015**	**2016**	**2017**	**2018**
Biomass share % (energy)	6.09%	7.16%	7.43%	7.49
Biomass (TJ)	4 342.97	5 158.95	5 464.18	5 697.80

According to the recommendation No ***SK-1A3b-2018-0001***, Slovakia managed to distinguish lube oil consumption in 2-stroke vehicles and 4-stroke vehicles (***Table 3.82***). The emissions from lube oil are allocated according to EMEP/EEA GB 2016 and recommendations:

- lube oil emissions from 2-stroke vehicles accordingly in the 1A3b categories;
- lube oil emissions from 4-stroke vehicles in the 2D3i category

Table 3.82: *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**	
2-stroke lube oil (t)	13.3597	12.0169	14.468	23.6603	2.0118	2.9329	
4-stroke (t)	3 636.456	3 720.0287	4 012.0265	4 211.1386	4 340.4322	4 501.7765	

Lube oil composition, including HMs was analysed and used for emission estimation for the years 2000–2018 (more info in **Chapter 3.8.4.2**). For the years 1990–1999 were used reconstructed data for fuel composition (***Table 3.85***), vehicle fleet and estimations in line with the recommendations ***SK-1A3b-2018-0003***, ***SK-1A3b-2018-0004*** and ***SK-1A3b-2018-0005***.

Emissions of all HMs are dependent on content level (***Table 3.83***) and fuel consumption, thus all irregularities are caused by the change in content and statistical fuel consumption in the appropriate vehicle category.

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

The emission factors for lead (Pb) after 2000 are estimated as the maximum allowed content (natural lead) in the FQD[11] (Fuel Quality directive) and reported under the article 8 (***SK-1A3b-2018-0002***). Lead emissions are allocated according to the previous paragraph.

Table 3.83: *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
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

3.6.4.3 Source-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 the 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.

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

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 the direct outcome of 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 regularly. Delivering actual and the most recent data of the composition of fuels is crucial for correct calculation and estimation of country-specific emission factors.

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

Table 3.84: *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	5.6	30.7	14.7	1.875	0.020
OMV	1.9	33.1	13.4	1.852	0.021
Unipetrol	3.8	33.9	11.3	1.843	0.024
Average	3.8	32.6	13.1	1.857	0.021

As it was mentioned above, the lube oil is more important for 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 3.85***. These data were used to estimate heavy metal emissions.

Table 3.85: *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	1773	0.097	0.126	2300	2.08
Shell rimula	0.171	0.039	0.101	0.083	0.087	0.037	1923	0.026	0.156	3300	2.02
Castrol edge	0.017	0.298	0.01	0.044	0.03	0.037	1384	0.021	0.159	2200	2.05
Castrol vecton	0.048	0.033	0.02	0.094	0.03	0.037	2440	0.067	0.018	7200	1.97
Average	0.08	0.10	0.05	0.07	0.05	0.04	1880	0.05	0.11	3750	2.03

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 – in 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 3.86***), that most of the deregistered cars were in EURO 1 emission category or older categories.

Through deeper analysis (***Table 3.87***) it was discovered, that the 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:

- Conventional diesel passenger cars;
- 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 degrease). 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 one);
- The SSP, a.s. has no significant effect on GHG emissions.

Table 3.86: *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 3.87*: 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 GB2016, updated April 2018 for petrol evaporation are the most important sources of evaporative emissions from a vehicle are the following:

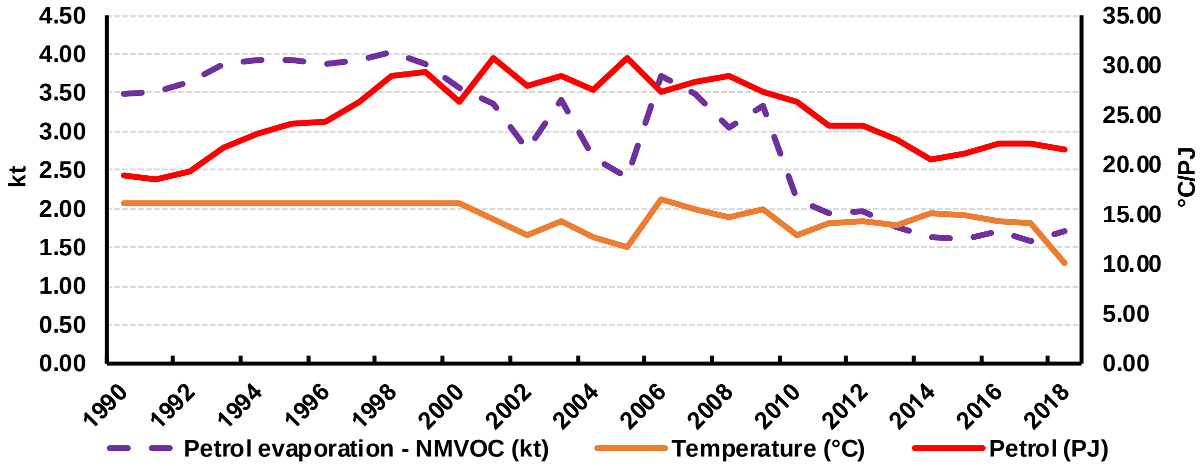
- Breathing losses through the tank vent. Breathing losses are due to evaporation of fuel in the tank during driving and parking, as a result of normal diurnal temperature variation;
- Fuel permeation/leakage. Various studies (e.g. CRC, 2004; Reuter et al., 1994) indicate that liquid fuel seepage and 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 to 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 3.31***) (according to recommendation ***SK-1A3bv-2018-0001***).

Figure 3.31*: Ambient air temperature and evaporation emissions correlation*



3.6.4.4 Source-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 3.88***).

Table 3.88: *Summary of the recalculations and changes in 1A3b*

NUMBER	CATEGORY	DESCRIPTION	REFERENCE
1.	1A3b	Recalculation of years 2010 – 2017 as a result of the introduction of CO_2 correction factor. Recalculation was made according to recommendations ***SK-1A3bi-2019-0001***, ***SK-1A3bii-2019-0001*** and ***SK-1A3biii-2019-0001***	See **Chapter 3.8.2**

Recalculations in Road transport were made as a result of the introduction of CO_2 correction factor (***Chapter 3.8.4.1***). Overview of recalculations is presented in ***Table 3.89***.

***Table 3.89:** Recalculation of air pollutants in road transportation for years 2010–2017*

EMISSIONS - ROAD TRANSPORT (1A3bi)															
YEAR	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
	NO_x (kt)			NMVOC (kt)			SO_x (kt)			NH_3 (kt)			$PM_{2.5}$ (kt)		
2010	10.28	10.35	0.6%	7.52	7.63	1.4%	0.01	0.01	-0.7%	0.43	0.44	0.3%	0.69	0.69	-0.1%
2011	8.83	8.88	0.6%	4.85	4.96	2.3%	0.01	0.01	-0.6%	0.37	0.37	1.3%	0.53	0.53	-0.3%
2012	9.53	9.58	0.5%	4.69	4.80	2.3%	0.01	0.01	-0.6%	0.37	0.38	1.4%	0.57	0.57	-0.3%
2013	9.11	9.15	0.4%	4.17	4.27	2.5%	0.01	0.01	-0.6%	0.35	0.36	1.3%	0.52	0.52	-0.3%
2014	9.15	9.18	0.3%	3.53	3.57	1.1%	0.01	0.01	-2.4%	0.33	0.32	-2.1%	0.49	0.51	3.0%
2015	10.24	9.42	-8.0%	3.22	3.26	1.2%	0.02	0.01	-8.0%	0.32	0.32	-1.0%	0.50	0.46	-7.6%
2016	9.93	9.95	0.2%	2.77	2.84	2.6%	0.02	0.02	-1.2%	0.33	0.33	-0.8%	0.43	0.44	2.0%
2017	10.14	10.13	-0.2%	2.57	2.63	2.5%	0.02	0.02	-0.5%	0.30	0.31	1.1%	0.44	0.44	-0.6%

EMISSIONS - ROAD TRANSPORT (1A3bi)									
YEAR	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
	CO (kt)			PAH (t)			BC (kt)		
2010	76.84	78.03	1.5%	0.07	0.07	0.2%	0.48	0.48	-0.1%
2011	49.26	50.46	2.4%	0.07	0.07	0.1%	0.38	0.38	-0.4%
2012	47.02	48.23	2.6%	0.08	0.08	0.1%	0.41	0.41	-0.4%
2013	41.53	42.65	2.7%	0.08	0.08	0.1%	0.39	0.38	-0.4%
2014	35.01	35.90	2.5%	0.08	0.08	-0.5%	0.37	0.38	2.8%
2015	31.66	32.72	3.3%	0.09	0.09	-9.5%	0.38	0.35	-7.9%
2016	27.31	28.42	4.1%	0.10	0.09	-0.4%	0.33	0.34	2.0%
2017	25.74	26.46	2.8%	0.10	0.10	-0.3%	0.34	0.34	-0.7%

EMISSIONS - ROAD TRANSPORT (1A3bii)															
YEAR	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
	NOx			NMVOC			SOx			NH_3			PM $_{2.5}$		
2010	4.42	4.42	-0.1%	0.68	0.68	0.4%	0.005	0.005	-1%	0.02	0.02	1.3%	0.45	0.45	-0.1%
2011	4.73	4.72	-0.3%	0.42	0.42	0.7%	0.005	0.005	-1%	0.02	0.02	1.8%	0.28	0.28	-0.4%
2012	4.78	4.76	-0.3%	0.40	0.40	0.7%	0.005	0.005	-1%	0.02	0.02	1.9%	0.26	0.26	-0.4%
2013	4.80	4.79	-0.3%	0.36	0.36	0.8%	0.005	0.005	-2%	0.02	0.02	2.0%	0.24	0.24	-0.4%
2014	5.22	5.19	-0.6%	0.32	0.32	0.6%	0.005	0.005	-2%	0.02	0.02	-0.2%	0.23	0.23	3.7%
2015	5.35	4.78	-10.6%	0.29	0.28	-6.0%	0.005	0.005	-11%	0.02	0.02	-3.0%	0.21	0.19	-7.2%
2016	3.57	3.55	-0.7%	0.31	0.31	0.5%	0.004	0.004	-1%	0.02	0.02	-0.3%	0.21	0.21	2.3%
2017	3.71	3.69	-0.6%	0.28	0.28	0.3%	0.005	0.005	-1%	0.02	0.02	1.1%	0.21	0.21	-0.7%

EMISSIONS - ROAD TRANSPORT (1A3bii)									
YEAR	**P**	**R**	**CHANGE**	**P**	**R**	**CHANGE**	**P**	**R**	**CHANGE**
	CO			**PAH**			**BC**		
2010	5.37	5.42	0.9%	0.02	0.02	-0.1%	0.32	0.32	-0.1%
2011	3.58	3.63	1.4%	0.02	0.02	-0.3%	0.20	0.20	-0.4%
2012	3.42	3.48	1.6%	0.03	0.03	-0.3%	0.19	0.19	-0.4%
2013	3.07	3.12	1.6%	0.03	0.03	-0.3%	0.17	0.17	-0.4%
2014	2.74	2.80	2.1%	0.03	0.03	-0.5%	0.16	0.17	3.4%
2015	2.56	2.52	-1.6%	0.03	0.03	-10.5%	0.15	0.14	-7.5%
2016	2.75	2.82	2.4%	0.02	0.02	-0.6%	0.16	0.17	2.0%
2017	2.30	2.32	1.2%	0.02	0.02	-0.6%	0.17	0.16	-0.7%

EMISSIONS - ROAD TRANSPORT (1A3biii)															
YEAR	**P**	**R**	**CHANGE**	**P**	**R**	**CHANGE**	**P**	**R**	**CHANGE**	**P**	**R**	**CHANGE**	**P**	**R**	**CHANGE**
	NOx			**NMVOC**			**SOx**			**NH_3**			**$PM_{2.5}$**		
2010	22.09	22.06	-0.1%	1.27	1.27	-0.1%	0.01	0.01	-2%	0.01	0.01	-0.1%	0.59	0.59	-0.1%
2011	15.95	15.89	-0.4%	0.74	0.74	-0.4%	0.01	0.01	-2%	0.02	0.02	-0.4%	0.38	0.37	-0.4%
2012	16.66	16.59	-0.4%	0.75	0.75	-0.4%	0.01	0.01	-2%	0.02	0.02	-0.4%	0.38	0.38	-0.4%
2013	15.42	15.36	-0.4%	0.68	0.68	-0.4%	0.01	0.01	-2%	0.02	0.02	-0.4%	0.35	0.35	-0.4%
2014	15.41	15.35	-0.4%	0.66	0.63	-4.3%	0.01	0.01	-2%	0.02	0.02	-13.2%	0.34	0.34	1.1%
2015	13.68	13.35	-2.4%	0.54	0.50	-7.2%	0.01	0.01	14%	0.02	0.03	33.7%	0.28	0.26	-6.9%
2016	12.68	12.60	-0.6%	0.49	0.47	-3.6%	0.01	0.01	-2%	0.03	0.03	-0.6%	0.24	0.25	0.6%
2017	11.02	10.94	-0.7%	0.44	0.44	-0.7%	0.01	0.01	-2%	0.03	0.03	-0.7%	0.22	0.22	-0.7%

EMISSIONS - ROAD TRANSPORT (1A3biii)									
YEAR	**P**	**R**	**CHANGE**	**P**	**R**	**CHANGE**	**P**	**R**	**CHANGE**
	CO			**PAH**			**BC**		
2010	5.32	5.31	-0.1%	0.05	0.05	-0.1%	0.36	0.36	-0.1%
2011	4.05	4.03	-0.4%	0.04	0.04	-0.4%	0.23	0.23	-0.4%
2012	4.27	4.25	-0.4%	0.05	0.05	-0.4%	0.24	0.24	-0.4%
2013	3.99	3.98	-0.4%	0.04	0.04	-0.4%	0.22	0.22	-0.4%
2014	4.04	3.98	-1.4%	0.05	0.05	-0.5%	0.22	0.22	1.0%
2015	3.75	3.84	2.4%	0.05	0.06	19.6%	0.18	0.16	-7.6%
2016	3.77	3.72	-1.3%	0.06	0.06	-0.6%	0.16	0.16	0.5%
2017	3.23	3.21	-0.7%	0.06	0.06	-0.7%	0.14	0.14	-0.7%

EMISSIONS - ROAD TRANSPORT (1A3biv)															
YEAR	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
	NOx			NMVOC			SOx			NH_3			$PM_{2.5}$		
2010	0.02	0.01	-19.1%	0.10	0.09	-11.0%	0.0002	0.0002	6%	0.0003	0.0003	1.1%	0.002	0.002	-0.3%
2011	0.02	0.01	-24.3%	0.09	0.08	-13.6%	0.0002	0.0002	7%	0.0002	0.0003	2.0%	0.002	0.002	-0.6%
2012	0.02	0.01	-24.2%	0.09	0.08	-13.6%	0.0002	0.0002	7%	0.0002	0.0002	2.2%	0.002	0.002	-0.4%
2013	0.01	0.01	-24.3%	0.08	0.07	-13.6%	0.0001	0.0002	7%	0.0002	0.0002	2.4%	0.002	0.002	-0.2%
2014	0.01	0.01	-24.1%	0.08	0.07	-15.1%	0.0001	0.0001	3%	0.0002	0.0002	-1.4%	0.002	0.002	-3.9%
2015	0.02	0.01	-23.0%	0.09	0.08	-13.9%	0.0002	0.0002	5%	0.0002	0.0002	0.2%	0.002	0.002	-2.4%
2016	0.03	0.02	-22.7%	0.15	0.13	-13.5%	0.0003	0.0003	6%	0.0004	0.0004	0.7%	0.003	0.003	-1.9%
2017	0.03	0.02	-25.7%	0.11	0.09	-17.7%	0.0001	0.0001	12%	0.0004	0.0004	2.5%	0.002	0.002	-1.8%

EMISSIONS - ROAD TRANSPORT (1A3biv)									
YEAR	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
	CO			PAH			BC		
2010	0.54	0.45	-17.9%	0.0002	0.0002	1.6%	0.0004	0.0004	-0.4%
2011	0.45	0.35	-22.0%	0.0002	0.0002	2.6%	0.0004	0.0004	-0.5%
2012	0.44	0.34	-22.0%	0.0002	0.0002	2.8%	0.0003	0.0003	-0.3%
2013	0.41	0.32	-22.0%	0.0001	0.0002	3.0%	0.0003	0.0003	-0.1%
2014	0.38	0.30	-22.3%	0.0001	0.0001	-0.9%	0.0003	0.0003	-3.8%
2015	0.45	0.35	-21.2%	0.0002	0.0002	0.8%	0.0004	0.0003	-2.2%
2016	0.73	0.58	-20.9%	0.0003	0.0003	1.3%	0.0006	0.0006	-1.8%
2017	0.73	0.58	-20.7%	0.0003	0.0003	3.2%	0.0004	0.0004	0.1%

	EMISSIONS - ROAD TRANSPORT (1A3bv)			EMISSIONS - ROAD TRANSPORT (1A3bvi)			EMISSIONS - ROAD TRANSPORT (1A3bvii)		
YEAR	2019	2020	DIFF.	2019	2020	DIFF.	2019	2020	DIFF.
	NMVOC			$PM_{2.5}$			$PM_{2.5}$		
2010	2.25	2.12	-5.7%	0.287	0.288	0.3%	0.159	0.159	0.3%
2011	2.07	1.94	-6.2%	0.273	0.274	0.4%	0.148	0.149	0.3%
2012	2.11	1.97	-6.9%	0.291	0.292	0.4%	0.159	0.159	0.3%
2013	1.91	1.75	-8.4%	0.283	0.284	0.4%	0.153	0.154	0.3%
2014	1.83	1.64	-10.4%	0.292	0.290	-0.5%	0.158	0.157	-0.5%
2015	1.77	1.62	-8.9%	0.322	0.324	0.7%	0.176	0.184	4.7%
2016	1.98	1.71	-13.7%	0.332	0.331	-0.2%	0.190	0.190	-0.3%
2017	1.83	1.59	-13.1%	0.337	0.337	0.1%	0.192	0.192	0.0%

3.6.5 RAILWAYS (NFR 1A3c)

3.6.5.1 Overview

Railways are the second most important source of emissions in transport (except 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 an 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 increase of safety. According to the Annual Report of Slovak Railways[12] in 2018, the length of managed railways was 3 627 km. The length of the electric railways was 1 587 km. Total emissions from railways transport decreased by 19.06% compared to the year 2005 and by 77.10% compared to the base year (***Table 3.90***). The decrease in fuels consumption was caused by the improvements of technical parameters (new locomotives and wagons and electrification of railways).

Table 3.90: *Overview of emissions in railways in years 1990–2018*

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	1.52	0.13	0.001	0.0002	0.04	0.31	0.0003	0.002
2016	1.56	0.14	0.000	0.0002	0.05	0.32	0.0003	0.002
2017	1.52	0.13	0.000	0.0002	0.04	0.31	0.0003	0.002
2018	1.42	0.13	0.000	0.0002	0.04	0.29	0.0003	0.002
2005-2018	**-19.06%**	**-19.06%**	**-43.50%**	**-19.06%**	**-19.06%**	**-19.06%**	**-19.06%**	**-19.06%**
1990-2018	**-77.10%**	**-77.10%**	**-84.02%**	**-77.10%**	**-77.10%**	**-77.10%**	**-77.10%**	**-77.10%**

3.6.5.2 Methodological issues

Railways transport represents the operation of diesel traction using the simple methodology tier 1 according to the EMEP/EEA GB2016. The emissions of the pollutants are calculated from the consumed fuels by diesel rail traction 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) for all years in time-series. It is assumed that the consumption of diesel oil in motor traction of railways transportation is equal to the diesel oil sold for the railways. The mobile sources of pollution in the railways' transport include vehicles of motor traction of ZSSK. This motor traction is divided into 2 basic groups of vehicles: motor locomotives (Traction 70) and motor wagons (Traction 80). Four depots in the organizational structure of ZSSK have operated the motor traction since 2002 (Bratislava, Zvolen, Žilina and Košice).

3.6.5.3 Source-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,

[12] Annual Report of Slovak Railway 2017, p.10, https://www.zsr.sk/o-nas/vyrocne-spravy/

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.

3.6.5.4 Source-specific recalculations

No recalculations in this submission.

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

3.6.6.1 Overview

The major share of emissions from inland shipping in Slovakia is realized as transit on 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, 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 3.91***), despite increase of 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 3.91: *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	0.744	0.002
1995	1.433	0.049	0.361	0.0001	0.101	0.134	0.656	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	0.008	0.000
2010	0.837	0.028	0.211	0.0001	0.059	0.078	0.383	0.001
2011	0.743	0.025	0.187	0.0001	0.052	0.069	0.340	0.001
2012	0.259	0.009	0.065	0.0000	0.018	0.024	0.118	0.000
2013	0.408	0.014	0.103	0.0000	0.029	0.038	0.187	0.000
2014	0.474	0.016	0.120	0.0000	0.033	0.044	0.217	0.000
2015	0.714	0.024	0.180	0.0001	0.050	0.067	0.326	0.001
2016	0.597	0.020	0.151	0.0001	0.042	0.057	0.273	0.001
2017	0.588	0.020	0.148	0.0001	0.046	0.055	0.291	0.001
2018	0.534	0.020	0.148	0.0001	0.042	0.055	0.002	0.000
2005-2018	**2910%**	**3221%**	**3216%**	**3215%**	**3215%**	**3215%**	**-80%**	**565%**
1990-2018	**-67%**	**-64%**	**-64%**	**-64%**	**-64%**	**-64%**	**-100%**	**-93%**

3.6.6.2 Methodological issues

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

Shipping between the Slovak ports on 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 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 Danube River, occur in Slovakia, however in a limited extent. The three shipping routes are:

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

While the public and tourist shipping activities in the Slovak Republic are not very frequent and have expanded only in the recent years (due to increase of 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 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 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
(**0.84 kg/dm^3**).

The emissions are calculated from the consumed fuel by diesel motor boats multiplied by the emission factor. The emission factors are taken from the EMEP/EEA GB$_{2016}$. Activity data for domestic navigation are shown in ***Tables 3.92*** and ***Table 3.93***.

Table 3.92: *The amount of diesel oil sold by shipping companies and allocation to the categories 1A3dii and 1A3di(ii) in selected years 2005–2018*

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

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
	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**
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**

***Table 3.93:** The emission estimation in national shipping for touristic purposes (NFR 1A3d) in 2018*

2018	**LOCATION**						**TOTAL**
ACTIVITY DATA	**Piešťany long trip**	**Piešťany short trip**	**Trenčín**	**Lipt. Mara**	**Oravská Priehrada**	**Zempl. Šírava**	
Number of Trips (per year)	237	0	36	180	460	150	**1 043**
Duration of Trip (hours)	1	0	0.35	1	1	0.75	
Total Duration (hours/year)	237	0	12.6	180	466	112.5	**988.1**
Fuel Consumption (l/hour)	12	0	12	12	5.99	12	
Total Consumption (l/year)	2 844	0	151.2	2 160	2 790	1 350	**7 135.2**
Total Consumption (kg/year)	2 376	0	126	1 555	2 331	1 128	**5 962.2**
Total Consumption (TJ/year)	0.100	0	0.005	0.06827	0.098	0.048	**0.861**

3.6.6.3 Source-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.

3.6.6.4 Source-specific recalculations

No recalculations in this submission.

3.6.7 PIPELINE TRANSPORT (NFR 1A3ei)

3.6.7.1 Overview

There is a significant decrease in 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 3.94***. This category is key for NOx.

Table 3.94: *Overview of emissions from pipeline transport in particular years*

YEAR	EMISSIONS (kt)				
	NOx	NMVOC	SOx	TSP	CO
1990	5.674	0.223	0.00156	0.00020	0.664
1995	3.678	0.144	0.00101	0.00013	0.431
2000	3.125	0.087	0.00098	0.00016	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
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
2005-2018	**-95%**	**-38%**	**-99%**	**8 506%**	**-67%**
1990-2018	**-96%**	**-33%**	**-99%**	**1 739%**	**-82%**

3.6.7.2 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.

Historical data 1990-1999 are not covered by NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***Table 3.95***).

Table 3.95: *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	178.169	6.994	0.049	0.01	100%	100%	20.86

3.6.7.3 Source-specific QA/QC

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

3.6.7.4 Source-specific recalculations

Recalculations were done due to change of categorisation of fuels. 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. Fuels in this category were reported in compliance with GHG inventory. Recalculation in 2008 was due to database error correction. Overview of recalculations presents ***Table 3.96***.

Table 3.96: *Previous and refined emissions in the category 1A2f*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	9.8439	5.6738	-42%	0.7554	0.2227	-71%	0.0018	0.0016	-13%
1991	9.2654	4.9704	-46%	0.7314	0.1951	-73%	0.0017	0.0014	-21%
1992	8.7042	4.2493	-51%	0.7074	0.1668	-76%	0.0017	0.0012	-30%
1993	8.1604	3.5190	-57%	0.6833	0.1381	-80%	0.0016	0.0010	-40%
1994	7.6341	2.1244	-72%	0.6592	0.0834	-87%	0.0016	0.0006	-63%
1995	7.1251	3.6783	-48%	0.6351	0.1444	-77%	0.0015	0.0010	-33%
1996	6.6336	4.2422	-36%	0.6110	0.1665	-73%	0.0014	0.0012	-19%
1997	6.1594	3.9817	-35%	0.5868	0.1563	-73%	0.0014	0.0011	-21%
1998	5.7026	4.0473	-29%	0.5627	0.1589	-72%	0.0013	0.0011	-16%
1999	5.2633	3.9479	-25%	0.5385	0.1550	-71%	0.0013	0.0011	-15%
2000	3.1252	3.1252	-	0.0871	0.0871	-	0.0010	0.0010	-
2001	2.9996	2.9996	-	0.0690	0.0690	-	0.0009	0.0009	-
2002	3.4589	3.4589	-	0.1218	0.1218	-	0.0010	0.0010	-
2003	3.3265	3.3265	-	0.2289	0.2289	-	0.0007	0.0007	-
2004	4.6959	4.6959	-	0.1874	0.1874	-	0.0012	0.0012	-
2005	3.9738	3.9738	-	0.2380	0.2380	-	0.0010	0.0010	-
2006	2.7464	2.7464	-	0.1499	0.1499	-	0.0006	0.0006	-
2007	2.9175	2.9175	-	0.0749	0.0749	-	0.0001	0.0001	-
2008	2.5851	3.5126	36%	0.2251	0.0977	-57%	0.0002	0.0001	-30%

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	2E-04	2E-04	-10%	2E-04	2E-04	-10%	2E-04	2E-04	-10%	0.8210	0.6643	-19%
1991	2E-04	2E-04	-18%	2E-04	2E-04	-18%	2E-04	2E-04	-18%	0.7794	0.5819	-25%
1992	2E-04	1E-04	-28%	2E-04	1E-04	-28%	2E-04	1E-04	-28%	0.7388	0.4975	-33%
1993	2E-04	1E-04	-38%	2E-04	1E-04	-38%	2E-04	1E-04	-38%	0.6991	0.4120	-41%
1994	2E-04	7E-05	-61%	2E-04	7E-05	-61%	2E-04	7E-05	-61%	0.6605	0.2487	-62%
1995	2E-04	1E-04	-31%	2E-04	1E-04	-31%	2E-04	1E-04	-31%	0.6229	0.4306	-31%
1996	2E-04	1E-04	-17%	2E-04	1E-04	-17%	2E-04	1E-04	-17%	0.5863	0.4967	-15%
1997	2E-04	1E-04	-19%	2E-04	1E-04	-19%	2E-04	1E-04	-19%	0.5507	0.4662	-15%
1998	2E-04	1E-04	-14%	2E-04	1E-04	-14%	2E-04	1E-04	-14%	0.5162	0.4739	-8%
1999	2E-04	1E-04	-12%	2E-04	1E-04	-12%	2E-04	1E-04	-12%	0.4826	0.4622	-4%
2000	1E-04	2E-04	31%	1E-04	2E-04	31%	1E-04	2E-04	31%	0.4181	0.4181	-
2001	1E-04	1E-04	35%	1E-04	1E-04	35%	1E-04	1E-04	35%	0.3427	0.3427	-
2002	1E-04	1E-04	0%	1E-04	1E-04	0%	1E-04	1E-04	0%	0.4037	0.4037	-
2003	1E-04	1E-04	0%	1E-04	1E-04	0%	1E-04	1E-04	0%	0.3470	0.3470	-
2004	2E-04	2E-04	0%	2E-04	2E-04	0%	2E-04	2E-04	0%	0.3849	0.3849	-
2005	4E-05	4E-05	-	4E-05	4E-05	-	4E-05	4E-05	-	0.3650	0.3650	-
2006	4E-05	4E-05	-	4E-05	4E-05	-	4E-05	4E-05	-	0.2227	0.2227	-
2007	7E-05	7E-05	-	7E-05	7E-05	-	7E-05	7E-05	-	0.2575	0.2575	-
2008	4E-05	5E-05	27%	4E-05	5E-05	27%	4E-05	5E-05	27%	0.1800	0.2897	61%

P–Previous
R–Refined

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 the 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 production of thermal energy in larger combustion activities, except the simple design of smaller appliances like fireplaces and stoves.

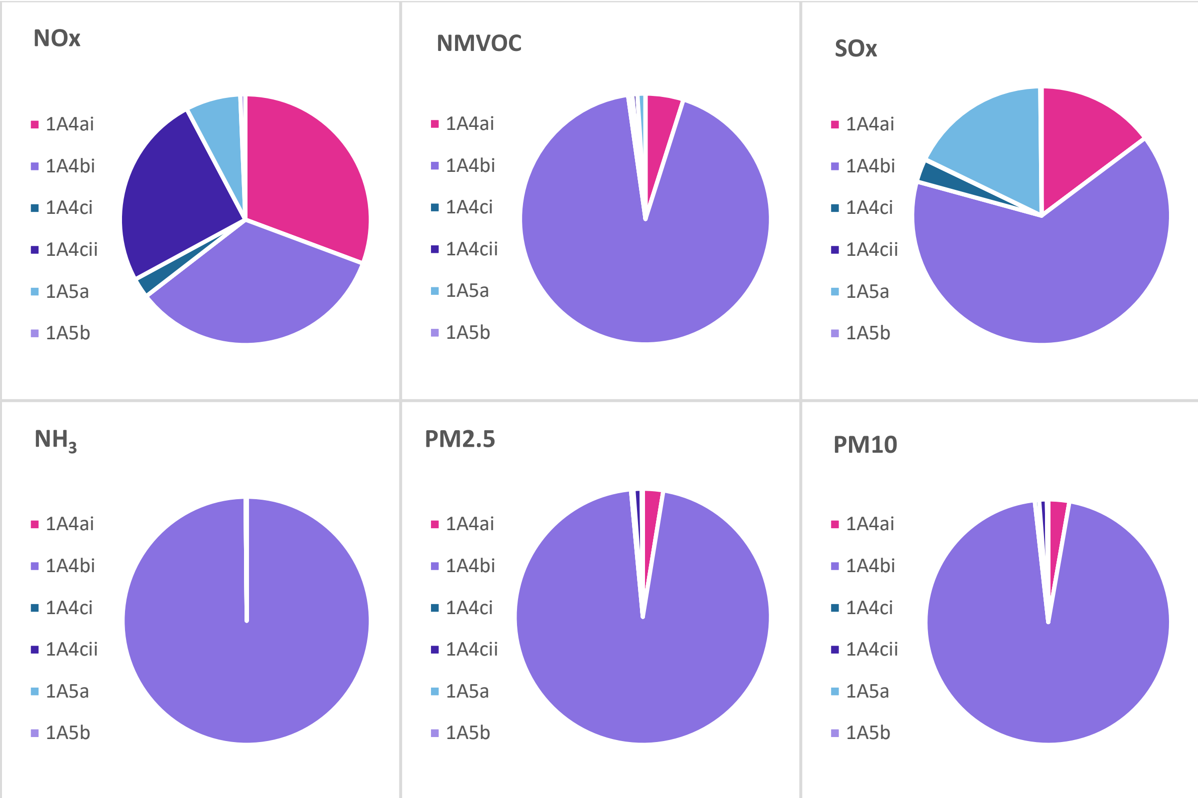
Relevant pollutants are SO2, NOx, CO, NMVOC, particulate matter (PM), black carbon (BC), heavy metals, PAH, polychlorinated dibenzo-dioxins and furans (PCDD/F) and hexachlorobenzene (HCB). For solid fuels, generally, the emissions due to incomplete combustion are many times greater in small appliances 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 to 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 3.32***).

Figure 3.32: *Share of emissions of main pollutants in 1A4 and 1A5 in 2018*



3.7.2 COMMERCIAL/INSTITUTIONAL: STATIONARY (NFR 1A4ai)

3.7.2.1 Overview

The fuel consumption in the long term has a decreasing trend, but since 2010 the consumption of biomass has increased. As a direct consequence of the change in fuel base, the heavy metals calculated by T1 method using the EMEP/EEA GB_{2019} default factors reflecting the increase in Zn.

This category is key for emissions of NOx, $PM_{2.5}$, PM_{10}, Zn and PCBs. Emissions of PMs show overall decreasing trend and emissions of NOx are increasing since 2007 which correlate with higher use of biomass as fuel since 2007. Emission trends of these pollutants are shown in ***Figure 3.33-3.34***.

Figure 3.33: *Trends of NOx, $PM_{2.5}$ and PM_{10} emissions in the category 1A4ai*

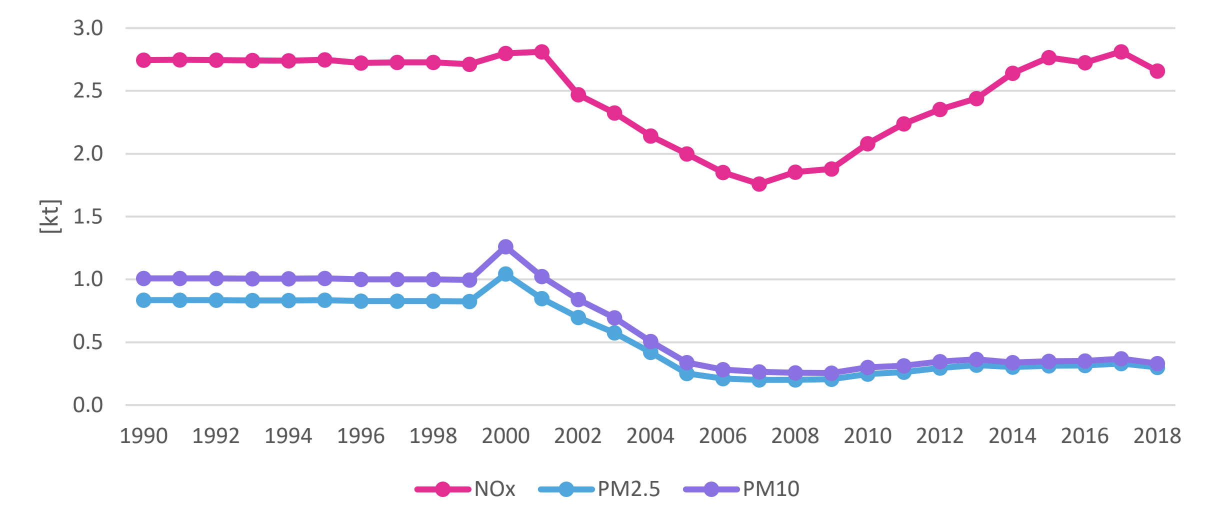
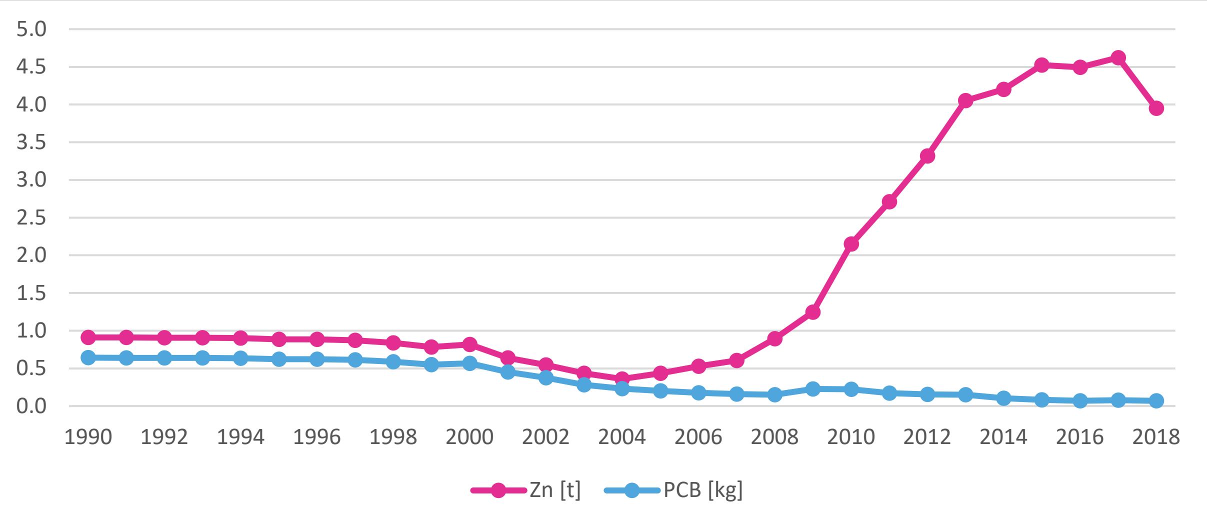


Figure 3.34: *Trends of Zn and PCBs emissions in the category 1A4ai*



Overview of the emissions is shown in ***Table 3.97***. 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 3.97: *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	2.7458	0.2274	2.1826	NO	0.8341	1.0078	1.4835	4.3300
1995	2.7473	0.2275	2.1838	NO	0.8345	1.0084	1.4843	4.3323
2000	2.7989	0.1819	2.8193	NO	1.0429	1.2602	1.8550	5.3816
2005	2.0000	0.0940	0.9170	NO	0.2522	0.3385	0.6388	2.1965
2010	2.0795	0.7785	0.5606	NO	0.2454	0.3004	0.4392	2.3249
2011	2.2375	0.9790	0.4987	NO	0.2607	0.3119	0.4368	2.5349
2012	2.3541	1.2333	0.4349	NO	0.2956	0.3456	0.4598	2.9354
2013	2.4408	1.5071	0.3969	NO	0.3178	0.3639	0.4536	3.1171
2014	2.6422	1.5831	0.3816	0.0001	0.3019	0.3389	0.4063	2.9099
2015	2.7655	1.7184	0.4287	0.0001	0.3130	0.3484	0.4136	2.8938
2016	2.7261	1.7456	0.3611	0.0001	0.3162	0.3519	0.4143	2.8132

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]]
2017	2.8127	1.7894	0.3610	0.0001	0.3299	0.3676	0.4290	2.7584
2018	2.6583	1.6967	0.2903	0.0001	0.2998	0.3317	0.3779	2.4580
1990/2018	**-3%**	**646%**	**-87%**	**-**	**-64%**	**-67%**	**-75%**	**-43%**
2017/2018	**-5%**	**-5%**	**-20%**	**-1%**	**-9%**	**-10%**	**-12%**	**-11%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.5158	0.0099	0.0343	0.0196	0.0603	0.0687	0.0928	0.0095	0.9124
1995	0.5001	0.0096	0.0334	0.0192	0.0584	0.0666	0.0897	0.0092	0.8842
2000	0.4552	0.0090	0.0306	0.0177	0.0543	0.0608	0.0905	0.0085	0.8177
2005	0.1680	0.0065	0.0133	0.0086	0.0252	0.0230	0.0316	0.0045	0.4354
2010	0.2746	0.0497	0.0153	0.0089	0.1029	0.0451	0.0387	0.0059	2.1497
2011	0.2677	0.0650	0.0133	0.0076	0.1266	0.0472	0.0347	0.0058	2.7100
2012	0.2872	0.0808	0.0132	0.0074	0.1532	0.0527	0.0329	0.0062	3.3167
2013	0.3235	0.0995	0.0138	0.0076	0.1859	0.0610	0.0315	0.0069	4.0530
2014	0.2969	0.1041	0.0119	0.0065	0.1912	0.0585	0.0280	0.0066	4.1987
2015	0.2984	0.1127	0.0113	0.0063	0.2051	0.0603	0.0279	0.0067	4.5214
2016	0.2879	0.1122	0.0108	0.0060	0.2034	0.0589	0.0256	0.0066	4.4936
2017	0.2986	0.1154	0.0112	0.0062	0.2093	0.0609	0.0265	0.0068	4.6223
2018	0.2573	0.0985	0.0099	0.0056	0.1788	0.0523	0.0226	0.0059	3.9487
1990/2018	**-50%**	**893%**	**-71%**	**-72%**	**196%**	**-24%**	**-76%**	**-37%**	**333%**
2017/2018	**-14%**	**-15%**	**-12%**	**-11%**	**-15%**	**-14%**	**-15%**	**-13%**	**-15%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.8148	0.2059	0.3564	0.1387	0.1179	0.8189	0.0036	0.6424
1995	0.7905	0.2007	0.3497	0.1361	0.1159	0.8024	0.0035	0.6229
2000	0.7215	0.1840	0.3247	0.1260	0.1076	0.7423	0.0033	0.5655
2005	0.2924	0.0842	0.1856	0.0711	0.0639	0.4048	0.0024	0.2000
2010	0.6453	0.1172	0.2220	0.0816	0.0706	0.4914	0.0190	0.2223
2011	0.7052	0.1136	0.2146	0.0772	0.0666	0.4720	0.0249	0.1722
2012	0.8070	0.1208	0.2260	0.0802	0.0688	0.4957	0.0310	0.1553
2013	0.9477	0.1344	0.2479	0.0870	0.0744	0.5437	0.0382	0.1522
2014	0.9307	0.1258	0.2379	0.0825	0.0708	0.5170	0.0400	0.1051
2015	0.9735	0.1275	0.2441	0.0839	0.0722	0.5277	0.0433	0.0838
2016	0.9562	0.1241	0.2401	0.0824	0.0711	0.5177	0.0431	0.0714
2017	0.9869	0.1284	0.2477	0.0851	0.0733	0.5345	0.0443	0.0769
2018	0.8467	0.1116	0.2172	0.0748	0.0647	0.4683	0.0378	0.0688
1990/2018	**4%**	**-46%**	**-39%**	**-46%**	**-45%**	**-43%**	**957%**	**-89%**
2017/2018	**-14%**	**-13%**	**-12%**	**-12%**	**-12%**	**-12%**	**-15%**	**-11%**

Overview of the activity data (energy consumption) for this source category is in ***Table 3.98*** below. This table represents fuels allocated to the fuel type for the calculations (following Table 3-2 of EMEP/EEA GB_{2019}, Part Small combustion). Fuels in the template are allocated following principle from IPCC 2006 Guidelines.

Table 3.98: *Overview of activity data in the category 1A2ai*

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
1990	341.26	3778.73	43088.66	232.57	NO
1995	328.65	3664.15	43251.18	222.41	NO

YEAR	LIQUID FUELS [TJ NCV]	HARD COAL, BROWN COAL [TJ NCV]	GASEOUS FUELS [TJ NCV]	BIOMASS [TJ NCV]	OTHER FUELS [TJ NCV]
2000	369.97	3326.20	41262.79	225.84	NO
2005	121.18	1176.35	37633.65	332.87	NO
2010	112.48	1306.13	29335.90	3642.62	NO
2011	91.99	1011.43	26178.08	4857.28	NO
2012	68.58	911.25	25488.35	6083.29	NO
2013	36.33	892.57	25622.82	7529.49	NO
2014	30.52	615.17	25674.94	7922.69	NO
2015	31.95	489.84	26593.77	8600.53	NO
2016	21.35	417.07	26903.28	8574.62	NO
2017	21.80	449.39	27546.40	8812.43	NO
2018	15.90	402.26	25148.47	7518.81	NO
1990/2018	**-95%**	**-89%**	**-42%**	**3133%**	**-**
2017/2018	**-27%**	**-10%**	**-9%**	**-15%**	**-**

3.7.2.2 Methodological issues

The category covers the sources that cannot be clearly identified to particular activity but generally it is the combustion process. The definition of sources is provided in ***Table 3.99***.

Table 3.99: *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

Table 3.100: *The overview of share of used calculation type for category 1A4ai in NEIS*

1A4ai	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	36%
4	Calculation using emission factor and amount of fuel	60%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0.2%
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	4%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

Historical data 1990-1999 are not covered by NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***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	57.88	4.79	46.01	31.27	56%	68%	91.27

Heavy metals and POPs are calculated at Tier 1 level. Emission factors used for calculation of heavy metals are default EF from EMEP/EEA GB2019 (***Table 3.102***).

Table 3.102: *Emission factor for heavy metals and POPs in the category 1A4ai*

T1	UNIT	LIQUID FUELS	HARD COAL/BROWN COAL	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	8	134	0.011	27
Cd	[mg/GJ]	0.15	1.8	0.0009	13
Hg	[mg/GJ]	0.1	7.9	0.1	0.56
As	[mg/GJ]	0.5	4	0.1	0.19
Cr	[mg/GJ]	10	13.5	0.013	23
Cu	[mg/GJ]	3	17.5	0.0026	6
Ni	[mg/GJ]	125	13	0.013	2
Se	[mg/GJ]	0.1	1.8	0.058	0.5
Zn	[mg/GJ]	18	200	0.73	512
PCDD/F	[ng/GJ]	6	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]	0.22	0.62	-	5
PCBs	[µg/GJ]	0.00013	170	-	0.06

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

Recalculations in this submission were done due to change of categorisation of fuels. 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 3.103*** shows the change in the data between final submission 2019 and this submission. Following recommendation No ***SK-1A4ai-2018-001*** emission factor for Cd was modified for liquid fuels.

Table 3.103: *Previous and refined emissions in the category 1A4ai*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	3.2275	2.7458	-15%	0.2673	0.2274	-15%	2.5655	2.1826	-15%
1991	3.0275	2.7477	-9%	0.2507	0.2275	-9%	2.4065	2.1841	-9%
1992	2.8491	2.7455	-4%	0.2359	0.2274	-4%	2.2647	2.1824	-4%
1993	2.6911	2.7423	2%	0.2229	0.2271	2%	2.1392	2.1798	2%
1994	2.5709	2.7404	7%	0.2129	0.2269	7%	2.0436	2.1783	7%
1995	2.4609	2.7473	12%	0.2038	0.2275	12%	1.9562	2.1838	12%
1996	2.3491	2.7231	16%	0.1945	0.2255	16%	1.8673	2.1646	16%
1997	2.6683	2.7275	2%	0.2210	0.2259	2%	2.1210	2.1680	2%
1998	2.3575	2.7273	16%	0.1952	0.2259	16%	1.8739	2.1679	16%
1999	2.2287	2.7136	22%	0.1846	0.2247	22%	1.7716	2.1570	22%

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	0.9804	0.8341	-15%	1.1846	1.0078	-15%	1.7438	1.4835	-15%	5.0896	4.3300	-15%
1991	0.9196	0.8346	-9%	1.1112	1.0085	-9%	1.6357	1.4845	-9%	4.7742	4.3330	-9%
1992	0.8654	0.8340	-4%	1.0457	1.0077	-4%	1.5393	1.4834	-4%	4.4929	4.3296	-4%
1993	0.8175	0.8330	2%	0.9878	1.0065	2%	1.4540	1.4816	2%	4.2438	4.3245	2%
1994	0.7810	0.8324	7%	0.9436	1.0058	7%	1.3891	1.4806	7%	4.0543	4.3215	7%
1995	0.7475	0.8345	12%	0.9033	1.0084	12%	1.3296	1.4843	12%	3.8808	4.3323	12%
1996	0.7136	0.8272	16%	0.8622	0.9995	16%	1.2692	1.4713	16%	3.7044	4.2943	16%
1997	0.8105	0.8285	2%	0.9794	1.0011	2%	1.4417	1.4736	2%	4.2078	4.3011	2%
1998	0.7161	0.8284	16%	0.8653	1.0010	16%	1.2737	1.4735	16%	3.7177	4.3008	16%
1999	0.6770	0.8243	22%	0.8180	0.9960	22%	1.2041	1.4661	22%	3.5146	4.2793	22%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	2.2827	0.5158	-77%	0.0511	0.0099	-81%	0.1521	0.0343	-77%	0.0914	0.0196	-79%
1991	1.9666	0.5142	-74%	0.0425	0.0099	-77%	0.1335	0.0342	-74%	0.0786	0.0196	-75%
1992	1.6821	0.5126	-70%	0.0351	0.0098	-72%	0.1168	0.0341	-71%	0.0672	0.0195	-71%
1993	1.4276	0.5114	-64%	0.0287	0.0098	-66%	0.1018	0.0341	-67%	0.0570	0.0195	-66%
1994	1.2020	0.5101	-58%	0.0234	0.0098	-58%	0.0886	0.0340	-62%	0.0493	0.0195	-61%
1995	1.0028	0.5001	-50%	0.0189	0.0096	-49%	0.0769	0.0334	-57%	0.0422	0.0192	-54%
1996	0.8279	0.4999	-40%	0.0150	0.0096	-36%	0.0666	0.0334	-50%	0.0347	0.0191	-45%
1997	1.6283	0.4913	-70%	0.0247	0.0095	-62%	0.1137	0.0329	-71%	0.0569	0.0189	-67%
1998	0.9510	0.4735	-50%	0.0149	0.0090	-39%	0.0737	0.0319	-57%	0.0356	0.0184	-48%
1999	0.6766	0.4408	-35%	0.0110	0.0084	-23%	0.0575	0.0300	-48%	0.0267	0.0174	-35%
2000	0.4474	0.4552	2%	0.0065	0.0090	40%	0.0487	0.0306	-37%	0.0191	0.0177	-8%
2001	0.3576	0.3623	1%	0.0051	0.0067	30%	0.0450	0.0255	-43%	0.0161	0.0152	-6%
2002	0.2958	0.3006	2%	0.0044	0.0058	32%	0.0402	0.0217	-46%	0.0142	0.0132	-7%
2003	0.2228	0.2277	2%	0.0035	0.0048	36%	0.0351	0.0172	-51%	0.0121	0.0108	-11%
2004	0.1835	0.1871	2%	0.0031	0.0039	26%	0.0317	0.0147	-54%	0.0106	0.0094	-11%
2005	0.1664	0.1680	1%	0.0061	0.0065	7%	0.0298	0.0133	-56%	0.0092	0.0086	-7%
2006	0.1485	0.1537	4%	0.0070	0.0094	34%	0.0278	0.0120	-57%	0.0083	0.0078	-5%
2007	0.1451	0.1469	1%	0.0110	0.0118	7%	0.0247	0.0110	-56%	0.0072	0.0070	-3%
2008	0.1446	0.1547	7%	0.0145	0.0193	33%	0.0243	0.0108	-56%	0.0070	0.0069	-2%
2009	0.2216	0.2284	3%	0.0235	0.0267	14%	0.0268	0.0144	-46%	0.0087	0.0085	-2%
2010	0.2702	0.2746	2%	0.0480	0.0497	4%	0.0282	0.0153	-46%	0.0094	0.0089	-5%
2011	0.2638	0.2677	1%	0.0634	0.0650	3%	0.0248	0.0133	-46%	0.0080	0.0076	-5%
2012	0.2850	0.2872	1%	0.0799	0.0808	1%	0.0244	0.0132	-46%	0.0077	0.0074	-4%
2013	0.3211	0.3235	1%	0.0985	0.0995	1%	0.0251	0.0138	-45%	0.0078	0.0076	-3%
2014	0.2948	0.2969	1%	0.1032	0.1041	1%	0.0231	0.0119	-49%	0.0067	0.0065	-3%
2015	0.2972	0.2984	0%	0.1123	0.1127	0%	0.0230	0.0113	-51%	0.0065	0.0063	-3%
2016	0.2878	0.2879	0%	0.1123	0.1122	0%	0.0226	0.0108	-52%	0.0062	0.0060	-3%
2017	0.2985	0.2986	0%	0.1154	0.1154	0%	0.0234	0.0112	-52%	0.0064	0.0062	-3%

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	0.2221	0.0601	-73%	0.2668	0.0684	-74%	0.1914	0.0923	-52%
1992	0.1881	0.0600	-68%	0.2278	0.0682	-70%	0.1638	0.0922	-44%
1993	0.1579	0.0598	-62%	0.1928	0.0681	-65%	0.1391	0.0923	-34%
1994	0.1317	0.0597	-55%	0.1625	0.0679	-58%	0.1172	0.0920	-22%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1995	0.1089	0.0584	-46%	0.1357	0.0666	-51%	0.0979	0.0897	-8%
1996	0.0891	0.0587	-34%	0.1116	0.0666	-40%	0.0809	0.0915	13%
1997	0.1682	0.0576	-66%	0.2153	0.0654	-70%	0.1585	0.0896	-43%
1998	0.0991	0.0553	-44%	0.1262	0.0630	-50%	0.0928	0.0854	-8%
1999	0.0712	0.0518	-27%	0.0901	0.0587	-35%	0.0661	0.0819	24%
2000	0.0460	0.0543	18%	0.0592	0.0608	3%	0.0440	0.0905	106%
2001	0.0369	0.0419	14%	0.0472	0.0482	2%	0.0353	0.0638	81%
2002	0.0307	0.0359	17%	0.0392	0.0401	2%	0.0292	0.0624	113%
2003	0.0235	0.0291	24%	0.0298	0.0308	3%	0.0222	0.0634	186%
2004	0.0198	0.0240	21%	0.0246	0.0253	3%	0.0183	0.0521	184%
2005	0.0233	0.0252	8%	0.0228	0.0230	1%	0.0164	0.0316	92%
2006	0.0234	0.0281	20%	0.0206	0.0216	5%	0.0146	0.0202	38%
2007	0.0294	0.0311	5%	0.0208	0.0212	2%	0.0140	0.0173	23%
2008	0.0351	0.0438	25%	0.0215	0.0237	10%	0.0138	0.0182	32%
2009	0.0555	0.0615	11%	0.0331	0.0345	4%	0.0208	0.0248	19%
2010	0.0987	0.1029	4%	0.0442	0.0451	2%	0.0244	0.0387	58%
2011	0.1229	0.1266	3%	0.0464	0.0472	2%	0.0230	0.0347	51%
2012	0.1511	0.1532	1%	0.0523	0.0527	1%	0.0242	0.0329	36%
2013	0.1838	0.1859	1%	0.0605	0.0610	1%	0.0269	0.0315	17%
2014	0.1893	0.1912	1%	0.0580	0.0585	1%	0.0241	0.0280	16%
2015	0.2039	0.2051	1%	0.0601	0.0603	0%	0.0239	0.0279	17%
2016	0.2032	0.2034	0%	0.0589	0.0589	0%	0.0229	0.0256	12%
2017	0.2091	0.2093	0%	0.0609	0.0609	0%	0.0238	0.0265	11%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0432	0.0095	-78%	4.2491	0.9124	-79%
1991	0.0371	0.0094	-75%	3.6078	0.9093	-75%
1992	0.0317	0.0094	-70%	3.0392	0.9067	-70%
1993	0.0269	0.0094	-65%	2.5392	0.9050	-64%
1994	0.0233	0.0094	-60%	2.1151	0.9027	-57%
1995	0.0200	0.0092	-54%	1.7462	0.8842	-49%
1996	0.0165	0.0092	-44%	1.4218	0.8864	-38%
1997	0.0263	0.0091	-65%	2.5715	0.8707	-66%
1998	0.0167	0.0089	-47%	1.5340	0.8379	-45%
1999	0.0127	0.0084	-33%	1.1131	0.7828	-30%
2000	0.0092	0.0085	-8%	0.7175	0.8177	14%
2001	0.0079	0.0074	-6%	0.5790	0.6389	10%
2002	0.0070	0.0065	-7%	0.4882	0.5433	11%
2003	0.0061	0.0054	-11%	0.3841	0.4331	13%
2004	0.0053	0.0048	-11%	0.3283	0.3600	10%
2005	0.0048	0.0045	-7%	0.4201	0.4354	4%
2006	0.0044	0.0042	-3%	0.4360	0.5300	22%
2007	0.0040	0.0039	-2%	0.5763	0.6058	5%
2008	0.0040	0.0041	2%	0.7074	0.8955	27%
2009	0.0050	0.0050	0%	1.1168	1.2437	11%
2010	0.0061	0.0059	-3%	2.0812	2.1497	3%
2011	0.0059	0.0058	-3%	2.6476	2.7100	2%
2012	0.0063	0.0062	-2%	3.2850	3.3167	1%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
2013	0.0069	0.0069	-1%	4.0134	4.0530	1%
2014	0.0066	0.0066	-1%	4.1637	4.1987	1%
2015	0.0068	0.0067	-1%	4.5035	4.5214	0%
2016	0.0067	0.0066	-1%	4.4947	4.4936	0%
2017	0.0069	0.0068	-1%	4.6234	4.6223	0%

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	0.5365	0.8148	52%	0.0086	0.8189	9430%	0.0678	0.0036	-95%	0.2442	0.6424	163%
1991	0.4589	0.8123	77%	0.0069	0.8173	11670%	0.0576	0.0036	-94%	0.2079	0.6404	208%
1992	0.3899	0.8099	108%	0.0055	0.8155	14663%	0.0486	0.0036	-93%	0.1755	0.6384	264%
1993	0.3291	0.8080	146%	0.0043	0.8139	18752%	0.0405	0.0036	-91%	0.1467	0.6368	334%
1994	0.2766	0.8060	191%	0.0036	0.8123	22499%	0.0345	0.0035	-90%	0.1261	0.6353	404%
1995	0.2310	0.7905	242%	0.0029	0.8024	27237%	0.0290	0.0035	-88%	0.1068	0.6229	483%
1996	0.1912	0.7902	313%	0.0022	0.7998	36887%	0.0233	0.0035	-85%	0.0857	0.6223	626%
1997	0.3430	0.7770	127%	0.0016	0.7912	49449%	0.0389	0.0034	-91%	0.1381	0.6117	343%
1998	0.2089	0.7494	259%	0.0012	0.7723	62185%	0.0235	0.0033	-86%	0.0843	0.5897	600%
1999	0.1545	0.6991	352%	0.0011	0.7366	69585%	0.0172	0.0030	-82%	0.0617	0.5487	789%
2000	0.1086	0.7215	564%	0.0004	0.7423	182765%	0.0108	0.0033	-70%	0.0388	0.5655	1358%
2001	0.0915	0.5780	532%	0.0003	0.6557	251163%	0.0084	0.0024	-72%	0.0311	0.4520	1352%
2002	0.0787	0.4828	513%	0.0003	0.5762	189604%	0.0072	0.0021	-71%	0.0262	0.3735	1326%
2003	0.0646	0.3711	475%	0.0004	0.4883	127603%	0.0059	0.0018	-70%	0.0218	0.2804	1188%
2004	0.0553	0.3077	456%	0.0004	0.4317	114525%	0.0049	0.0014	-70%	0.0187	0.2303	1135%
2005	0.0681	0.2924	329%	0.0012	0.4048	32519%	0.0049	0.0024	-51%	0.0143	0.2000	1294%
2006	0.0700	0.2852	308%	0.0016	0.3803	24427%	0.0047	0.0036	-25%	0.0117	0.1742	1386%
2007	0.0861	0.2837	230%	0.0028	0.3465	12485%	0.0055	0.0044	-19%	0.0110	0.1592	1347%
2008	0.0984	0.3303	236%	0.0038	0.3573	9400%	0.0062	0.0074	19%	0.0123	0.1490	1110%
2009	0.1437	0.4708	228%	0.0062	0.4258	6771%	0.0101	0.0102	0%	0.0294	0.2252	667%
2010	0.2482	0.6453	160%	0.0122	0.4914	3935%	0.0168	0.0190	13%	0.0368	0.2223	504%
2011	0.3147	0.7052	124%	0.0161	0.4720	2829%	0.0208	0.0249	20%	0.0394	0.1722	338%
2012	0.3920	0.8070	106%	0.0205	0.4957	2318%	0.0255	0.0310	22%	0.0427	0.1553	264%
2013	0.4734	0.9477	100%	0.0251	0.5437	2068%	0.0304	0.0382	26%	0.0474	0.1522	221%
2014	0.4957	0.9307	88%	0.0265	0.5170	1851%	0.0313	0.0400	28%	0.0438	0.1051	140%
2015	0.5455	0.9735	78%	0.0293	0.5277	1703%	0.0344	0.0433	26%	0.0471	0.0838	78%
2016	0.5534	0.9562	73%	0.0297	0.5177	1641%	0.0347	0.0431	24%	0.0454	0.0714	57%
2017	0.5669	0.9869	74%	0.0305	0.5345	1654%	0.0357	0.0443	24%	0.0476	0.0769	61%

P-Previous
R-Refined

3.7.3 COMMERCIAL/INSTITUTIONAL: MOBILE (NFR 1A4aii)

3.7.3.1 Overview

This activity is included in the category 1A2gviii, therefore notation key IE was used.

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 75% 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). Emission trends of these pollutants are shown in the following figures ***(Figure 3.35-3.38)***. Emission trend of all pollutants shows a very similar trend which correlates with the trend of biomass burning (wood) in Slovak households.

Figure 3.35: *Trends of NOx, SOx, NMVOC and CO emissions in the category 1A4bi*

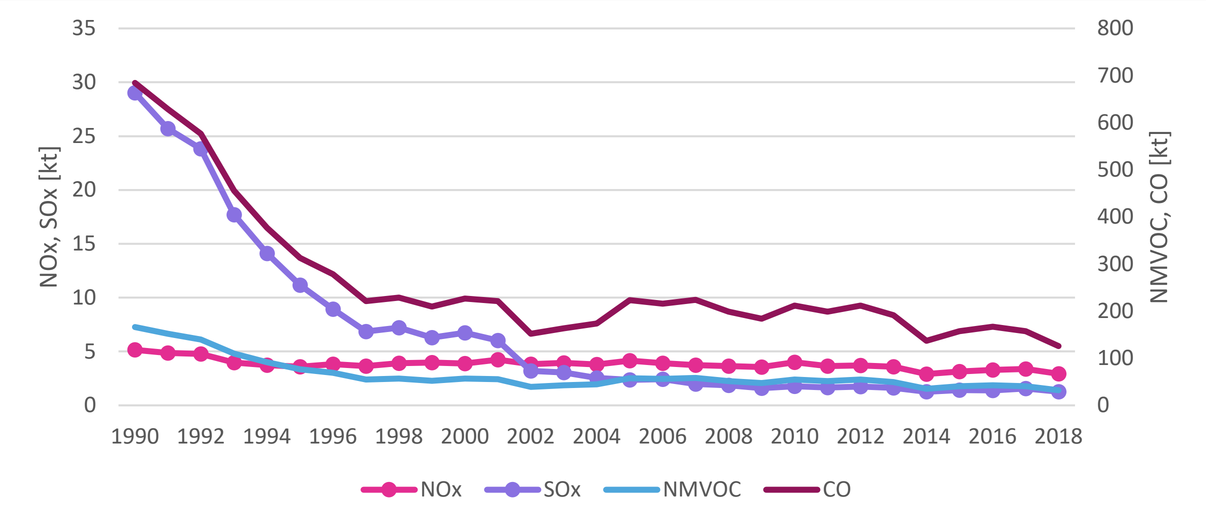


Figure 3.36: *Trends of PMs emissions in the category 1A4bi*

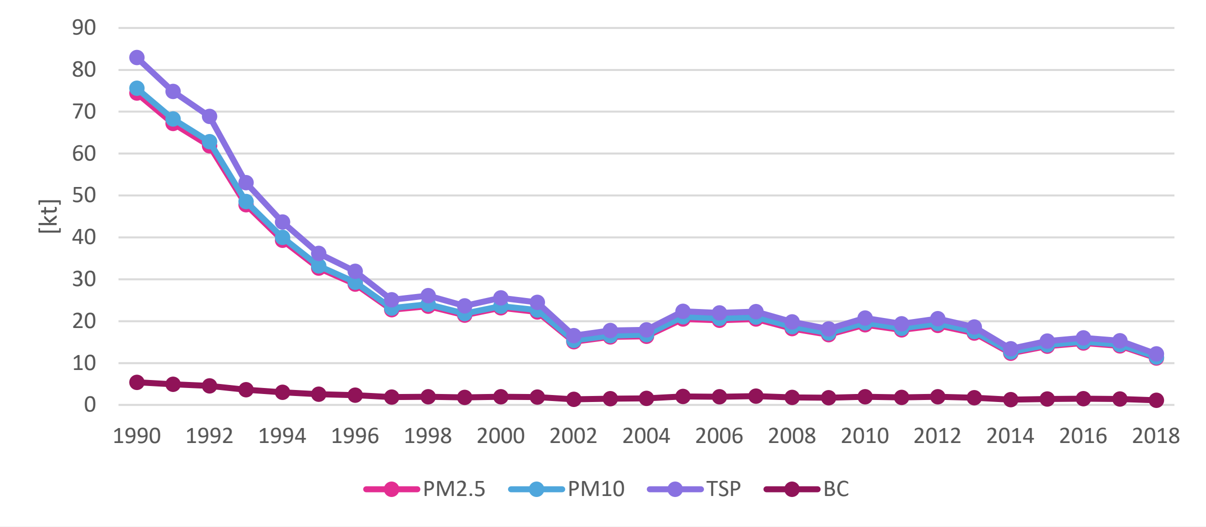


Figure 3.37: *Trends of HMs emissions in the category 1A4bi*

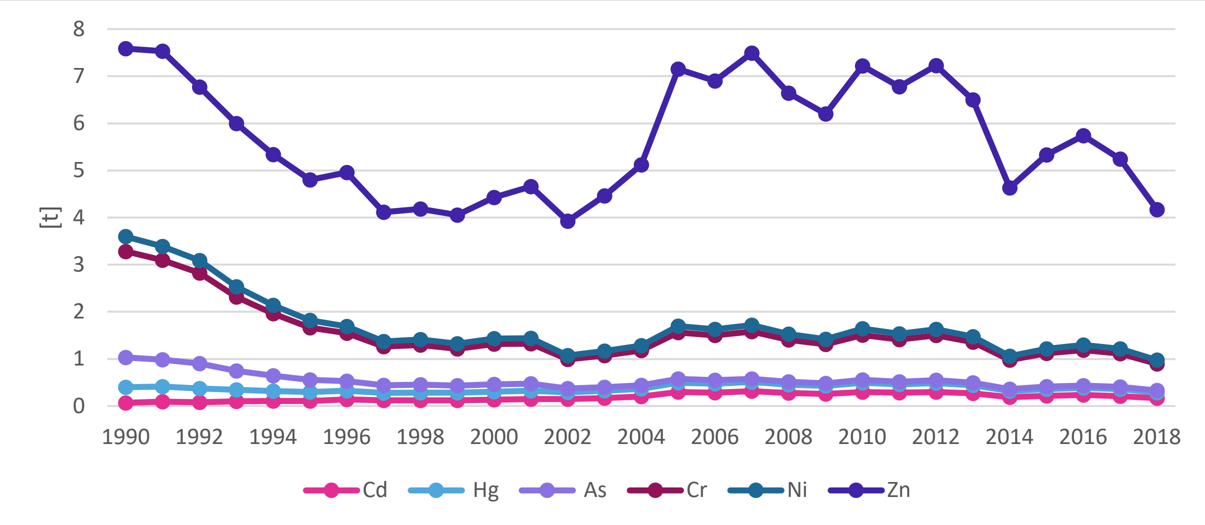
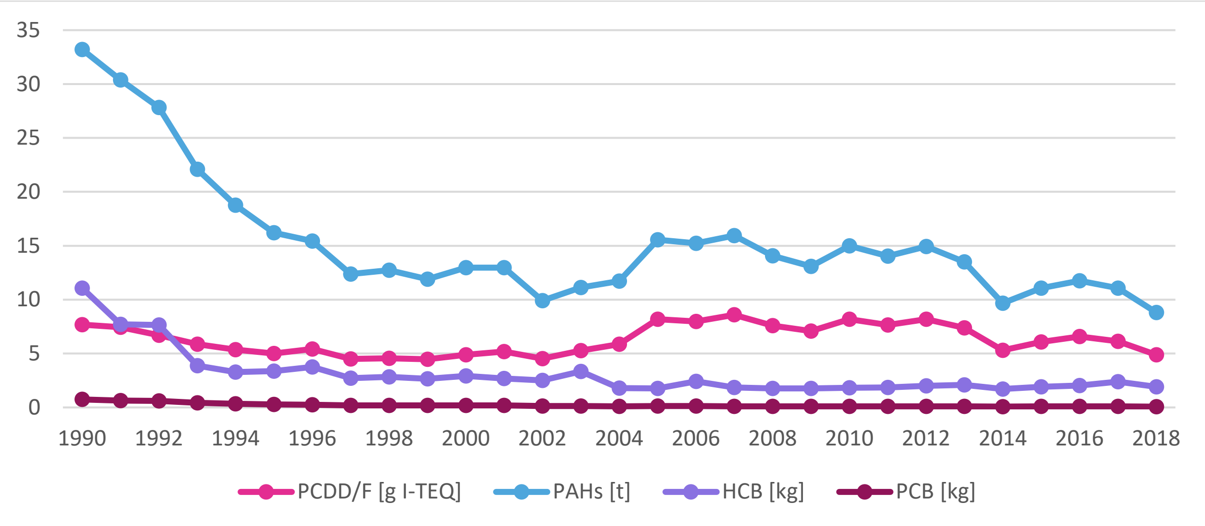


Figure 3.38: *Trends of POPs emissions in the category 1A4bi*



Overview of the emissions is shown in ***Table 3.104***.

Table 4.104: *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	5.1523	166.2038	29.0243	0.3237	74.4250	75.5867	82.9423	5.4104	684.3917
1995	3.6012	76.5433	11.1789	0.7085	32.6444	33.1986	36.2116	2.5279	313.2049
2000	3.8754	56.5627	6.7517	0.8989	23.1669	23.5911	25.5811	1.9027	226.9698
2005	4.1450	57.5756	2.3661	2.0455	20.5393	21.0137	22.3187	2.0268	222.9733
2010	4.0158	54.6960	1.7715	2.0730	19.1538	19.6070	20.7693	1.9305	211.9591
2011	3.6526	51.2636	1.6454	1.9382	17.8839	18.3067	19.3955	1.8015	198.9324
2012	3.7144	54.5286	1.7539	2.0643	18.9825	19.4313	20.5861	1.9129	212.0575
2013	3.5789	49.2669	1.6171	1.8474	17.1363	17.5397	18.5899	1.7218	191.6109
2014	2.9100	35.3439	1.2627	1.2956	12.3540	12.6417	13.4129	1.2311	137.3752
2015	3.1285	40.4434	1.4103	1.4882	14.0174	14.3447	15.2168	1.4002	157.4665
2016	3.2786	42.7582	1.4029	1.6040	14.7652	15.1123	16.0180	1.4841	166.6710
2017	3.3669	40.3060	1.5734	1.4329	14.0618	14.3848	15.2813	1.3893	157.4638
2018	2.9319	32.1487	1.2689	1.1340	11.1961	11.4526	12.1683	1.1046	125.8300
1990/2018	**-43%**	**-81%**	**-96%**	**250%**	**-85%**	**-85%**	**-85%**	**-80%**	**-82%**

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]]
2017/2018	**-13%**	**-20%**	**-19%**	**-21%**	**-20%**	**-20%**	**-20%**	**-20%**	**-20%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	1.0484	0.0679	0.3281	0.6353	2.2514	0.4117	0.3130	0.1446	3.9904
1995	0.4980	0.1104	0.1888	0.2560	1.1100	0.2183	0.1517	0.0640	2.9860
2000	0.3984	0.1346	0.1680	0.1612	0.8495	0.1827	0.1174	0.0507	3.0000
2005	0.4696	0.2967	0.2011	0.0757	0.9863	0.2491	0.1348	0.0523	5.4540
2010	0.4692	0.3005	0.1936	0.0616	0.9533	0.2489	0.1305	0.0507	5.5768
2011	0.4442	0.2809	0.1793	0.0574	0.8945	0.2345	0.1226	0.0480	5.2399
2012	0.4764	0.2988	0.1875	0.0607	0.9536	0.2511	0.1308	0.0512	5.5958
2013	0.4346	0.2674	0.1727	0.0560	0.8606	0.2273	0.1184	0.0472	5.0262
2014	0.3150	0.1883	0.1289	0.0430	0.6143	0.1627	0.0849	0.0347	3.5697
2015	0.3637	0.2169	0.1445	0.0484	0.7086	0.1882	0.0979	0.0397	4.1173
2016	0.3914	0.2335	0.1524	0.0488	0.7536	0.2024	0.1043	0.0423	4.4467
2017	0.3716	0.2089	0.1466	0.0522	0.7065	0.1884	0.0982	0.0414	4.0290
2018	0.2964	0.1654	0.1213	0.0432	0.5656	0.1502	0.0785	0.0333	3.1936
1990/2018	**-72%**	**143%**	**-63%**	**-93%**	**-75%**	**-64%**	**-75%**	**-77%**	**-20%**
2017/2018	**-20%**	**-21%**	**-17%**	**-17%**	**-20%**	**-20%**	**-20%**	**-20%**	**-21%**

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	7.6705	12.4562	8.8364	5.3064	6.6101	33.2091	11.0803	0.7432
1995	5.0139	6.1521	4.2831	2.5642	3.2198	16.2192	3.3701	0.2919
2000	4.8903	4.9321	3.4744	1.9952	2.5569	12.9587	2.9404	0.1976
2005	8.1973	6.0130	4.2074	2.3030	3.0397	15.5630	1.7794	0.1214
2010	8.1995	5.7863	4.0795	2.2041	2.9301	15.0000	1.8409	0.1088
2011	7.6618	5.4074	3.8384	2.0608	2.7477	14.0543	1.8678	0.1033
2012	8.1812	5.7368	4.0860	2.1875	2.9219	14.9321	2.0035	0.1104
2013	7.3938	5.1700	3.7205	1.9725	2.6471	13.5100	2.0802	0.1036
2014	5.3114	3.6923	2.6781	1.4107	1.8966	9.6777	1.7135	0.0792
2015	6.0640	4.2170	3.0690	1.6128	2.1724	11.0711	1.9122	0.0903
2016	6.5879	4.4746	3.2633	1.7093	2.3077	11.7549	2.0215	0.0949
2017	6.1409	4.1615	3.1154	1.5993	2.1817	11.0578	2.3823	0.0997
2018	4.8898	3.3057	2.4947	1.2735	1.7439	8.8178	1.9234	0.0802
1990/2018	**-36%**	**-73%**	**-72%**	**-76%**	**-74%**	**-73%**	**-83%**	**-89%**
2017/2018	**-20%**	**-21%**	**-20%**	**-20%**	**-20%**	**-20%**	**-19%**	**-20%**

Overview of the activity data (energy consumption) for this source category is in ***Table 3.105*** below. This table represents fuels allocated to the fuel type for calculations. Fuels in the template are allocated following principle prom IPCC 2006 Guidelines.

Table 3. 105: *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	13393.97	31.10
2005	652.91	305.54	2660.03	51.78	59225.83	322.00	30670.66	128.36
2010	706.47	293.34	1588.60	185.17	55629.42	552.00	31328.99	474.02
2011	802.14	216.50	1390.84	288.50	49133.79	276.00	29205.06	694.33
2012	887.42	222.68	1418.31	392.86	47192.12	460.00	30960.71	1011.03

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]
2013	942.90	230.19	1177.86	506.85	48200.08	368.00	27543.64	1171.53
2014	828.07	170.77	913.26	414.61	43395.60	184.00	19543.34	674.75
2015	982.83	147.10	955.40	570.61	43903.00	184.00	22341.44	1075.54
2016	1025.72	204.57	804.37	641.48	44697.43	368.00	24064.04	1310.20
2017	1252.68	217.24	863.90	936.44	49339.18	368.00	21481.99	1220.87
2018	1056.04	131.98	652.26	862.55	45735.20	368.00	16969.32	1005.07
1990/2018	**-56%**	**-97%**	**-98%**	**-**	**60%**	**-75%**	**255%**	**-**
2017/2018	**-16%**	**-39%**	**-24%**	**-8%**	**-7%**	**0%**	**-21%**	**-18%**

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

According to the recommendations No ***SK-1A4bi-2018-0001*** and ***SK-1A4bi-2018-0002*** the improvement of methodology for households' heating was done as a part of the project QUALITY IMPROVEMENTS OF THE AIR EMISSION ACCOUNTS AND EXTENSION OF PROVIDED TIME-SERIES funded by Eurostat (detailed implementation report is available at the link of SHMU webpage).

The essential sub-tasks of this project were the obtaining of new missing information from households to enable the progress in the methodology of emission calculations. Therefore, the focus and majority of the time of the project were devoted to the heating in the family houses with solid fuels as primary heating fuel. During the project, the statistical survey was designed for a specific purpose of obtaining information on energy use, solid fuels consumption and heating appliances in households. The statistical survey was prepared and conducted in collaboration with The Statistical Office of The Slovak. It was a standalone one-off statistical survey conducted within the pilot study.

Development and update of methodology and implementation of new gained data

The update of the methodology was performed and a new total household's energy demand was determined and verified with the new input data. Several options for the manner of methodology improvement for emissions from households' heating have been considered. The endeavours for harmonisation with Air Quality Modelling methodologies input data was not fully possible. This approach was only partially implemented. The international EMEP/EEA Guidebook for the compilation of air pollutants requires the historical time-series data of the specific type of fuel used, but improved data from the survey relates only to one year. Because of the inaccurate historical data on households fuel use registered by the Statistical Office of the SR and the absence of any other relevant source, it was concluded that the most reliable and accurate estimate of fuel consumption of wood is based on the principle of total energy demand (TED) per m2 of occupied area in the household sector.

The attention was focused on the reassessment and update of the all input and auxiliary data, development of new time-series and most importantly the implementation of new gathered information and elements as climate factors, new standards for constructed houses, new age structure of houses, new structure of heating appliances, new emission factors, etc.

The basic principle of the methodology

The methodology for households' heating is based on the principle of total energy demand (TED) per m^2 of an occupied area with the implementation of the ageing structure of housing units linked to the energy construction standards and the implementation of climate factor. Activity data on solid fuels sold to households from retailers are collected in the separate module of the NEIS database. The consumption of natural gas for individual households and dwellings is periodically announced by the Slovak Gas Industry, Ltd. (SPP, a.s.). The overall data on wood and wooden briquettes consumption are compiled from the energy demand by applying available values of fuels consumption from national statistics. The final emission compilation includes the division of appliances used in the households into the structure of 6 types and related emission factors for particular type of combustion appliance.

During the preparation of inventory, the climate factor was further enhanced after closer cooperation with an external expert for GHG inventory in data harmonization. The ratio of the number of households, which are not connected to central heating system in the individual regions has been used in the calculation of the overall climate parameter for the entire territory of the Slovak Republic.

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[13] measurement at low and nominal heat rating. These data were provided in the 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 the entire methodology and all EF are available in **Final report on implementation of the action**.

3.7.4.3 Completeness

All rising pollutants were reported.

3.7.4.4 Source-specific recalculations

Following recommendation No ***SK-1A4bi-2019-0001***, emissions of POPs were recalculated due to the error in the calculations (***Table 3.106***).

Table 3.106: *Previous and refined emissions in the category 1A4bi*

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0077	7.6705	99900%	0.0332	33.2091	99900%
1991	0.0074	7.4438	99900%	0.0304	30.3925	99900%
1992	0.0067	6.6874	99900%	0.0278	27.8288	99900%
1993	0.0059	5.8780	99900%	0.0221	22.1053	99900%
1994	0.0054	5.3511	99900%	0.0188	18.7528	99900%
1995	0.0050	5.0139	99900%	0.0162	16.2192	99900%
1996	0.0054	5.4190	99900%	0.0154	15.4395	99900%
1997	0.0045	4.4926	99900%	0.0124	12.3623	99900%
1998	0.0046	4.5686	99900%	0.0127	12.7193	99900%
1999	0.0045	4.4710	99900%	0.0119	11.9003	99900%
2000	0.0049	4.8903	99900%	0.0130	12.9587	99900%
2001	0.0052	5.1767	99900%	0.0130	12.9640	99900%

[13] https://powietrze.malopolska.pl/en/life-project/

YEAR	PCDD/F [g I-TEQ]			PAHs [t]		
	P	R	CHANGE	P	R	CHANGE
2002	0.0045	4.5435	99900%	0.0099	9.9122	99900%
2003	0.0053	5.2651	99900%	0.0111	11.1425	99900%
2004	0.0059	5.8786	99900%	0.0117	11.7343	99900%
2005	0.0082	8.1973	99900%	0.0156	15.5630	99900%
2006	0.0080	7.9633	99900%	0.0152	15.2226	99900%
2007	0.0086	8.5896	99900%	0.0159	15.9300	99900%
2008	0.0076	7.5957	99900%	0.0141	14.0785	99900%
2009	0.0071	7.0913	99900%	0.0131	13.0769	99900%
2010	0.0082	8.1995	99900%	0.0150	15.0000	99900%
2011	0.0077	7.6618	99900%	0.0141	14.0543	99900%
2012	0.0082	8.1812	99900%	0.0149	14.9321	99900%
2013	0.0074	7.3938	99900%	0.0135	13.5100	99900%
2014	0.0053	5.3114	99900%	0.0097	9.6777	99900%
2015	0.0061	6.0640	99900%	0.0111	11.0711	99900%
2016	0.0066	6.5879	99900%	0.0118	11.7549	99900%
2017	0.0061	6.1409	99900%	0.0111	11.0578	99900%

YEAR	HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0111	11.0803	99900%	0.0007	0.7432	99900%
1991	0.0077	7.7191	99900%	0.0006	0.6428	99900%
1992	0.0077	7.6558	99900%	0.0006	0.5987	99900%
1993	0.0039	3.8773	99900%	0.0004	0.4343	99900%
1994	0.0033	3.2852	99900%	0.0004	0.3523	99900%
1995	0.0034	3.3701	99900%	0.0003	0.2919	99900%
1996	0.0037	3.7488	99900%	0.0003	0.2529	99900%
1997	0.0027	2.7158	99900%	0.0002	0.1944	99900%
1998	0.0028	2.8337	99900%	0.0002	0.2032	99900%
1999	0.0027	2.6600	99900%	0.0002	0.1822	99900%
2000	0.0029	2.9404	99900%	0.0002	0.1976	99900%
2001	0.0027	2.6858	99900%	0.0002	0.1827	99900%
2002	0.0025	2.5011	99900%	0.0001	0.1186	99900%
2003	0.0034	3.3532	99900%	0.0001	0.1295	99900%
2004	0.0018	1.8104	99900%	0.0001	0.1094	99900%
2005	0.0018	1.7794	99900%	0.0001	0.1214	99900%
2006	0.0024	2.4070	99900%	0.0001	0.1264	99900%
2007	0.0019	1.8591	99900%	0.0001	0.1166	99900%
2008	0.0018	1.7594	99900%	0.0001	0.1056	99900%
2009	0.0018	1.7624	99900%	0.0001	0.0975	99900%
2010	0.0018	1.8409	99900%	0.0001	0.1088	99900%
2011	0.0019	1.8678	99900%	0.0001	0.1033	99900%
2012	0.0020	2.0035	99900%	0.0001	0.1104	99900%
2013	0.0021	2.0802	99900%	0.0001	0.1036	99900%
2014	0.0017	1.7135	99900%	0.0001	0.0792	99900%
2015	0.0019	1.9122	99900%	0.0001	0.0903	99900%
2016	0.0020	2.0215	99900%	0.0001	0.0949	99900%
2017	0.0024	2.3823	99900%	0.0001	0.0997	99900%

3.7.5 RESIDENTIAL: MOBILE (NFR 1A4bii)

3.7.5.1 Overview

This activity is included in the category 1A2gvii therefore notation key IE was used.

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

3.7.6.1 Overview

Overview of the emissions is shown in ***Table 3.107.*** Most of the emissions show an overall decreasing trend due to the decrease in the volume of use of coal. The significant peak of HMs and POPs emissions is visible in the year 2014 and 2015. The reason for the increase is the fuel basement that has recorded the increase of biomass usage in the category.

Table 4.107: *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
2000	0.1124	0.0402	0.1689	0.0418	0.0955	0.2089	0.4136
2005	0.1542	0.0354	0.1420	0.0462	0.0948	0.2044	0.2216
2010	0.1022	0.0101	0.0266	0.0329	0.0795	0.1791	0.1218
2011	0.1020	0.0269	0.0194	0.0357	0.0892	0.1984	0.1267
2012	0.1129	0.0794	0.0292	0.0303	0.0713	0.1543	0.1518
2013	0.1258	0.0815	0.0336	0.0276	0.0689	0.1528	0.1589
2014	0.2434	0.1877	0.0698	0.0313	0.0862	0.1967	0.2094
2015	0.2736	0.2765	0.0908	0.0297	0.0678	0.1451	0.2131
2016	0.2515	0.2101	0.0722	0.0308	0.0754	0.1648	0.2072
2017	0.2266	0.1798	0.0555	0.0269	0.0602	0.1265	0.1891
2018	0.2215	0.1896	0.0564	0.0363	0.0699	0.1343	0.2005
1990/2018	**104%**	**573%**	**-62%**	**18%**	**0%**	**-12%**	**-28%**
2017/2018	**-2%**	**5%**	**2%**	**35%**	**16%**	**6%**	**6%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0305	0.0014	0.0018	0.0010	0.0049	0.0042	0.0062	0.0005	0.0826
1995	0.0301	0.0014	0.0018	0.0010	0.0050	0.0042	0.0082	0.0005	0.0825
2000	0.0287	0.0013	0.0017	0.0009	0.0047	0.0040	0.0067	0.0005	0.0780
2005	0.0168	0.0012	0.0010	0.0007	0.0047	0.0027	0.0200	0.0003	0.0645
2010	0.0068	0.0008	0.0005	0.0003	0.0020	0.0011	0.0022	0.0002	0.0388
2011	0.0049	0.0012	0.0004	0.0002	0.0023	0.0009	0.0008	0.0002	0.0490
2012	0.0039	0.0010	0.0003	0.0002	0.0019	0.0007	0.0006	0.0002	0.0413
2013	0.0038	0.0010	0.0003	0.0003	0.0019	0.0007	0.0006	0.0002	0.0422
2014	0.0081	0.0033	0.0005	0.0004	0.0060	0.0017	0.0012	0.0003	0.1336
2015	0.0045	0.0015	0.0004	0.0004	0.0028	0.0009	0.0009	0.0002	0.0614
2016	0.0034	0.0010	0.0004	0.0004	0.0019	0.0006	0.0009	0.0002	0.0422
2017	0.0033	0.0009	0.0004	0.0003	0.0018	0.0006	0.0008	0.0002	0.0385
2018	0.0051	0.0020	0.0004	0.0003	0.0037	0.0011	0.0012	0.0002	0.0824
1990/2018	**-83%**	**47%**	**-79%**	**-68%**	**-23%**	**-75%**	**-80%**	**-51%**	**0%**
2017/2018	**55%**	**127%**	**-1%**	**-6%**	**112%**	**75%**	**48%**	**12%**	**114%**

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	0.0511	0.0111	0.0170	0.0065	0.0054	0.0400	0.0005	0.0358
1995	0.0505	0.0110	0.0172	0.0066	0.0054	0.0402	0.0005	0.0351

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2000	0.0481	0.0105	0.0164	0.0063	0.0052	0.0384	0.0005	0.0336
2005	0.0301	0.0070	0.0150	0.0052	0.0045	0.0317	0.0005	0.0170
2010	0.0146	0.0036	0.0084	0.0031	0.0028	0.0180	0.0003	0.0066
2011	0.0133	0.0029	0.0071	0.0026	0.0024	0.0149	0.0004	0.0032
2012	0.0110	0.0025	0.0066	0.0024	0.0022	0.0137	0.0004	0.0024
2013	0.0111	0.0027	0.0074	0.0027	0.0025	0.0153	0.0004	0.0023
2014	0.0287	0.0050	0.0128	0.0046	0.0042	0.0266	0.0013	0.0016
2015	0.0149	0.0037	0.0110	0.0041	0.0038	0.0227	0.0006	0.0019
2016	0.0110	0.0034	0.0108	0.0040	0.0038	0.0221	0.0004	0.0017
2017	0.0103	0.0031	0.0096	0.0036	0.0034	0.0198	0.0003	0.0018
2018	0.0181	0.0037	0.0102	0.0037	0.0035	0.0211	0.0008	0.0011
1990/2018	**-65%**	**-67%**	**-40%**	**-43%**	**-35%**	**-47%**	**50%**	**-97%**
2017/2018	**76%**	**17%**	**6%**	**3%**	**2%**	**7%**	**127%**	**-39%**

Overview of the activity data (energy consumption) for this source category is in ***Table 3.108*** below. This table represents fuels allocated to the fuel type for calculations (following Table 3-2 of EMEP/EEA GB$_{2019}$, Part Small combustion). Fuels in the template are allocated following principle prom IPCC 2006 Guidelines.

Table 3.108: *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	26.44	210.52	1028.81	76.70	NO
1995	42.64	206.46	1099.05	77.51	NO
2000	31.47	197.46	1076.44	72.61	NO
2005	147.99	100.24	1948.29	78.90	NO
2010	12.31	38.59	1727.91	57.84	NO
2011	3.11	18.80	1567.25	86.07	NO
2012	1.73	14.09	1561.62	72.86	NO
2013	1.87	13.29	1849.47	74.51	NO
2014	4.41	9.08	2804.45	253.26	NO
2015	4.01	10.86	2947.94	111.30	NO
2016	4.41	9.76	3096.19	73.99	NO
2017	4.23	10.67	2718.61	67.05	NO
2018	6.53	6.45	2512.45	154.66	NO
1990/2018	**-75%**	**-97%**	**144%**	**102%**	**-**
2017/2018	**54%**	**-40%**	**-8%**	**131%**	**-**

3.7.6.2 Methodological issues

Sources included within this category are listed in ***Table 3.109***.

Table 3.109: *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

Table 3.110: *The overview of share of used calculation type for category 1A4ci in NEIS*

1A1a	Type of emission compilation/calculation	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	1%
3	Calculation using representative individual mass flow and number of operating hours	60%
4	Calculation using emission factor and amount of fuel	34%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	1%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	3%

Historical data 1990-1999 are not covered by NEIS, therefore the estimations are done on base of development of IEF from emission and activity data of period 2000-2015 (***Table 3.111***).

Table 3.111: *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

Heavy metals and POPs are calculated at Tier 1 level. Emission factors used for calculation of heavy metals are default EF from EMEP/EEA GB_{2019} (***Table 3.112***).

Table 3.112: *Emission factor for heavy metals and POPs in the category 1A4ci*

T1	UNIT	LIQUID FUELS	HARD COAL/BROWN COAL	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	8	134	0.011	27
Cd	[mg/GJ]	0.15	1.8	0.0009	13
Hg	[mg/GJ]	0.1	7.9	0.1	0.56
As	[mg/GJ]	0.5	4	0.1	0.19
Cr	[mg/GJ]	10	13.5	0.013	23
Cu	[mg/GJ]	3	17.5	0.0026	6
Ni	[mg/GJ]	125	13	0.013	2
Se	[mg/GJ]	0.1	1.8	0.058	0.5
Zn	[mg/GJ]	18	200	0.73	512
PCDD/F	[ng/GJ]	6	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]	0.22	0.62	-	5
PCBs	[µg/GJ]	0.00013	170	-	0.06

3.7.6.3 Completeness

Emissions of NH_3 and BC are reported as NE.

3.7.6.4 Source-specific recalculations

Recalculations in this submission were done due to change of categorisation of fuels. 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 3.113*** shows the change in the data between final submission 2019 and this submission.

Table 3.113: *Previous and refined emissions in the category 1A4ci*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0801	0.1088	36%	0.0207	0.0282	36%	0.1079	0.1466	36%
1991	0.0697	0.1097	57%	0.0180	0.0284	57%	0.0939	0.1478	57%
1992	0.0651	0.1103	69%	0.0169	0.0286	69%	0.0877	0.1486	69%
1993	0.0658	0.1098	67%	0.0170	0.0284	67%	0.0887	0.1479	67%
1994	0.0712	0.1103	55%	0.0184	0.0286	55%	0.0959	0.1486	55%
1995	0.0804	0.1156	44%	0.0208	0.0299	44%	0.1083	0.1557	44%
1996	0.0927	0.1121	21%	0.0240	0.0290	21%	0.1249	0.1510	21%
1997	0.1074	0.1141	6%	0.0278	0.0295	6%	0.1448	0.1537	6%
1998	0.1238	0.1250	1%	0.0320	0.0324	1%	0.1668	0.1684	1%
1999	0.1410	0.1335	-5%	0.0365	0.0346	-5%	0.1900	0.1798	-5%

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	0.0226	0.0307	36%	0.0516	0.0701	36%	0.1128	0.1533	36%	0.2045	0.2780	36%
1991	0.0197	0.0310	57%	0.0449	0.0707	57%	0.0982	0.1546	57%	0.1780	0.2803	57%
1992	0.0184	0.0311	69%	0.0419	0.0710	69%	0.0917	0.1554	69%	0.1663	0.2817	69%
1993	0.0186	0.0310	67%	0.0424	0.0707	67%	0.0927	0.1547	67%	0.1682	0.2805	67%
1994	0.0201	0.0311	55%	0.0458	0.0710	55%	0.1003	0.1554	55%	0.1819	0.2817	55%
1995	0.0227	0.0326	44%	0.0518	0.0744	44%	0.1133	0.1628	44%	0.2054	0.2952	44%
1996	0.0262	0.0316	21%	0.0597	0.0722	21%	0.1306	0.1579	21%	0.2369	0.2863	21%
1997	0.0303	0.0322	6%	0.0692	0.0735	6%	0.1514	0.1607	6%	0.2745	0.2915	6%
1998	0.0349	0.0353	1%	0.0797	0.0805	1%	0.1744	0.1761	1%	0.3163	0.3193	1%
1999	0.0398	0.0377	-5%	0.0908	0.0860	-5%	0.1987	0.1880	-5%	0.3603	0.3410	-5%
2000	0.0418	0.0418	0%	0.0955	0.0955	-	0.2089	0.2089	-	0.4136	0.4136	-
2001	0.0476	0.0476	0%	0.1086	0.1086	-	0.2376	0.2376	-	0.4216	0.4216	-
2002	0.0473	0.0473	0%	0.1080	0.1080	-	0.2363	0.2363	-	0.4148	0.4148	-
2003	0.0394	0.0394	0%	0.0900	0.0900	-	0.1969	0.1969	-	0.3453	0.3453	-
2004	0.0449	0.0449	0%	0.1025	0.1025	-	0.2242	0.2242	-	0.3047	0.3047	-

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0022	0.0305	1304%	0.0001	0.0014	2472%	0.0006	0.0018	196%	0.0003	0.0010	200%
1991	0.0147	0.0304	108%	0.0002	0.0014	537%	0.0012	0.0018	47%	0.0006	0.0010	51%
1992	0.0246	0.0305	24%	0.0004	0.0014	294%	0.0017	0.0018	4%	0.0009	0.0010	5%
1993	0.0322	0.0304	-6%	0.0005	0.0014	203%	0.0022	0.0018	-17%	0.0012	0.0010	-17%
1994	0.0376	0.0303	-19%	0.0005	0.0014	158%	0.0025	0.0018	-28%	0.0014	0.0010	-30%
1995	0.0411	0.0301	-27%	0.0006	0.0014	135%	0.0027	0.0018	-35%	0.0016	0.0010	-37%
1996	0.0429	0.0303	-29%	0.0006	0.0014	119%	0.0029	0.0018	-38%	0.0017	0.0010	-42%
1997	0.0431	0.0293	-32%	0.0006	0.0014	114%	0.0030	0.0017	-43%	0.0018	0.0009	-47%
1998	0.0420	0.0296	-30%	0.0006	0.0014	114%	0.0031	0.0018	-43%	0.0019	0.0010	-48%
1999	0.0398	0.0289	-27%	0.0006	0.0014	118%	0.0031	0.0017	-44%	0.0019	0.0010	-49%
2000	0.0273	0.0287	5%	0.0007	0.0013	82%	0.0022	0.0017	-21%	0.0011	0.0009	-16%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2001	0.0220	0.0243	11%	0.0008	0.0014	68%	0.0022	0.0014	-34%	0.0016	0.0009	-44%
2002	0.0265	0.0288	9%	0.0009	0.0013	56%	0.0026	0.0017	-32%	0.0018	0.0010	-42%
2003	0.0182	0.0203	12%	0.0007	0.0013	71%	0.0020	0.0012	-38%	0.0014	0.0008	-45%
2004	0.0167	0.0191	14%	0.0008	0.0012	56%	0.0020	0.0012	-42%	0.0016	0.0008	-52%
2005	0.0148	0.0168	13%	0.0008	0.0012	59%	0.0019	0.0010	-46%	0.0013	0.0007	-46%
2006	0.0076	0.0091	21%	0.0007	0.0009	24%	0.0014	0.0006	-59%	0.0012	0.0005	-61%
2007	0.0064	0.0069	8%	0.0005	0.0007	34%	0.0012	0.0005	-58%	0.0005	0.0003	-27%
2008	0.0077	0.0082	6%	0.0006	0.0008	33%	0.0014	0.0006	-56%	0.0005	0.0004	-23%
2009	0.0076	0.0085	11%	0.0005	0.0009	68%	0.0012	0.0006	-53%	0.0005	0.0004	-32%
2010	0.0064	0.0068	7%	0.0006	0.0008	31%	0.0013	0.0005	-59%	0.0005	0.0003	-37%
2011	0.0044	0.0049	12%	0.0009	0.0012	27%	0.0010	0.0004	-66%	0.0004	0.0002	-37%
2012	0.0037	0.0039	5%	0.0009	0.0010	11%	0.0010	0.0003	-69%	0.0003	0.0002	-34%
2013	0.0037	0.0038	2%	0.0009	0.0010	5%	0.0011	0.0003	-71%	0.0004	0.0003	-37%
2014	0.0080	0.0081	1%	0.0033	0.0033	1%	0.0017	0.0005	-71%	0.0006	0.0004	-42%
2015	0.0045	0.0045	1%	0.0014	0.0015	2%	0.0017	0.0004	-74%	0.0005	0.0004	-31%
2016	0.0035	0.0034	-5%	0.0010	0.0010	-6%	0.0018	0.0004	-76%	0.0008	0.0004	-52%
2017	0.0034	0.0033	-4%	0.0009	0.0009	-5%	0.0016	0.0004	-75%	0.0007	0.0003	-52%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0002	0.0049	1886%	0.0004	0.0042	1083%	0.0002	0.0062	2601%
1991	0.0015	0.0049	227%	0.0020	0.0042	114%	0.0014	0.0065	352%
1992	0.0025	0.0049	97%	0.0033	0.0042	29%	0.0024	0.0066	176%
1993	0.0033	0.0049	50%	0.0043	0.0042	-1%	0.0031	0.0065	106%
1994	0.0038	0.0049	28%	0.0050	0.0042	-16%	0.0037	0.0067	82%
1995	0.0042	0.0050	20%	0.0055	0.0042	-23%	0.0040	0.0082	104%
1996	0.0044	0.0049	13%	0.0057	0.0042	-27%	0.0042	0.0070	67%
1997	0.0044	0.0049	11%	0.0058	0.0041	-29%	0.0042	0.0078	85%
1998	0.0043	0.0052	20%	0.0057	0.0042	-26%	0.0041	0.0110	168%
1999	0.0041	0.0053	28%	0.0054	0.0041	-24%	0.0039	0.0130	232%
2000	0.0033	0.0047	41%	0.0037	0.0040	8%	0.0027	0.0067	151%
2001	0.0030	0.0058	91%	0.0033	0.0037	14%	0.0022	0.0235	982%
2002	0.0034	0.0062	83%	0.0039	0.0043	11%	0.0026	0.0267	922%
2003	0.0025	0.0050	96%	0.0027	0.0031	14%	0.0018	0.0206	1042%
2004	0.0025	0.0054	121%	0.0027	0.0031	17%	0.0017	0.0288	1625%
2005	0.0024	0.0047	99%	0.0023	0.0027	16%	0.0015	0.0200	1261%
2006	0.0017	0.0038	123%	0.0014	0.0017	18%	0.0008	0.0227	2857%
2007	0.0014	0.0019	36%	0.0010	0.0011	8%	0.0006	0.0027	328%
2008	0.0015	0.0020	33%	0.0012	0.0012	7%	0.0008	0.0027	256%
2009	0.0014	0.0023	58%	0.0012	0.0013	12%	0.0007	0.0031	315%
2010	0.0015	0.0020	32%	0.0010	0.0011	4%	0.0006	0.0022	248%
2011	0.0018	0.0023	27%	0.0008	0.0009	7%	0.0004	0.0008	101%
2012	0.0017	0.0019	11%	0.0007	0.0007	0%	0.0003	0.0006	65%
2013	0.0018	0.0019	6%	0.0007	0.0007	-5%	0.0003	0.0006	66%
2014	0.0059	0.0060	3%	0.0018	0.0017	-5%	0.0007	0.0012	80%
2015	0.0027	0.0028	4%	0.0009	0.0009	-5%	0.0004	0.0009	120%
2016	0.0019	0.0019	-1%	0.0008	0.0006	-22%	0.0004	0.0009	145%
2017	0.0018	0.0018	-1%	0.0008	0.0006	-21%	0.0003	0.0008	145%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0002	0.0005	189%	0.0052	0.0826	1476%
1991	0.0003	0.0005	57%	0.0235	0.0826	252%
1992	0.0004	0.0005	11%	0.0382	0.0826	116%
1993	0.0005	0.0005	-12%	0.0497	0.0824	66%
1994	0.0006	0.0005	-25%	0.0582	0.0823	42%
1995	0.0007	0.0005	-34%	0.0639	0.0825	29%
1996	0.0008	0.0005	-39%	0.0672	0.0821	22%
1997	0.0008	0.0005	-44%	0.0685	0.0813	19%
1998	0.0009	0.0005	-45%	0.0678	0.0820	21%
1999	0.0009	0.0005	-47%	0.0655	0.0813	24%
2000	0.0005	0.0005	-14%	0.0551	0.0780	42%
2001	0.0008	0.0004	-44%	0.0566	0.0790	40%
2002	0.0009	0.0005	-44%	0.0618	0.0804	30%
2003	0.0007	0.0004	-45%	0.0485	0.0688	42%
2004	0.0008	0.0004	-54%	0.0491	0.0658	34%
2005	0.0006	0.0003	-46%	0.0467	0.0645	38%
2006	0.0006	0.0002	-62%	0.0390	0.0457	17%
2007	0.0003	0.0002	-24%	0.0279	0.0349	25%
2008	0.0003	0.0002	-20%	0.0304	0.0377	24%
2009	0.0003	0.0002	-28%	0.0286	0.0421	47%
2010	0.0003	0.0002	-32%	0.0316	0.0388	23%
2011	0.0002	0.0002	-28%	0.0398	0.0490	23%
2012	0.0002	0.0002	-27%	0.0380	0.0413	9%
2013	0.0002	0.0002	-30%	0.0408	0.0422	3%
2014	0.0004	0.0003	-30%	0.1326	0.1336	1%
2015	0.0003	0.0002	-24%	0.0608	0.0614	1%
2016	0.0004	0.0002	-46%	0.0456	0.0422	-7%
2017	0.0004	0.0002	-46%	0.0416	0.0385	-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	0.0010	0.0511	5111%	4E-05	0.0400	111116%	0.0002	0.0005	206%	0.0007	0.0358	5029%
1991	0.0036	0.0510	1323%	3E-05	0.0400	134353%	0.0004	0.0005	26%	0.0012	0.0357	2962%
1992	0.0057	0.0511	798%	3E-05	0.0402	134645%	0.0006	0.0005	-17%	0.0016	0.0357	2108%
1993	0.0073	0.0509	594%	3E-05	0.0400	114291%	0.0008	0.0005	-35%	0.0021	0.0356	1635%
1994	0.0085	0.0508	494%	4E-05	0.0399	90081%	0.0010	0.0005	-45%	0.0025	0.0355	1345%
1995	0.0094	0.0505	439%	6E-05	0.0402	70564%	0.0011	0.0005	-51%	0.0028	0.0351	1143%
1996	0.0099	0.0508	416%	7E-05	0.0401	55621%	0.0012	0.0005	-55%	0.0032	0.0355	1027%
1997	0.0100	0.0493	391%	9E-05	0.0392	43762%	0.0012	0.0005	-57%	0.0034	0.0341	893%
1998	0.0099	0.0496	399%	1E-04	0.0405	37572%	0.0013	0.0005	-58%	0.0037	0.0342	833%
1999	0.0096	0.0485	404%	1E-04	0.0404	32216%	0.0013	0.0005	-58%	0.0038	0.0331	763%
2000	0.0078	0.0481	520%	1E-04	0.0384	32661%	0.0008	0.0005	-38%	0.0020	0.0336	1581%
2001	0.0076	0.0417	451%	3E-04	0.0385	14332%	0.0011	0.0006	-50%	0.0039	0.0262	578%
2002	0.0088	0.0477	445%	3E-04	0.0445	16164%	0.0013	0.0005	-59%	0.0043	0.0320	648%
2003	0.0067	0.0352	430%	2E-04	0.0340	14129%	0.0010	0.0005	-50%	0.0033	0.0216	551%
2004	0.0067	0.0328	387%	3E-04	0.0344	11425%	0.0012	0.0005	-58%	0.0041	0.0195	371%
2005	0.0067	0.0301	348%	3E-04	0.0317	11940%	0.0009	0.0005	-48%	0.0031	0.0170	450%
2006	0.0050	0.0174	249%	3E-04	0.0228	7333%	0.0009	0.0004	-57%	0.0034	0.0076	127%
2007	0.0038	0.0141	269%	1E-04	0.0175	12762%	0.0003	0.0003	-14%	0.0009	0.0069	690%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2008	0.0039	0.0163	321%	1E-04	0.0198	14485%	0.0003	0.0003	-8%	0.0008	0.0085	913%
2009	0.0034	0.0170	395%	1E-04	0.0185	13568%	0.0003	0.0003	2%	0.0010	0.0085	784%
2010	0.0039	0.0146	277%	2E-04	0.0180	10520%	0.0003	0.0003	-10%	0.0010	0.0066	585%
2011	0.0049	0.0133	170%	2E-04	0.0149	6421%	0.0004	0.0004	17%	0.0008	0.0032	279%
2012	0.0048	0.0110	128%	2E-04	0.0137	6091%	0.0003	0.0004	9%	0.0007	0.0024	232%
2013	0.0052	0.0111	114%	2E-04	0.0153	6313%	0.0004	0.0004	2%	0.0008	0.0023	182%
2014	0.0135	0.0287	112%	7E-04	0.0266	3726%	0.0009	0.0013	36%	0.0018	0.0016	-12%
2015	0.0075	0.0149	98%	3E-04	0.0227	6797%	0.0005	0.0006	18%	0.0010	0.0019	89%
2016	0.0062	0.0110	77%	3E-04	0.0221	7257%	0.0006	0.0004	-32%	0.0017	0.0017	-2%
2017	0.0057	0.0103	80%	3E-04	0.0198	6983%	0.0005	0.0003	-33%	0.0016	0.0018	11%

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. The Slovak Republic was able to separate the consumption in years 2014–2018 in this report for the category 1A4cii from other categories previously reported within this category. 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 3.114: *Overview of emissions of off-road vehicles in the Agriculture/forestry/fishing category (1A4cii) for the years 1990–2018*

YEARS	AGRICULTURE/FORESTRY/FISHING: OFF-ROAD VEHICLES AND OTHER MACHINERY								
	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	CO	BC	PRIORITY HEAVY METALS	PAH
	t							kg	
1990	729.04	129.16	0.50	0.19	42.35	2 633.92	25.89	0.00	NE
1991	729.04	129.16	0.50	0.19	42.35	2 633.92	25.89	0.00	NE
1992	729.04	129.16	0.50	0.19	42.35	2 633.92	25.89	0.00	NE
1993	729.04	129.16	0.50	0.19	42.35	2 633.92	25.89	0.00	NE
1994	729.04	129.16	0.50	0.19	42.35	2 633.92	25.89	0.00	NE
1995	729.04	129.16	0.50	0.19	42.35	2 633.92	25.89	0.00	NE
1996	729.04	129.16	0.50	0.19	42.35	2 633.92	25.89	0.00	NE
1997	678.30	120.17	0.47	0.17	39.41	2 450.60	24.09	0.00	NE
1998	729.04	129.16	0.50	0.19	42.35	2 633.92	25.89	0.00	NE
1999	743.62	131.74	0.51	0.19	43.20	2 686.60	26.41	0.00	NE
2000	1 993.30	539.88	1.55	0.54	99.34	15 536.65	59.23	0.78	NE
2001	1 900.28	514.69	1.48	0.52	94.70	14 811.54	56.47	0.74	NE
2002	1 899.79	514.55	1.48	0.52	94.68	14 807.76	56.45	0.74	NE
2003	2 111.32	571.85	1.65	0.58	105.22	16 456.51	62.74	0.82	NE
2004	2 370.36	642.01	1.85	0.65	118.13	18 475.60	70.44	0.92	NE
2005	2 518.35	682.09	1.96	0.69	125.51	19 629.04	74.83	0.98	NE
2006	2 327.26	630.33	1.81	0.63	115.98	18 139.66	69.16	0.91	NE
2007	2 336.75	632.90	1.82	0.64	116.46	18 213.60	69.44	0.91	NE
2008	2 469.74	668.92	1.92	0.67	123.09	19 250.16	73.39	0.96	NE
2009	2 350.79	636.71	1.83	0.64	117.16	18 323.05	69.85	0.92	NE
2010	2 346.58	635.57	1.83	0.64	116.95	18 290.24	69.73	0.91	NE
2011	2 407.14	651.97	1.88	0.66	119.97	18 762.25	71.53	0.94	NE
2012	2 446.51	662.63	1.91	0.67	121.93	19 069.14	72.70	0.95	NE

YEARS	AGRICULTURE/FORESTRY/FISHING: OFF-ROAD VEHICLES AND OTHER MACHINERY								
	NOx	NMVOC	SOx	NH_3	$PM_{2.5}$	CO	BC	PRIORITY HEAVY METALS	PAH
	t							kg	
2013	2 486.30	673.41	1.94	0.68	123.91	19 379.27	73.88	0.97	NE
2014	2 723.81	279.99	1.58	0.63	151.22	906.62	87.82	0.79	0.63
2015	2 385.66	245.23	1.38	0.55	132.45	794.07	76.92	0.69	0.55
2016	2 352.38	241.81	1.37	0.55	130.60	782.99	75.85	0.68	0.55
2017	2 712.42	734.65	2.11	0.74	135.18	725.64	80.60	1.06	0.51
2018	2 180.09	224.10	1.27	0.51	121.04	725.64	70.29	0.63	0.51

3.7.7.2 Source specific recalculations

Recalculation was made due to new statistical fuel consumption according to separations of categories according to recommendation ***SK-1A4cii-2018-0001***.

Table 3.115: *Recalculation of non-road mobile machinery (1A4cii)*

YEARS	NO_x (kt)			NMVOC (kt)			SO_X (kt)		
	2019	2020	Difference	2019	2020	Difference	2019	2020	Difference
1990	0.729	0.729	0.00%	0.13	0.13	0.00%	0.001	0.001	0.00%
1991	0.729	0.729	0.00%	0.13	0.13	0.00%	0.001	0.001	0.00%
1992	0.729	0.729	0.00%	0.13	0.13	0.00%	0.001	0.001	0.00%
1993	0.729	0.729	0.00%	0.13	0.13	0.00%	0.001	0.001	0.00%
1994	0.729	0.729	0.00%	0.13	0.13	0.00%	0.001	0.001	0.00%
1995	0.729	0.729	0.00%	0.13	0.13	0.00%	0.001	0.001	0.00%
1996	0.729	0.729	0.00%	0.13	0.13	0.00%	0.001	0.001	0.00%
1997	0.678	0.678	0.00%	0.12	0.12	0.00%	0.000	0.000	0.00%
1998	0.729	0.729	0.00%	0.13	0.13	0.00%	0.001	0.001	0.00%
1999	0.744	0.744	0.00%	0.13	0.13	0.00%	0.001	0.001	0.00%
2000	1.993	1.993	0.00%	0.54	0.54	0.00%	0.002	0.002	0.00%
2001	1.900	1.900	0.00%	0.51	0.51	0.00%	0.001	0.001	0.00%
2002	1.900	1.900	0.00%	0.51	0.51	0.00%	0.001	0.001	0.00%
2003	2.111	2.111	0.00%	0.57	0.57	0.00%	0.002	0.002	0.00%
2004	2.370	2.370	0.00%	0.64	0.64	0.00%	0.002	0.002	0.00%
2005	2.518	2.518	0.00%	0.68	0.68	0.00%	0.002	0.002	0.00%
2006	2.327	2.327	0.00%	0.63	0.63	0.00%	0.002	0.002	0.00%
2007	2.337	2.337	0.00%	0.63	0.63	0.00%	0.002	0.002	0.00%
2008	2.470	2.470	0.00%	0.67	0.67	0.00%	0.002	0.002	0.00%
2009	2.351	2.351	0.00%	0.64	0.64	0.00%	0.002	0.002	0.00%
2010	2.347	2.347	0.00%	0.64	0.64	0.00%	0.002	0.002	0.00%
2011	2.407	2.407	0.00%	0.65	0.65	0.00%	0.002	0.002	0.00%
2012	2.447	2.447	0.00%	0.66	0.66	0.00%	0.002	0.002	0.00%
2013	2.486	2.486	0.00%	0.67	0.67	0.00%	0.002	0.002	0.00%
2014	3.108	2.724	-14.10%	0.84	0.28	-200.65%	0.002	0.002	-53.17%
2015	2.856	2.386	-19.72%	0.77	0.25	-215.44%	0.002	0.001	-60.71%
2016	2.836	2.352	-20.57%	0.77	0.24	-217.68%	0.002	0.001	-61.85%
2017	2.712	2.180	-24.42%	0.73	0.22	-227.82%	0.002	0.001	-67.02%

YEAR	NH_3 (kt)			$PM_{2.5}$ (kt)			CO (kt)		
	2019	2020	Difference	2019	2020	Difference	2019	2020	Difference
1990	1.9E-04	1.9E-04	0.00%	0.04	0.04	0.00%	2.63	2.63	0.00%
1991	1.9E-04	1.9E-04	0.00%	0.04	0.04	0.00%	2.63	2.63	0.00%
1992	1.9E-04	1.9E-04	0.00%	0.04	0.04	0.00%	2.63	2.63	0.00%
1993	1.9E-04	1.9E-04	0.00%	0.04	0.04	0.00%	2.63	2.63	0.00%
1994	1.9E-04	1.9E-04	0.00%	0.04	0.04	0.00%	2.63	2.63	0.00%
1995	1.9E-04	1.9E-04	0.00%	0.04	0.04	0.00%	2.63	2.63	0.00%
1996	1.9E-04	1.9E-04	0.00%	0.04	0.04	0.00%	2.63	2.63	0.00%
1997	1.7E-04	1.7E-04	0.00%	0.04	0.04	0.00%	2.45	2.45	0.00%
1998	1.9E-04	1.9E-04	0.00%	0.04	0.04	0.00%	2.63	2.63	0.00%

YEAR	NH_3 (kt)			$PM_{2.5}$ (kt)			CO (kt)		
	2019	2020	Difference	2019	2020	Difference	2019	2020	Difference
1999	1.9E-04	1.9E-04	0.00%	0.04	0.04	0.00%	2.69	2.69	0.00%
2000	5.4E-04	5.4E-04	0.00%	0.10	0.10	0.00%	15.54	15.54	0.00%
2001	5.2E-04	5.2E-04	0.00%	0.09	0.09	0.00%	14.81	14.81	0.00%
2002	5.2E-04	5.2E-04	0.00%	0.09	0.09	0.00%	14.81	14.81	0.00%
2003	5.8E-04	5.8E-04	0.00%	0.11	0.11	0.00%	16.46	16.46	0.00%
2004	6.5E-04	6.5E-04	0.00%	0.12	0.12	0.00%	18.48	18.48	0.00%
2005	6.9E-04	6.9E-04	0.00%	0.13	0.13	0.00%	19.63	19.63	0.00%
2006	6.3E-04	6.3E-04	0.00%	0.12	0.12	0.00%	18.14	18.14	0.00%
2007	6.4E-04	6.4E-04	0.00%	0.12	0.12	0.00%	18.21	18.21	0.00%
2008	6.7E-04	6.7E-04	0.00%	0.12	0.12	0.00%	19.25	19.25	0.00%
2009	6.4E-04	6.4E-04	0.00%	0.12	0.12	0.00%	18.32	18.32	0.00%
2010	6.4E-04	6.4E-04	0.00%	0.12	0.12	0.00%	18.29	18.29	0.00%
2011	6.6E-04	6.6E-04	0.00%	0.12	0.12	0.00%	18.76	18.76	0.00%
2012	6.7E-04	6.7E-04	0.00%	0.12	0.12	0.00%	19.07	19.07	0.00%
2013	6.8E-04	6.8E-04	0.00%	0.12	0.12	0.00%	19.38	19.38	0.00%
2014	8.5E-04	6.3E-04	-34.03%	0.15	0.15	-2.43%	24.22	0.91	-2 572.01%
2015	7.8E-04	5.5E-04	-40.62%	0.14	0.13	-7.47%	22.26	0.79	-2703.48%
2016	7.7E-04	5.5E-04	-41.62%	0.14	0.13	-8.23%	22.11	0.78	-2723.43%
2017	7.4E-04	5.1E-04	-46.14%	0.14	0.12	-11.69%	21.14	0.73	-2813.52%

YEAR	BC (kt)			Priority heavy metals (t)			PAH (t)		
	2019	2020	Difference	2019	2020	Difference	2019	2020	Difference
1990	0.03	0.03	0.00%	2.50E-07	2.50E-07	0.00%	NE	NE	NE
1991	0.03	0.03	0.00%	2.50E-07	2.50E-07	0.00%	NE	NE	NE
1992	0.03	0.03	0.00%	2.50E-07	2.50E-07	0.00%	NE	NE	NE
1993	0.03	0.03	0.00%	2.50E-07	2.50E-07	0.00%	NE	NE	NE
1994	0.03	0.03	0.00%	2.50E-07	2.50E-07	0.00%	NE	NE	NE
1995	0.03	0.03	0.00%	2.50E-07	2.50E-07	0.00%	NE	NE	NE
1996	0.03	0.03	0.00%	2.50E-07	2.50E-07	0.00%	NE	NE	NE
1997	0.02	0.02	0.00%	2.33E-07	2.33E-07	0.00%	NE	NE	NE
1998	0.03	0.03	0.00%	2.50E-07	2.50E-07	0.00%	NE	NE	NE
1999	0.03	0.03	0.00%	2.55E-07	2.55E-07	0.00%	NE	NE	NE
2000	0.06	0.06	0.00%	0.001	0.001	0.00%	NE	NE	NE
2001	0.06	0.06	0.00%	0.001	0.001	0.00%	NE	NE	NE
2002	0.06	0.06	0.00%	0.001	0.001	0.00%	NE	NE	NE
2003	0.06	0.06	0.00%	0.001	0.001	0.00%	NE	NE	NE
2004	0.07	0.07	0.00%	0.001	0.001	0.00%	NE	NE	NE
2005	0.07	0.07	0.00%	0.001	0.001	0.00%	NE	NE	NE
2006	0.07	0.07	0.00%	0.001	0.001	0.00%	NE	NE	NE
2007	0.07	0.07	0.00%	0.001	0.001	0.00%	NE	NE	NE
2008	0.07	0.07	0.00%	0.001	0.001	0.00%	NE	NE	NE
2009	0.07	0.07	0.00%	0.001	0.001	0.00%	NE	NE	NE
2010	0.07	0.07	0.00%	0.001	0.001	0.00%	NE	NE	NE
2011	0.07	0.07	0.00%	0.001	0.001	0.00%	NE	NE	NE
2012	0.07	0.07	0.00%	0.001	0.001	0.00%	NE	NE	NE
2013	0.07	0.07	0.00%	0.001	0.001	0.00%	NE	NE	NE
2014	0.09	0.09	-5.16%	0.001	0.001	-53.17%	0.010	0.001	-1 431.72%
2015	0.08	0.08	-10.33%	0.001	0.001	-60.71%	0.009	0.001	-1 507.09%
2016	0.08	0.08	-11.12%	0.001	0.001	-61.85%	0.009	0.001	-1 518.52%
2017	0.08	0.07	-14.66%	0.001	0.001	-67.02%	0.008	0.001	-1 570.16%

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

Overview of the emissions is shown in ***Table 3.116***. An increase of emissions is linked with the increasing consumption of biomass in recent years. Decrease of HMs and POPs in 2018 was caused by the significant decrease of the amount of burned biomass (-13 186.16 t) with NCV lower of 62%.

Table 3.116: *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	0.0045	0.3803	0.0051	0.0575	0.0767	0.1453	0.2958
2005	0.1958	0.0308	0.3183	0.0043	0.0218	0.0322	0.0800	0.1827
2010	0.1304	0.0324	0.1006	0.0016	0.0120	0.0173	0.0351	0.1396
2011	0.1740	0.0338	0.1186	0.0015	0.0143	0.0197	0.0391	0.1770
2012	0.3651	0.2195	0.2344	0.0013	0.0244	0.0302	0.0510	0.2433
2013	0.6197	0.2730	0.2973	0.0016	0.0271	0.0324	0.0522	0.3603
2014	0.4491	0.3012	0.2368	0.0003	0.0230	0.0269	0.0388	0.2366
2015	0.4062	0.3254	0.2074	0.0020	0.0218	0.0259	0.0391	0.2101
2016	0.5112	0.2942	0.2863	0.0005	0.0264	0.0310	0.0455	0.2621
2017	0.6503	0.3904	0.3673	0.0006	0.0171	0.0212	0.0357	0.2710
2018	0.6149	0.3573	0.3471	0.0011	0.0155	0.0208	0.0442	0.2641
1990/2018	**237%**	**5262%**	**10%**	**-79%**	**-59%**	**-59%**	**-54%**	**20%**
2017/2018	**-5%**	**-8%**	**-5%**	**86%**	**-9%**	**-2%**	**24%**	**-3%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0428	0.0006	0.0027	0.0015	0.0044	0.0056	0.0053	0.0007	0.0661
1995	0.0425	0.0006	0.0027	0.0015	0.0044	0.0056	0.0054	0.0007	0.0656
2000	0.0404	0.0006	0.0026	0.0014	0.0042	0.0053	0.0055	0.0007	0.0626
2005	0.0273	0.0006	0.0019	0.0011	0.0032	0.0036	0.0032	0.0005	0.0522
2010	0.0083	0.0003	0.0007	0.0004	0.0014	0.0012	0.0028	0.0002	0.0222
2011	0.0056	0.0004	0.0006	0.0004	0.0011	0.0008	0.0018	0.0002	0.0209
2012	0.0443	0.0189	0.0015	0.0008	0.0340	0.0094	0.0050	0.0010	0.7529
2013	0.0524	0.0233	0.0018	0.0010	0.0418	0.0113	0.0055	0.0013	0.9267
2014	0.0578	0.0263	0.0017	0.0008	0.0469	0.0126	0.0061	0.0013	1.0405
2015	0.0629	0.0286	0.0018	0.0009	0.0511	0.0137	0.0078	0.0013	1.1305
2016	0.0578	0.0257	0.0018	0.0009	0.0459	0.0124	0.0058	0.0013	1.0184
2017	0.0748	0.0339	0.0022	0.0011	0.0605	0.0162	0.0066	0.0017	1.3440
2018	0.0282	0.0120	0.0011	0.0007	0.0216	0.0060	0.0034	0.0007	0.4773
1990/2018	**-34%**	**1917%**	**-59%**	**-54%**	**385%**	**6%**	**-37%**	**6%**	**623%**
2017/2018	**-62%**	**-65%**	**-50%**	**-40%**	**-64%**	**-63%**	**-49%**	**-56%**	**-64%**

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	0.0660	0.0160	0.0249	0.0099	0.0082	0.0590	0.0002	0.0542
1995	0.0655	0.0160	0.0250	0.0099	0.0082	0.0591	0.0002	0.0537
2000	0.0623	0.0152	0.0238	0.0094	0.0078	0.0562	0.0002	0.0511
2005	0.0441	0.0115	0.0211	0.0082	0.0071	0.0480	0.0002	0.0339
2010	0.0146	0.0043	0.0100	0.0038	0.0034	0.0215	0.0001	0.0098
2011	0.0111	0.0038	0.0102	0.0039	0.0036	0.0215	0.0001	0.0063
2012	0.1546	0.0189	0.0363	0.0122	0.0105	0.0779	0.0073	0.0064

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2013	0.1880	0.0233	0.0468	0.0158	0.0138	0.0997	0.0090	0.0051
2014	0.2085	0.0238	0.0442	0.0146	0.0124	0.0951	0.0101	0.0041
2015	0.2264	0.0256	0.0469	0.0154	0.0130	0.1009	0.0110	0.0046
2016	0.2061	0.0243	0.0460	0.0154	0.0131	0.0988	0.0099	0.0058
2017	0.2698	0.0312	0.0586	0.0195	0.0166	0.1258	0.0130	0.0057
2018	0.0989	0.0132	0.0279	0.0096	0.0085	0.0593	0.0046	0.0043
1990/2018	**50%**	**-17%**	**12%**	**-2%**	**4%**	**1%**	**2135%**	**-92%**
2017/2018	**-63%**	**-58%**	**-52%**	**-51%**	**-49%**	**-53%**	**-65%**	**-24%**

Overview of the activity data (energy consumption) for this source category is in ***Table 3.117*** below. This table represents fuels allocated to the fuel type for calculations (following Table 3-2 of EMEP/EEA GB_{2019}, Part Small combustion). Fuels in the template are allocated following principle prom IPCC 2006 Guidelines.

Table 3.117: *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	9.15	318.74	2071.06	1.24	NO
1995	9.80	315.99	2159.90	1.25	NO
2000	12.50	300.32	2040.68	1.62	NO
2005	3.90	199.38	3096.90	19.46	49.83
2010	15.99	57.35	2089.72	17.37	43.57
2011	10.03	36.82	2602.21	22.41	13.29
2012	12.81	37.03	3691.50	1450.38	NO
2013	11.75	29.40	5611.89	1790.05	NO
2014	13.62	23.49	3580.12	2017.43	NO
2015	24.09	26.11	3430.87	2192.02	NO
2016	11.12	33.60	4270.06	1969.50	13.29
2017	7.43	32.70	5126.45	2604.66	13.29
2018	9.21	25.26	4018.54	916.38	NO
1990/2018	**1%**	**-92%**	**94%**	**73915%**	**-**
2017/2018	**24%**	**-23%**	**-22%**	**-65%**	**-**

3.7.9.2 Methodological issues

The stationary sources and emissions from their activities included in 1A5a are presented in following table. All data are from operator – facility data.

Table 3.118: *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	

Table 3.119: The overview of share of used calculation type for category 1A5a in NEIS

1A5a	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	77%
4	Calculation using emission factor and amount of fuel	22%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	1%
8	Calculation using emission factor related to calorific value	1%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

Historical data 1990-1999 are not covered by NEIS, therefore the estimations are done on the base of development of IEF from emission and activity data of period 2000-2015 (***Table 3.120***).

Table 3.120: 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

Heavy metals and POPs are calculated at Tier 1 level. Emission factors used for calculation of heavy metals are default EF from EMEP/EEA GB_{2019} (***Table 3.121***).

Table 3.121: Emission factor for heavy metals and POPs in the category 1A5a

T1	UNIT	LIQUID FUELS	HARD COAL/BROWN COAL	GASEOUS FUELS	BIOMASS
Pb	[mg/GJ]	8	134	0.011	27
Cd	[mg/GJ]	0.15	1.8	0.0009	13
Hg	[mg/GJ]	0.1	7.9	0.1	0.56
As	[mg/GJ]	0.5	4	0.1	0.19
Cr	[mg/GJ]	10	13.5	0.013	23
Cu	[mg/GJ]	3	17.5	0.0026	6
Ni	[mg/GJ]	125	13	0.013	2
Se	[mg/GJ]	0.1	1.8	0.058	0.5
Zn	[mg/GJ]	18	200	0.73	512
PCDD/F	[ng/GJ]	6	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]	0.22	0.62	-	5
PCBs	[µg/GJ]	0.00013	170	-	0.06

3.7.9.3 Completeness

Emissions of BC are reported as NE.

3.7.9.4 Source-specific recalculations

Recalculations in this submission were done due to change of categorisation of fuels. 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 3.122*** shows the change in the data between final submission 2019 and this submission.

Table 3.122: *Previous and refined emissions in the category 1A5a*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.4343	0.1822	-58%	0.0159	0.0067	-58%	0.7543	0.3165	-58%	0.0124	0.0052	-58%
1991	0.4066	0.1835	-55%	0.0149	0.0067	-55%	0.7063	0.3188	-55%	0.0116	0.0052	-55%
1992	0.3834	0.1831	-52%	0.0140	0.0067	-52%	0.6659	0.3180	-52%	0.0109	0.0052	-52%
1993	0.3641	0.1833	-50%	0.0133	0.0067	-50%	0.6325	0.3184	-50%	0.0104	0.0052	-50%
1994	0.3567	0.1838	-48%	0.0130	0.0067	-48%	0.6196	0.3193	-48%	0.0102	0.0052	-48%
1995	0.3162	0.1888	-40%	0.0116	0.0069	-40%	0.5493	0.3280	-40%	0.0090	0.0054	-40%
1996	0.2911	0.1821	-37%	0.0106	0.0067	-37%	0.5056	0.3163	-37%	0.0083	0.0052	-37%
1997	0.2790	0.1909	-32%	0.0102	0.0070	-32%	0.4846	0.3316	-32%	0.0080	0.0055	-32%
1998	0.2654	0.1947	-27%	0.0097	0.0071	-27%	0.4610	0.3382	-27%	0.0076	0.0056	-27%
1999	0.2645	0.2026	-23%	0.0097	0.0074	-23%	0.4595	0.3518	-23%	0.0076	0.0058	-23%

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	0.0899	0.0377	-58%	0.1198	0.0503	-58%	0.2269	0.0952	-58%	0.5249	0.2203	-58%
1991	0.0841	0.0380	-55%	0.1122	0.0506	-55%	0.2125	0.0959	-55%	0.4915	0.2218	-55%
1992	0.0793	0.0379	-52%	0.1058	0.0505	-52%	0.2004	0.0957	-52%	0.4634	0.2213	-52%
1993	0.0753	0.0379	-50%	0.1004	0.0506	-50%	0.1903	0.0958	-50%	0.4401	0.2216	-50%
1994	0.0738	0.0380	-48%	0.0984	0.0507	-48%	0.1864	0.0961	-48%	0.4311	0.2222	-48%
1995	0.0654	0.0391	-40%	0.0872	0.0521	-40%	0.1653	0.0987	-40%	0.3822	0.2282	-40%
1996	0.0602	0.0377	-37%	0.0803	0.0502	-37%	0.1521	0.0952	-37%	0.3518	0.2201	-37%
1997	0.0577	0.0395	-32%	0.0770	0.0527	-32%	0.1458	0.0998	-32%	0.3372	0.2308	-32%
1998	0.0549	0.0403	-27%	0.0732	0.0537	-27%	0.1387	0.1018	-27%	0.3208	0.2353	-27%
1999	0.0547	0.0419	-23%	0.0730	0.0559	-23%	0.1382	0.1059	-23%	0.3197	0.2448	-23%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.5117	0.0428	-92%	0.0069	0.0006	-91%	0.0312	0.0027	-91%	0.0155	0.0015	-90%
1991	0.4327	0.0428	-90%	0.0058	0.0006	-90%	0.0266	0.0027	-90%	0.0132	0.0015	-89%
1992	0.3631	0.0428	-88%	0.0049	0.0006	-88%	0.0227	0.0027	-88%	0.0111	0.0015	-87%
1993	0.3022	0.0427	-86%	0.0041	0.0006	-85%	0.0192	0.0027	-86%	0.0093	0.0015	-84%
1994	0.2493	0.0426	-83%	0.0034	0.0006	-82%	0.0162	0.0027	-83%	0.0078	0.0015	-81%
1995	0.2039	0.0425	-79%	0.0027	0.0006	-79%	0.0134	0.0027	-80%	0.0064	0.0015	-77%
1996	0.1654	0.0424	-74%	0.0022	0.0006	-74%	0.0111	0.0027	-76%	0.0053	0.0015	-72%
1997	0.1332	0.0419	-69%	0.0018	0.0006	-68%	0.0093	0.0027	-71%	0.0043	0.0015	-66%
1998	0.1066	0.0418	-61%	0.0014	0.0006	-60%	0.0077	0.0027	-65%	0.0035	0.0015	-58%
1999	0.0850	0.0409	-52%	0.0012	0.0006	-50%	0.0065	0.0026	-60%	0.0029	0.0015	-49%
2000	0.0403	0.0404	0%	0.0006	0.0006	2%	0.0035	0.0026	-26%	0.0015	0.0014	-3%
2001	0.0383	0.0384	0%	0.0005	0.0005	3%	0.0039	0.0026	-34%	0.0015	0.0015	-2%
2002	0.0376	0.0378	1%	0.0005	0.0005	4%	0.0036	0.0025	-31%	0.0015	0.0014	-7%
2003	0.0328	0.0331	1%	0.0005	0.0005	5%	0.0035	0.0022	-37%	0.0014	0.0013	-8%
2004	0.0314	0.0316	1%	0.0005	0.0006	24%	0.0035	0.0021	-38%	0.0013	0.0012	-2%
2005	0.0269	0.0273	2%	0.0004	0.0006	47%	0.0033	0.0019	-42%	0.0011	0.0011	-1%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2006	0.0251	0.0255	2%	0.0004	0.0006	51%	0.0029	0.0017	-39%	0.0010	0.0010	-2%
2007	0.0116	0.0121	4%	0.0002	0.0004	94%	0.0020	0.0009	-53%	0.0006	0.0006	-7%
2008	0.0141	0.0147	4%	0.0006	0.0008	35%	0.0019	0.0010	-46%	0.0007	0.0006	-11%
2009	0.0069	0.0075	8%	0.0002	0.0004	101%	0.0015	0.0006	-60%	0.0005	0.0004	-16%
2010	0.0078	0.0083	6%	0.0002	0.0003	103%	0.0016	0.0007	-58%	0.0005	0.0004	-14%
2011	0.0052	0.0056	8%	0.0002	0.0004	92%	0.0017	0.0006	-67%	0.0005	0.0004	-10%
2012	0.0439	0.0443	1%	0.0188	0.0189	1%	0.0031	0.0015	-52%	0.0008	0.0008	-6%
2013	0.0521	0.0524	1%	0.0232	0.0233	1%	0.0043	0.0018	-58%	0.0011	0.0010	-4%
2014	0.0574	0.0578	1%	0.0261	0.0263	1%	0.0032	0.0017	-48%	0.0009	0.0008	-6%
2015	0.0628	0.0629	0%	0.0286	0.0286	0%	0.0033	0.0018	-46%	0.0010	0.0009	-13%
2016	0.0578	0.0578	0%	0.0257	0.0257	0%	0.0037	0.0018	-51%	0.0010	0.0009	-5%
2017	0.0748	0.0748	0%	0.0339	0.0339	0%	0.0045	0.0022	-50%	0.0012	0.0011	-6%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0516	0.0044	-91%	0.0669	0.0056	-92%	0.0497	0.0053	-89%
1991	0.0436	0.0044	-90%	0.0565	0.0056	-90%	0.0420	0.0053	-87%
1992	0.0366	0.0044	-88%	0.0474	0.0056	-88%	0.0353	0.0053	-85%
1993	0.0305	0.0044	-85%	0.0395	0.0056	-86%	0.0293	0.0053	-82%
1994	0.0252	0.0044	-82%	0.0326	0.0056	-83%	0.0242	0.0053	-78%
1995	0.0206	0.0044	-79%	0.0267	0.0056	-79%	0.0198	0.0054	-73%
1996	0.0167	0.0044	-74%	0.0216	0.0056	-74%	0.0161	0.0055	-66%
1997	0.0135	0.0044	-68%	0.0174	0.0055	-68%	0.0130	0.0052	-60%
1998	0.0108	0.0044	-60%	0.0139	0.0055	-61%	0.0104	0.0054	-48%
1999	0.0086	0.0043	-50%	0.0111	0.0054	-52%	0.0083	0.0059	-29%
2000	0.0041	0.0042	4%	0.0053	0.0053	0%	0.0039	0.0055	40%
2001	0.0039	0.0040	3%	0.0050	0.0050	0%	0.0038	0.0048	28%
2002	0.0038	0.0042	8%	0.0050	0.0050	1%	0.0037	0.0072	95%
2003	0.0034	0.0037	10%	0.0043	0.0044	1%	0.0032	0.0068	110%
2004	0.0033	0.0035	8%	0.0041	0.0042	1%	0.0031	0.0038	23%
2005	0.0028	0.0032	14%	0.0035	0.0036	3%	0.0026	0.0032	20%
2006	0.0026	0.0030	14%	0.0033	0.0034	3%	0.0025	0.0030	21%
2007	0.0013	0.0017	35%	0.0016	0.0017	6%	0.0012	0.0023	96%
2008	0.0021	0.0026	27%	0.0020	0.0021	6%	0.0014	0.0038	176%
2009	0.0009	0.0015	65%	0.0010	0.0011	12%	0.0007	0.0033	369%
2010	0.0009	0.0014	52%	0.0011	0.0012	8%	0.0008	0.0028	256%
2011	0.0007	0.0011	55%	0.0007	0.0008	12%	0.0005	0.0018	239%
2012	0.0337	0.0340	1%	0.0093	0.0094	1%	0.0034	0.0050	47%
2013	0.0414	0.0418	1%	0.0112	0.0113	1%	0.0040	0.0055	37%
2014	0.0465	0.0469	1%	0.0125	0.0126	1%	0.0044	0.0061	39%
2015	0.0508	0.0511	0%	0.0137	0.0137	0%	0.0048	0.0078	63%
2016	0.0458	0.0459	0%	0.0124	0.0124	0%	0.0044	0.0058	31%
2017	0.0604	0.0605	0%	0.0163	0.0162	0%	0.0057	0.0066	16%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0070	0.0007	-90%	0.7655	0.0661	-91%
1991	0.0060	0.0007	-88%	0.6478	0.0660	-90%
1992	0.0050	0.0007	-86%	0.5440	0.0660	-88%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1993	0.0042	0.0007	-84%	0.4532	0.0659	-85%
1994	0.0035	0.0007	-80%	0.3746	0.0658	-82%
1995	0.0029	0.0007	-76%	0.3067	0.0656	-79%
1996	0.0024	0.0007	-71%	0.2492	0.0654	-74%
1997	0.0020	0.0007	-65%	0.2011	0.0649	-68%
1998	0.0016	0.0007	-57%	0.1614	0.0646	-60%
1999	0.0013	0.0007	-49%	0.1293	0.0635	-51%
2000	0.0007	0.0007	-4%	0.0621	0.0626	1%
2001	0.0007	0.0007	-3%	0.0597	0.0603	1%
2002	0.0007	0.0007	-8%	0.0589	0.0597	1%
2003	0.0007	0.0006	-8%	0.0520	0.0530	2%
2004	0.0006	0.0006	-1%	0.0505	0.0550	9%
2005	0.0005	0.0005	0%	0.0444	0.0522	17%
2006	0.0005	0.0005	-1%	0.0408	0.0483	18%
2007	0.0003	0.0003	-5%	0.0213	0.0293	37%
2008	0.0004	0.0003	-10%	0.0373	0.0453	21%
2009	0.0003	0.0002	-14%	0.0164	0.0247	51%
2010	0.0003	0.0002	-13%	0.0156	0.0222	42%
2011	0.0002	0.0002	-7%	0.0141	0.0209	48%
2012	0.0010	0.0010	-2%	0.7479	0.7529	1%
2013	0.0013	0.0013	-2%	0.9213	0.9267	1%
2014	0.0013	0.0013	-2%	1.0351	1.0405	1%
2015	0.0014	0.0013	-5%	1.1313	1.1305	0%
2016	0.0013	0.0013	-2%	1.0187	1.0184	0%
2017	0.0017	0.0017	-2%	1.3446	1.3440	0%

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	0.7761	0.0660	-92%	0.5708	0.0590	-90%	0.0024	0.0002	-91%	0.6491	0.0542	-92%
1991	0.6566	0.0659	-90%	0.4857	0.0590	-88%	0.0020	0.0002	-90%	0.5489	0.0541	-90%
1992	0.5512	0.0659	-88%	0.4108	0.0590	-86%	0.0017	0.0002	-88%	0.4606	0.0541	-88%
1993	0.4590	0.0657	-86%	0.3453	0.0589	-83%	0.0014	0.0002	-85%	0.3833	0.0540	-86%
1994	0.3791	0.0657	-83%	0.2892	0.0589	-80%	0.0012	0.0002	-82%	0.3162	0.0539	-83%
1995	0.3103	0.0655	-79%	0.2385	0.0591	-75%	0.0009	0.0002	-78%	0.2587	0.0537	-79%
1996	0.2519	0.0652	-74%	0.1961	0.0585	-70%	0.0008	0.0002	-73%	0.2098	0.0536	-74%
1997	0.2031	0.0647	-68%	0.1612	0.0587	-64%	0.0006	0.0002	-67%	0.1689	0.0530	-69%
1998	0.1628	0.0644	-60%	0.1322	0.0588	-56%	0.0005	0.0002	-59%	0.1351	0.0528	-61%
1999	0.1301	0.0631	-51%	0.1095	0.0585	-47%	0.0004	0.0002	-49%	0.1077	0.0517	-52%
2000	0.0621	0.0623	0%	0.0561	0.0562	0%	0.0002	0.0002	6%	0.0511	0.0511	0%
2001	0.0596	0.0598	0%	0.0598	0.0598	0%	0.0002	0.0002	5%	0.0486	0.0486	0%
2002	0.0582	0.0586	1%	0.0561	0.0562	0%	0.0002	0.0002	11%	0.0476	0.0476	0%
2003	0.0512	0.0516	1%	0.0536	0.0537	0%	0.0002	0.0002	14%	0.0415	0.0415	0%
2004	0.0492	0.0501	2%	0.0517	0.0520	1%	0.0002	0.0002	29%	0.0396	0.0396	0%
2005	0.0425	0.0441	4%	0.0474	0.0480	1%	0.0001	0.0002	54%	0.0339	0.0339	0%
2006	0.0395	0.0410	4%	0.0424	0.0429	1%	0.0001	0.0002	58%	0.0317	0.0317	0%
2007	0.0190	0.0207	9%	0.0266	0.0272	2%	0.0001	0.0002	112%	0.0146	0.0146	0%
2008	0.0241	0.0258	7%	0.0272	0.0280	3%	0.0002	0.0003	41%	0.0168	0.0168	0%
2009	0.0120	0.0138	15%	0.0200	0.0207	3%	0.0001	0.0002	127%	0.0084	0.0084	0%
2010	0.0131	0.0146	11%	0.0210	0.0215	2%	0.0001	0.0001	135%	0.0097	0.0098	0%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			HCB [kg]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2011	0.0097	0.0111	14%	0.0209	0.0215	3%	0.0001	0.0001	107%	0.0063	0.0063	0%
2012	0.1535	0.1546	1%	0.0631	0.0779	23%	0.0072	0.0073	1%	0.0064	0.0064	0%
2013	0.1868	0.1880	1%	0.0816	0.0997	22%	0.0089	0.0090	1%	0.0051	0.0051	0%
2014	0.2073	0.2085	1%	0.0747	0.0951	27%	0.0100	0.0101	1%	0.0041	0.0041	0%
2015	0.2264	0.2264	0%	0.0792	0.1009	27%	0.0110	0.0110	0%	0.0046	0.0046	0%
2016	0.2060	0.2061	0%	0.0792	0.0988	25%	0.0099	0.0099	0%	0.0058	0.0058	0%
2017	0.2698	0.2698	0%	0.1000	0.1258	26%	0.0130	0.0130	0%	0.0057	0.0057	0%

P-Previous
R-Refined

3.7.10 OTHER, MOBILE (INCLUDING MILITARY, LAND BASED AND RECREATIONAL BOATS) (NFR 1A5b)

3.7.10.1 Overview

This category was first time reported in the year 2018. Total fuel consumption was 169.78 TJ. This consumption includes petrol, diesel oil and jet fuel. Emissions of mobile combustion in the military are shown in ***Table 3.123***.

Table 3.123 *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

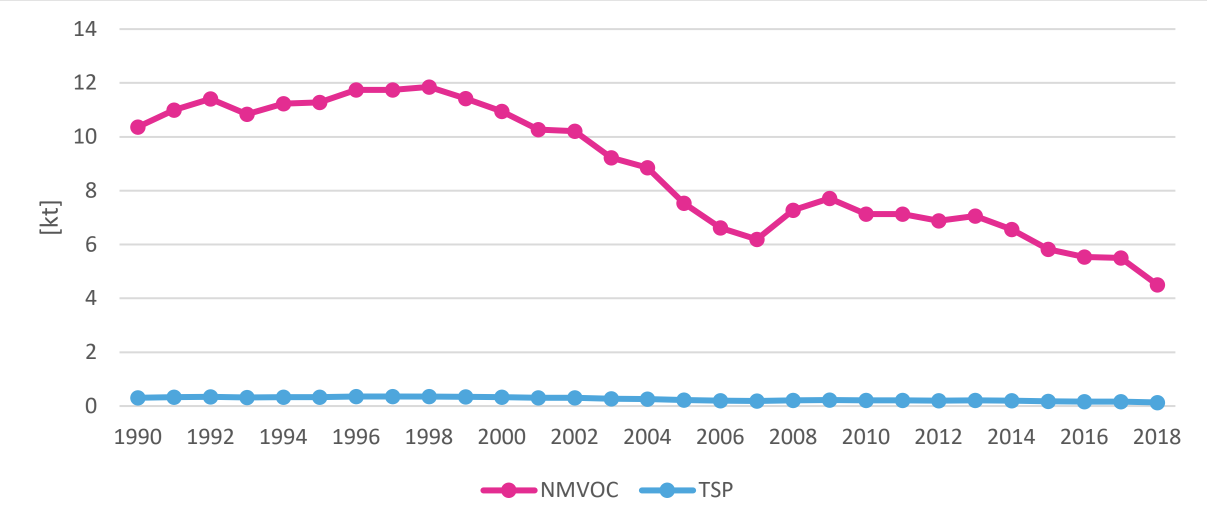
3.8 FUGITIVE EMISSIONS (NFR 1B)

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. Its emission trends are shown in ***Figure 3.39***. Emissions in this category have a decreasing trend due to the decrease of the activity in the Slovak Republic.

Figure 3.39: *Trends in emissions of air pollutants in 1B1a*



Overview of the emissions and activity data is shown in ***Table 3.124***.

Table 3.124: *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	0.0173	0.1452	0.3076
1995	3.76	11.2773	0.0188	0.1579	0.3346
2000	3.65	10.9479	0.0182	0.1533	0.3248
2005	2.51	7.5336	0.0126	0.1055	0.2235
2010	2.38	7.1326	0.0119	0.0999	0.2116
2011	2.38	7.1281	0.0119	0.0998	0.2115
2012	2.29	6.8766	0.0115	0.0963	0.2040
2013	2.35	7.0582	0.0118	0.0988	0.2094
2014	2.19	6.5632	0.0109	0.0919	0.1947
2015	1.94	5.8180	0.0097	0.0815	0.1726
2016	1.85	5.5414	0.0092	0.0776	0.1644
2017	1.83	5.5020	0.0092	0.0770	0.1632
2018	1.50	4.5060	0.0075	0.0631	0.1337
1990/2018	**-57%**	**-57%**	**-57%**	**-57%**	**-57%**
2017/2018	**-18%**	**-18%**	**-18%**	**-18%**	**-18%**

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 Tier 1 emission factors due to absence of activity data about hole drilled (***Table 3.125***).

Table 3.125: *Emission factor in the category 1A5a*

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 key were used following EMEP/EEA GB_{2019}.

3.8.1.4 Source-specific recalculations

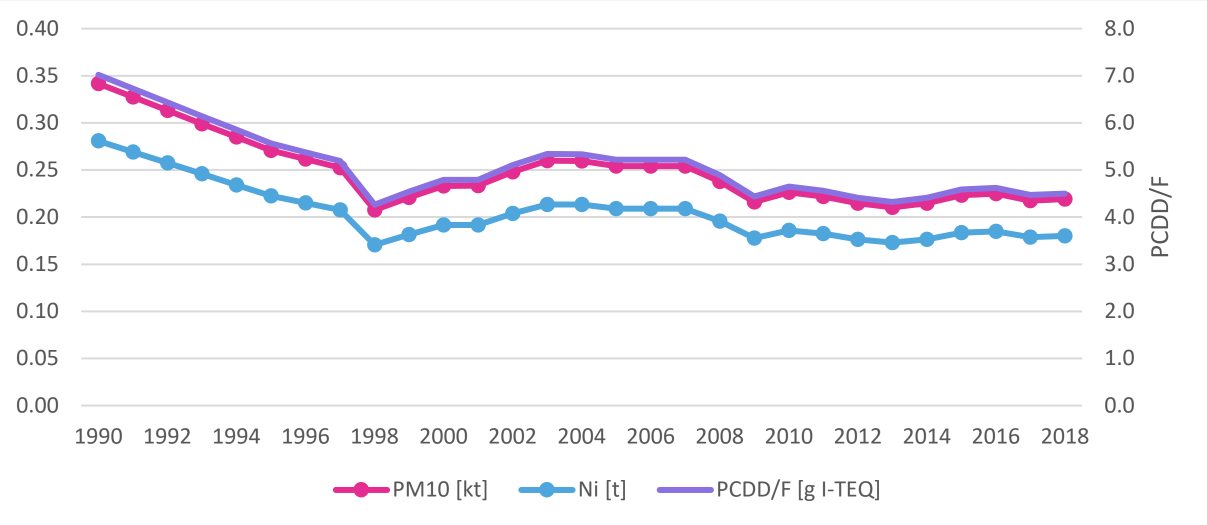
No recalculations in this submission.

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. Emission trends pf these pollutants are shown in ***Figure 3.40***.

Figure 3.40: *Trends of emissions of PM_{10}, Ni and PCDD/F in the category 1B1b*



Overview of the emissions is shown in ***Table 3.126***.

Table 3.126: *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
1990/2018	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**
2017/2018	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.8892	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

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
2000	0.6068	0.0112	0.0192	0.0208	0.2715	0.0767	0.1916	0.0256	0.3513
2005	0.6612	0.0122	0.0209	0.0226	0.2958	0.0835	0.2088	0.0278	0.3828
2010	0.5890	0.0109	0.0186	0.0202	0.2635	0.0744	0.1860	0.0248	0.3410
2011	0.5776	0.0106	0.0182	0.0198	0.2584	0.0730	0.1824	0.0243	0.3344
2012	0.5586	0.0103	0.0176	0.0191	0.2499	0.0706	0.1764	0.0235	0.3234
2013	0.5472	0.0101	0.0173	0.0187	0.2448	0.0691	0.1728	0.0230	0.3168
2014	0.5586	0.0103	0.0176	0.0191	0.2499	0.0706	0.1764	0.0235	0.3234
2015	0.5814	0.0107	0.0184	0.0199	0.2601	0.0734	0.1836	0.0245	0.3366
2016	0.5852	0.0108	0.0185	0.0200	0.2618	0.0739	0.1848	0.0246	0.3388
2017	0.5662	0.0104	0.0179	0.0194	0.2533	0.0715	0.1788	0.0238	0.3278
2018	0.5700	0.0105	0.0180	0.0195	0.2550	0.0720	0.1800	0.0240	0.3300
1990/2018	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**
2017/2018	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]
1990	7.0200	0.3744	0.4680	0.2340	0.1638	1.2402
1995	5.5620	0.2966	0.3708	0.1854	0.1298	0.9826
2000	4.7908	0.2555	0.3194	0.1597	0.1118	0.8464
2005	5.2200	0.2784	0.3480	0.1740	0.1218	0.9222
2010	4.6500	0.2480	0.3100	0.1550	0.1085	0.8215
2011	4.5600	0.2432	0.3040	0.1520	0.1064	0.8056
2012	4.4100	0.2352	0.2940	0.1470	0.1029	0.7791
2013	4.3200	0.2304	0.2880	0.1440	0.1008	0.7632
2014	4.4100	0.2352	0.2940	0.1470	0.1029	0.7791
2015	4.5900	0.2448	0.3060	0.1530	0.1071	0.8109
2016	4.6200	0.2464	0.3080	0.1540	0.1078	0.8162
2017	4.4700	0.2384	0.2980	0.1490	0.1043	0.7897
2018	4.5000	0.2400	0.3000	0.1500	0.1050	0.7950
1990/2018	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**	**-36%**
2017/2018	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**

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 3.127***).

Table 3.127: *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. Production of crude oil shows a decreasing trend since 1990. The trend of the amount of transported oil is fluctuating slightly in recent years. Overview of emissions and activity data is shown in ***Table 3.128***.

Table 3.128: *Overview of emissions and activity data in the category 1B2ai*

YEAR	CRUDE OIL PRODUCED [Mt]	CRUDE OIL TRANSPORTED [Mt]	NMVOC [kt]
1990	73.14	13581.00	0.0286
1995	74.25	13581.00	0.0290

YEAR	CRUDE OIL PRODUCED [Mt]	CRUDE OIL TRANSPORTED [Mt]	NMVOC [kt]
2000	59.00	9300.00	0.0281
2005	31.00	10662.34	0.0383
2010	13.00	10075.33	0.0190
2011	15.00	9919.73	0.0040
2012	11.00	8417.68	0.0116
2013	10.00	9788.06	0.0175
2014	12.00	8945.00	0.0302
2015	12.00	9932.04	0.0372
2016	10.00	9171.32	0.0346
2017	8.00	9582.25	0.0269
2018	7.00	9460.16	0.0218
1990/2018	**-90%**	**-30%**	**-24%**
2017/2018	**-13%**	**-1%**	**-19%**

3.8.4.2 Methodological issues

For the calculation of NMVOC emissions are used the data from the NEIS database reported by the operators (definition of included activities is shown in ***Table 3.129***) and they are completed by the calculations of emissions from the extracted oil. For the the calculation the default EF=0.1 kg/t is used (Land-based activities).

Table 3.129: *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

3.8.4.3 Completeness

Notation key of NA is used for the other emissions except of SO_X where NE is used in compliance with the EMEP/EEA GB_{2019}.

3.8.4.4 Source-specific recalculations

Activity data were modified in compliance with GHG inventory, therefore, recalculations of several years were done (***Table 3.130***).

Table 3.130*: Previous and refined emissions in the category 1B2ai*

YEAR	NMVOC [kt]		
	PREVIOUS	REFINED	CHANGE
1990	0.0286	0.0286	-
1991	0.0283	0.0284	0%
1992	0.0281	0.0274	-3%
1993	0.0279	0.0279	-
1994	0.0284	0.0281	-1%
1995	0.0290	0.0290	-
1996	0.0266	0.0266	-
1997	0.0290	0.0290	-
1998	0.0286	0.0286	-
1999	0.0290	0.0290	-
2000	0.0281	0.0281	-
2001	0.0278	0.0278	-
2002	0.0275	0.0275	-
2003	0.0266	0.0266	-

YEAR	NMVOC [kt]		
	PREVIOUS	REFINED	CHANGE
2004	0.0939	0.0939	-
2005	0.0383	0.0383	-
2006	0.0197	0.0197	-
2007	0.0045	0.0051	13%
2008	0.0057	0.0057	-
2009	0.0095	0.0095	-
2010	0.0190	0.0190	-
2011	0.0040	0.0040	-
2012	0.0116	0.0116	-
2013	0.0175	0.0175	0%
2014	0.0299	0.0302	1%
2015	0.0370	0.0372	1%
2016	0.0344	0.0346	1%
2017	0.0267	0.0269	1%

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 3.131***. Emissions in this category show a decreasing trend which is connected with a decrease of the activity.

Table 3.131: *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	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0355
1995	5.17	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0295
2000	5.44	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0310
2005	5.60	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0319
2010	5.45	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0311
2011	5.99	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0341
2012	5.40	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0308
2013	5.87	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0335
2014	5.22	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0298
2015	5.95	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0339
2016	5.74	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0327
2017	5.56	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0317
2018	5.46	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	3E-05	0.0311
1990/2018	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**	**-12%**
2017/2018	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**

3.8.5.2 Methodological issues

Calculation for heavy metals and POPs remain for reporting. The calculation use the default EF from EMEP/EEA GB_{2019} (***Table 3.132***).

Table 3.132: 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 fugitives are reported in the chapter of Petroleum refining (NFR 1A1b), and notation key IE was used as the recommendation No ***SK-1B2aiv-2018-0001*** raised during the last review recommends. Notation keys for PAHs, HCB and PCBs were used in compliance with EMEP/EEA GB_{2019}.

3.8.5.4 Source-specific recalculations

No recalculations in this submission.

3.8.6 DISTRIBUTION OF OIL PRODUCTS (NFR 1B2av)

3.8.6.1 Overview

An overall trend of activity data is shown in ***Table 3.133***. Emissions in this category show an increasing trend which is connected with an increase of the activity.

Table 3.133: Overview of emissions and activity data in the category 1B2aiv

YEAR	OIL CONSUMED [Mt]	NMVOC [kt]
1990	1.61	0.2729
1995	1.40	0.2840
2000	1.36	0.3085
2005	2.05	0.4082
2010	2.38	0.5164
2011	2.27	0.4811
2012	2.36	0.4415
2013	2.31	0.4395
2014	2.40	0.4361
2015	2.48	0.4534
2016	2.27	0.4746
2017	2.69	0.4707
2018	2.69	0.4978
1990/2018	**67%**	**82%**
2017/2018	**0%**	**6%**

3.8.6.2 Methodological issues

The reported emissions of NMVOC are compiled in the NEIS. The definition of stationary sources and emissions from their activities included in 1B2av are presented in following ***Table 3.134***. All data are from the operator – facility data. Historical data were calculated with the emission factor **199.4 g/Mg** that was calculated as the average of IEFs for individual years (2003-2015).

Table 3.134: *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

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

No recalculations in this submission.

3.8.7 FUGITIVE EMISSIONS FROM NATURAL GAS (EXPLORATION, PRODUCTION, PROCESSING, TRANSMISSION, STORAGE, DISTRIBUTION AND OTHER) (NFR 1B2b)

3.8.7.1 Overview

An overall trend of activity data is shown in the ***Table 3.135***. Emissions in this category show an increasing trend which is connected with an increase of the activity. This category is key for NMVOC.

Table 3.135: *Overview of emissions and activity data in the category 1B2aiv*

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	73600.00	6666.00	1.00	8.1155
1995	344.00	344.00	73600.00	6485.00	159.40	8.0932
2000	173.00	173.00	68600.00	7136.00	524.30	7.6606
2005	147.00	147.00	73900.00	7399.00	50.00	8.1643
2010	104.00	104.00	65302.00	6098.00	103.00	7.1711
2011	121.00	121.00	68093.00	5630.00	395.00	7.4360
2012	150.00	150.00	45470.00	5289.00	385.00	5.1444
2013	124.00	124.00	52780.00	5820.00	132.00	5.8980
2014	100.00	100.00	46500.00	4535.00	319.00	5.1554
2015	93.00	93.00	55800.00	4639.00	139.00	6.0764
2016	92.00	92.00	60600.00	4716.00	246.00	6.5746
2017	140.00	140.00	64200.00	4901.25	418.00	6.9799
2018	93.00	93.00	59700.00	4777.99	423.00	6.5087
1990/2018	**-79%**	**-79%**	**-19%**	**-28%**	**42200%**	**-20%**
2017/2018	**-34%**	**-34%**	**-7%**	**-3%**	**1%**	**-7%**

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/m³ NG for each activity.

3.8.7.3 Completeness

Notation key 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 refinery, technological losses and storage are included in different categories, because they are part of already categorised sources in NEIS (1A1c; 1A1b). Notation key IE is used for main pollutants. BC, CO, HMs and POPs are reported using NK in compliance with EMEP/EEA GB_{2019}.

3.8.9 OTHER FUGITIVE EMISSIONS FROM ENERGY PRODUCTION (NFR 1B2d)

3.8.9.1 Overview

The category is reported as NO according to recommendation ***SK-1B2d-2019-0001***. Geothermal energy is not developed in the Slovak Republic. Most of the sources are used for recreational purposes and they are considered as negligible.

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

Last update: 13.3.2020

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.

<u>The data sources:</u>

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. In the year 2018, the system contained 13 774 large and medium sources.

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.

The inventory is partly 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 compilation of final emissions.

Table 4.1: *Overview of reported categories, tier or notation key used in 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	NK	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

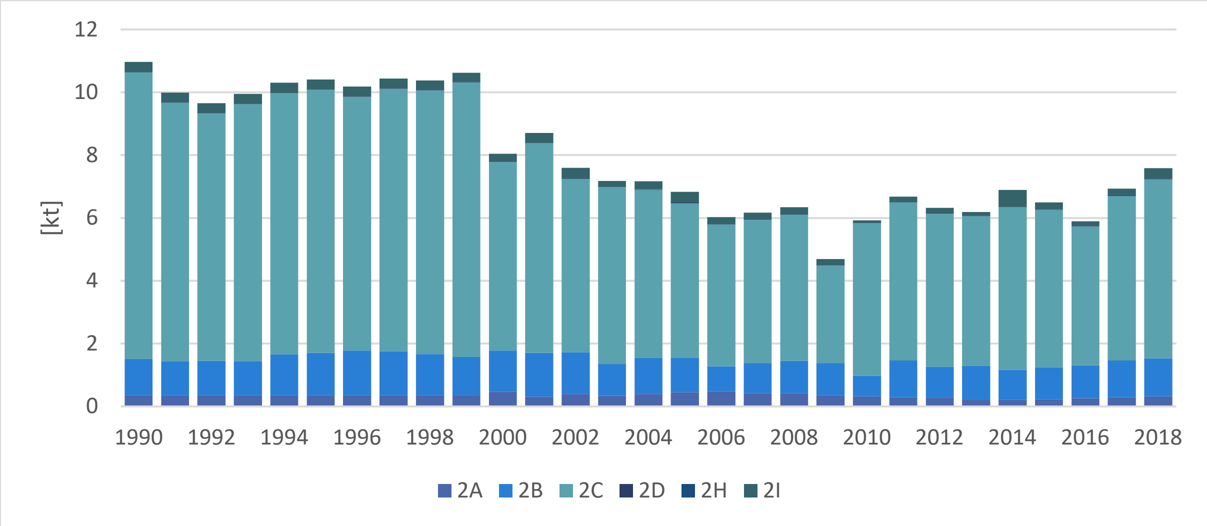
NFR	LONGNAME OF CATEGORY	METHODOLOGY / TIER					
		NOx, NMVOC, SOx, CO	NH_3	$PM_{2.5}$, PM_{10}, TZL	BC	HM	POPs
2A6	Other mineral products	T3	T3	T3	NK	NK	NK
	CHEMICAL INDUSTRY						
2B1	Ammonia production	T3	T1	T3	T1	NK	NK
2B2	Nitric acid production	T3, NK	T3	NK	NK	NK	NK
2B3	Adipic acid production	NK	NK	NK	NK	NK	NK
2B5	Carbide production	T3	NK	T3	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	T1	T1, NK
2C2	Ferroalloys production	T3	T3, NK	T3	T1	NK	NK
2C3	Aluminium production	NK	NK	NK	NK	NK	T1, NK
2C4	Magnesium production	T3	T3	T3	NK	NK	NK
2C5	Lead production	T3, NK	NK	T3, NK	NK	T2, NK	T1, NK
2C6	Zinc production	T1, NK	NK	T1,NK	NK	T1, NK	T1, NK
2C7a	Copper production	NK	NK	NK	NK	T2, NK	T1, NK
2C7b	Nickel production	NK	NK	NK	NK	NK	NK
2C7c	Other metal production	T3	T3	T3	T1	NK	NK
2C7d	Storage, handling and transport of metal products	NK	NK	NK	NK	NK	NK
	SOLVENTS						
2D3a	Domestic solvent use including fungicides	T1, 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	T4	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	NK	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	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 figures 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 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).

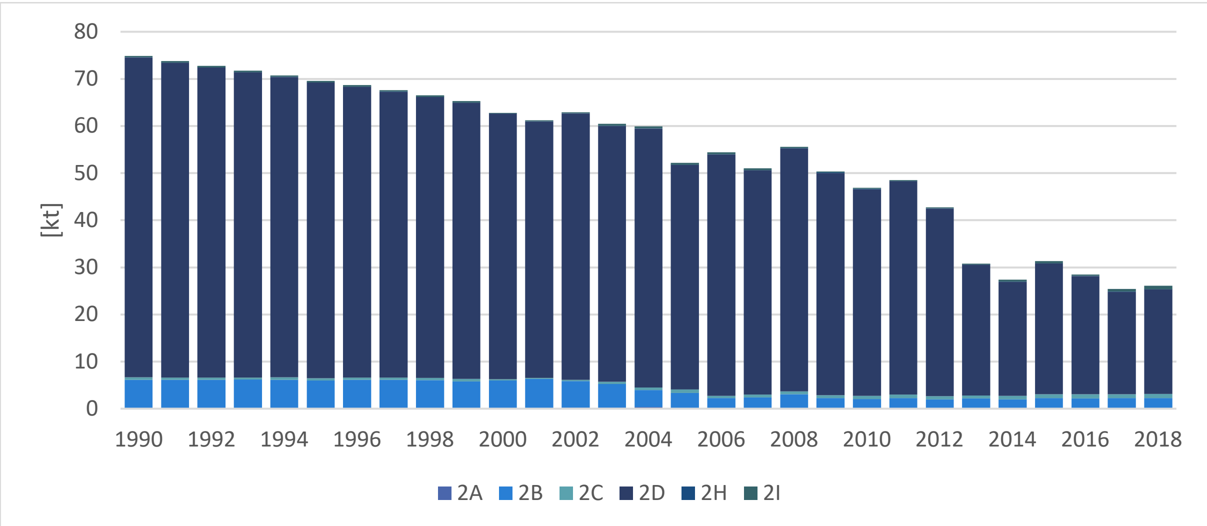
The main contributor to the NOx emissions in the industry sector are categories Iron and steel (2C1) and Ferroalloys productions (2C2). These two activities are also key categories for this pollutant. As shown in ***Figure 4.1***, the most significant decrease was recorded in the period 2001-2009, since then, emissions have a fluctuating trend.

Figure 4.1: *The overall trend in NOx emissions by categories of Industry sector*



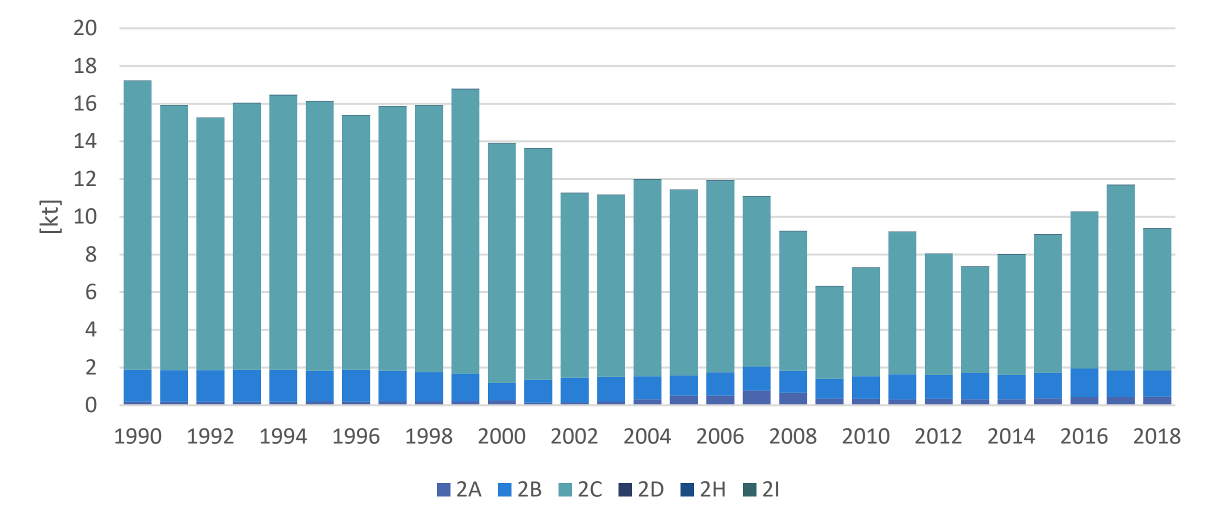
Solvents use contributes by averagely 90% to NMVOC emissions. Emission trend shows a decreasing trend due to stricter limits and technical requirements for solvents use (***Figure 4.2***). Key categories for this pollutant in the industrial sector are Domestic solvent use (2D3a), Coating application (2D3d), Degreasing (2D3e), Chemical products (2D3g), Printing (2D3h) and Other solvent use (2D3i).

Figure 4.2: *The overall trend in NMVOC emissions by categories of Industry sector*



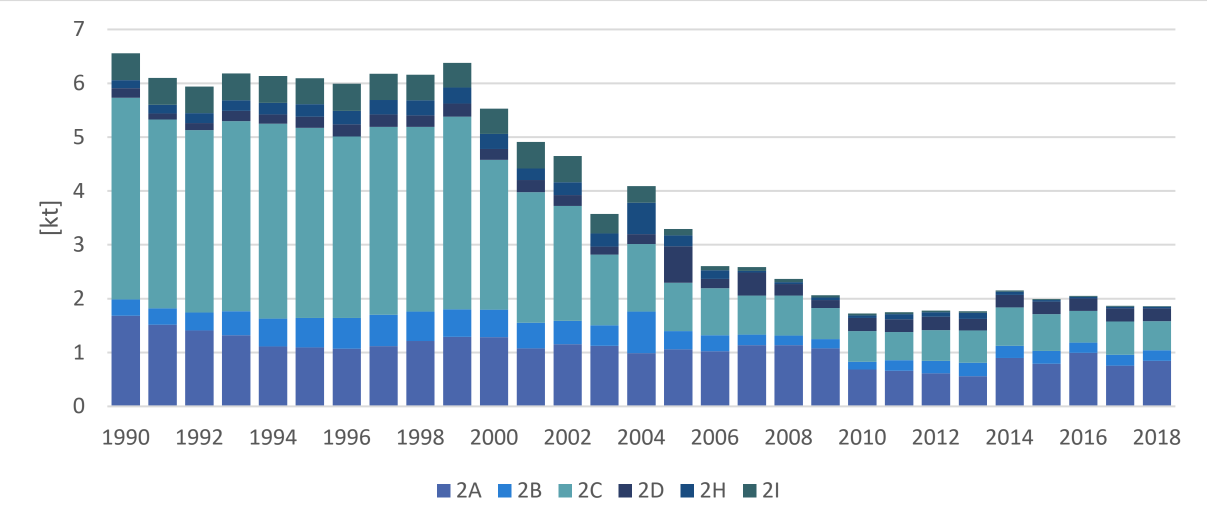
SOx emissions have a decreasing trend until 2009 in the sector industry, since then emissions are fluctuating slightly (***Figure 4.3***). Key categories from industrial processes are Iron and steel (2C1), Other metal production (2C7c) and Other chemical industry (2B10a – contains manufacture of urea, industrial fertilizers based on nitrogen, phosphorus and potassium, inorganic pigments, refining and bleaching preparations, industrial explosives, production and processing of carbonaceous materials, Manufacture of soaps, detergents and cosmetics).

Figure 4.3: *The overall trend in SOx emissions by categories of Industry sector*



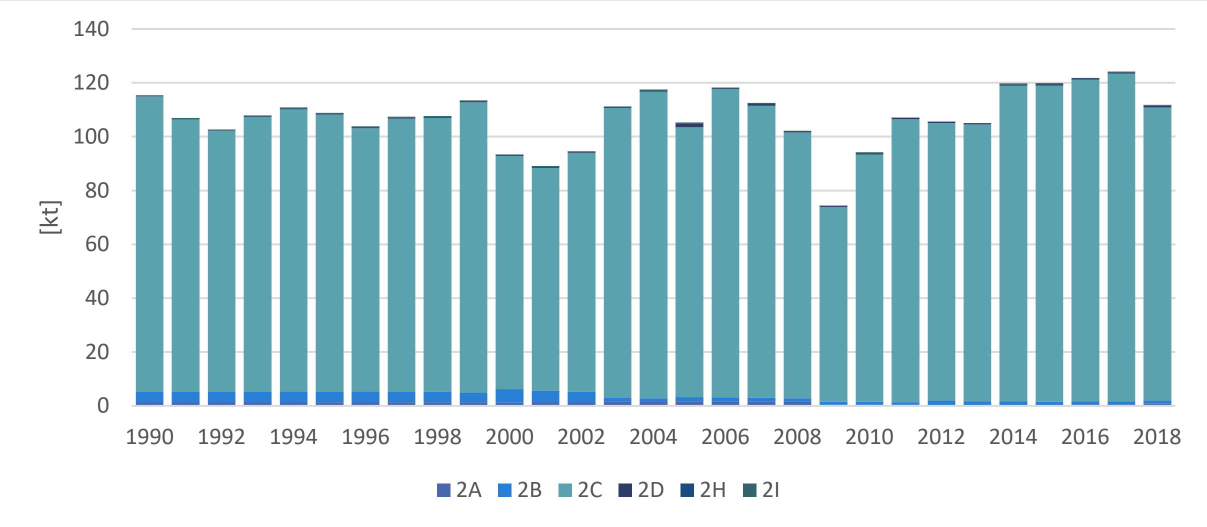
As shown in ***Figure 4.4***, emissions of PM_{10} decreased the most substantially during the period 2000-2010, because of stricter emission limits and the introduction of more effective abatement technologies. Since 2011, emissions fluctuating as a result of activity in category Construction and demolition (2A5b), which is also a key category for this pollutant.

Figure 4.4: *The overall trend in PM_{10} emissions by categories of Industry sector*



The Fluctuation of CO emissions in the industry sector (***Figure 4.5***) is connected with activity in the category Iron and steel production (2C1) which is a key category for this pollutant.

Figure 4.5: The overall trend in CO emissions by categories of Industry sector



Metal production categories (2C1, 2C7a) are key for emissions of priority heavy metals and persistent organic pollutants (PCDD/F, PAHs and PCBs). Emissions of these pollutants have an increasing trend connected to activity within the category Iron and steel production (***Figure 4.6-4.11***).

Figure 4.6: The overall trend in Pb emissions by categories of Industry sector

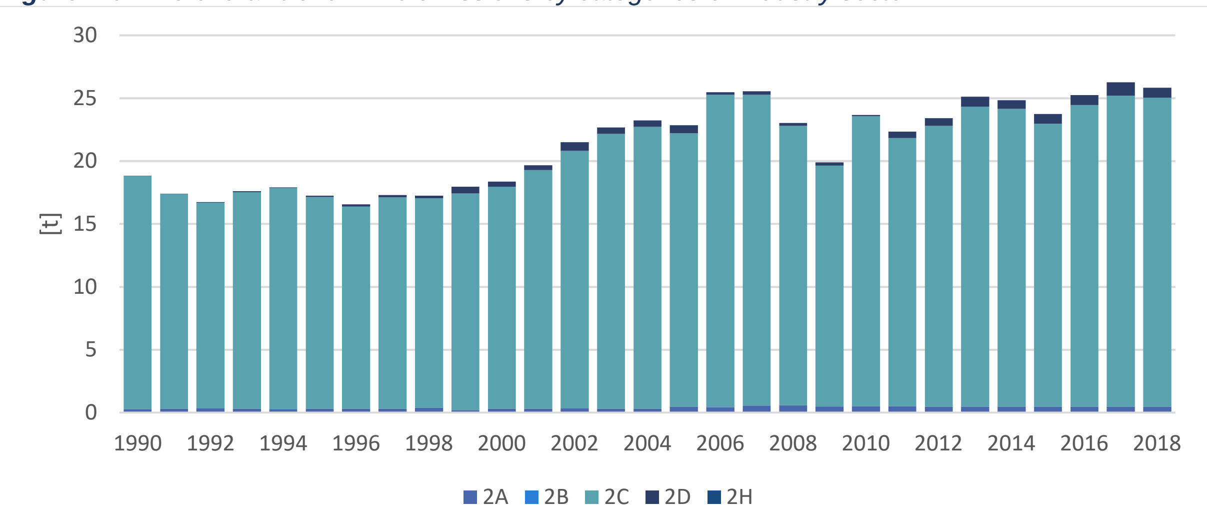


Figure 4.7: *The overall trend in Cd emissions by categories of Industry sector*

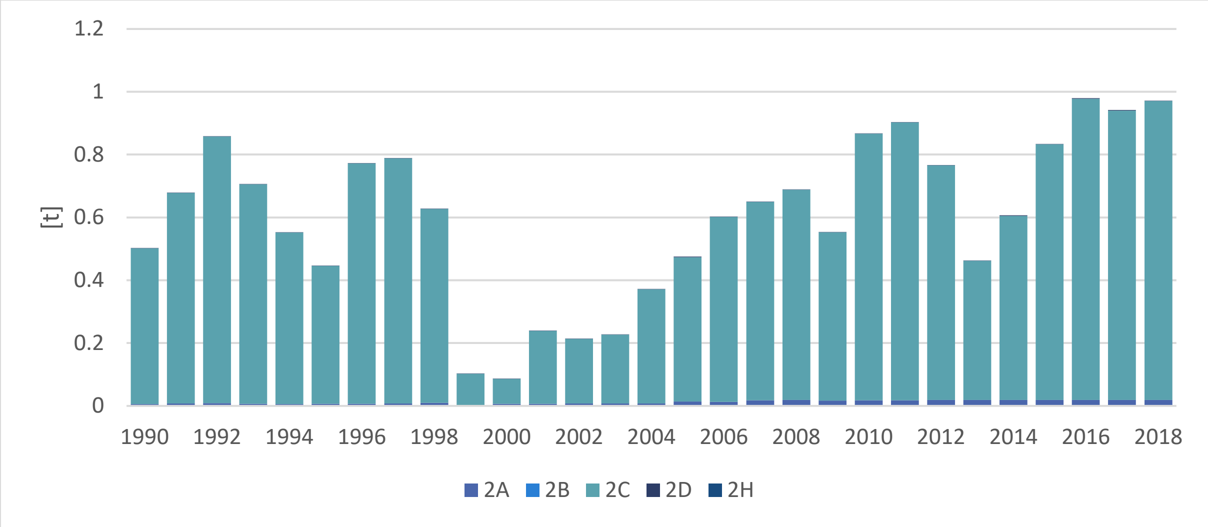


Figure 4.8: *The overall trend in Hg emissions by categories of Industry sector*

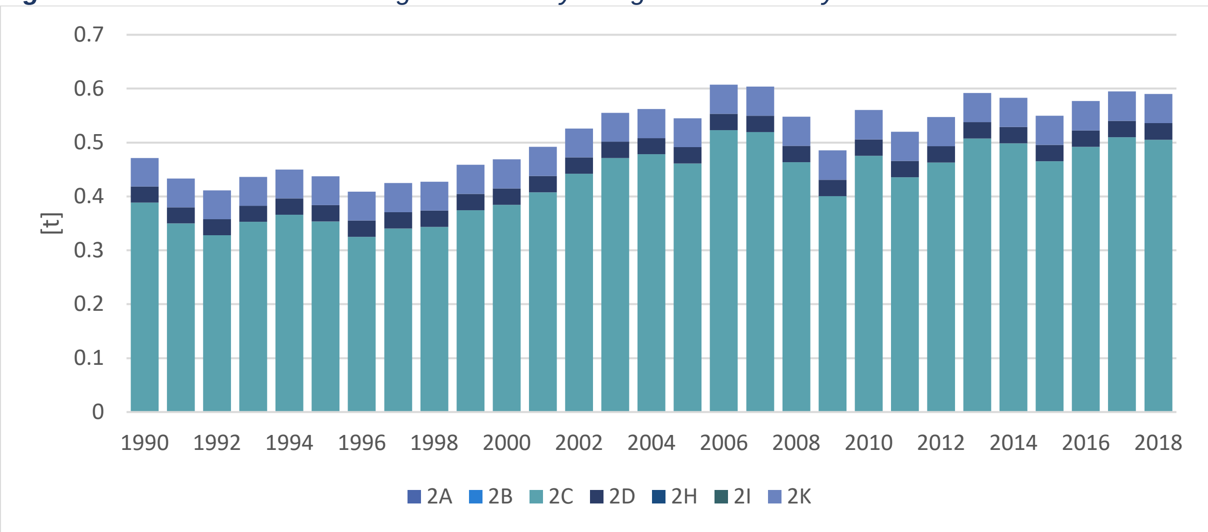


Figure 4.9: *The overall trend in PCDD/F emissions by categories of Industry sector*

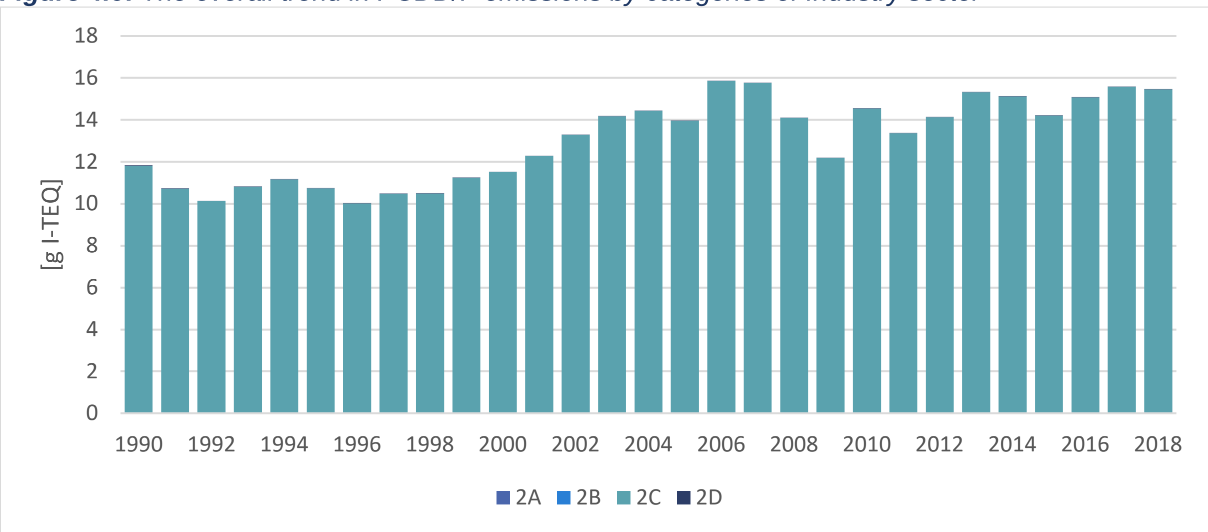


Figure 4.10: *The overall trend in PAHs emissions by categories of Industry sector*

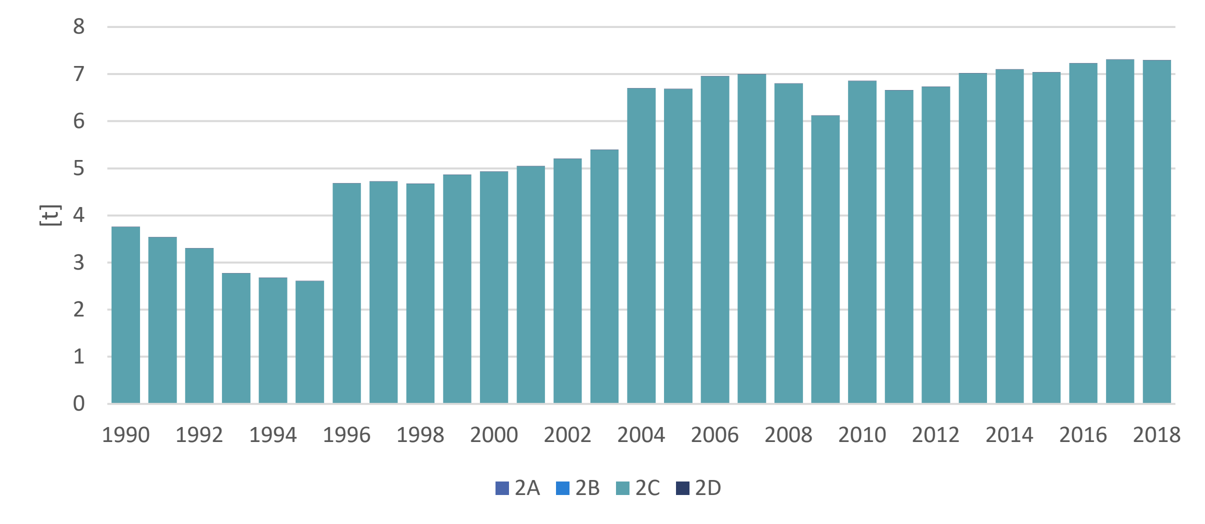
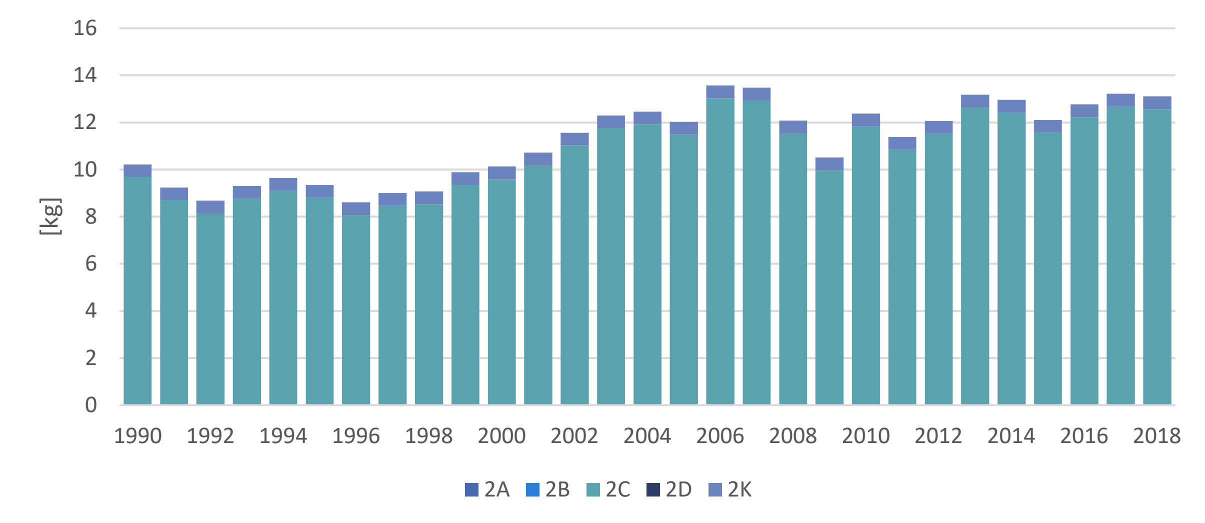


Figure 4.11: *The overall trend in PCBs emissions by categories of Industry sector*



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.

Methodology used in the previous submission was assumed as outdated and impossible to further improvements. Therefore, all categories were recalculated using EMEP/EEA GB_{2019} emission factors on Tier 1 level. This step will be followed by improvement of the methodology of all key categories to higher level. Due to lack of capacity, the next step will be provided in the next submission.

Combustion emissions were removed from industry categories 2A1, 2A2, 2A3 and 2H1 and allocated to the particular energy categories, which caused significant decrease in industrial sector and increase in the sector energy. There is planned detailed analysis of allocation of sources to the NFR categories across the whole NEIS database in the next period, as it was already identified that some sources might be allocated incorrectly within the database.

Also, emission factors for main pollutants were changed due to change for the period 1990-1999 (1990-2004 for $PM_{2.5}$ and PM_{10}) due to re-categorisation of fuels.

4.4 MINERAL INDUSTRY (NFR 2A)

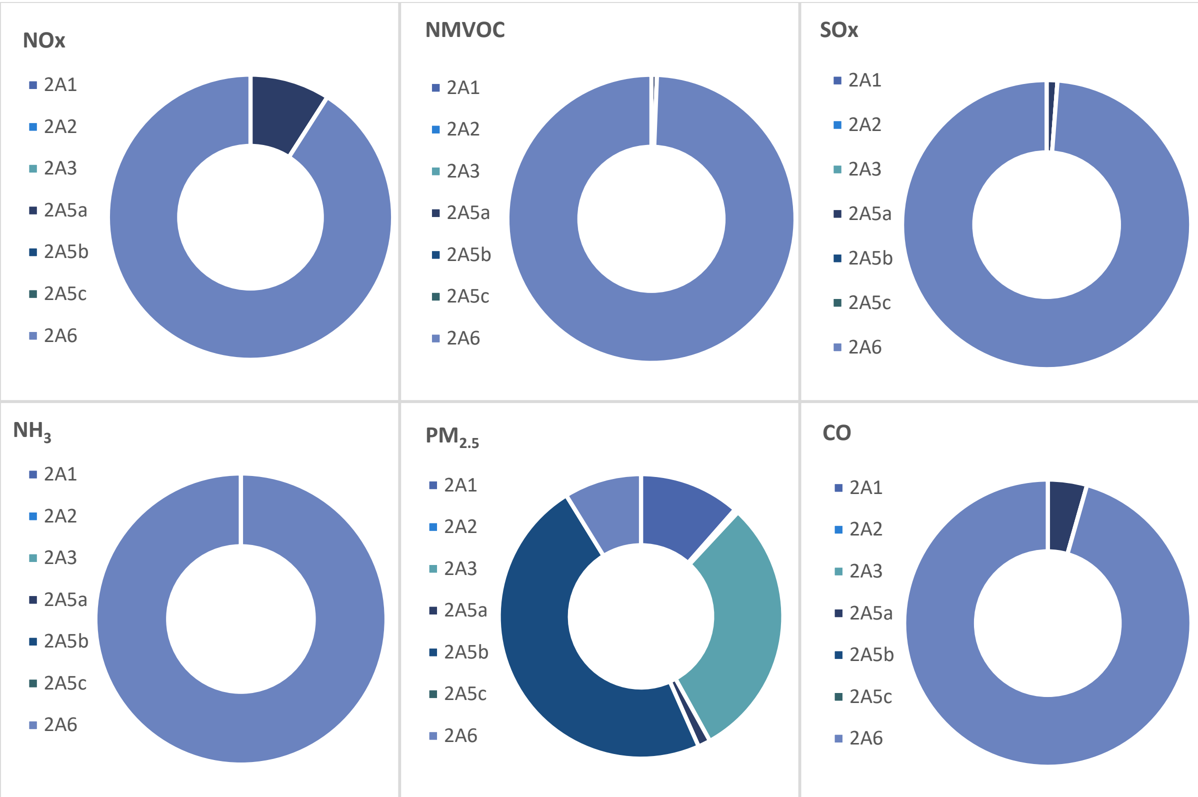
4.4.1 OVERVIEW

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.

Shares of NO_X, NMVOC, SO_X, NH_3, $PM_{2.5}$, CO emission in 2018 NFR categories included in the mineral industry are shown in ***Figure 4.12***.

Figure 4.12: *Shares of emission in 2A in 2018*



4.4.2 CEMENT PRODUCTION (NFR 2A1)

4.4.2.1 Overview

The cement manufacturing is 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 ***Figure 4.13*** and ***Table 4.2***.

Figure 4.13: *Trends of emissions in the category 2A1*

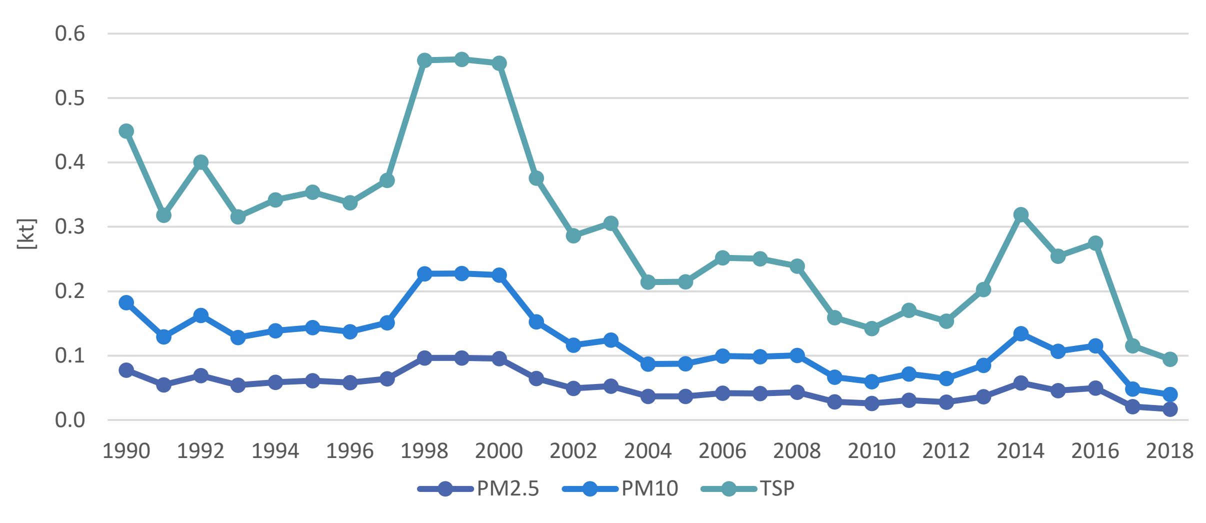


Table 4.2: *Activity data and emissions in the category 2A1*

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
1990/2018	**-5%**	**-78%**	**-78%**	**-79%**	**-78%**
2017/2018	**0%**	**-18%**	**-18%**	**-18%**	**-18%**

4.4.2.2 Methodological issues

Activities listed within this category are shown in ***Table 4.3.***

Table 4.3: *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 Ministry of Environment and detailed methodology are presented in **ANNEX IV.** The following ***Table 4.4*** presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS. As it is seen from the table, the majority (79%) of emissions are determined or monitored by continuous measurement and (20%) by discontinuous measurement of representative mass flow and monitored operational hours.

Table 4.4: *The overview of share of used calculation type for category 2A1 in the NEIS*

2A1	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	79%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	20%
4	Calculation using emission factor and amount of fuel	0%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	2%

Emission factors used for reconstruction of historical years 1990–1999 (1990-2004 for $PM_{2.5}$, PM_{10} and BC) were calculated using average IEF for each pollutant for the period 2000-2005 (***Table 4.5).***

Table 4.5: *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

Following recommendation No ***SK-2A1-2019-0001***, use of country-specific emission factors was reconsidered. Combustion emissions were reallocated to the category **1A2f** and notation key were used. Historical years were recalculated due to update of emission factors (***Table 4.6***). Tier 3 methodology for heavy metals could not be applied as the results of discontinues measurement were not consistent.

__Table 4.6:__ Previous and refined emissions in the category 2A1

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	1.3978	0.0773	-94%	3.2775	0.1824	-94%	7.9214	0.4489	-94%	0.0419	0.0023	-94%
1991	1.0072	0.0548	-95%	2.3617	0.1293	-95%	5.7079	0.3182	-94%	0.0302	0.0016	-95%
1992	0.6166	0.0690	-89%	1.4458	0.1627	-89%	3.4945	0.4006	-89%	0.0185	0.0021	-89%
1993	0.4156	0.0543	-87%	0.9745	0.1281	-87%	2.3553	0.3153	-87%	0.0125	0.0016	-87%
1994	0.2146	0.0589	-73%	0.5032	0.1389	-72%	1.2161	0.3418	-72%	0.0064	0.0018	-73%
1995	0.1461	0.0610	-58%	0.3426	0.1438	-58%	0.8281	0.3539	-57%	0.0044	0.0018	-58%
1996	0.0950	0.0581	-39%	0.2227	0.1370	-38%	0.5383	0.3373	-37%	0.0028	0.0017	-39%
1997	0.1030	0.0641	-38%	0.2414	0.1513	-37%	0.5835	0.3723	-36%	0.0031	0.0019	-38%
1998	0.1178	0.0962	-18%	0.2761	0.2269	-18%	0.6674	0.5586	-16%	0.0035	0.0029	-18%
1999	0.1124	0.0965	-14%	0.2636	0.2276	-14%	0.6371	0.5601	-12%	0.0034	0.0029	-14%
2000	0.0978	0.0954	-2%	0.2293	0.2251	-2%	0.5541	0.5541	-	0.0029	0.0029	-2%
2001	0.0663	0.0647	-2%	0.1554	0.1526	-2%	0.3757	0.3757	-	0.0020	0.0019	-2%
2002	0.0506	0.0493	-2%	0.1185	0.1164	-2%	0.2865	0.2865	-	0.0015	0.0015	-2%
2003	0.0539	0.0526	-2%	0.1264	0.1241	-2%	0.3055	0.3055	-	0.0016	0.0016	-2%
2004	0.0378	0.0369	-2%	0.0886	0.0870	-2%	0.2142	0.2142	-	0.0011	0.0011	-2%

P-Previous
R-Refined

4.4.3 LIME PRODUCTION (NFR 2A2)

4.4.3.1 Overview

The production of lime during the year 2018 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 (***Figure 4.14***) and activity data (***Table 4.7***) are presented in the following figures.

__Figure 4.14:__ Trends of emissions in the category 2A2

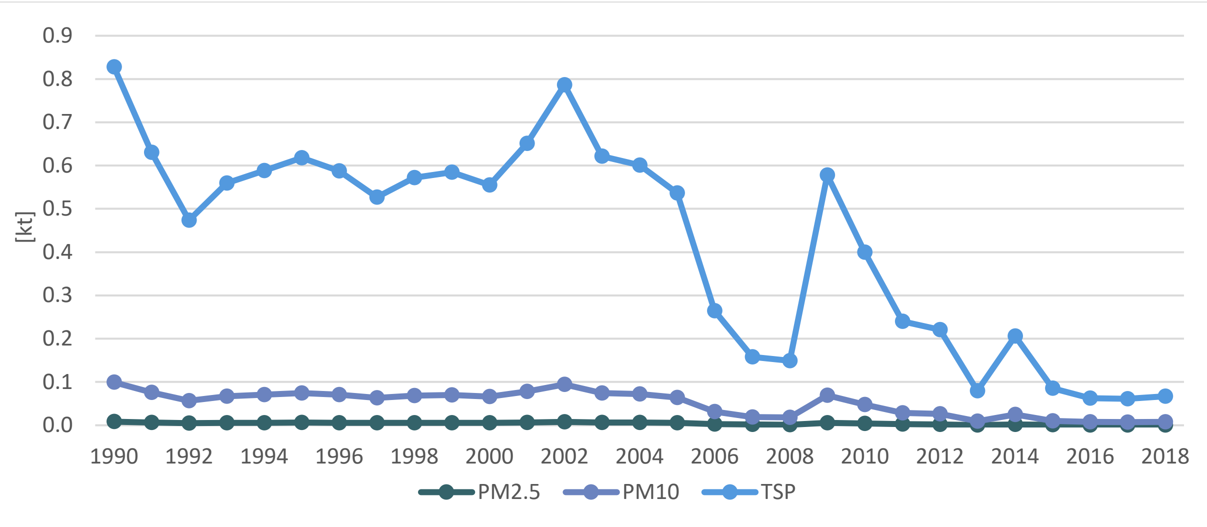


Table 4.7: *Activity data and emissions in the category 2A2*

YEAR	LIME PRODUCED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	1076.00	0.0083	0.0993	0.8279	4E-05
1995	803.00	0.0062	0.0741	0.6179	3E-05
2000	753.59	0.0056	0.0666	0.5552	3E-05
2005	913.08	0.0054	0.0644	0.5365	2E-05
2010	822.36	0.0040	0.0480	0.3999	2E-05
2011	856.05	0.0024	0.0288	0.2398	1E-05
2012	797.33	0.0022	0.0265	0.2206	1E-05
2013	716.54	0.0008	0.0096	0.0798	4E-06
2014	727.63	0.0021	0.0247	0.2059	9E-06
2015	680.20	0.0009	0.0102	0.0854	4E-06
2016	663.02	0.0006	0.0075	0.0628	3E-06
2017	640.06	0.0006	0.0073	0.0612	3E-06
2018	668.99	0.0007	0.0080	0.0667	3E-06
1990/2018	**-38%**	**-92%**	**-92%**	**-92%**	**-92%**
2017/2018	**5%**	**9%**	**9%**	**9%**	**9%**

4.4.3.2 Methodological issues

Activities listed within this category are shown in ***Table 4.8.***

Table 4.8: *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 could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of Ministry of Environment and detailed methodology are presented in **ANNEX IV.** The following ***Table 4.9*** presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.

Table 4.9: *The overview of share of used calculation type for category 2A2 in the NEIS*

2A2	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	22%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	76%
4	Calculation using emission factor and amount of fuel	2%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

Emission factors used for reconstruction of historical years 1990–1999 (1990-2004 for $PM_{2.5}$, PM_{10} and BC) were calculated using average IEF for each pollutant for the period 2000-2005 (***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}

TSP, PMs

Reported values are taken from the NEIS (Tier 3) from technological units or from part of technological units that do not use fuel, thus are considered as the processing emissions.

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

Combustion emissions were reallocated to the category **1A2f** and notation key were used. Historical years were recalculated due to update of emission factors (***Table 4.11***).

Table 4.11: Previous and refined emissions in the category 2A2

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	0.0086	0.0083	-4%	0.1033	0.0993	-4%	0.8608	0.8279	-4%	0.0000	0.0000	-4%
1991	0.0066	0.0063	-4%	0.0786	0.0756	-4%	0.6552	0.6302	-4%	0.0000	0.0000	-4%
1992	0.0049	0.0047	-4%	0.0591	0.0569	-4%	0.4928	0.4740	-4%	0.0000	0.0000	-4%
1993	0.0058	0.0056	-4%	0.0698	0.0671	-4%	0.5816	0.5594	-4%	0.0000	0.0000	-4%
1994	0.0061	0.0059	-4%	0.0734	0.0706	-4%	0.6120	0.5886	-4%	0.0000	0.0000	-4%
1995	0.0064	0.0062	-4%	0.0771	0.0741	-4%	0.6424	0.6179	-4%	0.0000	0.0000	-4%
1996	0.0061	0.0059	-4%	0.0733	0.0705	-4%	0.6112	0.5878	-4%	0.0000	0.0000	-4%
1997	0.0055	0.0053	-4%	0.0658	0.0632	-4%	0.5480	0.5271	-4%	0.0000	0.0000	-4%
1998	0.0060	0.0057	-4%	0.0714	0.0687	-4%	0.5951	0.5724	-4%	0.0000	0.0000	-4%
1999	0.0061	0.0058	-4%	0.0729	0.0701	-4%	0.6075	0.5843	-4%	0.0000	0.0000	-4%
2000	0.0056	0.0056	0%	0.0666	0.0666	0%	0.5552	0.5552	-	0.0000	0.0000	0%
2001	0.0065	0.0065	0%	0.0782	0.0782	0%	0.6514	0.6514	-	0.0000	0.0000	0%
2002	0.0079	0.0079	0%	0.0944	0.0944	0%	0.7865	0.7865	-	0.0000	0.0000	0%
2003	0.0062	0.0062	0%	0.0746	0.0746	0%	0.6217	0.6217	-	0.0000	0.0000	0%
2004	0.0060	0.0060	0%	0.0721	0.0721	0%	0.6009	0.6009	-	0.0000	0.0000	0%

P-Previous
R-Refined

4.4.4 GLASS PRODUCTION (NFR 2A3)

4.4.4.1 Overview

The emission from glass production is coved 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 (***Figure 4.15*** and ***Table 4.12***) from glass production are presented below. This category is key for the emissions of Se.

Figure 4.15: *Trends in emissions of air pollutants in 2A3*

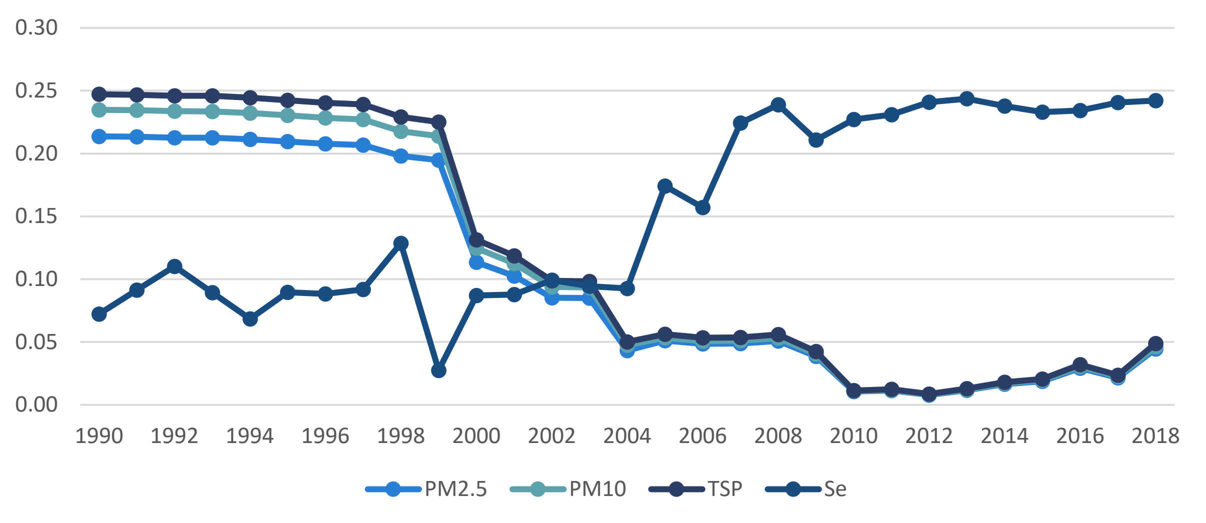


Table 4.12: *Activity data and emissions in the category 2A3*

YEAR	CONTAINER GLASS [kt]	GLASS FIBRE [kt]	LEAD CRYSTAL GLASS [kt]	WATER GLASS [kt]	PM2.5 [kt]	PM10 [kt]	TSP [kt]	BC [kt]
1990	48.26	93.08	13.26	78.69	0.2137	0.2348	0.2472	1E-04
1995	59.67	92.88	13.23	78.52	0.2097	0.2304	0.2425	1E-04
2000	57.96	93.94	13.38	79.41	0.1136	0.1248	0.1314	7E-05
2005	116.14	82.25	11.72	69.54	0.0512	0.0535	0.0563	3E-05
2010	151.45	44.19	6.29	37.36	0.0106	0.0110	0.0115	7E-06
2011	153.95	44.19	6.29	37.36	0.0113	0.0118	0.0124	7E-06
2012	160.58	103.83	-	36.70	0.0079	0.0082	0.0087	5E-06
2013	162.43	134.63	-	35.32	0.0117	0.0122	0.0128	7E-06
2014	158.51	125.45	-	35.99	0.0165	0.0172	0.0181	1E-05
2015	155.42	151.18	-	35.19	0.0187	0.0195	0.0205	1E-05
2016	156.25	156.08	-	40.90	0.0292	0.0305	0.0321	2E-05
2017	160.38	157.46	-	42.51	0.0216	0.0225	0.0237	1E-05
2018	161.53	155.98	-	43.63	0.0445	0.0464	0.0488	3E-05
1990/2018	**235%**	**68%**	**-**	**-45%**	**-79%**	**-80%**	**-80%**	**-79%**
2017/2018	**1%**	**-1%**	**-**	**3%**	**106%**	**106%**	**106%**	**106%**

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

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
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
1990/2018	**72%**	**235%**	**55%**	**235%**	**235%**	**55%**	**235%**	**235%**	**55%**
2017/2018	**1%**	**1%**	**0%**	**1%**	**1%**	**0%**	**1%**	**1%**	**0%**

4.4.4.2 Methodological issues

Activities listed within this category are shown in ***Table 4.13***.

Table 4.13: *Activities according to national categorization included in 2A3*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.7. Manufacture of glass, glass products, including glass fibre wit projected melting capacity in t/d

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 Ministry of Environment and detailed methodology are presented in **ANNEX IV*.*** The following ***Table 4.14*** presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.

Table 4.14: *The overview of share of used calculation type for category 2A3 in the NEIS*

2A3	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0.45%
3	Calculation using representative individual mass flow and number of operating hours	97%
4	Calculation using emission factor and amount of fuel	3%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

In the process is used various types of fuels including the alternative waste. Emission factors used for reconstruction of historical years 1990–1999 (1990-2004 for $PM_{2.5}$, PM_{10} and BC) were calculated using average IEF for each pollutant for the period 2000-2005 (***Table 4.15***).

Table 4.15: *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}

<u>TSP, PMs</u>

Reported values are taken from the NEIS (Tier 3) from technological units or from part of technological units that do not use fuel, thus are considered as the processing emissions.

<u>HMs</u>

Heavy metals are reported by T2 method.

The emissions of heavy metals are processed by the national emission factors presented in ***Table 4.16***. The methodology distinguishes several types of products.

$EM = \sum AD_{pi} * EF_i$

AD_{pi} = amount of product (i)

EF_i = emission factor (i) related to specific product (i)

Table 4.16*: Emission factors of heavy metals in 2A3*

EF [g/t [PRODUCT]/ TYPE OF PRODUCT	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
Container glass	2.9	0.12	-	0.29	0.37	-	0.24	1.5	-
Glass Fibre	-	-	-	-	-	-	-	-	-
Lead crystal glass	10	-	-	-	-	-	-	-	-
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

Combustion emissions were reallocated to the category **1A2f** and notation key were used. Historical years were recalculated due to update of emission factors (***Table 4.17***).

Table 4.17: *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	0.2123	0.2137	1%	0.2216	0.2348	6%	0.2333	0.2472	6%	0.0001	0.0001	1%
1991	0.2237	0.2134	-5%	0.2336	0.2345	0%	0.2459	0.2468	0%	0.0001	0.0001	-5%
1992	0.2352	0.2127	-10%	0.2456	0.2337	-5%	0.2585	0.2460	-5%	0.0001	0.0001	-10%
1993	0.2226	0.2126	-4%	0.2323	0.2336	1%	0.2446	0.2459	1%	0.0001	0.0001	-4%
1994	0.2099	0.2114	1%	0.2191	0.2323	6%	0.2307	0.2445	6%	0.0001	0.0001	1%
1995	0.1779	0.2097	18%	0.1857	0.2304	24%	0.1954	0.2425	24%	0.0001	0.0001	18%
1996	0.1777	0.2079	17%	0.1855	0.2285	23%	0.1953	0.2405	23%	0.0001	0.0001	17%
1997	0.1344	0.2068	54%	0.1403	0.2272	62%	0.1477	0.2392	62%	0.0001	0.0001	54%
1998	0.1477	0.1982	34%	0.1542	0.2178	41%	0.1623	0.2293	41%	0.0001	0.0001	34%
1999	0.1103	0.1947	76%	0.1152	0.2140	86%	0.1212	0.2252	86%	0.0001	0.0001	76%
2000	0.1196	0.1136	-5%	0.1248	0.1248	0%	0.1314	0.1314	-	0.0001	0.0001	-5%
2001	0.1079	0.1025	-5%	0.1126	0.1126	0%	0.1186	0.1186	-	0.0001	0.0001	-5%
2002	0.0899	0.0854	-5%	0.0938	0.0938	0%	0.0988	0.0988	-	0.0001	0.0001	-5%
2003	0.0895	0.0850	-5%	0.0934	0.0934	0%	0.0983	0.0983	-	0.0001	0.0001	-5%
2004	0.0456	0.0433	-5%	0.0476	0.0476	0%	0.0501	0.0501	-	0.0000	0.0000	-5%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHAN.	P	R	CHANGE
1990	10.2262	0.2725	-97%	7.3376	0.0058	-100%	0.0117	0.0007	-94%	1.4158	0.0140	-99%
1991	12.2982	0.3092	-97%	8.1814	0.0073	-100%	0.0123	0.0007	-94%	1.7448	0.0177	-99%
1992	14.3703	0.3457	-98%	9.0253	0.0088	-100%	0.0129	0.0008	-94%	2.0739	0.0213	-99%
1993	12.8325	0.3054	-98%	7.0611	0.0072	-100%	0.0122	0.0007	-94%	1.8304	0.0173	-99%
1994	11.2947	0.2649	-98%	5.0970	0.0055	-100%	0.0115	0.0007	-94%	1.5869	0.0132	-99%
1995	9.1550	0.3054	-97%	8.5628	0.0072	-100%	0.0122	0.0007	-94%	1.1991	0.0173	-99%
1996	12.8298	0.3036	-98%	7.8351	0.0071	-100%	0.0122	0.0007	-94%	1.9205	0.0171	-99%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHAN.	P	R	CHANGE
1997	11.2765	0.3100	-97%	8.9602	0.0073	-100%	0.0123	0.0007	-94%	1.5950	0.0178	-99%
1998	10.0667	0.3812	-96%	6.3998	0.0103	-100%	0.0135	0.0008	-94%	1.3032	0.0249	-98%
1999	8.6635	0.1848	-98%	5.6019	0.0022	-100%	0.0101	0.0006	-94%	1.1960	0.0053	-100%
2000	13.4736	0.3019	-98%	6.1290	0.0070	-100%	0.0122	0.0007	-94%	2.0305	0.0168	-99%
2001	14.8236	0.3000	-98%	6.1321	0.0070	-100%	0.0120	0.0007	-94%	2.3322	0.0170	-99%
2002	15.6787	0.3240	-98%	3.9593	0.0079	-100%	0.0125	0.0008	-94%	2.4837	0.0192	-99%
2003	14.2169	0.3136	-98%	4.6683	0.0075	-100%	0.0123	0.0007	-94%	2.2072	0.0182	-99%
2004	15.0089	0.3149	-98%	5.5715	0.0074	-100%	0.0126	0.0008	-94%	2.3437	0.0179	-99%
2005	15.7658	0.4540	-97%	4.8292	0.0139	-100%	0.0140	0.0008	-94%	2.4344	0.0337	-99%
2006	11.6613	0.4455	-96%	4.5260	0.0126	-100%	0.0151	0.0009	-94%	1.6547	0.0304	-98%
2007	6.0706	0.5567	-91%	0.0520	0.0180	-65%	0.0161	0.0010	-94%	0.4929	0.0434	-91%
2008	5.6343	0.5895	-90%	0.0547	0.0191	-65%	0.0169	0.0010	-94%	0.3652	0.0462	-87%
2009	3.5536	0.4866	-86%	0.0414	0.0169	-59%	0.0125	0.0008	-94%	0.1412	0.0407	-71%
2010	6.9147	0.5021	-93%	0.0503	0.0182	-64%	0.0154	0.0007	-95%	0.6965	0.0439	-94%
2011	4.2224	0.5094	-88%	0.0405	0.0185	-54%	0.0121	0.0007	-94%	0.2996	0.0446	-85%
2012	3.6134	0.4657	-87%	0.0496	0.0193	-61%	0.0151	0.0009	-94%	0.0361	0.0466	29%
2013	3.9885	0.4710	-88%	0.0544	0.0195	-64%	0.0166	0.0010	-94%	0.0399	0.0471	18%
2014	3.8431	0.4597	-88%	0.0524	0.0190	-64%	0.0160	0.0010	-94%	0.0384	0.0460	20%
2015	4.1015	0.4507	-89%	0.0555	0.0187	-66%	0.0171	0.0010	-94%	0.0410	0.0451	10%
2016	6.6879	0.4531	-93%	0.0573	0.0188	-67%	0.0177	0.0011	-94%	0.5441	0.0453	-92%
2017	7.2388	0.4651	-94%	0.0581	0.0192	-67%	0.0180	0.0011	-94%	0.6404	0.0465	-93%

YEAR	Cr			Cu [t]			Ni [t]		
	P	R	CHAN.	P	R	CHAN.	P	R	CHAN.
1990	0.5599	0.0179	-97%	0.1501	0.0016	-99%	0.4432	0.0116	-97%
1991	0.5901	0.0225	-96%	0.1627	0.0017	-99%	0.4672	0.0146	-97%
1992	0.6203	0.0272	-96%	0.1753	0.0018	-99%	0.4911	0.0176	-96%
1993	0.5870	0.0221	-96%	0.1640	0.0017	-99%	0.4647	0.0143	-97%
1994	0.5536	0.0169	-97%	0.1527	0.0016	-99%	0.4383	0.0109	-98%
1995	0.5863	0.0221	-96%	0.1546	0.0017	-99%	0.4642	0.0143	-97%
1996	0.5858	0.0218	-96%	0.1569	0.0017	-99%	0.4637	0.0141	-97%
1997	0.5906	0.0227	-96%	0.1583	0.0017	-99%	0.4676	0.0147	-97%
1998	0.6492	0.0317	-95%	0.1719	0.0019	-99%	0.5140	0.0206	-96%
1999	0.4849	0.0068	-99%	0.1293	0.0014	-99%	0.3839	0.0044	-99%
2000	0.5873	0.0214	-96%	0.1588	0.0017	-99%	0.4649	0.0139	-97%
2001	0.5771	0.0216	-96%	0.1551	0.0017	-99%	0.4569	0.0140	-97%
2002	0.6007	0.0245	-96%	0.1611	0.0018	-99%	0.4756	0.0159	-97%
2003	0.5904	0.0233	-96%	0.1575	0.0017	-99%	0.4674	0.0151	-97%
2004	0.6030	0.0228	-96%	0.1617	0.0018	-99%	0.4774	0.0148	-97%
2005	0.6711	0.0430	-94%	0.1786	0.0020	-99%	0.5313	0.0279	-95%
2006	0.7265	0.0387	-95%	0.1837	0.0021	-99%	0.5752	0.0251	-96%
2007	0.7705	0.0554	-93%	0.1926	0.0022	-99%	0.6100	0.0359	-94%
2008	0.8099	0.0589	-93%	0.2025	0.0024	-99%	0.6411	0.0382	-94%
2009	0.6022	0.0520	-91%	0.1506	0.0018	-99%	0.4768	0.0337	-93%
2010	0.7391	0.0560	-92%	0.1848	0.0017	-99%	0.5851	0.0363	-94%
2011	0.5803	0.0570	-90%	0.1451	0.0017	-99%	0.4594	0.0369	-92%
2012	0.7227	0.0594	-92%	0.1807	0.0021	-99%	0.5721	0.0385	-93%
2013	0.7977	0.0601	-92%	0.1994	0.0023	-99%	0.6315	0.0390	-94%
2014	0.7686	0.0587	-92%	0.1922	0.0022	-99%	0.6085	0.0380	-94%

YEAR	Cr			Cu [t]			Ni [t]		
	P	R	CHAN.	P	R	CHAN.	P	R	CHAN.
2015	0.8203	0.0575	-93%	0.2051	0.0024	-99%	0.6494	0.0373	-94%
2016	0.8478	0.0578	-93%	0.2119	0.0025	-99%	0.6711	0.0375	-94%
2017	0.8648	0.0593	-93%	0.2162	0.0025	-99%	0.6847	0.0385	-94%

YEAR	Se [t]			Zn [t]		
	P	R	CHAN.	P	R	CHAN.
1990	4.1991	0.0724	-98%	2.5661	0.0863	-97%
1991	4.4258	0.0914	-98%	2.7047	0.0910	-97%
1992	4.6526	0.1103	-98%	2.8432	0.0956	-97%
1993	4.4022	0.0894	-98%	2.6903	0.0905	-97%
1994	4.1519	0.0684	-98%	2.5373	0.0853	-97%
1995	4.3974	0.0895	-98%	2.6873	0.0904	-97%
1996	4.3933	0.0884	-98%	2.6848	0.0903	-97%
1997	4.4296	0.0919	-98%	2.7070	0.0911	-97%
1998	4.8691	0.1287	-97%	2.9755	0.1001	-97%
1999	3.6370	0.0275	-99%	2.2226	0.0748	-97%
2000	4.4044	0.0869	-98%	2.6916	0.0905	-97%
2001	4.3284	0.0877	-98%	2.6451	0.0890	-97%
2002	4.5056	0.0994	-98%	2.7534	0.0926	-97%
2003	4.4278	0.0944	-98%	2.7059	0.0910	-97%
2004	4.5229	0.0926	-98%	2.7640	0.0930	-97%
2005	5.0336	0.1742	-97%	3.0761	0.1035	-97%
2006	5.4491	0.1570	-97%	3.3300	0.1120	-97%
2007	5.7791	0.2244	-96%	3.5317	0.1188	-97%
2008	6.0740	0.2389	-96%	3.7119	0.1249	-97%
2009	4.5168	0.2107	-95%	2.7603	0.0928	-97%
2010	5.5429	0.2272	-96%	3.3873	0.0885	-97%
2011	4.3523	0.2309	-95%	2.6597	0.0895	-97%
2012	5.4202	0.2409	-96%	3.3123	0.1114	-97%
2013	5.9828	0.2436	-96%	3.6562	0.1230	-97%
2014	5.7647	0.2378	-96%	3.5229	0.1184	-97%
2015	6.1523	0.2331	-96%	3.7598	0.1265	-97%
2016	6.3582	0.2344	-96%	3.8856	0.1307	-97%
2017	6.4862	0.2406	-96%	3.9638	0.1333	-97%

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 2018 (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 (***Figure 4.16*** and ***Table 4.18***) are presented on the following figures.

Figure 4.16 *Trends in emissions of particulate matter in 2A5a*

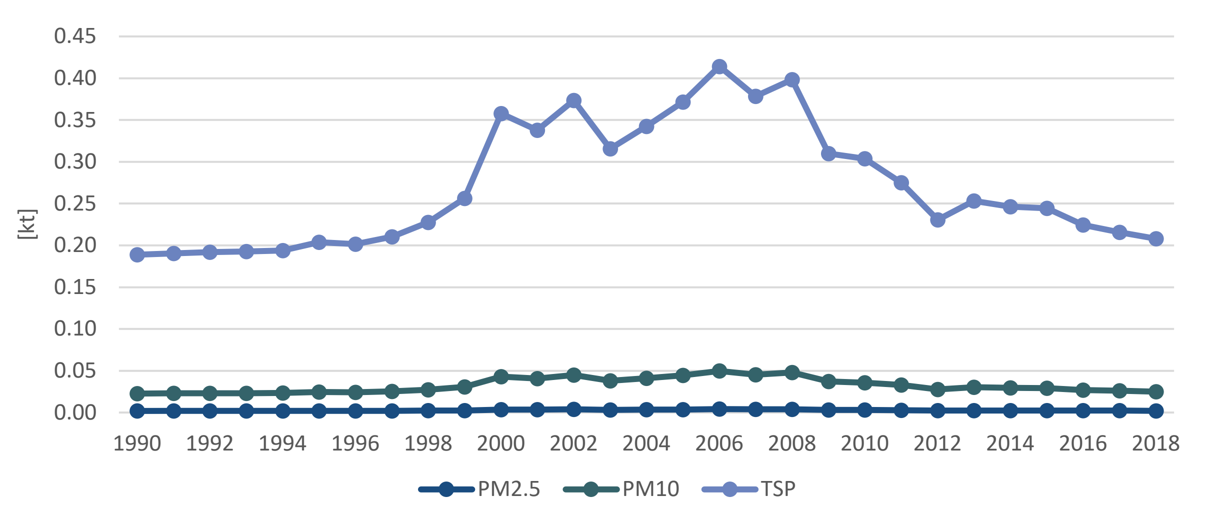


Table 4.18: *Overview of emissions in the category 2A5a*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.0084	0.0002	0.0064	0.0019	0.0227	0.1888	0.0227
1995	0.0091	0.0002	0.0069	0.0020	0.0245	0.2039	0.0245
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
1990/2018	**244%**	**465%**	**-14%**	**10%**	**10%**	**10%**	**58%**
2017/2018	**-21%**	**-13%**	**-31%**	**-13%**	**-5%**	**-4%**	**-15%**

4.4.5.2 Methodological issues

Activities listed within this category are shown in ***Table 4.19***.

Table 4.19*: 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 construct materials. Or mining and processing of other materials used in industry except of sand and gravel in the wet state.

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 Ministry of Environment and detailed methodology are presented in **ANNEX IV.** The following ***Table 4.20*** presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.

Table 4.20: *The overview of share of used calculation type for category 2A5a in the NEIS*

2A5a	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%

2A5a	TYPE OF EMISSION COMPILATION/CALCULATION	%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	34%
4	Calculation using emission factor and amount of fuel	1%
5	Calculation using emission factor and amount of related quantity other than fuel	64%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0.04%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	1%

For Quarries and related stone processing for emission calculation, it can be used the official bulletin of the Ministry of Environment.

Table 4.21: *Emission factors for stone processing*

PROCESS - EQUIPMENT	EF FOR TSP IN G/T PROCESSED STONE							
	HUMIDITY IN %							
	0-0.5	0.5-1	1-1.5	1.5-2	2-3	3-4	4-5	5-7
Drilling of rock	9	6	4	3	2	1	0.5	0.2
Loading of cargo	0.2	0.2	0.1	0.1	0.1	0.1	0	0
Unloading of cargo	0.2	0.2	0.1	0.1	0.1	0.1	0	0
Primary crushing	15	10	6.5	4.3	2.4	1.1	0.5	0.2
Primary sorting	14	9	6.2	4.1	2.2	1	0.5	0.2
Transporting on conveyor belts	2	1.4	0.9	0.6	0.3	0.15	0.007	0.002
Secondary crushing	28	19	13	8.5	4.6	2.1	1	0.3
secondary sorting	27	18	12	8	4.4	2	1	0.3
Transporting on conveyor belts	4	2.7	1.8	1.2	0.7	0.2	0.14	0.04
Tertiary crushing	53	36	24	16	8.8	4	1.8	0.5
Tertiary sorting	51	35	23	15	8.5	3.8	1.7	0.5
Transporting on conveyor belts	8	5.5	3.7	2.5	1.4	0.6	0.3	0.1
Tertiary fine crushing (under 4 mm)	640	429	288	193	106	48	21	6.5
Tertiary fine sorting	604	405	271	182	100	45	20	6.1
Transporting on conveyor belts	33	22	15	10	5.5	2.5	1.1	0.3

4.4.5.3 Completeness

All rising pollutants were reported.

4.4.5.4 Source-specific recalculations

Historical years were recalculated due to update of emission factors (***Table 4.22***).

Table 4.22: *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	0.0348	0.0084	-76%	0.0004	0.0002	-63%	0.0448	0.0064	-86%	0.1273	0.0227	-82%
1991	0.0336	0.0085	-75%	0.0005	0.0002	-64%	0.0423	0.0064	-85%	0.1201	0.0229	-81%
1992	0.0325	0.0085	-74%	0.0005	0.0002	-65%	0.0399	0.0065	-84%	0.1131	0.0230	-80%
1993	0.0314	0.0086	-73%	0.0005	0.0002	-66%	0.0376	0.0065	-83%	0.1063	0.0231	-78%
1994	0.0303	0.0086	-72%	0.0005	0.0002	-66%	0.0353	0.0066	-81%	0.0997	0.0232	-77%
1995	0.0292	0.0091	-69%	0.0005	0.0002	-65%	0.0331	0.0069	-79%	0.0934	0.0245	-74%

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1996	0.0281	0.0090	-68%	0.0005	0.0002	-66%	0.0310	0.0068	-78%	0.0872	0.0242	-72%
1997	0.0270	0.0093	-65%	0.0005	0.0002	-65%	0.0289	0.0071	-75%	0.0813	0.0252	-69%
1998	0.0259	0.0101	-61%	0.0005	0.0002	-63%	0.0269	0.0077	-71%	0.0756	0.0273	-64%
1999	0.0249	0.0114	-54%	0.0005	0.0002	-58%	0.0250	0.0087	-65%	0.0700	0.0307	-56%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0111	0.0019	-83%	0.1332	0.0227	-83%	1.1097	0.1888	-83%
1991	0.0105	0.0019	-82%	0.1254	0.0229	-82%	1.0454	0.1906	-82%
1992	0.0098	0.0019	-80%	0.1180	0.0230	-80%	0.9829	0.1918	-80%
1993	0.0092	0.0019	-79%	0.1107	0.0231	-79%	0.9224	0.1927	-79%
1994	0.0086	0.0019	-78%	0.1037	0.0233	-78%	0.8638	0.1938	-78%
1995	0.0081	0.0020	-75%	0.0969	0.0245	-75%	0.8071	0.2039	-75%
1996	0.0075	0.0020	-73%	0.0903	0.0242	-73%	0.7524	0.2017	-73%
1997	0.0070	0.0021	-70%	0.0839	0.0252	-70%	0.6995	0.2103	-70%
1998	0.0065	0.0023	-65%	0.0778	0.0273	-65%	0.6486	0.2275	-65%
1999	0.0060	0.0026	-57%	0.0719	0.0307	-57%	0.5995	0.2562	-57%
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 of emissions are shown in ***Figure 4.17***.

Figure 4.17: *Trends in emissions of air pollutants in 2A5b*

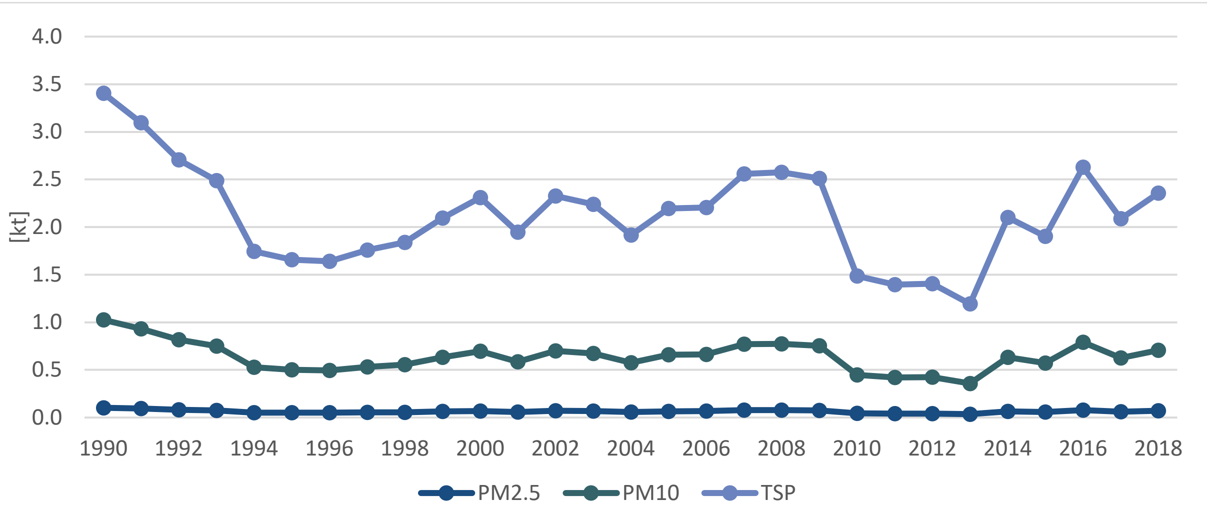


Table 4.23: *Overview of emissions in the category 2A5b*

YEAR	CONSTRUCTED FLOOR SPACE [mil.m^2]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]
1990	2.42	0.1026	1.0259	3.4054
1995	0.84	0.0501	0.5013	1.6590
2000	1.67	0.0696	0.6958	2.3100
2005	1.82	0.0661	0.6605	2.1962
2010	1.30	0.0447	0.4472	1.4879
2011	1.15	0.0420	0.4196	1.3951
2012	1.19	0.0423	0.4230	1.4069
2013	1.14	0.0358	0.3581	1.1927
2014	1.88	0.0631	0.6310	2.1001
2015	1.80	0.0571	0.5714	1.9033
2016	2.09	0.0791	0.7910	2.6289
2017	1.96	0.0627	0.6270	2.0882
2018	2.21	0.0708	0.7080	2.3578
1990/2018	**-9%**	**-31%**	**-31%**	**-31%**
2017/2018	**12%**	**13%**	**13%**	**13%**

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, Construction of houses (detached single-family, detached two-family and single-family terraced). Road construction was not included yet due to missing activity data.

Table 4.24: *EF used for the calculations in category 2A5b*

$EF_{GB2019 - division}$	[kg/m^2]	[kg/m^2]	[kg/m^2]
Non-residential construction	0.1	1	3.3
Construction of apartments	0.03	0.3	1
Construction of houses (detached single family, detached two family and single family terraced)	0.0086	0.086	0.29

4.4.6.3 Completeness

All rising pollutants were reported.

4.4.6.4 Source-specific recalculations

No recalculations in this submission.

4.4.7 STORAGE, HANDLING AND TRANSPORT OF MINERAL PRODUCTS (NFR 2A5c)

4.4.7.1 Overview

The category is reported by notation key NA and IE for TSP and PMi 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 (***Figure 4.18*** and ***Table 4.25***).

The list of included activities is provided in the ***Table 4.27***.

Figure 4.18: *Trends in emissions in the category 2A6*

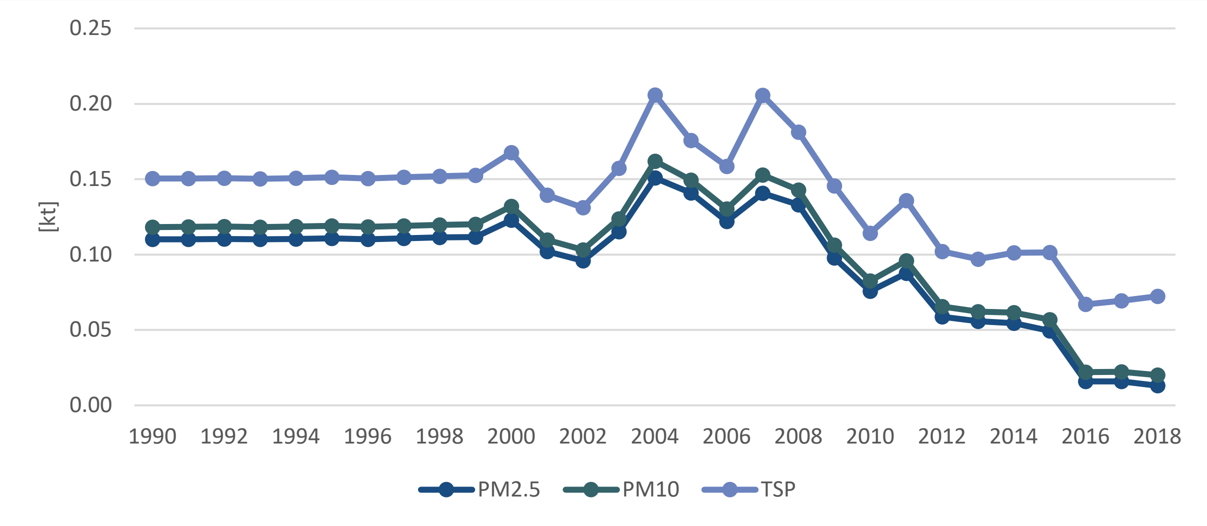


Table 4.25: *Overview of emissions in the category 2A6*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.3421	0.1695	0.1831	0.0006	0.1101	0.1183	0.1504	1.2966
1995	0.3443	0.1706	0.1843	0.0006	0.1108	0.1191	0.1513	1.3050
2000	0.4456	0.0803	0.2455	0.0001	0.1228	0.1319	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
1990/2018	**-15%**	**-13%**	**144%**	**3642%**	**-88%**	**-83%**	**-52%**	**-40%**
2017/2018	**12%**	**18%**	**5%**	**3%**	**-18%**	**-10%**	**4%**	**40%**

4.4.8.2 Methodological issues

Activities listed within this category are shown in ***Table 4.26***.

Table 4.26: *Activities according to national categorization included in 2A6*

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.4. Production of magnesium oxide from magnesite and production of alkaline refractory materials with a projected production capacity t/d
3.6. Installations for melting of mineral substances including the processing of melt materials and production of mineral fibres with a melting capacity projected in t/d
3.8. Manufacture of ceramic products by firing, roofing tiles, bricks, tiles, stoneware or porcelain:
-with a projected production capacity in t/d or
-with a kiln capacity in m3 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 m3 /d
3.12. Production of unfired masonry materials and precast units with a projected production capacity m3 /h
3.13. Industrial production of concrete, mortar or other building materials with a projected production capacity in m3/h

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
3.99. Other industrial production and processing of non-metallic mineral products - division by point 2.99
4.32. Production and processing of carbon materials:
a) production of charcoal with a projected production in kg/d
b) production of soot
c) burning carbonaceous materials, including impregnation
d) mechanical processing of carbonaceous materials

Emission data is compiled in the NEIS database therefore the individual specific EF could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of Ministry of Environment and detailed methodology are presented in **ANNEX IV*.*** The following ***Table 4.27*** presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.

Table 4.27: *The overview of share of used calculation type for category 2A6 in the NEIS*

2A6	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	2%
3	Calculation using representative individual mass flow and number of operating hours	92%
4	Calculation using emission factor and amount of fuel	1%
5	Calculation using emission factor and amount of related quantity other than fuel	4%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0.002%
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	0.007%
8	Calculation using emission factor related to calorific value	0.054%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0.48%

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 4.28*** (valid for 2000-2018). Emission factors for the historical years were calculated as average IEF of the period 2000-2004 (***Table 4.29***).

Table 4.28: *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

PROCESS	EF	
	TSP	PM_{10}
	g/m^3	
filling the drum with solid material - abated	0.2	0.1
average humidity and batching of materials	19.7	9.5

Table 4.29: *Emission factors for calculation of historical years*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH3 [g/GJ]	TSP [g/GJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO [g/GJ]
EF	159.71	79.15	85.49	0.30	70.19	73%	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 4.30***).

Table 4.30: *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	0.8244	0.3421	-59%	0.4122	0.1695	-59%	0.8244	0.1831	-78%	0.1237	0.0006	-99%
1991	0.7988	0.3424	-57%	0.3994	0.1697	-58%	0.7988	0.1833	-77%	0.1198	0.0006	-99%
1992	0.7732	0.3429	-56%	0.3866	0.1699	-56%	0.7732	0.1835	-76%	0.1160	0.0006	-99%
1993	0.7476	0.3420	-54%	0.3738	0.1695	-55%	0.7476	0.1831	-76%	0.1121	0.0006	-99%
1994	0.7220	0.3428	-53%	0.3610	0.1699	-53%	0.7220	0.1835	-75%	0.1083	0.0006	-99%
1995	0.6964	0.3443	-51%	0.3482	0.1706	-51%	0.6964	0.1843	-74%	0.1045	0.0006	-99%
1996	0.6709	0.3421	-49%	0.3354	0.1696	-49%	0.6709	0.1831	-73%	0.1006	0.0006	-99%
1997	0.6453	0.3441	-47%	0.3226	0.1705	-47%	0.6453	0.1842	-71%	0.0968	0.0006	-99%
1998	0.6197	0.3459	-44%	0.3098	0.1714	-45%	0.6197	0.1852	-70%	0.0930	0.0007	-99%
1999	0.5941	0.3471	-42%	0.2970	0.1720	-42%	0.5941	0.1858	-69%	0.0891	0.0007	-99%

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	1.6076	0.1101	-93%	1.7312	0.1183	-93%	2.4732	0.1504	-94%	2.4732	1.2966	-48%
1991	1.5577	0.1102	-93%	1.6775	0.1184	-93%	2.3964	0.1505	-94%	2.3964	1.2979	-46%
1992	1.5078	0.1103	-93%	1.6237	0.1185	-93%	2.3196	0.1507	-94%	2.3196	1.2994	-44%
1993	1.4579	0.1101	-92%	1.5700	0.1183	-92%	2.2429	0.1503	-93%	2.2429	1.2962	-42%
1994	1.4080	0.1103	-92%	1.5163	0.1185	-92%	2.1661	0.1507	-93%	2.1661	1.2993	-40%
1995	1.3581	0.1108	-92%	1.4625	0.1191	-92%	2.0893	0.1513	-93%	2.0893	1.3050	-38%
1996	1.3082	0.1101	-92%	1.4088	0.1183	-92%	2.0126	0.1504	-93%	2.0126	1.2967	-36%
1997	1.2583	0.1107	-91%	1.3551	0.1190	-91%	1.9358	0.1512	-92%	1.9358	1.3042	-33%
1998	1.2084	0.1113	-91%	1.3013	0.1196	-91%	1.8590	0.1520	-92%	1.8590	1.3110	-29%
1999	1.1585	0.1117	-90%	1.2476	0.1200	-90%	1.7823	0.1525	-91%	1.7823	1.3154	-26%
2000	0.1090	0.1228	13%	0.1174	0.1319	12%	0.1677	0.1677	-	1.0779	1.0779	-
2001	0.0906	0.1021	13%	0.0976	0.1096	12%	0.1394	0.1394	-	1.2592	1.2592	-
2002	0.0852	0.0960	13%	0.0918	0.1031	12%	0.1311	0.1311	-	1.2713	1.2713	-
2003	0.1023	0.1152	13%	0.1101	0.1238	12%	0.1573	0.1573	-	1.6922	1.6922	-
2004	0.1338	0.1508	13%	0.1441	0.1620	12%	0.2059	0.2059	-	1.6028	1.6028	-

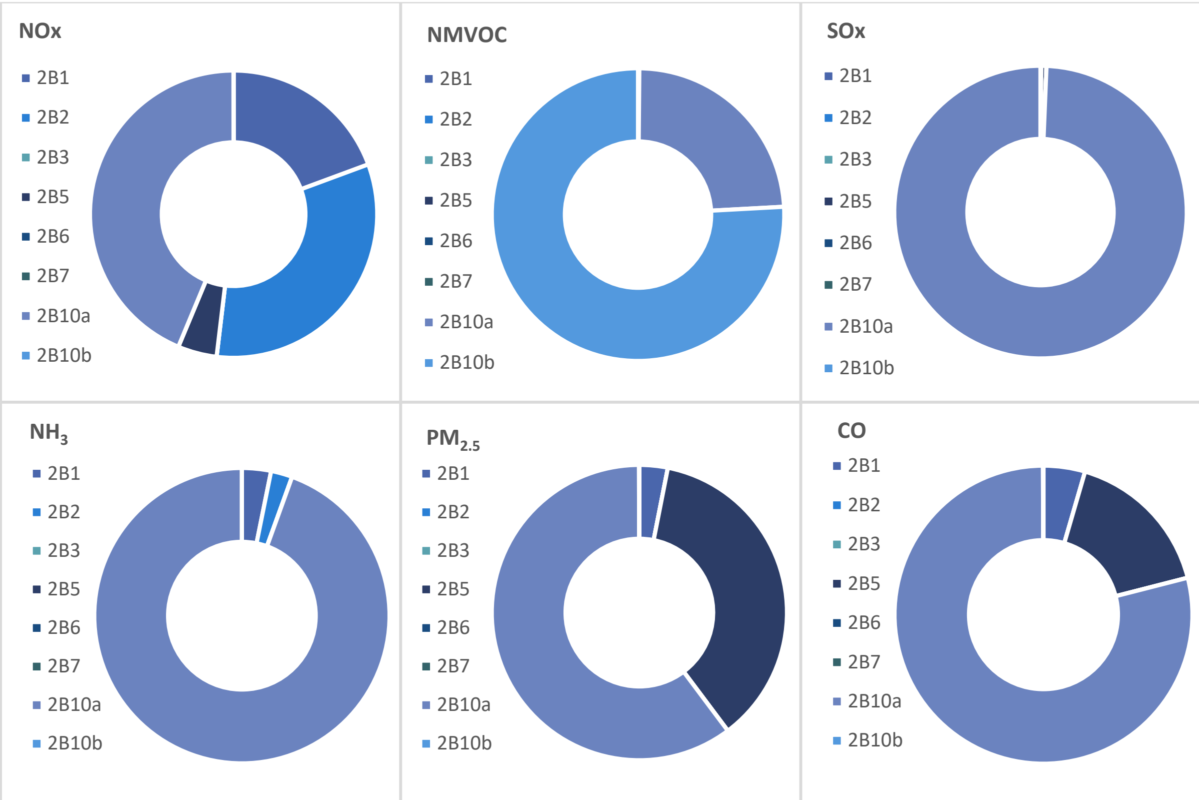
P-Previous
R-Refined

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). Not all are occurring at the territory of Slovakia. Shares of released emission of main air pollutants in 2018 NFR categories included are provided in the figure below (***Figure 4.19***).

Figure 4.19: *Shares of emissions in 2B in 2018*



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 ***Figure 4.20*** and ***Table 4.31***. Emission of particulate matter from this source decreased significantly in 2004 due to abatement technology installation.

***Figure 4.20**: Trends in emissions of air pollutants in 2B1*

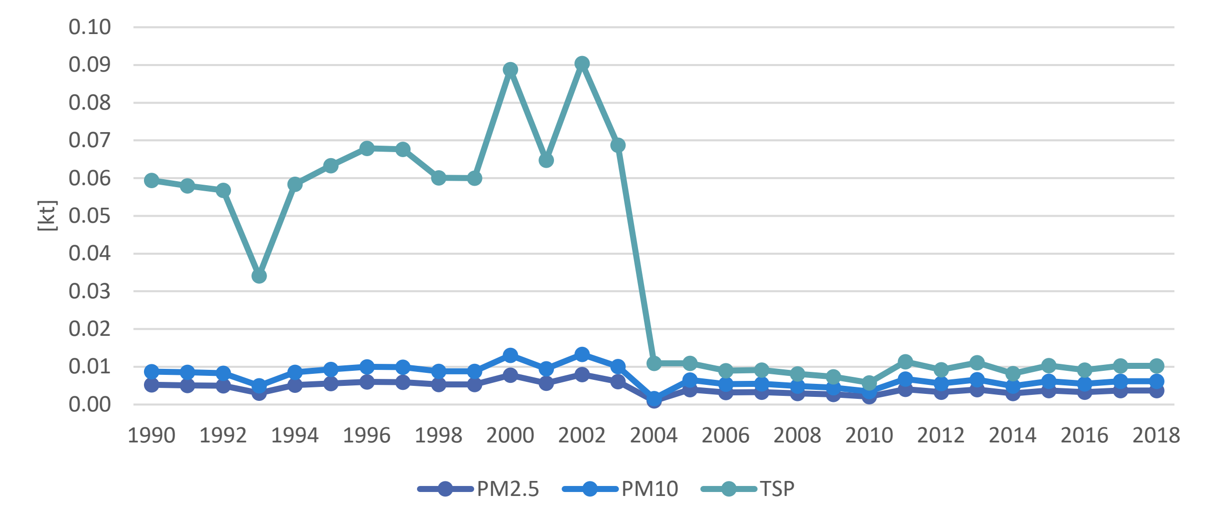


***Table 4.31:** Activity data and emissions in the category 2B1*

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	0.2116	0.0038	0.0011	0.0036	0.0052	0.0087	0.0594	0.0360
1995	383.80	0.2256	0.0041	0.0012	0.0038	0.0056	0.0093	0.0633	0.0384
2000	403.00	0.2182	0.0049	0.0015	0.0040	0.0078	0.0130	0.0888	0.0403
2005	426.35	0.2711	0.0045	0.0013	0.0043	0.0039	0.0066	0.0109	0.0426
2010	233.56	0.1274	0.0017	0.0007	0.0023	0.0021	0.0035	0.0058	0.0234
2011	455.48	0.2496	0.0033	0.0014	0.0046	0.0041	0.0068	0.0113	0.0455
2012	377.30	0.2037	0.0027	0.0011	0.0038	0.0033	0.0056	0.0093	0.0377
2013	474.91	0.2436	0.0032	0.0013	0.0047	0.0040	0.0066	0.0111	0.0475
2014	346.27	0.1799	0.0024	0.0010	0.0035	0.0029	0.0049	0.0082	0.0346
2015	476.94	0.2279	0.0030	0.0012	0.0048	0.0037	0.0062	0.0104	0.0477
2016	403.96	0.2017	0.0026	0.0011	0.0040	0.0033	0.0055	0.0092	0.0404
2017	458.88	0.2253	0.0029	0.0012	0.0046	0.0037	0.0061	0.0102	0.0459
2018	516.74	0.2354	0.0030	0.0012	0.0052	0.0037	0.0061	0.0102	0.0517
1990/2018	**44%**	**11%**	**-22%**	**11%**	**44%**	**-30%**	**-30%**	**-83%**	**44%**
2017/2018	**13%**	**4%**	**1%**	**0%**	**13%**	**0%**	**0%**	**0%**	**13%**

4.5.2.2 Methodological issues

Activities listed within this category are shown in ***Table 4.32***.

***Table 4.32:** 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 could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of Ministry of Environment and detailed methodology are presented in **ANNEX IV.**

Emissions of NH_3 and CO were calculated using Tier 1 emission factor from the EMEP/EEA GB_{2019}. Historical years were calculated using IEF for each pollutant from the period 2000-2004 (***Table 4.33***).

Table 4.33: Emission factors for calculation of historical years and NH_3 and CO emissions

	NOx [kg/t]	NMVOC [kg/t]	SOx [kg/t]	NH_3 *[kg/t]	TSP [kg/t]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	CO *[kg/t]
EF	0.5877	0.0106	0.0031	0.01	0.165	9%	15%	0.1

*Tier 1 EMEP/EEA GB_{2019}

4.5.2.3 Completeness

All rising pollutants were reported. This category was in previous submissions reported under 2B10a and notation key NO for this category was used. After identification of the incorrect allocation, emissions were moved to the category 2B1.

4.5.2.4 Source-specific recalculations

Emissions were reported for the first time in this submission.

4.5.3 NITRIC ACID PRODUCTION (2B2)

4.5.3.1 Overview

NO_X and NH_3 emissions have an overall increasing trend since 1990 due to the increase in production of nitric acid (***Figure 4.21, Table 4.34***). Significant increase and subsequent decrease of NH_3 emissions between 2008/2009 were recorded due to temporal malfunction on the source.

Figure 4.21: Trends in emissions of air pollutants in 2B2

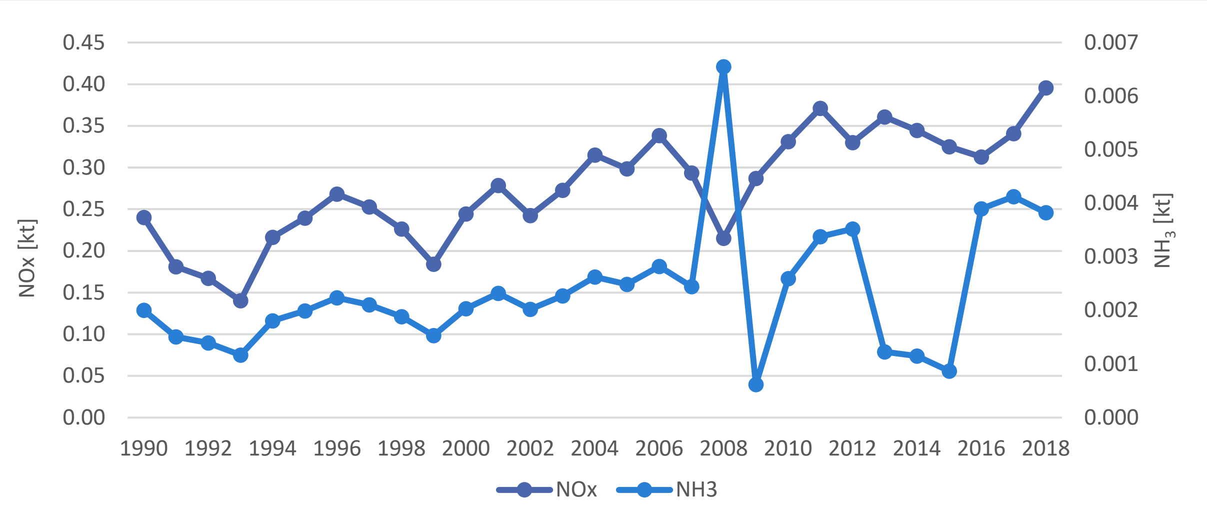


Table 4.34: Activity data and emissions in the category 2B2

YEAR	ANITRIC ACID PRODUCED [kt]	NOx [kt]	NH_3[kt]
1990	400.54	0.2403	0.0020
1995	398.80	0.2393	0.0020
2000	407.22	0.2443	0.0020
2005	497.68	0.2986	0.0025
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

YEAR	ANITRIC ACID PRODUCED [kt]	NOx [kt]	NH_3[kt]
2018	575.32	0.3955	0.0038
1990/2018	**44%**	**65%**	**91%**
2017/2018	**-11%**	**16%**	**-7%**

4.5.3.2 Methodological issues

The definition of activities covered by the category 2B2 is provided in ***Table 4.35***. 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 4.35: *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 could be used for sources recorded in the database. Almost all emissions are calculated by using measured representative individual mass flow and number of operating hours per year as it can be seen in ***Table 4.36***.

Table 4.36: *The overview of share of used calculation type for category 2B2 in the NEIS*

2B2	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	99.80%
4	Calculation using emission factor and amount of fuel	0%
5	Calculation using emission factor and amount of related quantity other than fuel	0.095%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0.108%

For a reconstruction of historical years before 2005 (data in the NEIS are recorded since 2005), rounded weighted IEF of available data was used (excluding the year of malfunction), therefore implied emission factor for this period for nitrogen oxides was **IEF_{NOx}=600 g/t** and for ammonia **IEF_{NH3} = 5 g/t**.

4.5.3.3 Completeness

All rising pollutants were reported.

4.5.3.4 Source-specific recalculations

No recalculations in this submission.

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 (***Figure 4.22***, ***Table 4.37***) are presented. This category is a key category of PM_{10} and TSP.

Figure 4.22: *Trends in emissions of air pollutants in 2B5*

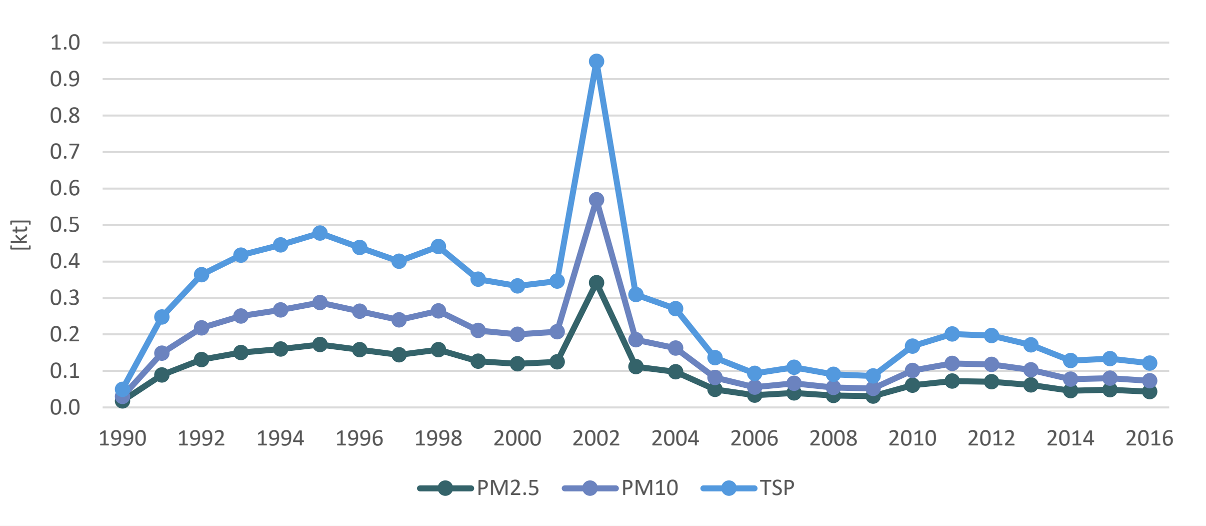


Table 4.37: *Activity data and emissions in the category 2B5*

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	0.2008	0.0046	0.0146	0.1502	0.2504	0.4173	0.0638
2000	88.82	0.3865	0.0059	0.0250	0.1586	0.2644	0.4406	0.0679
2005	97.03	0.0688	0.0053	0.0089	0.1114	0.1856	0.3093	0.0660
2010	98.26	0.0561	2E-05	0.0027	0.0326	0.0543	0.0905	0.2789
2011	107.40	0.0565	1E-06	0.0027	0.0310	0.0516	0.0860	0.2791
2012	100.48	0.0522	4E-06	0.0043	0.0605	0.1008	0.1681	0.3169
2013	81.79	0.0433	1E-05	0.0058	0.0725	0.1208	0.2013	0.3324
2014	74.30	0.0505	3E-05	0.0053	0.0707	0.1179	0.1965	0.2972
2015	56.18	0.0502	2E-05	0.0067	0.0617	0.1028	0.1713	0.2817
2016	67.95	0.0590	1E-05	0.0083	0.0462	0.0770	0.1284	0.3341

YEAR	CARBIDE PRODUCED [kt]	NOx [kt]	NMVOC[kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2017	71.64	0.0580	3E-05	0.0083	0.0482	0.0803	0.1338	0.2139
2018	70.15	0.0535	2E-05	0.0079	0.0436	0.0726	0.1210	0.1890
1990/2018	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
2017/2018	**-2%**	**-8%**	**-3%**	**-4%**	**-10%**	**-10%**	**-10%**	**-12%**

4.5.5.2 Methodological issues

The definition of activities covered by category 2B5 is provided in ***Table 4.38***. The characteristic of involved industrial activity is wider, but the only activity of calcium carbide production belonging to the occurring production activities.

Table 4.38: *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 could be used for sources recorded in the database. Majority of the emissions are calculated by using measured representative individual mass flow and number of operating hours per year as it can be seen in ***Table 4.39*****.**

Table 4.39*: The overview of share of used calculation type for category 2B5 in the NEIS*

2B5	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	71%
4	Calculation using emission factor and amount of fuel	0.25%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	29.18%

Historical years for this source category were calculated using IEF for each pollutant from the period 2000-2004 (***Table 4.40***).

Table 4.40: *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	2 382.00	54.38	173.66	4 950.16	36%	60%	757.36

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 4.41***). NMVOC emission data for the period 2002-2005 were recalculated due to error correction in the database.

Table 4.41: *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	0.6565	0.0238	-96%	0.0109	0.0005	-95%	0.0438	0.0017	-96%	0.4916	0.0076	-98%
1993	0.4749	0.1191	-75%	0.0079	0.0027	-66%	0.0317	0.0087	-73%	0.3556	0.0379	-89%
1994	0.3682	0.1751	-52%	0.0061	0.0040	-35%	0.0245	0.0128	-48%	0.2758	0.0557	-80%
1995	0.3192	0.2008	-37%	0.0053	0.0046	-14%	0.0213	0.0146	-31%	0.2390	0.0638	-73%
1996	0.2933	0.2144	-27%	0.0049	0.0049	0%	0.0196	0.0156	-20%	0.2197	0.0682	-69%
1997	0.2634	0.2301	-13%	0.0044	0.0053	20%	0.0176	0.0168	-4%	0.1972	0.0732	-63%
1998	0.2997	0.2110	-30%	0.0050	0.0048	-4%	0.0200	0.0154	-23%	0.2244	0.0671	-70%
1999	0.3348	0.1926	-42%	0.0056	0.0044	-21%	0.0223	0.0140	-37%	0.2507	0.0612	-76%
2000	0.3865	0.3865	-	0.0059	0.0059	-	0.0250	0.0250	-	0.0679	0.0679	-
2001	0.4137	0.4137	-	0.0042	0.0042	-	0.0288	0.0288	-	0.0708	0.0708	-
2002	0.1017	0.1017	-	0.0049	0.0054	11%	0.0101	0.0101	-	0.0700	0.0700	-
2003	0.1032	0.1032	-	0.0056	0.0055	-3%	0.0095	0.0095	-	0.0695	0.0695	-
2004	0.1364	0.1364	-	0.0057	0.0054	-5%	0.0103	0.0103	-	0.0921	0.0921	-
2005	0.0688	0.0688	-	0.0048	0.0053	9%	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	0.3151	0.0178	-94%	0.5252	0.0297	-94%	0.8753	0.0495	-94%
1993	0.2280	0.0891	-61%	0.3799	0.1485	-61%	0.6332	0.2475	-61%
1994	0.1767	0.1310	-26%	0.2946	0.2183	-26%	0.4910	0.3638	-26%
1995	0.1532	0.1502	-2%	0.2554	0.2504	-2%	0.4256	0.4173	-2%
1996	0.1408	0.1604	14%	0.2347	0.2673	14%	0.3911	0.4455	14%
1997	0.1264	0.1721	36%	0.2107	0.2869	36%	0.3511	0.4782	36%
1998	0.1438	0.1579	10%	0.2397	0.2632	10%	0.3996	0.4386	10%
1999	0.1607	0.1441	-10%	0.2678	0.2402	-10%	0.4464	0.4003	-10%
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 4.42.*** The overall trend of emissions is presented in the following ***Figure 4.23***.

Emissions of air pollutants show a decreasing tendency in the long-term. This category is a key category for emissions of SOx.

***Figure 4.23:** Trends in emissions of particulate matter in 2B10a*

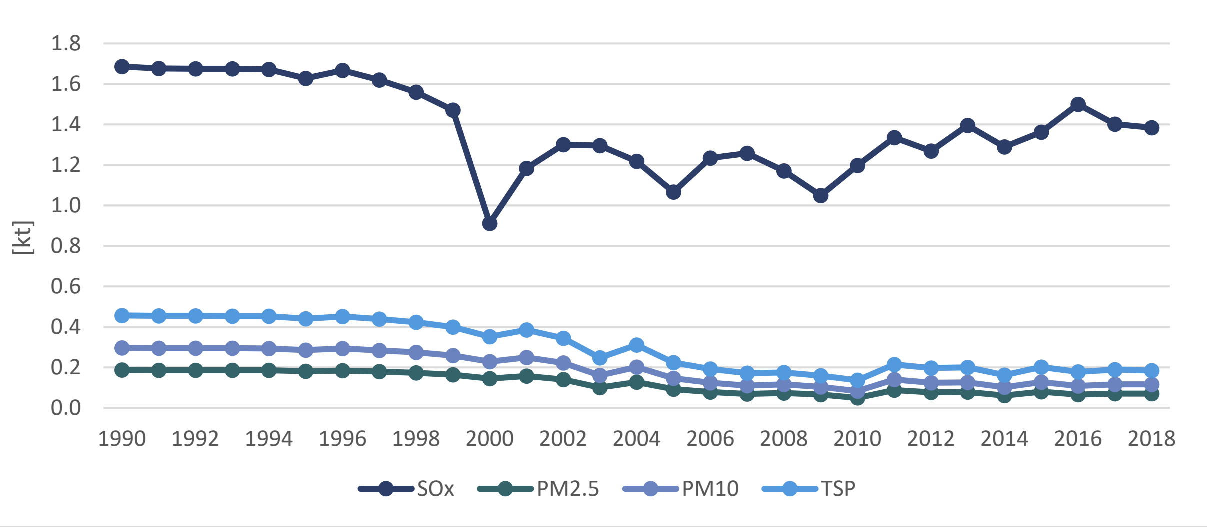


***Table 4.42:** Overview of emissions in the category 2B10a*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.7122	2.8582	1.6861	0.2462	0.1874	0.2967	0.4569	0.0034	3.9943
1995	0.6873	2.7581	1.6271	0.2376	0.1808	0.2863	0.4409	0.0033	3.8544
2000	0.4653	3.2960	0.9122	0.1619	0.1447	0.2291	0.3528	0.0026	4.9742
2005	0.4649	1.3922	1.0667	0.2149	0.0930	0.1463	0.2234	0.0017	1.3587
2010	0.1286	0.6126	1.1984	0.0635	0.0497	0.0833	0.1365	0.0009	0.7377
2011	0.4867	0.8527	1.3355	0.1589	0.0884	0.1398	0.2152	0.0016	0.5813
2012	0.4064	0.6851	1.2691	0.1475	0.0777	0.1250	0.1965	0.0014	1.2631
2013	0.4287	0.7083	1.3955	0.1001	0.0785	0.1269	0.2000	0.0014	0.8680
2014	0.3862	0.5724	1.2887	0.0593	0.0621	0.1020	0.1632	0.0011	0.9824
2015	0.4142	0.5748	1.3627	0.0888	0.0801	0.1285	0.2017	0.0014	0.8963
2016	0.4751	0.5024	1.5005	0.1495	0.0659	0.1095	0.1790	0.0012	0.7526
2017	0.5485	0.5574	1.4021	0.1370	0.0705	0.1162	0.1890	0.0013	0.9156
2018	0.5312	0.5058	1.3845	0.1536	0.0715	0.1159	0.1850	0.0013	0.9041
1990/2018	**-25%**	**-82%**	**-18%**	**-38%**	**-62%**	**-61%**	**-60%**	**-62%**	**-77%**
2017/2018	**-3%**	**-9%**	**-1%**	**12%**	**2%**	**0%**	**-2%**	**2%**	**-1%**

4.5.8.2 Methodological issues

The definition of activities covered by category 2B10a is provided in the ***Table 4.43***.

***Table 4.43:** 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

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
4.15 Production of plant protection products or of biocides
4.16 Production of auxiliary agents for 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

Prevailing manner - 62% of amount of all emissions is determined as continuous measuring (***Table 4.44***).

Table 4.44: *The overview of share of used calculation type for category 2B10a in the NEIS*

2B10a	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	62%
2	Calculation using representative concentration and volume of flue gas	0.002%
3	Calculation using representative individual mass flow and number of operating hours	26%
4	Calculation using emission factor and amount of fuel	11%
5	Calculation using emission factor and amount of related quantity other than fuel	0.17%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0.000%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0.27%

Historical years for this source category were calculated using IEF for each pollutant from the period 2000-2004 (***Table 4.45***).

Table 4.45: *Emission factors for calculation of historical years*

	NOx [g/GJ]	NMVOC [g/GJ]	SOx [g/GJ]	NH3 [g/GJ]	TSP [g/GJ]	$PM_{2.5}$ [% of TSP]	PM_{10} [% of TSP]	BC* [% of $PM_{2.5}$]	CO [g/GJ]
EF	360.78	1447.76	854.08	124.73	231.44	41%	65%	1.8%	2023.25

*Tier 1 EMEP/EEA GB_{2019}

4.5.8.3 Completeness

Emissions of HMs and POPs were removed from this category due to a general change of approach with the usage of CS EF. All rising pollutants were reported. Notation key was 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 (**Table 4.46**). Emissions from ammonia production were removed from this category.

Table 4.46: Previous and refined emissions of main pollutants

YEAR	NOx [kt]			NMVOC [kt]			NH_3 [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	1.1626	0.7122	-39%	3.8129	2.8582	-25%	1.8150	1.6861	-7%	0.4458	0.4632	4%
1991	1.0734	0.7083	-34%	3.5202	2.8424	-19%	1.6757	1.6768	0%	0.4116	0.4607	12%
1992	1.0471	0.7079	-32%	3.4339	2.8407	-17%	1.6346	1.6758	3%	0.4015	0.4604	15%
1993	1.0207	0.7078	-31%	3.3476	2.8401	-15%	1.5935	1.6755	5%	0.3914	0.4603	18%
1994	0.9944	0.7064	-29%	3.2613	2.8348	-13%	1.5524	1.6724	8%	0.3813	0.4595	20%
1995	0.9681	0.6873	-29%	3.1750	2.7581	-13%	1.5113	1.6271	8%	0.3712	0.4470	20%
1996	0.9418	0.7040	-25%	3.0887	2.8251	-9%	1.4702	1.6666	13%	0.3611	0.4579	27%
1997	0.9155	0.6840	-25%	3.0023	2.7447	-9%	1.4292	1.6192	13%	0.3511	0.4448	27%
1998	0.8892	0.6592	-26%	2.9160	2.6451	-9%	1.3881	1.5604	12%	0.3410	0.4287	26%
1999	0.8628	0.6217	-28%	2.8297	2.4948	-12%	1.3470	1.4718	9%	0.3309	0.4044	22%
2000	0.6835	0.4653	-32%	3.3008	3.2960	0%	0.9137	0.9122	0%	0.3147	0.3147	-
2001	0.7084	0.4070	-43%	2.5733	2.5685	0%	1.1855	1.1841	0%	0.3122	0.3122	-
2002	0.9902	0.7473	-25%	2.2874	2.2835	0%	1.3017	1.3006	0%	0.3772	0.3772	-
2003	0.6272	0.4881	-22%	1.7077	1.7051	0%	1.2969	1.2962	0%	0.3403	0.3403	-
2004	0.7028	0.4316	-39%	0.7984	0.7935	-1%	1.2191	1.2178	0%	0.3030	0.3030	-
2005	0.7360	0.4649	-37%	1.3967	1.3922	0%	1.0680	1.0667	0%	0.2149	0.2149	-
2006	0.3731	0.1619	-57%	0.5780	0.5744	-1%	1.2352	1.2341	0%	0.1259	0.1259	-
2007	0.5773	0.3763	-35%	0.4999	0.4962	-1%	1.2585	1.2574	0%	0.1949	0.1949	-
2008	0.7286	0.5501	-24%	1.2720	1.2696	0%	1.1719	1.1709	0%	0.0911	0.0911	-
2009	0.6630	0.5000	-25%	0.8872	0.8850	0%	1.0495	1.0486	0%	0.0839	0.0839	-
2010	0.2560	0.1286	-50%	0.6142	0.6126	0%	1.1991	1.1984	0%	0.0635	0.0635	-
2011	0.7363	0.4867	-34%	0.8559	0.8527	0%	1.3369	1.3355	0%	0.1589	0.1589	-
2012	0.6101	0.4064	-33%	0.6878	0.6851	0%	1.2703	1.2691	0%	0.1475	0.1475	-
2013	0.6723	0.4287	-36%	0.7114	0.7083	0%	1.3968	1.3955	0%	0.1001	0.1001	-
2014	0.5661	0.3862	-32%	0.5748	0.5724	0%	1.2897	1.2887	0%	0.0593	0.0593	-
2015	0.6421	0.4142	-35%	0.5778	0.5748	-1%	1.3640	1.3627	0%	0.0888	0.0888	-
2016	0.6768	0.4751	-30%	0.5051	0.5024	-1%	1.5016	1.5005	0%	0.1495	0.1495	-
2017	0.7738	0.5485	-29%	0.5603	0.5574	-1%	1.4034	1.4021	0%	0.1370	0.1370	-

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	0.2346	0.1874	-20%	0.3868	0.2967	-23%	0.6341	0.4569	-28%	5.9220	3.9943	-33%
1991	0.2166	0.1864	-14%	0.3571	0.2951	-17%	0.5855	0.4544	-22%	5.4674	3.9723	-27%
1992	0.2113	0.1863	-12%	0.3484	0.2949	-15%	0.5711	0.4541	-20%	5.3333	3.9699	-26%
1993	0.2060	0.1862	-10%	0.3396	0.2949	-13%	0.5568	0.4540	-18%	5.1993	3.9691	-24%
1994	0.2007	0.1859	-7%	0.3309	0.2943	-11%	0.5424	0.4532	-16%	5.0652	3.9617	-22%
1995	0.1954	0.1808	-7%	0.3221	0.2863	-11%	0.5280	0.4409	-17%	4.9312	3.8544	-22%
1996	0.1901	0.1852	-3%	0.3134	0.2933	-6%	0.5137	0.4516	-12%	4.7971	3.9481	-18%
1997	0.1848	0.1800	-3%	0.3046	0.2849	-6%	0.4993	0.4388	-12%	4.6631	3.8357	-18%
1998	0.1794	0.1734	-3%	0.2958	0.2746	-7%	0.4850	0.4228	-13%	4.5290	3.6965	-18%
1999	0.1741	0.1636	-6%	0.2871	0.2590	-10%	0.4706	0.3988	-15%	4.3950	3.4866	-21%
2000	0.1634	0.1447	-11%	0.2694	0.2291	-15%	0.4416	0.3528	-20%	4.9903	4.9742	0%
2001	0.1663	0.1579	-5%	0.2742	0.2499	-9%	0.4496	0.3848	-14%	4.3879	4.2664	-3%
2002	0.1607	0.1410	-12%	0.2649	0.2233	-16%	0.4342	0.3438	-21%	3.8349	3.7367	-3%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2003	0.1169	0.1014	-13%	0.1928	0.1606	-17%	0.3160	0.2473	-22%	1.1016	1.0519	-5%
2004	0.1190	0.1274	7%	0.1961	0.2017	3%	0.3216	0.3106	-3%	1.1446	1.0448	-9%
2005	0.0970	0.0930	-4%	0.1528	0.1463	-4%	0.2344	0.2234	-5%	1.4651	1.3587	-7%
2006	0.0817	0.0784	-4%	0.1299	0.1245	-4%	0.2012	0.1922	-4%	1.4322	1.3519	-6%
2007	0.0723	0.0690	-5%	0.1158	0.1104	-5%	0.1808	0.1716	-5%	1.0104	0.9430	-7%
2008	0.0777	0.0747	-4%	0.1213	0.1164	-4%	0.1830	0.1749	-4%	1.0980	1.0382	-5%
2009	0.0689	0.0662	-4%	0.1087	0.1042	-4%	0.1664	0.1590	-4%	0.7405	0.6858	-7%
2010	0.0518	0.0497	-4%	0.0868	0.0833	-4%	0.1423	0.1365	-4%	0.7804	0.7377	-5%
2011	0.0925	0.0884	-4%	0.1466	0.1398	-5%	0.2265	0.2152	-5%	0.6649	0.5813	-13%
2012	0.0810	0.0777	-4%	0.1305	0.1250	-4%	0.2057	0.1965	-5%	1.3314	1.2631	-5%
2013	0.0825	0.0785	-5%	0.1335	0.1269	-5%	0.2111	0.2000	-5%	0.9456	0.8680	-8%
2014	0.0650	0.0621	-5%	0.1069	0.1020	-5%	0.1714	0.1632	-5%	1.0397	0.9824	-6%
2015	0.0838	0.0801	-4%	0.1347	0.1285	-5%	0.2121	0.2017	-5%	0.9727	0.8963	-8%
2016	0.0692	0.0659	-5%	0.1150	0.1095	-5%	0.1882	0.1790	-5%	0.8202	0.7526	-8%
2017	0.0741	0.0705	-5%	0.1223	0.1162	-5%	0.1992	0.1890	-5%	0.9912	0.9156	-8%

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 ***Figure 4.24*** and ***Table 4.47***.

Figure 4.24: *Trends in emissions of air pollutants in 2B10b*

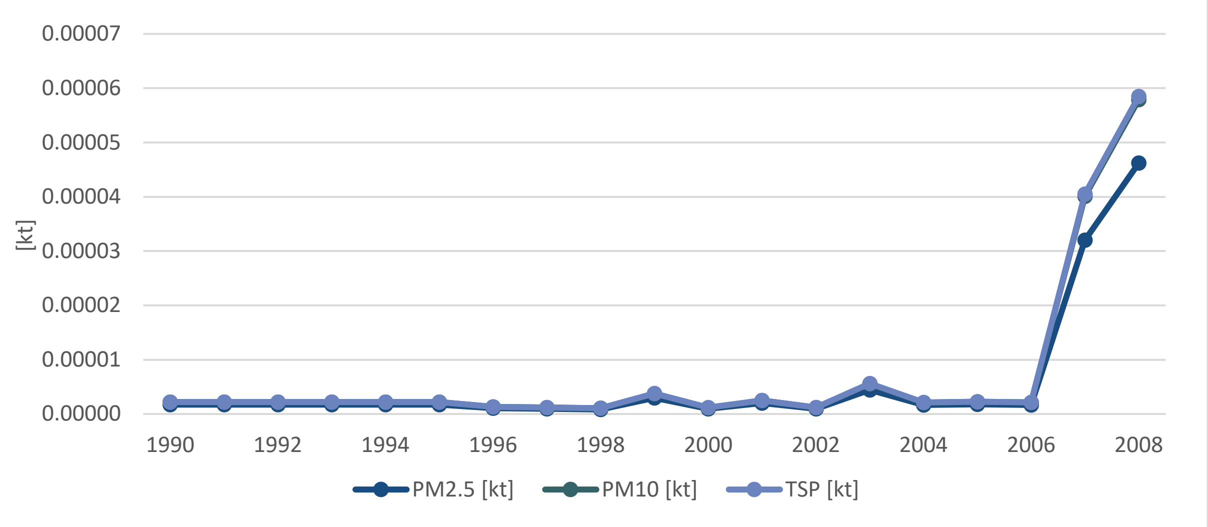


Table 4.47: *Overview of emissions in the category 2B10b*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.0001	1.9612	2E-06	0.0001	2E-06	2E-06	2E-06	1E-05
1995	0.0001	1.9661	2E-06	0.0001	2E-06	2E-06	2E-06	1E-05
2000	0.0001	2.6163	2E-06	0.0001	2E-06	2E-06	2E-06	1E-05
2005	0.0001	1.7804	2E-06	0.0001	2E-06	2E-06	2E-06	1E-05
2010	0.0001	1.3799	1E-07	NO	9E-07	1E-06	1E-06	4E-06

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2011	0.0001	1.3636	2E-07	NO	2E-06	2E-06	3E-06	1E-05
2012	0.0001	1.1992	1E-07	NO	9E-07	1E-06	1E-06	9E-06
2013	0.0001	1.4284	7E-07	NO	4E-06	6E-06	6E-06	3E-05
2014	0.0001	1.3556	2E-07	NO	2E-06	2E-06	2E-06	2E-05
2015	0.0001	1.6226	3E-07	NO	2E-06	2E-06	2E-06	2E-05
2016	0.0000	1.5281	2E-07	NO	2E-06	2E-06	2E-06	2E-05
2017	0.0002	1.5373	2E-06	NO	3E-05	4E-05	4E-05	2E-04
2018	0.0001	1.5985	2E-07	NO	5E-05	6E-05	6E-05	6E-04
1990/2018	**109%**	**-18%**	**-88%**	**-**	**2573%**	**2573%**	**2573%**	**4723%**
2017/2018	**-45%**	**4%**	**-89%**	**-**	**44%**	**44%**	**44%**	**213%**

4.5.9.2 Methodological issues

Activities listed within this category are shown in ***Table 4.48***.

Table 4.48: *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 m3 according to which is higher.

As shown in ***Table 4.49***, the majority of emissions are calculated by the use of specific individual mass flow and the number of operating hours (87%). Activity data for this category is not available, therefore, historical years are linearly extrapolated.

Table 4.49*: The overview of share of used calculation type for category 2B10a in the NEIS*

2B10B	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	87%
4	Calculation using emission factor and amount of fuel	13%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

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

Historical years were recalculated due to change of emission factors for this period (***Table 4.50***).

Table 4.50: *Previous and refined emissions in the category 2B10b*

YEAR	NMVOC [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE
1990	1.9612	3.1138	59%	0.0001	0.0001	7%
1991	1.9622	3.1199	59%	0.0001	0.0001	7%

YEAR	NMVOC [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE
1992	1.9631	3.1309	59%	0.0001	0.0001	8%
1993	1.9641	3.1436	60%	0.0001	0.0001	10%
1994	1.9651	3.1431	60%	0.0001	0.0001	10%
1995	1.9661	3.0553	55%	0.0001	0.0001	-1%
1996	1.9671	3.1503	60%	0.0001	0.0001	9%
1997	1.9681	3.1856	62%	0.0001	0.0001	14%
1998	1.9691	3.2070	63%	0.0001	0.0001	19%
1999	1.9700	3.1407	59%	0.0001	0.0001	8%

P-Previous
R-Refined

4.6 METAL PRODUCTION (2C)

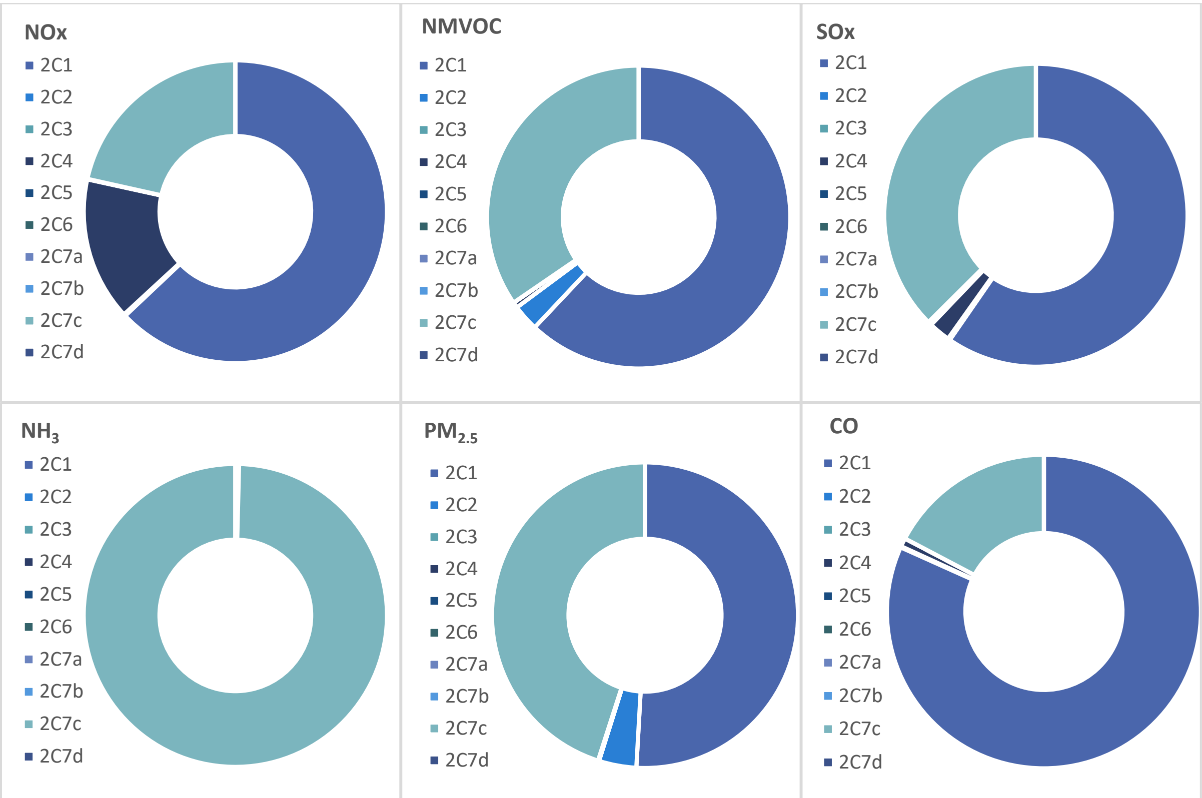
4.6.1 OVERVIEW

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).

The major contributors of emissions are Iron and steel production (NO_X - 63%; NMVOC – 62%, SO_X - 60%; $PM_{2.5}$ - 51%; CO 82%) and Other metal production (NH_3 – 99.6%). Shares of released emissions of air pollutants in 2018 included in NFR categories 2C are presented in ***Figure 4.25***.

Figure 4.25: *Shares of emissions in 2C in 2018*



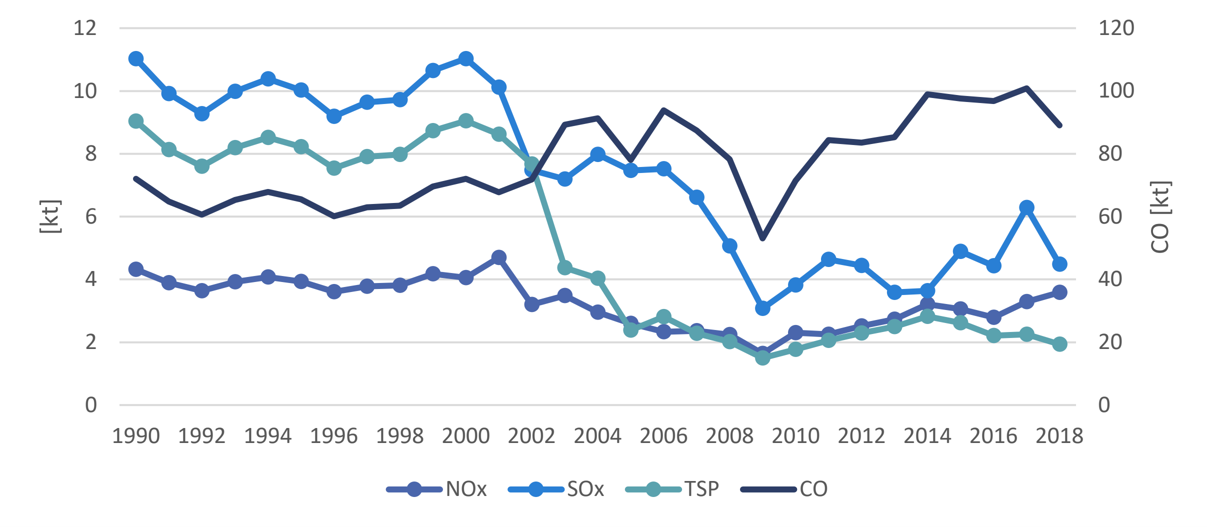
4.6.2 IRON AND STEEL PRODUCTION

4.6.2.1 Overview

Iron and steel industry is a significant activity in the Slovak Republic, which produced 30% of national CO emissions and 22% of national SOx emissions in 2018. Overview of the activity data, emissions and its trends are shown in ***Table 4.51*** and ***Figures 4.24*** - ***Figure 4.27***. Emission of the most of the pollutants decreased slightly in 2018 compared to the year 2017.

Figures below show the emission trend of the pollutants for which 2C1 is a key category. Emissions of main pollutants (except CO) show an overall decreasing trend due to installation of abatement technologies (***Figure 4.26***).

Figure 4.26: *Trends in emissions of main pollutants in the category 2C1*



An increasing trend of emissions of heavy metals and POPs (***Figure 4.27-4.29***) are connected with the increase of production of steel within this category.

Figure 4.27: *Trends in emissions of Priority heavy metals in pollutants in the category 2C1*

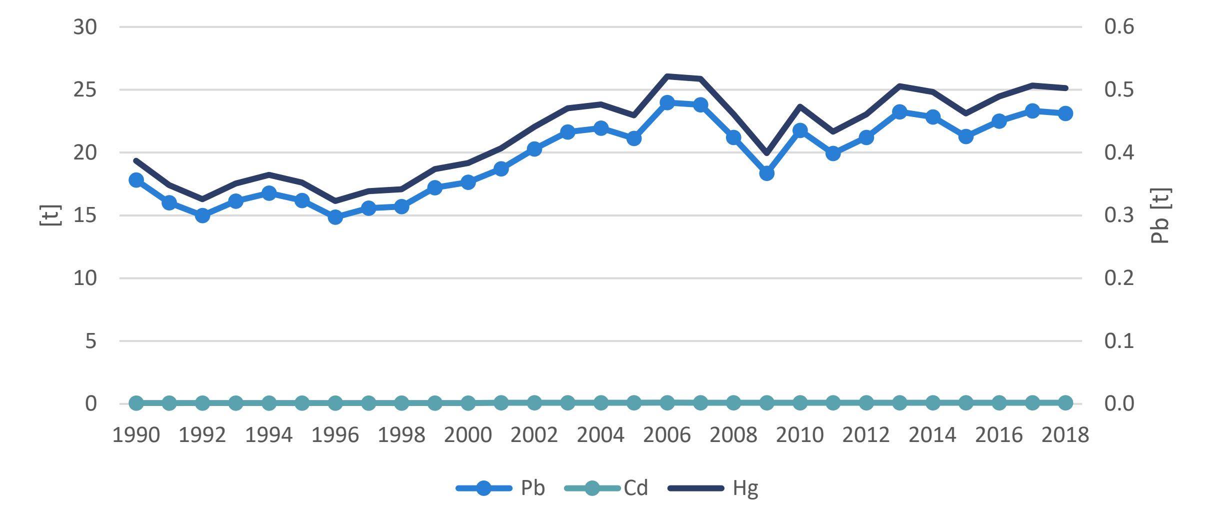


Figure 4.28: *Trends in emissions of Additional heavy metals in pollutants in the category 2C1*

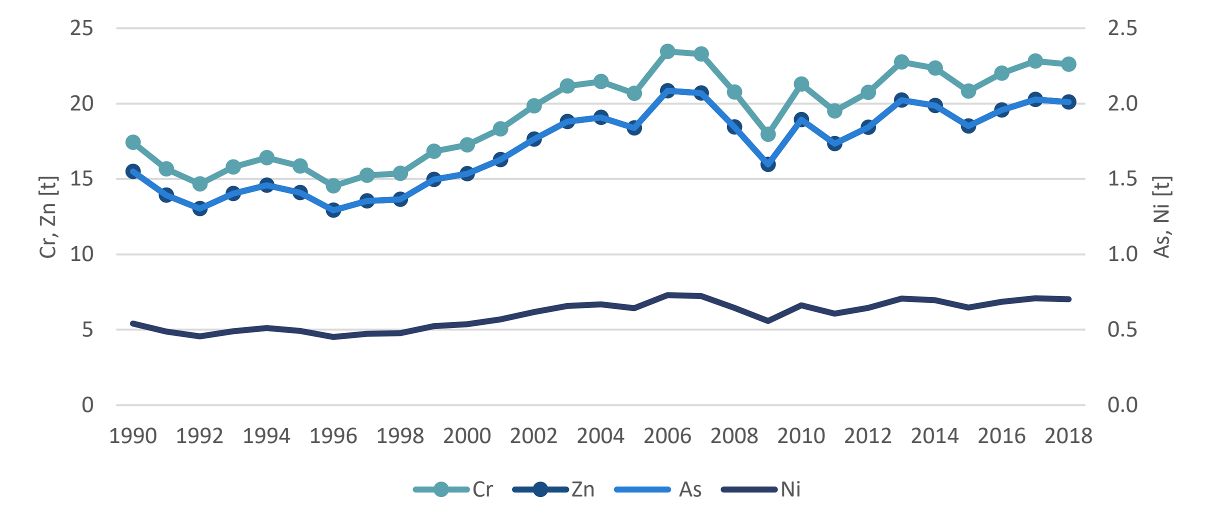


Figure 4.29: *Trends in emissions of POPs metals in pollutants in the category 2C1*

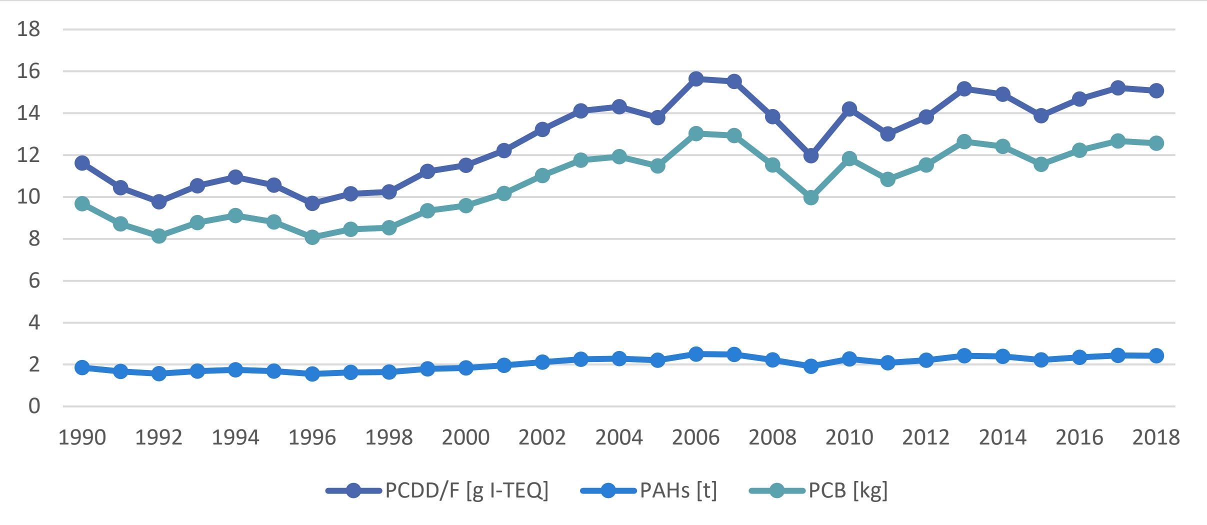


Table 4.51: *Trends in emissions of air pollutants in 2C1*

YEAR	STEEL 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	3872.23	4.3231	0.1577	11.0227	7E-04	1.3887	2.1691	9.0424	0.0050	72.0391
1995	3522.04	3.9321	0.1435	10.0259	6E-04	1.2631	1.9729	8.2246	0.0045	65.5242
2000	3836.35	4.0544	0.1578	11.0293	7E-04	1.3896	2.1704	9.0478	0.0050	72.0820
2005	4595.02	2.6012	0.5416	7.4668	2E-05	0.3871	0.6021	2.3878	0.0014	78.0150
2010	4733.03	2.2989	0.4037	3.8173	1E-05	0.1821	0.3143	1.7725	0.0007	71.3922
2011	4335.24	2.2516	0.4809	4.6387	2E-05	0.1953	0.3451	2.0534	0.0007	84.3547
2012	4608.59	2.5153	0.5077	4.4450	2E-05	0.2131	0.3793	2.2904	0.0008	83.5158
2013	5055.59	2.7281	0.4807	3.5912	2E-05	0.2320	0.4129	2.4998	0.0008	85.3274
2014	4967.34	3.2091	0.5369	3.6345	2E-05	0.2742	0.4820	2.8250	0.0010	98.9535
2015	4625.98	3.0538	0.5460	4.8942	2E-05	0.2620	0.4560	2.6219	0.0009	97.6335
2016	4893.24	2.7957	0.4971	4.4276	4E-06	0.2148	0.3825	2.2128	0.0008	96.7478
2017	5069.77	3.2859	0.5143	6.2832	2E-06	0.2156	0.3857	2.2470	0.0008	100.8391
2018	5024.27	3.5863	0.5405	4.4805	3E-06	0.1830	0.3283	1.9362	0.0007	89.0361
1990/2018	**30%**	**-17%**	**243%**	**-59%**	**-100%**	**-87%**	**-85%**	**-79%**	**-87%**	**24%**
2017/2018	**-1%**	**9%**	**5%**	**-29%**	**22%**	**-15%**	**-15%**	**-14%**	**-15%**	**-12%**

4.6.2.2 Methodological issues

Activities defined in national legislation involved in 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 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

Category covers sources of several companies operating in the Slovak Republic (for the year 2018).

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 manufacturers of iron and steel in blast furnaces (integrated production of iron and steel) produced totally 0.11 kt of pig iron (which was sold and not processed to steel) and 4 641.84 kt of steel in 2018. Total production of steel produced by the EAF technology was 380.30 kt in 2018. 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 in the end of 2014, the production was stopped.

70% of the amount of all emissions of air pollutants (HM and POP are separately calculated) are continuously measured (***Table 4.53***). But the rest is determined by another manner.

Table 4.53*: The overview of share of used calculation type for category 2C1 in the NEIS*

2C1	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	70.9%
2	Calculation using representative concentration and volume of flue gas	0.010%
3	Calculation using representative individual mass flow and number of operating hours	3.5%
4	Calculation using emission factor and amount of fuel	8.9%
5	Calculation using emission factor and amount of related quantity other than fuel	0.73%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	16.0%

Historical years for this source category were calculated using IEF for each pollutant from the period 2000-2004 (***Table 4.54***). Emissions of BC were calculated using EMEP/EEA GB_{2019} emission factor thought the whole time series.

Table 4.54: *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	1 116.42	40.73	2 846.61	0.18	2 335.19	15%	24%	0.36%	18 604.04

*Tier 1 EMEP/EEA GB_{2019}

Heavy metals and POPs

As a part of the process to improve the inventory of heavy metals and POPs, emissions factors used for calculation was changed to Tier 1 level of EMEP/EEA GB_{2019} (***Table 4.55, 4.56***). Emission factors used in the previous submission were outdated. In the following reporting cycle, it is planned to improve the methodology of this source to the Tier 2 level for key categories.

Table 4.55*: Emission factor for heavy metals using in calculations for iron and steel production*

	Pb [g/t]	As [g/t]	Cd [g/t]	Cr [g/t]	Cu [g/t]	Hg [g/t]	Ni [g/t]	Se [g/t]	Zn[g/t]
EF	4.6	0.02	0.1	0.4	4.5	0.07	0.14	0.02	4

Table 4.56: *Emission factors of POPs in 2C1*

	PCDD/F [µg/t]	PAHs [g/t]	HCB [mg/t]	PCBs [mg/t]
EF	3	0.48	0.03	2.5

4.6.2.3 Completeness

All rising pollutants were reported. Notation key was used in compliance with EMEP/EEA GB_{2019}.

4.6.2.4 Source-specific recalculations

Historical years were recalculated due to change of emission factors for this period. Emission factors for HMs and POPs were changed in the whole time-series. Due to error correction in the database, NMVOC emissions were recalculated in the period 2000-2004 (***Table 4.57***).

Recommendation No ***SK-2C1-2018-0002*** was implemented to this submission and emissions of HCB were calculated.

Table 4.57: *Previous and refined emissions in the category 2C1*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]			NH_3 [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	7.8759	4.3231	-45%	0.2113	0.1577	-25%	63.0068	11.0227	-83%	9E-04	7E-04	-25%
1991	7.8668	3.8889	-51%	0.2230	0.1419	-36%	62.9342	9.9158	-84%	9E-04	6E-04	-32%
1992	4.3392	3.6362	-16%	0.2346	0.1327	-43%	39.2885	9.2715	-76%	9E-04	6E-04	-37%
1993	4.2462	3.9177	-8%	0.2461	0.1429	-42%	31.3945	9.9892	-68%	9E-04	6E-04	-32%
1994	4.1534	4.0714	-2%	0.2577	0.1486	-42%	23.5186	10.3811	-56%	9E-04	7E-04	-29%
1995	4.0608	3.9321	-3%	0.2692	0.1435	-47%	23.4914	10.0259	-57%	9E-04	6E-04	-31%
1996	3.9683	3.6059	-9%	0.2807	0.1316	-53%	15.6428	9.1941	-41%	9E-04	6E-04	-37%
1997	3.8761	3.7796	-2%	0.2922	0.1379	-53%	15.6246	9.6371	-38%	9E-04	6E-04	-34%
1998	3.7841	3.8121	1%	0.3036	0.1391	-54%	10.6462	9.7200	-9%	9E-04	6E-04	-33%
1999	3.6923	4.1750	13%	0.3151	0.1523	-52%	10.1898	10.6453	4%	9E-04	7E-04	-27%
2000	4.0544	4.0544	-	0.3339	0.1578	-53%	11.0293	11.0293	-	7E-04	7E-04	-
2001	4.6937	4.6937	-	0.3032	0.1517	-50%	10.1136	10.1136	-	9E-04	9E-04	-
2002	3.1955	3.1955	-	0.3437	0.1609	-53%	7.4765	7.4765	-	2E-03	2E-03	-
2003	3.4887	3.4887	-	0.3788	0.3394	-10%	7.1981	7.1981	-	3E-03	3E-03	-
2004	2.9550	2.9550	-	0.3699	0.4564	23%	7.9813	7.9813	-	2E-05	2E-05	-

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	1.2858	1.3887	8%	2.1350	2.1691	2%	10.9998	9.0424	-18%	157.5171	72.0391	-54%
1991	1.2374	1.2493	1%	2.0546	1.9513	-5%	10.5853	8.1343	-23%	157.3355	64.8046	-59%
1992	1.1890	1.1681	-2%	1.9743	1.8245	-8%	10.1717	7.6058	-25%	117.8655	60.5942	-49%
1993	1.1408	1.2585	10%	1.8942	1.9657	4%	9.7590	8.1945	-16%	117.7293	65.2844	-45%
1994	1.0927	1.3079	20%	1.8143	2.0428	13%	9.3473	8.5160	-9%	101.9141	67.8458	-33%
1995	1.0446	1.2631	21%	1.7345	1.9729	14%	8.9364	8.2246	-8%	101.7961	65.5242	-36%
1996	0.9967	1.1583	16%	1.6550	1.8093	9%	8.5265	7.5423	-12%	87.5069	60.0883	-31%
1997	0.9489	1.2142	28%	1.5756	1.8964	20%	8.1176	7.9057	-3%	86.4195	62.9831	-27%
1998	0.9012	1.2246	36%	1.4964	1.9128	28%	7.7095	7.9737	3%	85.3344	63.5254	-26%
1999	0.8536	1.3412	57%	1.4174	2.0948	48%	7.3024	8.7328	20%	84.2517	69.5728	-17%
2000	1.0576	1.3896	31%	1.7561	2.1704	24%	9.0478	9.0478	-	72.0820	72.0820	-
2001	1.0075	1.3236	31%	1.6728	2.0674	24%	8.6186	8.6186	-	67.8010	67.8010	-
2002	0.8968	1.1782	31%	1.4890	1.8403	24%	7.6716	7.6716	-	71.8670	71.8670	-
2003	0.5109	0.6712	31%	0.8483	1.0484	24%	4.3706	4.3706	-	89.2128	89.2128	-
2004	0.4718	0.6198	31%	0.7834	0.9682	24%	4.0360	4.0360	-	91.3099	91.3099	-

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	1.3190	17.8123	1250%	0.0143	0.0774	440%	0.0143	0.3872	2601%	0.0717	1.5489	2061%
1991	1.1836	16.0235	1254%	0.0129	0.0697	442%	0.0129	0.3483	2608%	0.0643	1.3933	2066%
1992	1.0482	14.9824	1329%	0.0114	0.0651	472%	0.0114	0.3257	2759%	0.0570	1.3028	2187%
1993	1.0725	16.1421	1405%	0.0117	0.0702	502%	0.0117	0.3509	2910%	0.0583	1.4037	2308%
1994	1.0968	16.7754	1429%	0.0119	0.0729	512%	0.0119	0.3647	2959%	0.0596	1.4587	2347%
1995	1.0924	16.2014	1383%	0.0119	0.0704	493%	0.0119	0.3522	2866%	0.0594	1.4088	2273%
1996	0.9544	14.8573	1457%	0.0104	0.0646	523%	0.0104	0.3230	3013%	0.0519	1.2919	2391%
1997	0.9616	15.5731	1520%	0.0105	0.0677	548%	0.0105	0.3385	3139%	0.0523	1.3542	2491%
1998	0.9664	15.7072	1525%	0.0105	0.0683	550%	0.0105	0.3415	3151%	0.0525	1.3658	2500%
1999	1.0030	17.2024	1615%	0.0109	0.0748	586%	0.0109	0.3740	3330%	0.0545	1.4959	2644%

YEAR	Pb [t]			Cd [t]			Hg [t]			As [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2000	1.0486	17.6472	1583%	0.0114	0.0767	573%	0.0114	0.3836	3266%	0.0570	1.5345	2593%
2001	1.1239	18.7200	1566%	0.0122	0.0814	566%	0.0122	0.4070	3231%	0.0611	1.6278	2565%
2002	1.2173	20.2886	1567%	0.0132	0.0882	567%	0.0132	0.4411	3233%	0.0662	1.7642	2567%
2003	1.2971	21.6374	1568%	0.0141	0.0941	567%	0.0141	0.4704	3236%	0.0705	1.8815	2569%
2004	1.2596	21.9362	1642%	0.0137	0.0954	597%	0.0137	0.4769	3383%	0.0685	1.9075	2686%
2005	1.2682	21.1371	1567%	0.0138	0.0919	567%	0.0138	0.4595	3233%	0.0689	1.8380	2567%
2006	1.4388	23.9801	1567%	0.0156	0.1043	567%	0.0156	0.5213	3233%	0.0782	2.0852	2567%
2007	1.4281	23.8015	1567%	0.0155	0.1035	567%	0.0155	0.5174	3233%	0.0776	2.0697	2567%
2008	1.2729	21.2152	1567%	0.0138	0.0922	567%	0.0138	0.4612	3233%	0.0692	1.8448	2567%
2009	1.1013	18.3556	1567%	0.0120	0.0798	567%	0.0120	0.3990	3233%	0.0599	1.5961	2567%
2010	1.3662	21.7719	1494%	0.0149	0.0947	537%	0.0149	0.4733	3087%	0.0743	1.8932	2450%
2011	1.1965	19.9421	1567%	0.0130	0.0867	567%	0.0130	0.4335	3233%	0.0650	1.7341	2567%
2012	1.2476	21.1995	1599%	0.0136	0.0922	580%	0.0136	0.4609	3299%	0.0678	1.8434	2619%
2013	1.2739	23.2557	1726%	0.0138	0.1011	630%	0.0138	0.5056	3551%	0.0692	2.0222	2821%
2014	1.3245	22.8497	1625%	0.0144	0.0993	590%	0.0144	0.4967	3350%	0.0720	1.9869	2660%
2015	1.1898	21.2795	1689%	0.0129	0.0925	615%	0.0129	0.4626	3477%	0.0647	1.8504	2762%
2016	1.3508	22.5089	1566%	0.0147	0.0979	567%	0.0147	0.4893	3233%	0.0734	1.9573	2566%
2017	1.1338	23.3209	1957%	0.0123	0.1014	723%	0.0123	0.5070	4014%	0.0616	2.0279	3191%

YEAR	Cr [t]			Cu [t]			Ni [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.1673	17.4250	10318%	2.6046	0.2711	-90%	2.6332	0.5421	-79%
1991	0.1501	15.6751	10343%	2.3372	0.2438	-90%	2.3630	0.4877	-79%
1992	0.1329	14.6567	10926%	2.0699	0.2280	-89%	2.0927	0.4560	-78%
1993	0.1360	15.7912	11510%	2.1179	0.2456	-88%	2.1412	0.4913	-77%
1994	0.1391	16.4107	11699%	2.1658	0.2553	-88%	2.1897	0.5106	-77%
1995	0.1385	15.8492	11341%	2.1571	0.2465	-89%	2.1809	0.4931	-77%
1996	0.1210	14.5343	11909%	1.8846	0.2261	-88%	1.9054	0.4522	-76%
1997	0.1219	15.2345	12393%	1.8988	0.2370	-88%	1.9197	0.4740	-75%
1998	0.1226	15.3657	12438%	1.9083	0.2390	-87%	1.9293	0.4780	-75%
1999	0.1272	16.8285	13131%	1.9805	0.2618	-87%	2.0023	0.5236	-74%
2000	0.1330	17.2636	12882%	2.0706	0.2685	-87%	2.0934	0.5371	-74%
2001	0.1425	18.3130	12749%	2.2194	0.2849	-87%	2.2438	0.5697	-75%
2002	0.1544	19.8475	12757%	2.4038	0.3087	-87%	2.4302	0.6175	-75%
2003	0.1645	21.1670	12769%	2.5613	0.3293	-87%	2.5895	0.6585	-75%
2004	0.1597	21.4594	13335%	2.4873	0.3338	-87%	2.5146	0.6676	-73%
2005	0.1608	20.6776	12757%	2.5043	0.3217	-87%	2.5319	0.6433	-75%
2006	0.1825	23.4588	12757%	2.8411	0.3649	-87%	2.8724	0.7298	-75%
2007	0.1811	23.2841	12757%	2.8200	0.3622	-87%	2.8510	0.7244	-75%
2008	0.1614	20.7540	12757%	2.5135	0.3228	-87%	2.5412	0.6457	-75%
2009	0.1397	17.9566	12757%	2.1747	0.2793	-87%	2.1987	0.5586	-75%
2010	0.1733	21.2986	12193%	2.6978	0.3313	-88%	2.7275	0.6626	-76%
2011	0.1517	19.5086	12757%	2.3627	0.3035	-87%	2.3887	0.6069	-75%
2012	0.1582	20.7387	13009%	2.4635	0.3226	-87%	2.4906	0.6452	-74%
2013	0.1615	22.7502	13983%	2.5155	0.3539	-86%	2.5432	0.7078	-72%
2014	0.1680	22.3530	13208%	2.6155	0.3477	-87%	2.6443	0.6954	-74%
2015	0.1509	20.8169	13697%	2.3494	0.3238	-86%	2.3752	0.6476	-73%
2016	0.1713	22.0196	12754%	2.6674	0.3425	-87%	2.6968	0.6851	-75%
2017	0.1438	22.8139	15767%	2.2388	0.3549	-84%	2.2635	0.7098	-69%

YEAR	Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0143	0.0774	440%	5.4959	15.4889	182%
1991	0.0129	0.0697	442%	4.9318	13.9335	183%
1992	0.0114	0.0651	472%	4.3677	13.0282	198%
1993	0.0117	0.0702	502%	4.4689	14.0366	214%
1994	0.0119	0.0729	512%	4.5701	14.5873	219%
1995	0.0119	0.0704	493%	4.5517	14.0882	210%
1996	0.0104	0.0646	523%	3.9767	12.9194	225%
1997	0.0105	0.0677	548%	4.0066	13.5418	238%
1998	0.0105	0.0683	550%	4.0268	13.6584	239%
1999	0.0109	0.0748	586%	4.1791	14.9586	258%
2000	0.0114	0.0767	573%	4.3692	15.3454	251%
2001	0.0122	0.0814	566%	4.6831	16.2782	248%
2002	0.0132	0.0882	567%	5.0721	17.6422	248%
2003	0.0141	0.0941	567%	5.4045	18.8151	248%
2004	0.0137	0.0954	597%	5.2483	19.0750	263%
2005	0.0138	0.0919	567%	5.2843	18.3801	248%
2006	0.0156	0.1043	567%	5.9950	20.8523	248%
2007	0.0155	0.1035	567%	5.9504	20.6970	248%
2008	0.0138	0.0922	567%	5.3038	18.4480	248%
2009	0.0120	0.0798	567%	4.5889	15.9614	248%
2010	0.0149	0.0947	537%	5.6925	18.9321	233%
2011	0.0130	0.0867	567%	4.9855	17.3409	248%
2012	0.0136	0.0922	580%	5.1982	18.4344	255%
2013	0.0138	0.1011	630%	5.3079	20.2224	281%
2014	0.0144	0.0993	590%	5.5189	19.8693	260%
2015	0.0129	0.0925	615%	4.9574	18.5039	273%
2016	0.0147	0.0979	567%	5.6284	19.5730	248%
2017	0.0123	0.1014	723%	4.7241	20.2791	329%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	4.1117	11.6167	183%	0.0812	1.8587	2188%	1.4831	9.6806	553%
1991	3.9704	10.4501	163%	0.0785	1.6720	2031%	1.3341	8.7084	553%
1992	3.8291	9.7711	155%	0.0757	1.5634	1966%	1.2474	8.1426	553%
1993	3.6879	10.5275	185%	0.0729	1.6844	2212%	1.3440	8.7729	553%
1994	3.5466	10.9405	208%	0.0701	1.7505	2398%	1.3967	9.1171	553%
1995	3.4053	10.5661	210%	0.0673	1.6906	2413%	1.3489	8.8051	553%
1996	3.5737	9.6896	171%	0.0658	1.5503	2254%	1.2370	8.0746	553%
1997	3.7422	10.1564	171%	0.0644	1.6250	2423%	1.2966	8.4636	553%
1998	3.8701	10.2438	165%	0.0595	1.6390	2653%	1.3078	8.5365	553%
1999	2.8231	11.2190	297%	0.0618	1.7950	2806%	1.4323	9.3492	553%
2000	3.4974	11.5090	229%	0.0646	1.8414	2751%	1.4693	9.5909	553%
2001	3.9547	12.2087	209%	0.0692	1.9534	2722%	1.5586	10.1739	553%
2002	3.8942	13.2317	240%	0.0750	2.1171	2724%	1.6892	11.0264	553%
2003	4.0434	14.1113	249%	0.0799	2.2578	2726%	1.8015	11.7595	553%
2004	4.3193	14.3062	231%	0.0776	2.2890	2850%	1.8264	11.9219	553%
2005	4.4166	13.7851	212%	0.0781	2.2056	2724%	1.7599	11.4876	553%
2006	4.7331	15.6392	230%	0.0886	2.5023	2724%	1.9966	13.0327	553%
2007	4.8513	15.5227	220%	0.0880	2.4836	2724%	1.9817	12.9356	553%

YEAR	PCDD/F [g I-TEQ]			PAHs [t]			PCBs [kg]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2008	4.6720	13.8360	196%	0.0784	2.2138	2724%	1.7664	11.5300	553%
2009	4.2091	11.9710	184%	0.0678	1.9154	2724%	1.5283	9.9759	553%
2010	6.3821	14.1991	122%	0.0842	2.2719	2600%	1.8128	11.8326	553%
2011	4.5344	13.0057	187%	0.0737	2.0809	2724%	1.6604	10.8381	553%
2012	4.5536	13.8258	204%	0.0768	2.2121	2779%	1.7651	11.5215	553%
2013	4.1552	15.1668	265%	0.0784	2.4267	2994%	1.9363	12.6390	553%
2014	4.4433	14.9020	235%	0.0816	2.3843	2823%	1.9025	12.4183	553%
2015	4.0126	13.8780	246%	0.0786	2.2205	2724%	1.7718	11.5650	553%
2016	3.8579	14.6797	281%	0.0832	2.3488	2724%	1.8741	12.2331	553%
2017	4.5106	15.2093	237%	0.0862	2.4335	2724%	1.9417	12.6744	553%

P-Previous
R-Refined

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. Emission trends are shown in the following ***Figure 4.30***. As shown emissions of PMs and NOx decreased significantly in period 1999-2000 due to installation of abatement technologies. This category is key for the emissions of NOx. Activity data, emissions and its trends are presented in ***Table 4.58***.

Figure 4.30: *Trends in emissions of air pollutants in 2C2*

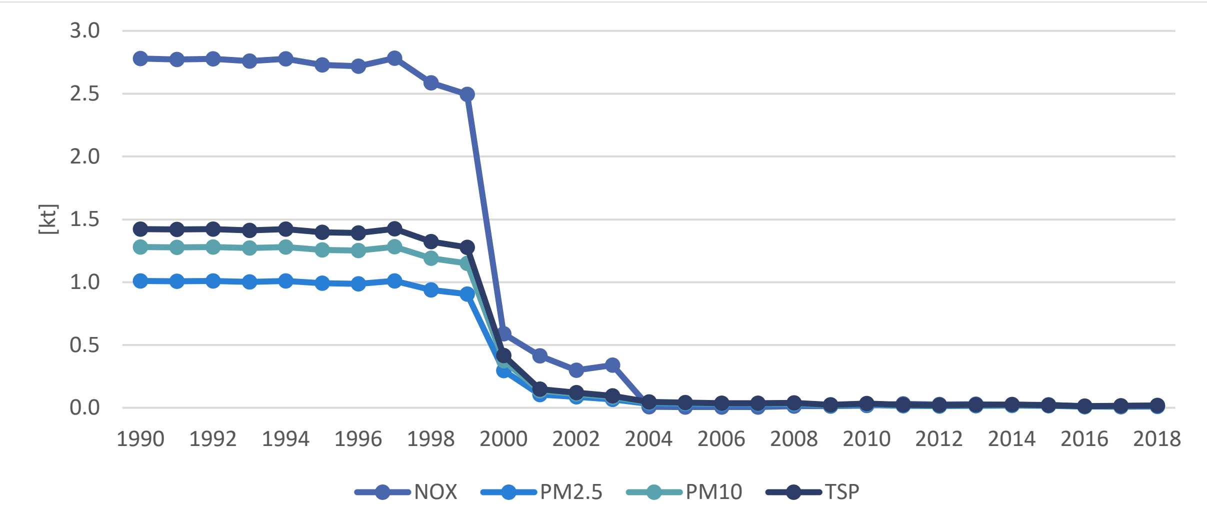


Table 4.58: *Activity data and emissions in the category 2C2*

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	2.7810	0.2157	1.7401	0.0001	1.0100	1.2805	1.4235	0.1010	17.6009
1995	134.80	2.7302	0.2118	1.7083	0.0001	0.9915	1.2571	1.3975	0.0992	17.2795
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

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]
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
1990/2018	**-33%**	**-100%**	**-89%**	**-99%**	**-94%**	**-99%**	**-99%**	**-99%**	**-99%**	**-99%**
2017/2018	**-12%**	**32%**	**26%**	**40%**	**0%**	**25%**	**25%**	**25%**	**25%**	**24%**

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 4.59: *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

More than 98% of air pollutant emissions are measured by the way of representative individual mass flow and number of operating hours (***Table 4.60***).

Table 4.60*: The overview of share of used calculation type for category 2C2 in the NEIS*

2C2	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	98.42%
4	Calculation using emission factor and amount of fuel	0.72%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0.72%

Historical years for this source category were calculated using 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]	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	3 075.01	238.49	1 924.08	0.10	1 574.00	71%	90%	10%	19 461.79

*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 4.62***).

Table 4.62: 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	3.4092	2.7810	-18%	0.0824	0.2157	162%	0.8450	1.7401	106%	0.0000	0.0001	166%
1991	3.0940	2.7728	-10%	0.0773	0.2151	178%	0.8250	1.7350	110%	0.0000	0.0001	184%
1992	2.7729	2.7775	0%	0.0719	0.2154	200%	0.8000	1.7379	117%	0.0000	0.0001	207%
1993	2.3864	2.7609	16%	0.0645	0.2141	232%	0.4500	1.7275	284%	0.0000	0.0001	242%
1994	2.1052	2.7773	32%	0.0597	0.2154	261%	0.4359	1.7378	299%	0.0000	0.0001	273%
1995	1.7615	2.7302	55%	0.0527	0.2118	302%	0.3199	1.7083	434%	0.0000	0.0001	318%
1996	1.5141	2.7186	80%	0.0483	0.2109	336%	0.3087	1.7011	451%	0.0000	0.0001	356%
1997	1.2271	2.7829	127%	0.0423	0.2158	410%	0.2851	1.7413	511%	0.0000	0.0001	437%
1998	1.1769	2.5853	120%	0.0445	0.2005	350%	0.3177	1.6177	409%	0.0000	0.0001	378%
1999	0.8581	2.4946	191%	0.0365	0.1935	430%	0.2763	1.5609	465%	0.0000	0.0001	468%

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	1.8989	1.0100	-47%	2.4070	1.2805	-47%	2.6745	1.4235	-47%	5.8935	17.6009	199%
1991	1.7121	1.0070	-41%	2.1702	1.2767	-41%	2.4114	1.4193	-41%	5.4974	17.5491	219%
1992	1.5226	1.0087	-34%	1.9301	1.2789	-34%	2.1445	1.4217	-34%	5.0819	17.5789	246%
1993	1.2985	1.0027	-23%	1.6460	1.2713	-23%	1.8289	1.4132	-23%	4.5310	17.4738	286%
1994	1.1329	1.0086	-11%	1.4360	1.2788	-11%	1.5956	1.4216	-11%	4.1630	17.5774	322%
1995	0.9351	0.9915	6%	1.1854	1.2571	6%	1.3171	1.3975	6%	3.6525	17.2795	373%
1996	0.7900	0.9873	25%	1.0015	1.2518	25%	1.1127	1.3916	25%	3.3203	17.2061	418%
1997	0.6261	1.0107	61%	0.7936	1.2814	61%	0.8818	1.4245	62%	2.8782	17.6132	512%
1998	0.5825	0.9389	61%	0.7383	1.1904	61%	0.8204	1.3233	61%	2.9981	16.3625	446%
1999	0.4065	0.9060	123%	0.5152	1.1486	123%	0.5725	1.2769	123%	2.4257	15.7883	551%
2000	0.2959	0.2957	0%	0.3750	0.3749	0%	0.4167	0.4167	-	2.7839	2.7839	-
2001	0.1065	0.1064	0%	0.1349	0.1349	0%	0.1499	0.1499	-	2.5911	2.5911	-
2002	0.0866	0.0865	0%	0.1098	0.1097	0%	0.1220	0.1220	-	2.7566	2.7566	-
2003	0.0673	0.0672	0%	0.0853	0.0852	0%	0.0947	0.0947	-	2.2963	2.2963	-
2004	0.0328	0.0328	0%	0.0416	0.0416	0%	0.0462	0.0462	-	0.6335	0.6335	-

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 production 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 are allocated in 2C7c as the Decree 410/2012 Coll. generally defines the production and processing of metals, therefore it is currently not possible to separate by type of produced metals.

Emissions of POPs show an increasing trend due to the increase of activity in this category (***Figure 4.31***, ***Table 4.63***.

Figure 4.31: Trends in emissions and activity data in 2C3

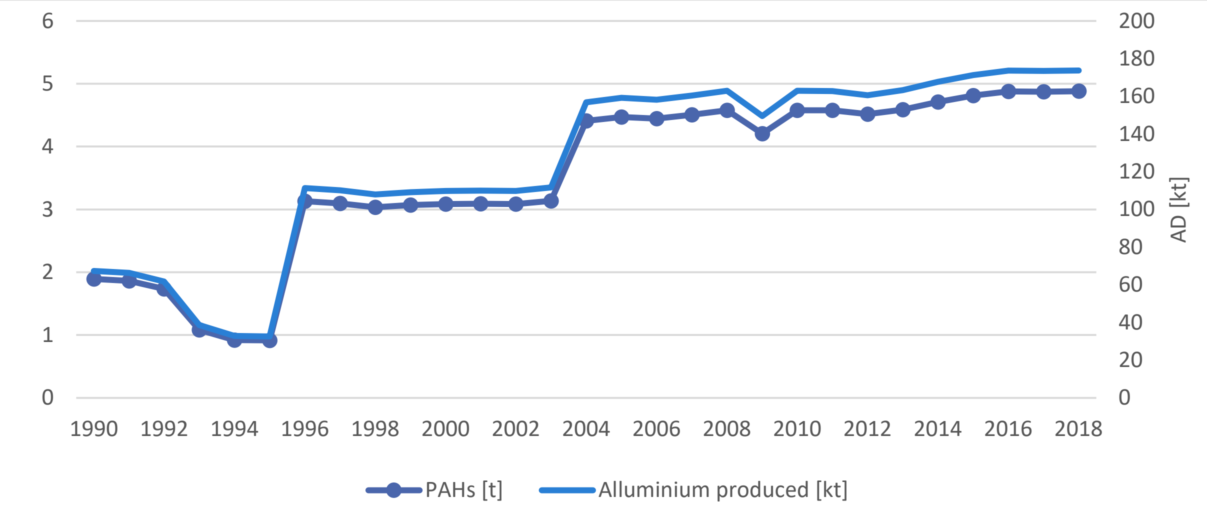


Table 4.63: Activity data and emissions in the category 2C3

YEAR	ALUMINIUM PRODUCED [kt]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]
1990	67.40	0.6066	0.6066	0.6066	0.0741	1.8939
1995	32.60	0.2934	0.2934	0.2934	0.0359	0.9161
2000	109.81	0.9883	0.9883	0.9883	0.1208	3.0857
2005	159.20	1.4328	1.4328	1.4328	0.1751	4.4736
2010	163.00	1.4670	1.4670	1.4670	0.1793	4.5802
2011	162.84	1.4656	1.4656	1.4656	0.1791	4.5758
2012	160.66	1.4459	1.4459	1.4459	0.1767	4.5145
2013	163.30	1.4697	1.4697	1.4697	0.1796	4.5886
2014	167.67	1.5090	1.5090	1.5090	0.1844	4.7114
2015	171.33	1.5420	1.5420	1.5420	0.1885	4.8143
2016	173.64	1.5628	1.5628	1.5628	0.1910	4.8794
2017	173.49	1.5614	1.5614	1.5614	0.1908	4.8751
2018	173.72	1.5635	1.5635	1.5635	0.1911	4.8815
1990/2018	**158%**	**158%**	**158%**	**158%**	**158%**	**158%**
2017/2018	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**

4.6.4.2 Methodological issues

Emissions of air pollutants are included in category 2C7c - Other metal production because 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. Notation key IE is used for reporting.

POPs

POPs were calculated using Tier 1 emission factors from EMEP/EEA GB2019 (***Table 4.64***)

Table 4.64: Emission factors of POPs in 2C3

	B(a)P [g/t]	B(b)F [g/t]	B(k)F [g/t]	I()P [g/t]	PAHs [g/t]
EFs	9	9	9	1.1	28.1

4.6.4.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2019}. Emissions of Cd, Ni and Zn were removed from the calculation as country-specific emission factors were assumed as inappropriate.

4.6.4.4 Source-specific recalculations

Country-specific emission factors for PAHs were reconsidered and EMEP/EEA GB_{2019} emission factors were used. Recalculations are shown in ***Table 4.65.***

Table 4.65: *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	0.1668	0.6066	264%	0.1678	0.6066	262%	0.1641	0.6066	270%	0.0214	0.0741	247%
1991	0.1566	0.5967	281%	0.1573	0.5967	279%	0.1539	0.5967	288%	0.0201	0.0729	264%
1992	0.1422	0.5553	291%	0.1427	0.5553	289%	0.1397	0.5553	297%	0.0182	0.0679	273%
1993	0.1056	0.3474	229%	0.1066	0.3474	226%	0.1041	0.3474	234%	0.0136	0.0425	213%
1994	0.0898	0.2952	229%	0.0906	0.2952	226%	0.0885	0.2952	234%	0.0115	0.0361	213%
1995	0.0807	0.2934	264%	0.0812	0.2934	262%	0.0794	0.2934	270%	0.0103	0.0359	247%
1996	0.2247	1.0026	346%	0.2242	1.0026	347%	0.2202	1.0026	355%	0.0287	0.1225	327%
1997	0.2767	0.9917	258%	0.2785	0.9917	256%	0.2723	0.9917	264%	0.0355	0.1212	242%
1998	0.2780	0.9720	250%	0.2801	0.9720	247%	0.2737	0.9720	255%	0.0357	0.1188	233%
1999	0.3049	0.9828	222%	0.3081	0.9828	219%	0.3005	0.9828	227%	0.0392	0.1201	207%
2000	0.2776	0.9883	256%	0.2795	0.9883	254%	0.2732	0.9883	262%	0.0356	0.1208	239%
2001	0.2639	0.9906	275%	0.2652	0.9906	273%	0.2595	0.9906	282%	0.0338	0.1211	258%
2002	0.2853	0.9883	246%	0.2876	0.9883	244%	0.2809	0.9883	252%	0.0366	0.1208	230%
2003	0.3042	1.0046	230%	0.3071	1.0046	227%	0.2997	1.0046	235%	0.0391	0.1228	214%
2004	0.3756	1.4120	276%	0.3775	1.4120	274%	0.3693	1.4120	282%	0.0481	0.1726	259%
2005	0.3766	1.4328	280%	0.3783	1.4328	279%	0.3702	1.4328	287%	0.0482	0.1751	263%
2006	0.3815	1.4246	273%	0.3835	1.4246	271%	0.3751	1.4246	280%	0.0489	0.1741	256%
2007	0.3823	1.4442	278%	0.3842	1.4442	276%	0.3759	1.4442	284%	0.0490	0.1765	260%
2008	0.4004	1.4670	266%	0.4027	1.4670	264%	0.3938	1.4670	272%	0.0513	0.1793	249%
2009	0.3686	1.3464	265%	0.3708	1.3464	263%	0.3626	1.3464	271%	0.0473	0.1646	248%
2010	0.3918	1.4670	274%	0.3938	1.4670	272%	0.3853	1.4670	281%	0.0502	0.1793	257%
2011	0.3537	1.4656	314%	0.3541	1.4656	314%	0.3472	1.4656	322%	0.0452	0.1791	296%
2012	0.3886	1.4459	272%	0.3906	1.4459	270%	0.3821	1.4459	278%	0.0498	0.1767	255%
2013	0.4007	1.4697	267%	0.4031	1.4697	265%	0.3942	1.4697	273%	0.0514	0.1796	250%
2014	0.4186	1.5090	260%	0.4214	1.5090	258%	0.4119	1.5090	266%	0.0537	0.1844	244%
2015	0.4227	1.5420	265%	0.4253	1.5420	263%	0.4158	1.5420	271%	0.0542	0.1885	248%
2016	0.4101	1.5628	281%	0.4119	1.5628	279%	0.4032	1.5628	288%	0.0525	0.1910	264%
2017	0.4093	1.5614	282%	0.4111	1.5614	280%	0.4023	1.5614	288%	0.0524	0.1908	264%

P-Previous
R-Refined

4.6.5 MAGNESIUM PRODUCTION (2C4)

4.6.5.1 Overview

The production of magnesium oxide from magnesite and production of basic refractory materials with projected production capacity in t / d are occurring in the Slovak Republic. Therefore this activity was included into the category 2C4.

The trends of emission and activity data are presented in ***Figures 4.32*** and ***Table 4.66.***

Figure 4.32: *Trends in emissions of particulate matter in 2C4*

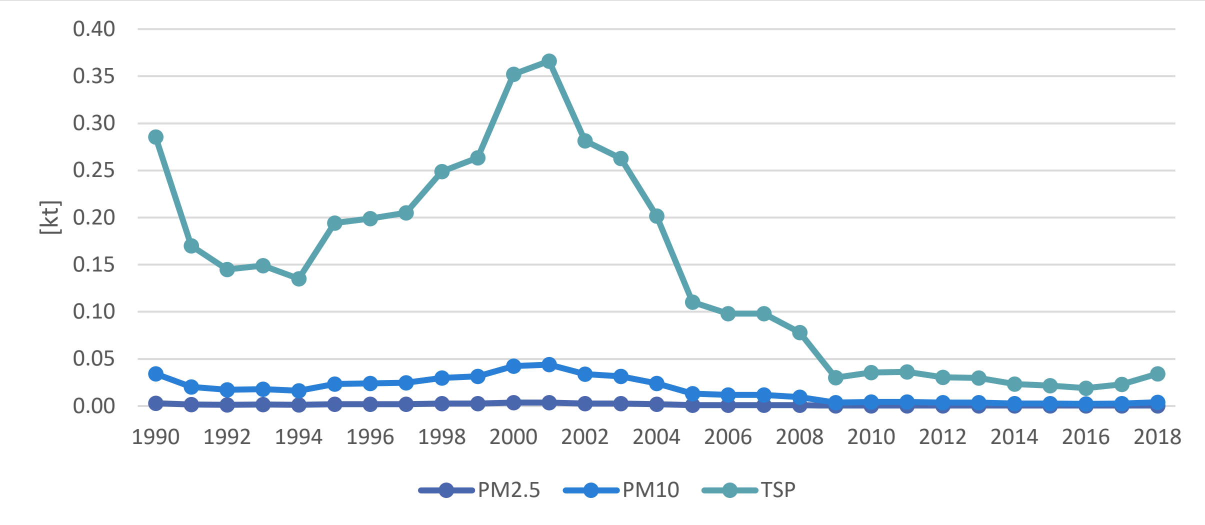


Table 4.66: *Activity data and emissions on the category 2C4*

YEAR	MAGNESITE RAW MATERIAL [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	887.74	1.2017	0.0105	0.5585	0.0010	0.0029	0.0343	0.2855	3.8674
1995	604.32	0.8180	0.0072	0.3802	0.0007	0.0019	0.0233	0.1943	2.6327
2000	850.57	0.9611	0.0097	0.3510	0.0017	0.0035	0.0422	0.3520	3.8178
2005	988.58	1.2604	0.0089	0.8608	0.0009	0.0011	0.0133	0.1104	4.5563
2010	820.32	1.2674	0.0069	0.2942	0.0002	0.0004	0.0043	0.0354	1.9697
2011	724.27	1.3406	0.0069	0.3566	0.0002	0.0004	0.0044	0.0363	2.9037
2012	634.97	0.9418	0.0055	0.2503	0.0002	0.0003	0.0037	0.0306	2.9057
2013	603.38	0.9582	0.0050	0.1927	0.0001	0.0003	0.0036	0.0299	2.6620
2014	590.33	0.9248	0.0047	0.1800	0.0000	0.0002	0.0028	0.0234	2.6315
2015	550.04	0.8528	0.0043	0.1765	0.0000	0.0002	0.0026	0.0216	2.6385
2016	462.81	0.5162	0.0035	0.1330	0.0000	0.0002	0.0023	0.0190	1.6368
2017	463.81	0.6514	0.0049	0.1612	0.0000	0.0002	0.0028	0.0231	1.2759
2018	315.89	0.8721	0.0052	0.1722	0.0000	0.0003	0.0041	0.0344	0.9580
1990/2018	**-64%**	**-27%**	**-51%**	**-69%**	**-100%**	**-88%**	**-88%**	**-88%**	**-75%**
2017/2018	**-32%**	**34%**	**5%**	**7%**	**47%**	**49%**	**49%**	**49%**	**-25%**

4.6.5.4 Methodological issues

Activities defined in national legislation involved in category are presented in ***Table 4.67***.

Table 4.67: *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

More than 71% of air pollutant emissions are measured by the way of representative individual mass flow and the number of operating hours and 29% are measured by continuous measurement (***Table 4.68***).

Table 4.68: *The overview of share of used calculation type for category 2C4 in the NEIS*

2C4	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	28.7%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	71.2%

2C4	TYPE OF EMISSION COMPILATION/CALCULATION	%
4	Calculation using emission factor and amount of fuel	0.034%
5	Calculation using emission factor and amount of related quantity other than fuel	0.00000%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

Historical years for this source category were calculated using IEF for each pollutant from the period 2000-2004 (***Table 4.69***).

Table 4.69: *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	1 353.64	11.86	629.14	1.12	321.59	1%	12%	4 356.42

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 4.70***).

Table 4.70: *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	2.7076	1.2017	-56%	0.0107	0.0105	-1%	1.3316	0.5585	-58%	0.0018	0.0010	-44%
1991	1.6125	0.7157	-56%	0.0063	0.0063	-1%	0.7930	0.3326	-58%	0.0011	0.0006	-44%
1992	1.3760	0.6107	-56%	0.0054	0.0054	-1%	0.6767	0.2838	-58%	0.0009	0.0005	-44%
1993	1.4146	0.6278	-56%	0.0056	0.0055	-1%	0.4638	0.2918	-37%	0.0009	0.0005	-44%
1994	1.2807	0.5684	-56%	0.0050	0.0050	-1%	0.4199	0.2642	-37%	0.0008	0.0005	-44%
1995	1.8432	0.8180	-56%	0.0073	0.0072	-1%	0.4835	0.3802	-21%	0.0012	0.0007	-44%
1996	1.8876	0.8378	-56%	0.0074	0.0073	-1%	0.4951	0.3894	-21%	0.0012	0.0007	-44%
1997	1.9448	0.8631	-56%	0.0077	0.0076	-1%	0.4272	0.4012	-6%	0.0013	0.0007	-44%
1998	2.3602	1.0475	-56%	0.0093	0.0092	-1%	0.5185	0.4869	-6%	0.0015	0.0009	-44%
1999	2.4995	1.1093	-56%	0.0098	0.0097	-1%	0.5491	0.5156	-6%	0.0016	0.0009	-44%

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	0.0080	0.0029	-64%	0.0962	0.0343	-64%	0.8014	0.2855	-64%	5.0233	3.8674	-23%
1991	0.0045	0.0017	-62%	0.0542	0.0204	-62%	0.4521	0.1700	-62%	2.9320	2.3032	-21%
1992	0.0036	0.0015	-60%	0.0437	0.0174	-60%	0.3639	0.1451	-60%	2.4510	1.9653	-20%
1993	0.0035	0.0015	-58%	0.0424	0.0179	-58%	0.3534	0.1492	-58%	2.4676	2.0206	-18%
1994	0.0030	0.0014	-55%	0.0358	0.0162	-55%	0.2987	0.1350	-55%	2.1867	1.8293	-16%
1995	0.0040	0.0019	-52%	0.0482	0.0233	-52%	0.4020	0.1943	-52%	3.0789	2.6327	-14%
1996	0.0038	0.0020	-48%	0.0462	0.0239	-48%	0.3849	0.1990	-48%	3.0833	2.6961	-13%
1997	0.0036	0.0021	-43%	0.0432	0.0246	-43%	0.3597	0.2051	-43%	3.1049	2.7778	-11%
1998	0.0041	0.0025	-39%	0.0492	0.0299	-39%	0.4099	0.2489	-39%	3.6808	3.3711	-8%
1999	0.0039	0.0026	-33%	0.0470	0.0316	-33%	0.3913	0.2635	-33%	3.4645	3.5701	3%
2000	0.0035	0.0035	0%	0.0422	0.0422	0%	0.3520	0.3520	-	3.8178	3.8178	-

YEAR	$PM_{2.5}$ [kt]			PM_{10} [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2001	0.0037	0.0037	0%	0.0439	0.0439	0%	0.3661	0.3661	-	4.2224	4.2224	-
2002	0.0028	0.0028	0%	0.0338	0.0338	0%	0.2815	0.2815	-	3.7377	3.7377	-
2003	0.0026	0.0026	0%	0.0315	0.0315	0%	0.2628	0.2628	-	3.7588	3.7588	-
2004	0.0020	0.0020	0%	0.0242	0.0242	0%	0.2016	0.2016	-	4.6096	4.6096	-

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 2011-2018. Therefore this activity was included into the category 2C5. The trends of emissions from production are presented in ***Figures 4.33*** and trends in activity data in ***Table 4.71***.

Figure 4.33: *Trends in emissions of air pollutants in 2C5*

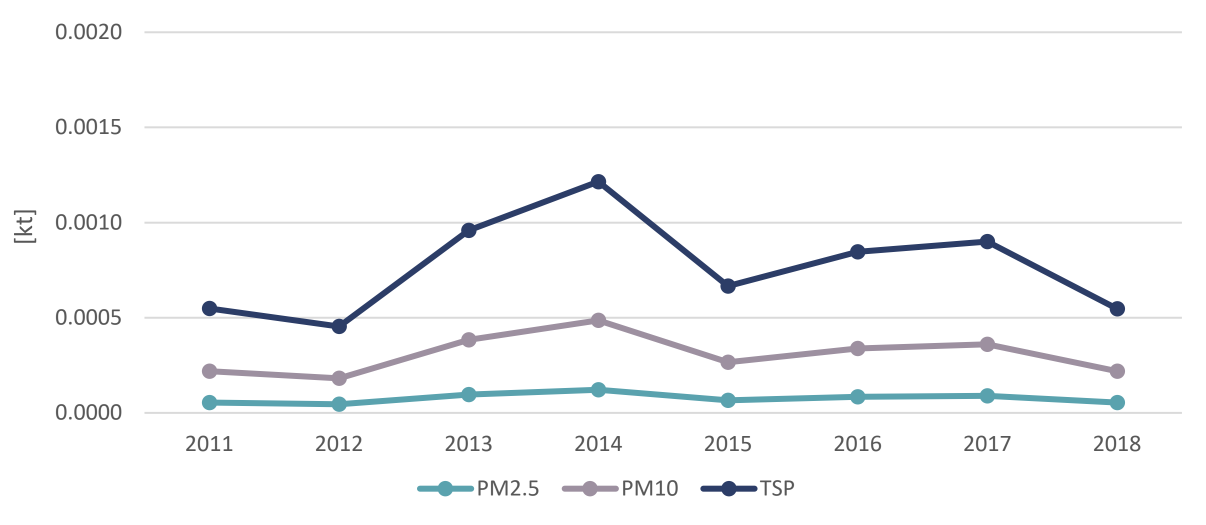


Table 4.71: *Activity data and emissions in the category 2C5*

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
1990/2018	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
2017/2018	**-84%**	**-68%**	**-82%**	**-4%**	**-39%**	**-39%**	**-39%**	**-49%**

4.6.6.2 Methodological issues

Activities defined in national legislation involved in category are presented in ***Table 4.72***.

Table 4.72: *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

About 89% of air pollutant emissions are measured by the way of representative individual mass flow and the number of operating hours (***Table 4.73***).

Table 4.73*: The overview of share of used calculation type for category 2C5 in the NEIS*

2C5	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	98%
4	Calculation using emission factor and amount of fuel	2%
5	Calculation using emission factor and amount of related quantity other than fuel	0%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0%

<u>HMs and POPs</u>

HMs and POPs were balanced using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 4.74***).

Table 4.74: *Emission factors of HMs and POPs in 2C5*

	Pb [g/t]	Cd [g/t]	Hg [g/t]	As [g/t]	Zn [g/t]	PCDD/F [µg I-*TEQ/t]	PCBs [µg/t]
EF	1.8	0.1	0.1	0.1	0.6	4.5	2

4.6.6.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2019}.

4.6.6.4 Source-specific recalculations

Activity data in this category was recalculated to be in compliance with GHG inventory.

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 are shown in the ***Table 4.75***.

Table 4.75: *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]	As [t]	Zn [t]	PCDD/F [g I-TEQ]	PCBs [kg]
2012	0.044	6E-05	5E-07	6E-07	7E-07	9E-09	2E-09	2E-09	1E-09	2E-07	2E-07	9E-08
2013	0.031	4E-05	4E-07	4E-07	5E-07	6E-09	1E-09	1E-09	9E-10	2E-07	2E-07	6E-08
2014	0.024	3E-05	3E-07	3E-07	4E-07	5E-09	1E-09	1E-09	7E-10	1E-07	1E-07	5E-08

4.6.7.2 Methodological issues

Tie 1 methodology from EMEP/EEA GB2019 was used to calculate emissions from this source. Emission factors are displayed in ***Table 4.76***.

Table 4.76: *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 riding pollutants were reported. For the period 1990-2013 and 2015-2018, notation key NO was used.

4.6.7.3 Source-specific recalculations

This category was reported for the first time in this submission.

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 included in category 2C7c - Other metal production because 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.

This category is key for emissions of Pb, Cd, Cr, Cu and Ni. Trends of these emissions are shown in ***Figure 4.34***. Activity data, emissions and its trend are shown in ***Table 4.77***. Emission trend of these pollutants is increasing due to the activity within the category.

Figure 4.34*: Emission trends in the category 2C7a*

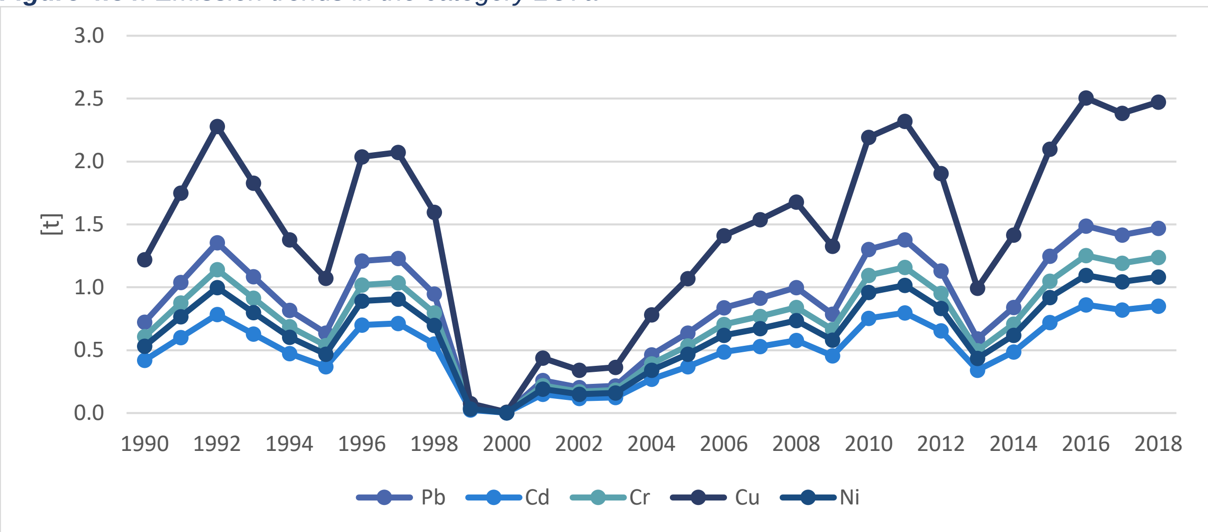


Table 4.77: Activity data and emissions in the category 2C7a

YEAR	COPPER PRODUCED [kt]	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	PCDD/F [g I-TEQ]	PCBs [kg]
1990	38.08	0.7236	0.4189	0.0009	0.1523	0.6093	1.2187	0.5332	0.1904	3E-05
1995	33.51	0.6367	0.3686	0.0008	0.1340	0.5361	1.0723	0.4691	0.1675	3E-05
2000	0.22	0.0042	0.0024	0.0000	0.0009	0.0035	0.0071	0.0031	0.0011	2E-07
2005	33.44	0.6354	0.3679	0.0008	0.1338	0.5351	1.0701	0.4682	0.1672	3E-05
2010	68.51	1.3017	0.7536	0.0016	0.2740	1.0961	2.1923	0.9591	0.3425	6E-05
2011	72.49	1.3772	0.7973	0.0017	0.2899	1.1598	2.3195	1.0148	0.3624	7E-05
2012	59.51	1.1306	0.6546	0.0014	0.2380	0.9521	1.9042	0.8331	0.2975	5E-05
2013	31.02	0.5893	0.3412	0.0007	0.1241	0.4963	0.9925	0.4342	0.1551	3E-05
2014	44.24	0.8406	0.4866	0.0010	0.1770	0.7078	1.4157	0.6194	0.2212	4E-05
2015	65.61	1.2466	0.7217	0.0015	0.2624	1.0497	2.0995	0.9185	0.3280	6E-05
2016	78.29	1.4875	0.8612	0.0018	0.3132	1.2526	2.5053	1.0960	0.3914	7E-05
2017	74.50	1.4156	0.8196	0.0017	0.2980	1.1921	2.3842	1.0431	0.3725	7E-05
2018	77.31	1.4689	0.8504	0.0018	0.3092	1.2369	2.4739	1.0823	0.3865	7E-05
1990/2018	**103%**	**103%**	**103%**	**103%**	**103%**	**103%**	**103%**	**103%**	**103%**	**103%**
2017/2018	**4%**	**4%**	**4%**	**4%**	**4%**	**4%**	**4%**	**4%**	**4%**	**4%**

4.6.8.2 Methodological issues

Heavy metals and POPs

Inventory of heavy metals and POPs is calculated following Tier 1 EF from EMEP/EEA GB_{2019} (***Table 4.78***).

Table 4.78: Emission factor for heavy metals and POPs in the category 2C7a

	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]
EF	19	11	0.023	4	16	32	14	5	0.9

4.6.8.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2019}. Emissions of HMs and POPs was changed from country-specific to following EMEP/EEA GB_{2019}.

4.6.8.4 Source-specific recalculations

This category was recalculated due to change of source of emission factors (***Table 4.79***). Following recommendation No ***SK-2C7a-2019-0002***, country-specific emission factors were reconsidered and emission factor from EMEP/EEA GB_{2019}. Emission factor for PCBs was corrected. Change of methodology caused that implementation of recommendation No ***SK-2C7a-2019-0001*** was not possible.

Table 4.79: Previous and refined emissions in the category 2C5

YEAR	Pb [t]			Cd[t]			Hg [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.1095	0.7236	561%	NA	0.4189	-	12.1801	0.0009	-100%
1991	6.3690	1.0388	-84%	0.0592	0.6014	917%	8.1765	0.0013	-100%
1992	12.6284	1.3541	-89%	0.1183	0.7839	563%	4.1730	0.0016	-100%
1993	10.1690	1.0857	-89%	0.0952	0.6286	561%	3.2796	0.0013	-100%
1994	7.7096	0.8174	-89%	0.0720	0.4732	557%	2.3862	0.0010	-100%
1995	7.1768	0.6367	-91%	0.0683	0.3686	440%	0.1129	0.0008	-99%
1996	11.1298	1.2104	-89%	0.0832	0.7008	743%	3.8901	0.0015	-100%
1997	11.1329	1.2311	-89%	0.0832	0.7127	757%	4.2381	0.0015	-100%

YEAR	Pb [t]			Cd[t]			Hg [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1998	8.3519	0.9477	-89%	0.0727	0.5487	655%	3.6257	0.0011	-100%
1999	0.3238	0.0445	-86%	NA	0.0258	-	0.2623	0.0001	-100%
2000	0.0006	0.0042	561%	NA	0.0024	-	0.0705	0.0000	-100%
2001	2.9515	0.2596	-91%	0.0375	0.1503	301%	0.0526	0.0003	-99%
2002	2.3204	0.2028	-91%	0.0276	0.1174	326%	0.0113	0.0002	-98%
2003	2.5447	0.2164	-91%	0.0540	0.1253	132%	0.0002	0.0003	21%
2004	5.4025	0.4640	-91%	0.0978	0.2686	175%	0.0119	0.0006	-95%
2005	7.4561	0.6354	-91%	0.1538	0.3679	139%	0.0006	0.0008	25%
2006	9.8022	0.8383	-91%	0.1884	0.4853	158%	0.0008	0.0010	35%
2007	10.8528	0.9130	-92%	0.2738	0.5286	93%	0.0011	0.0011	1%
2008	11.6995	0.9971	-91%	0.2373	0.5773	143%	0.0009	0.0012	27%
2009	9.1365	0.7878	-91%	0.1452	0.4561	214%	0.0006	0.0010	64%
2010	14.9850	1.3017	-91%	0.1925	0.7536	291%	0.0008	0.0016	105%
2011	15.8654	1.3772	-91%	0.2080	0.7973	283%	0.0008	0.0017	100%
2012	12.9540	1.1306	-91%	0.1434	0.6546	357%	0.0006	0.0014	139%
2013	6.8237	0.5893	-91%	0.1046	0.3412	226%	0.0004	0.0007	71%
2014	9.7481	0.8406	-91%	0.1580	0.4866	208%	0.0006	0.0010	61%
2015	14.3441	1.2466	-91%	0.1862	0.7217	288%	0.0007	0.0015	103%
2016	17.2270	1.4875	-91%	0.2642	0.8612	226%	0.0011	0.0018	70%
2017	16.4412	1.4155	-91%	0.2697	0.8195	204%	0.0011	0.0017	59%

YEAR	As [t]			Cu [t]		
	P	R	CHANGE	P	R	CHANGE
1990	73.4621	0.1523	-100%	53.4685	1.2187	-98%
1991	67.8267	0.2187	-100%	55.3216	1.7496	-97%
1992	62.1912	0.2851	-100%	57.1748	2.2805	-96%
1993	50.2466	0.2286	-100%	46.0463	1.8286	-96%
1994	38.3020	0.1721	-100%	34.9178	1.3767	-96%
1995	19.7480	0.1340	-99%	21.5176	1.0723	-95%
1996	54.4264	0.2548	-100%	50.6122	2.0386	-96%
1997	56.5251	0.2592	-100%	52.1398	2.0734	-96%
1998	47.8493	0.1995	-100%	42.4761	1.5962	-96%
1999	2.7694	0.0094	-100%	2.3057	0.0750	-97%
2000	0.4251	0.0009	-100%	0.3094	0.0071	-98%
2001	4.7724	0.0547	-99%	6.9283	0.4372	-94%
2002	3.6402	0.0427	-99%	5.3723	0.3415	-94%
2003	5.3211	0.0456	-99%	6.3747	0.3645	-94%
2004	11.0159	0.0977	-99%	13.5564	0.7814	-94%
2005	17.1807	0.1338	-99%	19.5932	1.0701	-95%
2006	21.6111	0.1765	-99%	25.3580	1.4119	-94%
2007	21.1771	0.1922	-99%	25.9327	1.5376	-94%
2008	20.8145	0.2099	-99%	27.4162	1.6794	-94%
2009	15.8086	0.1658	-99%	21.5572	1.3268	-94%
2010	19.7899	0.2740	-99%	32.4363	2.1923	-93%
2011	21.2243	0.2899	-99%	34.4506	2.3195	-93%
2012	18.2428	0.2380	-99%	28.8870	1.9042	-93%
2013	12.4487	0.1241	-99%	16.4896	0.9925	-94%
2014	22.8763	0.1770	-99%	26.2634	1.4157	-95%
2015	26.8872	0.2624	-99%	35.3849	2.0995	-94%

YEAR	As [t]			Cu [t]		
	P	R	CHANGE	P	R	CHANGE
2016	29.4963	0.3132	-99%	40.5687	2.5053	-94%
2017	27.8241	0.2980	-99%	38.3675	2.3840	-94%

P-Previous
R-Refined

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 use of NO key for fuels was advised by TERT.

4.6.10 OTHER METAL PRODUCTION (2C7c)

4.6.10.1 Overview

The trends of emission from other metal production are presented in ***Figures 4.35*** and trends in fuel in ***Table 4.80***. An increasing trend of emissions is connected to the increase of activity data (**Chapter 4.6.4, Chapter 4.6.8**).

Figure 4.35: *Trends in emissions of particulate matter in 2C7c*

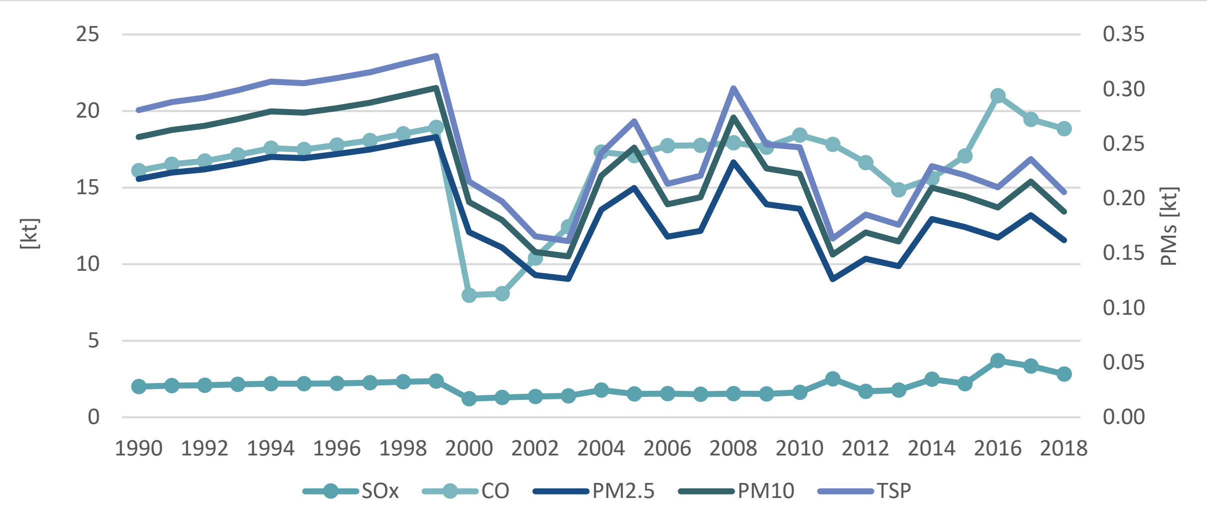


Table 4.80: *Overview of emissions in the category 2C7c*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	0.8261	0.1054	2.0090	0.0080	0.2180	0.2561	0.2809	0.0002	16.0954
1995	0.8979	0.1146	2.1838	0.0087	0.2369	0.2784	0.3054	0.0002	17.4955
2000	0.3979	0.0782	1.2100	0.0057	0.1693	0.1969	0.2155	0.0002	7.9739
2005	1.0360	0.2146	1.5127	0.0048	0.2096	0.2467	0.2706	0.0002	17.0967
2010	1.2762	0.2347	1.6297	0.0034	0.1907	0.2224	0.2468	0.0002	18.4346
2011	1.3917	0.2615	2.5044	0.0034	0.1262	0.1489	0.1634	0.0001	17.8252
2012	1.3795	0.1708	1.6797	0.0043	0.1448	0.1690	0.1852	0.0001	16.6361
2013	1.0435	0.1318	1.7763	0.0043	0.1382	0.1608	0.1760	0.0001	14.8450
2014	1.0100	0.2102	2.4813	0.0043	0.1811	0.2099	0.2297	0.0002	15.6133
2015	1.0792	0.2261	2.1903	0.0037	0.1739	0.2022	0.2213	0.0002	17.0755
2016	1.0810	0.3766	3.6912	0.0032	0.1642	0.1918	0.2102	0.0002	20.9922

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2017	1.2824	0.3203	3.3387	0.0030	0.1848	0.2155	0.2360	0.0002	19.4547
2018	1.2257	0.3012	2.8157	0.0031	0.1619	0.1881	0.2059	0.0002	18.8361
1990/2018	**48%**	**186%**	**40%**	**-61%**	**-26%**	**-27%**	**-27%**	**-26%**	**17%**
2017/2018	**-4%**	**-6%**	**-16%**	**4%**	**-12%**	**-13%**	**-13%**	**-12%**	**-3%**

4.6.10.2 Methodological issues

Activities defined in national legislation involved in category are presented in ***Table 4.81***.

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 projected volume of baths in m3 b) Surface treatment - by using an chemical processes with projected volume of baths in m3 c) Surface treatment - application of metal or alloy layers and metal coatings and their alloys except for crude steel in melt with a projected capacity in kg / h d) Surface treatment - application of metal or alloy layers, using flame, electric arc, plasma or other method with projected capacity in kg/h e) Surface treatment - application of protective coating from molten metals with 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 m2 / h h) Related activities - abrasive cleaning (blasting), excluding cassette equipment, with a projected capacity of processed material in m2 / h i) Related activities - thermal cleaning: - with the volume of the combustion chamber in m3 or - with operation hours per year j) Related activities - electrolytic-plasma cleaning, degreasing and polishing with a projected capacity in dm2 / h

More than 74% of air pollutant emissions are calculated using another manner of determination defined in the Decree 410/2012 Coll. (***Table 4.82***).

Table 4.82*: The overview of share of used calculation type for category 2C7c in the NEIS*

2C7C	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0.003%
3	Calculation using representative individual mass flow and number of operating hours	24.473%
4	Calculation using emission factor and amount of fuel	0.251%
5	Calculation using emission factor and amount of related quantity other than fuel	0.684%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0.018%
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	0.000%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	74.6%

4.6.10.3 Completeness

All rising pollutants were reported. Notation keys were used in compliance with EMEP/EEA GB_{2019}. Methodology for HMs and POPs was considered as outdated and due to possible double-counting with the **Energy sector** emissions were replaced by notation key following the EMEP/EEA GB_{2019}.

4.6.10.4 Source-specific recalculations

This category was recalculated due to change of source of emission factors (***Table 4.83***).

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	0.9406	0.8261	-12%	0.0453	0.1054	133%	4.2650	2.0090	-53%	0.0251	0.0080	-68%
1991	0.9548	0.8476	-11%	0.0533	0.1082	103%	4.1924	2.0614	-51%	0.0239	0.0082	-66%
1992	0.9575	0.8592	-10%	0.0609	0.1097	80%	4.0635	2.0896	-49%	0.0232	0.0083	-64%
1993	0.9695	0.8795	-9%	0.0694	0.1122	62%	3.9688	2.1390	-46%	0.0223	0.0085	-62%
1994	0.9836	0.9022	-8%	0.0784	0.1151	47%	3.8756	2.1942	-43%	0.0217	0.0087	-60%
1995	0.9681	0.8979	-7%	0.0852	0.1146	34%	3.6625	2.1838	-40%	0.0202	0.0087	-57%
1996	0.9722	0.9120	-6%	0.0939	0.1164	24%	3.5221	2.2180	-37%	0.0188	0.0088	-53%
1997	0.9774	0.9274	-5%	0.1029	0.1184	15%	3.3807	2.2556	-33%	0.0173	0.0089	-48%
1998	0.9893	0.9496	-4%	0.1130	0.1212	7%	3.2555	2.3094	-29%	0.0159	0.0092	-42%
1999	1.0000	0.9711	-3%	0.1233	0.1239	1%	3.1189	2.3619	-24%	0.0139	0.0094	-33%

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	0.3642	0.2180	-40%	0.4235	0.2561	-40%	0.4636	0.2809	-39%	20.2308	16.0954	-20%
1991	0.3622	0.2236	-38%	0.4211	0.2628	-38%	0.4611	0.2883	-37%	20.3975	16.5149	-19%
1992	0.3555	0.2267	-36%	0.4133	0.2664	-36%	0.4525	0.2922	-35%	20.3113	16.7411	-18%
1993	0.3519	0.2321	-34%	0.4092	0.2727	-33%	0.4480	0.2991	-33%	20.4174	17.1369	-16%
1994	0.3488	0.2380	-32%	0.4056	0.2797	-31%	0.4440	0.3068	-31%	20.5604	17.5791	-15%
1995	0.3349	0.2369	-29%	0.3894	0.2784	-29%	0.4264	0.3054	-28%	20.0806	17.4955	-13%
1996	0.3278	0.2406	-27%	0.3812	0.2827	-26%	0.4173	0.3102	-26%	20.0070	17.7694	-11%
1997	0.3207	0.2447	-24%	0.3730	0.2875	-23%	0.4083	0.3154	-23%	19.9514	18.0705	-9%
1998	0.3155	0.2505	-21%	0.3669	0.2944	-20%	0.4017	0.3230	-20%	20.0234	18.5016	-8%
1999	0.3095	0.2562	-17%	0.3599	0.3011	-16%	0.3940	0.3303	-16%	20.0653	18.9221	-6%
2000	0.1693	0.1672	-1%	0.1969	0.1965	0%	0.2155	0.2155	-	7.9739	7.9739	-
2001	0.1551	0.1532	-1%	0.1804	0.1800	0%	0.1975	0.1975	-	8.0808	8.0808	-
2002	0.1300	0.1284	-1%	0.1512	0.1509	0%	0.1655	0.1655	-	10.3992	10.3992	-
2003	0.1265	0.1249	-1%	0.1471	0.1468	0%	0.1611	0.1611	-	12.4361	12.4361	-
2004	0.1898	0.1874	-1%	0.2207	0.2202	0%	0.2416	0.2416	-	17.3221	17.3221	-

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. Heavy metals and POPs are reported by NA or NE.

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 in addition 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*

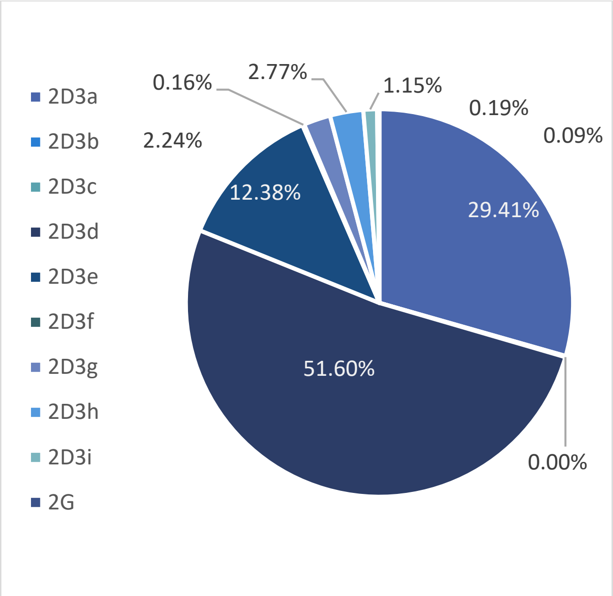
NFR CODE	LONGNAME
2D3a	Domestic solvent use including fungicides
2D3b	Road paving with asphalt
2D3c	Asphalt roofing
2D3d	Coating applications
2D3e	Degreasing
2D3f	Dry cleaning
2D3g	Chemical products
2D3h	Printing
2D3i	Other solvent use
2G	Other product use

4.7.1 OVERVIEW

Concerning air protection, the most important emissions rising up 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.

Shares of released emissions of NMVOC in 2018 included in NFR categories 2D are presented in ***Figure 4.36***.

Figure 4.36 *The share in NMVOC emissions of individual categories in 2D in 2018*



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 (***Figure 4.37***). Emissions, its trend and activity data are shown in ***Table 4.85***. This category is key for NMVOC.

Figure 4.37: *NMVOC emission trend in the category 2D3a*

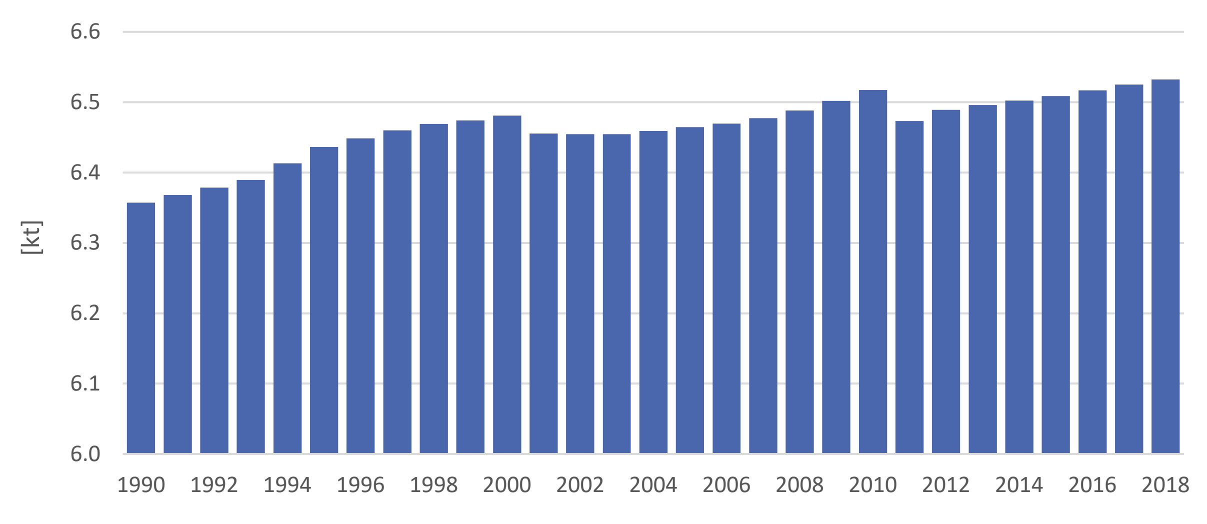


Table 4.85: *Activity data and emissions in the category 2D3a*

YEAR	INHABITANTS	NMVOC [kt]	Hg [t]
1990	5297774	6.3573	0.0297
1995	5363676	6.4364	0.0300
2000	5400679	6.4808	0.0302
2005	5387285	6.4647	0.0302
2010	5431024	6.5172	0.0304
2011	5394251	6.4731	0.0302
2012	5407579	6.4891	0.0303
2013	5413392.5	6.4961	0.0303
2014	5418649	6.5024	0.0303
2015	5423800	6.5086	0.0304
2016	5430798	6.5170	0.0304
2017	5437754	6.5253	0.0305
2018	5446770.5	6.5361	0.0305
1990/2018	**3%**	**3%**	**3%**
2017/2018	**0%**	**0%**	**0%**

4.7.1.2 Methodological issues

This category is performed by Tier 1 method due to the lack of detailed activity data from households. The equation is used:

$$Em_{\ TOTAL} = AD * EF_{(GB2019)}$$

Where

AD = inhabitants

EF = 1200 [g/capita]

Activity data (Mid-year population) is from the Statistical Office. Emission factor (EF) used for calculation is based on the EMEP/EEA GB_{2019} for Other countries **1 200 g/capita**.

4.7.1.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.1.4 Source-specific recalculations

No recalculations in this submission.

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 (***Figure 4.38***, ***Table 4.86***).

Figure 4.38: *NMVOC emission trend in the category 2D3b*

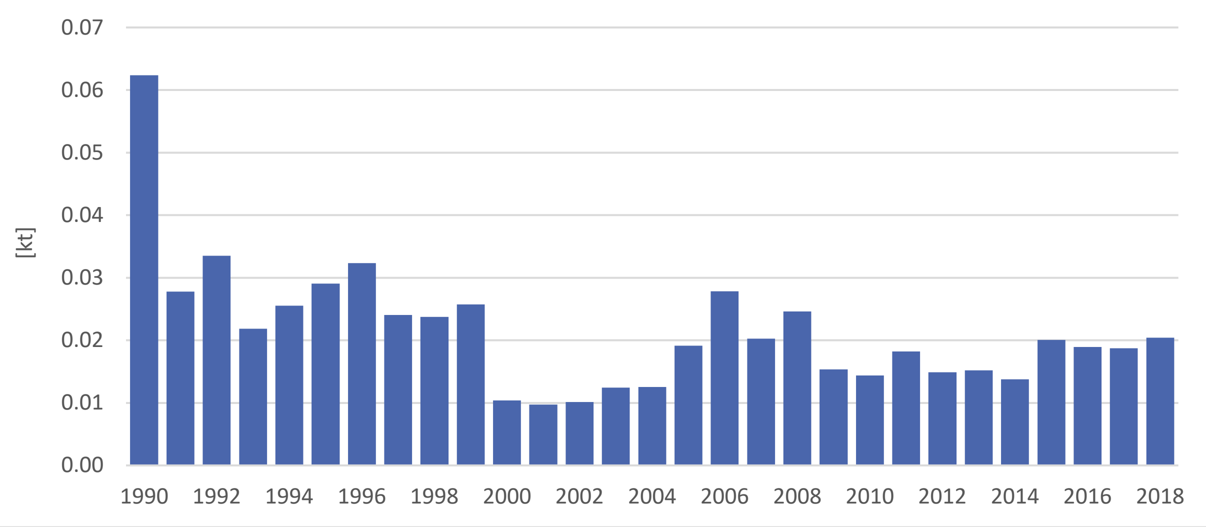


Table 4.86: *Activity data and emissions in the category 2D3b*

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	0.0624	0.0019	0.0225	0.1874	1E-04	0.0257
1995	170986.00	0.0291	0.0009	0.0105	0.0873	5E-05	0.0120
2000	60963.00	0.0104	0.0003	0.0031	0.0258	1E-05	0.0043
2005	112992.00	0.0191	0.0001	0.0014	0.0117	7E-06	0.0079
2010	105650.00	0.0144	0.0001	0.0008	0.0069	4E-06	0.0074
2011	125300.00	0.0182	0.0001	0.0011	0.0088	5E-06	0.0088
2012	102250.00	0.0149	0.0001	0.0008	0.0070	4E-06	0.0072
2013	85950.00	0.0152	0.0001	0.0010	0.0086	5E-06	0.0060
2014	79195.00	0.0137	0.0001	0.0010	0.0082	5E-06	0.0055
2015	147300.00	0.0201	0.0001	0.0015	0.0124	7E-06	0.0103
2016	105800.00	0.0189	0.0001	0.0007	0.0058	3E-06	0.0074
2017	109993.00	0.0187	0.0001	0.0006	0.0054	3E-06	0.0077
2018	128394.00	0.0204	0.0000	0.0006	0.0047	3E-06	0.0090
1990/2018	**-65%**	**-67%**	**-98%**	**-98%**	**-98%**	**-98%**	**-65%**
2017/2018	**17%**	**9%**	**-13%**	**-13%**	**-13%**	**-13%**	**17%**

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 4.87: *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 / hours.

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: The 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.

$$Em\ [t] = q\ [kg/hod] * t\ [hod] * 10^{-3}$$

Where

q = Mass flow

t = Number of operational hours for related year

The rest of operators (approx. 30 %) report the emissions by the calculation:

$$Em\ [t] = (1-\eta/100) * EF\ [kg/M\ of\ AD] * AD\ [M\ of\ AD] * 10^{-3}$$

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:

$$Em\ [t] = (1-\eta/100) * EF\ [kg/t] * AD\ [t] * 10^{-3}$$

$$Em_{TOTAL} = (1-\eta/100) * EF\ [kg/mil.m^3] * AD\ [tis.m^3]$$

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 from 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 2018.

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 2005-2015 and related yearly consumption of asphalt. PMs were calculated as an average of share from TSP in previous years 2005–2015.

EF_{NMVOC} = 170 [g/Mg Asphalt]

EF_{TSP} = 510.80 [g/Mg Asphalt]

$EF_{PM2.5}$ = 1% EF_{TSP}

EF_{PM10} = 12% EF_{TSP}

4.7.2.3. Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.2.4 Source-specific recalculations

No recalculation in this submission.

4.7.3 ASPHALT ROOFING (NFR 2D3c)

4.7.3.1 Overview

The category reports NMVOC, $PM_{2.5}$, PM_{10}, TSP, BC and CO emissions. The emissions have an overall decreasing trend (***Figure 4.39***, ***Table 4.88***). However, in absolute values, the amount of released emissions in 2018 is 0.001kt, which is an insignificant amount.

[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

Figure 4.39: *NMVOC emission trend in the category 2D3c*

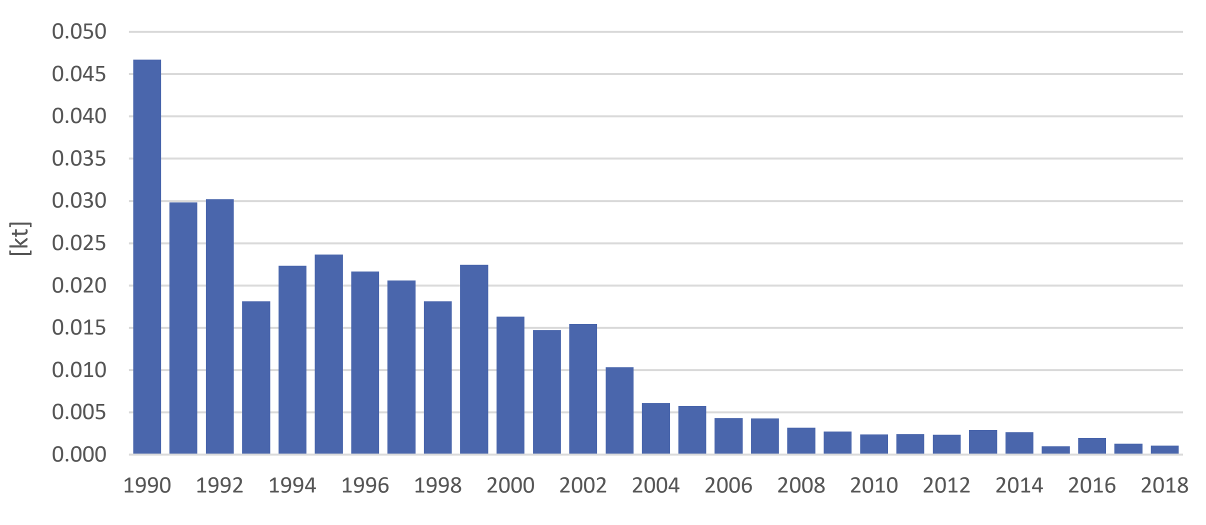


Table 4.88: *Activity data and emissions in the category 2D3c*

YEAR	ASPHALT USED FOR ROOFING [kt]	NMVOC [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	130.17	0.0467	0.1120	0.1403	0.1417	1E-03	0.0007
1995	65.92	0.0237	0.0567	0.0711	0.0718	7E-04	0.0004
2000	46.47	0.0163	0.0454	0.0570	0.0575	6E-04	0.0003
2005	32.28	0.0058	0.0038	0.0047	0.0048	5E-05	0.0001
2010	25.26	0.0024	0.0014	0.0017	0.0017	2E-05	0.0002
2011	28.10	0.0024	0.0015	0.0019	0.0019	2E-05	0.0001
2012	27.59	0.0023	0.0014	0.0018	0.0018	2E-05	0.0001
2013	6.64	0.0029	0.0014	0.0018	0.0018	2E-05	0.0002
2014	18.54	0.0026	0.0011	0.0013	0.0013	1E-05	0.0001
2015	NE	0.0010	0.0004	0.0005	0.0005	5E-06	0.0001
2016	NE	0.0020	0.0006	0.0008	0.0008	8E-06	0.0001
2017	NE	0.0013	0.0004	0.0006	0.0006	6E-06	0.0001
2018	NE	0.0011	0.0004	0.0005	0.0005	6E-06	0.0001
1990/2018	**-**	**-98%**	**-100%**	**-100%**	**-100%**	**-100%**	**-89%**
2017/2018	**-**	**-17%**	**-3%**	**-3%**	**-3%**	**-3%**	**6%**

4.7.3.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.89*: 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 a 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 years 2005 to 2018.

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 2005-2015 and related consumption of asphalt used for roofing from statistics. PMs were calculated as an average of share from TSP in previous years 2005–2015. 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_{CO} = 5.53 [g/Mg Asphalt Use for Roofing]

$EF_{PM2.5}$ = 79% EF_{TSP}

EF_{PM10} 99% EF_{TSP}

EF_{BC} = 0.013% EF_{TSP}

4.7.3.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.3.4 Source-specific recalculation

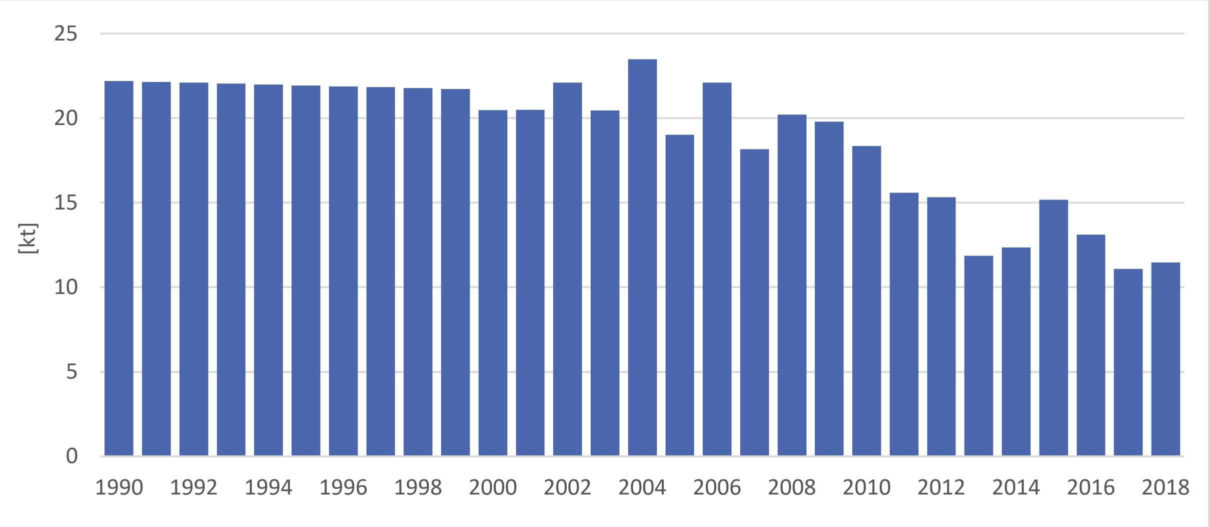
No recalculation in this submission.

4.7.4 COATING APPLICATIONS (NFR 2D3d)

4.7.4.1 Overview

The category reports NMVOC emissions. The emissions have an overall decreasing trend (***Figure 4.40***). This category is key for emissions of NMVOC.

Figure 4.40: *NMVOC emission trend in the category 2D3d*



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 4.90**: 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 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 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:

$$\boxed{Em_{\text{TOTAL}} = Em_{\text{SMALL SOURCES}} + Em_{\text{NEIS}}}$$

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:

a) $E\ [t] = c\ [mg/m^3] * V\ [tis.m^{-3}] * 10^{-6}$

Where

c = concentration of air pollutant

V = quantity/volume of released waste gas

b) $E\ [t] = q\ [kg/hod] * t\ [hod] * 10^{-3}$

Where

q = mass flow

t = number of operational hours for related year

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

<u>*Calculations of Small Sources:*</u> Small sources were balanced. The balance is performed by 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%.

<u>*Small sources calculation:*</u>

Production + Import – Export = Total Product Consumption

Total Product Consumption → Calculation of Total Solvents Consumption

Total Solvents Consumption - Industrial Solvents Consumption = Small Sources

<u>Adjustment for VOC content:</u> To implement recommendation No SK-2A1-2019-0001, the following section was added. The data is reduced by the coefficient 0.7 from 2010 to the last reported year. The coefficient represents average reduction referred to the reduced content of VOCs in products since 2010 to previous values. 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 2018. 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 4.91: *Statistical activity data of total product consumption in t*

YEAR	SB	WB
2001	32 009	21 231
2002	36 099	23 569
2003	33 595	26 342
2004	40 746	26 516
2005	35 395	30 356
2006	47 038	31 443
2007	37 268	37 450
2008	37 402	76 942
2009	38 083	62 771
2010	51 429	77 875
2011	45 838	47 400
2012	45 410	43 655
2013	46 748	52 248
2014	52 626	58 059
2015	54 251	97 764
2016	51 658	65 932
2017	43 334	74 089
2018	45 025	98 840

Table 4.92: *2D3d - Emission of NMVOC (t) in division of Small sources and Industrial sources*

YEAR	EM SS	EM NEIS
2005	12 542	6 479
2006	15 663	6 430
2007	10 436	7 735

YEAR	EM SS	EM NEIS
2008	13 140	7 063
2009	13 422	6 371
2010	11 196	7 154
2011	8 355	7 234
2012	7 995	7 335
2013	8 816	3 052
2014	9 094	3 259
2015	11 843	3 342
2016	9 624	3 490
2017	7 422	3 658
2018	8 157	3 857

4.7.4.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.4.4 Source-specific recalculations

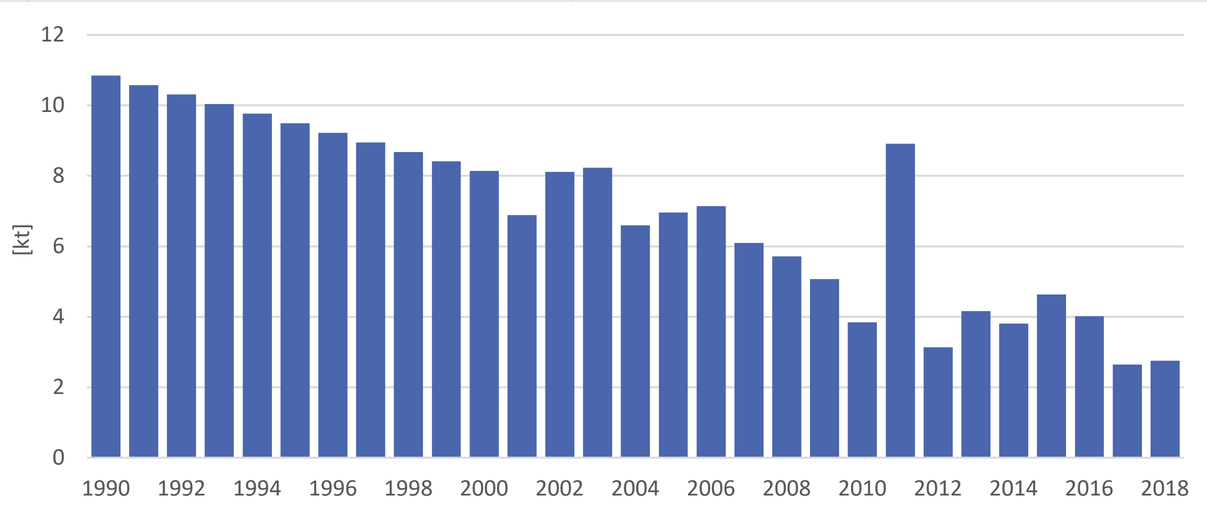
No recalculation in this submission.

4.7.5 DEGREASING (NFR 2D3e)

4.7.5.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (***Figure 4.41***). The peak of recorded emission in 2011 relates to the activity data from statistics, namely decrease of exported solvents and increased amount of imported. 2D3e is a key category for emissions of NMVOC.

Figure 4.41: *NMVOC emission trend in the category 2D3e*



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 4.93: *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:

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
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 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 (perchlorethylene), 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 4.94: *2D3e- Emission of NMVOC (t) in division of small sources and industrial sources*

YEAR	EM SS	EM NEIS
2005	6 680	280
2006	6 866	277
2007	5 742	359
2008	5 418	292
2009	4 864	210
2010	3 627	217
2011	8 700	214
2012	2 934	202
2013	4 060	96
2014	3 719	89
2015	4 542	90
2016	3 918	94
2017	2 536	112
2018	4 312	97

4.7.5.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.5.4 Source-specific recalculations

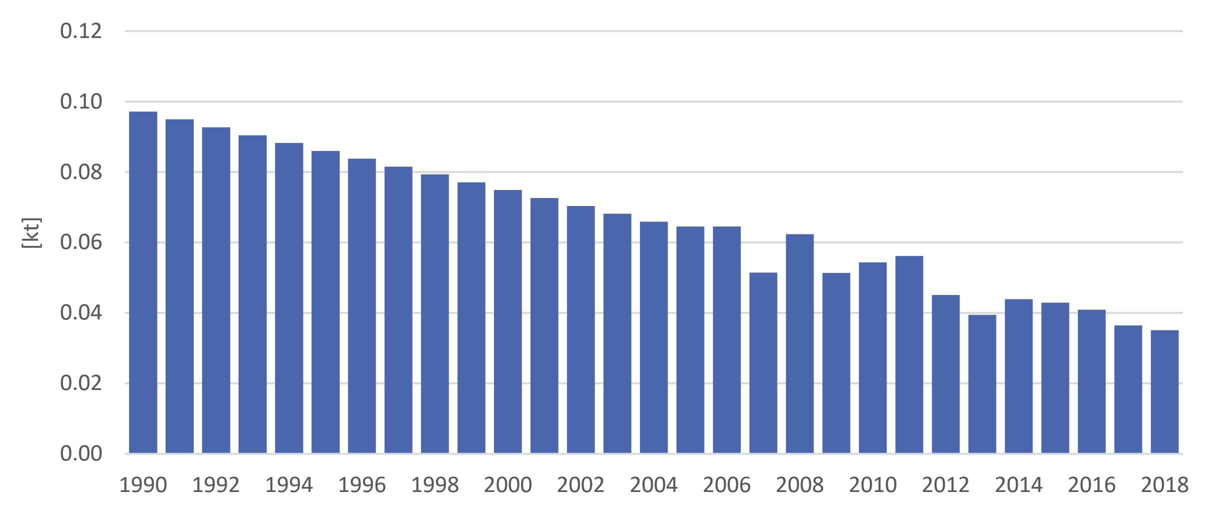
No recalculation in this submission.

4.7.6 DRY CLEANING (NFR 2D3f)

4.7.6.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (***Figure 4.42***).

Figure 4.42: *NMVOC emission trend in the category 2D3f*



4.7.6.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.95: *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.

$Em_{TOTAL} = Em_{NEIS}$

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 are calculated by equations:

$E\ [t] = c\ [mg/m^3] * V\ [tis.m^{-3}] * 10^{-6}$

Where

c = concentration of air pollutant

V = quantity/volume of released waste gas

b) $E\ [t] = q\ [kg/hod] * t\ [hod] * 10^{-3}$

Where

q = mass flow

t = number of operational hours for related year

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 2018. Due to the absence of statistical data before 2001 as well as data in the NEIS before 2005, the historical data are extrapolated with a linear trend.

4.7.6.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.6.4 Source-specific recalculations

No recalculation in this submission.

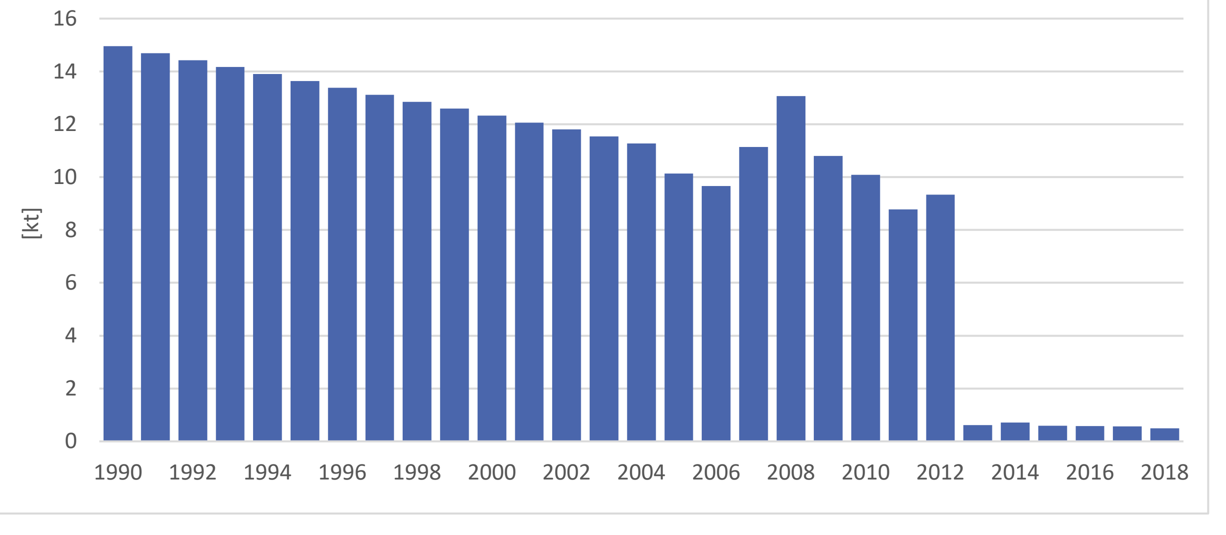
4.7.7 CHEMICAL PRODUCTS (NFR 2D3g)

4.7.7.1 Overview

The category reports NMVOC emissions. The emissions show a decreasing overall trend (***Figure 4.43***). The most remarkable decline was in 2013 (from 9.3313 kt in 2012 dropped to 0.6198 kt in 2013). The significant change has been caused by reconstruction of the major contributing company, that is classified under 4.19 – Manufacture of paints, varnishes, inks, glues and adhesives during 2013 when the installation was out of the service, while in 2015 the small emission values were due to the realization of technological improvements.

Also, the data for 2012 and earlier were processed by the same method, but the technical inconsistency in the database was found as a result of quality check. The solution for correcting data will be delivered in the next submission. Emissions in the period 1990-2012 are overestimated significantly. This category is key for emissions of NMVOC.

Figure 4.43: *NMVOC emission trend in the category 2D3g*



4.7.7.2 Methodological issues

The source of emissions is the NEIS database – recorded facility data from operators.

Table 4.96: *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 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 a projected quantities for tonne / day b) treatment of the leather, except of footwear and shoes 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 production and activities. Thus facility data from the NEIS (b/ Tier 3: Em TOTAL = 100% NEIS) is used.

$$\boxed{Em_{TOTAL} = Em_{NEIS}}$$

__*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:

a) $E\ [t] = c\ [mg/m^3] * V\ [tis.m^{-3}] * 10^{-6}$

Where

c = concentration of air pollutant

V = quantity/volume of released waste gas

b) $E\ [t] = q\ [kg/hod] * t\ [hod]*10^{-3}$

Where

q = mass flow

t = number of operational hours for the related year

c) Direct and indirect balance in case of unambiguous emission dependence

$E = O1 + F$

Where

O1 = Emissions released by outputs

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 2005 to 2018. Due to the absence of any statistical data before 2001 as well as data in the NEIS before 2005, the historical data are extrapolated with a linear trend.

4.7.7.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.7.4 Source-specific recalculations

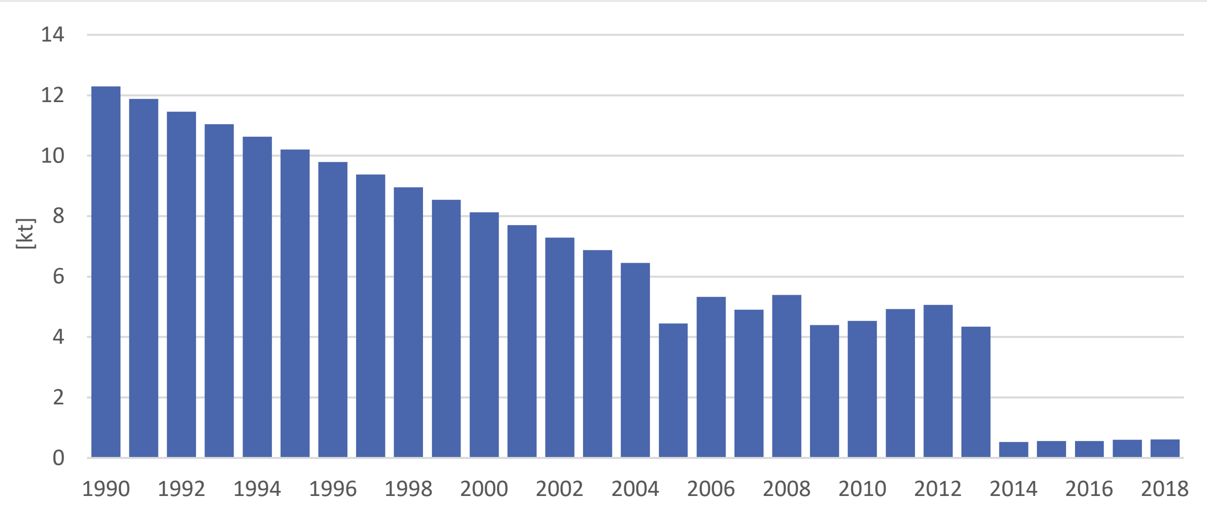
No recalculations in this submission. The solution for correcting data will be delivered in next submission (2021) due to change in the position of the expert for this sector.

4.7.8 PRINTING (NFR 2D3h)

4.7.8.1 Overview

The category reports NMVOC emissions. The emissions have decreasing overall trend (***Figure 4.44***). Decrease in 2013 is a result of the technological problem within the source database. Emissions in the period 1990-2012 are overestimated significantly.

Figure 4.44: *NMVOC emission trend in the category 2D3h*



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 4.97: *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

CATEGORIZATION ACCORDING TO THE ANNEX NO 6 OF DECREE NO 410/2012 COLL. AS AMENDED:
g) other printing techniques, such as cold offset, sheet-fed equipment and other

Emission calculations:

$$Em_{\text{TOTAL}} = Em_{\text{SMALL SOURCES}} + Em_{\text{NEIS}}$$

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 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 years 2005 to 2018. Due to the absence of any statistical data before 2001 as well as data in the NEIS before 2005, the historical data are extrapolated with a linear trend.

4.7.8.3 Completeness

All pollutants are covered. Notation keys were used following the EMEP/EEA GB_{2019}.

4.7.8.4 Source-specific recalculations

No recalculations in this submission. After the check of the NEIS database, it was recorded that for 2012 and older years, the technical inconsistency in the database was found as a result of quality check. The solution for correcting data will be performed in next submission.

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 4.98***. Emission trend of NMVOC and Zn (2D3i is a key category for this pollutant) are shown in ***Figure 4.45.*** Emissions in this category calculated from lubricant consumption in transport show ***Table 4.99***.

Figure 4.45: *NMVOC emissions in the category 2D3i*

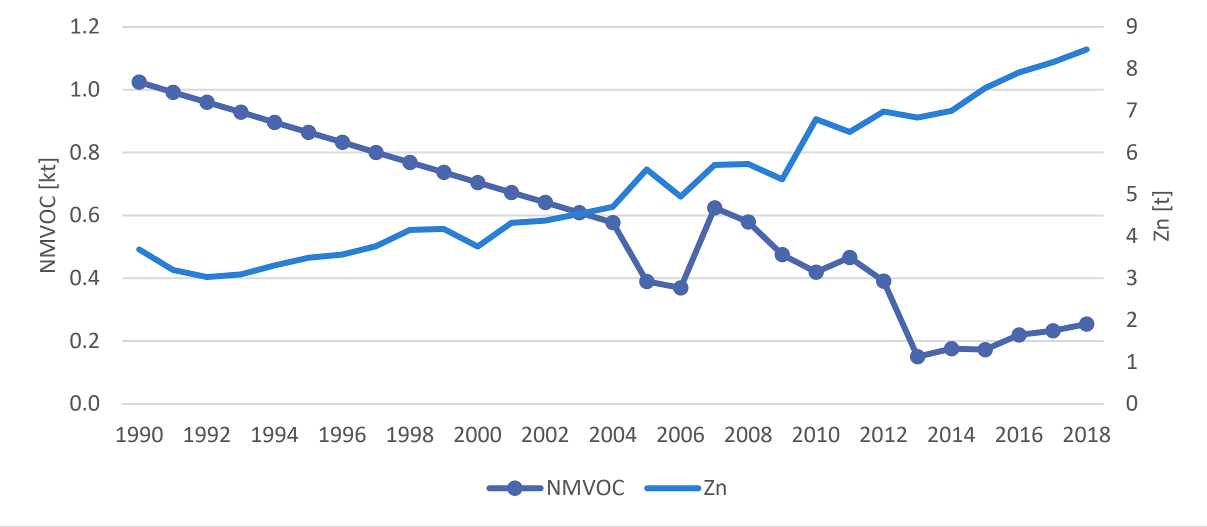


Table 4.98: *Overview of emissions of NMVOC fin the category 2D3i*

YEAR	NMVOC [kt]
1990	1.0244
1995	0.8647
2000	0.7050
2005	0.3901
2010	0.4191
2011	0.4667
2012	0.3910
2013	0.1504
2014	0.1761
2015	0.1729
2016	0.2195
2017	0.2328
2018	0.2546
1990/2018	**-75%**
2017/2018	**9%**

Table 4.99: *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
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

YEAR	SOx	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2018	0.0338	0.0004	0.0005	0.0002	0.0005	0.0003	0.0002	0.0002	0.0002	8.4633
1990/2018	**129%**	**139%**	**135%**	**142%**	**139%**	**138%**	**122%**	**143%**	**112%**	**129%**
2017/2018	**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 4.100***.

Table 4.100: *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 industry:

$$Em_{\text{TOTAL}} = Em_{\text{SMALL SOURCES}} + Em_{\text{NEIS}}$$

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 2005 to 2018. 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.

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

Recalculations were provided in the emissions of lubricant consumption in transport due to the change of CO_2 correction factor in the sector Transport for the year 2010-2017 (***Table 4.101***).

Table 4.101*: Previous and refined emissions from the category 2D3i*

YEAR	SOx [kt]			Pb [t]			Cd[t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2010	0.0270	0.0271	0%	2.9E-04	2.9E-04	0%	3.6E-04	3.6E-04	0%
2011	0.0257	0.0259	1%	2.7E-04	2.8E-04	1%	3.4E-04	3.5E-04	1%
2012	0.0277	0.0278	1%	3.0E-04	3.0E-04	1%	3.7E-04	3.7E-04	1%
2013	0.0271	0.0273	1%	2.9E-04	2.9E-04	1%	3.6E-04	3.6E-04	1%
2014	0.0281	0.0279	-1%	3.0E-04	3.1E-04	4%	3.7E-04	3.8E-04	2%
2015	0.0311	0.0301	-3%	3.3E-04	3.4E-04	1%	4.1E-04	4.1E-04	-1%
2016	0.0316	0.0316	0%	3.4E-04	3.5E-04	4%	4.2E-04	4.3E-04	2%
2017	0.0324	0.0326	0%	3.5E-04	3.6E-04	5%	4.3E-04	4.4E-04	3%

YEAR	Hg [t]			As [t]			Cr[t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2010	1.8E-04	1.8E-04	0%	4.0E-04	4.0E-04	0%	2.5E-04	2.5E-04	0%
2011	1.7E-04	1.7E-04	1%	3.8E-04	3.8E-04	1%	2.4E-04	2.4E-04	1%
2012	1.8E-04	1.9E-04	1%	4.1E-04	4.1E-04	1%	2.6E-04	2.6E-04	1%
2013	1.8E-04	1.8E-04	1%	4.0E-04	4.0E-04	1%	2.5E-04	2.5E-04	1%
2014	1.9E-04	2.0E-04	5%	4.1E-04	4.3E-04	4%	2.6E-04	2.7E-04	3%

YEAR	Hg [t]			As [t]			Cr[t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2015	2.1E-04	2.1E-04	2%	4.6E-04	4.6E-04	1%	2.9E-04	2.9E-04	0%
2016	2.1E-04	2.2E-04	5%	4.6E-04	4.8E-04	4%	3.0E-04	3.1E-04	3%
2017	2.2E-04	2.3E-04	6%	4.8E-04	5.0E-04	5%	3.0E-04	3.1E-04	4%

YEAR	Cu [t]			Ni [t]			Se [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2010	1.8E-04	1.8E-04	0%	1.8E-04	1.8E-04	0%	1.4E-04	1.4E-04	0%
2011	1.7E-04	1.7E-04	1%	1.7E-04	1.7E-04	1%	1.4E-04	1.4E-04	1%
2012	1.8E-04	1.9E-04	1%	1.8E-04	1.9E-04	1%	1.5E-04	1.5E-04	1%
2013	1.8E-04	1.8E-04	1%	1.8E-04	1.8E-04	1%	1.4E-04	1.5E-04	1%
2014	1.9E-04	1.8E-04	-4%	1.9E-04	2.0E-04	5%	1.5E-04	1.4E-04	-8%
2015	2.1E-04	1.9E-04	-6%	2.1E-04	2.1E-04	3%	1.7E-04	1.5E-04	-10%
2016	2.1E-04	2.0E-04	-3%	2.1E-04	2.2E-04	6%	1.7E-04	1.6E-04	-8%
2017	2.2E-04	2.1E-04	-3%	2.2E-04	2.3E-04	6%	1.7E-04	1.6E-04	-7%

YEAR	Zn [t]		
	P	R	CHANGE
2010	6.7657	6.7983	0%
2011	6.4485	6.4890	1%
2012	6.9382	6.9798	1%
2013	6.7942	6.8365	1%
2014	7.0330	6.9937	-1%
2015	7.7942	7.5426	-3%
2016	7.9265	7.9169	0%
2017	8.1328	8.1600	0%

P-Previous
R-Refined

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 a number of 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 4.102*** below shows a significant increase in emissions in this category from 1990 due to increase of tobacco and fireworks use. In ***Figure 4.46*** substantial increase of tobacco combusted, and therefore increasing of emissions were recorded in the year 2005 and 2009, too. 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

[3] U.S. Dept. of Health and Human Services, 1981: The Health Consequences of Smoking: The Changing Cigarette

in 2009. Use of fireworks and associated emissions was influenced by economic status in the Slovak Republic (***Figure 4.47***). Significant decrease in 2010 related to the economic depression of inhabitants after the crisis. The next period of economic stability brought an increase in sales of this segment until 2018 although usage of fireworks has been since 2014 limited.[4]

Figure 4.46: *Amount of tobacco combusted in the Slovak Republic*

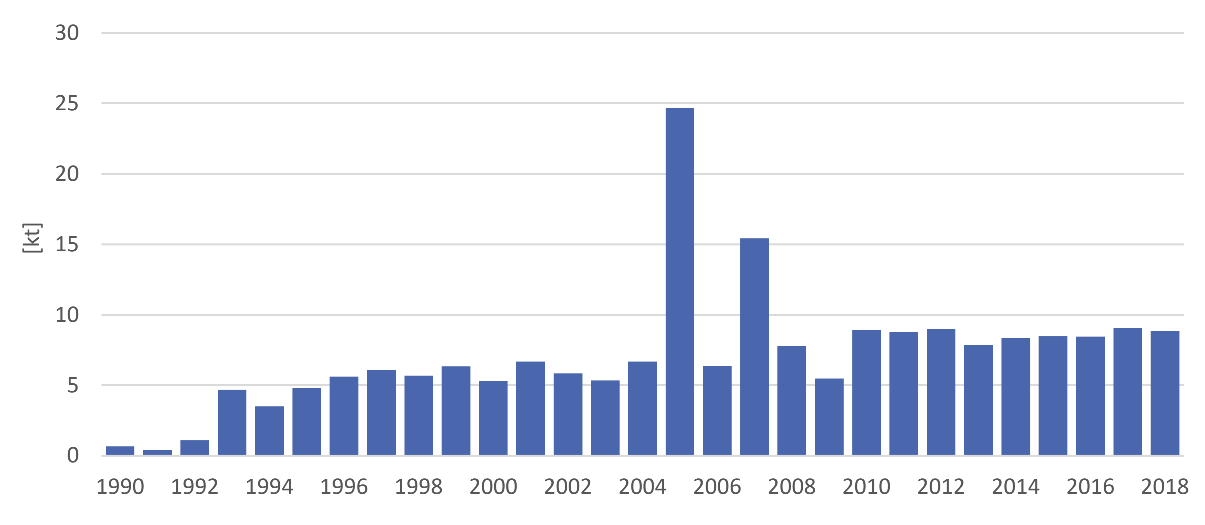


Figure 4.47: *Amount of fireworks used in the Slovak Republic*

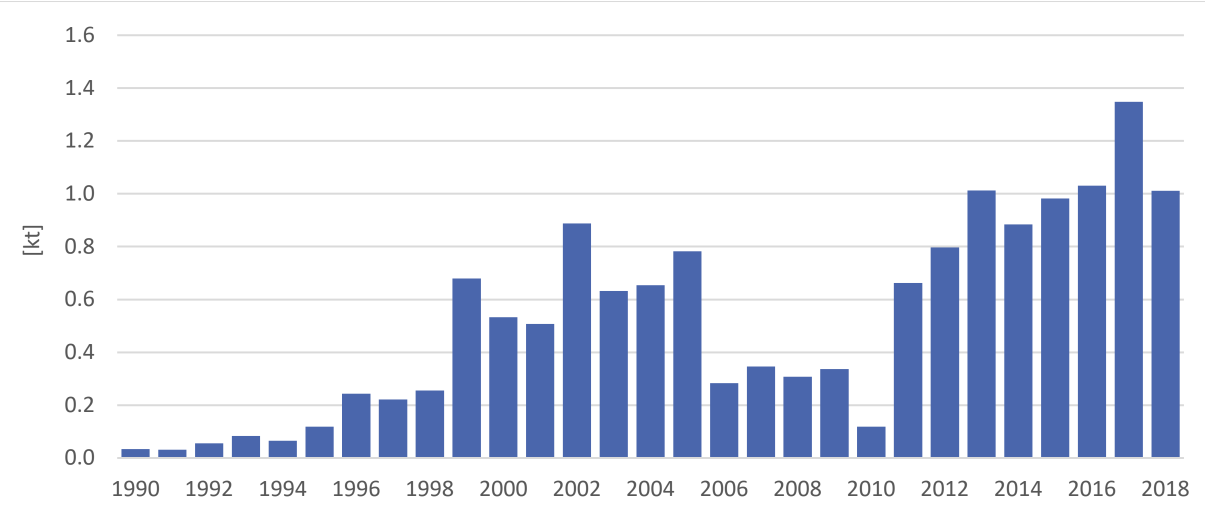


Table 4.102: *Overview of emissions in the category Other product use*

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

[4] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2014/58/

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
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
1990/2018	**1235%**	**1223%**	**2856%**	**1223%**	**1223%**	**1223%**	**1223%**	**1223%**	**1234%**
2017/2018	**-3%**	**-2%**	**-25%**	**-2%**	**-2%**	**-2%**	**-2%**	**-2%**	**-3%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Zn [t]
1990	0.0268	0.0001	2E-06	0.0000	0.0005	0.0152	0.0010	0.0089
1995	0.0925	0.0002	7E-06	0.0002	0.0018	0.0524	0.0036	0.0307
2000	0.4180	0.0008	3E-05	0.0007	0.0083	0.2368	0.0160	0.1386
2005	0.6138	0.0013	4E-05	0.0010	0.0122	0.3477	0.0236	0.2036
2010	0.0932	0.0002	7E-06	0.0002	0.0019	0.0528	0.0036	0.0309
2011	0.5192	0.0010	4E-05	0.0009	0.0103	0.2941	0.0199	0.1722
2012	0.6244	0.0012	5E-05	0.0011	0.0124	0.3537	0.0239	0.2071
2013	0.7939	0.0015	6E-05	0.0013	0.0158	0.4496	0.0304	0.2633
2014	0.6932	0.0014	5E-05	0.0012	0.0138	0.3926	0.0265	0.2299
2015	0.7700	0.0015	6E-05	0.0013	0.0153	0.4361	0.0295	0.2554
2016	0.8080	0.0016	6E-05	0.0014	0.0161	0.4577	0.0309	0.2680
2017	1.0569	0.0020	8E-05	0.0018	0.0210	0.5986	0.0405	0.3505
2018	0.7925	0.0015	6E-05	0.0013	0.0158	0.4489	0.0304	0.2629
1990/2018	**2856%**	**2747%**	**2856%**	**2856%**	**2856%**	**2856%**	**2853%**	**2856%**
2017/2018	**-25%**	**-24%**	**-25%**	**-25%**	**-25%**	**-25%**	**-25%**	**-25%**

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]
1990	0.0001	0.0001	0.0000	0.0000	0.0000	0.0002
1995	0.0005	0.0005	0.0002	0.0002	0.0002	0.0012
2000	0.0005	0.0006	0.0002	0.0002	0.0002	0.0013
2005	0.0025	0.0027	0.0011	0.0011	0.0011	0.0061
2010	0.0009	0.0010	0.0004	0.0004	0.0004	0.0022
2011	0.0009	0.0010	0.0004	0.0004	0.0004	0.0022
2012	0.0009	0.0010	0.0004	0.0004	0.0004	0.0022
2013	0.0008	0.0009	0.0004	0.0004	0.0004	0.0019
2014	0.0008	0.0009	0.0004	0.0004	0.0004	0.0021
2015	0.0008	0.0009	0.0004	0.0004	0.0004	0.0021
2016	0.0008	0.0009	0.0004	0.0004	0.0004	0.0021
2017	0.0009	0.0010	0.0004	0.0004	0.0004	0.0022
1990/2018	**1 255%**	**1 255%**	**1 255%**	**1 255%**	**1 255%**	**1 255%**
2017/2018	**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 were used. There was no production of firework in the Slovak Republic in the whole time series. For calculations of fireworks used ***Equation 4.1*** for the period 1991-2018 was used:

Equation 4.1: *Amount of product used in the Slovak Republic in particular year*

$$Product\ total\ = Product\ import\ total - Product\ export\ total$$

There was 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 4.1*** was used for cigarettes for period 2005-2018 and for cigars and cigarillos for period 2009-2018. 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 production of tobacco product were planned. ***Table 4.103*** shows the results of these calculations.

Table 4.103*: 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

Emission factors for the calculations originate from the Tier 2 methodology in EEA/EMEP GB2019 (***Table 4.104, 4.105***). **Condensable component of PMs** is included in emission factors for tobacco combustion, for use of fireworks is this information unknown.

Table 4.104: *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 4.105: *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

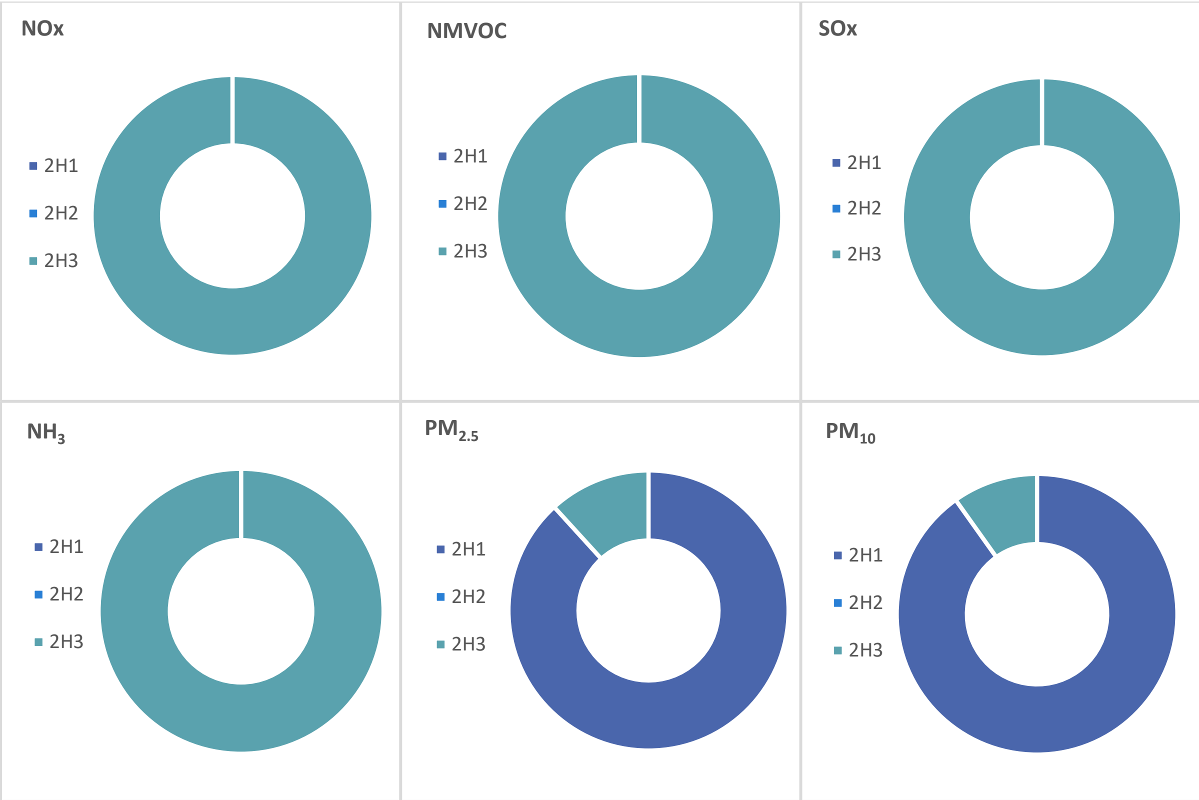
No recalculations in this submission.

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).

Shares of NO_X, NMVOC, SO_X, NH_3, $PM_{2.5}$, CO emission in 2018 included in NFR categories are shown in ***Figure 4.48***.

Figure 4.48: *Shares of emissions in 2H in 2018*



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.

Emissions from paper and pulp production include non-methane volatile organic compounds (NMVOC), sulphur oxides (SOx), particulates, nitrogen oxides (NOx) and carbon monoxide (CO).

Several companies were operating during the year 2018 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 ***Figure 4.49*** can be seen that emissions of all pollutants decreased in general since the year 1990.

Figure 4.49: Emissions trends in the category 2H1

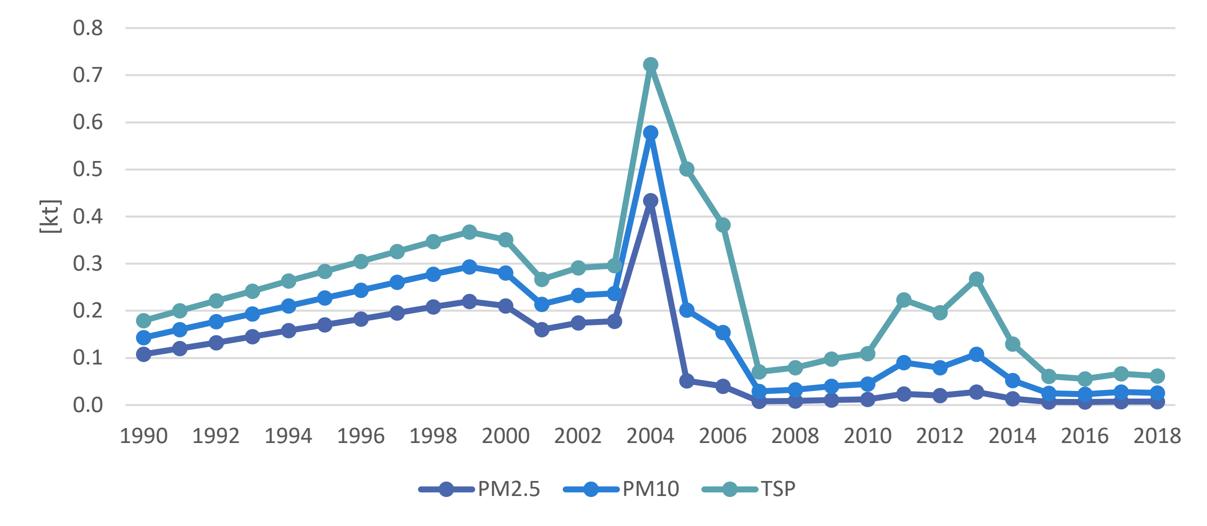


Table 4.106: Activity data and emissions in the category 2H1

YEAR	PULP PRODUCED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]
1990	179.23	0.1075	0.1434	0.1792	0.0028
1995	283.87	0.1703	0.2271	0.2839	0.0044
2000	388.64	0.2105	0.2806	0.3508	0.0055
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
1990/2018	**272%**	**-93%**	**-82%**	**-66%**	**-93%**
2017/2018	**-4%**	**-6%**	**-7%**	**-7%**	**-6%**

4.8.1.2 Methodological issues

Activities assigned in this category are listed in ***Table 4.107***.

Table 4.107: 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 could be used for sources recorded in the database. Otherwise, general EFs of the Bulletin of Ministry of Environment and detailed methodology of the NEIS are presented in **ANNEX IV.** The following table presents the share of use of different types of calculation of emissions reported from plants and sources in the NEIS.

Table 4.108: The overview of share of used calculation type for category 2H1 in the NEIS

2H1	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	87.43%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	0.08%

2H1	TYPE OF EMISSION COMPILATION/CALCULATION	%
4	Calculation using emission factor and amount of fuel	1.05%
5	Calculation using emission factor and amount of related quantity other than fuel	1.03%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	10.41%

Emissions from production of pulp and paper is in large scale continuously measured (87.4%). Historical years from 1990-1999 were calculated using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 4.109***).

Table 4.109: *Emission factors for calculation of historical years and BC*

	$PM_{2.5}$ %TSP	PM_{10} %TSP	TSP [g/t]	BC %$PM_{2.5}$
EF	60%	80%	1	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 comply with the EMEP/EEA GB_{2019}.

4.8.1.4 Source-specific recalculations

Historical years were recalculated using EMEP/EEA GB_{2019} emission factors (***Table 4.110***). Combustion emissions were reallocated to the category **1A2d**.

Table 4.110*: Previous and refined emissions from the category 2H1*

YEAR	$PM_{2.5}$ [kt]			PM_{10} [t]			TSP [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0415	0.1075	159%	0.1567	0.1434	-8%	0.3853	0.1792	-53%
1991	0.0417	0.1201	188%	0.1574	0.1602	2%	0.3872	0.2002	-48%
1992	0.0419	0.1326	216%	0.1582	0.1768	12%	0.3891	0.2210	-43%
1993	0.0421	0.1452	245%	0.1590	0.1936	22%	0.3910	0.2420	-38%
1994	0.0423	0.1579	273%	0.1597	0.2105	32%	0.3928	0.2631	-33%
1995	0.0425	0.1703	301%	0.1605	0.2271	41%	0.3947	0.2839	-28%
1996	0.0427	0.1827	328%	0.1613	0.2437	51%	0.3966	0.3046	-23%
1997	0.0429	0.1956	356%	0.1620	0.2608	61%	0.3985	0.3260	-18%
1998	0.0431	0.2081	383%	0.1628	0.2775	70%	0.4004	0.3469	-13%
1999	0.0450	0.2202	390%	0.1697	0.2936	73%	0.4174	0.3670	-12%
2000	0.0378	0.2105	457%	0.1426	0.2806	97%	0.3508	0.3508	-
2001	0.0288	0.1602	457%	0.1085	0.2136	97%	0.2669	0.2669	-
2002	0.0313	0.1746	457%	0.1183	0.2328	97%	0.2910	0.2910	-
2003	0.0319	0.1778	457%	0.1205	0.2370	97%	0.2963	0.2963	-
2004	0.0779	0.4336	457%	0.2939	0.5782	97%	0.7227	0.7227	-

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 a number of years before consumption.

Double-counting was recorded in this category as emissions from this combustion and process activities were reported in the category **1A2d**.

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. ***Figure 4.50*** shows emission trend in this category.

Figure 4.50: *Emission trends in the category 2H3*

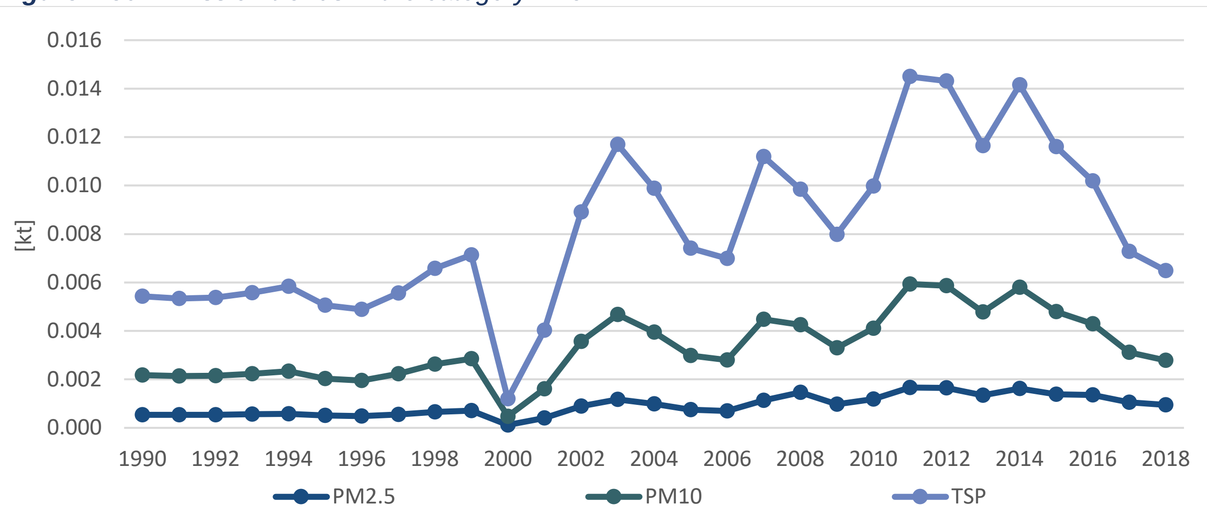


Table 4.111: *Overview of emissions in the category 2H3*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.0003	0.0391	0.0000	3E-03	0.0005	0.0022	0.0054	5E-05
1995	0.0003	0.0370	3E-06	3E-03	0.0005	0.0020	0.0051	5E-05
2000	0.0001	0.0153	2E-07	8E-04	0.0001	0.0005	0.0012	3E-05
2005	0.0007	0.0530	2E-05	1E-06	0.0008	0.0030	0.0074	1E-04
2010	0.0001	0.0935	3E-07	8E-07	0.0012	0.0041	0.0100	8E-05
2011	0.0002	0.0268	2E-07	1E-06	0.0017	0.0059	0.0145	1E-04
2012	0.0003	0.0341	3E-07	1E-06	0.0016	0.0059	0.0143	1E-04
2013	0.0001	0.0267	1E-03	8E-07	0.0013	0.0048	0.0116	6E-05
2014	0.0009	0.0312	1E-03	5E-07	0.0016	0.0058	0.0142	3E-05
2015	0.0014	0.0336	2E-03	1E-07	0.0014	0.0048	0.0116	3E-05
2016	0.0021	0.0367	3E-03	1E-05	0.0014	0.0043	0.0102	1E-03

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
2017	0.0021	0.0243	3E-03	6E-08	0.0010	0.0031	0.0073	NO
2018	0.0021	0.0231	3E-03	6E-08	0.0010	0.0028	0.0065	NO
1990/2018	**643%**	**-41%**	**115206%**	**-100%**	**75%**	**28%**	**19%**	**-**
2017/2018	**2%**	**-5%**	**2%**	**0%**	**-9%**	**-11%**	**-11%**	**-**

4.8.3.2 Methodological issues

Activities listed in the ***Table 4.112*** were reported in this category.

Table 4.112: *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

Emissions from this category is in large scale measured using individual mass flow and the number of operating hours (96.8%).

Table 4.113*: The overview of share of used calculation type for category 2H3 in the NEIS*

2H3	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	0%
2	Calculation using representative concentration and volume of flue gas	0%
3	Calculation using representative individual mass flow and number of operating hours	96.8%
4	Calculation using emission factor and amount of fuel	0%
5	Calculation using emission factor and amount of related quantity other than fuel	1.8%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	1.4%

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 linearly extrapolated from the trend of the period 2000-2004.

4.8.3.3 Completeness

Heavy metals and POPs are reported with notation key NA in compliance with the EMEP/EEA GB_{2019}.

4.8.31.4 Source-specific recalculations

Historical years were recalculated using EMEP/EEA GB_{2019} emission factors (***Table 4.114***).

Table 4.114*: Previous and refined emissions from the category 2H3*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0006	0.0003	-52%	0.0488	0.0391	-20%	0.0004	0.0000	-99%
1991	0.0006	0.0003	-53%	0.0489	0.0384	-21%	0.0004	0.0000	-99%
1992	0.0006	0.0003	-55%	0.0489	0.0387	-21%	0.0004	0.0000	-99%
1993	0.0006	0.0003	-52%	0.0489	0.0402	-18%	0.0004	0.0000	-99%
1994	0.0006	0.0003	-46%	0.0489	0.0414	-15%	0.0004	0.0000	-99%
1995	0.0006	0.0003	-53%	0.0490	0.0370	-24%	0.0004	0.0000	-99%

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1996	0.0006	0.0002	-59%	0.0490	0.0348	-29%	0.0004	0.0000	-99%
1997	0.0006	0.0002	-64%	0.0490	0.0406	-17%	0.0004	0.0000	-100%
1998	0.0006	0.0004	-40%	0.0490	0.0472	-4%	0.0004	0.0000	-100%
1999	0.0006	0.0005	-13%	0.0491	0.0475	-3%	0.0004	0.0000	-98%

YEAR	NH_3 [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0008	0.0031	269%	0.0084	0.0054	-35%	0.0003	0.0001	-82%
1991	0.0008	0.0031	271%	0.0084	0.0053	-37%	0.0003	0.0001	-84%
1992	0.0008	0.0032	279%	0.0084	0.0054	-36%	0.0004	0.0001	-86%
1993	0.0008	0.0032	284%	0.0085	0.0056	-34%	0.0004	0.0001	-85%
1994	0.0008	0.0032	277%	0.0088	0.0058	-34%	0.0003	0.0001	-83%
1995	0.0008	0.0028	231%	0.0091	0.0051	-45%	0.0003	0.0001	-84%
1996	0.0008	0.0032	286%	0.0093	0.0049	-47%	0.0003	0.0000	-84%
1997	0.0008	0.0035	317%	0.0096	0.0056	-42%	0.0003	0.0000	-85%
1998	0.0008	0.0034	310%	0.0097	0.0066	-32%	0.0003	0.0001	-79%
1999	0.0008	0.0029	242%	0.0097	0.0071	-26%	0.0003	0.0001	-76%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0011	0.0005	-51%	0.0039	0.0022	-45%
1991	0.0011	0.0005	-51%	0.0039	0.0021	-46%
1992	0.0011	0.0005	-51%	0.0040	0.0022	-46%
1993	0.0011	0.0006	-49%	0.0040	0.0022	-44%
1994	0.0011	0.0006	-47%	0.0040	0.0023	-41%
1995	0.0011	0.0005	-54%	0.0040	0.0020	-49%
1996	0.0011	0.0005	-56%	0.0040	0.0020	-51%
1997	0.0011	0.0006	-50%	0.0040	0.0022	-44%
1998	0.0011	0.0007	-40%	0.0040	0.0026	-34%
1999	0.0011	0.0007	-35%	0.0040	0.0029	-28%

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.

Figure 4.51 shows emission trends in this category, where emissions decreasing in general. Overview of emissions and its trends are presented in ***Table 4.115***.

Figure 4.51: *Emission trend in the category 2I*

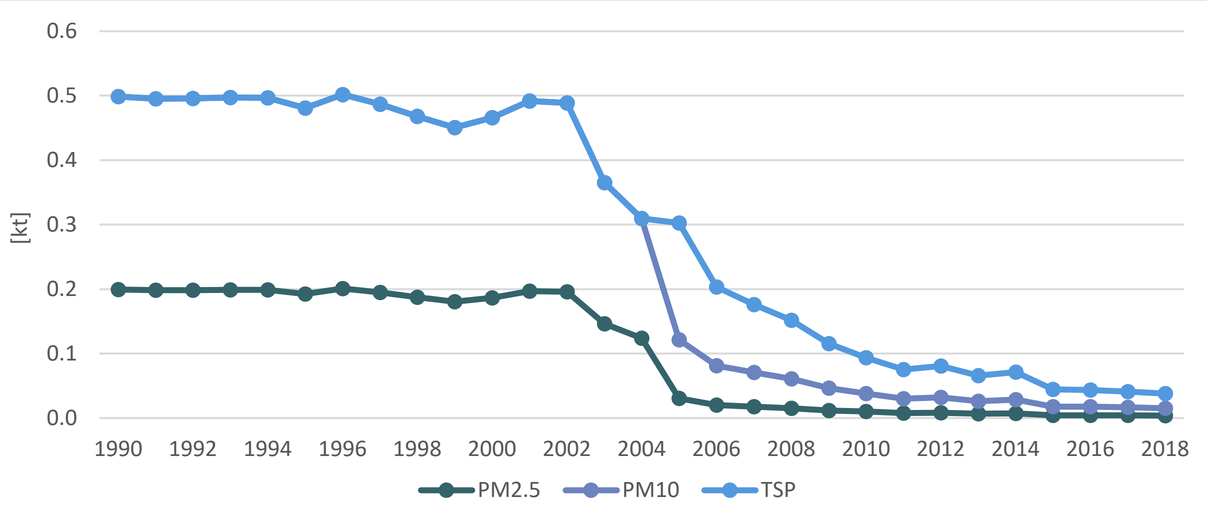


Table 4.115: *Overview of emissions in the category 2I*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	0.3184	0.3013	0.0023	0.0025	0.1996	0.4985	0.4985	0.3994
1995	0.3071	0.2906	0.0022	0.0024	0.1925	0.4808	0.4808	0.3852
2000	0.2549	0.1294	0.0016	0.0006	0.1865	0.4660	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
1990/2018	**7%**	**134%**	**-98%**	**288%**	**-98%**	**-97%**	**-92%**	**-11%**
2017/2018	**61%**	**29%**	**7%**	**3%**	**-8%**	**-8%**	**-8%**	**68%**

4.9.2 METHODOLOGICAL ISSUES

The definition of activities covered by category 2I is provided in ***Table 4.116***. 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 4.116: *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
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

About 44% of main pollutants are reported to the NEIS database using emission factor and amount of related quantity other than fuel (***Table 4.117***).

Table 4.117: *The overview of share of used calculation type for category 2I in the NEIS*

2I	TYPE OF EMISSION COMPILATION/CALCULATION	%
1	Continuous measurement	32.99%
2	Calculation using representative concentration and volume of flue gas	0.08%
3	Calculation using representative individual mass flow and number of operating hours	17.61%
4	Calculation using emission factor and amount of fuel	4.81%
5	Calculation using emission factor and amount of related quantity other than fuel	43.97%
6	Calculation using emission factor related to content of AP in fuel and amount of fuel	0%
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	0.01%
8	Calculation using emission factor related to calorific value	0%
9	Calculation using emission factor related to content of AP in fuel and related to calorific value and to amount of fuel	0%
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	0%
99	Other manner of determination	0.53%

Emissions from the production of pulp and paper were on large scale continuously measured (87.4%). Historical years from 1990-1999 were calculated using Tier 1 emission factors from EMEP/EEA GB_{2019} (***Table 4.118***).

Table 4.118: *Emission factors for calculation of historical years and BC*

	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	606.24	573.71	4.39	4.73	40%	100%	949.30	760.59

4.9.3 COMPLETENESS

Heavy metals and POPs are reported with notation key 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 4.119***).

Table 4.119: *Previous and refined emissions from the category 2I*

YEAR	NOx [kt]			NMVOC [kt]			SOx [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.4360	0.3215	-26%	0.4191	0.3089	-26%	0.0032	0.0023	-27%
1991	0.4337	0.3195	-26%	0.4169	0.3070	-26%	0.0032	0.0023	-27%
1992	0.4313	0.3198	-26%	0.4147	0.3073	-26%	0.0032	0.0023	-27%
1993	0.4290	0.3206	-25%	0.4125	0.3080	-25%	0.0032	0.0023	-26%
1994	0.4267	0.3203	-25%	0.4103	0.3078	-25%	0.0032	0.0023	-26%
1995	0.4244	0.3112	-27%	0.4080	0.2991	-27%	0.0031	0.0023	-28%
1996	0.4221	0.3232	-23%	0.4058	0.3105	-23%	0.0031	0.0024	-25%
1997	0.4198	0.3146	-25%	0.4036	0.3023	-25%	0.0031	0.0023	-26%
1998	0.4175	0.3035	-27%	0.4014	0.2916	-27%	0.0031	0.0022	-28%
1999	0.5722	0.2925	-49%	0.5502	0.2811	-49%	0.0042	0.0021	-50%

YEAR	NH_3 [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0036	0.0026	-27%	0.6855	0.5012	-27%	0.5549	0.4074	-27%
1991	0.0036	0.0026	-27%	0.6819	0.4981	-27%	0.5519	0.4049	-27%
1992	0.0035	0.0026	-27%	0.6783	0.4986	-26%	0.5490	0.4053	-26%

YEAR	NH_3 [kt]			TSP [kt]			CO [kt]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1993	0.0035	0.0026	-26%	0.6746	0.4998	-26%	0.5460	0.4063	-26%
1994	0.0035	0.0026	-26%	0.6710	0.4993	-26%	0.5431	0.4059	-25%
1995	0.0035	0.0025	-28%	0.6674	0.4852	-27%	0.5402	0.3944	-27%
1996	0.0035	0.0026	-24%	0.6637	0.5038	-24%	0.5372	0.4096	-24%
1997	0.0035	0.0026	-26%	0.6601	0.4905	-26%	0.5343	0.3987	-25%
1998	0.0034	0.0025	-28%	0.6565	0.4731	-28%	0.5314	0.3846	-28%
1999	0.0047	0.0024	-50%	0.8998	0.4561	-49%	0.7283	0.3707	-49%

YEAR	$PM_{2.5}$ [kt]			PM_{10} [t]		
	P	R	CHANGE	P	R	CHANGE
1990	0.0686	0.2007	193%	0.2742	0.5012	83%
1991	0.0682	0.1994	192%	0.2728	0.4981	83%
1992	0.0678	0.1996	194%	0.2713	0.4986	84%
1993	0.0675	0.2001	197%	0.2699	0.4998	85%
1994	0.0671	0.1999	198%	0.2684	0.4993	86%
1995	0.0667	0.1943	191%	0.2669	0.4852	82%
1996	0.0664	0.2017	204%	0.2655	0.5038	90%
1997	0.0660	0.1964	198%	0.2640	0.4905	86%
1998	0.0656	0.1894	189%	0.2626	0.4731	80%
1999	0.0900	0.1826	103%	0.3599	0.4561	27%
2000	0.0466	0.1865	300%	0.1864	0.4660	150%
2001	0.0492	0.1969	300%	0.1967	0.4919	150%
2002	0.0489	0.1958	300%	0.1956	0.4889	150%
2003	0.0365	0.1461	300%	0.1460	0.3650	150%
2004	0.0310	0.1239	300%	0.1238	0.3095	150%

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. 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.

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 ***Figures 4.52*** and ***Table 4.120***.

Figure 4.52: *Trend of Hg and PCBs emissions in 2K*

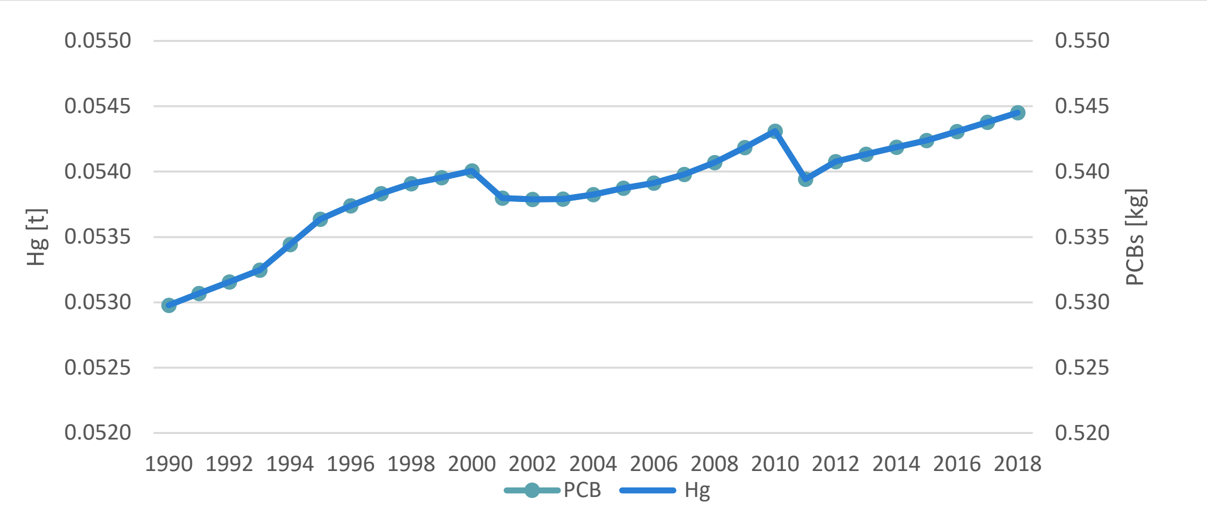


Table 4.120: *Activity data and emissions in the category 2K*

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	5413393	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	5445089	0.0545	0.5447
1990/2018	**3%**	**3%**	**3%**
2017/2018	**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, PMi, 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 emissions of Hg and PCBs from this source category:

$$E = EF_{GB2019} * AD_{(ŠÚ\ SR)}$$

Emission factors used for the calculation are shown in ***Table 4.121***.

Table 4.121: *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

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: 13.3.2020

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 (NO_X) emissions are analysed according to the $EMEP/EEA_{2016}$ when principles of good practice in agriculture are taken into account. The emissions of NH_3, NO_X, PM, TSP, and NMVOC can be reduced if effective measures are implemented in agricultural practice. The abatements were implemented for the conditions of the Slovak Republic. The absence of sufficient data about the storage and application of manure resulted in the fact that the emissions were evaluated in the same way as usual. Slovak agricultural inventory takes advantage of parallel inventory preparation and reporting of greenhouse gases (GHGs) 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 the 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.

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 2018. Share of foreign agri-food trade in exports and imports was decreased. Agriculture, according to preliminary data, achieved a positive economic result in 2018. The economic result was influenced by the increase in prices of agricultural products, which was reflected in increased sales, especially in crop production in agricultural production. The subsidies from the Common Agricultural Policies played a decisive role, almost 75 % of the financial support of Slovak agriculture. The rest of the finance was provided by the state budget of the Slovak Republic. The structure of gross agricultural output at current prices interannual stagnates. Share of crop production in sector is 59.9% and the share of animal production is 40.1% in 2018.Gross value added in agriculture upsurges a result of the decrease in gross agricultural output, in crops by 1.02% and in animals by 0.99% compared to the previous year. The total production of slaughter animals was decreased by 0.7% due to the decrease in the number of livestock except for the production of slaughter poultry and pigs. The prices of raw products were increased compared to the previous year. The increase in prices was visible in raw cow's milk (7.5%), cereals (6.8) and fruits (11.1%) (Based on references published in the Green Report 2018).[1]

Slovak farmers adapted to changes in Agriculture after 1990. They invested in the development of their farms to avoid the 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, a decrease of pasture time, new storage capacity for organic waste, which was supported by the Decree No 410/2012 Coll. and Nitrates Directive.[2]

Table 5.1: *Overview of the GHG gases and Tiers reported in the Agriculture sector according to the CRF categories in 2018*

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-T1,NO_x-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	PMi-T1, TSP-T1
3De Cultivated Crops	NMVOC-T2

5.2 EMISSION TRENDS

5.2.1 AMMONIA (NH_3)

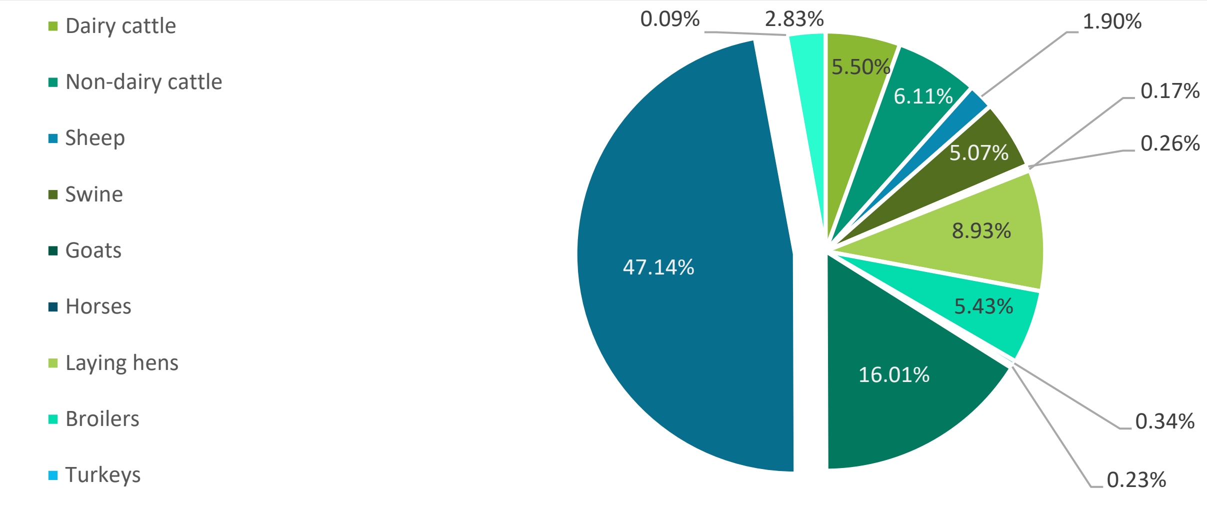
Sector agriculture is a dominant contributor to NH_3 emissions, with the 93% share of the national total in 2018. The largest share of ammonia emissions was generated by 3D Agricultural soils, which produced 18.48 Gg (70%) of NH_3 within the sector in 2018. The key NH_3 emissions source is the Animal manure applied to soils with the share of 47%, followed by the category Inorganic N-fertilizers representing 16% of the total NH_3 emissions. Emissions from 3B1 Cattle, 3B3 Swine and 3B2 Sheep

[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)

produced 5.2 Gg of NH_3 (14%) in the sector in 2018. ***Figure 5.1*** shows the distribution of significant categories of ammonia from agriculture for 2018.

Figure 5.1: *NH_3 emissions per subsectors in %*



Agricultural NH_3 emissions have decreased by 55% since 1990, and 13 % 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 3.D 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*

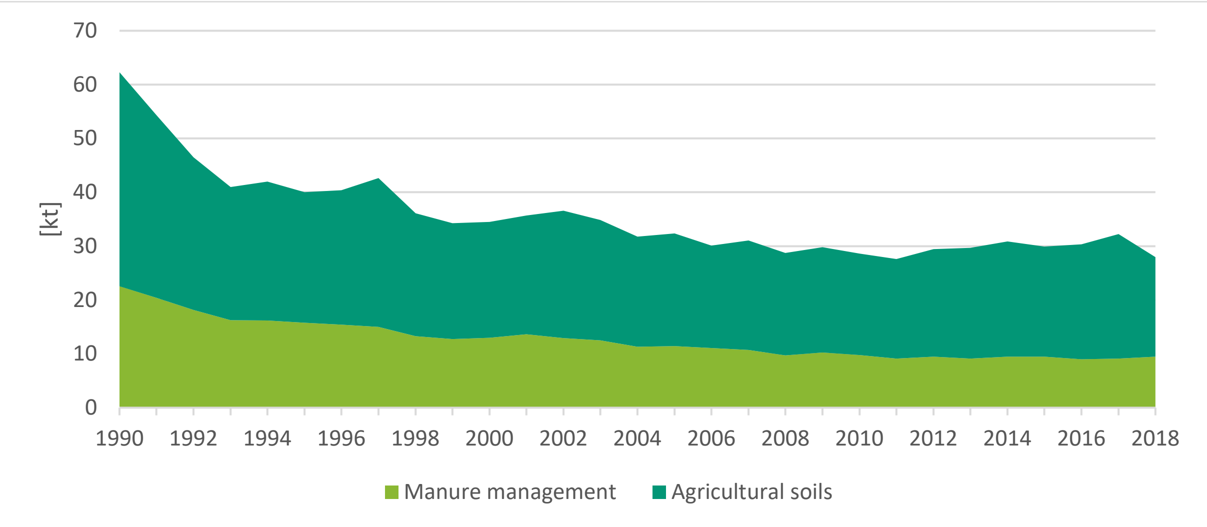


Table 5.2: NH_3 emission time-series by sub-sectors in Gg

YEARS	3B MANURE MANAGEMENT	3D AGRICULTURAL SOILS	3 AGRICULTURE TOTAL
	in Gg		
1990	22.58	39.71	62.29
1995	15.76	24.29	40.05
2000	12.97	21.53	34.51
2005	11.42	20.96	32.38
2010	9.79	18.83	28.62
2011	9.13	18.50	27.63
2012	9.49	19.97	29.46
2013	9.09	20.62	29.71
2014	9.47	21.41	30.88
2015	9.48	20.45	29.93
2016	8.99	21.37	30.36
2017	9.14	23.07	32.21
2018	9.49	18.47	27.96
SHARE WITH TOTAL IN 2018	**31.50%**	**61.33%**	**92.83%**
TREND 1990-2018	**-58%**	**-53%**	**-55%**
TREND 2005-2018	**-17%**	**-12%**	**-13%**

5.2.2 PARTICULATE MATTERS

In 2018, agriculture accounted for 1.3% (0.19 Gg) of $PM_{2.5}$, 12.62% (2.52 Gg) of PM_{10} and 15.31% (4.3 Gg) of the national total, TSP emissions. The Agriculture sector is no key source for particulate matter. The contribution of the 3.D.c was 75% (1.87 Gg) to the total PM_{10} emissions from the sector.

$PM_{2.5}$, TSP emissions from agriculture have stagnated in the 2005-2018 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

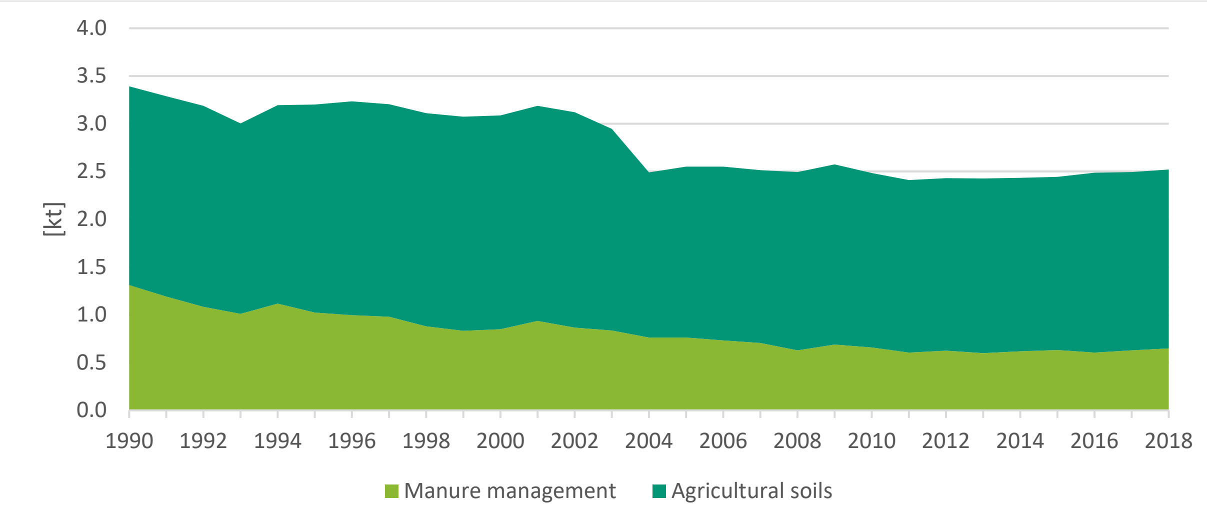


Figure 5.4: *$PM_{2.5}$ emission trends by sectors*

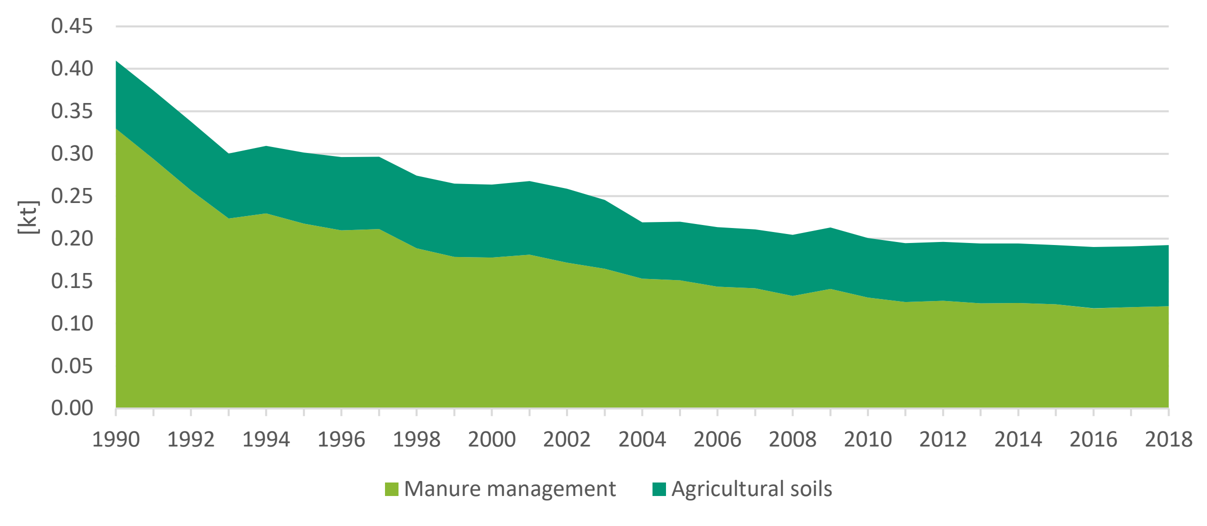


Table 5.3: *TSP emission time-series by sub-sectors in Gg*

YEARS	3B MANURE MANAGEMENT	3D AGRICULTURAL SOILS	3 AGRICULTURE TOTAL
		in Gg	
1990	5.33	2.08	7.41
1995	4.34	2.18	6.52
2000	3.37	2.24	5.61
2005	2.92	1.79	4.71
2010	2.50	1.83	4.33
2011	2.31	1.81	4.11
2012	2.39	1.81	4.20
2013	2.28	1.83	4.11
2014	2.32	1.82	4.14
2015	2.39	1.81	4.20
2016	2.29	1.88	4.18
2017	2.35	1.87	4.21
2018	2.43	1.87	4.30
SHARE WITH TOTAL IN 2017	**9%**	**7%**	**15%**
TREND 1990-2018	**-54%**	**-10%**	**-42%**
TREND 2005-2018	**-17%**	**5%**	**-9%**

5.2.3 NON-METHANE VOLATILE ORGANIC COMPOUNDS (NMVOC)

In 2018, Agricultural NMVOC emissions consisted of 6.54 Gg and 7.6% share of the national total (***Table 5.4***). The primary agricultural source of MNVOC emissions is the 3.B Manure management accounting for 7.16% of national total NMVOC emission (6.17Gg). 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 (55%), while cultivated crops were an insignificant source with a share of 5.6% of total NMVOC emissions in 2018. NMVOC emissions have decreased by 61% over the period 1990-2018, 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	16.21	0.51	16.72
1995	10.72	0.53	11.24
2000	8.94	0.53	9.47
2005	7.80	0.36	8.16
2010	6.58	0.36	6.94
2011	6.31	0.36	6.68
2012	6.42	0.36	6.78
2013	6.26	0.36	6.63
2014	6.37	0.36	6.73
2015	6.38	0.37	6.75
2016	6.14	0.37	6.51
2017	6.25	0.37	6.62
2018	6.17	0.37	6.54
SHARE WITH TOTAL IN 2018	**7%**	**0.4%**	**8%**
TREND 1990-2018	**-62%**	**-28%**	**-61%**
TREND 2005-2018	**-21%**	**1%**	**-20%**

5.2.4 NITROGEN OXIDES (NO_X)

Agricultural NOx emissions have decreased by 46% 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 2016-2018, NOx emissions from the agricultural sector increased due to a markedly increase in inorganic fertilizer and increase the number of poultry and pigs.

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	0.265	13.025	13.290
1995	0.170	5.642	5.812
2000	0.149	5.318	5.467
2005	0.135	5.389	5.524
2010	0.116	5.383	5.499
2011	0.110	5.549	5.660
2012	0.114	5.962	6.076
2013	0.110	6.483	6.594
2014	0.114	6.789	6.903
2015	0.112	6.646	6.759
2016	0.108	6.872	6.980
2017	0.108	6.735	6.843
2018	0.112	7.043	7.155
SHARE WITH TOTAL IN 2018	**0.17%**	**10.6%**	**10.7%**
TREND 1990-2018	**-58%**	**-46%**	**-46%**
TREND 2005-2018	**-17%**	**31%**	**30%**

5.3 CATEGORY-SPECIFIC IMPROVEMENTS AND IMPLEMENTATION OF RECOMMENDATIONS

According to the Final Outcomes Report 2019 of the second phase of the review of national air pollution emission inventories (published in 22.11.2019), several improvements were made as a reflection to identified recommendations from the previous reviews:

- Recommendation No ***SK-3B1a-2019-0001*** - Calculation of NMVOC emission from dairy cattle were corrected and information on the variables used was included - MJ, NH_3 emission, Frac-silage storage, Frac-silage. More information in **Chapter 5.8.6**
- Recommendation No ***SK-3Df-2019-0001*** – Slovakia reports HCB emissions from 3Df Use of pesticides, and description is provided in **Chapter 5.12**
- Recommendation No. ***SK-3De-2019-0001***- Information on the cultivated area distributed on different crop types was included (***Table 5.42*** in this IIR). More information in **Chapter 5.10.2** and **5.10.3**
- Recommendation No. ***SK-3Da1-2019-0001*** – Implementation of Tier 2 approach according to the EMEP/EEA GB_{2019}. More information in **Chapter 5.9.3**
- Recommendation No. ***SK-3B-2019-0001***. More information in **Annex VI**- **Chapter A6.3**.

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_{2016}.

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.

Part of QA/QC activities is a comparison of FAO database and national inventory, described in the **Chapter 5.4.1** below.

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 the 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 of 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

5.4.1 COMPARISON OF THE FAO DATA WITH THE NATIONAL ACTIVITY DATA

The comparison of consistency with the international bodies and statistics were made. The several presentations on international and national conferences, publications and references were published in Meteorological journal 2017.[3] Results of this article were presented in the international conference Air Protection 2017.[4] Detailed information was presented in the SVK IIR 2017. The NIS SR decided that data consistency will be provided every year until full consistency. The activity data were also compared during the 2020 submission preparation.

2019 submission

- New corrected data were sent in the FAO.

Outcomes of the comparison:

The Ministry of Environment of the Slovak Republic compiled an official letter, which was sent to all relevant and responsible parties (ÚKSUP, ŠÚ SR). The official letter contained our results of the

Inorganic N-fertilizers: The QA comparison of activity data was provided for fertilizer consumption (***Table 5.6***). Main inconsistencies between the FAO 2019 database (FAOSTAT) and national inventory caused a shift in the timeline beginning in 2003 (*cursive number*) and different rounding rules (***bold cursive number***). The discrepancy of consumption data is visible from 1993 to 2002 time-series. Consumption for 2018 was not available in the FAOSTAT.

Table 5.6: *Fertilizers consumption and comparison of FAO 2020 and SVK IIR 2020 data (t/year)*

COMPARISON YEARS	SVK IIR 2020	FAO 2020
1993	64 852 000	**64 883 000**
1994	68 669 000	**68 656 000**
1995	69 587 000	**72 029 000**
1996	74 464 000	**77 644 000**
1997	88 017 000	**72 500 000**
1998	81 842 000	**82 814 000**
1999	65 392 000	**65 357 000**
2000	72 653 000	**82 100 000**
2001	76 032 000	**81 345 000**
2002	88 260 000	**81 300 000**
2003	81 300 000	*79 911 000*
2004	79 911 000	*81 317 000*
2005	81 317 000	*78 681 000*
2006	78 681 120	*88 935 000*
2007	88 935 400	*87 737 000*
2008	87 736 950	*77 058 000*
2009	77 058 450	*86 873 000*
2010	86 873 000	*92 969 000*
2011	92 969 000	*101 004 000*
2012	101 004 000	**113 581 000**
2013	113 581 390	***113 581 000***
2014	119 036 050	***119 036 000***
2015	114 773 000	114 773 000

[3] http://www.shmu.sk/File/ExtraFiles/MET_CASOPIS/2017-1_MC.pdf
[4] https://www.kongres-studio.sk/inpage/ochrana-ovzdusia-2017/

COMPARISON YEARS	SVK IIR 2020	FAO 2020
2016	126 235 769	***126 236 000***
2017	122 541 152	122 541 152
2018	128 976 885	NA

The number of livestock: The number of animals is the most important input parameter into the emission inventory. We recognized differences in the methodological approach of data collection used by the FAOSTAT and by the ŠÚ SR. FAOSTAT grouped livestock in 12-months periods ending on 30th September each year. On the other hand, the ŠÚ SR provides annual national data on livestock by 31st December of a given year. The statistical survey is based on data collected from selected farms, animal census, by selected animal's categories, up to the regional level and finally up to national level. Therefore, the animal population in FAOSTAT 2019 is different. In addition, detailed analysis of the data provided in ***Table 5.7*** shows a shift in the timeline of goats (since 1994), sheep (since 1994), horses (since 1994) and swine (since 1994) (blue values). In 2019, FAO revised the number of cattle (dairy and non-dairy cattle. The timeline is shifted since 2000 (blue values). Different allocation of cattle population (**bold values**) is visible in 1993-1997 (**bold values**). This inconsistency is caused by the different rules for distribution between dairy and non-dairy cattle. Revision of livestock in 2019 mentioned above, led to the unification of cattle data between two databases, but the different allocation of dairy and non-dairy and shift in the timeline were corrected partially. Besides, the FAO prepare annually own estimates of broilers and layers number. Therefore, the inconsistencies are visible in bold values. The revision of poultry population provided by the ŠÚ SR into the FAOSTAT was not taking into consideration.

The ŠÚ SR as a partner of the EUROSTAT collect, process and disseminate statistical data in line with the current national and EU legislation. Therefore, we are obliged to use statistical background data based on national statistics as the most appropriate and accurate. However, comparison of data and methodologies with the independent data source as it is FAOSTAT is a useful tool for the QA activities. It can be assumed from this exercise, that the activity data used in inventory of the Agriculture sector is in good consistency and accuracy

Table 5.7: *Comparison of livestock population (heads) for the time series 1993–2018*

YEAR	DAIRY CATTLE		NON-DIARY CATTLE		GOATS		SHEEP		HORSES		SWINE		POULTRY	
	SVK IIR 2020	FAO 2020	SVK IIR 2020	FAO 2020	SVK IIR 2020	FAO 2020	SVK IIR 2020	FAO 2020	SVK IIR 2020	FAO 2020	SVK IIR 2020	FAO 2020	SVK IIR 2020	FAO 2020
1993	282 274	**429 171**	710 689	**752 489**	24 974	20 278	411 442	571 837	11 188	11 652	2 179 029	2 269 232	12 234 120	**13 084 000**
1994	272 450	**385 949**	643 703	**607 014**	25 010	24 974	397 043	411 442	10 652	11 188	2 037 371	2 179 029	14 245 954	**12 057 000**
1995	262 664	**359 348**	666 042	**556 805**	25 046	**27 747**	427 844	397 043	10 109	10 000	2 076 439	2 037 370	13 382 391	**7 852 000**
1996	245 833	**355 199**	646 158	**573 507**	26 147	25 046	418 823	427 844	9 722	10 109	1 985 223	2 076 439	14 147 177	**13 214 000**
1997	299 614	**335 381**	503 784	**556 610**	26 778	26 147	417 337	418 823	9 533	9 722	1 809 868	1 985 223	14 221 713	**13 985 000**
1998	267 282	299 614	437 510	503 784	50 905	26 778	326 200	417 337	9 550	9 533	1 592 599	1 809 868	13 116 796	**14 071 000**
1999	250 974	**283 895**	414 081	**420 897**	51 075	50 905	340 346	326 199	9 342	9 550	1 562 106	1 592 599	12 247 440	**13 027 000**
2000	242 496	250 974	403 652	414 081	51 419	51 075	347 983	340 346	9 516	9 342	1 488 441	1 562 105	13 580 042	**12 160 000**
2001	230 379	242 496	394 811	403 652	40 386	51 419	316 302	347 983	7 883	9 516	1 517 291	1 488 441	15 590 404	**13 482 000**
2002	230 182	230 379	377 653	394 811	40 194	40 386	316 028	316 302	8 122	7 883	1 553 880	1 517 291	13 959 404	**15 352 000**
2003	214 467	230 182	378 715	377 653	39 225	40 194	325 521	316 028	8 114	8 122	1 443 013	1 553 880	14 216 798	**13 817 000**
2004	201 725	214 467	338 421	378 715	39 012	39 225	321 227	325 521	8 209	8 114	1 149 282	1 443 013	13 713 239	**14 052 000**
2005	198 580	201 725	329 309	338 421	39 566	39 012	320 487	321 227	8 328	8 209	1 108 265	1 149 282	14 084 079	**13 565 000**
2006	184 950	198 580	322 870	329 309	38 352	39 566	332 571	320 487	8 222	8 328	1 104 829	1 108 265	13 038 303	**13 932 000**
2007	180 207	184 950	321 610	322 870	37 873	38 352	347 179	332 571	8 017	8 222	951 934	1 104 829	12 880 124	**12 882 000**
2008	173 854	180 207	314 527	321 610	37 088	37 873	361 634	347 179	8 421	8 017	748 515	951 934	11 228 140	**12 718 000**
2009	162 504	173 854	309 461	314 527	35 686	37 088	376 978	361 634	7 199	8 421	740 862	748 515	13 583 284	**11 081 000**
2010	159 260	162 504	307 865	309 461	35 292	35 686	394 175	376 978	7 111	7 199	687 260	740 862	12 991 916	**13 438 000**
2011	154 105	159 260	309 253	307 865	34 053	35 292	393 927	394 175	6 937	7 111	580 393	687 260	11 375 603	**12 846 000**
2012	150 272	154 105	320 819	309 253	34 823	34 053	409 569	393 927	7 249	6 937	631 464	580 393	11 849 818	**11 252 000**
2013	144 875	150 272	322 945	320 819	35.457	34 823	399 908	409 569	7 161	7 249	637 167	631 464	10 968 918	**11 693 000**
2014	143 083	144 875	322 460	322 945	35 178	35 457	391 151	399 908	6 828	7 161	641 827	637 167	12 494 074	**10 786 000**
2015	139 229	143 083	318 357	322 460	36 324	35 178	381 724	391 151	6 866	6 828	633 116	641 827	12 836 224	**13 084 000**
2016	132 610	139 229	313 502	318 357	36 355	36 324	368 896	381 724	6 407	6 866	585 843	633 116	12 130 501	**12 057 000**
2017	129 863	132 610	309 963	313 502	37 067	36 355	365 344	368 896	6 145	6 407	614 384	585 843	13 353 837	**13 133 000**
2018	127 871	129 863	310 984	309 963-	36 907	37 067	351 122	365 344	7 102	6 145	627 022	614 384	14 056 914	**13 354 000**

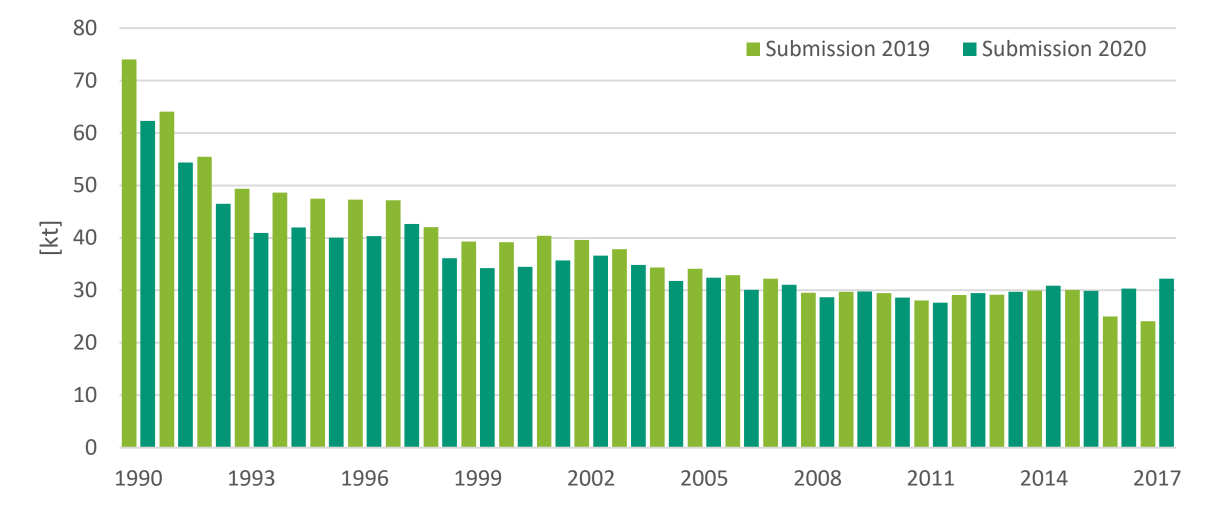
5.5 CATEGORY-SPECIFIC RECALCULATIONS

Recalculations made in the agriculture sector were provided and implemented in line with the Improvement Plan reflecting recommendations made during previous reviews. ***Table 5.8*** shows an overview of these recalculations and corrections, which were corrected and implemented in the 2019 submission.

Table 5.8: *Overview of recalculations in the agricultural sector*

NUMBER	CATEGORY	POLLUTION	DESCRIPTION	REFERENCE
15.FEBRUARY 2019				
1	3.B	NH_3	Abatements were removed from the inventory in 2016 and 2017	**Annex VI., Chapter A6.3**
2	3.B	NO_x	Removal order error in all categories	**5.8.4**
3	3B1a,3B1b	NH_3, NO_x	The NPPC-VÚŽV (Research Institute for Animals) provided new breed structure of cattle for 1995 – 2017. Years 1990 – 1995 were extrapolated. The structure is essential for body weight estimation. The result of implementation led to changes in the current consistent body weights to dynamic bodyweight according to the changes in breed structure.	**5.5**
4	3B1a,3B1b	NH_3, NO_x	Nitrogen excretion rate for cattle was calculated using the Tier 2 approach with the implementation of average annual requirements for crude protein.	**5.8.2**
5	3.B.2	NH_3, NO_x	Correction of EFs for sheep category	**5.8.4**
6	3.B.3	NH_3, NO_x	Nitrogen excretion rate for swine was calculated using the Tier 2 approach with the implementation of the more developed disaggregation of pigs´ category.	**5.8.2**
7	3B4gi	NH_3, NO_x	Correction of EFs for laying hens category	**5.8.4**
8	3B4giv	NH_3, NO_x	Correction of EFs for other poultry categories	**5.8.4**
9	3B1	NMVOC	NMVOC change compared to last year in dairy cattle and non-dairy cattle, based on a change in enteric fermentation. The proportion of silage in feed and the energy value of feed changed, other categories unchanged.	**5.8.6**
10	3.B.3	$PM_{2.5}$	Correction of EFs for swine category	**5.8.5**
11	3B4d	PM_{10}	Correction of EFs for goats category	**5.8.5**
12	3B4e	PM_{10}	Correction of EFs for horses category	**5.8.5**
13	3Da2a	NH_3, NO_x	Recalculation are connected with the recalculations in 3B1,3B2,3B3 and 3B4	**5.9.2**
14	3Da2c	NH_3, NO_x	New activity data was implemented into the category. Vitahum and digesters slurry consumption were added into calculations.	**5.9.6**
15	3Da1	NH_3	Implementation of Tier 2 approach	**5.9.3**
16	3De	NMVOC	Correction of EF for the wheat base of Tier 2 approach	**5.10.3**
17	3Ba3	NH_3, NO_x	Recalculation are connected with the recalculations in 3B1,3B2	**5.9.2**

Figure 5.5: Comparison of NH_3 emissions from the Agriculture sector due to recalculations



NH_3 emissions: The VÚŽV provided new breed structure of cattle for 1995-2017 time-series. Years 1990-1995 were extrapolated with the linear extrapolation tool in excel spreadsheet. The structure is essential for body weight estimation (***Table 5.9)***. The result of implementation exchanged the current consistent body weights in cattle (dairy cattle, suckling cows and calves) categories to dynamic body weight according to the changes in breed structure in that time. Methodological changes had an impact on the estimation of nitrogen excretion rate from the 3B1 category.

Table 5.9: *Changes in average body weight in dairy cattle category for submissions 2019 and 2020*

AVERAGE BODY WEIGHT (KG)		
	DAIRY CATTLE IN 2020 SUBMISSION	DAIRY CATTLE IN 2019 SUBMISSION
1990	589.41	597.92
1991	589.77	597.64
1992	590.40	597.76
1993	590.75	597.76
1994	590.77	597.76
1995	590.21	597.76
1996	586.98	597.76
1997	586.26	597.72
1998	587.65	597.65
1999	588.58	597.71
2000	591.02	597.71
2001	591.97	597.84
2002	592.93	597.84
2003	593.31	597.86
2004	593.65	597.88
2005	594.76	597.88
2005	595.41	597.86
2006	595.97	597.85
2008	596.53	597.88
2009	597.09	597.83
2010	597.81	597.86
2011	597.86	597.91
2012	598.08	597.90
2013	598.37	597.89

AVERAGE BODY WEIGHT (KG)		
	DAIRY CATTLE IN 2020 SUBMISSION	DAIRY CATTLE IN 2019 SUBMISSION
2014	598.50	597.86
2015	598.57	597.81
2016	598.65	597.75
2017	598.70	597.73
2018	598.75	-

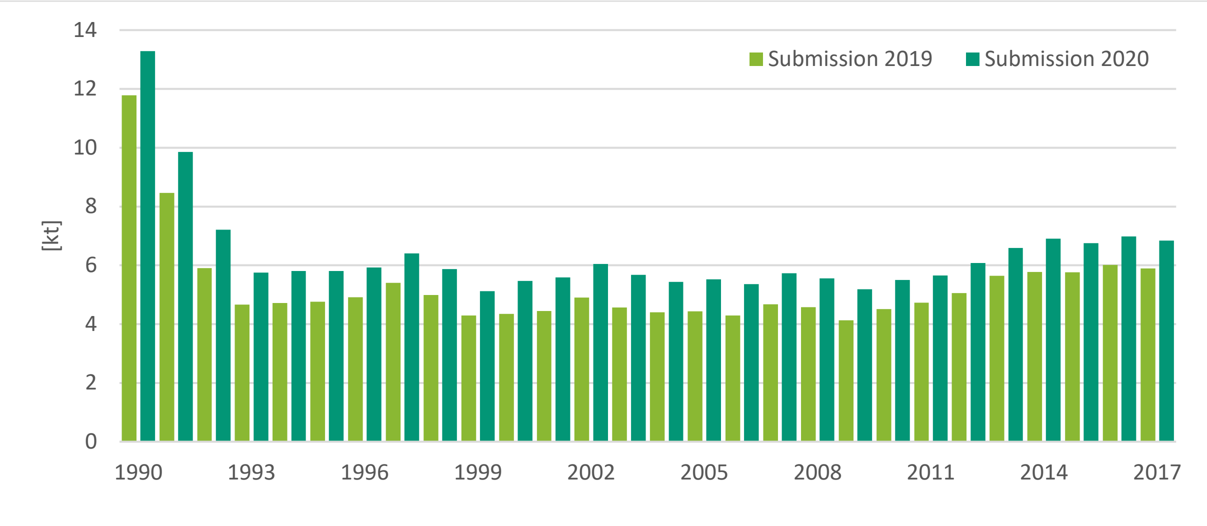
For the first time, the Tier 2 approach for the estimating nitrogen excretion rate in 3B1 Cattle category was presented. Estimates are based on average annual requirements of crude protein for pregnancy, maintenance, milk yield and daily gain. Information on crude protein from feeding ration for cattle was not applicable for this purpose, due to low estimated value. Applicate changes in 3A1 had a direct influence as well, especially changes in body weight. Detailed information on recalculations and methodological changes and changes in used parameters are available in the ***Chapters 5.8.2***. Recalculations had an impact on NO_x emissions as well.

Abatements technics were removed from NH_3 a much more sophisticated system needs to be developed to implement them, please see **Annex VI – Chapter A6.3**.

Recalculation in 3Da2a is connected with the recalculations in 3B1 and 3B3 categories. New nitrogen excretion rate for cattle and swine was implemented. In addition, new activity data was implemented in the 3Da2c category. Vitahum and digesters slurry consumption were added into calculations of emissions from the Other organic fertilizers use. Detailed information on changes in activity data is available in the ***Chapters 5.9.4***. Recalculations had an impact on NO_x emissions as well.

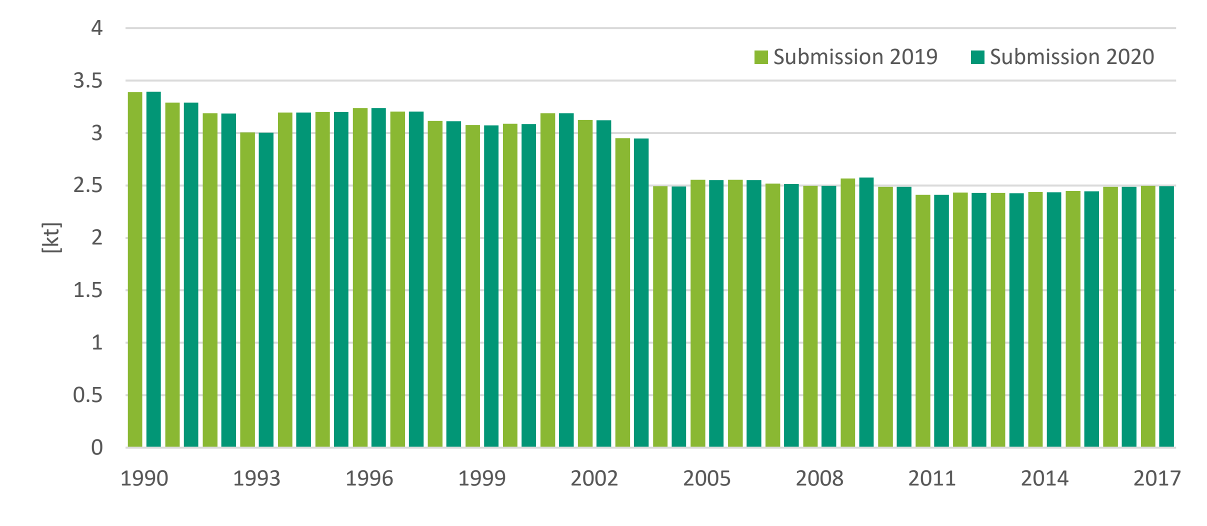
Recalculation in 3Da3 Urine and dung applied to the soils is connected with the recalculations in 3B1 and 3B3, where nitrogen excretion rate values were revised, percentage of AWMS is unchanged. Revision leads to the recalculation in 1990-2017 time series. Recalculations had an impact on NO_x emissions as well. Recalculation of mentioned categories leads to increase (***Figure 5.6***) of NH_3 emission compare to the previously submission on 34 % (2017).

Figure 5.6: *Comparison of NOx emissions from the Agriculture sector due to recalculations*



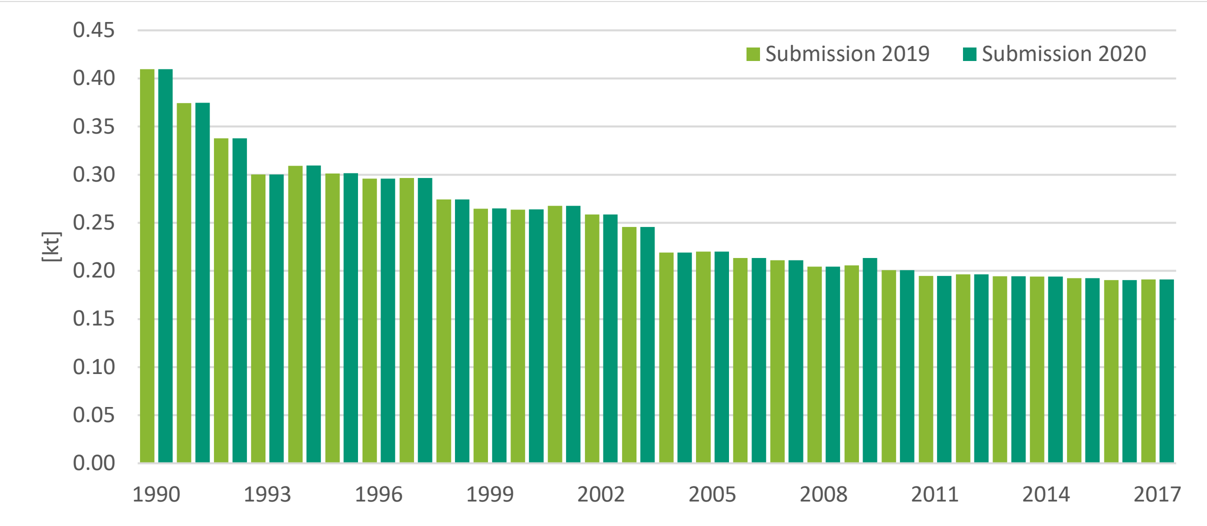
NO_X emissions: Order errors were found and corrected in 3.B Manure management. Emissions are recalculated in all subcategories (3B1, 3B2, 3B3, 3B4).Recalculation of NO_x leads to the increase of emission compared to the previous submission on 16 % (2017) (***Figure 5.7***).

Figure 5.7: Comparison of PM_{10} emissions from the Agriculture sector due to recalculations



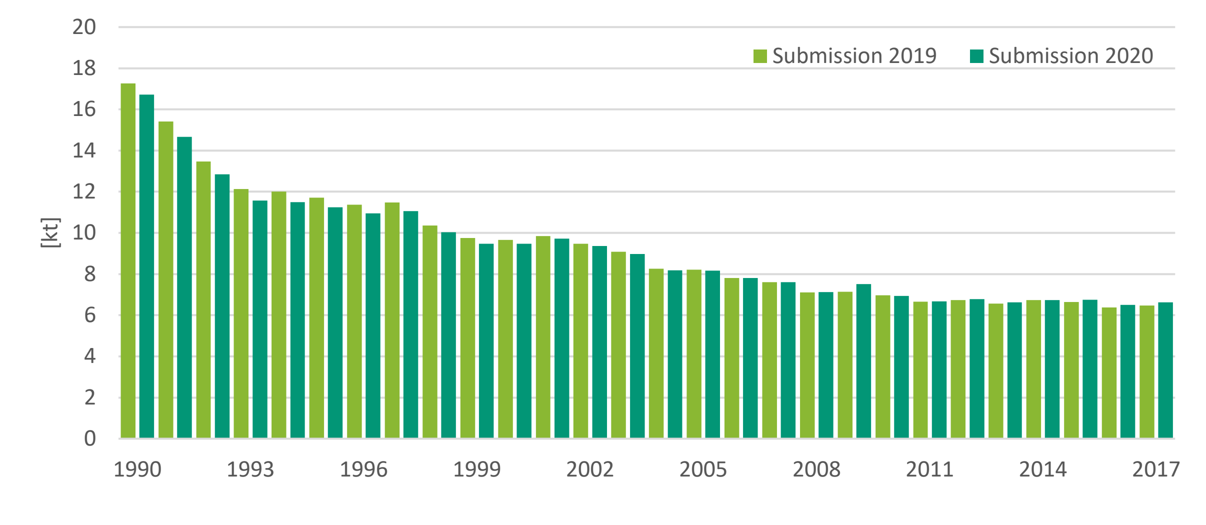
PM_{10} emissions: Recalculation on PM_{10} emissions were made due to error in used emission factors. The changes have an insignificant effect on reported emissions. Recalculation of NO_x leads to the decrease of emissions compared to the previous submission on 0.09% (2017). More information is available in ***Chapter 5.8.5***.

Figure 5.8: Comparison of $PM_{2.5}$ emissions from the Agriculture sector due to recalculations



$PM_{2.5}$ emissions: Recalculation on PM_{10} emissions were made due to error in used emission factors. These changes have an insignificant effect on reported emissions. Recalculation of NO_x leads to increase of emission compared to the previous submission on 0.02 % (2017). More information is available in ***Chapter 5.8.5***.

Figure 5.9: Comparison of NMVOC emissions from the Agriculture sector due to recalculations



NMVOC emissions: Feeding plans were updated in cattle category. Changes in feed composition influenced the implementation of the new values of digestibility of feed. Digestibility had an impact on changes in gross energy intake in all time-series. Recalculation of emission in 3B1 Cattle category reflected increasing livestock efficiency, gross energy intake and digestibility of feed correlated with milk yield in historical years. Updates of energy intake and recalculation of ammonia emissions have an impact on increase emissions in 2017(***Figure 5.9***). More information is available in ***Chapter 5.8.6***.

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 the 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.[5] These measures are well advanced and copy the practices used in Western European countries. Therefore, also in inventory, default parameters for Western Europe are used. 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 on 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 5.11*** and ***5.12***. High producing dairy cows (milked 23 litres/day) need to be fed by 8 kg of cereals with excellent digestibility and high nutrition. Annual increases of milking productivity document increase in 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 5.10***).

[5] Nitrates Directive http://www.mpsr.sk/index.php?start&navID=78&id=1325%20 (in Slovak)

Figure 5.10: *Trend in average gross energy intake in different Slovak regions*

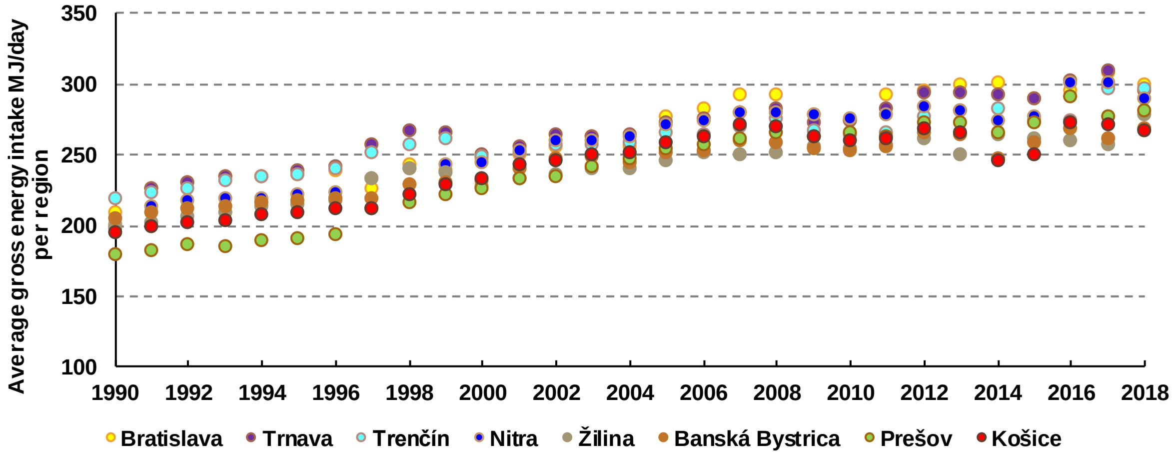
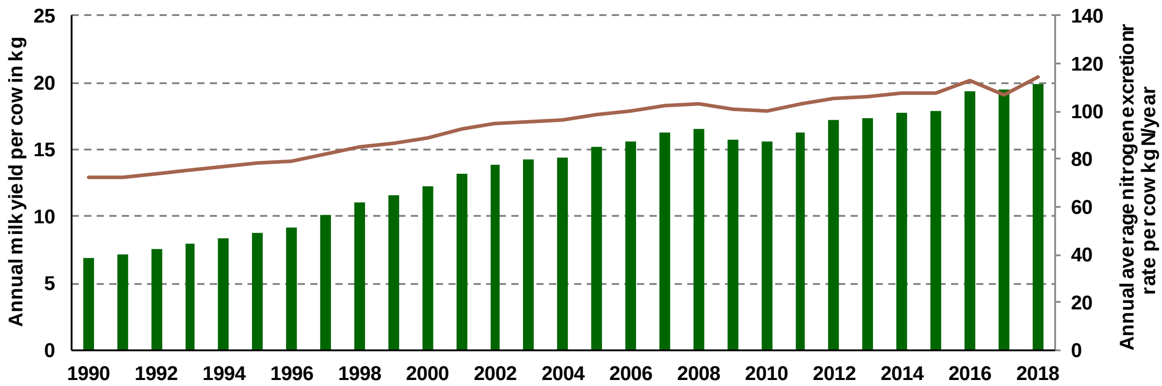
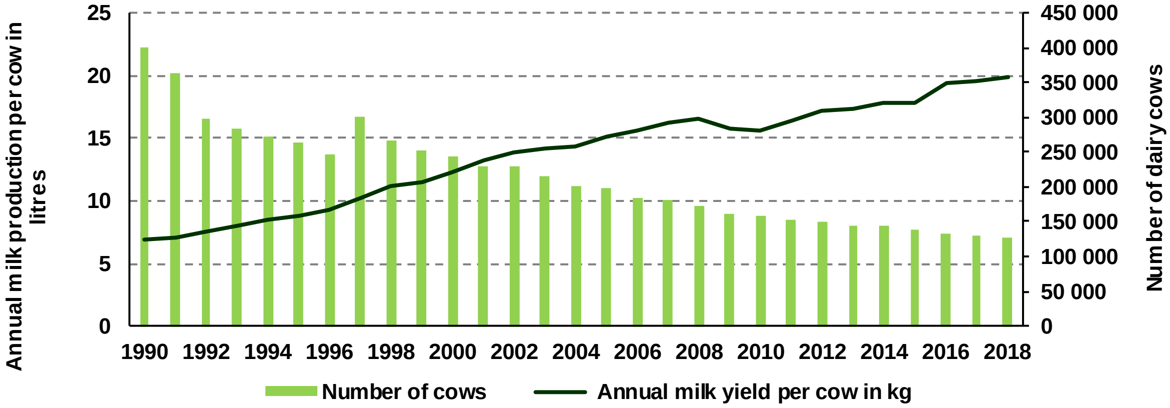


Figure 5.11: *Correlation between milk production and Nitrogen excretion rate*



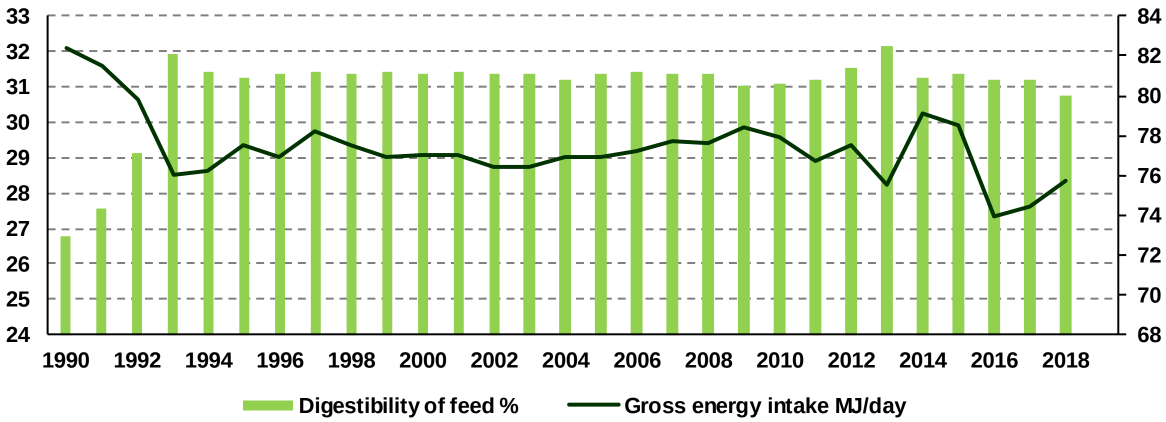
The number of dairy cows decreased to 68% in 2018 compared to 1990 (***Figure 5.11***) according to data from the Statistical Office (ŠÚ SR). Milk production increased to 186% in 2018 (***Figure 5.12***) compare to 1990 despite the continuously decreasing of the dairy cows. The main reason is the increase in performance average. 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 dairy cow per year.

Figure 5.12: Trend in dairy cattle population and dairy milk production per cow



The pig farming system in the Slovak Republic is divided into two types - breeding and fattening pigs. Breeding pigs are bred for reproduction purposes. Fattening pigs are bred mainly for the production of pork meat and fat. Pigs are housed in the Slovak conditions for the whole year. Housing technology and diet can significantly affect the production of greenhouse gases and pollutants. 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 5.13***).

Figure 5.13: Trend of digestibility and gross energy intake of swine in the Slovak Republic



5.7 UNCERTAINTIES

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

5.8 MANURE MANAGEMENT (NFR 3B)

Emitted gas: *NH_3, NMVOC, NOx, TSP, PM_{10}, $PM_{2.5}$*
Methods: *T1 and T2*
Emissions factors: *D, CS*
Key sources: *Yes*
Significant subcategories: *Cattle, Swine, Poultry*

The emissions of NH_3, NOx, TSP NMVOC and PM were estimated from category 3B Manure management.

NOx and NH_3 emissions from Sector 3 Agriculture were estimated according to the EMEP/EEA GB_{2016} as Tier 2 approach for dairy cattle, non-dairy cattle, sheep, swine, goats, horses and poultry. Nitrogen excretion rate for the swine category is calculated based on the nitrogen content of the feed according to the IPCC 2006 GL methodology.

Detailed Tier 2 method was used to calculate NMVOC emissions for dairy cows and non-dairy cattle (key sources of emission). The other animal's categories were calculated by the Tier 1 approach, and the EMEP/EEA GB_{2016} was considered. The TSP, PM_{10}, and $PM_{2.5}$ were calculated by the EMEP/EEA GB_{2016}. Tier 1 approach was used for all animal species because the Tier 2 methodology is unavailable.

5.8.1 ANIMAL WASTE MANAGEMENT SYSTEMS

Activity data on the allocation of manure to animal waste management systems are based on the survey, which analysed manure management practices. A questionnaire survey in farms was performed with the cooperation with the NPPC - VÚŽV and other research institutions in 2014. Farmers reported the amount of solid and liquid manure and manure, which was processed in anaerobic digesters by regions. This survey defined more accurately defined numbers of days on pasture for cattle, sheep, goats, and horses. Manure left on pasture was estimated based on this data. Time-series was completed by extrapolation.

Allocation according to the climate conditions is 100% for cool climate for all animals based on the IPCC 2006 methodology and climate data for the Slovak Republic. Western Europe default value for nitrogen excretion was used; the reasons for this choice are described in **Chapter 5.5**.

5.8.2 NITROGEN EXCRETION RATE

Nitrogen Excretion rate – cattle– a country-specific nitrogen excretion rate was used for cattle category, based on the tier 2 approach. The approach was implemented to estimations faecal, urinary, and total manure N excretions. The approach was implemented for each subcategory of cattle based on statistical inputs - milk yield, the weight of the animal and daily gain. The method estimates average annual requirements of crude protein for the maintenance, lactation, pregnancy and daily gain. Milk yield, daily gain and share of proteins in milk on the regional level, were taken from the Statistical Office of the Slovak Republic. Average body weights were estimated with the country-specific method; more information about the approach is documented in ***Chapter 5.5***. The calculation model is in line with enteric fermentation model same activity data was implemented. The methodology was developed in the National Agricultural and Food Centre – The Research Institute for Animal Production in Nitra. Additional information on the usability of maintenance and pregnancy was taken into account. Parameters are documented in ***Table 5.10.***

Table 5.10: *Additional parameters for estimation of nitrogen excretion rate:*

PARAMETER	UNITS*	SOURCES
Crude protein per litter of milk	85g per litter	P.Petrikovič – A Sommer Nutrition for cattle
Share of protein in calf meat	21,5%	Keresteš, J. at all. Biotechnology nutrition and health

PARAMETER	UNITS*	SOURCES
Usability for maintenance	2%	P.Petrikovič – A Sommer Nutrition for cattle
Usability for pregnancy	20%	P.Petrikovič – A Sommer Nutrition for cattle
Nitrogen overage -dairy cattle	25%	Expert judgement
Nitrogen overage - other cattle	20%	Expert judgement
Share of protein in beef meat	21%	Keresteš, J. at all. Biotechnology nutrition and health
The conversion factor from CP to N	6.25	2006 IPCC GL p.10.58
Time without milking	60 days	https://www.plis.sk/
Crude protein for pregnancy begin part of pregnancy	680g/day	P.Petrikovič – A Sommer Nutrition for cattle
Crude protein for pregnancy begin part of pregnancy	765 g/day	P.Petrikovič – A Sommer Nutrition for cattle

*consistent in all time-series

The nitrogen excretion rate was determined for the whole time-series with methods according to the Petrikovič, P. a col.: Nutrition for cattle[6].[7] The complex of crude protein contains the amount of protein nitrogen and non-protein nitrogen estimated with the Kjeldahl method. Crude protein is multiplied by a conversion factor of 6.25 to dietary nitrogen.

The calculation method is based on a reverse estimation of nitrogen excretion from the average parameters of animal production (milk yield and daily gain, body weight) of the cattle. Parameters a multiplied with tabular values of crude protein from individual physiological activities. Subsequently, the partial crude protein from activities is summed to the total crude protein. Total crude protein was recalculated to the nitrogen.

Dairy cattle:

$$\mathrm{CP}_{m-Total} = \left[(4.93 * \mathrm{H}^{0.75} * U_m) - \left(\frac{CP_m}{100} * U_m\right)\right]$$

$$\mathrm{CP}_{l-Total} = \left[(\mathrm{MY} * CP_l) - \left(\frac{MY * 1000}{100 * SP_l}\right)\right]$$

$$\mathrm{CP}_{p-Total} = \frac{C_{p1+}C_{p2}}{100} * U_p$$

$$Total_{CP} \frac{\frac{(\mathrm{CP}_{m-Total}+\mathrm{CP}_{l-Total})*lactation\ period}{1000} + \frac{(\mathrm{CP}_{m-Total}+\mathrm{CP}_{p-Total})*time\ without\ milking}{1000}}{intervening\ period} * 365$$

$$N_{intake\ (T)} = \left(\frac{\frac{Total_{Cp}}{100}}{6.25}\right)$$

$$NEX_{(T)} = N_{intake\ (T)} + \left(N_{intake\ (T)} * O_N\right)$$

[6] http://old.agroporadenstvo.sk/zv/hd/ziviny_hd/ziviny21.htm

[7] http://old.agroporadenstvo.sk/zv/hd/ziviny_hd/ziviny23.htm

Non-dairy cattle:

$$\mathbf{CP}_{m-Total} = \left[(\mathbf{4.93} * \mathbf{H}^{0.75} * \boldsymbol{U_m}) - \left(\frac{\boldsymbol{CP_m}}{\mathbf{100}} * \boldsymbol{U_m} \right) \right]$$

$$\boldsymbol{CP_{dg-Total}} = \left[\left(\mathbf{200} + \left(\mathbf{4.43} * \mathbf{H}^{0.75} \right) \right) * \mathbf{dg} \right] * \boldsymbol{SP_m}$$

$$\boldsymbol{Total_{CP}} = \frac{(\mathbf{CP}_{m-Total} + \mathbf{CP}_{dg-Total})}{\mathbf{1000}} * \mathbf{365}$$

$$\boldsymbol{N_{intake\,(T)}} = \left(\frac{\frac{\boldsymbol{Total_{Cp}}}{\mathbf{100}}}{\mathbf{6.25}} \right)$$

$$\boldsymbol{NEX_{(T)}} = \boldsymbol{N_{intake\,(T)}} + \left(\boldsymbol{N_{intake\,(T)}} * \boldsymbol{O_N} \right)$$

Where: **$CP_{m\text{-}Total}$** =crude protein for maintenance in g per day, **$H^{0.75}$=**metabolic body size, **H =**average body weight in kg, **U_m**= Usability for maintenance in %, **MY**= milk yield in kg/day **$CP_{l\text{-}Total}$=** crude protein for lactation g per day, **$CP_{p\text{-}Total}$=** crude protein for pregnancy in g per day, **$CP_{dg\text{-}Total}$=** crude protein for daily gain in g per day, dg = daily gain of animal in kg, **4.93** factor for maintenance, **4.43** factor crude protein per daily gain, **SP_l**= share of proteins in milk in %, **SP_m**= share of proteins in meat in %, **lactation period** = period of milk production in days, **intervening period** = is a figure indicating the time elapsed between two calves in days, **$Total_{CP}$** = total calculated crude protein in kg, **$NEX_{(T)}$** = annual N excretion rates, kg N animal^{-1} year^{-1}, **6.25**= conversion from kg of dietary protein to kg dietary N, kg feed protein (kg N)$^{-1}$,**O_N =** share of overage of nitrogen in N, **N_{INTAKE} (T)** = daily N consumed per animal of category T , **C_{p1}=** crude protein for pregnancy begin part of pregnancy **C_{p2}=** crude protein for final pregnancy part of pregnancy

Nitrogen Excretion rate – swine – a country-specific nitrogen excretion rate was used for swine category, based on the tier 2 methodology from the IPCC 2006 GL. The nitrogen-excretion rates were developed based on the nitrogen content of the feed. The amounts of the nitrogen-containing feed ingredients in the diet were determined for the whole time-series. Feeding rations for different subcategories of pigs were estimated with model “Software for Feeding Ration Optimization” from the National Agricultural and Food Centre - the Research Institute for Animal Production in Nitra (NPPC - VÚŽV).

The Nitrogen intakes were determined from the crude protein content of each feed ingredient in the feeding ration for all sub-categories of swine. The value of gross energy intake is consistent with the value of the 3B3 category. Data on gross energy intake were calculated according to publication Petrikovič, P. a col.: Nutrition for Pigs. Experimental feeding rations were compiled with "The Animal Optimization Software" from Agrokonzulta Žamberk. Ltd. (CZ). This program uses the feed database, and Nutrition Standards developed at the NPPC-VÚŽV Nitra. The nitrogen intakes were determined from the crude protein content of each feed ingredient in the diet for all subcategories of swine and gross energy intake of the swine.

$$\boldsymbol{N_{intake\,(T)}} = \frac{\boldsymbol{GE}}{\mathbf{18.45}} * \left(\frac{\frac{\boldsymbol{CP}\,\%}{\mathbf{100}}}{\mathbf{6.25}} \right)$$

Where: N_{INTAKE} (T) = daily N consumed per animal of category T, kg N/head/day, GE = gross energy intake from feeding ration MJ/animal/day, 18.45 = conversion factor for dietary GE/kg of dry matter MJ/kg, CP = percent crude protein in diet %, 6.25 = conversion from kg of dietary protein to kg of dietary N, kg feed protein (kg/N).

The values of the annual nitrogen excretions that is retained by animals and their sources are summarized in ***Tables 5.11-5.15***. The results for swine for 2018 were presented in ***Table 5.11-5.12***. Sheep are also significant contributors to emissions, but data about crude protein were unavailable. The N-excretion rates were calculated according to Equation 10.32 of the IPCC 2006 GL:

$$NEX_{(T)} = N_{intake\ (T)} * (1 - N_{retention})$$

Where: N_{EXT} = annual N excretion rates in kg N/head/yr, N_{INTAKE} (T) = the annual N intake per head of animal of species/category T, kg N /head/yr, $N_{RETENTION}$ (T) = fraction of annual N intake that is retained by animal of species (according to the Table 10.20 of the IPCC 2006 GL).

Table 5.11: *Country-specific regional parameters for 3B3 Swine for the period for 1990*

3B3 Breeding swine							
1990		**SOWS**	**GILTS PREGNANT**	**GILTS UNPREGNANT**	**HOGS**	**PIGLETS 20 KG**	**PIGLETS 21-50 KG**
N-intake $_{(T)}$	*(kg N animal/year)*	30.28	19.57	15.76	19.18	4.89	9.19
N-EXCRETION	*kg N/head/year*	21.20	13.70	11.03	18.48	3.42	6.43

3B3 Market swine						
1990		**FATTENING PIGS UP TO 20 KG**	**FATTENING PIGS 21-50 KG**	**FATTENING PIGS 50-80 KG**	**FATTENING PIGS 80-110 KG**	**FATTENING PIGS FROM 110 KG**
N-intake $_{(T)}$	*(kg N animal/year)*	6.46	11.71	17.16	21.54	24.03
N-EXCRETION	*kg N/head/year*	4.52	8.20	12.01	15.07	16.82

Table 5.12: *Country-specific regional parameters for 3B3 Swine for the period for 2018*

3B3 Breeding swine							
2018		**SOWS**	**GILTS PREGNANT**	**GILTS UNPREGNANT**	**HOGS**	**PIGLETS 20 KG**	**PIGLETS 21-50 KG**
N-intake $_{(T)}$	*(kg N animal/year)*	28.18	19.76	15.92	18.97	4.94	9.28
N-EXCRETION	*kg N/head/year*	19.72	13.83	11.14	18.26	3.46	6.49

3B3 Market swine						
2018		**FATTENING PIGS UP TO 20 KG**	**FATTENING PIGS 21-50 KG**	**FATTENING PIGS 50-80 KG**	**FATTENING PIGS 80-110 KG**	**FATTENING PIGS FROM 110 KG**
N-intake $_{(T)}$	*(kg N animal/year)*	5.50	9.98	14.62	18.35	20.47
N-EXCRETION	*kg N/head/year*	3.85	6.98	10.24	12.84	14.33

Other animals - the calculation is based on the determination of body weight. All animals have their specific body weight. This parameter was estimated and is country-specific. The regional differences were considered only for cattle category; each region has specific body mass. The body weight parameter is consistent across the time-series and specific for animal species. The NPPC - VÚŽV provided the specific body mass for animals. Annual nitrogen excretion rates were calculated for sheep, goats, horses, and poultry. N-excretion rates for animals' categories were calculated based on the IPCC 2006 GL, Equation 10.30:

$$\mathbf{NEX_T = N_{rate(T)} * \frac{TAM}{1000} * 365}$$

Where: **N_{EXT}** = annual N-excretion for each livestock spices respectively category in kg N per animal; **$N_{RATE(T)}$** = default N-excretion rate in kg N (100 kg/animal mass)/day (IPCC 2006 GL), **TAM** = country specific animal mass for each livestock species/category in kg per animal

Table 5.13: Country-specific regional parameters for dairy cattle in 2018

CATEGORIES		N_{EX} kg N/head/year	BODY MASS kg	LIQUID	SOLID	PASTURE	ANAEROB. DIGEST.
				%			
DAIRY CATTLE	DAIRY COWS BRATISLAVA	129.72	599	42.874	56.855	0.270	0.00
	DAIRY COWS TRNAVA REGION	131.09	599	16.455	70.423	1.251	11.87
	DAIRY COWS TRENČÍN REGION	120.55	599	6.582	80.228	5.417	7.77
	DAIRY COWS NITRA REGION	124.77	599	16.218	80.742	0.676	2.36
	DAIRY COWS ŽILINA REGION	102.96	599	5.768	72.771	17.842	3.62
	DAIRY COWS BANSKÁ	106.90	599	10.496	75.040	10.172	4.29
	DAIRY COWS PREŠOV REGION	104.99	599	4.053	79.391	14.853	1.70
	DAIRY COWS KOŠICE REGION	104.64	599	2.289	56.855	10.109	6.45

Table 5.14: Country-specific regional parameters for dairy cattle in 1990

CATEGORIES		N_{EX} kg N head/year	BODY MASS kg	LIQUID	SOLID	PASTURE	ANAEROB. DIGEST.
				%			
DAIRY CATTLE	DAIRY COWS BRATISLAVA	82.63	589	42.85	56.86	0.29	-
	DAIRY COWS TRNAVA	78.69	589	18.57	79.79	1.64	-
	DAIRY COWS TRENČÍN	74.60	589	7.12	86.92	5.97	-
	DAIRY COWS NITRA REGION	75.83	589	16.56	82.62	0.82	-
	DAIRY COWS ŽILINA REGION	66.06	589	5.93	75.34	18.73	-
	DAIRY COWS BANSKÁ	71.65	589	10.67	77.88	11.44	-
	DAIRY COWS PREŠOV	62.65	589	4.06	80.43	15.51	-
	DAIRY COWS KOŠICE REGION	69.36	589	2.41	86.29	11.30	-

Table 5.15: N_{EX} and share (%) for different domestic livestock and share in AWMS in 2018

CATEGORIES		N_{EX} N kg/head	LIQUID	SOLID	PASTURE	OTHER (LITTER)
			%			
Non-dairy cattle	Suckling cows	71.31	-	45.21	54.79	-
	Calves in 6 month (milk type)	12.41	-	-	100.00	-
	Heifer (milk type)	35.87	-	97.56	2.44	-
	Heifer (pregnant) (milk type)	62.88	-	97.56	2.44	-
	Fattening (milk type)	42.62	10	90	-	-
	Oxen (milk type)	84.32	-	100	-	-
	Breeding bull (milk type)	44.07	-	75.34	24.66	-
	Calves in 6 month (beef type)	7.07	-	40	60.00	-
	Heifer (beef type)	38.28	-	45.21	54.79	-
	Heifer (pregnant) (beef type)	61.05	-	45.21	54.79	-
	Fattening (beef type)	44.07	20	80	-	-
	Oxen (beef type)	84.32	-	100		-
	Breeding bull (beef type)	44.07	-	75.34	24.66	-
	Weighted average in 2018	**42.48**				**-**
Sheep	Mature ewes (milk type)	18.62	-	49.59	50.41	-
	Mature ewes (beef type)	21.72	-	45.20	54.80	-
	Weighted average in 2018	**19.74**	**-**	**48.00**	**52.00**	**-**
	Growing lambs (milk type)	10.8	-	49.59	50.41	-
	Growing lambs pregnant (milk type)	17.6	-	49.59	50.41	-

CATEGORIES		N_{EX} *N kg/head*	LIQUID	SOLID	PASTURE	OTHER (LITTER)
			%			
	Growing lambs (beef type)	14.74	-	45.21	54.79	-
	Growing lambs pregnant (beef type)	20.17	-	45.21	54.79	-
	Weighted average in 2018	**14.55**		**48.14**	**51.86**	**-**
	Rams (milk type)	24.82	-	100.00	-	-
	Rams (beef type)	27.92	-	100.00	-	-
	Weighted average in 2018	**25.92**		**100.00**	**-**	**-**
Goats	Mature female goats	25.70	-	49.60	50.40	-
	Pregnant goats	22.19	-	49.60	50.40	-
	Other mature goats	10.5	-	49.60	50.40	-
	Weighted average in 2018	**23.65**		**49.60**	**50.40**	**-**
Horses	Young horses	27.28	70.00	-	30.00	-
	Castrated horses	66.43	70.00	-	30.00	-
	Stallions	52.20	70.00	-	30.00	-
	Mares	47.45	70.00	-	30.00	-
	Weighted average in 2018	**47.13**	**70.00**		**30.00**	**-**
Poultry	Laying hens + cocks	1.10	-			100.00
	Broilers	0.80	-			100.00
	Turkeys	1.84	-			100.00
	Ducks	1.21	-			100.00
	Geese	1.82	-			100.00
	Weighted average in 2018	**0.95**				**100.00**

5.8.2.1 Methodological issues –Method NH_3 and NOx

Emissions of NOx and NH_3 from 3B1 Cattle, 3B2 Sheep and 3B3 Swine and other animals 3B4 were calculated using the Tier 2 method of the EMEP/EEA GB_{2016} and country-specific values whenever is possible.

5.8.2.2 Emissions factors NH_3 and NOx

All animals

The values of the N excretion, housed-period and the proportion of solid, liquid and yard manure were replaced by the country-specific values year by year for all animal species. The input data on regional N-excretion and percentage of liquid, solid and yard manure are presented in ***Tables 5.11 - 5.15.*** Solid storage of manure was found as the most frequent AMWS for cattle. The regional differences for horses, goats and poultry categories were not considered.

For the remaining input data as well as for the emission factors, standards and default values provided in the EMEP/EEA GB_{2016} were applied.

Table 5.16: *Country-specific NH_3 emission factors for 3B1a Dairy cattle and background data for the period 1990-2018*

3B1a DAIRY CATTLE CATEGORY				
YEAR	BODY MASS AVERAGE*	MILK YIELD	N-EXCRETION*	IMPLIED EMISSION FACTOR FOR 3B1a
	(*kg/head*)	*(kg/head/year)*	(*kg N/year/head*)	(*kg NH_3/head/year*)
1990	589.41	6.96	72.09	7.65
1991	589.77	7.14	72.71	7.72

1992	590.40	7.61	74.27	7.88
1993	590.75	8.02	75.60	8.03
1994	590.77	8.42	76.91	8.16
1995	590.21	8.83	78.18	8.30
1996	586.98	9.23	79.32	8.42
1997	586.26	10.17	82.31	8.74
3B1a DAIRY CATTLE CATEGORY				
YEAR	**BODY MASS AVERAGE***	**MILK YIELD**	**N-EXCRETION***	**IMPLIED EMISSION FACTOR FOR 3B1a**
	(*kg/head*)	(*kg/head/year*)	(*kg N/year/head*)	(*kg NH_3/head/year*)
1998	587.65	11.12	85.42	9.07
1999	588.58	11.56	86.89	9.23
2000	591.02	12.24	89.22	9.47
2001	591.97	13.23	92.46	9.81
2002	592.93	13.92	94.76	10.06
2003	593.31	14.21	95.71	10.15
2004	593.65	14.36	96.22	10.20
2005	594.76	15.18	98.93	10.49
2006	595.41	15.57	100.23	10.61
2007	595.97	16.31	102.63	10.87
2008	596.53	16.52	103.36	10.95
2009	597.09	15.79	101.06	10.68
2010	597.81	15.62	100.52	10.63
2011	597.86	16.35	102.87	10.88
2012	598.08	17.22	105.70	11.17
2013	598.37	17.34	106.11	11.20
2014	598.50	17.74	107.51	11.32
2015	598.57	17.85	107.74	11.31
2016	598.65	19.41	112.79	10.97
2017	598.70	19.56	106.94	11.21
2018	598.75	19.89	114.64	12.03

***Weighted average from 8 Slovak regions

5.8.3 ACTIVITY DATA

Basic data sources used for the evaluations of emissions were published in the Census of sowing areas of field crops in the Slovak Republic, the Annual census of domestic livestock in the Slovak Republic, the Statistical Yearbooks 1990–2017 and the research results from projects and studies provided by several organizations inside the NPPC.

Activity data for dairy, non-dairy cattle, and sheep, swine are based on bottom-up statistical information at the district level (regions). The aggregation of input parameters performed as a weighted average. The ŠÚ SR provided national data of annual livestock numbers on a detailed region level in 2018 (***Table 5.16***). Data based on livestock census held on 31st December of each year. Before 2016, the number of livestock were extrapolated, because statistical data was not available up to the 1990s. After 2016 extrapolated data was replaced by officially statistical data.

The ŠÚ SR provided a complete time series of the livestock number on the regional level in 2016. Data could not be implemented immediately, due to a different regionalization in years 1990–1996 (only three regions: Západoslovenský, Stredoslovenský, and Východoslovenský) it was necessary to reallocate this older data into new regions (8 districts after 1997):

- Západoslovenský region (1990–1996) is equal to Bratislavský, Nitrianský, Trnavský, Trenčiansky regions (1997- present);
- Stredoslovenský region (1990–1996) is equal to Banskobystrický and Žilinský regions (1997 - current);
- Východoslovenský region (1990–1996) is equal to Prešovský and Košický regions (1997-current);

A reallocation was prepared by using the linear extrapolation tools to reach statistical totals as reported by the ŠÚ SR. The ŠÚ SR uses a standard statistical approach for extrapolations. The Eurostat reviews used standards. The good statistical practice is to describe in Eurostat guidance.[8] After 2016 submission extrapolation number of swine was reported. The SHMÚ filled the data gap by using a standard statistical approach for extrapolation (linear extrapolation in spreadsheets). In 2017 submission, the ŠÚ SR provided complete time-series with official data, which is inconsistent with Eurostat and FAOSTAT (**Chapter 5.4.1**). Detailed statistical information is available on the level of the region and emissions are estimated by bottom-up Tier 2. The NPPC - VÚŽV implemented the results of a questionnaire farm survey. Better classification and disaggregation of cattle, sheep and swine categories were used. Based on survey data, cattle were divided into dairy and non-dairy. Dairy cattle are estimated separately from non-dairy cattle. Dairy cows are defined as cows that produce milk only for human consumption (high producing cows). Suckling cows are defined as cows that are bred for the nutrition of calves (low producing cows). Suckling cows have included in the subcategory non-dairy cattle. Category Non-dairy includes a subcategory of cattle like a breeding bull, oxen, calves, heifer pregnant, un-pregnant heifers, fattening and mentioned suckling cows. Categorization is consistent throughout the calculation cycle.

Table 5.17: *Animal population according to the districts for the year 2018*

CATEGORY		**NUMBER OF LIVESTOCK (*HEAD*)**							
DISTRICT		**Bratislava**	**Trnava**	**Trenčín**	**Nitra**	**Žilina**	**Banská Bystrica**	**Prešov**	**Košice**
Dairy cattle		4 766	20 377	13 872	19 460	22 131	18 143	19 872	9 250
Non-dairy cattle	Suckling cows	1 742	8 816	5 932	10 296	7 138	5 857	6 584	2 883
	Calves in 6 month (milk sort)	1 908	5 476	4 279	6 617	7 928	6 436	7 154	3 521
	Heifer (milk sort)	1 163	5 151	3 364	6 414	5 230	4 515	4 000	1 678
	Heifer (pregnant) (milk sort)	597	10 179	3 944	7 719	4 556	4 619	3 622	1 871
	Fattening (milk sort)	1	0	12	47	290	38	5	1
	Oxen (milk sort)	21	82	98	122	345	413	400	497
	Breeding bull (milk sort)	587	1 106	1 800	698	2 574	5 180	7 085	3 658
	Calves in 6 month (beef sort)	642	687	1 298	448	2 859	5 692	7 697	4 469
	Heifer (beef sort)	391	646	1021	435	1 885	3 993	4 303	2 130
	Heifer (pregnant) (beef sort)	201	1277	1 197	523	1 642	4 085	3 897	2 374
	Fattening (beef sort)	0	0	4	3	105	34	6	1
	Oxen (beef sort)	42	164	196	243	689	825	800	994
	Breeding bull (beef sort)	864	1 766	20 314	6 461	56 148	73 370	50 260	25 088
Sheep	Mature ewes	374	540	4 918	1 357	12 988	21 346	12 263	6 326
	Growing lambs	10	316	6 981	1 102	11 710	15 325	8 716	5 482

[8] http://ec.europa.eu/eurostat/documents/3859598/5921861/KS-32-11-955-EN.PDF/5fa1ebc6-90bb-43fa-888f-dde032471e15

CATEGORY		NUMBER OF LIVESTOCK (*HEAD*)							
DISTRICT		**Bratislava**	**Trnava**	**Trenčín**	**Nitra**	**Žilina**	**Banská Bystrica**	**Prešov**	**Košice**
	Growing lambs (pregnant)	22	52	682	189	1 696	2 217	1 475	764
	Other mature sheep	1 742	8 816	5 932	10 296	7 138	5 857	6 584	2 883
Swine	Swine	27 888	235 752	48 058	152 009	9982	73 088	50 192	30 053
Horses	Horses (0-3year)	131	76	212	430	204	355	244	195
	Stallions	87	82	130	248	205	274	286	108
	Mares	172	108	241	369	253	555	429	221
	Castrated stallions	74	88	115	186	261	306	335	122
Goats	Mature goats	468	1459	2 509	2 987	5 362	7 279	3 729	3 623
	Growing goats (pregnant)	70	281	669	849	1 042	1 822	1 004	922
	Other mature goats	55	154	249	457	505	670	533	369
Poultry	Laying hens and cocks	833 762	453 224	627 622	1818058	634 640	935 027	456 386	571 925
	Broilers	253 192	1 051 421	617 244	1 975 604	689 603	181 189	107 175	2 523 242
	Turkeys	1 358	11 758	3 402	91 846	34 869	7 047	3 595	2149
	Ducks	6 416	29 036	10 318	44 930	7 309	27 243	14 754	7 005
	Geese	1 340	3 067	1 926	7 018	2 885	4 506	1 642	2 181

5.8.4 CATEGORY-SPECIFIC RECALCULATIONS

Cattle: Recalculation was done due to implementation of new nitrogen excretion rate in cattle category according to the Tier 2 approach based on 2006 IPCC Guideline. The methodological approach is described in **Chapter 5.8.2**. Methodological changes impacted on NH_3 emission and NO_x as well. In addition, NOx was corrected due to order error, which has an impact on all cattle subcategories. Abatement in manure management was removed, which has a significant impact on the increasing of NH_3 emission. Recalculation of emissions leads to an increase in NO_x and NH_3 emissions. The percentage of difference is visible in ***Table 5.18***.

Table 5.18: *The effect of recalculations NH_3 and NOx emissions in 1990–2017 in cattle category*

CATEGORY	TOTAL NH_3 (Gg)		TOTAL NOx (Gg)	
Year of submission	**2019**	**2020**	**2019**	**2020**
1990	11.241	9.621	0.021	0.174
1991	9.903	8.455	0.019	0.154
1992	8.376	7.169	0.016	0.130
1993	7.249	6.177	0.014	0.114
1994	6.712	5.764	0.013	0.107
1995	6.735	5.513	0.013	0.100
1996	6.475	5.357	0.012	0.097
1997	6.374	5.327	0.012	0.099
1998	5.649	4.797	0.011	0.090
1999	5.352	4.590	0.010	0.086
2000	5.188	4.645	0.010	0.088
2001	5.029	4.457	0.010	0.083
2002	4.899	4.387	0.010	0.083
2003	4.677	4.215	0.009	0.079
2004	4.315	3.895	0.008	0.074
2005	4.239	4.081	0.008	0.079

CATEGORY	TOTAL NH_3 (Gg)		TOTAL NOx (Gg)	
Year of submission	**2019**	**2020**	**2019**	**2020**
2006	3.998	3.872	0.008	0.074
2007	3.940	3.845	0.008	0.074
2008	3.823	3.733	0.007	0.071
2009	3.629	3.810	0.007	0.072
2010	3.564	3.420	0.007	0.065
2011	3.526	3.415	0.007	0.065
2012	3.528	3.460	0.007	0.066
2013	3.479	3.413	0.007	0.064
2014	3.454	3.400	0.007	0.064
2015	3.335	3.295	0.006	0.062
2016	1.953	3.233	0.006	0.061
2017	1.937	3.101	0.006	0.059
SUBMISSION 2019/2020		**60%**		**872%**

Sheep: Recalculation was done due to the correction of wrong summing of nitrogen in mature ewes category. Changes impacted NH_3 emission and NO_x as well. In addition, NOx was corrected due to order error, which has an impact on all cattle subcategories. Abatement in manure management was removed, which has an impact on NH_3 emission only. Recalculation of emissions leads to an increase in NO_x and NH_3 emissions. The percentage of difference is visible in ***Table 5.19***.

Table 5.19: *The effect of recalculations NH_3 and NOx emissions in 1990–2017 in the sheep category*

CATEGORY	TOTAL NH_3 (Gg)		TOTAL NOx (Gg)	
Year of submission	**2019**	**2020**	**2019**	**2020**
1990	0.646	0.927	0.001	0.017
1991	0.541	0.835	0.001	0.016
1992	0.605	0.866	0.001	0.016
1993	0.417	0.646	0.001	0.012
1994	0.408	0.622	0.001	0.012
1995	0.437	0.673	0.001	0.013
1996	0.433	0.659	0.001	0.012
1997	0.405	0.631	0.001	0.012
1998	0.259	0.477	0.000	0.009
1999	0.265	0.491	0.000	0.009
2000	0.277	0.502	0.001	0.010
2001	0.267	0.475	0.000	0.009
2002	0.267	0.480	0.000	0.009
2003	0.286	0.493	0.001	0.009
2004	0.274	0.491	0.000	0.009
2005	0.262	0.493	0.000	0.009
2006	0.281	0.503	0.001	0.010
2007	0.311	0.523	0.001	0.010
2008	0.324	0.549	0.001	0.010
2009	0.339	0.523	0.001	0.010
2010	0.363	0.595	0.001	0.011
2011	0.358	0.595	0.001	0.011
2012	0.383	0.616	0.001	0.012
2013	0.357	0.604	0.001	0.011
2014	0.355	0.591	0.001	0.011
2015	0.344	0.577	0.001	0.011
2016	0.309	0.557	0.001	0.011

CATEGORY	TOTAL NH_3 (Gg)		TOTAL NOx (Gg)	
Year of submission	**2019**	**2020**	**2019**	**2020**
2017	0.299	0.551	0.001	0.011
SUBMISSION 2019/2020		**84%**		**1 693%**

Swine: Recalculation was done due to revision of nitrogen excretion rate according to the Tier 2 approach base of 2006 IPCC Guideline. The pig's categories were extended from 6 to 11. Major changes in Nitrogen excretion rate is visible in the Piglets category. Nitrogen excretion rate decrease compares to 2019 submission. The methodological approach is described in **Chapter 5.8.2**. Methodological changes impacted on NH_3 emission and NO_x as well. In addition, NOx was corrected due to order error, which has an impact on all pigs' subcategories. Abatements in manure management were removed, which has an impact on NH_3 emission only. Recalculation of emissions leads to an increase in NO_x and NH_3 emissions. The percentage difference is visible in ***Table 5.20***.

Table 5.20: *The effect of recalculations NH_3 and NOx emissions in 1990–2017 in the swine category*

CATEGORY	TOTAL NH_3 (Gg)		TOTAL NOx (Gg)	
Year of submission	**2019**	**2020**	**2019**	**2020**
1990	8.397	6.726	0.004	0.033
1991	8.097	6.420	0.004	0.032
1992	7.631	5.820	0.004	0.028
1993	7.248	5.215	0.004	0.025
1994	6.703	4.824	0.004	0.024
1995	6.533	5.033	0.003	0.025
1996	6.596	4.789	0.004	0.023
1997	6.222	4.445	0.003	0.022
1998	5.433	3.826	0.003	0.019
1999	5.205	3.741	0.003	0.018
2000	5.009	3.609	0.003	0.018
2001	5.092	3.692	0.003	0.018
2002	5.197	3.722	0.003	0.018
2003	4.791	3.452	0.003	0.017
2004	3.789	2.771	0.002	0.013
2005	3.683	2.617	0.002	0.013
2006	3.704	2.711	0.002	0.013
2007	3.181	2.355	0.002	0.011
2008	2.472	1.854	0.001	0.009
2009	2.446	1.740	0.001	0.008
2010	2.254	1.696	0.001	0.008
2011	1.917	1.396	0.001	0.007
2012	2.062	1.561	0.001	0.008
2013	2.083	1.502	0.001	0.007
2014	2.100	1.619	0.001	0.008
2015	2.113	1.596	0.001	0.008
2016	1.208	1.333	0.001	0.007
2017	1.272	1.401	0.001	0.007
SUBMISSION 2019/2020		**10%**		**555%**

Poultry: Recalculation was done due to correction of emission factor. In 2019 Submission, the slurry system was included in laying hen's category, which was inconsistent with reporting of Greenhouse gases under the Kyoto protocol. The slurry system was replaced with solid manure system. Abatements in the poultry category were removed. Recalculation of emissions leads to an increase in NO_x and NH_3 emissions. The percentage of difference is visible in ***Table 5.21****.*

Table 5.21: *The effect of recalculations NH_3 and NOx emissions in 1990–2017 in the poultry category*

CATEGORY	TOTAL NH_3 (Gg)		TOTAL NOx (Gg)	
Year of submission	**2019**	**2020**	**2019**	**2020**
1990	5.275	5.184	0.002	0.038
1991	4.678	4.589	0.002	0.031
1992	4.307	4.195	0.002	0.030
1993	4.194	4.082	0.001	0.027
1994	5.156	4.863	0.002	0.034
1995	4.525	4.414	0.002	0.030
1996	4.573	4.483	0.002	0.032
1997	4.579	4.490	0.002	0.032
1998	4.057	4.019	0.002	0.030
1999	3.779	3.741	0.002	0.028
2000	4.084	4.045	0.002	0.031
2001	4.920	4.881	0.002	0.036
2002	4.261	4.226	0.002	0.032
2003	4.256	4.220	0.002	0.033
2004	4.060	4.024	0.002	0.031
2005	4.129	4.095	0.002	0.032
2006	3.927	3.893	0.002	0.030
2007	3.912	3.876	0.002	0.029
2008	3.500	3.470	0.002	0.026
2009	4.117	3.876	0.002	0.029
2010	3.996	3.963	0.002	0.029
2011	3.639	3.611	0.001	0.026
2012	3.766	3.735	0.002	0.027
2013	3.488	3.455	0.001	0.025
2014	3.772	3.743	0.002	0.028
2015	3.920	3.893	0.002	0.029
2016	3.464	3.754	0.002	0.027
2017	3.673	3.974	0.002	0.030
SUBMISSION 2019/2020		**8%**		**1 446%**

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 2018, 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 the poultry production. Total $PM_{2.5}$ from manure management decreased from 0.33 Gg in 1990 to 0.12 Gg in 2018, which is the decrease by 64% compared to a basic year and increase by nearly 1% compared to the previous year. Total PM_{10} from manure management decreased from 1.31 Gg in 1990 to 0.65 Gg in 2018, which is the decrease by 51% compared to 1990 and increase by 3% compared to the previous year. Total TSP from manure management decreased from 5.33 Gg in 1990 to 2.13 Gg in 2018, which is the decrease by 54% and increase by 4% compared to the previous year. The decreasing trend in the number of animals influenced emissions trend.

5.8.5.1 Methodological issues

Emission estimation is based on the Tier 1 methodology of the EMEP/EEA GB_{2016}. The PM emissions are related to the annual average population (AAP) and to the time the animal is housed (***Table 5.22***). The PM emission from grazing animals is considered as 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 5.22: *Time to spend animals into grassland*

CATEGORIES	GRASSING TIME days
Dairy cattle	150
Calves	148
Hefers unpregnant	9
Hefers pregnant	9
Fattening	0
Oxen	0
Suckling cows	200
Calves	290
Hefers unpregnant	225
Hefers pregnant	225
Fattening	0
Oxen	0
Breeding bulls	90
Sows 180 kg	0
Wearners	0
Fattening pigs	0
Laying hens including cocks	0
Broilers	0
Turkeys	0
Ducks	0
Geese	0
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 by the default Tier 1 emissions factors for each category of farm animals (***Table 5.23***). The same emissions factors were used for all years.

Table 5.23: *Default emissions PM and TSP factors*

CATEGORIES	EMISSION FACTOR TSP *(kg/head/year^{-1})*	EMISSION FACTOR PM_{10} *(kg/head/year^{-1})*	EMISSION FACTOR $PM_{2.5}$ *(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

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})*
Hefers pregnant	0.59	0.27	0.18
Fattening	0.59	0.27	0.18
Oxen	0.59	0.27	0.18
Suckling 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 the correction of emission factors in swine, goats and horses categories. Factors were exchanged in horses and goats categories. Piglet's category was corrected, as well. Agriculture is not a significant contributor to mentioned emissions and emissions are under the threshold of significance. The used methods are described in the previous category.

The recalculation let to increasing total $PM_{2.5}$ emissions from manure management by 0.03% in 2017, as shown in ***Table 5.24***. The recalculation let to decrease of the total PM_{10} by 0.37% (***Table 5.24***).

***Table 5.24:** The impact of recalculations of TSP, $PM_{2.5}$, PM_{10} emissions in manure management in 1990–2017*

CATEGORY	TOTAL PM_{10} (Gg)		TOTAL $PM_{2.5}$ (Gg)	
Year of submission	**2019**	**2020**	**2019**	**2020**
1990	1.312	1.313	0.330	0.330
1991	1.193	1.193	0.294	0.294
1992	1.084	1.084	0.257	0.257
1993	1.012	1.011	0.223	0.224
1994	1.120	1.119	0.229	0.230
1995	1.023	1.022	0.217	0.218
1996	0.999	0.998	0.210	0.210
1997	0.982	0.981	0.211	0.211
1998	0.882	0.879	0.188	0.189
1999	0.837	0.834	0.179	0.179
2000	0.851	0.848	0.178	0.178
2001	0.939	0.937	0.181	0.181
2002	0.867	0.865	0.172	0.172
2003	0.838	0.835	0.164	0.165
2004	0.765	0.763	0.153	0.153
2005	0.763	0.761	0.151	0.151
2006	0.733	0.730	0.143	0.143
2007	0.709	0.706	0.141	0.142
2008	0.629	0.627	0.133	0.133
2009	0.679	0.689	0.133	0.141
2010	0.659	0.657	0.130	0.130
2011	0.606	0.604	0.125	0.125
2012	0.626	0.624	0.127	0.127
2013	0.601	0.599	0.124	0.124
2014	0.622	0.620	0.124	0.124
2015	0.633	0.631	0.123	0.123
2016	0.607	0.605	0.118	0.118
2017	0.630	0.628	0.119	0.119
Submissions 2019/2020		**-0.37%**		**0.03%**

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 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 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 GB_{2016}.

5.8.6.2 Emissions factors

Dairy cattle

Dairy cattle and non-dairy cattle were calculated using the Tier 2 methodology according to the EMEP/EEA GB_{2016}.

This methodology distinguishes emission factors 'with silage feeding' from cattle categories, and emission estimate is reliable. $Frac_{silage}$ used in the Slovak inventory was calculated from 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 (suckling cows, calves 6 months, heifers, pregnancy heifers, breeding bull, oxen, fattening) and followed parameters (***Tables 5.25-Table 5.26)***.

NMVOC for cattle is based on the following equations [1]:

$$E_{NMVOC\,i} = N_A.\left(E_{NMVOC.storr\ silage\ \ i} + E_{NMVOC.silage\ feeding\ i+} + E_{NMVOC.\ \ house\ i} + E_{MVOC.applic.i} + E_{NMVOC.pasture\ i}\right)$$

$$E_{NMVOC.silage\ store\ i} = MJ_i.\,x_{house\ i}\left(EF_{NMVOC.silage\ feeding\ \ i}.\,Frac_{silage}\right)$$

$$E_{NMVOC.\ \ silage\ feeding\ i} = MJ_i.\,x_{housing\ i}.\left(EF_{NMVOC\ feed\ silage\ i}.\,Frac_{silage}\right)$$

$$E_{NMVOC\ house\ i} = MJ_i.\,x_{house\ i}.\left(EF_{NMVOC\ silage}\right)$$

$$E_{NMVOC\ manure\ store\ i} = E_{NMVOC\ \ house\ i}.\,x_{house\ i}.\left(\frac{E_{NH_3\ storage\ i}}{E_{NH_3\ house\ i}}\right)$$

$$E_{NMVOC\ application\ i} = E_{NMVOC\ \ house\ i}.\,x_{house\ i}.\left(\frac{E_{NH_3\ appli\ i}}{E_{NH_3\ house\ i}}\right)$$

$$E_{NMVOC\ graz\ i} = MJ_i.\,(1 - x_{house\ i}).\,EF_{NMVOC.graz\ i}$$

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 3.B Manure Management.

Table 5.25: Overview of parameters and emissions factors for dairy cattle categories in 2018

DAIRY CATTLE							
PARAMETERS/ YEAR	**REGION**	**1990**	**2000**	**2005**	**2010**	**2015**	**2018**
BE (MJ/year)	Bratislava	95 747	104 573	111 004	111 504	126 301	118 096
BE (MJ/year)	Trnava	108 602	108 602	111 810	112 668	120 063	116 380
BE (MJ/year)	Trenčín	95 966	103 733	105 967	106 843	113 318	114 063
BE (MJ/year)	Nitra	99 718	102 733	108 894	110 292	115 245	104 374
BE (MJ/year)	Žilina	88 951	92 261	95 977	97 313	101 039	99 171
BE (MJ/year)	Banská Bystrica	93 258	95 667	98 258	97 889	102 802	96 506
BE (MJ/year)	Prešov	89 352	92 929	96 762	97 466	104 624	100 631
BE (MJ/year)	Košice	90 812	95 010	97 889	98 550	101 142	94 696
Buildings. manure BH slurry (Gg)		0.44	0.23	0.18	0.16	0.12	0.11

DAIRY CATTLE							
PARAMETERS/ YEAR	**REGION**	**1990**	**2000**	**2005**	**2010**	**2015**	**2018**
Buildings. manure BH FYM (Gg)	Bratislava	3.01	1.85	1.53	1.20	1.07	1.00
Yards (Gg)	Trnava	0.00	0.00	0.00	0.00	0.00	0.00
Slurry storage (Gg)	Trenčín	0.08	0.04	0.03	0.03	0.02	0.02
FYM storage (Gg)	Nitra	0.93	0.57	0.47	0.37	0.31	0.29
Slurry application (Gg)	Žilina	0.93	0.49	0.38	0.35	0.26	0.24
Solid application (Gg)	Banská Bystrica	8.49	5.22	4.31	3.39	3.00	2.80
Pasture (Gg)	Prešov	1.26	0.76	0.62	0.50	0.44	0.41
Fracsilage *(%)*	Bratislava	0.71	0.71	0.71	0.71	0.71	0.71
Fracsilage *(%)*	Trnava	0.68	0.68	0.68	0.68	0.68	0.68
Fracsilage *(%)*	Trenčín	0.46	0.46	0.46	0.46	0.46	0.46
Fracsilage *(%)*	Nitra	0.72	0.72	0.72	0.72	0.72	0.72
Fracsilage *(%)*	Žilina	0.39	0.39	0.39	0.39	0.39	0.39
Fracsilage *(%)*	Banská Bystrica	0.38	0.38	0.38	0.38	0.38	0.38
Fracsilage *(%)*	Prešov	0.41	0.41	0.41	0.41	0.41	0.41
Fracsilage *(%)*	Košice	0.41	0.41	0.41	0.41	0.41	0.41
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**

***consistent in all-time series.**

Table 5.26: *Overview of parameters and emissions factors for non-dairy cattle categories in 2018*

CATEGORIES	SUBCATEGORY	$FRAC_{SILAG}$	MJ PER YEAR	X_{HOUSE}	IEF KG NMVOC HEAD YEAR^{-1}
		(%)	*(MJ/cow/year)*		
NON-DAIRY CATTLE	Calves (6 month)	-	14 612.07	0.59	0.58
	Heifer	40	36 170.73	0.98	4.42
	Heifer pregnant	33	53 323.54	0.98	5.87
	Fattening	52	37 923.23	1.00	5.39
	Oxen	58	91 175.41	1.00	14.63
	Breeding Bull	56	67 050.50	0.75	8.59
	Suckling Cows	7	75 216.16	0.45	2.01
	Calves (7 month)	0,1	23 531.86	0.21	0.07
	Heifer	14	40 161.76	0.45	2.34
	Heifer pregnant	15	59 138.48	0.45	1.97
	Fattening	60	49 567.10	1.00	7.91
	Oxen	58	90 324.23	1.00	14.64
	Breeding Bull	56	67 050.50	0.75	8.59

***all parameters are weighted average represent aggregation in level SR.**

Other animals

NMVOC emissions from other animal categories were calculated using the Tier 1 methodology and emission factors outlined in the EMEP/EEA GB_{2016}.Used emission factors summarized ***Table 5.27***. There is no evidence about adding silage into feeding ration for other animal categories.

Table 5.27: *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

Feeding plans were updated in cattle category. Changes in feed composition had an influence on the implementation of the new values of energy from feeding rations and fraction of silage in rations. Parameters had an impact on changes in emissions in all time-series. Recalculation of emission in 3B1 Cattle category reflected increasing livestock efficiency, gross energy intake and digestibility of feed correlated with milk yield in historical years. Emissions from 3.D (Animal manure applied to soils and Urine and dung deposited by grazing animals) were included in 3.B category. Emissions were summing in 3B Manure management category, and notation keys IE were used. Recalculation leads to the increasing of NMVOC emissions in 2017 on 34.35%.

Table 5.28: *The effect of recalculations NMVOC emissions in 1990–2017*

CATEGORY	MANURE MANAGEMENT NMVOC (Gg)	
YEAR OF SUBMISSION	**2019**	**2020**
1990	12.153	16.210
1991	10.807	14.159
1992	9.475	12.340
1993	8.529	11.054
1994	8.584	10.976
1995	8.321	10.715
1996	8.103	10.417
1997	8.211	10.522
1998	7.380	9.501
1999	6.893	8.935
2000	6.874	8.942
2001	7.141	9.202
2002	6.775	8.843
2003	6.503	8.474
2004	5.988	7.827
2005	5.948	7.799
2006	5.650	7.428
2007	5.482	7.240
2008	5.022	6.756
2009	5.130	7.145
2010	4.987	6.580
2011	4.707	6.314
2012	4.788	6.422
2013	4.642	6.265
2014	4.806	6.371
2015	4.751	6.380
2016	4.528	6.136
2017	4.654	6.253
Submission 2019/2020	**34.35%**	

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 GB2016. The emissions decreased by almost 6.9% compared to 2017 and by 49% compared to the base year 1990. The major reason for the overall decreasing trend is a sharp decrease in the use of synthetic fertilizers in 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 5.29: *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	30.42	0.0035	0.08	1.49	39.71
1995	2.91	20.26	0.0006	0.07	1.05	24.29
2000	3.04	17.49	0.0017	0.07	0.94	21.53
2005	4.36	15.73	0.0038	0.01	0.86	20.96
2010	4.52	13.48	0.0040	0.03	0.81	18.83
2011	4.98	12.69	0.0015	0.03	0.80	18.50
2012	5.95	13.12	0.0054	0.07	0.82	19.97
2013	6.94	12.66	0.0022	0.20	0.81	20.62
2014	7.14	13.20	0.0000	0.26	0.82	21.41
2015	6.17	13.11	NO	0.36	0.80	20.45
2016	8.04	12.51	NO	0.03	0.79	21.37
2017	9.59	12.67	NO	0.04	0.77	23.07
2018	4.48	13.18	NO	0.02	0.79	18.47

Table 5.30: *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	2.54	0.0011	0.04	1.56	13.03
1995	2.78	1.73	0.0002	0.03	1.09	5.64
2000	2.91	1.46	0.0005	0.04	0.91	5.32
2005	3.25	1.28	0.0012	0.00	0.85	5.39
2010	3.47	1.07	0.0012	0.01	0.83	5.38
2011	3.72	0.99	0.0005	0.01	0.82	5.55
2012	4.04	1.03	0.0017	0.04	0.85	5.96
2013	4.54	1.00	0.0007	0.10	0.84	6.48
2014	4.76	1.04	0.0000	0.13	0.85	6.79
2015	4.59	1.04	NO	0.18	0.84	6.65
2016	5.05	0.98	NO	0.01	0.83	6.87
2017	4.90	1.00	NO	0.02	0.81	6.74
2018	5.16	1.04	NO	0.01	0.83	7.04

Figure 5.14: *The share of NH_3 emissions by categories within agricultural soils in 2018*

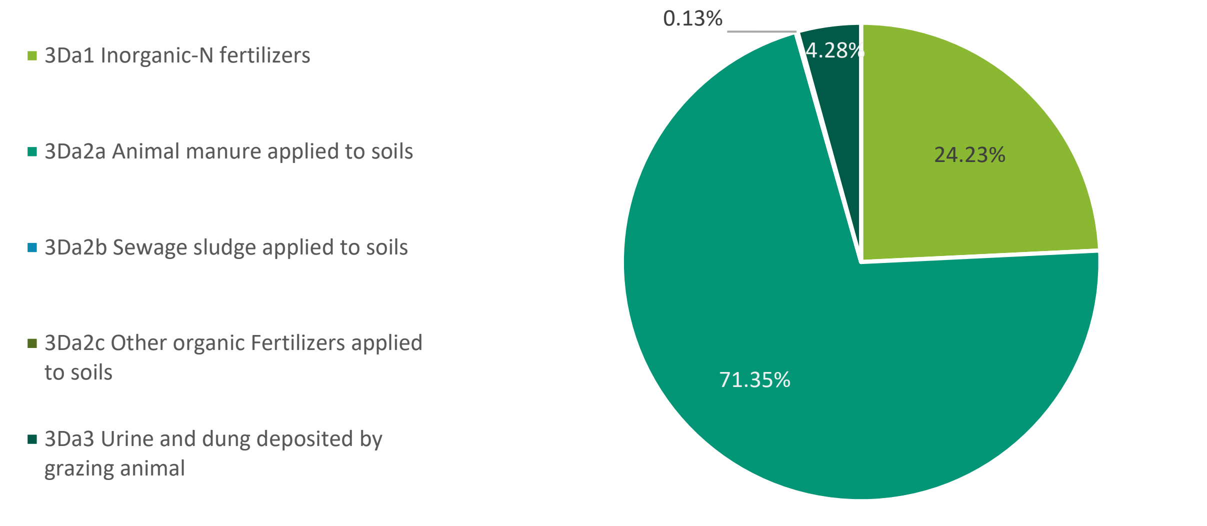
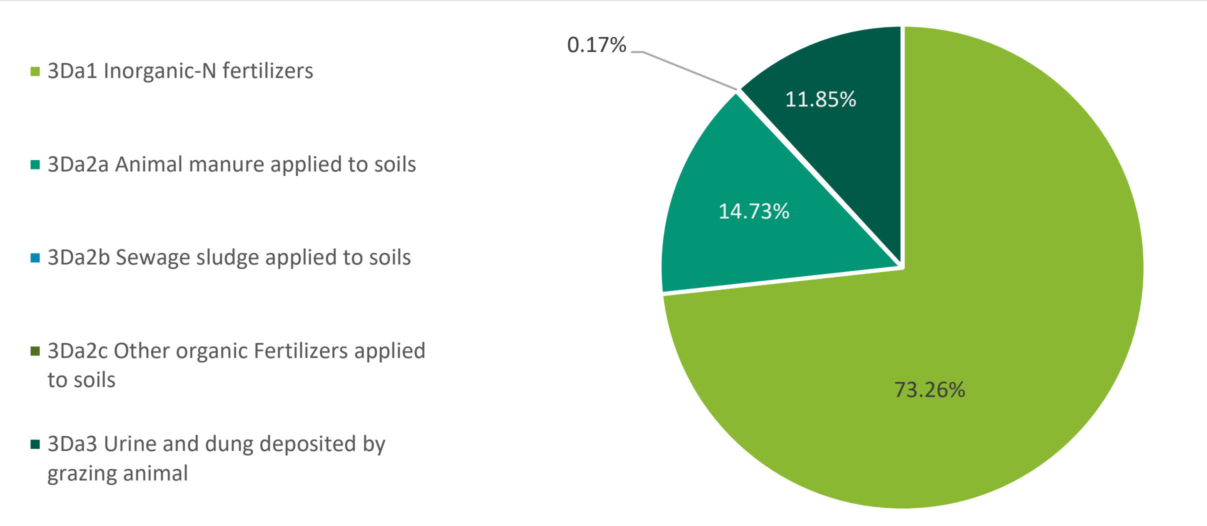


Figure 5.15: *The share of NOx emissions by categories within agricultural soils in 2018*



5.9.1 ACTIVITY DATA

Data of sown areas were taken from the ŠÚ SR. Data is available on 20th May every year (***Table 5.31***).

Table 5.31: *A Sown area in thousand hectares for years 1990-2018*

SOWING AREAS				
YEAR	WHEAT	RYE	OIL PLANTS/RAPE	GRASS
	ha			
1990	412 423	40 474	67 087	813 000
1995	442 874	31 162	87 883	835 000
2000	406 400	29 800	178 300	820 000
2005	375 801	32 500	215 547	524 110
2010	349 700	29 370	280 000	513 029
2011	364 000	13 358	261 600	518 230
2012	388 700	28 568	225 100	514 942
2013	368 200	35 408	254 800	513 704
2014	380 200	29 369	243 400	510 801
2015	379 400	15 175	247 400	520 581
2016	417 700	12 843	254 000	521 441
2017	374 781	10 380	292 854	517 679
2018	408 168	14 292	259 801	518 415
TREND 1990-2018	**9%**	**38%**	**-11%**	**0%**
TREND 2016-2018	**-1%**	**-65%**	**287%**	**-36%**

5.9.2 CATEGORY-SPECIFIC RECALCULATIONS

Recalculation in 3Da1 is connected with implementation of the Tier 2 approach. Inorganic nitrogen fertilizers use key sources of emissions. Recalculation has no impact on NO_x

Recalculation in 3Da2a is connected with the recalculations in 3B1 and 3B3 categories. New nitrogen excretion rate for cattle and swine was implemented. In addition, new activity data was implemented in the 3Da2c category. Vitahum and digesters slurry consumption were added into calculations of emissions from the Other organic fertilizers use. Detailed information on changes in activity data is available in the ***Chapters 5.9.6.*** Recalculation in 3Da3 Urine and dung applied to the soils is connected with the recalculations in 3B1 and 3B3, where nitrogen excretion rate values were revised, percentage of AWMS is unchanged. Revision leads to the recalculation in 1990-2017 time series.

Recalculation led to increasing (***Table 5.32***) NOx and NH_3 in emissions compared to the previous submission from this category at 14% and 38% in 2017.

Table 5.32: *The impact of recalculations of NH_3 emissions in Inorganic N Fertilizers use in 1990–2017*

Category	**3Da1 Inorganic N Fertilizers** *(Gg)*	
EF (kg/head) in 2017	***0.05***	***0.03***
Year of submission	**2019**	**2020**
1990	11.11	7.71
1991	7.32	5.30
1992	4.51	2.85
1993	3.24	2.25
1994	3.43	3.77
1995	3.48	2.91
1996	3.72	3.94
1997	4.40	6.79
1998	4.09	4.12
1999	3.27	3.53
2000	3.63	3.04

Category	3Da1 Inorganic N Fertilizers *(Gg)*	
EF (kg/head) in 2017	***0.05***	***0.03***
Year of submission	**2019**	**2020**
2001	3.80	3.32
2002	4.41	5.49
2003	4.07	4.72
2004	4.00	4.27
2005	4.07	4.36
2006	3.93	3.02
2007	4.45	4.75
2008	4.39	4.51
2009	3.85	4.37
2010	4.34	4.52
2011	4.65	4.98
2012	5.05	5.95
2013	5.68	6.94
2014	5.95	7.14
2015	5.74	6.17
2016	6.31	8.04
2017	6.13	9.59
2019/2020 Submission 2020		**57%**

Table 5.33: *The impact of recalculations of NH3, NOx emissions in Organic N Fertilizers use in 1990–2017*

Category	3Da2 Organic N Fertilizers NH_3 *(Gg)*		3Da2 Organic N Fertilizers NO_x *(Gg)*	
EF (kg/head) in 2017	***0.01***	***0.01***	***0.01***	***0.01***
Year of submission	**2019**	**2020**	**2019**	**2020**
1990	35.24	30.51	1.69	2.58
1991	31.57	27.25	1.51	2.32
1992	28.22	24.23	1.31	2.08
1993	25.34	21.38	1.16	1.84
1994	24.62	20.96	1.09	1.81
1995	24.11	20.33	1.08	1.76
1996	23.86	19.99	1.05	1.73
1997	23.54	19.80	1.05	1.70
1998	20.90	17.76	0.93	1.53
1999	19.81	17.06	0.88	1.46
2000	19.77	17.56	0.87	1.50
2001	20.20	17.86	0.86	1.52
2002	19.49	17.23	0.84	1.47
2003	18.71	16.70	0.79	1.41
2004	16.92	15.34	0.72	1.27
2005	16.79	15.73	0.71	1.29
2006	16.07	15.14	0.67	1.25
2007	15.47	14.75	0.65	1.20
2008	14.09	13.62	0.61	1.09
2009	14.44	14.11	0.60	1.12

Category	3Da2 Organic N Fertilizers NH_3 *(Gg)*		3Da2 Organic N Fertilizers NO_x *(Gg)*	
EF (kg/head) in 2017	***0.01***	***0.01***	***0.01***	***0.01***
Year of submission	**2019**	**2020**	**2019**	**2020**
2010	14.01	13.50	0.58	1.08
2011	13.11	12.72	0.56	1.01
2012	13.45	13.20	0.57	1.07
2013	13.01	12.87	0.56	1.10
2014	13.44	13.46	0.56	1.18
2015	13.38	13.47	0.55	1.21
2016	10.91	12.54	0.52	0.99
2017	9.89	12.71	0.52	1.02
2019/2020 Submission 2020	**29%**		**95%**	

Table 5.34: *The impact of recalculations of NH_3, NO_x emissions in Urine and dung deposited by grazing animals in 1990–2017*

Category	3Da3 Urine and dung deposited by grazing animals NH_3 *(Gg)*		3Da3 Urine and dung deposited by grazing animals NO_x *(Gg)*	
EF (kg/head) in 2017	***0.01***	***0.01***	***0.01***	***0.01***
Year of submission	**2019**	**2020**	**2019**	**2020**
1990	1.90	1.49	1.14	1.56
1991	1.73	1.37	1.02	1.44
1992	1.53	1.24	0.90	1.32
1993	1.35	1.09	0.79	1.14
1994	1.27	1.05	0.73	1.08
1995	1.26	1.05	0.73	1.09
1996	1.20	1.02	0.69	1.06
1997	1.18	1.04	0.63	1.01
1998	1.05	0.95	0.56	0.92
1999	1.00	0.93	0.54	0.90
2000	0.99	0.94	0.54	0.91
2001	0.93	0.90	0.51	0.88
2002	0.94	0.92	0.52	0.90
2003	0.90	0.89	0.50	0.88
2004	0.85	0.85	0.47	0.84
2005	0.84	0.86	0.46	0.85
2006	0.82	0.84	0.45	0.84
2007	0.81	0.85	0.45	0.85
2008	0.80	0.84	0.44	0.84
2009	0.77	0.84	0.43	0.84
2010	0.78	0.81	0.43	0.83
2011	0.77	0.80	0.43	0.82
2012	0.78	0.82	0.44	0.85
2013	0.76	0.81	0.43	0.84
2014	0.77	0.82	0.44	0.85
2015	0.76	0.80	0.44	0.84
2016	0.74	0.79	0.42	0.83
2017	0.74	0.77	0.45	0.81

Category	3Da3 Urine and dung deposited by grazing animals NH_3 *(Gg)*		3Da3 Urine and dung deposited by grazing animals NO_x *(Gg)*	
EF (kg/head) in 2017	***0.01***	***0.01***	***0.01***	***0.01***
Year of submission	**2019**	**2020**	**2019**	**2020**
2019/2020 Submission 2020	**4%**		**82%**	

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 the 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 in relation to 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 distribution of type of fertilizers was taken from the IFASTAT (1990-2017). The UKSÚP data was used in 2018. 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 kt in 2018 (42%). Consumption of synthetic fertilizers increased by 59% in 2018 compared with 2005 and the increased by almost 5% in comparison with the year 2017. Decreasing numbers of domestic livestock caused the demand for inorganic nitrogen is bigger. Missing organic nitrogen compensates a higher consumption of synthetic fertilizers.

Table 5.35: *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

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
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	48 372	12 858	31 983	1 004	NO	4 781	1 125	NO	28 853	NO

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}. In order 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 5.36: *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 5.37: *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	0.03	0.04	4.48	5.16
TREND 1990-2018	**-42%**			**-42%**	**-42%**
TREND 2017-2018	**5%**			**-53%**	**5%**

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_{2016} for spreading of slurry and solid manure were applied in the proportion of total ammoniacal nitrogen (TAN) according to the Table 3.9 p 29 of

EMEP/EEA GB_{2016}. Default NOx emission factor of the EMEP/EEA GB_{2016} 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.

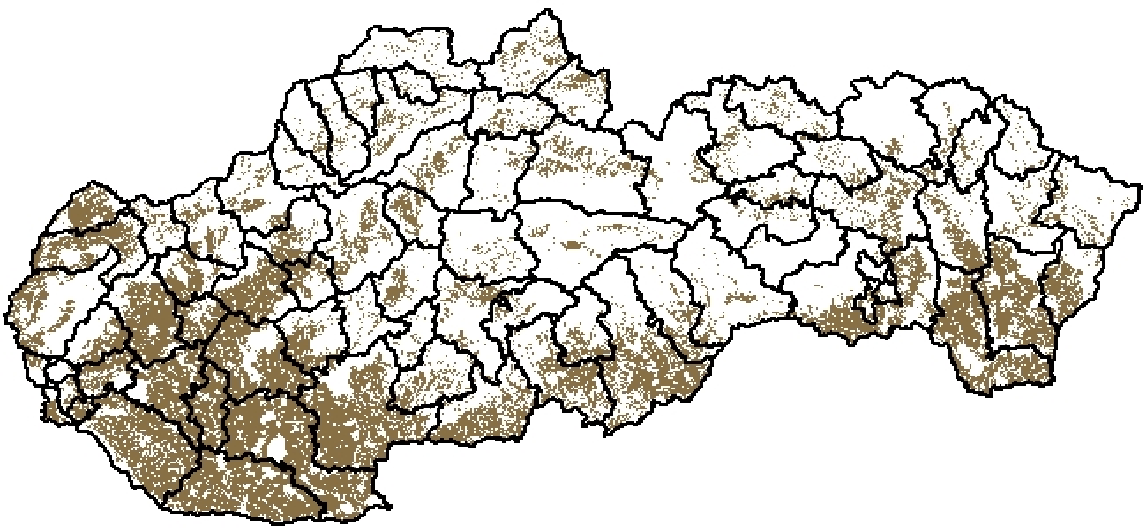
5.9.5 SEWAGE SLUDGE APPLIED TO SOILS (NFR 3Da2b)

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 into agricultural soils in the year 2018. The notation key NO was used in these years.

Figure 5.16: *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 in accordance with the

EMEP/EEA GB_{2016}. Percentage of pure nitrogen in sewage sludge was provided from the Soil Science and Conservation Research Institute.[9] 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 5.38: *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
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
Trend 1990-2017	**-100%**	**-100%**			**-100%**	**-100%**
Trend 2017-2018	**-100%**	**-100%**			**-100%**	**-100%**

5.9.6 OTHER ORGANIC FERTILIZERS APPLIED TO SOILS (NFR 3.Da2c)

Emissions of NH_3 and NOx from compost applied to soils contributed less than 1% to the emissions from agricultural soils in 2017.

5.9.6.1 Activity data

Other Organic Fertilizers applied to soils contents the composted waste, digestant from biogas stations and vitahum. Consumption of organic fertilizers (***Table 5.39***) is based on the data provided by the UKSÚP. Data are available from 2000 to 2018. 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.

[9] *Guideline for sewage sludge application (In Slovak):* http://www.vupop.sk/dokumenty/prv/prirucka_pre_aplikaciu_kalu.pdf

Table 5.39: Input parameters and emissions 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
1991	142 430	NO	NO	142 430	997 008
1992	139 044	NO	NO	139 044	973 310
1993	137 198	NO	NO	137 198	960 384
1994	130 799	NO	NO	130 799	915 596
1995	122 381	NO	NO	122 381	856 668
1996	113 612	NO	NO	113 612	795 282
1997	104 863	NO	NO	104 863	734 038
1998	94 134	NO	NO	94 134	658 941
1999	83 929	NO	NO	83 929	587 502
2000	74 923	NO	50 641	125 564	878 947
2001	40 885	NO	54 338	95 223	666 564
2002	36 422	NO	42 810	79 232	554 623
2003	34 225	NO	9 321	43 546	304 821
2004	42 904	NO	2 845	45 749	320 245
2005	7 006	NO	3 552	10 558	73 903
2006	13 878	NO	10 828	24 706	172 939
2007	21 762	NO	8 758	30 520	213 640
2008	21 317	NO	7 185	28 503	199 518
2009	25 364	NO	195	25 558	178 909
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	413 633

5.9.6.2 Methodological issues – Methods – NOx, NH_3

Default methodology Tier 1 according to EMEP/EEA GB_{2016} 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. Percentage of nitrogen in used compost was provided by the Soil Science and Conservation Research Institute.[10] Amount of compost applied to soils provided the UKSÚP. Emissions were estimated using these equations:

$$A_{compost} = N_{compost} * P_N$$

$$NO_{compost} = A_{compost} * EF_{NO}$$

$$NH_{3\ compost} = A_{compost} * EF_{NH_3}$$

[10] *Guideline for sewage sludge application (In Slovak):* http://www.vupop.sk/dokumenty/prv/prirucka_pre_aplikaciu_kalu.pdf

Where: $N_{compost_t}$ is the input of pure nitrogen in compost applied to the soil in kg. $N_{compost}$ is the amount of compost from the composting plant. P_N is 1 tonne of compost = 7 kg N

Table 5.40: *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
TREND 1990-2018	**-**	**-**	**-70%**	**-70%**
TREND 2017-2018	**-**	**-**	**-45%**	**-45%**

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 5.20***.

5.9.7.1 Activity data

This analysis was based on the questionnaires from 222 agricultural subjects (21.3% of total subjects in Slovakia). These subjects cultivated 14.7% of total agricultural land and 15.2% of arable land. The duration of the grazing period can vary significantly depending on weather conditions in different parts of the Slovak Republic. Reliable data for statistical evaluation is not available, but significant differences can be found in this regard. NH_3 and NOx emissions from pasture were based on the proportion of the pasture for housing that was made by the NPPC - VÚŽV. Activity data is summarized in ***Table 5.17***. 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_{2016}. Emission of urine and dung deposited by grazing animals is based on nitrogen excreted from farm animals, a number of days the animals are on the pasture and the emission factors.

Table 5.41: Input parameters, EFs and emissions in 3Da3- Other organic fertilizers applied to soils

YEARS	NITROGEN EXCRETED DURING PASTURE	EMISSION FACTORS NMVOC	EMISSION FACTORS NOx	EMISSIONS NOx	EMISSIONS NH_3
	kg/year	kg NH_3/kg N	kg NOx/kg N	Gg	Gg
1990	14 709 383	0.101	0.106	1.559	1.491
1995	10 309 981	0.102	0.106	1.095	1.055
2000	6 913 108	0.135	0.132	0.913	0.937
2005	6 427 607	0.134	0.132	0.850	0.863
2010	7 407 080	0.109	0.112	0.827	0.807
2011	7 339 829	0.109	0.112	0.823	0.802
2012	7 849 988	0.105	0.109	0.853	0.825
2013	7 844 224	0.103	0.107	0.841	0.809
2014	8 105 558	0.101	0.105	0.852	0.816
2015	8 077 931	0.099	0.104	0.842	0.803
2016	7 902 001	0.097	0.105	0.831	0.793
2017	7 683 159	0.100	0.106	0.814	0.768
2018	8 165 248	0.097	0.102	0.834	0.792
Trend 1990-2017	**-44%**	**-4%**	**-4%**	**-46%**	**-47%**
Trend 2005-2017	**27%**	**-28%**	**-23%**	**-2%**	**-8%**

5.9.7.3 Methodological issues –Methods - NMVOC

Cattle

All references for calculation are in **Chapter 5.8.6.2**. 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 20th May every year.

Table 5.42: Sowing areas in time series

YEAR	CROPS - SOWING AREAS			
	WHEAT	RAY	OIL PLANTS/RAPESEED	MEADOWS
1990	412 423	40 474	67 087	813 000
1991	418 158	46 335	70 906	808 000
1992	408 196	38 332	91 622	810 000
1993	354 431	23 637	67 351	832 000
1994	398 058	23 196	74 760	835 000
1995	442 874	31 162	87 883	835 000
1996	437 846	31 201	125 691	840 000
1997	417 562	29 019	136 400	842 000
1998	415 033	29 745	140 562	846 000

YEAR	CROPS - SOWING AREAS			
	WHEAT	RAY	OIL PLANTS/RAPESEED	MEADOWS
1999	431 700	34 400	140 250	829 631
2000	406 400	29 800	178 300	820 000
2001	446 500	31 500	180 900	783 905
2002	406 100	38 200	204 000	798 668
2003	308 400	38 000	213 100	794 733
2004	369 400	25 200	199 000	514 478
2005	375 801	32 500	215 547	524 110
2006	350 900	28 717	252 200	535 537
2007	360 800	36 408	233 600	528 502
2008	374 400	41 388	250 600	531 584
2009	380 300	33 555	271 600	523 609
2010	349 700	29 370	280 000	513 029
2011	364 000	13 358	261 600	518 230
2012	388 700	28 568	225 100	514 942
2013	368 200	35 408	254 800	513 704
2014	380 200	29 369	243 400	510 801
2015	379 400	15 175	247 400	520 581
2016	417 700	12 843	254 000	521 441
2017	374 781	10 380	292 854	517 679
2018	408 168	14 292	259 801	518 415

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 5.43***.

Table 5.43: *Used emission factors in kg/ha*

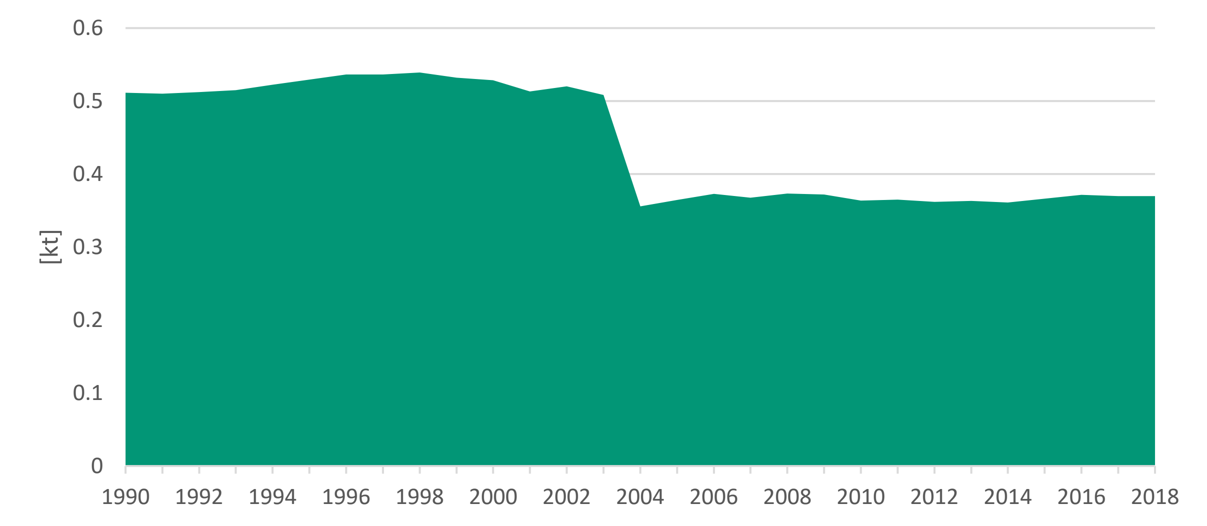
TYPE OF CROPS	EMISSION FACTORS (*kg/ha*)
Wheat	0.11
Rye	0.05
Rapeseed	0.13
Grass	0.56

Calculations were prepared in accordance with 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 5.17: 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 1990-2017, due to correction of emission factor for wheat. The 3De category is not a significant contributor to mentioned emissions and emissions are under the threshold of significance. The changes describe ***Table 5.44***.

The recalculation led to decreased of emission from the Cultivated crops (NFR 3De) by 1%.

Table 5.44: *The impact of recalculations of NMVOC emissions in 3De category in 1990-2016*

CATEGORY	NMVOC EMISSIONS FROM FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE. HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCT (Gg)	
EF (kg/head) in 2017	***0.06***	***0.06***
Year of submission	**2019**	**2020**
1990	0.516	0.511
1991	0.514	0.510
1992	0.516	0.512
1993	0.518	0.515
1994	0.526	0.522
1995	0.534	0.529
1996	0.541	0.536
1997	0.541	0.537
1998	0.543	0.539
1999	0.536	0.532
2000	0.533	0.529
2001	0.518	0.513
2002	0.524	0.520
2003	0.512	0.509
2004	0.360	0.356
2005	0.368	0.364
2006	0.376	0.373
2007	0.371	0.368
2008	0.377	0.374
2009	0.376	0.372
2010	0.367	0.364

CATEGORY	NMVOC EMISSIONS FROM FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE. HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCT (Gg)	
2011	0.369	0.365
2012	0.366	0.362
2013	0.367	0.363
2014	0.365	0.361
2015	0.370	0.366
2016	0.376	0.372
2017	0.373	0.370
Submission 2019/2020	**-1%**	

5.11 PM AND TSP EMISSIONS FROM FARM-LEVEL AGRICULTURAL OPERATIONS INCLUDING STORAGE, HANDLING AND TRANSPORT OF AGRICULTURAL PRODUCTS (NFR 3Dc)

Particular matters raised during agricultural soils ploughing. They have a diameter of less than 10 or 2.5 micrometres, which is about 3% of the diameter of human hair. They are dangerous for health due to their size. During breathing, particular matters easier penetrate the lungs. The particular matters have a filterable character.

5.11.1 METHODOLOGICAL ISSUES - METHODS

Pollution $PM_{2.5}$, PM_{10}, and TSP were calculated using the Tier 1 methodology from EMEP/EEA GB_{2019}.

Table 5.45: *Used emission factors in kg/ha*

EF PM_{10}	1.56
EF $PM_{2.5}$	0.06
EF TSP	1.56

Emissions were calculated with the following equation:

$$\mathrm{E_{PM}} = \mathrm{EF_{PM,TSP}} * \sum \mathrm{S_{area}}$$

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

5.11.2 ACTIVITY DATA

Data of sown areas were taken from the ŠÚ SR. Data is available 20th May every year.

5.11.3 CATEGORY-SPECIFIC RECALCULATIONS

No recalculation in this submission.

5.12 AGRICULTURE OTHER INCLUDING USE OF PESTICIDES (NFR 3Df)

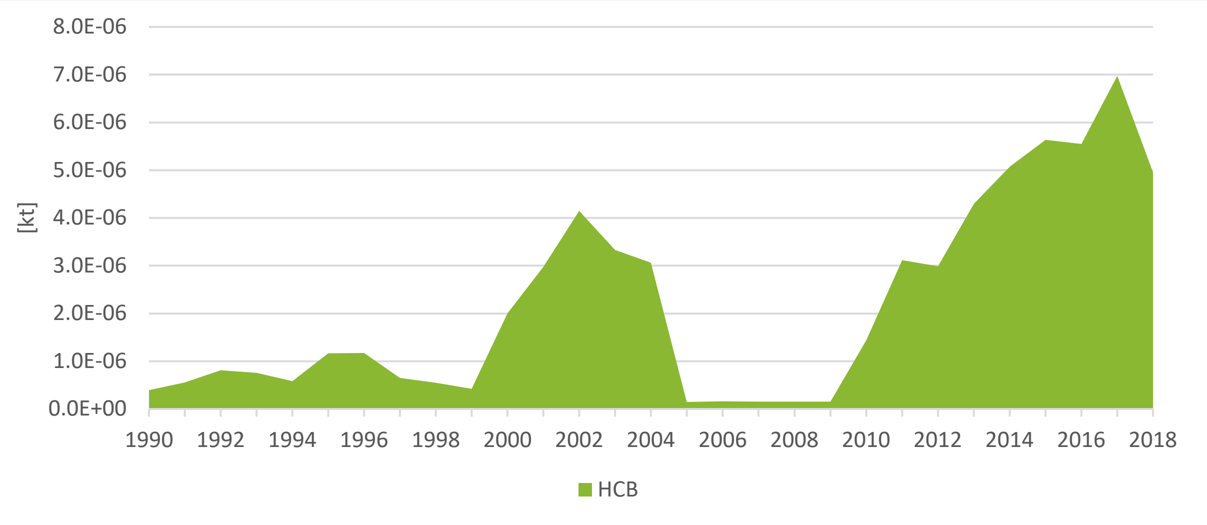
A scope of pesticides is used in the Slovak agricultural sector, and a very small amount of them contain Hexachlorobenzene (HCB) as an impurity. HCB as the active substance is carried out in the Slovak

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 5.18: *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 5.46: *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

YEAR	NAME OF PESTICIDE (*kg*)					
	ATRAZIN	CLOPIRALID	CHLOROTHALONIL	ENDOSULFAN	PICLORAM	SIMAZIN
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
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

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 bellow:

- Act No. 223/2001 Coll. on wastes and on amendment and implement of some acts in 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 on the amendment and implement of some acts

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Last update: 13.3.2020

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 (NFR 5)*

NFR CODE	LONGNAME
5A	Biological treatment of waste - Solid waste disposal on land
5B1	Biological treatment of waste - Composting
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities
5C1a	Municipal waste incineration
5C1bi	Industrial waste incineration
5C1bii	Hazardous waste incineration
5C1biii	Clinical waste incineration
5C1biv	Sewage sludge incineration
5C1bv	Cremation
5C1bvi	Other waste incineration
5C2	Open burning of waste
5D1	Domestic wastewater handling
5D2	Industrial wastewater handling
5D3	Other wastewater handling
5E	Other waste
6A	Other (included in national total for entire territory)

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 2018 was 2 325.18 kt. Amount of municipal waste produced increased compared to the previous year (10%). Generation of the municipal waste per capita in the Slovak Republic is still below the European average. However, the predominant waste treatment is still landfilling (54%) and there is still insufficiency in the recovery of waste (44%). In 2017, prevailed waste recovery treatment was composting (39% of recovered waste, 15% of all waste); in 2018, it was material recycling (48% of recovered waste, 22% of all waste).

In the year 2018, total industrial and other waste was produced in an amount of 11 152.86 kt. The amount increased by 10% compared to the year 2017. The largest share represents waste from construction and demolition (35%) which has increased by 23% annually due to significant year-on-year growth in construction output in all three construction segments - residential, non-residential and civil engineering. The most significant increase was recorded in the overall growth of engineering constructions, whose production grew by 12.1% year-on-year. The highest growth was caused mainly by civil engineering works, whose production increased by 22.6% year-on-year. Stimulating the economy had an influence on the amount of produced industrial waste.

In general, in most of the waste categories, the **condensable component of PMs** is not included in emission factors.

6.2 TRENDS IN WASTE SECTOR

The waste sector is, in general, the minor source of the air pollutants. However, based on the analysis of key categories, emissions in this sector has a significantly impact on the national totals of Hg and PCDD/PCDF emissions (***Table 6.2***).

Emissions of air pollutants (excluding NMVOC and NH_3) in this sector are emitted into the air by waste incineration plants. The trend in these categories is relative stable, except for a period 2005-2011, when emission limits for large and medium sources were implemented. Wastewater handling and composting are the main contributors to ammonia emissions in this sector. The ratio of the population using 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 decreasing in the long term, due to improvement of disposal practice. 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.

Table 6.2: *The overview of the significant pollutants in the Waste sector and their trends*

YEAR	NOx [kt]	NMVOC [kt]	SOx [kt]	NH_3 [kt]	$PM_{2,5}$ [kt]	Hg [t]	PCDD/F [g I-TEQ]	HCB [kg]	PCBs [kg]
1990	0.0276	0.6108	0.0091	1.2522	0.1388	0.3974	292.1749	0.7401	0.1458
1995	0.0231	0.4673	0.0072	1.1566	0.1461	0.3092	225.3464	0.5700	0.1131
2000	0.0183	0.4329	0.0046	0.9960	0.1390	0.1794	127.5887	0.3797	0.0763
2005	0.0167	0.3985	0.0033	0.8596	0.1516	0.1131	74.0648	0.2840	0.0586
2010	0.0160	0.3974	0.0019	0.7106	0.1791	0.0348	11.9651	0.2065	0.0450
2011	0.0164	0.3844	0.0019	0.5925	0.1980	0.0352	11.6958	0.2617	0.0563
2012	0.0151	0.3645	0.0018	0.6086	0.1933	0.0311	8.5806	0.1782	0.0398
2013	0.0160	0.4169	0.0020	0.5057	0.1847	0.0344	9.7706	0.1847	0.0410
2014	0.0159	0.3425	0.0020	0.4793	0.1616	0.0344	9.7694	0.1853	0.0413
2015	0.0176	0.3592	0.0021	0.5349	0.1882	0.0373	10.8603	0.2715	0.0594
2016	0.0159	0.2631	0.0020	0.4092	0.1942	0.0371	10.3758	0.2654	0.0578
2017	0.0167	0.3094	0.0021	0.3564	0.2033	0.0421	11.0192	0.3039	0.0647
2018	0.0180	0.3305	0.0022	0.3394	0.1840	0.0401	10.8058	0.2795	0.0609
1990/2018	**-35%**	**-46%**	**-76%**	**-73%**	**33%**	**-90%**	**-96%**	**-62%**	**-58%**
2005/2018	**8%**	**-17%**	**-34%**	**-61%**	**21%**	**-65%**	**-85%**	**-2%**	**4%**
2017/2018	**8%**	**7%**	**5%**	**-5%**	**-9%**	**-5%**	**-2%**	**-8%**	**-6%**

Several categories were recalculated thought 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*).**

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	ŠÚ 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	1A2gviii
5C1bii	-	-	-	-	5C1bi
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	ŠÚ 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 CATEGORY-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 wasperformed by comparing reported year data to previous year's data. 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 website 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 from 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 CATEGORY-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 2020.

The recommendation No. ***SK-5D2-2019-0001*** asks for the correction of description in the IIR for the category 5D2. This is described in **Chapter 6.8.2.2**.

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 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

[1] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/1991/238/
[2] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/1992/606/vyhlasene_znenie.html
[3] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2001/223/20160101
[4] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2001/283/20011201.html
[5] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/79/20170101
[6] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/372/20160101.html

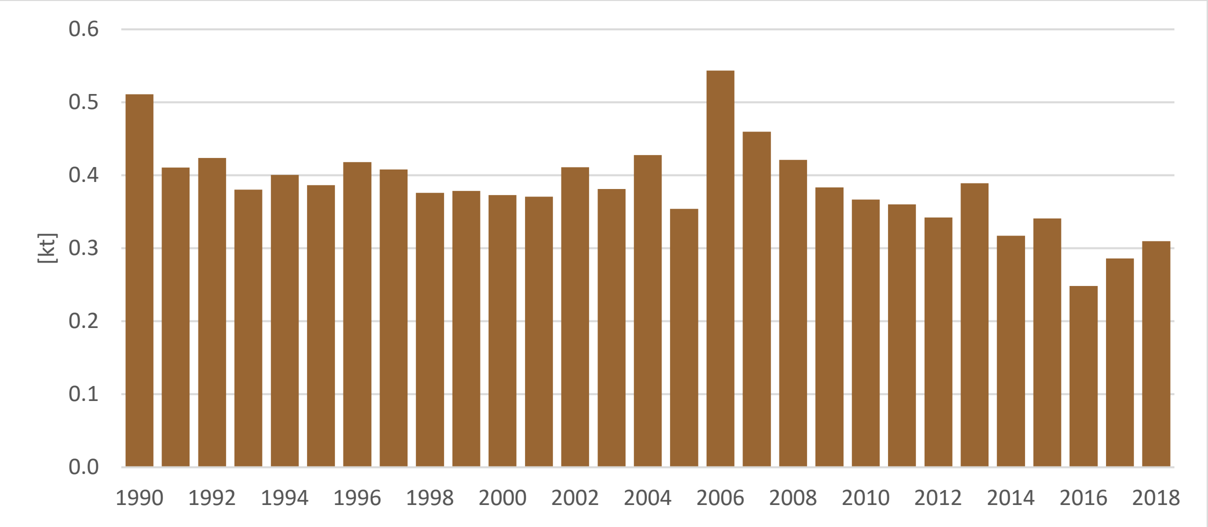
landfill. New landfills must be provided with the building of the isolation by bio-membrane or geotextile, a drainage system and degassing system.

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: *ISW categories with share of the biodegradable in kt*

YEAR	WASTE – TOTAL [t]	DEPOSITED MSW [t]	DEPOSITED ISW [t]	DEPOSITED BIODEG. WASTE [t]	BIODEG. MSW [t]	BIODEG ISW [t]
1990	6854.59	1368495	5486096	327.622	168633.1	158988.9
1995	4689.813	1116152	3573661	247.7919	144225.9	103565.9
2000	4512.676	1055925	3456750	239.1652	138987.3	100177.8
2005	4114.93	1226570	2888360	226.836	155959.4	70876.63
2010	3808.783	1411543	2397241	235.0946	173663	61431.62
2011	4114.948	1320073	2794875	230.9351	163338.7	67596.46
2012	4014.825	1297480	2717346	219.4632	154925	64538.27
2013	4938.147	1201906	3736241	249.4108	143610	105800.9
2014	3765.656	1210043	2555613	203.3837	142580.4	60803.3
2015	3933.537	1303845	2629691	218.5836	151158.7	67424.96
2016	3789.335	1289895	2499439	159.3382	144202.3	15135.91
2017	3830.219	1312787	2517432	183.4885	139091.7	44396.85
2018	3344.077	1250280	2093797	198.6158	148588.1	50027.71

Figure 6.1: *NMVOCs emission trend in the category Solid waste disposal on land*



In comparison with the base year, emissions of NMVOC in this category ***(Figure 6.1)*** show moderately decreasing character due to stricter legislation. 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. Emission totals and activity data are displayed in ***Table 6.5.***

Table 6.5: *Overview of the activity data, emissions and trends in the category Solid waste disposal on land*

YEAR	WASTE DISPOSED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BIO- WASTE DISPOSED [kt]	NMVOCs [kt]
1990	6854.59	0.0002	0.0015	0.0032	327.62	0.5111

[7] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2015/79/20170101

YEAR	WASTE DISPOSED [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BIO- WASTE DISPOSED [kt]	NMVOCs [kt]
1995	4689.81	0.0002	0.0010	0.0022	247.79	0.3866
2000	4512.68	0.0001	0.0010	0.0021	239.17	0.3731
2005	4114.93	0.0001	0.0009	0.0019	226.84	0.3539
2010	3808.78	0.0001	0.0008	0.0018	235.09	0.3667
2011	4114.95	0.0001	0.0009	0.0019	230.94	0.3603
2012	4014.83	0.0001	0.0009	0.0019	219.46	0.3424
2013	4938.15	0.0002	0.0011	0.0023	249.41	0.3891
2014	3765.66	0.0001	0.0008	0.0017	203.38	0.3173
2015	3933.54	0.0001	0.0009	0.0018	218.58	0.3410
2016	3789.33	0.0001	0.0008	0.0018	159.34	0.2486
2017	3830.22	0.0001	0.0008	0.0018	183.49	0.2862
2018	3344.08	0.0001	0.0007	0.0015	198.62	0.3098
1990/2018	**-51%**	**-51%**	**-51%**	**-51%**	**-39%**	**-39%**
2017/2018	**-13%**	**-13%**	**-13%**	**-13%**	**8%**	**8%**

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*

$$Em_{TOTAL} = (Deposited\ municipal\ waste + Deposited\ industrial\ waste) * EF_{(GB2016)}$$

For calculation of NMVOCs, only an amount of biodegradable solid waste disposed on landfill sites was used, as recommended during the capacity building webinar in 2017. Amount of biodegradable ISW landfilled in specific waste categories was determined using default values of a degradable organic compound from IPCC 2006 Guidelines (***Table 6.6***).

Table 6.6: *Default values of share of degradable organic compound in the ISW landfilled*

WASTE GROUPS CONTAINING BIODEGRADABLE WASTE	DOC	MAIN WASTE TYPE
02 Wastes from agriculture, horticulture, forestry, hunting and fishing	0.15	Food waste
03 Wastes from wood processing and the production of paper, cardboard, pulp, panels and furniture	0.01	Other
04 Wastes from the leather, fur and textile industries	0.24	Textile
15 Waste packaging, absorbents, cloths, filter materials and protective clothing	0.01	Other
17 Construction and demolition wastes	0.04	Construction and demolition
18 Wastes from human or animal health care or related research	0.15	Clinical waste
19 Wastes from waste management facilities ,waste water treatment plants and the preparation of water for human consumption and for industrial use	0.09	Sludge

By MSW landfilled, a dynamic ratio of biodegradable waste, consistent with GHGs inventory was used in calculations (***Table 6.7***).

Table 6.7: *Share of biodegradable organic compound in the MSW landfilled*

YEAR	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018
Ratio	0.123	0.129	0.132	0.127	0.123	0.124	0.119	0.119	0.118	0.116	0.112	0.106	0.119

Tier 1 emission factors from EMEP/EEA GB_{2019} were used (***Table 6.8***). The **condensable component of PMs** is not included in EF.

[8] Waste in the Slovak Republic – Yearbook – available since 2008 https://slovak.statistics.sk/

Table 6.8: Emissions factors in the category Solid waste disposal on land

POLLUTANT	NMVOC	TSP	PM_{10}	$PM_{2.5}$
Unit	[kg/t biodegradable waste]	[g/t]	[g/t]	[g/t]
Value	1.56	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 due increasing consistency with GHGs inventory. The dynamic ratio of the degradable organic part of waste for MSW was changed according to GHG inventory data. ***Table 6.9*** shows the difference between 2018 and 2019 submission and percentage change.

Table 6.9: Previous and refined amount of the landfilled biodegradable waste

YEAR	PREVIOUS [kt]	REFINED [kt]	CHANGE
1990	327.31	327.62	0.1%
1991	262.74	263.32	0.2%
1992	270.11	271.75	0.6%
1993	241.38	243.88	1.0%
1994	252.17	256.85	1.9%
1995	245.32	247.79	1.0%
1996	266.47	267.86	0.5%
1997	258.59	261.40	1.1%
1998	238.02	240.87	1.2%
1999	238.51	242.64	1.7%
2000	234.28	239.17	2.1%
2001	232.37	237.75	2.3%
2002	253.79	263.39	3.8%
2003	235.00	244.34	4.0%
2004	263.39	274.16	4.1%
2005	222.97	226.84	1.7%
2006	342.22	348.25	1.8%
2007	291.20	294.83	1.2%
2008	265.41	269.84	1.7%
2009	240.19	245.68	2.3%
2010	227.99	235.09	3.1%
2011	222.05	230.94	4.0%
2012	215.05	219.46	2.1%
2013	242.82	249.41	2.7%
2014	196.33	203.38	3.6%
2015	210.85	218.58	3.7%
2016	151.86	159.34	4.9%
2017	178.30	183.49	2.9%

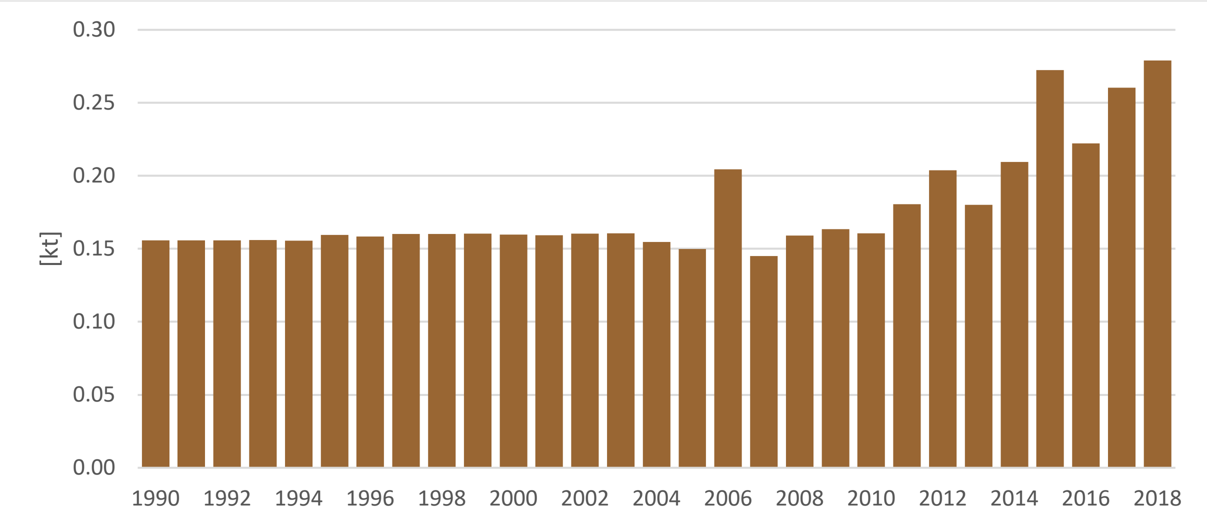
6.6 BIOLOGICAL TREATMENT OF WASTE (NFR 5B)

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. Emission trend of NH_3 is shown in ***Figure 6.2***.

Figure 6.2: *NH_3 emission trend in the category Composting of waste*



In the year 2004, there were four large or medium composting plants and their number increased in 2018 to 19. 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 totals and activity data, are displayed in ***Table 6.10***.

Table 6.10*: 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

[9] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2001/223/20160101

YEAR	COMPOSTED WASTE [kt]	NH_3 [kt]
2015	1135.48	0.2725
2016	925.74	0.2222
2017	1084.58	0.2603
2018	1162.12	0.2789
1990/2018	**79%**	**79%**
2017/2018	**7%**	**7%**

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 6.11***).

Table 6.11: *Emission factors in the category Composting of waste*

POLLUTANT	NH_3
Unit	[kg/t]
Value	0.24

6.6.1.3 Completeness

CO, PMs and BC were reported as NE due to absence of methodology.

6.6.1.4 Source-specific recalculations

No recalculation in this submission.

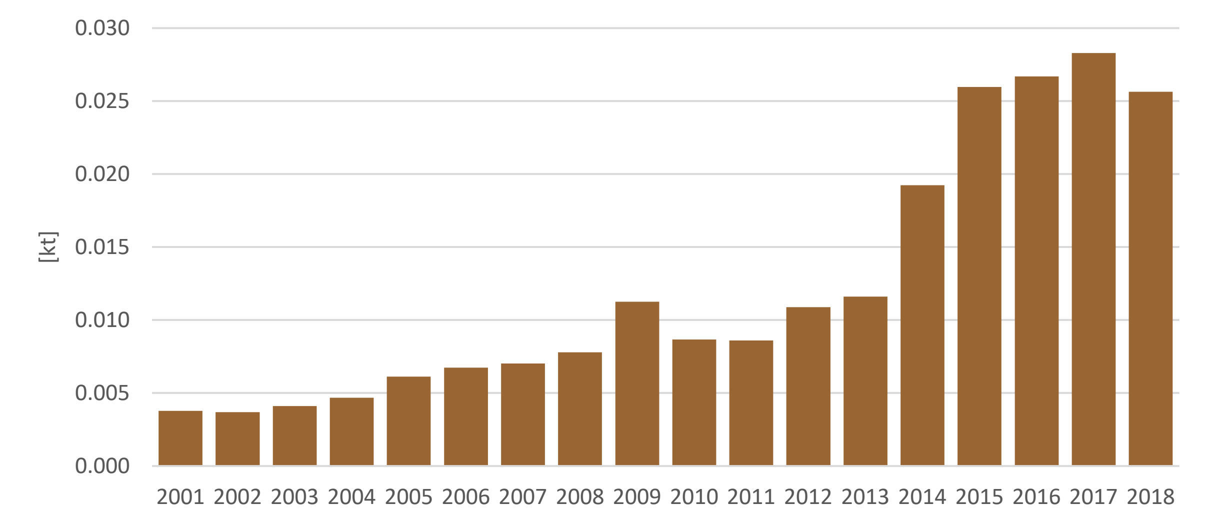
6.6.2 ANAEROBIC DIGESTION AT BIOGAS FACILITIES (NFR 5B2)

6.6.2.1 Overview of the Category

No biogas facilities operated in the Slovak Republic until the year 2000. In 2009, only seven biogas facilities were recorded. After the 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.

[10] Waste in the Slovak Republic – Yearbook – available since 2008, https://slovak.statistics.sk/
[11] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2009/309/20150801

Figure 6.3: *NH_3 emissions in the category Anaerobic digestion at biogas facilities*



In 2018 ninety-two biogas stations operated. After the Decree No. 221/2013 Coll.[12], which provides price regulation in the electricity sector, entered into force, a significant increase in 2014 was noticed (***Figure 6.3***). The decrease in 2018 was caused by the limitation of donations into this activity and stricter legislation. ***Table 6.12*** shows the NH_3 emission trend in this category.

Table 6.12: *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	0.18	0.0061
2010	0.26	0.0087
2011	0.26	0.0086
2012	0.33	0.0109
2013	0.35	0.0116
2014	0.58	0.0192
2015	0.78	0.0260
2016	0.80	0.0267
2017	0.85	0.0283
2018	0.77	0.0256
2001/2018	**579%**	**579%**
2017/2018	**-9%**	**-9%**

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.

6.6.2.3 Completeness

Notation keys were changed in comply with EMEP/EEA GB_{2019}.

[12] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2013/221/vyhlasene_znenie.html

6.6.2.4 Source-specific recalculations

Amount of the nitrogen entering to biogas facility was recalculated due to change of NEX value in the agricultural sector. Recalculations are shown in ***Table 6.13***.

Table 6.13: *Previous and refined amount of the nitrogen entering to biogas facility*

YEAR	PREVIOUS [kt]	REFINED [kt]	CHANGE
2001	0.1266	0.1131	-11%
2002	0.1189	0.1103	-7%
2003	0.1324	0.1230	-7%
2004	0.1506	0.1403	-7%
2005	0.1914	0.1831	-4%
2006	0.2125	0.2020	-5%
2007	0.2132	0.2105	-1%
2008	0.2352	0.2332	-1%
2009	0.3100	0.3373	9%
2010	0.2701	0.2593	-4%
2011	0.2665	0.2576	-3%
2012	0.3246	0.3262	0%
2013	0.3463	0.3476	0%
2014	0.5498	0.5761	5%
2015	0.8085	0.7777	-4%
2016	0.7805	0.7990	2%
2017	0.6251	0.8472	36%

6.7 WASTE INCINERATION AND OPEN BURNING OF WASTE (5C)

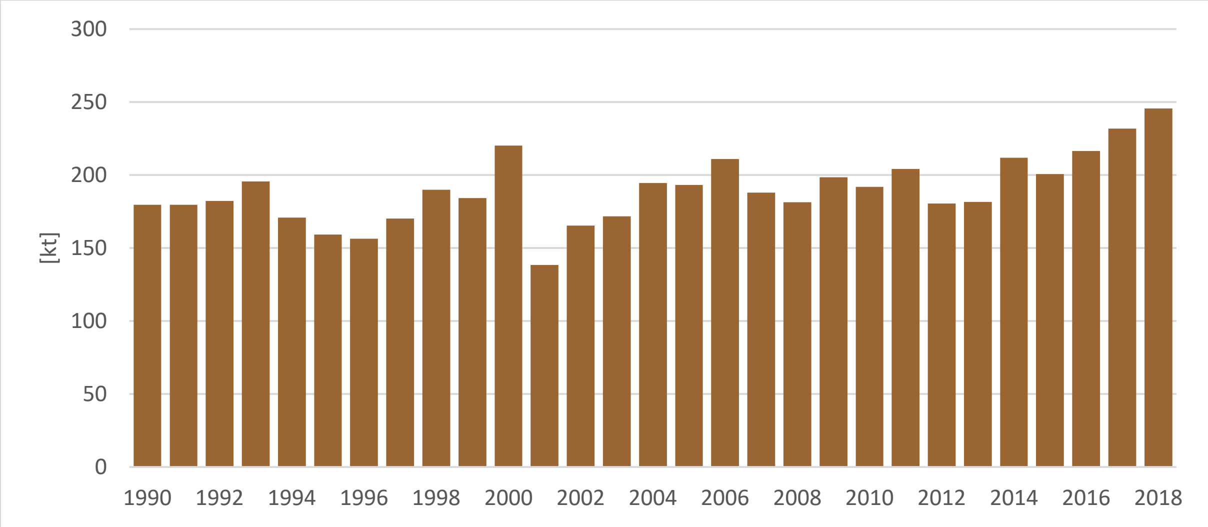
6.7.1 MUNICIPAL WASTE INCINERATION (NFR 5C1a)

6.7.1.1 Overview of the category

There are two large municipal waste incinerators in the country, in Bratislava and in 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 ***Figure 6.4*** As shown, amount of incinerated municipal waste shows a slightly increasing trend since 1990, due to the gradual prioritization of MSW incineration before landfilling.

Figure 6.4: *Trend in amount of total municipal waste incinerated with energy recovery*



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 6.14***).

Table 6.14: *Overview of the activity data, emissions and trends in the category Municipal waste incineration*

YEAR	MSW INCINERATED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	CO [kt]
1990	179606.40	184.3563	1.0307	32.7791	3.9304	3.9304	9.6613	36.9120
1995	159343.94	154.2849	0.7241	30.5025	3.6157	3.6157	8.7475	28.1880
2000	220212.97	259.2259	1.7315	44.1270	5.3634	5.3634	13.4502	61.3581
2005	193182.00	222.3611	1.5774	38.4776	8.2537	8.2537	11.0050	47.9241
2010	191934.71	138.4137	1.7561	6.5962	0.9738	0.9738	1.2985	9.5744
2011	204129.54	163.0953	1.7821	6.9451	0.6821	0.6821	0.9095	8.4308
2012	180545.92	157.7773	2.0132	6.3079	1.2911	1.2977	1.7325	7.6476
2013	181517.86	139.8683	2.5763	7.5138	1.2102	1.2181	1.6267	8.2382
2014	211892.56	150.4350	2.2508	10.9108	1.7602	1.7608	2.3479	17.2965
2015	200755.52	123.9697	2.0582	6.7225	1.2195	1.2195	1.6260	8.3321
2016	216543.08	142.6330	1.5711	8.6845	1.2315	1.2315	1.6420	8.7610
2017	231893.72	146.5159	1.6298	9.7303	1.5910	1.5910	2.1213	14.0986
2018	245609.56	155.9944	1.8790	9.5173	1.2981	1.2981	1.7308	12.2058
1990/2018	**37%**	**-15%**	**82%**	**-71%**	**-67%**	**-67%**	**-82%**	**-67%**
2017/2018	**6%**	**6%**	**15%**	**-2%**	**-18%**	**-18%**	**-18%**	**-13%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Ni [t]	Se [t]	PCDD/F [g I-TEQ]	HCB [kg]
1990	18.6791	0.6107	0.5029	0.3844	0.0216	0.0021	628.6224	0.3592
1995	16.5718	0.5418	0.4462	0.3410	0.0191	0.0019	557.7038	0.3187
2000	22.9021	0.7487	0.6166	0.4713	0.0264	0.0026	770.7454	0.4404
2005	7.6674	0.2525	0.2096	0.1592	0.0124	0.0023	258.2458	0.3864
2010	0.0086	0.0033	0.0054	0.0019	0.0078	0.0022	0.6718	0.3839
2011	0.0092	0.0035	0.0057	0.0020	0.0082	0.0024	0.7145	0.4083
2012	0.0081	0.0031	0.0051	0.0018	0.0072	0.0021	0.6319	0.3611
2013	0.0081	0.0031	0.0051	0.0018	0.0073	0.0021	0.6353	0.3630

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Ni [t]	Se [t]	PCDD/F [g I-TEQ]	HCB [kg]
2014	0.0093	0.0036	0.0059	0.0020	0.0088	0.0025	0.7416	0.4238
2015	0.0090	0.0034	0.0056	0.0020	0.0081	0.0023	0.7026	0.4015
2016	0.0095	0.0037	0.0061	0.0021	0.0090	0.0025	0.7579	0.4331
2017	0.0100	0.0039	0.0065	0.0021	0.0099	0.0027	0.8116	0.4638
2018	0.0104	0.0042	0.0069	0.0022	0.0108	0.0029	0.8596	0.4912
1990/2018	**-100%**	**-99%**	**-99%**	**-99%**	**-50%**	**37%**	**-100%**	**37%**
2017/2018	**4%**	**6%**	**6%**	**2%**	**9%**	**6%**	**6%**	**6%**

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 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 2005-2018 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.

Values of emission factors are given in ***Table 6.15*** and values of abatement technology efficiency, separately for each operator in ***Table 6.16***.

Table 6.15: *Emission factors in the category 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 6.16: *Abatement technology efficiency for heavy metals and DIOX 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%

[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/

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

Recalculations of main pollutants are included in the category **1A1a**. Recalculations of heavy metals and POPs were performed because of new Tier 2 methodology as this category is key for heavy metals and POPs (***Table 6.17***).

Table 6.17: *Previous and refined emissions of Heavy metals, POPs and activity data*

YEAR	Pb [t]			Cd [t]			Hg [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0099	18.6791	189 343%	0.0008	0.6107	77 990%	0.0032	0.5029	15 635%
1991	0.0099	18.6791	189 343%	0.0008	0.6107	77 990%	0.0032	0.5029	15 635%
1992	0.0100	18.9536	189 343%	0.0008	0.6196	77 990%	0.0032	0.5103	15 635%
1993	0.0107	20.3557	189 343%	0.0009	0.6655	77 990%	0.0035	0.5480	15 635%
1994	0.0094	17.7676	189 343%	0.0007	0.5809	77 990%	0.0030	0.4784	15 635%
1995	0.0087	16.5718	189 343%	0.0007	0.5418	77 990%	0.0028	0.4462	15 635%
1996	0.0086	16.2559	189 343%	0.0007	0.5314	77 990%	0.0028	0.4377	15 635%
1997	0.0093	17.7124	189 343%	0.0007	0.5791	77 990%	0.0030	0.4769	15 635%
1998	0.0104	19.7603	189 343%	0.0008	0.6460	77 990%	0.0034	0.5320	15 635%
1999	0.0101	19.1729	189 343%	0.0008	0.6268	77 990%	0.0033	0.5162	15 635%
2000	0.0121	22.9021	189 343%	0.0010	0.7487	77 990%	0.0039	0.6166	15 635%
2001	0.0076	14.4015	189 343%	0.0006	0.4708	77 990%	0.0025	0.3877	15 635%
2002	0.0091	17.1954	189 343%	0.0007	0.5622	77 990%	0.0029	0.4630	15 635%
2003	0.0094	6.5966	69 886%	0.0007	0.2173	28 971%	0.0031	0.1805	5 807%
2004	0.0107	7.2958	68 223%	0.0008	0.2404	28 288%	0.0035	0.1997	5 671%
2005	0.0106	7.6674	72 198%	0.0008	0.2525	29 919%	0.0034	0.2096	5 998%
2006	0.0110	0.0095	-14%	0.0009	0.0036	310%	0.0036	0.0059	65%
2007	0.0105	0.0085	-19%	0.0008	0.0032	286%	0.0034	0.0053	55%
2008	0.0091	0.0081	-11%	0.0007	0.0031	326%	0.0030	0.0051	72%
2009	0.0103	0.0089	-14%	0.0008	0.0034	313%	0.0033	0.0056	66%
2010	0.0106	0.0086	-19%	0.0008	0.0033	287%	0.0034	0.0054	56%
2011	0.0108	0.0092	-14%	0.0009	0.0035	307%	0.0035	0.0057	64%
2012	0.0097	0.0081	-16%	0.0008	0.0031	297%	0.0032	0.0051	60%
2013	0.0101	0.0081	-19%	0.0008	0.0031	286%	0.0033	0.0051	56%
2014	0.0108	0.0093	-13%	0.0009	0.0036	321%	0.0035	0.0059	70%
2015	0.0111	0.0090	-19%	0.0009	0.0034	288%	0.0036	0.0056	56%
2016	0.0114	0.0095	-17%	0.0009	0.0037	307%	0.0037	0.0061	64%
2017	0.0114	0.0100	-12%	0.0009	0.0039	335%	0.0037	0.0065	75%

YEAR	As [t]			Cr [t]			Cu [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0011	0.3844	36 367%	0.0028	0.0332	1 092%	0.0023	0.0167	617%
1991	0.0011	0.3844	36 367%	0.0028	0.0332	1 092%	0.0023	0.0167	617%
1992	0.0011	0.3900	36 367%	0.0028	0.0337	1 092%	0.0024	0.0169	617%
1993	0.0011	0.4189	36 367%	0.0030	0.0362	1 092%	0.0025	0.0182	617%

YEAR	As [t]			Cr [t]			Cu [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1994	0.0010	0.3656	36 367%	0.0027	0.0316	1 092%	0.0022	0.0159	617%
1995	0.0009	0.3410	36 367%	0.0025	0.0295	1 092%	0.0021	0.0148	617%
1996	0.0009	0.3345	36 367%	0.0024	0.0289	1 092%	0.0020	0.0145	617%
1997	0.0010	0.3645	36 367%	0.0026	0.0315	1 092%	0.0022	0.0158	617%
1998	0.0011	0.4066	36 367%	0.0029	0.0352	1 092%	0.0025	0.0177	617%
1999	0.0011	0.3945	36 367%	0.0029	0.0341	1 092%	0.0024	0.0171	617%
2000	0.0013	0.4713	36 367%	0.0034	0.0407	1 092%	0.0029	0.0205	617%
2001	0.0008	0.2963	36 367%	0.0021	0.0256	1 092%	0.0018	0.0129	617%
2002	0.0010	0.3538	36 367%	0.0026	0.0306	1 092%	0.0021	0.0154	617%
2003	0.0010	0.1370	13 498%	0.0027	0.0137	415%	0.0022	0.0079	255%
2004	0.0011	0.1516	13 180%	0.0030	0.0153	406%	0.0025	0.0088	250%
2005	0.0011	0.1592	13 941%	0.0030	0.0158	428%	0.0025	0.0091	262%
2006	0.0012	0.0021	77%	0.0031	0.0039	25%	0.0026	0.0053	103%
2007	0.0011	0.0019	69%	0.0030	0.0035	18%	0.0025	0.0046	88%
2008	0.0010	0.0018	84%	0.0026	0.0034	30%	0.0022	0.0045	110%
2009	0.0011	0.0019	76%	0.0029	0.0037	26%	0.0024	0.0050	106%
2010	0.0011	0.0019	65%	0.0030	0.0036	18%	0.0025	0.0048	93%
2011	0.0012	0.0020	78%	0.0030	0.0038	24%	0.0025	0.0051	99%
2012	0.0010	0.0018	73%	0.0028	0.0033	21%	0.0023	0.0045	95%
2013	0.0011	0.0018	67%	0.0028	0.0034	18%	0.0024	0.0045	90%
2014	0.0012	0.0020	76%	0.0030	0.0039	29%	0.0025	0.0054	114%
2015	0.0012	0.0020	67%	0.0031	0.0037	18%	0.0026	0.0050	92%
2016	0.0012	0.0021	69%	0.0032	0.0040	24%	0.0027	0.0056	108%
2017	0.0012	0.0021	75%	0.0032	0.0043	33%	0.0027	0.0061	127%

YEAR	Ni [t]			Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0037	0.0216	487%	0.0020	0.0021	6%	0.004165	0.161646	3 781%
1991	0.0037	0.0216	487%	0.0020	0.0021	6%	0.004165	0.161646	3 781%
1992	0.0037	0.0219	487%	0.0020	0.0021	6%	0.0042262	0.164022	3 781%
1993	0.0040	0.0235	487%	0.0022	0.0023	6%	0.0045389	0.176155	3 781%
1994	0.0035	0.0205	487%	0.0019	0.0020	6%	0.0039618	0.153758	3 781%
1995	0.0033	0.0191	487%	0.0018	0.0019	6%	0.0036951	0.14341	3 781%
1996	0.0032	0.0188	487%	0.0017	0.0018	6%	0.0036247	0.140676	3 781%
1997	0.0035	0.0204	487%	0.0019	0.0020	6%	0.0039495	0.153281	3 781%
1998	0.0039	0.0228	487%	0.0021	0.0022	6%	0.0044061	0.171003	3 781%
1999	0.0038	0.0221	487%	0.0020	0.0022	6%	0.0042751	0.165919	3 781%
2000	0.0045	0.0264	487%	0.0024	0.0026	6%	0.0051067	0.198192	3 781%
2001	0.0028	0.0166	487%	0.0015	0.0016	6%	0.0032112	0.124629	3 781%
2002	0.0034	0.0198	487%	0.0018	0.0019	6%	0.0038342	0.148807	3 781%
2003	0.0035	0.0109	209%	0.0019	0.0020	6%	0.0039815	0.086282	2 067%
2004	0.0040	0.0121	205%	0.0022	0.0023	6%	0.0045107	0.096675	2 043%
2005	0.0039	0.0124	215%	0.0021	0.0023	6%	0.0044798	0.098568	2 100%
2006	0.0041	0.0085	107%	0.0022	0.0025	11%	0.0046548	0.056964	1 124%
2007	0.0039	0.0075	92%	0.0021	0.0022	4%	0.0044153	0.050785	1 050%
2008	0.0034	0.0073	115%	0.0018	0.0021	15%	0.0038538	0.048967	1 171%
2009	0.0038	0.0081	110%	0.0021	0.0023	12%	0.0043548	0.053599	1 131%
2010	0.0040	0.0078	97%	0.0021	0.0022	5%	0.0044903	0.051822	1 054%
2011	0.0040	0.0082	104%	0.0022	0.0024	10%	0.0045447	0.055115	1 113%

YEAR	Ni [t]			Se [t]			Zn [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2012	0.0036	0.0072	99%	0.0020	0.0021	8%	0.0041144	0.048747	1 085%
2013	0.0038	0.0073	95%	0.0020	0.0021	5%	0.0042547	0.04901	1 052%
2014	0.0040	0.0088	119%	0.0022	0.0025	14%	0.0045555	0.057211	1 156%
2015	0.0041	0.0081	96%	0.0022	0.0023	5%	0.0046901	0.054204	1 056%
2016	0.0042	0.0090	113%	0.0023	0.0025	10%	0.0048174	0.058467	1 114%
2017	0.0043	0.0099	133%	0.0023	0.0027	18%	0.0048282	0.062611	1 197%

YEAR	PCDD/F]g I-TEQ]			B(a)P [t]			B(b)F [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	10.2000	628.6224	6063%	0.0001	0.0008	534%	0.0032	0.0006	-82%
1991	10.2000	628.6224	6063%	0.0001	0.0008	534%	0.0032	0.0006	-82%
1992	10.3499	637.8631	6063%	0.0001	0.0008	534%	0.0033	0.0006	-82%
1993	11.1156	685.0475	6063%	0.0001	0.0008	534%	0.0035	0.0006	-82%
1994	9.7023	597.9475	6063%	0.0001	0.0007	534%	0.0031	0.0005	-82%
1995	9.0493	557.7038	6063%	0.0001	0.0007	534%	0.0029	0.0005	-82%
1996	8.8768	547.0734	6063%	0.0001	0.0007	534%	0.0028	0.0005	-82%
1997	9.6722	596.0912	6063%	0.0001	0.0007	534%	0.0031	0.0005	-82%
1998	10.7904	665.0108	6063%	0.0001	0.0008	534%	0.0034	0.0006	-82%
1999	10.4696	645.2406	6063%	0.0001	0.0008	534%	0.0033	0.0006	-82%
2000	12.5061	770.7454	6063%	0.0001	0.0009	534%	0.0040	0.0007	-82%
2001	7.8642	484.6675	6063%	0.0001	0.0006	534%	0.0025	0.0004	-82%
2002	9.3898	578.6920	6063%	0.0001	0.0007	534%	0.0030	0.0005	-82%
2003	5.8763	222.1890	3681%	0.0001	0.0007	534%	0.0031	0.0005	-82%
2004	6.6574	245.7489	3591%	0.0001	0.0008	534%	0.0035	0.0006	-82%
2005	6.6118	258.2458	3806%	0.0001	0.0008	534%	0.0035	0.0006	-82%
2006	0.0760	0.7384	872%	0.0001	0.0009	566%	0.0036	0.0007	-81%
2007	0.0721	0.6583	813%	0.0001	0.0008	526%	0.0034	0.0006	-82%
2008	0.0629	0.6348	909%	0.0001	0.0008	592%	0.0030	0.0006	-81%
2009	0.0711	0.6948	877%	0.0001	0.0008	570%	0.0034	0.0006	-81%
2010	0.0733	0.6718	816%	0.0001	0.0008	528%	0.0035	0.0006	-82%
2011	0.0742	0.7145	863%	0.0001	0.0009	560%	0.0035	0.0007	-81%
2012	0.0672	0.6319	841%	0.0001	0.0008	545%	0.0032	0.0006	-82%
2013	0.0695	0.6353	815%	0.0001	0.0008	527%	0.0033	0.0006	-82%
2014	0.0744	0.7416	897%	0.0001	0.0009	584%	0.0035	0.0007	-81%
2015	0.0766	0.7026	818%	0.0001	0.0008	529%	0.0036	0.0006	-82%
2016	0.0787	0.7579	864%	0.0001	0.0009	561%	0.0037	0.0007	-81%
2017	0.0788	0.8116	930%	0.0001	0.0010	606%	0.0037	0.0007	-80%

YEAR	B(k)F [t]			I()P [t]			PAHs [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.0032	0.0006	-83%	0.0000	0.0000	-93%	0.0066	0.0019	-71%
1991	0.0032	0.0006	-83%	0.0000	0.0000	-93%	0.0066	0.0019	-71%
1992	0.0033	0.0006	-83%	0.0000	0.0000	-93%	0.0067	0.0019	-71%
1993	0.0035	0.0006	-83%	0.0000	0.0000	-93%	0.0072	0.0021	-71%
1994	0.0031	0.0005	-83%	0.0000	0.0000	-93%	0.0063	0.0018	-71%
1995	0.0029	0.0005	-83%	0.0000	0.0000	-93%	0.0059	0.0017	-71%
1996	0.0028	0.0005	-83%	0.0000	0.0000	-93%	0.0058	0.0016	-71%
1997	0.0031	0.0005	-83%	0.0000	0.0000	-93%	0.0063	0.0018	-71%
1998	0.0034	0.0006	-83%	0.0000	0.0000	-93%	0.0070	0.0020	-71%

YEAR	B(k)F [t]			I()P [t]			PAHs [t]		
	P	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1999	0.0033	0.0006	-83%	0.0000	0.0000	-93%	0.0068	0.0019	-71%
2000	0.0040	0.0007	-83%	0.0000	0.0000	-93%	0.0081	0.0023	-71%
2001	0.0025	0.0004	-83%	0.0000	0.0000	-93%	0.0051	0.0015	-71%
2002	0.0030	0.0005	-83%	0.0000	0.0000	-93%	0.0061	0.0017	-71%
2003	0.0031	0.0005	-83%	0.0000	0.0000	-93%	0.0063	0.0018	-71%
2004	0.0035	0.0006	-83%	0.0000	0.0000	-93%	0.0072	0.0020	-71%
2005	0.0035	0.0006	-83%	0.0000	0.0000	-93%	0.0071	0.0020	-71%
2006	0.0036	0.0007	-82%	0.0000	0.0000	-92%	0.0074	0.0022	-70%
2007	0.0034	0.0006	-83%	0.0000	0.0000	-93%	0.0070	0.0020	-72%
2008	0.0030	0.0006	-81%	0.0000	0.0000	-92%	0.0061	0.0019	-69%
2009	0.0034	0.0006	-82%	0.0000	0.0000	-92%	0.0069	0.0021	-70%
2010	0.0035	0.0006	-83%	0.0000	0.0000	-93%	0.0071	0.0020	-72%
2011	0.0035	0.0006	-82%	0.0000	0.0000	-92%	0.0072	0.0021	-70%
2012	0.0032	0.0006	-82%	0.0000	0.0000	-93%	0.0065	0.0019	-71%
2013	0.0033	0.0006	-83%	0.0000	0.0000	-93%	0.0068	0.0019	-72%
2014	0.0035	0.0007	-81%	0.0000	0.0000	-92%	0.0072	0.0022	-69%
2015	0.0036	0.0006	-83%	0.0000	0.0000	-93%	0.0074	0.0021	-72%
2016	0.0037	0.0007	-82%	0.0000	0.0000	-92%	0.0076	0.0023	-70%
2017	0.0037	0.0007	-81%	0.0000	0.0000	-92%	0.0077	0.0024	-68%

YEAR	HCB [kg]			PCBs [kg]			AD [kt]		
	P]	R	CHANGE	P	R	CHANGE	P	R	CHANGE
1990	0.5100	0.3592	-30%	0.9010	0.9519	6%	170.00	179.61	6%
1991	0.5100	0.3592	-30%	0.9010	0.9519	6%	170.00	179.61	6%
1992	0.5175	0.3645	-30%	0.9142	0.9659	6%	172.50	182.25	6%
1993	0.5558	0.3915	-30%	0.9819	1.0374	6%	185.26	195.73	6%
1994	0.4851	0.3417	-30%	0.8570	0.9055	6%	161.70	170.84	6%
1995	0.4525	0.3187	-30%	0.7994	0.8445	6%	150.82	159.34	6%
1996	0.4438	0.3126	-30%	0.7841	0.8284	6%	147.95	156.31	6%
1997	0.4836	0.3406	-30%	0.8544	0.9027	6%	161.20	170.31	6%
1998	0.5395	0.3800	-30%	0.9532	1.0070	6%	179.84	190.00	6%
1999	0.5235	0.3687	-30%	0.9248	0.9771	6%	174.49	184.35	6%
2000	0.6253	0.4404	-30%	1.1047	1.1671	6%	208.43	220.21	6%
2001	0.3932	0.2770	-30%	0.6947	0.7339	6%	131.07	138.48	6%
2002	0.4695	0.3307	-30%	0.8294	0.8763	6%	156.50	165.34	6%
2003	0.2990	0.3434	15%	0.8613	0.9100	6%	162.51	171.69	6%
2004	0.3388	0.3890	15%	0.9758	1.0309	6%	184.11	194.51	6%
2005	0.3364	0.3864	15%	0.9691	1.0239	6%	182.85	193.18	6%
2006	0.0190	0.4220	2121%	1.0070	1.1182	11%	189.99	210.98	11%
2007	0.0180	0.3762	1987%	0.9551	0.9969	4%	180.22	188.09	4%
2008	0.0157	0.3627	2206%	0.8337	0.9612	15%	157.30	181.36	15%
2009	0.0178	0.3970	2134%	0.9421	1.0521	12%	177.75	198.51	12%
2010	0.0183	0.3839	1994%	0.9714	1.0173	5%	183.28	191.93	5%
2011	0.0185	0.4083	2101%	0.9831	1.0819	10%	185.50	204.13	10%
2012	0.0168	0.3611	2050%	0.8900	0.9569	8%	167.93	180.55	8%
2013	0.0174	0.3630	1990%	0.9204	0.9620	5%	173.66	181.52	5%
2014	0.0186	0.4238	2179%	0.9855	1.1230	14%	185.94	211.89	14%
2015	0.0191	0.4015	1997%	1.0146	1.0640	5%	191.43	200.76	5%
2016	0.0197	0.4331	2103%	1.0421	1.1477	10%	196.63	216.54	10%

YEAR	HCB [kg]			PCBs [kg]			AD [kt]		
	P]	R	CHANGE	P	R	CHANGE	P	R	CHANGE
2017	0.0197	0.4638	2253%	1.0445	1.2290	18%	197.07	231.89	18%

P–Previous, R–Refined
AD–Amount of incinerated MSW

6.7.2 INDUSTRIAL WASTE INCINERATION (NFR 5C1bi)

6.7.2.1 Overview of the category

The industrial 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 11 non-MSW incinerators and co-incineration plants, 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:

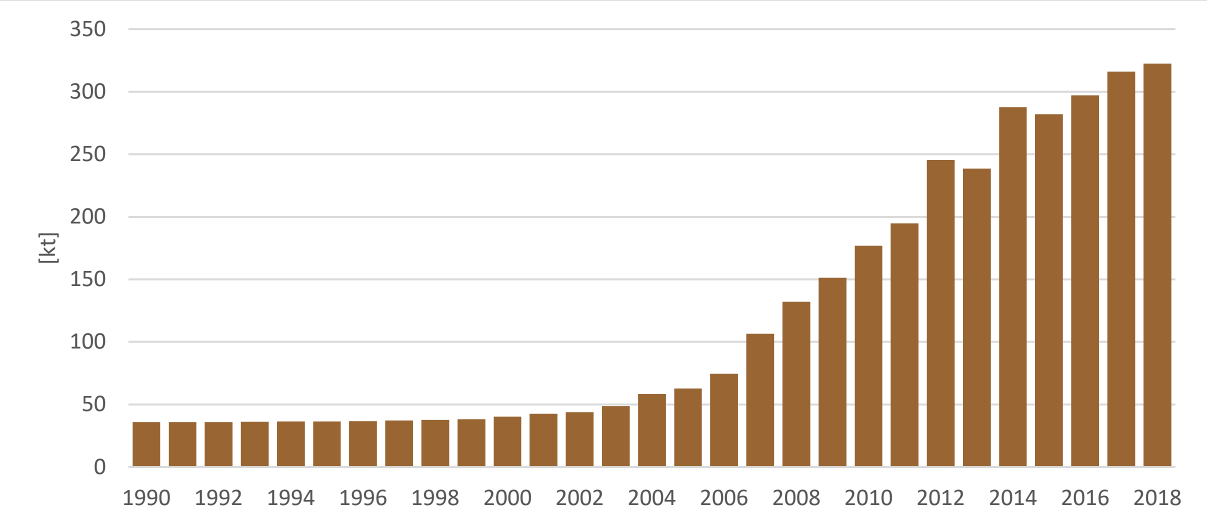
- Slovnaft Inc., Bratislava (3.7 t/hour) – incinerate industrial sludge without energy recovery;
- Duslo Inc., Šaľa (1.26 t/hour) – with energy recovery;
- Light Stabilizers Ltd., Strážske (0.18 t/hour) – without energy recovery;
- Fecupral Ltd.., Prešov (0.15 t/hour) – without energy recovery;
- Archiv SB Ltd., Liptovský Mikuláš (0.15 t/hour) – without enrgy recovery;
- FCC Environment Ltd., Kysucké Nové Mesto (0.4 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.

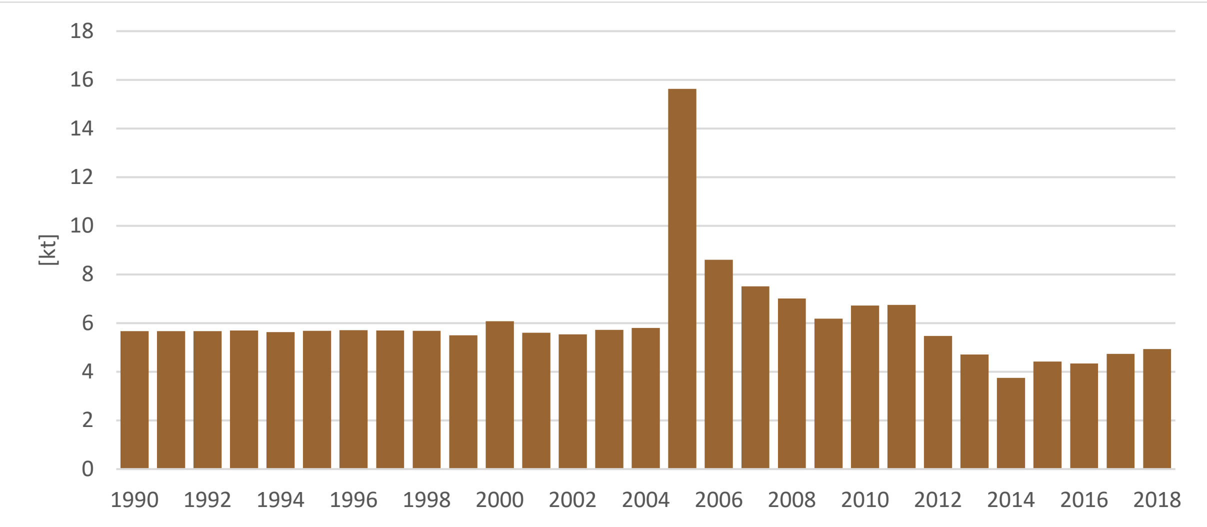
The most of the industrial waste is burned in co-incineration plants producing cement and lime. These emissions are allocated in the category **1A2f**. Amount of waste co-incinerated within the cement and lime production is shown in ***Figure 6.5***. The increasing trend of incinerated waste in this category is caused by the increase of the prize of traditional fuels and political support of energy recovery of waste instead of its disposal.

Figure 6.5: Amount of waste co-incinerated within the cement and lime production



Emissions from ISW burned with energy recovery (Slovnaft, Duslo) were allocated in **1A2gviii**. Amount of waste incinerated within this category is shown in ***Figure 6.6***. 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.

Figure 6.6: Amount of waste co-incinerated within the category 1A2gviii



In this category, emissions from sources without energy recovery are included. This category is not a key category for any pollutants. ***Table 6.18*** shows activity data, emissions of most significant pollutants and their trends.

Table 6.18: Overview of activity data, emissions and emission trends of most significant pollutants in the category Industrial waste incineration without E recovery

YEAR	ISW INCINERATED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
1990	11.23	0.0098	0.0831	5E-04	4E-05	8E-05	1E-04	2E-06	8E-04
1995	8.73	0.0076	0.0646	4E-04	3E-05	6E-05	9E-05	1E-06	6E-04
2000	6.27	0.0055	0.0464	3E-04	3E-05	4E-05	6E-05	9E-07	4E-04
2005	4.51	0.0039	0.0333	2E-04	2E-05	3E-05	5E-05	6E-07	3E-04
2010	2.55	0.0022	0.0189	1E-04	1E-05	2E-05	3E-05	4E-07	2E-04

YEAR	ISW INCINERATED [kt]	NOx [kt]	NMVOC [kt]	SOx [kt]	$PM_{2.5}$ [kt]	PM_{10} [kt]	TSP [kt]	BC [kt]	CO [kt]
2011	1.85	0.0016	0.0137	9E-05	7E-06	1E-05	2E-05	3E-07	1E-04
2012	1.74	0.0015	0.0128	8E-05	7E-06	1E-05	2E-05	2E-07	1E-04
2013	2.34	0.0020	0.0173	1E-04	9E-06	2E-05	2E-05	3E-07	2E-04
2014	2.07	0.0018	0.0153	1E-04	8E-06	1E-05	2E-05	3E-07	1E-04
2015	1.06	0.0009	0.0079	5E-05	4E-06	7E-06	1E-05	1E-07	7E-05
2016	0.53	0.0005	0.0039	2E-05	2E-06	4E-06	5E-06	7E-08	4E-05
2017	1.59	0.0014	0.0118	7E-05	6E-06	1E-05	2E-05	2E-07	1E-04
2018	1.71	0.0015	0.0127	8E-05	7E-06	1E-05	2E-05	2E-07	1E-04
1990/2018	**-85%**	**-85%**	**-85%**	**-85%**	**-85%**	**-85%**	**-85%**	**-85%**	**-85%**
2017/2018	**8%**	**8%**	**8%**	**8%**	**8%**	**8%**	**8%**	**8%**	**8%**

YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Ni [t]	PCDD/F [g I-TEQ]	PAHs [t]	HCB [kg]	PCB [kg]
1990	0.0146	0.0011	6E-04	2E-04	0.0016	3.9306	2E-04	0.0225	0.0146
1995	0.0113	0.0009	5E-04	1E-04	0.0012	3.0551	2E-04	0.0175	0.0113
2000	0.0082	0.0006	4E-04	1E-04	0.0009	2.1943	1E-04	0.0125	0.0082
2005	0.0059	0.0005	3E-04	7E-05	0.0006	1.5768	9E-05	0.0090	0.0059
2010	0.0033	0.0003	1E-04	4E-05	0.0004	0.8925	5E-05	0.0051	0.0033
2011	0.0024	0.0002	1E-04	3E-05	0.0003	0.6491	4E-05	0.0037	0.0024
2012	0.0023	0.0002	1E-04	3E-05	0.0002	0.6075	3E-05	0.0035	0.0023
2013	0.0030	0.0002	1E-04	4E-05	0.0003	0.8190	5E-05	0.0047	0.0030
2014	0.0027	0.0002	1E-04	3E-05	0.0003	0.7241	4E-05	0.0041	0.0027
2015	0.0014	0.0001	6E-05	2E-05	0.0001	0.3723	2E-05	0.0021	0.0014
2016	0.0007	0.0001	3E-05	9E-06	0.0001	0.1862	1E-05	0.0011	0.0007
2017	0.0021	0.0002	9E-05	3E-05	0.0002	0.5569	3E-05	0.0032	0.0021
2018	0.0022	0.0002	1E-04	3E-05	0.0002	0.5994	3E-05	0.0034	0.0022
1990/2018	**-85%**	**-85%**	**-85%**	**-85%**	**-85%**	**-85%**	**-85%**	**-85%**	**-85%**
2017/2018	**8%**	**8%**	**8%**	**8%**	**8%**	**8%**	**8%**	**8%**	**8%**

Figure 6.7: *Amount of the ISW incinerated without E recovery*

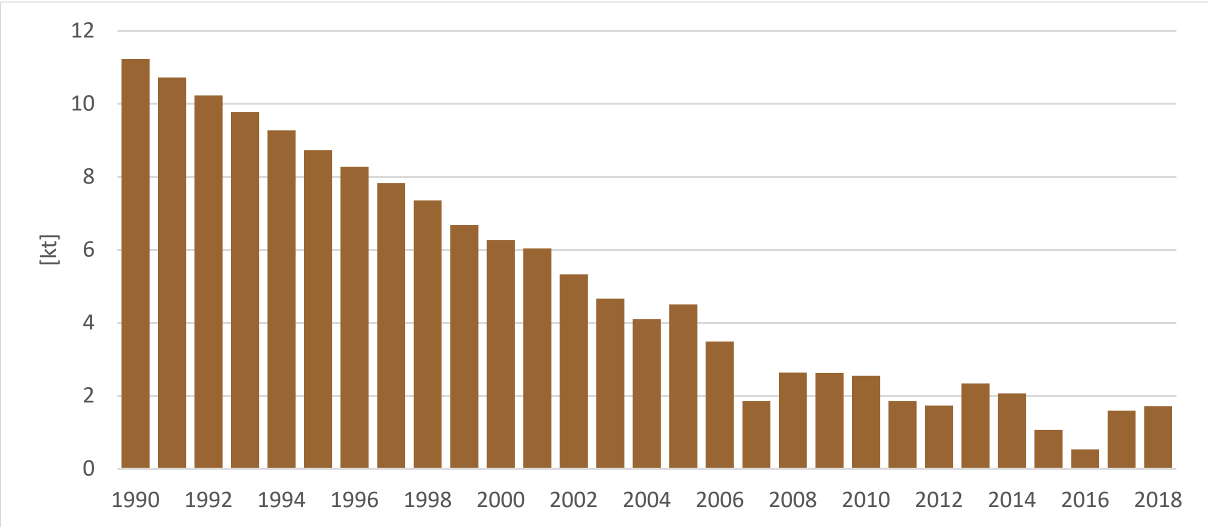


Figure 6.7 displays trend of waste incinerated with and without energy recovery through the period 1990-2018.

6.7.2.2 Methodological issues

For industrial waste incineration sources without energy recovery, data from the NEIS database were used. In the previous submission, statistical activity data was used. Using these data was reconsidered after detailed analysis and comparing the data with other sources. Statistical data were assumed as highly overestimated. Detailed description can be found in **ANNNEX VIII**. Tier 1 methodology from the EMEP/EEA GB_{2019} was used to calculate emissions in this category. Emission factors are shown in ***Table 6.19***.

The **condensable component of PMs** is not included in EFs.

Table 6.19: *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 Completeness

Emissions from Industrial waste incineration with energy recovery are reported in the energy sector under **1A2f** and **1A2gviii**. Notation keys were used in comply with EMEP/EEA GB_{2019}.

6.7.2.4 Source-specific recalculations

Amounts of industrial waste incinerated were reconsidered after comparing official statistical data with other data sources (ETS, NEIS database, reports from the operators). Detailed description can be found in **ANNEX VIII**. Recalculation of the amount of industrial waste is shown in ***Table 6.20***.

Table 6.20: *Previous and refined amount of incinerated industrial waste with and without energy recovery*

YEAR	IW WITHOUT ENERGY RECOVERY [kt]		CHANGE	IW WITH ENERGY RECOVERY [kt]		CHANGE
	PREVIOUS	REFINED		PREVIOUS	REFINED	
1990	113.91	11.23	-90%	571.18	41.61	-93%
1991	97.64	10.73	-89%	553.68	41.66	-92%
1992	93.64	10.23	-89%	536.18	41.69	-92%
1993	77.06	9.78	-87%	518.69	41.81	-92%
1994	81.52	9.28	-89%	501.19	41.94	-92%
1995	73.55	8.73	-88%	483.69	42.10	-91%
1996	76.75	8.27	-89%	466.19	42.36	-91%
1997	74.88	7.83	-90%	448.69	42.98	-90%
1998	68.66	7.36	-89%	431.19	43.51	-90%
1999	66.97	6.68	-90%	413.70	43.74	-89%
2000	71.05	6.27	-91%	396.20	46.35	-88%
2001	70.50	6.04	-91%	378.70	48.16	-87%
2002	73.61	5.33	-93%	385.30	49.36	-87%
2003	76.58	4.66	-94%	567.95	54.40	-90%
2004	71.73	4.10	-94%	238.22	64.30	-73%
2005	100.37	4.51	-96%	304.00	78.33	-74%
2006	97.77	3.49	-96%	265.35	83.13	-69%
2007	83.24	1.86	-98%	161.75	114.11	-29%
2008	64.79	2.64	-96%	428.51	139.01	-68%

YEAR	IW WITHOUT ENERGY RECOVERY [kt]		CHANGE	IW WITH ENERGY RECOVERY [kt]		CHANGE
	PREVIOUS	REFINED		PREVIOUS	REFINED	
2009	27.37	2.63	-90%	154.65	157.46	2%
2010	94.59	2.55	-97%	83.42	183.65	120%
2011	35.35	1.85	-95%	121.29	201.43	66%
2012	65.80	1.74	-97%	111.11	250.75	126%
2013	57.32	2.34	-96%	134.80	243.28	80%
2014	54.28	2.07	-96%	126.60	291.38	130%
2015	44.42	1.06	-98%	131.20	286.35	118%
2016	33.89	0.53	-98%	360.22	301.54	-16%
2017	44.30	1.59	-96%	541.93	320.84	-41%

6.7.3 HAZARDOUS WASTE INCINERATION (NFR 5C1bii)

6.7.3.1 Overview of the category

Emissions are allocated in the category 5C1bi and the notation key IE was used.

6.7.4 CLINICAL WASTE INCINERATION (NFR 5C1biii)

6.7.4.1 Overview of the category

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 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 6.21*** shows emissions released to the air from this activity using the methodology described below.

[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

Table 6.21: *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	7.17	0.0129	0.0050	0.0079	0.1648	0.0038	0.0108
1995	5.52	0.0099	0.0039	0.0061	0.1269	0.0029	0.0083
2000	3.66	0.0066	0.0026	0.0034	0.0714	0.0016	0.0054
2005	2.74	0.0049	0.0019	0.0021	0.0425	0.0010	0.0040
2010	2.00	0.0036	0.0014	0.0004	0.0086	0.0002	0.0029
2011	2.56	0.0046	0.0018	0.0005	0.0097	0.0002	0.0037
2012	1.73	0.0031	0.0012	0.0003	0.0063	0.0001	0.0024
2013	1.78	0.0032	0.0012	0.0004	0.0068	0.0002	0.0024
2014	1.79	0.0032	0.0013	0.0004	0.0071	0.0002	0.0025
2015	2.67	0.0048	0.0019	0.0004	0.0097	0.0002	0.0039
2016	2.62	0.0047	0.0018	0.0005	0.0091	0.0002	0.0036
2017	2.99	0.0054	0.0021	0.0007	0.0091	0.0002	0.0036
2018	2.75	0.0049	0.0019	0.0005	0.0094	0.0002	0.0037
1990/2018	**-62%**	**-62%**	**-62%**	**-93%**	**-94%**	**-94%**	**-65%**
2017/2018	**-8%**	**-8%**	**-8%**	**-24%**	**4%**	**4%**	**5%**

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	0.2580	0.0215	0.3870	7E-04	0.0029	0.0430	0.0022	286.6787	3E-07	7E-01	1E-01
1995	0.1986	0.0165	0.2979	6E-04	0.0022	0.0331	0.0017	220.6320	2E-07	6E-01	1E-01
2000	0.1099	0.0092	0.1670	3E-04	0.0012	0.0196	0.0011	123.7859	1E-07	4E-01	7E-02
2005	0.0633	0.0054	0.0978	2E-04	0.0007	0.0127	0.0008	70.6984	1E-07	3E-01	5E-02
2010	0.0074	0.0008	0.0152	3E-05	0.0001	0.0054	0.0006	8.9278	8E-08	2E-01	4E-02
2011	0.0070	0.0009	0.0155	3E-05	0.0001	0.0068	0.0007	8.7143	1E-07	3E-01	5E-02
2012	0.0045	0.0006	0.0110	3E-05	0.0001	0.0044	0.0005	5.6776	7E-08	2E-01	3E-02
2013	0.0055	0.0006	0.0136	4E-05	0.0001	0.0044	0.0005	6.7313	7E-08	2E-01	4E-02
2014	0.0058	0.0007	0.0136	4E-05	0.0001	0.0045	0.0005	7.0529	7E-08	2E-01	4E-02
2015	0.0065	0.0008	0.0147	3E-05	0.0001	0.0070	0.0008	8.1970	1E-07	3E-01	5E-02
2016	0.0062	0.0008	0.0166	4E-05	0.0001	0.0064	0.0007	7.8767	1E-07	3E-01	5E-02
2017	0.0063	0.0008	0.0228	9E-05	0.0001	0.0063	0.0007	8.0830	1E-07	3E-01	6E-02
2018	0.0064	0.0008	0.0174	5E-05	0.0001	0.0067	0.0007	8.1001	1E-07	3E-01	5E-02
1990/2018	**-98%**	**-96%**	**-96%**	**-93%**	**-96%**	**-84%**	**-66%**	**-97%**	**-62%**	**-62%**	**-62%**
2017/2018	**2%**	**4%**	**-24%**	**-45%**	**0%**	**6%**	**7%**	**0%**	**-8%**	**-8%**	**-8%**

Category clinical waste incineration is a key category for the emissions PCDD/PCDF and Hg. ***Figures 6.8*** and ***6.9*** shows increase in 2005 and subsequently a rapid decrease in 2006 for both pollutants, which 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.

Figure 6.8: *Hg emission trend in the category Clinical waste incineration without E recovery*

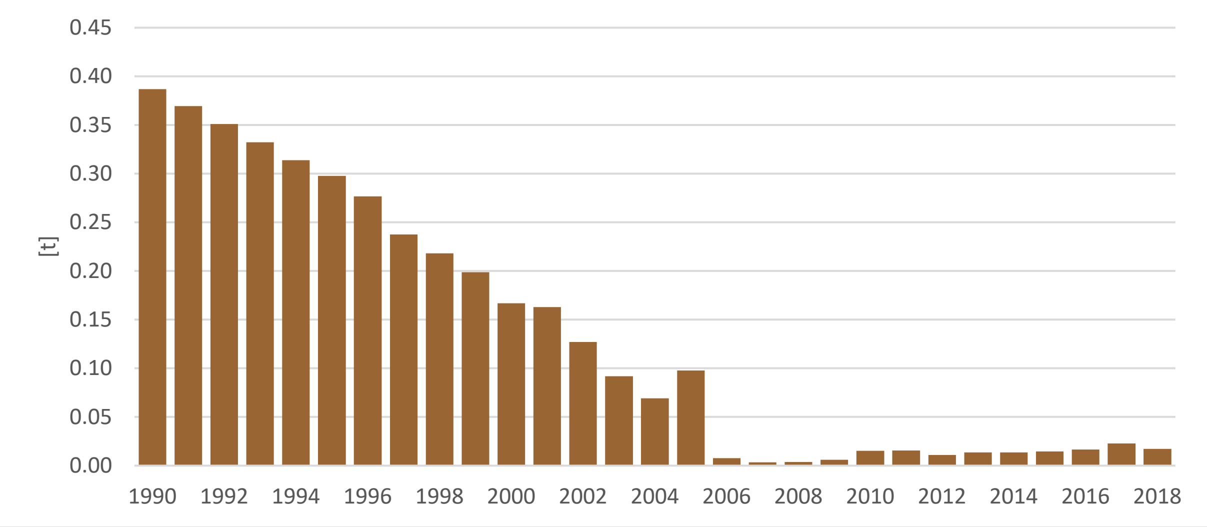
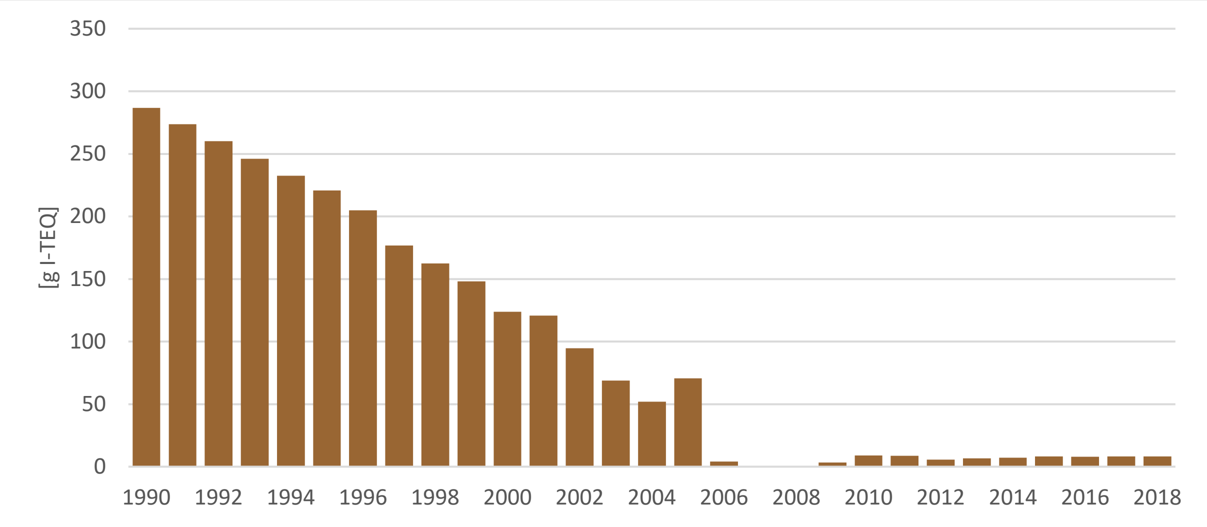


Figure 6.9: *PCDD/F emission trend in the category Clinical waste incineration without E recovery*



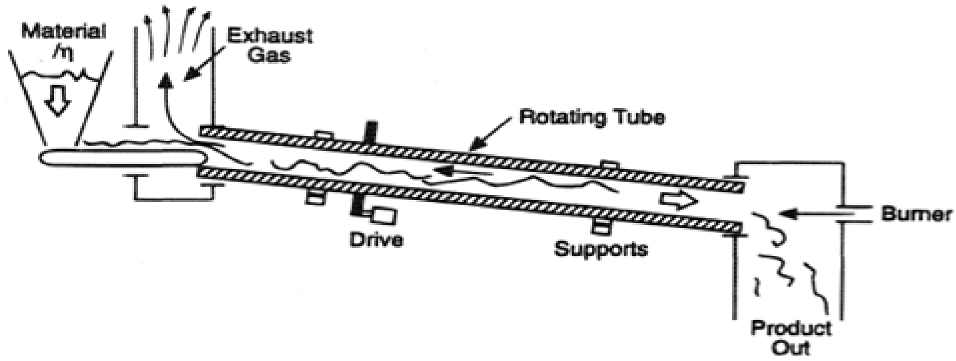
6.7.4.2 Methodological issues

Activity data for this source of pollution the NEIS database, which contains detailed information about amounts and types of waste incinerated in each plant for the years 2005-2018. 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.

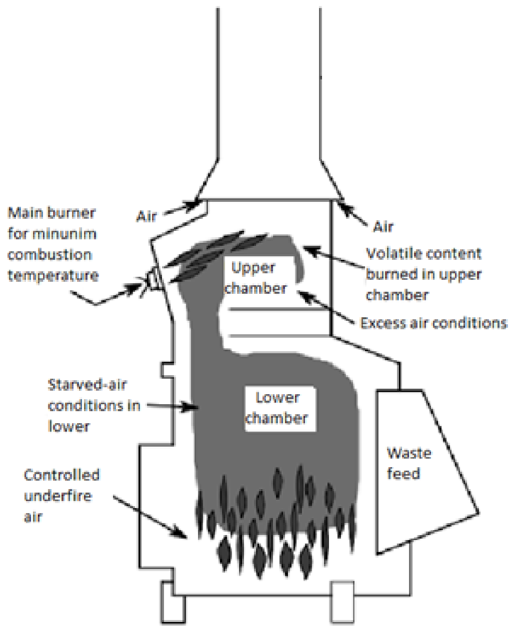
In the EMEP/EEA GB_{2019}, there are described two types of abatement technologies. **Rotary kiln (*Figure 6.10*)** is defined as technology where waste is fed into a slightly inclined, rotating, refractory-lined drum, which acts as a grate surface. The rotating action of the drum mixes it with air supplied through the walls.

Figure 6.10: *Scheme of rotary kiln*



Source: https://www.911metallurgist.com/blog/rotary-kiln-lining

Figure 6.11: *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 6.11***).

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 6.22*** shows the analysis of the distribution of clinical waste burned by combustion technologies in period 1990-2018.

Table 6.22: *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	
1990-1996	100%			
1997	91%	9%		9% Minimal APC
1998	90%	10%		10% Minimal APC
1999	88%	12%		12% Minimal APC
2000	83%	14%	3%	17% Minimal APC
2001	83%	14%	3%	17% Minimal APC
2002	73%	24%	3%	27% Minimal APC
2003	61%	35%	4%	39% Minimal APC
2004	54%	42%	4%	46% Minimal APC

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	
2005	64%	32%	4%	36% Minimal APC
2006	8%	84%	8%	92% *Good APC
2007	0%	93%	7%	100% Good APC
2008	0%	93%	7%	100% Good APC
2009	4%	96%	0%	96% Good APC
2010	10%	85%	5%	90% Good APC
2011	8%	89%	4%	92% Good APC
2012	7%	86%	7%	93% Good APC
2013	9%	79%	12%	91% Good APC
2014	9%	81%	10%	91% Good APC
2015	7%	91%	3%	93% Good APC
2016	7%	84%	10%	93% Good APC
2017	6%	71%	23%	94% Good APC
2018	6%	83%	10%	94% Good APC
	No abatement			
	Default value of abatement efficiency (GB_{2019})			

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 6.23***.

Table 6.23: *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 1997-2006	93	-	-	-
% Efficiency 2007-2017	99	-	-	-

6.7.4.3 Completeness

All rising pollutants are recorded and reported.

6.7.4.4 Source-specific recalculations

This category was recalculated to increase accuracy and completeness. Activity data were recalculated because of adding the amount of waste considered as incinerated with energy recovery and error correction in the last submission. The methodology was also slightly improved by adding new data to the calculation (***Table 6.24***).

Table 6.24: *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	1.86	7.17	286%	0.0033	0.0129	286%	0.0013	0.0050	286%	0.0020	0.0079	286%
1991	1.91	6.84	259%	0.0034	0.0123	259%	0.0013	0.0048	259%	0.0021	0.0075	259%
1992	1.88	6.50	245%	0.0034	0.0117	245%	0.0013	0.0046	245%	0.0021	0.0072	245%
1993	1.94	6.15	218%	0.0035	0.0111	218%	0.0014	0.0043	218%	0.0021	0.0068	218%
1994	1.82	5.81	219%	0.0033	0.0105	219%	0.0013	0.0041	219%	0.0020	0.0064	219%
1995	1.86	5.52	197%	0.0033	0.0099	197%	0.0013	0.0039	197%	0.0020	0.0061	197%
1996	1.80	5.12	185%	0.0032	0.0092	185%	0.0013	0.0036	185%	0.0020	0.0056	185%
1997	1.91	4.80	152%	0.0034	0.0086	152%	0.0013	0.0034	152%	0.0018	0.0049	175%
1998	1.73	4.50	160%	0.0033	0.0081	147%	0.0012	0.0031	160%	0.0016	0.0045	183%
1999	1.82	4.17	129%	0.0034	0.0075	118%	0.0013	0.0029	129%	0.0017	0.0041	140%
2000	1.89	3.66	94%	0.0034	0.0066	94%	0.0013	0.0026	94%	0.0016	0.0034	111%
2001	1.72	3.59	109%	0.0031	0.0065	109%	0.0012	0.0025	109%	0.0014	0.0034	135%
2002	1.76	3.15	79%	0.0032	0.0057	79%	0.0012	0.0022	79%	0.0013	0.0026	102%
2003	1.41	2.68	91%	0.0025	0.0048	91%	0.0010	0.0019	91%	0.0007	0.0019	194%
2004	1.64	2.27	38%	0.0048	0.0041	-14%	0.0011	0.0016	38%	0.0009	0.0015	65%
2005	2.57	2.74	6%	0.0046	0.0049	6%	0.0018	0.0019	6%	0.0020	0.0021	2%
2006	1.06	1.14	8%	0.0019	0.0020	8%	0.0007	0.0008	8%	0.0002	0.0002	-9%
2007	1.34	1.42	6%	0.0024	0.0026	6%	0.0009	0.0010	6%	0.0002	0.0002	-4%
2008	1.09	1.47	35%	0.0020	0.0026	35%	0.0008	0.0010	35%	0.0001	0.0002	25%
2009	1.54	1.55	1%	0.0028	0.0028	1%	0.0011	0.0011	1%	0.0002	0.0002	22%
2010	1.86	2.00	7%	0.0034	0.0036	7%	0.0013	0.0014	7%	0.0003	0.0004	43%
2011	2.37	2.56	8%	0.0043	0.0046	8%	0.0017	0.0018	8%	0.0002	0.0005	88%
2012	1.67	1.73	3%	0.0030	0.0031	3%	0.0012	0.0012	3%	0.0002	0.0003	71%
2013	1.73	1.78	3%	0.0031	0.0032	3%	0.0012	0.0012	3%	0.0002	0.0004	66%
2014	1.67	1.79	7%	0.0030	0.0032	7%	0.0012	0.0013	7%	0.0002	0.0004	80%
2015	2.90	2.67	-8%	0.0052	0.0048	-8%	0.0020	0.0019	-8%	0.0003	0.0004	35%
2016	2.45	2.62	7%	0.0044	0.0047	7%	0.0017	0.0018	7%	0.0003	0.0005	63%
2017	2.81	2.99	6%	0.0051	0.0054	6%	0.0020	0.0021	6%	0.0005	0.0007	39%

YEAR	TSP [kt]			BC [kt]			CO [kt]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.0427	0.1648	286%	0.0010	0.0038	286%	0.0028	0.0108	286%
1991	0.0438	0.1573	259%	0.0010	0.0036	259%	0.0029	0.0103	259%
1992	0.0433	0.1495	245%	0.0010	0.0034	245%	0.0028	0.0098	245%
1993	0.0446	0.1416	218%	0.0010	0.0033	218%	0.0029	0.0092	218%
1994	0.0419	0.1337	219%	0.0010	0.0031	219%	0.0027	0.0087	219%
1995	0.0428	0.1269	197%	0.0010	0.0029	197%	0.0028	0.0083	197%
1996	0.0413	0.1178	185%	0.0010	0.0027	185%	0.0027	0.0077	185%
1997	0.0371	0.1019	174%	0.0009	0.0023	174%	0.0029	0.0072	152%
1998	0.0311	0.0937	202%	0.0007	0.0022	202%	0.0026	0.0067	160%
1999	0.0336	0.0854	155%	0.0008	0.0020	155%	0.0027	0.0063	129%
2000	0.0335	0.0714	113%	0.0008	0.0016	113%	0.0027	0.0054	98%
2001	0.0293	0.0697	138%	0.0007	0.0016	138%	0.0025	0.0053	114%
2002	0.0268	0.0548	104%	0.0006	0.0013	104%	0.0025	0.0046	82%
2003	0.0132	0.0401	203%	0.0003	0.0009	203%	0.0020	0.0039	97%
2004	0.0182	0.0304	67%	0.0004	0.0007	67%	0.0023	0.0033	41%

YEAR	TSP [kt]			BC [kt]			CO [kt]		
	P	R	Change	P	R	Change	P	R	Change
2005	0.0413	0.0425	3%	0.0010	0.0010	3%	0.0037	0.0040	7%
2006	0.0046	0.0043	-7%	0.0001	0.0001	-7%	0.0015	0.0016	9%
2007	0.0032	0.0031	-3%	0.0001	0.0001	-3%	0.0019	0.0020	6%
2008	0.0023	0.0032	39%	0.0001	0.0001	39%	0.0015	0.0021	39%
2009	0.0034	0.0050	49%	0.0001	0.0001	49%	0.0022	0.0023	6%
2010	0.0060	0.0086	43%	0.0001	0.0002	43%	0.0027	0.0029	7%
2011	0.0052	0.0097	85%	0.0001	0.0002	85%	0.0034	0.0037	9%
2012	0.0036	0.0063	75%	0.0001	0.0001	75%	0.0024	0.0024	3%
2013	0.0035	0.0068	93%	0.0001	0.0002	93%	0.0023	0.0024	4%
2014	0.0035	0.0071	104%	0.0001	0.0002	104%	0.0023	0.0025	8%
2015	0.0063	0.0097	56%	0.0001	0.0002	56%	0.0041	0.0039	-4%
2016	0.0051	0.0091	77%	0.0001	0.0002	77%	0.0034	0.0036	7%
2017	0.0051	0.0091	79%	0.0001	0.0002	79%	0.0033	0.0036	8%

YEAR	Pb [t]			Cd [t]			Hg [t]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.0668	0.2580	286%	0.0056	0.0215	286%	0.1002	0.3870	286%
1991	0.0686	0.2463	259%	0.0057	0.0205	259%	0.1029	0.3694	259%
1992	0.0678	0.2341	245%	0.0056	0.0195	245%	0.1016	0.3511	245%
1993	0.0698	0.2216	218%	0.0058	0.0185	218%	0.1046	0.3323	218%
1994	0.0657	0.2093	219%	0.0055	0.0174	219%	0.0985	0.3140	219%
1995	0.0669	0.1986	197%	0.0056	0.0165	197%	0.1004	0.2979	197%
1996	0.0647	0.1844	185%	0.0054	0.0154	185%	0.0971	0.2766	185%
1997	0.0570	0.1579	177%	0.0048	0.0132	176%	0.0860	0.2376	176%
1998	0.0486	0.1449	198%	0.0041	0.0121	200%	0.0729	0.2182	199%
1999	0.0511	0.1319	158%	0.0043	0.0111	157%	0.0773	0.1987	157%
2000	0.0510	0.1099	116%	0.0043	0.0092	115%	0.0785	0.1670	113%
2001	0.0445	0.1072	141%	0.0038	0.0090	140%	0.0686	0.1630	138%
2002	0.0399	0.0831	108%	0.0034	0.0070	107%	0.0621	0.1272	105%
2003	0.0177	0.0594	234%	0.0016	0.0051	221%	0.0294	0.0919	213%
2004	0.0254	0.0442	74%	0.0022	0.0038	71%	0.0409	0.0691	69%
2005	0.0620	0.0633	2%	0.0053	0.0054	2%	0.0957	0.0978	2%
2006	0.0042	0.0032	-23%	0.0004	0.0004	-14%	0.0090	0.0077	-14%
2007	0.0005	NO	-	0.0002	0.0002	-16%	0.0041	0.0036	-13%
2008	NO	NO	-	0.0001	0.0002	39%	0.0032	0.0038	20%
2009	NO	0.0025	-	0.0002	0.0004	122%	0.0037	0.0062	67%
2010	0.0034	0.0074	120%	0.0005	0.0008	70%	0.0091	0.0152	67%
2011	NO	0.0070	-	0.0003	0.0009	214%	0.0051	0.0155	207%
2012	NO	0.0045	-	0.0002	0.0006	197%	0.0042	0.0110	160%
2013	NO	0.0055	-	0.0002	0.0006	246%	0.0057	0.0136	139%
2014	NO	0.0058	-	0.0002	0.0007	267%	0.0051	0.0136	168%
2015	NO	0.0065	-	0.0003	0.0008	157%	0.0073	0.0147	100%
2016	NO	0.0062	-	0.0003	0.0008	195%	0.0071	0.0166	132%
2017	NO	0.0063	-	0.0003	0.0008	203%	0.0133	0.0228	71%

YEAR	As [t]			Cr [t]			Cu [t]		
	P	R	Change	P	R	Change	P	R	Change
1990	2E-04	7E-04	286%	7E-04	3E-03	286%	0.0111	0.0430	286%
1991	2E-04	7E-04	259%	8E-04	3E-03	259%	0.0114	0.0410	259%

YEAR	As [t]			Cr [t]			Cu [t]		
	P	R	Change	P	R	Change	P	R	Change
1992	2E-04	7E-04	245%	8E-04	3E-03	245%	0.0113	0.0390	245%
1993	2E-04	6E-04	218%	8E-04	2E-03	218%	0.0116	0.0369	218%
1994	2E-04	6E-04	219%	7E-04	2E-03	219%	0.0109	0.0349	219%
1995	2E-04	6E-04	197%	7E-04	2E-03	197%	0.0112	0.0331	197%
1996	2E-04	5E-04	185%	7E-04	2E-03	185%	0.0108	0.0307	185%
1997	2E-04	4E-04	177%	6E-04	2E-03	176%	0.0103	0.0273	166%
1998	1E-04	4E-04	198%	5E-04	2E-03	200%	0.0081	0.0253	212%
1999	1E-04	4E-04	158%	6E-04	1E-03	157%	0.0095	0.0232	145%
2000	2E-04	3E-04	108%	6E-04	1E-03	115%	0.0094	0.0196	108%
2001	1E-04	3E-04	126%	5E-04	1E-03	139%	0.0084	0.0191	128%
2002	1E-04	2E-04	100%	5E-04	9E-04	106%	0.0080	0.0157	95%
2003	6E-05	2E-04	192%	2E-04	7E-04	220%	0.0050	0.0122	146%
2004	8E-05	1E-04	63%	3E-04	5E-04	71%	0.0063	0.0097	54%
2005	2E-04	2E-04	2%	7E-04	7E-04	2%	0.0122	0.0127	4%
2006	2E-05	2E-05	-13%	6E-05	5E-05	-14%	0.0028	0.0029	4%
2007	1E-05	1E-05	-8%	3E-05	2E-05	-15%	0.0031	0.0033	4%
2008	1E-05	1E-05	4%	2E-05	2E-05	37%	0.0024	0.0033	39%
2009	1E-05	8E-06	-21%	2E-05	5E-05	115%	0.0036	0.0041	14%
2010	2E-05	3E-05	56%	6E-05	1E-04	70%	0.0047	0.0054	15%
2011	1E-05	3E-05	165%	4E-05	1E-04	210%	0.0056	0.0068	21%
2012	1E-05	3E-05	99%	3E-05	8E-05	190%	0.0038	0.0044	15%
2013	2E-05	4E-05	59%	3E-05	9E-05	229%	0.0037	0.0044	18%
2014	2E-05	4E-05	79%	3E-05	9E-05	251%	0.0037	0.0045	24%
2015	2E-05	3E-05	19%	4E-05	1E-04	148%	0.0066	0.0070	6%
2016	3E-05	4E-05	68%	4E-05	1E-04	185%	0.0054	0.0064	19%
2017	7E-05	9E-05	26%	4E-05	1E-04	176%	0.0053	0.0063	20%

YEAR	Ni [t]			PCDD/F [g I-TEQ]			PAHs [t]		
	P	R	Change	P	R	Change	P	R	Change
1990	0.0006	0.0022	286%	74.2128	286.6787	286%	7E-08	3E-07	286%
1991	0.0006	0.0021	259%	76.2443	273.6436	259%	8E-08	3E-07	259%
1992	0.0006	0.0020	245%	75.2793	260.0757	245%	8E-08	3E-07	245%
1993	0.0006	0.0018	218%	77.5146	246.1786	218%	8E-08	2E-07	218%
1994	0.0005	0.0017	219%	72.9522	232.5693	219%	7E-08	2E-07	219%
1995	0.0006	0.0017	197%	74.3621	220.6320	197%	7E-08	2E-07	197%
1996	0.0005	0.0015	185%	71.8974	204.8924	185%	7E-08	2E-07	185%
1997	0.0006	0.0014	152%	64.2133	176.6528	175%	8E-08	2E-07	152%
1998	0.0004	0.0013	233%	55.0903	162.3733	195%	7E-08	2E-07	160%
1999	0.0005	0.0013	129%	57.8890	147.9875	156%	7E-08	2E-07	129%
2000	0.0005	0.0011	99%	57.9707	123.7859	114%	8E-08	1E-07	94%
2001	0.0005	0.0010	114%	50.7615	120.8061	138%	7E-08	1E-07	109%
2002	0.0005	0.0009	83%	46.1918	94.6544	105%	7E-08	1E-07	79%
2003	0.0004	0.0008	98%	22.2832	68.8565	209%	6E-08	1E-07	91%
2004	0.0005	0.0007	41%	30.8760	51.9984	68%	7E-08	9E-08	38%
2005	0.0007	0.0008	7%	40.4131	70.6984	75%	1E-07	1E-07	6%
2006	0.0003	0.0003	9%	5.0199	4.0173	-20%	4E-08	5E-08	8%
2007	0.0004	0.0004	6%	1.0684	0.5681	-47%	5E-08	6E-08	6%
2008	0.0003	0.0004	39%	0.4347	0.5879	35%	4E-08	6E-08	35%
2009	0.0004	0.0005	7%	0.6161	3.3717	447%	6E-08	6E-08	1%

YEAR	Ni [t]			PCDD/F [g I-TEQ]			PAHs [t]		
	P	R	Change	P	R	Change	P	R	Change
2010	0.0005	0.0006	7%	0.7454	8.9278	1098%	7E-08	8E-08	7%
2011	0.0007	0.0007	9%	0.9461	8.7143	821%	9E-08	1E-07	8%
2012	0.0005	0.0005	3%	0.6694	5.6776	748%	7E-08	7E-08	3%
2013	0.0005	0.0005	4%	0.6919	6.7313	873%	7E-08	7E-08	3%
2014	0.0004	0.0005	8%	0.6685	7.0529	955%	7E-08	7E-08	7%
2015	0.0008	0.0008	-4%	1.1605	8.1970	606%	1E-07	1E-07	-8%
2016	0.0007	0.0007	7%	0.9807	7.8767	703%	1E-07	1E-07	7%
2017	0.0006	0.0007	8%	1.1256	8.0830	618%	1E-07	1E-07	6%

YEAR	HCB [kg]			PCBs [kg]		
	P	R	Change	P	R	Change
1990	0.1855	0.7167	286%	0.0371	0.1433	286%
1991	0.1906	0.6841	259%	0.0381	0.1368	259%
1992	0.1882	0.6502	245%	0.0376	0.1300	245%
1993	0.1938	0.6154	218%	0.0388	0.1231	218%
1994	0.1824	0.5814	219%	0.0365	0.1163	219%
1995	0.1859	0.5516	197%	0.0372	0.1103	197%
1996	0.1797	0.5122	185%	0.0359	0.1024	185%
1997	0.1907	0.4799	152%	0.0381	0.0960	152%
1998	0.1732	0.4498	160%	0.0346	0.0900	160%
1999	0.1819	0.4174	129%	0.0364	0.0835	129%
2000	0.1888	0.3660	94%	0.0378	0.0732	94%
2001	0.1716	0.3588	109%	0.0343	0.0718	109%
2002	0.1761	0.3149	79%	0.0352	0.0630	79%
2003	0.1409	0.2684	91%	0.0282	0.0537	91%
2004	0.1643	0.2273	38%	0.0329	0.0455	38%
2005	0.2570	0.2735	6%	0.0514	0.0547	6%
2006	0.1055	0.1136	8%	0.0211	0.0227	8%
2007	0.1342	0.1420	6%	0.0268	0.0284	6%
2008	0.1087	0.1470	35%	0.0217	0.0294	35%
2009	0.1540	0.1550	1%	0.0308	0.0310	1%
2010	0.1864	0.1995	7%	0.0373	0.0399	7%
2011	0.2365	0.2561	8%	0.0473	0.0512	8%
2012	0.1674	0.1728	3%	0.0335	0.0346	3%
2013	0.1730	0.1780	3%	0.0346	0.0356	3%
2014	0.1671	0.1792	7%	0.0334	0.0358	7%
2015	0.2901	0.2673	-8%	0.0580	0.0535	-8%
2016	0.2452	0.2624	7%	0.0490	0.0525	7%
2017	0.2814	0.2989	6%	0.0563	0.0598	6%

P–Previous
R–Refined

6.7.5 SEWAGE SLUDGE INCINERATION (NFR 5C1biv)

6.7.5.1 Overview of the category

Sewage sludge incineration without energy recovery is not occurring in the Slovak Republic, therefore notation key NO was used.

6.7.6 CREMATION (NFR 5C1bv)

6.7.6.1 Overview of the category

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 6.25***, ***Figure 6.14***, cremation shows an increasing trend in Slovakia, though in 2016 a slight decrease and subsequently increase in 2018 was recorded.

Table 6.25: *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	6010	0.0050	0.0001	0.0007	0.0002	0.0002	0.0002	0.0008
1995	6744	0.0056	0.0001	0.0008	0.0002	0.0002	0.0003	0.0009
2000	7528	0.0062	0.0001	0.0009	0.0003	0.0003	0.0003	0.0011
2005	9542	0.0079	0.0001	0.0011	0.0003	0.0003	0.0004	0.0013
2010	12332	0.0102	0.0002	0.0014	0.0004	0.0004	0.0005	0.0017
2011	12332	0.0102	0.0002	0.0014	0.0004	0.0004	0.0005	0.0017
2012	12686	0.0105	0.0002	0.0014	0.0004	0.0004	0.0005	0.0018
2013	13102	0.0108	0.0002	0.0015	0.0005	0.0005	0.0005	0.0018
2014	13233	0.0109	0.0002	0.0015	0.0005	0.0005	0.0005	0.0019
2015	14398	0.0119	0.0002	0.0016	0.0005	0.0005	0.0006	0.0020
2016	12991	0.0107	0.0002	0.0015	0.0005	0.0005	0.0005	0.0018
2017	12072	0.0100	0.0002	0.0014	0.0004	0.0004	0.0005	0.0017
2018	14494	0.0120	0.0002	0.0016	0.0005	0.0005	0.0006	0.0020
1990/2018	**141%**	**141%**	**141%**	**141%**	**141%**	**141%**	**141%**	**141%**
2017/2018	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**

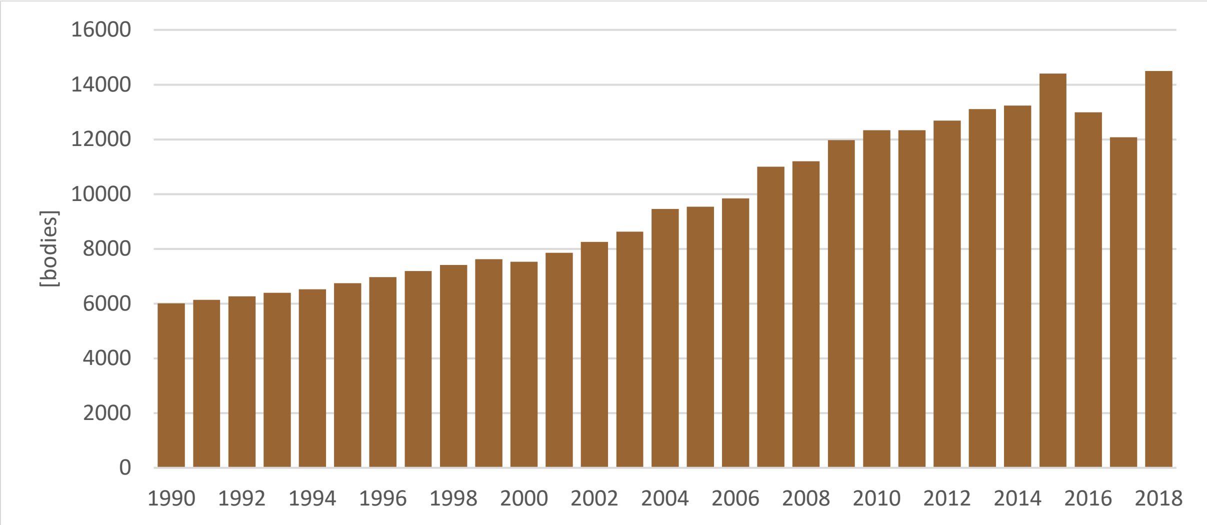
YEAR	Pb [t]	Cd [t]	Hg [t]	As [t]	Cr [t]	Cu [t]	Ni [t]	Se [t]	Zn [t]
1990	0.0002	0.0000	0.0090	0.0001	0.0001	0.0001	0.0001	0.0001	0.0010
1995	0.0002	0.0000	0.0100	0.0001	0.0001	0.0001	0.0001	0.0001	0.0011
2000	0.0002	0.0000	0.0112	0.0001	0.0001	0.0001	0.0001	0.0001	0.0012
2005	0.0003	0.0000	0.0142	0.0001	0.0001	0.0001	0.0002	0.0002	0.0015
2010	0.0004	0.0001	0.0184	0.0002	0.0002	0.0002	0.0002	0.0002	0.0020
2011	0.0004	0.0001	0.0184	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	0.0004	0.0001	0.0195	0.0002	0.0002	0.0002	0.0002	0.0003	0.0021
2014	0.0004	0.0001	0.0197	0.0002	0.0002	0.0002	0.0002	0.0003	0.0021
2015	0.0004	0.0001	0.0215	0.0002	0.0002	0.0002	0.0002	0.0003	0.0023
2016	0.0004	0.0001	0.0194	0.0002	0.0002	0.0002	0.0002	0.0003	0.0021
2017	0.0004	0.0001	0.0180	0.0002	0.0002	0.0002	0.0002	0.0002	0.0019
2018	0.0004	0.0001	0.0216	0.0002	0.0002	0.0002	0.0003	0.0003	0.0023
1990/2018	**141%**	**141%**	**141%**	**141%**	**141%**	**141%**	**141%**	**141%**	**141%**
2017/2018	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**

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	0.1623	8E-08	4E-08	4E-08	4E-08	2E-07	0.0009	0.0025
1995	0.1821	9E-08	5E-08	4E-08	5E-08	2E-07	0.0010	0.0028
2000	0.2033	1E-07	5E-08	5E-08	5E-08	3E-07	0.0011	0.0031
2005	0.2576	1E-07	7E-08	6E-08	7E-08	3E-07	0.0014	0.0039

YEAR	PCDD/F [g I-TEQ]	B(a)P [t]	B(b)F [t]	B(k)F [t]	I()P [t]	PAHs [t]	HCB [kg]	PCB [kg]
2010	0.3330	2E-07	9E-08	8E-08	9E-08	4E-07	0.0018	0.0051
2011	0.3330	2E-07	9E-08	8E-08	9E-08	4E-07	0.0018	0.0051
2012	0.3425	2E-07	9E-08	8E-08	9E-08	4E-07	0.0019	0.0052
2013	0.3538	2E-07	9E-08	8E-08	9E-08	4E-07	0.0020	0.0054
2014	0.3573	2E-07	1E-07	9E-08	9E-08	4E-07	0.0020	0.0054
2015	0.3887	2E-07	1E-07	9E-08	1E-07	5E-07	0.0022	0.0059
2016	0.3508	2E-07	9E-08	8E-08	9E-08	4E-07	0.0019	0.0053
2017	0.3259	2E-07	9E-08	8E-08	8E-08	4E-07	0.0018	0.0049
2018	0.3913	2E-07	1E-07	9E-08	1E-07	5E-07	0.0022	0.0059
1990/2018	**141%**	**141%**	**141%**	**141%**	**141%**	**141%**	**141%**	**141%**
2017/2018	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**	**20%**

As shown in ***Table 6.25***, ***Figure 6.12***, cremation shows an increasing trend in Slovakia, though in 2016 a slight decrease and subsequently increase in 2018 was recorded.

Figure 6.12: *Amount of cremated human bodies*



6.7.6.2 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 6.26***).

Inclusion/exclusion of the **condensable component of PMs** is unknown.

Table 6.26: *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

6.7.6.3 Completeness

All rising pollutants are recorded and reported.

6.7.6.4 Source-specific recalculations

No recalculation in this submission.

6.7.7 OPEN BURNING OF WASTE (5C2)

6.7.7.1 Overview of the category

This activity is against the law of the Slovak Republic (Decree No. 410/2012 Coll.[16] as amended). It is forbidden to perform 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 base year. ***Table 6.27*** and ***Figure 6.18*** show emission trend of NH_3.

Table 6.27: *Overview, activity data and emission trends in the category Domestic wastewater handling*

YEAR	DOMESTIC WASTEWATER DISCHARGED [th. m^3]	POPULATION USING DRY TOILETTES [inhabitants]	NMVOC [kt]	NH_3 [kt]
1990	462 220.19	0.0069	1.0964	462 220.19
1995	502 507.00	0.0075	0.9971	502 507.00
2000	461 531.00	0.0069	0.8363	461 531.00
2005	387 150.32	0.0058	0.7037	387 150.32
2010	454 069.00	0.0068	0.5413	454 069.00
2011	364 941.00	0.0055	0.4034	364 941.00
2012	337 545.00	0.0051	0.3939	337 545.00
2013	400 954.00	0.0060	0.3140	400 954.00
2014	377 445.00	0.0057	0.2505	377 445.00

[16] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2012/410/
[17] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31991L0271&from=EN

YEAR	DOMESTIC WASTEWATER DISCHARGED [th. m³]	POPULATION USING DRY TOILETTES [inhabitants]	NMVOC [kt]	NH_3 [kt]
2015	362 142.00	0.0054	0.2364	362 142.00
2016	385 463.00	0.0058	0.1604	385 463.00
2017	424 269.00	0.0064	0.0678	424 269.00
2018	409 241.00	0.0061	0.0349	409 241.00
1990/2018	**-11%**	**-11%**	**-97%**	**-11%**
2017/2018	**-4%**	**-4%**	**-49%**	**-4%**

As shown in the ***Table 6.27***, ***Figure 6.13*** emissions of NMVOC decreased from 1996 to 2008, since 2009 emissions show slightly increasing trend due to increase of households connected to public sewage system and water supply. ***Figure 6.14*** displays decreasing emission trend of NH_3, due to decrease of inhabitants using dry toilettes.

Figure 6.13: *NMVOC emission trend in the category Domestic wastewater handling*

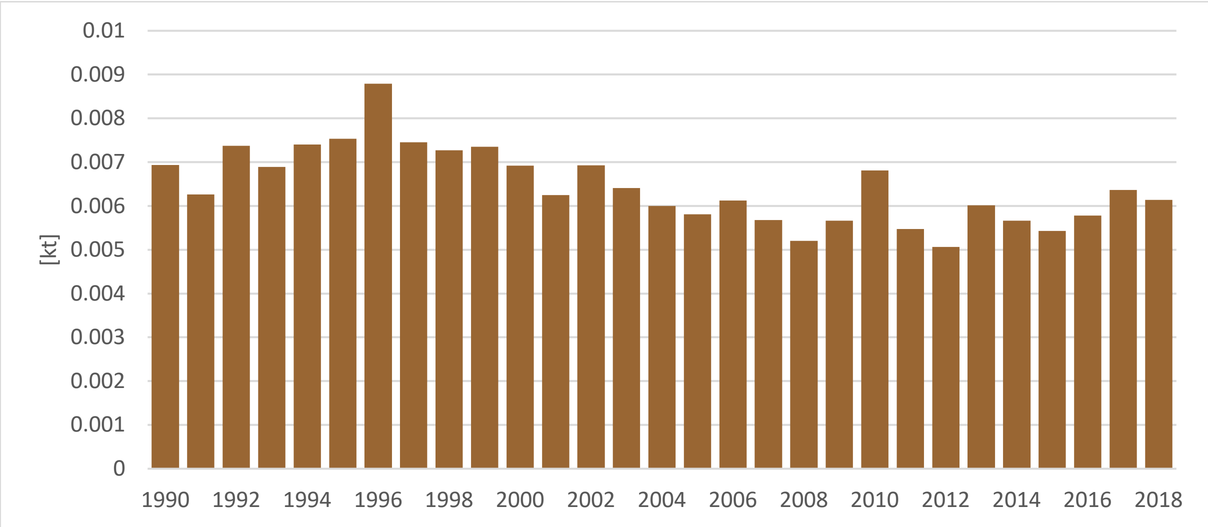
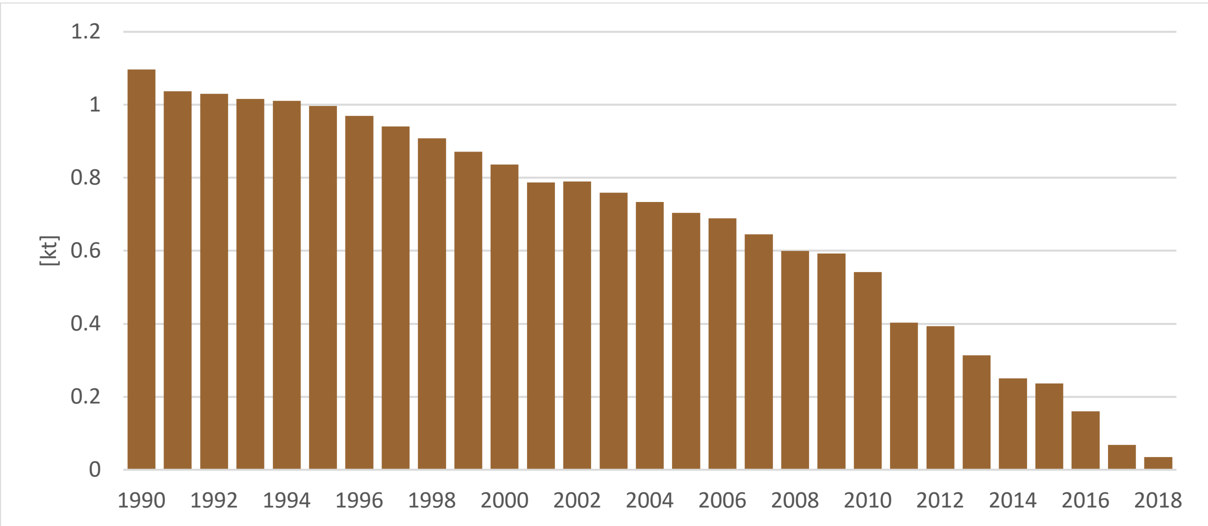


Figure 6.14: *NH_3 emission trend in the category Domestic wastewater treatment*



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 air during wastewater handling. In table below, emission factor used to calculate emissions are shown. Notation keys from EMEP/EEA GB_{2019} were applied for other pollutants.

For the usage of dry toilettes, 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 have been multiplied with Tier 2 emissions factors for dry toilettes form EMEP/EEA GB_{2019} (***Table 6.28***).

Table 6.28: *Emission factors in the category Domestic wastewater handling*

POLLUTANT	NMVOC	NH_3
Unit	[mg/m^3[	[kg/person]
Value	15	1.6

6.8.1.3 Completeness

Sources of NH_3 an NMVOC emissions are well covered.

6.8.1.4 Source-specific recalculations

Ratio of population using dry toilettes was change to be in comply with GHG inventory, therefore NH_3 emissions were recalculated (***Table 6.29***).

Table 6.29*: Previous and refined activity data and NH_3 emissions in the category Domestic wastewater treatment*

YEAR	POPULATION USING DRY TOILETTES			NH_3 [kt]		
	PREVIOUS	REFINED	CHANGE	PREVIOUS	REFINED	CHANGE
1990	683413	685274	0%	1.0935	1.0964	0%
1991	647421	648123	0%	1.0359	1.0370	0%
1992	643197	643925	0%	1.0291	1.0303	0%
1993	633631	635318	0%	1.0138	1.0165	0%
1994	630610	632028	0%	1.0090	1.0112	0%
1995	622186	623177	0%	0.9955	0.9971	0%
1996	607239	605802	0%	0.9716	0.9693	0%
1997	586772	587750	0%	0.9388	0.9404	0%
1998	566041	567890	0%	0.9057	0.9086	0%
1999	544928	544856	0%	0.8719	0.8718	0%
2000	523866	522718	0%	0.8382	0.8363	0%
2001	489560	491977	0%	0.7833	0.7872	0%
2002	478714	493807	3%	0.7659	0.7901	3%
2003	451832	474400	5%	0.7229	0.7590	5%
2004	419841	458477	9%	0.6717	0.7336	9%
2005	393272	439790	12%	0.6292	0.7037	12%
2006	371992	430891	16%	0.5952	0.6894	16%
2007	329264	403175	22%	0.5268	0.6451	22%
2008	291976	374983	28%	0.4672	0.6000	28%
2009	276337	370188	34%	0.4421	0.5923	34%
2010	228103	338340	48%	0.3650	0.5413	48%
2011	129462	252109	95%	0.2071	0.4034	95%
2012	113559	246164	117%	0.1817	0.3939	117%
2013	99471	196245	97%	0.1592	0.3140	97%
2014	81638	156568	92%	0.1306	0.2505	92%
2015	67001	147745	121%	0.1072	0.2364	121%
2016	55007	100235	82%	0.0880	0.1604	82%
2017	45172	42356	-6%	0.0723	0.0678	-6%

6.8.2 INDUSTRIAL WASTEWATER HANDLING (NFR 5D2)

6.8.2.1 Overview of the category

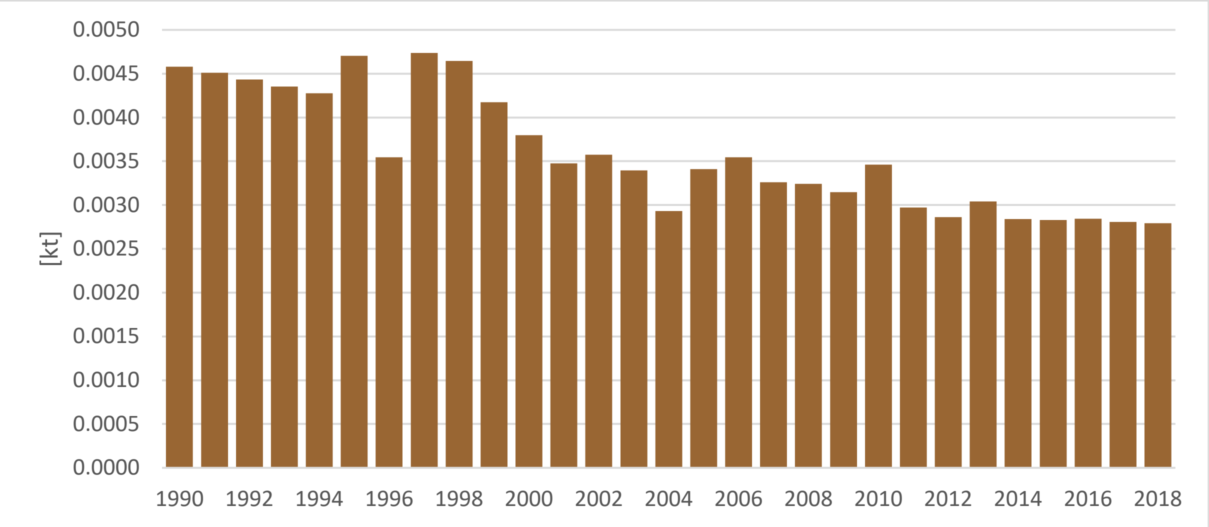
Water consumption for industrial purposes and resulting discharge of wastewater have significantly decreased in the period 1990–2018. This decrease is caused by general modernisation of the Slovak industries and stricter standards for discharge of industrial wastewater to public sewers or to watercourses.

Table 6.30: *Overview of emissions and trends in the category Industrial wastewater handling*

YEAR	INDUSTRIAL WASTEWATER DISCHARGED [th.m^3]	NH_3 [kt]
1990	305 371.48	0.0046
1995	313 699.00	0.0047
2000	253 214.00	0.0038
2005	227 446.85	0.0034
2010	230 670.00	0.0035
2011	198 242.00	0.0030
2012	190 699.00	0.0029
2013	202 692.00	0.0030
2014	189 387.00	0.0028
2015	188 578.00	0.0028
2016	189 571.00	0.0028
2017	187 218.00	0.0028
2018	186 178.00	0.0028
1990/2018	**-39%**	**-39%**
2017/2018	**-1%**	**-1%**

In ***Table 6.30*** and ***Figure 6.15***, activity data, emissions and their trends are displayed. Emissions of NH_3 decreased substantially in the year 1996, and from 1998 to 2004 due to stricter regulation of wastewater discharged to watercourses[18]

Figure 6.15: *NMVOC emission trend in the category Industrial wastewater handling*



[18] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2002/184/vyhlasene_znenie.html
https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2004/364/

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**. Recommendation No ***SK-5D2-2019-0001*** was implemented.

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

No recalculation in this submission.

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 6.31*** and ***Table 6.32*** overview of statistical activity data and emission trends are displayed. This category is key for emissions of PCDD/F.

Table 6.31*: 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	1059	520	228

Table 6.32: *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
1990/2018	**33%**	**33%**	**33%**	**32%**	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**
2017/2018	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-10%**	**-9%**

6.9.2 METHODOLOGICAL ISSUES

Activity data were obtained from the fire statistics provided by Fire Appraisal Institute of the Ministry of Interior (***Table 6.33***). 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 6.33: *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.

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CHAPTER 7: OTHER AND NATURAL EMISSIONS (NFR 6, NFR 11)

7.1 OTHER SOURCES (NFR 6A)

7.1.1 OVERVIEW OF THE CATEGORY

No other activities are 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 [19]

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	0.2557	0.1160	0.0088	0.0100	1.0961	1.3397	2.0705	0.0987	9.1193
1995	0.1787	0.0352	0.0027	0.0030	0.8163	0.9977	1.5419	0.0735	6.3750
2000	0.6253	0.4636	0.0352	0.0399	2.2937	2.8034	4.3325	0.2064	22.3018
2005	0.6092	0.2640	0.0201	0.0227	2.4997	3.0552	4.7217	0.2250	21.7293
2010	0.4647	0.0960	0.0073	0.0083	2.0746	2.5356	3.9187	0.1867	16.5741
2011	0.5572	0.2013	0.0153	0.0173	2.3280	2.8454	4.3974	0.2095	19.8739
2012	1.0635	0.8417	0.0640	0.0724	3.5870	4.3841	6.7754	0.3228	37.9306
2013	0.3520	0.1351	0.0103	0.0116	1.4510	1.7735	2.7408	0.1306	12.5542

[19] 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]
2014	0.5241	0.0959	0.0073	0.0082	2.3570	2.8808	4.4521	0.2121	18.6924
2015	0.5881	0.1763	0.0134	0.0152	2.5157	3.0748	4.7520	0.2264	20.9769
2016	0.4865	0.0874	0.0066	0.0075	2.1896	2.6762	4.1360	0.1971	17.3522
2017	0.5406	0.1488	0.0113	0.0128	2.3357	2.8547	4.4118	0.2102	19.2831
2018	0.5339	0.1242	0.0094	0.0107	2.3490	2.8710	4.4370	0.2114	19.0413

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	0.6090	0.0365	0.0487	0.0207	0.0140	0.1200	0.0107	0.0731
1995	0.4535	0.0272	0.0363	0.0154	0.0104	0.0893	0.0080	0.0544
2000	1.2743	0.0765	0.1019	0.0433	0.0293	0.2510	0.0224	0.1529
2005	1.3887	0.0833	0.1111	0.0472	0.0319	0.2736	0.0244	0.1666
2010	1.1526	0.0692	0.0922	0.0392	0.0265	0.2271	0.0203	0.1383
2011	1.2934	0.0776	0.1035	0.0440	0.0297	0.2548	0.0228	0.1552
2012	1.9928	0.1196	0.1594	0.0678	0.0458	0.3926	0.0351	0.2391
2013	0.8061	0.0484	0.0645	0.0274	0.0185	0.1588	0.0142	0.0967
2014	1.3094	0.0786	0.1048	0.0445	0.0301	0.2580	0.0230	0.1571
2015	1.3976	0.0839	0.1118	0.0475	0.0321	0.2753	0.0246	0.1677
2016	1.2165	0.0730	0.0973	0.0414	0.0280	0.2396	0.0214	0.1460
2017	1.2976	0.0779	0.1038	0.0441	0.0298	0.2556	0.0228	0.1557
2018	0.0013	0.0783	0.1044	0.0444	0.0300	0.2571	0.0230	0.1566

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	95.28	121.79
1995	70.42	9.00	81.70	90.70
2000	927.25	134.10	120.76	254.85
2005	527.96	81.92	195.83	277.75
2010	191.96	31.64	198.87	230.51
2011	402.55	66.98	191.69	258.67
2012	1683.46	283.61	114.95	398.55
2013	270.26	45.88	115.35	161.22
2014	191.73	32.56	229.33	261.89
2015	352.57	60.08	219.45	279.53
2016	174.88	29.94	213.36	243.29
2017	297.66	51.03	208.49	259.52
2018	248.38	42.63	218.37	261.00

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 last submission.

7.3.5 SOURCE-SPECIFIC RECALCULATIONS

No recalculation in this submission.

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: 13.3.2020

8.1 OVERVIEW BY GASES

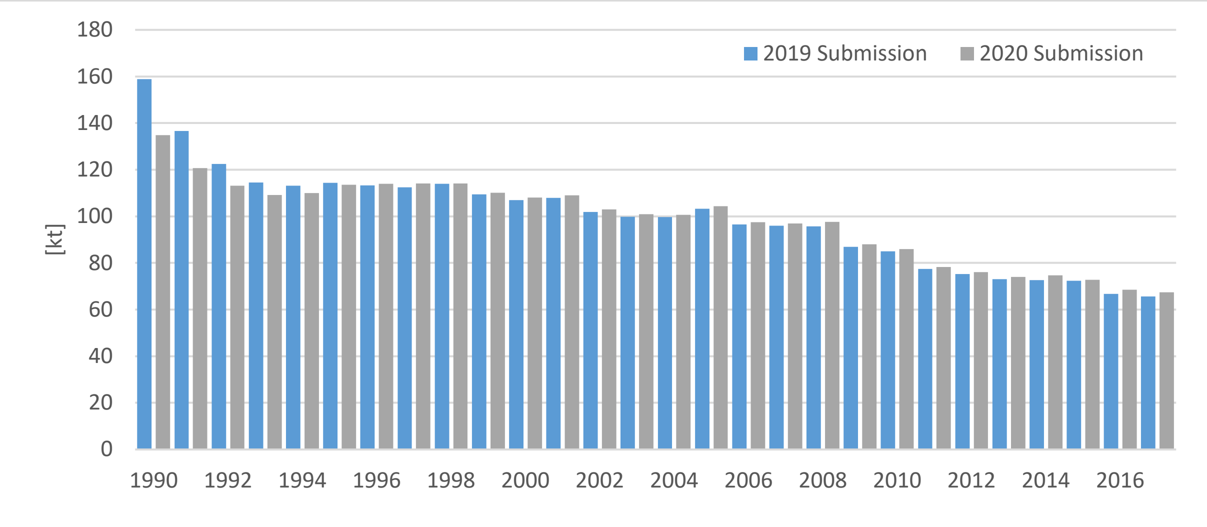
Sector specific-recalculations are described within each of the relevant chapters. These chapters should be referred to for details of recalculations and method changes. This chapter summarises the impact of these changes on the emissions totals of final versions of the submissions and highlights the largest changes for each pollutant.

8.1.1 NOx (as NO_2)

Impact of recalculations on NOx emission total in this submission is shown in ***Figure 8.1***.

Main changes were made in Energy sector. Categorisation of fuels was changed to be in comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in relation of trends in GHG and statistics.

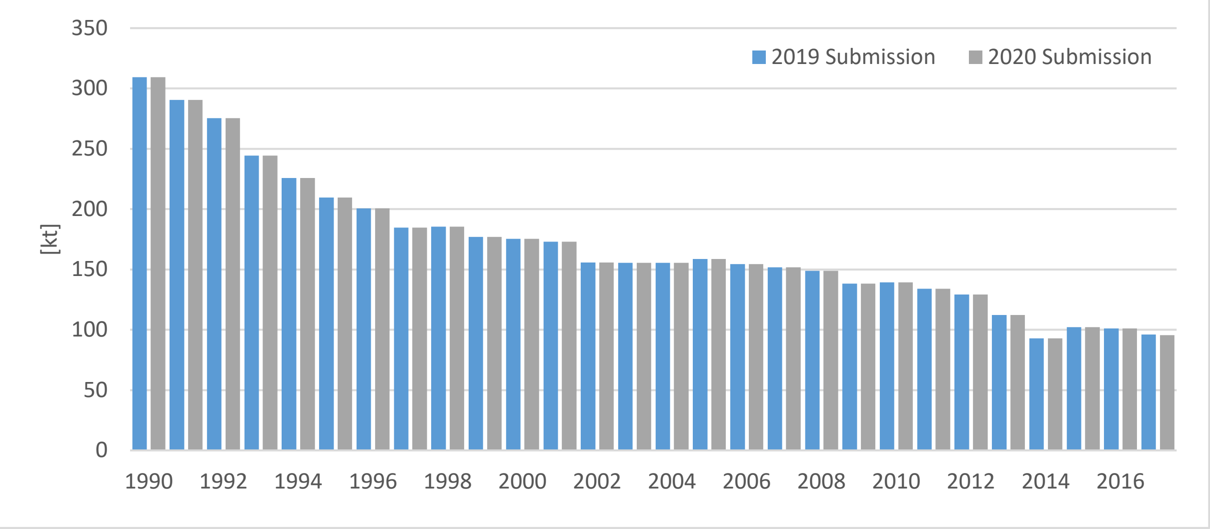
Figure 8.1: *Comparison of NOx emission total between 2019 final submission and 2020 final submission*



8.1.2 NMVOC

New methodology for residential heating (NFR 1A4bi) caused significant increase of emissions of NMVOC (***Figure 8.2***). Main changes were made in the Energy sector. A categorisation of fuels was changed to comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in the relation of trends in GHG and statistics.

Figure 8.2: Comparison of NMVOC emission total between 2019 final submission and 2020 final submission

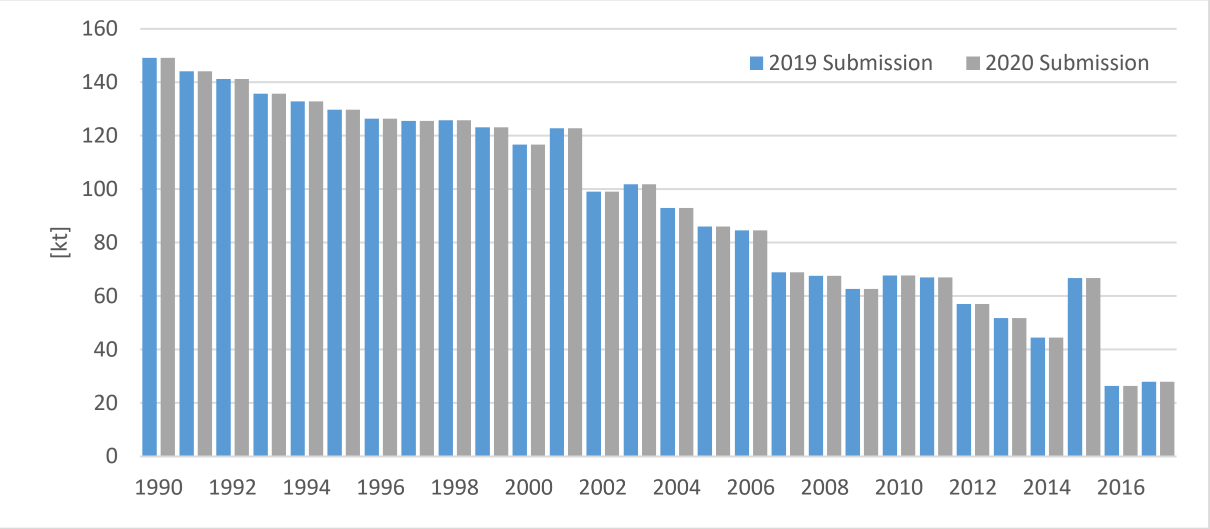


8.1.3 SOx (as SO_2)

Impact of recalculations on SOx emission total in this submission is shown in the ***Figure 8.3***.

Main changes were made in the Energy sector. A categorisation of fuels was changed to comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in the relation of trends in GHG and statistics.

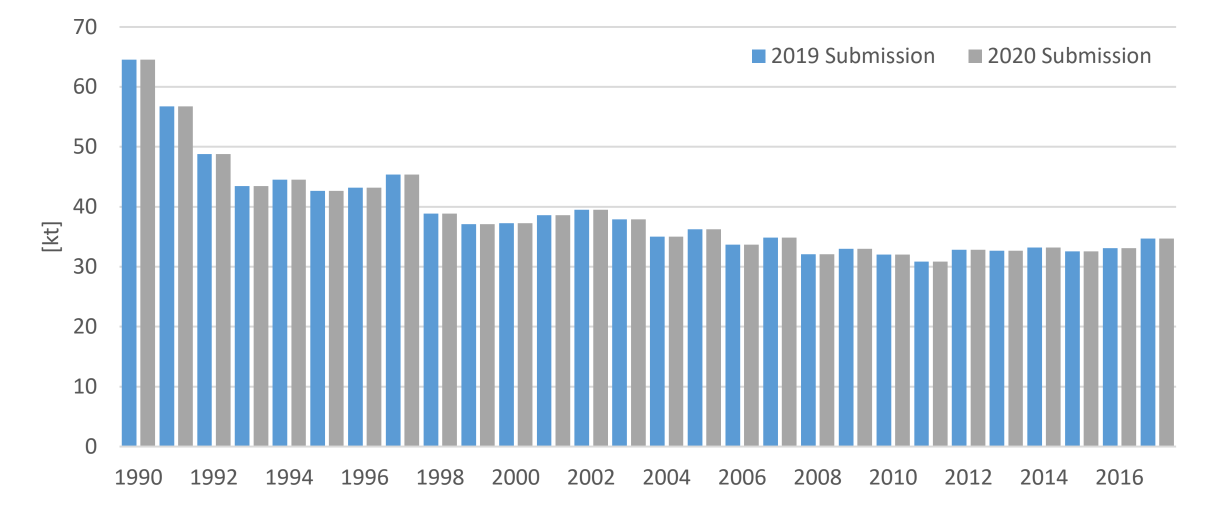
Figure 8.3: Comparison of SOx emission total between 2019 final submission and 2020 final submission



8.1.4 NH_3

Abatements were removed from the inventory in 2016 and 2017. A country-specific nitrogen excretion rate was used for cattle, swine and other animals' category, based on the tier 2 approach.

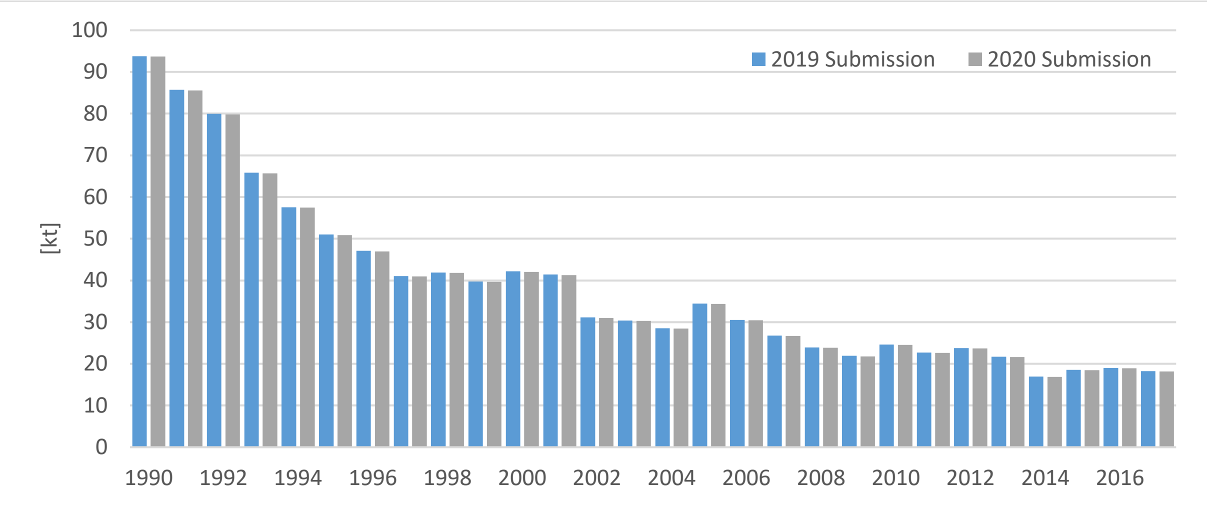
__Figure 8.4:__ Comparison of NH_3 emission total between 2019 final submission and 2020 final submission



8.1.5 $PM_{2.5}$

Main changes were made in the Energy sector. A categorisation of fuels was changed to comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in the relation of trends in GHG and statistics. Overview of the changes is shown in ***Figure 8.5***.

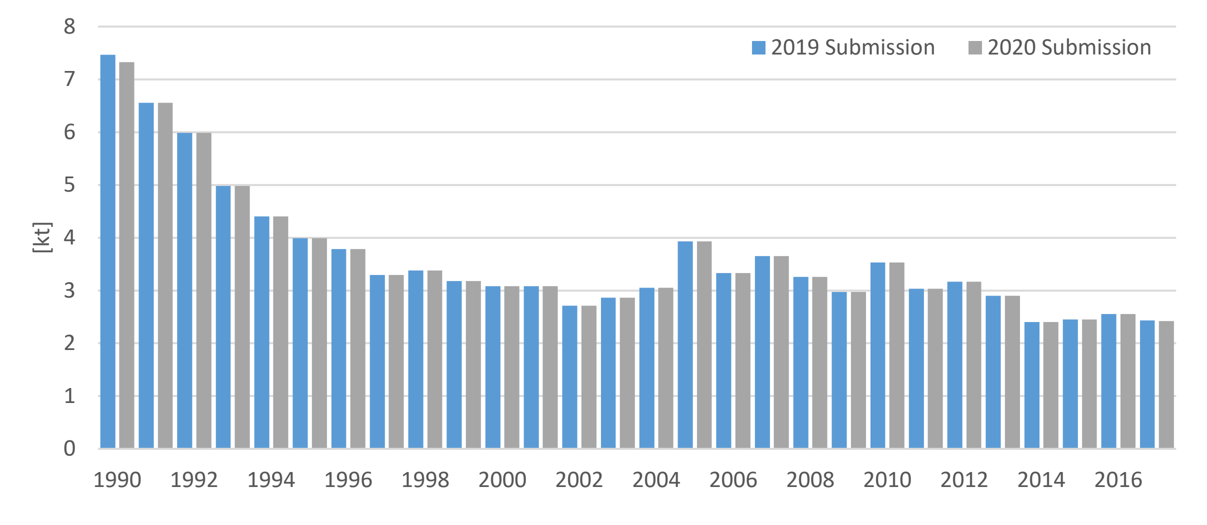
__Figure 8.5:__ Comparison of PM2.5 emission total between 2019 final submission and 2020 final submission



8.1.6 TSP, PM_{10}, BC

Main changes were made in the Energy sector. A categorisation of fuels was changed to comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in the relation of trends in GHG and statistics. Overview of the changes is shown in ***Figure 8.6***.

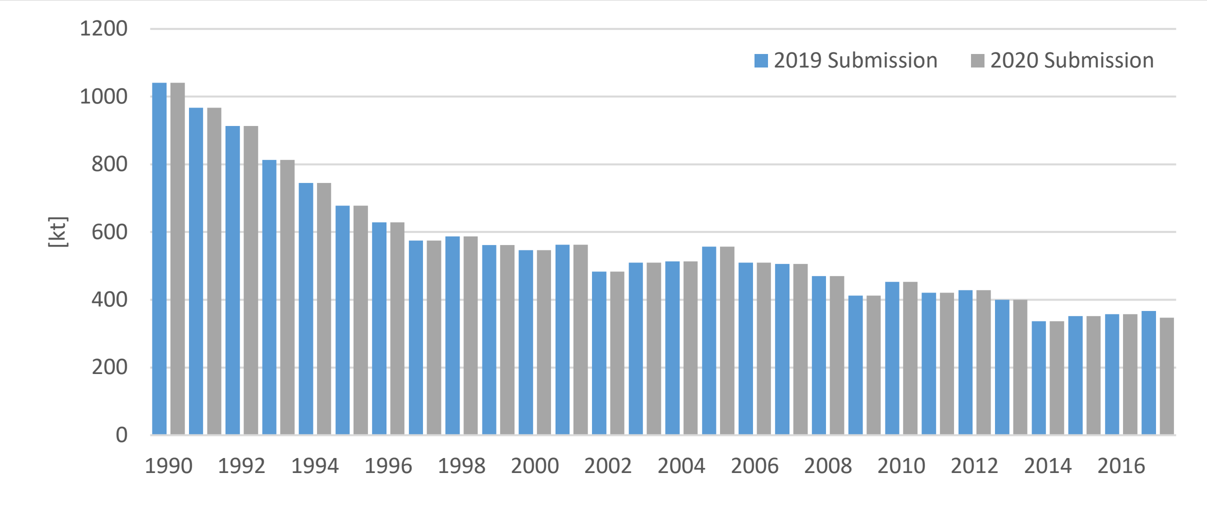
Figure 8.6: *Comparison of BC emission total between 2019 final submission and 2020 final submission*



8.1.7 CO

Main changes were made in the Energy sector. A categorisation of fuels was changed to comply with IPCC 2006 Guidelines. Historical data of fuel consumption 1990-1999 were estimated with the trend of fuel consumption individual categories in the relation of trends in GHG and statistics. Overview of the changes is shown in ***Figure 8.7***.

Figure 8.7: *Comparison of CO emission total between 2019 final submission and 2020 final submission*



8.1.8 Priority heavy metals (Pb, Cd, Hg)

Outdated country-specific emission factors for calculation of heavy metals were replaced by the EMEP/EEA GB2019 methodology (***Figure 8.8*** – ***Figure 8.10***).

Figure 8.8: *Comparison of Pb emission total between 2019 final submission and 2020 final submission*

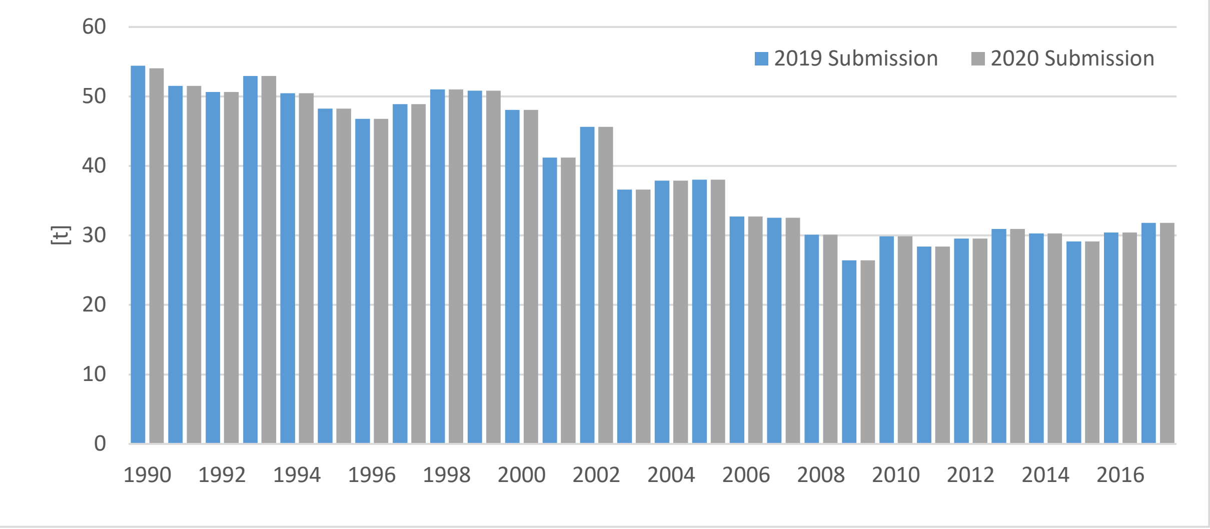


Figure 8.9: *Comparison of Cd emission total between 2019 final submission and 2020 final submission*

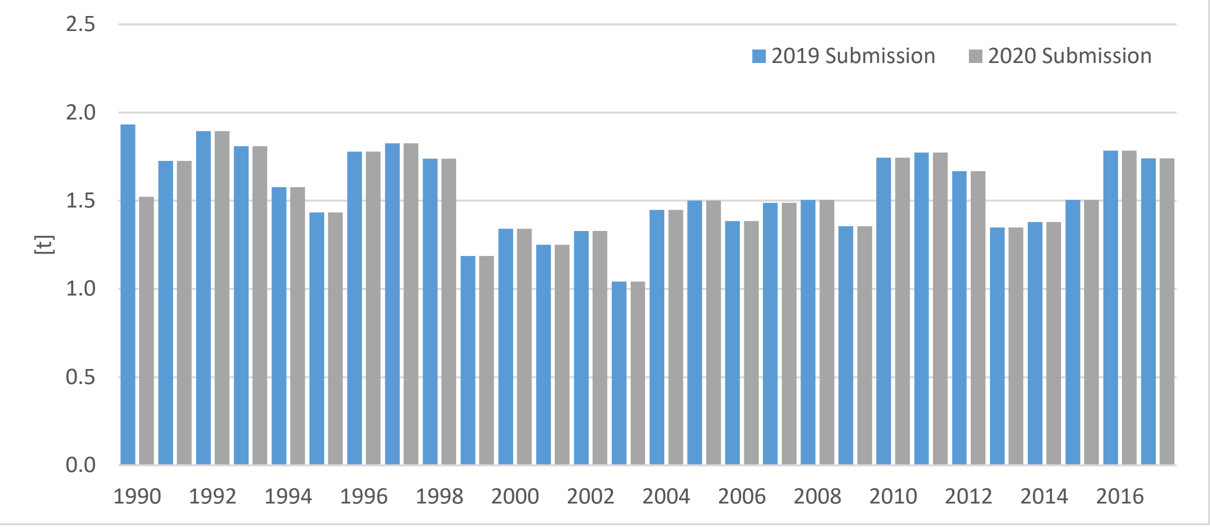
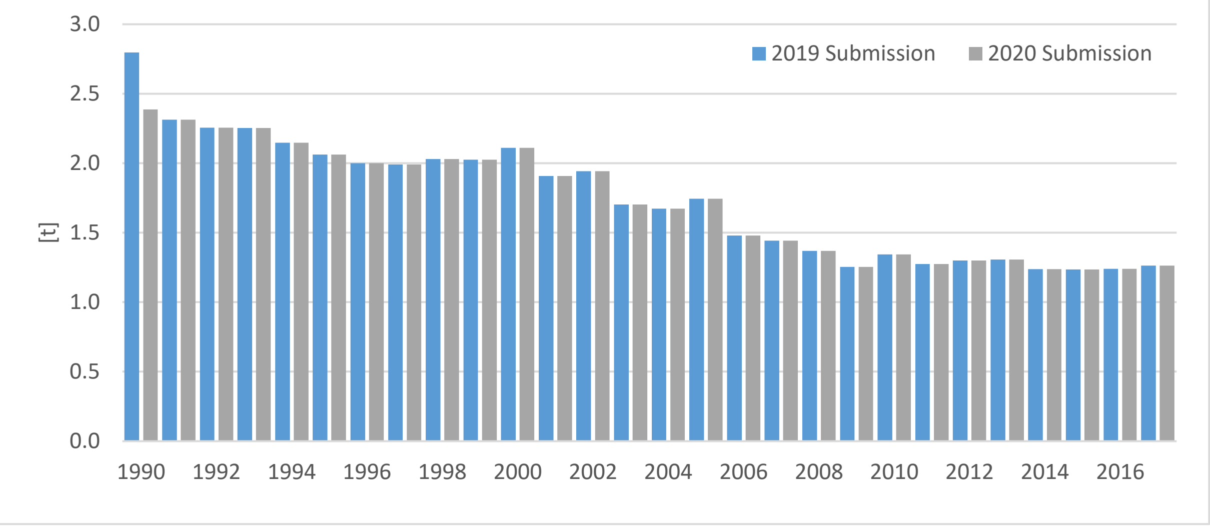


Figure 8.10: *Comparison of Hg emission total between 2019 final submission and 2020 final submission*



8.1.9 POPs

Recalculations of PCDD/F emissions were done due to change to Tier 2 methodology for the MSW incineration with energy recovery (allocated in the category 1A1a). Correction of a calculation error in the category 1A4bi led to significant changes in emissions of PAHs, HCB and PCBs.

Figure 8.11: *Comparison of PCDD/F emission total between 2019 final submission and 2020 final submission*

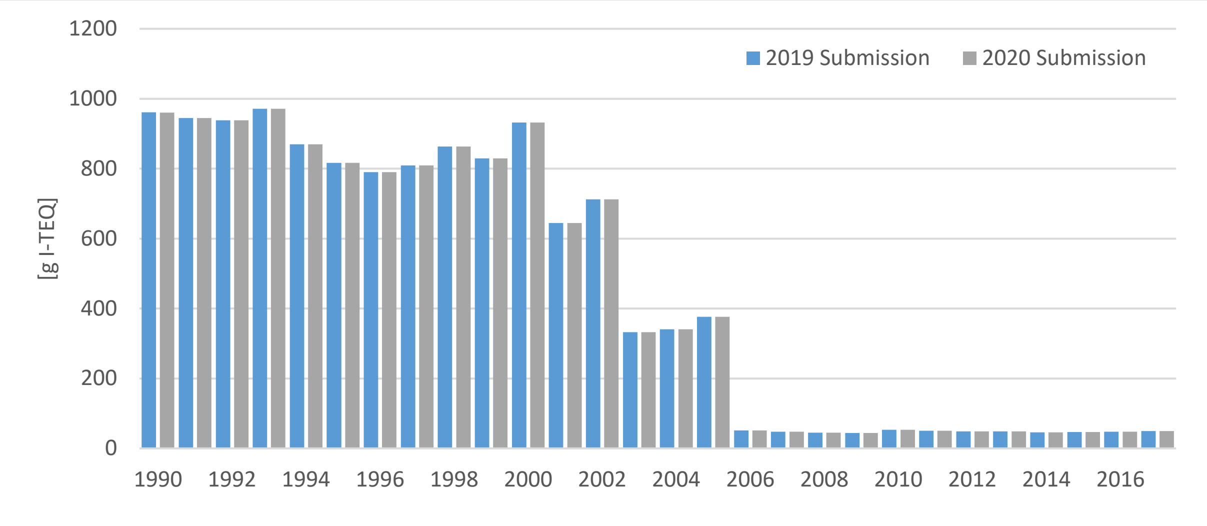


Figure 8.12: *Comparison of PAHs emission total between 2019 final submission and 2020 final submission*

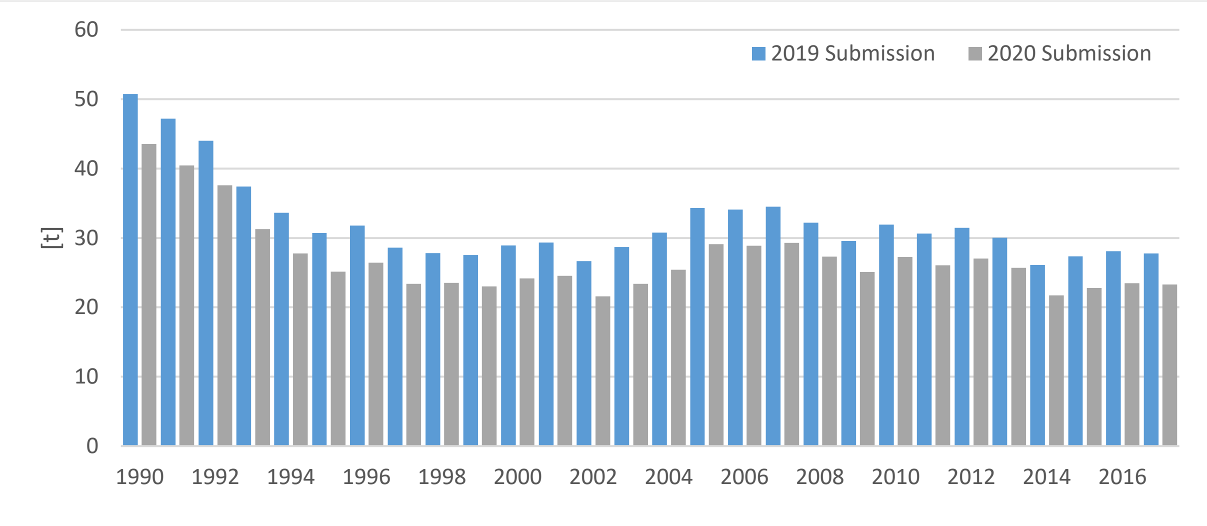


Figure 8.13: *Comparison of HCB emission total between 2019 final submission and 2020 final submission*

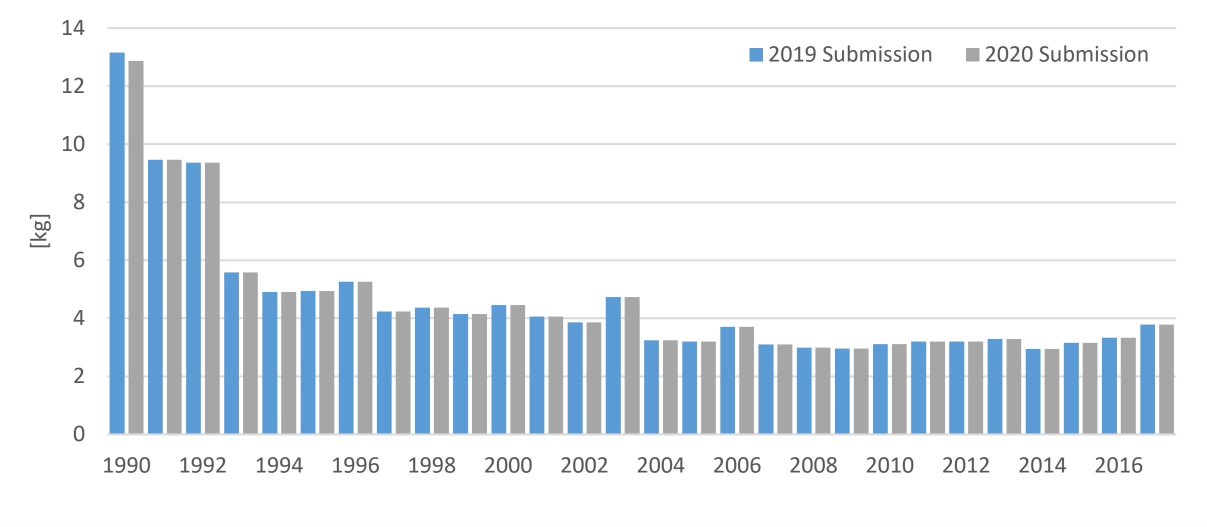
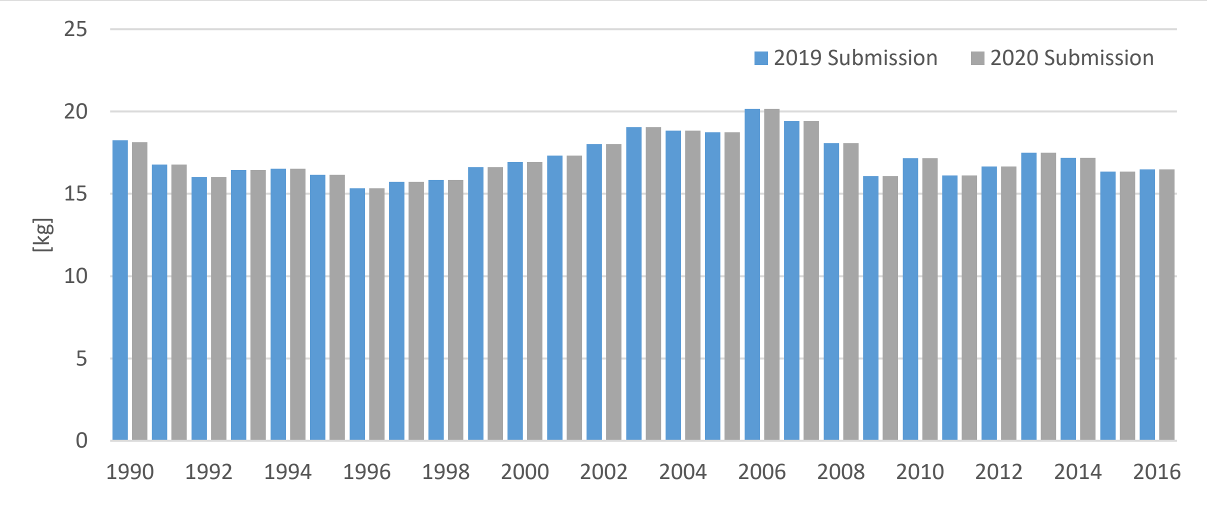


Figure 8.14: *Comparison of PCBs emission total between 2019 final submission and 2020 final submission*



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 8.1- Table 8.3***.

Table 8.1: *Recalculations between 1st and final version of national inventory 2020 – main pollutants*

YEAR/POLLUTANT	2020_V1	2020_V2	CHANGE %
NOx			
2017	67.9637	67.4313	-0.783%
2018	66.7523	66.7527	0.001%
NMVOC			
2017	96.0300	95.5195	-0.532%
2018	86.1592	86.1488	-0.012%
SOx			
2017	27.9955	27.9947	-0.003%
2018	20.3510	20.3510	0.0001%
NH_3			
2017	34.7235	34.7232	-0.001%
$PM_{2.5}$			
1990	93.7720	93.6660	-0.113%
1991	85.7009	85.5727	-0.150%
1992	79.9703	79.8372	-0.166%
1993	65.8454	65.7189	-0.192%
1994	57.5729	57.4419	-0.228%
1995	51.0159	50.8844	-0.258%
1996	47.0702	46.9332	-0.291%
1997	41.0771	40.9401	-0.334%
1998	41.9166	41.7783	-0.330%
1999	39.7673	39.6341	-0.335%
2000	42.1592	42.0315	-0.303%
2001	41.4000	41.2801	-0.289%
2002	31.1195	31.0005	-0.383%
2003	30.4013	30.2937	-0.354%
2004	28.5231	28.4198	-0.362%
2005	34.4332	34.3453	-0.255%
2006	30.5318	30.4546	-0.253%
2007	26.7384	26.6662	-0.270%
2008	23.9153	23.8305	-0.355%
2009	21.8988	21.8088	-0.411%
2010	24.5945	24.5113	-0.338%
2011	22.7194	22.6362	-0.366%
2012	23.7809	23.7006	-0.337%
2013	21.7134	21.6311	-0.379%
2014	16.9211	16.8445	-0.453%
2015	18.5486	18.4808	-0.366%
2016	19.0109	18.9462	-0.340%
2017	18.2075	18.1291	-0.430%
2018	15.1720	15.1195	-0.346%
PM_{10}			
1990	104.2220	103.4217	-0.768%
1991	95.7507	94.8789	-0.910%
1992	89.7384	88.8331	-1.009%
1993	75.2319	74.3717	-1.143%
1994	66.9263	66.0350	-1.332%
1995	60.2636	59.3690	-1.485%
1996	56.2944	55.3628	-1.655%

YEAR/POLLUTANT	2020_V1	2020_V2	CHANGE %
1997	50.2501	49.3185	-1.854%
1998	51.0581	50.1178	-1.842%
1999	48.9300	48.0241	-1.852%
2000	51.4329	50.5644	-1.689%
2001	50.5046	49.6897	-1.614%
2002	39.6808	38.8713	-2.040%
2003	38.2638	37.5319	-1.913%
2004	35.7609	35.0583	-1.965%
2005	40.9662	40.3686	-1.459%
2006	36.5250	36.0000	-1.438%
2007	32.3880	31.8967	-1.517%
2008	29.4929	28.9162	-1.955%
2009	27.4012	26.7891	-2.234%
2010	29.7394	29.1736	-1.903%
2011	27.7424	27.1769	-2.038%
2012	28.8785	28.3330	-1.889%
2013	26.7187	26.1588	-2.096%
2014	21.9670	21.4463	-2.370%
2015	23.5329	23.0713	-1.961%
2016	24.1326	23.6929	-1.822%
2017	23.0969	22.6463	-1.951%
2018	19.9821	19.6247	-1.789%
BC			
1990	7.4644	7.3271	-1.83962%
2017	6.5568	6.5568	-0.423753%
2018	5.9878	5.9878	0.000003%
CO			
2017	367.1939	346.7778	-5.56003%
2018	301.3908	301.3909	0.00001%

Table 8.2: *Recalculations between 1st and final version of national inventory 2020 – heavy metals*

YEAR/POLLUTANT	2019_V1	2019_V2	CHANGE %
Pb			
1990	54.4062	54.0408	-0.6717%
2018	31.1444	31.1450	0.0017%
Cd			
1990	1.9333	1.5222	-21.2604%
2017	1.7405	1.7401	-0.0244%
2018	1.6816	1.6817	0.0025%
Hg			
1990	2.7976	2.3866	-14.6918%
2018	1.2232	1.2232	0.0019%
As			
1990	3.9173	3.7918	-3.2038%
2018	3.0298	3.0298	0.0002%
Cr			
1990	22.3114	22.1785	-0.596%
2017	26.7847	26.7826	-0.008%
Cu			
1990	9.9182	9.6875	-2.326%

YEAR/POLLUTANT	2019_V1	2019_V2	CHANGE %
2017	11.6583	11.5863	-0.618%
Ni			
2017	3.1218	3.1188	-0.095%
2018	3.0836	3.0836	0.002%
Se			
1990	2.9588	-12.745%	2.9588
2017	1.9173	1.9169	-0.022%
Zn			
1990	39.6993	39.4771	-0.560%
2017	59.1726	59.1302	-0.072%

Table 8.3: *Recalculations between 1st and final version of national inventory 2020 – POPs*

YEAR/POLLUTANT	2020_V1	2020_V2	CHANGE %
PCDD/F			
1990	960.8047	959.8419	-0.100%
2017	46.8810	47.0260	0.309%
PAHs			
1990	50.7318	43.5493	-14.158%
1991	47.1793	40.4509	-14.261%
1992	44.0253	37.5885	-14.621%
1993	37.4336	31.2884	-16.416%
1994	33.6491	27.7955	-17.396%
1995	30.7254	25.1634	-18.102%
1996	31.7894	26.4134	-16.911%
1997	28.5820	23.3920	-18.158%
1998	27.8114	23.5477	-15.331%
1999	27.5387	23.0020	-16.474%
2000	28.9467	24.1559	-16.550%
2001	29.3351	24.5418	-16.340%
2002	26.6721	21.5725	-19.120%
2003	28.7067	23.3686	-18.595%
2004	30.7499	25.4178	-17.340%
2005	34.3089	29.0889	-15.215%
2006	34.1151	28.8951	-15.301%
2007	34.5025	29.2824	-15.129%
2008	32.2216	27.3315	-15.176%
2009	29.5549	25.1148	-15.023%
2010	31.9382	27.2882	-14.559%
2011	30.6247	26.0647	-14.890%
2012	31.4651	27.0551	-14.016%
2013	30.0182	25.6982	-14.391%
2014	26.1332	21.7232	-16.875%
2015	27.3731	22.7831	-16.768%
2016	28.1139	23.4939	-16.433%
2017	27.7690	23.2990	-16.097%
2018	25.3501	20.8500	-17.751%
HCB			
1990	13.1571	12.8719	-2.167%
2018	3.2902	3.2910	0.025%
PCBs			
1990	18.2469	18.1417	-0.577%

CHAPTER 9: PROJECTIONS OF EMISSIONS

Last Update:13.3.2020

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 2019 under the Regulation (EU) No 525/2013 of the European Parliament and the Council on a mechanism for monitoring and reporting greenhouse gas emissions and also consistent with the 7. National communication of the Slovak republic on Climate Change under the UNFCCC and Kyoto protocol. Actualized emissions projections for the base scenario with measures was prepared for national air pollution control programmes.

The year 2016 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 2018. Actualization was based on changes in key parameters in the most emission-intensive categories. Changes were driven by the new data from the new energy model (CPS – Compact Primes for Slovakia), which came from the study of low carbon development by the Ministry of Environment of the Slovak Republic in cooperation with the World Bank and E3modelling. 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	5 489	5 501	5 492	5 467	5 449
EU ETS carbon price	EUR/EUA	7.5	15.0	22.5	33.5	42.0	50.0
International coal import prices	EUR/MWh	7.2	8.9	10.7	12.8	13.5	14.1
International oil import prices	EUR/MWh	30.0	46.8	53.1	58.5	61.0	64.6
International gas import prices	EUR/MWh	24.2	29.5	32.1	35.2	37.8	39.1

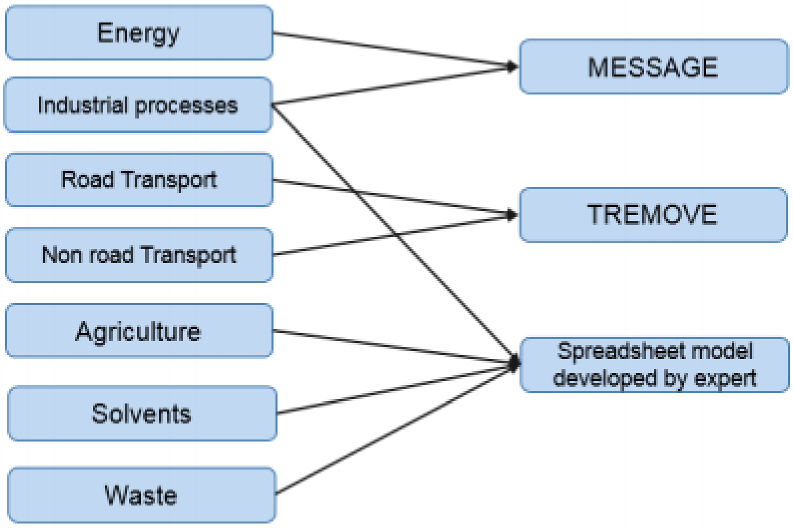
Even use of a wide range of input data and improvement of methodological approach at activity projection in relevant sectors, the results are influenced by the uncertainties of future development, preferably in the case of the macro-economic data and elasticity of the final energy consumption. These 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 important role plays the decision 406/2009/EC on effort sharing in the sectors not included in the emission trading.

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. Data from the new CPS model was used for some projected parameters and indicators due to lack of national information for the future trends

The emission modelling was prepared by software MESSAGE (energy + industry)[1],[2] software TREMOVE (transport)[3],[4] as well as the specific calculations in MS EXCEL environment (agriculture, waste, industry). As you can see in ***Figure 9.1***. The air protection legislation was implemented directly into both models, considering existing and future requirements on the emission concentration limits.

Figure 9.1*: Models and tools used in individual sectors*



Energy and Industry

MESSAGE is an optimization model with linear programming. The program seeks an optimal solution for a selected period. The model is flexible and allows seeking a minimum optimal function for whatever parameters (not only energy systems). The mathematical description is complex. The optimization function seeks minimum costs to meet demands for the final consumption supply from primary and imported energy sources. The model also allows inserting certain constraints that simulate regulation of the system based upon the source limits, price regulation, and emission impact. The electricity network creates an integrated part and curves of load could be adjusted for individual periods. It also supports the modelling of combined electricity and heat production

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

[1] http://www.iiasa.ac.at/web/home/research/researchPrograms/Energy/MESSAGE.en.html
[2] Energy supply model MESSAGE. https://pure.iiasa.ac.at/1542/
[3] https://www.tmleuven.be/en/navigation/TREMOVE
[4] http://unfccc.int/files/national_reports/annex_i_natcom/submitted_natcom/application/pdf/976840315_slovakia-nc7-1-7nc_svk.pdf

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 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.

Detailed description is provided in the Final Project Report here[5]

Transport

TREMOVE is the transport and emission simulation model developed for the European Commission designed to study the effects of different transport and environment policies on the emissions of the transport sector. The model estimates transport demand, the modal split, vehicle fleets, vehicle stock renewal, the emission of air pollutants and the welfare level under different policy scenarios. All relevant transport modes are modelled, including aviation.

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. The model was used adaptive methods for time series parameters projections. The Projections of parameters is based on 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.

The calculations were based on the analysis of historical time series of the individual forecasted indicators, assuming that the current status of other external factors is maintained. The external factors influence the forecast parameters in different intensity and direction, but future development is often unpredictable. For example, the CAP measures have a significant impact on both animal and plant production. However, negotiations on its direction beyond 2020 are still ongoing, and the final reform for 2021–2028 will be known in the coming years. In addition to the CAP, several other factors can influence the indicators - whether economic (supply, demand, agricultural input and output prices, etc.), political or accidental (natural disasters, climate change, etc.).

Even though the current projections may differ from the actual values achieved in the future due to several external actors, the forecasts reflect reasonably well the current trends and expectations for the future. In particular, there is a continuing decline in livestock production in the Slovak Republic (cattle, pigs, poultry, horses and partly sheep). The consumption of inorganic N-fertilizers also increases, which will need to replace the lack of organic nitrogen into soils. The agricultural production will increase as a result of the reduction in livestock numbers.

Emission calculation: The Slovak Hydrometeorological Institute compiles annually NH3 balance and uses emission factors according to the 2016 EMEP/EEA Guideline. Country-specific parameters were implemented during the NH_3 calculation. The ŠU SR do not dispose of official information about

[5] https://www.minzp.sk/files/oblasti/politika-zmeny-klimy/2019_01_low-carbon-study.pdf

abatements. The National Emission Inventory System (NEIS) is the abatement information sourced from the farms. The abatements technics are available for the 2006-2017 time series.

The NH_3, NOx emission projections were estimated according to the EMEP/EEA$_{2016}$ Guidebook methodologies, the Slovak Republic did not used the specific model for forecasting emissions. Emission factors calculated by the calculation sheet (4.B appendix.xls) provided by the EMEP/EEA GB$_{2013}$. In the calculation sheet, the values of the N excretion, housed-period and the proportion of solid, liquid and yard manure were replaced by the country-specific values year by year for all animal species. The basis for the accurate calculation of the NOx and NH_3 emissions is the nitrogen flow. The nitrogen flow as an available national parameter was taken into account for more accurate emissions estimations.

PM_{10}, $PM_{2.5}$, emissions from manure management and agricultural soils were calculated using by 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$_{2016}$. NMVOC emissions from other animal categories were calculated using the Tier 1 methodology and emission factors outlined in the EMEP/EEA GB$_{2016}$. NMVOC emissions from Agricultural soils were calculated using the Tier 1 methodology and emission factors outlined in EMEP/EEA GB$_{2016}$.

The farms from the NEIS (the National Emission Information system) 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 result of the research was a list of abatements applied to the emission balance. Table 5 summarized a share of applied abatements reported by farmers into the NEIS system in 2017. The percentage was calculated for a better interpretation and usability in the NH_3 calculations. NH_3 emissions from Agriculture emissions are estimated as a Tier 2 approach for cattle, sheep, goats, pigs, horses and poultry categories. Emissions of NH_3 at one stage of manure management, during housing, can influence NH_3 emissions at later stages of manure management, during manure storage and application to land. The more NH_3 emitted at early stages of manure management the less is available for emission later. Manure management also affects NH_3 emissions from grazed pastures. The more time grazing livestock is housed, the smaller the proportion of their excreta deposited on grazed pastures will be, and hence the smaller the emissions from those pastures. For this reason, emissions at the Tier 2 level were calculated sequentially using a mass-flow approach and the Nitrogen cycle in Agriculture is considered. The mass-flow approach was developed to a Tier 3 methodology that can make proper allowances for the introduction of abatement techniques.

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[6]. Total generated waste is estimated from demographic projections and waste per capita. Generated waste is divided into a mixed municipal waste, 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 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.

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[6] 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

9.2 KEY CHANGES IN UPDATED PROJECTIONS

Residential heating – Probably the most crucial sector cover most of $PM_{2.5}$ emissions and a considerable amount of NOx and NMVOC emissions. Based on the new information from the questionnaire survey, datasets were improved and on these base estimations of natural improvement in the structure of households, heating equipment was implemented. In this scenario was not included any measure which would force equipment changes. Change rate was extrapolated on based on the historical data collected by the survey.

Energy efficiency – New action plan of energy efficiency was taken in place in 2017 – 4th Action plan of energy efficiency for the years 2017-2019 with outlook to 2020. This action plan replaced the 3rd Action Plan which was less ambitious.

Transport – Actualization based on new consumption data from CPS model.

Industry – Changes in industry was driven by new estimated sectoral demand from CPS and based on information from producers. Many emission reduction measures have been in place since recent years, so these measures cannot bring further savings. Considerable improvement is expected in the production of chemicals and iron and steel.

Energy – Actualization was similar as in the industry sector. However, there is a significant decrease in emission caused by planned measures by key producers.

Agriculture – Key sector in case of NH_3 emissions. New estimations of future livestock numbers and fertilizers use were obtained in cooperation with Research Institute of Agriculture and Food Economics. Based on the new information from the National Emission Information System, existing measures for biggest agricultural producers were applied to the calculations.

Activity data: Emission projections of the livestock numbers up to the year 2040 assumed additional significant decreasing, which is not in compliance with the Conception of the Agricultural Development of the Slovak Republic. Livestock numbers were estimated by the National Agriculture and Food Centre - Research Institute of Agriculture and food economics centre - (NPPC - VÚEPP) - status and forecasting reports.

The number of livestock is the most important parameter and it is used in estimation PMs, NMVOC, NOx and NH3 from 3.D Agricultural Soils and emission projections from manure management (NH_3, NMVOC, NO_x, PMs). The results were used in the WEM scenario.

National Agriculture and Food Centre - Research Institute of Agriculture and food economics Centre - (NPPC - VÚEPP) - status and forecasting reports

The status and forecasting reports analyzed the new available legislation and national strategies for future animal developing. It shows, that no legislation or strategies were taken into account.

National Agriculture and Food Centre – Research Institute of Animal Production (NPPC - VÚŽV) – animal feeding information

Animal feeding information is important in NH_3 estimation from the manure management used in the WEM scenario.

Central Control and Testing Institute in Agriculture (ÚKSÚP) – statistical database of inorganic nitrogen fertilizers

Consumption of nitrogen fertilizers was implemented in WEM scenario.

Activity data on projected parameter are shown in ***Table 9.2.***

Table 9.2: Projections parameters used in scenario WEM scenario until 2040

SOURCES/ YEARS	2017*	2020	2025	2030	2035	2040
1 000 heads						
Cattle	439.83	420.26	409.24	406.00	405.04	404.76
Sheep	365.34	349.25	344.12	354.48	372.33	394.32
Swine	614.384	524.34	475.22	445.51	427.54	416.66
Goat	37.067	37.25	37.60	37.71	37.75	37.76
Horses	6.145	6.06	5.40	4.75	4.11	3.46
Poultry	13 353.84	12 112.59	11 921.31	11 733.78	11 549.95	11 369.73
tons						
Inorganic N-fertilizers	122 541.15	124 614.67	134 062.06	143 509.45	152 956.83	162 404.22

**Real data*

9.3 POLICIES AND MEASURES

Projections of air pollutant emissions were prepared for the years 2015-2030 within the following scenarios:

With measures scenario (WEM) – projections reflect all measures implemented or adopted before the date of preparation of the projections (31 August 2018).

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

Energy Efficiency Action Plan for the period 2017-2019 with the outlook for 2020: Energy efficiency improvement and reducing the energy consumption of the industrial sector. Improving the thermal performance of buildings - family houses, residential buildings, office buildings, hotels and restaurants, public buildings. The table below shows the effect of energy savings (MWyr) in chosen categories.

***Table 9.3**: Energy savings according Energy Efficiency Action Plan*

AP EE - ENERGY SAVED (MWYR)		2015	2016	2017	2018	2019	2020	2025	2030
1A1a	Public electricity and heat production	95.92	191.83	260.93	330.04	399.14	468.24	468.24	468.24
1A4a	Commercial/institutional: Stationary	34.97	69.94	96.21	122.48	148.75	175.02	175.02	175.02
1A4b	Residential: Stationary	14.93	29.85	41.43	53.01	64.58	76.16	76.16	76.16

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.

Assessment of the future structure of appliances used for household heating: Based on the data from the Statistical survey.

TRANSPORT

Hybrid transport in cities: Buying low floor hybrid buses in selected cities

Modal shift to public transport: The measure consists of the implementation of specific projects to modernisation public transportation. Free travel for students and citizens of retirement age.

Transport Policy of the Slovak Republic into 2015: Energy savings are achieved by reducing fuel consumption by users of the road infrastructure in the new technically superior infrastructure in comparison with the original technically outdated road infrastructure. Ensure speedy completion of the motorway network included in the TEN-T routes

Government Regulation of the Slovak Republic No 246/2006 Coll. on the minimum quantity of fuels produced from renewable sources in the petrol and diesel fuels placed on the market in the Slovak Republic: Continuously increasing of the share of bioethanol and biodiesel blended with gasoline and diesel. It is planned to increase the use of CNG - filling station infrastructure support.

Strategy of Development of Electromobility

INDUSTRY

Use of BAT level technologies in Industry

AGRICULTURE

Mitigation measures were defined as any anthropogenic interventions that can reduce pollutants, namely ammonia, 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 in the Slovak conditions (2):

During feeding of the livestock,

During the housing of animals,

During storage of manure and slurries,

During spreading of manure and slurries into the agricultural soils.

Feeding of the livestock

Nitrogen excretion at the animals is a natural process and possible to prevent it. The level of crude protein in the feed takes into account the animal's age and species - production stage. The reduction of nitrogen losses can be achieved by controlling and monitoring the nitrogen level of the feed rations, which ends as organic waste. The use of feed additives, such as enzymes and amino acids, increase feed efficiency, nutrient retention improving and reducing nitrogen losses. Feeding of animals provides the most cost-effective way to reduce nitrogen excretion and emissions, it can reduce approximately 15% depending on the type of livestock

Housing of animals

During housing of animals can be achieved a reduction of nitrogen emissions. One of the cost-effective methods are keeping in all areas of the housing system dry and clean or use partly slatted floors. The faeces and urine should separate or remove immediately from the housing of animals, which can help reduce ammonia emissions. Manure surfaces in storage pits have to be as small as possible to avoid volatilisation of ammonia. Air velocity and temperature of the air over surfaces fouled with excreta has to low, except where manure is being dried, by cooling incoming air or, in the case of natural ventilation, considering prevailing wind direction. One of the most expensive systems of cleaning the exhaust air is air scrubber used or artificially ventilated buildings

Storage of manure and slurries

After removal from animal houses, solid manure may be stacked on a concrete area, sometimes with walls, usually with drainage and a pit for collecting leachate. In the Slovak Republic, it is permitted to store manure in stacks on the soil in fields — at least over a limited period.

However, this can lead to significant losses through NH_3 emissions, denitrification and leaching. Litter and manure from poultry, especially air-dried dung from laying hens, is increasingly stored in bunkers.

The slurries are stored either in concrete, steel or wooden tanks (or silos), in lagoons or bags. Tanks have a larger area per unit volume and thus a greater potential for NH_3 emissions. The effective but expensive way to avoid nitrogen emissions during disposal manure and slurries is the recovery in biogas plants, where organic waste is used as feedstock for heat or electricity generation.

Table 9.4: *Low-emission manure storage techniques*

MITIGATION MEASURES DURING STORAGE	REDUCTION POTENTIAL
Rigid lid or roof	80%
Flexible cover	80%
Floating plastic bodies	60%
Natural crust	40%
Storage in bags	100%
Closed tanks	30-60%
Storage bag	100%

Spreading of manure and slurries into the agricultural soils

NH_3 emissions from the application of manures (slurries and solid manures such as farmyard manure and broiler litter) account for a large proportion of NH_3 emissions from agriculture. It is important to minimize losses at this stage of management because any NH_3 saved earlier, from livestock housing or manure storage, might be lost if an appropriate field application technique does not control it. Reducing NH_3 loss means that more nitrogen is potentially available for crop uptake. To gain the maximum agronomic benefit from manures, and to avoid increasing risk of nitrate leaching, attention should be paid to the N contented of the manure so that the rate, method and time of application match to crop requirements, taking account of the amount of N saved when using low-emission practices. (3)

The techniques summarized below reduce emissions of NH_3 by reducing exposure of the manure to the atmosphere. Hence the methods are effective for all climates. Although total NH_3 emissions will be influenced by climate, tending to increase with increasing temperature, the proportion of the NH_3 emission abated by reduced-emission techniques has not been found to depend on climate. Emission reductions are shown in ***Table 9.5.***

Table 9.5: *Low-emission manure spreading techniques*

MITIGATION MEASURES DURING SPREADING	REDUCTION POTENTIAL
Trailing hoses	30%
Incorporation into the soil within 4 hours	45-65%
Incorporation into the soil within 12 hours	50%
Incorporation into the soil within 24 hours	30%
Deep injection (including arable injectors)	90%
Shallow injection	50%

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.

<u>Measures in WAM scenario was proposed in close cooperation with the World Bank team, which helps with next steps to increase air quality in Slovakia. Measures are focused on transport, residential and agricultural sectors. List of proposed measures:</u>

Replacement of old diesel vehicles – Subsiding of new vehicles sales, decreasing numbers of old vehicles.

Introducing subsidies for alternatively-fuelled vehicles - replacement of an average 2016 diesel vehicle (a weighted average of diesels in the fleet in 2016) with either a battery-electric, or with a plug-in hybrid electric vehicle.

Setting stricter requirements for periodical technical controls – Stricter check on NOx emissions during the vehicle inspection.

Frequency of technical controls of vehicles older than 8 years to be raised from current once every two years to once a year.

Roadside emission controls – raising the frequency of controls.

Unification of tax rate for petrol and diesel over a period of 5 years.

Incentives for replacement of unsuitable boilers: subsidy scheme - The program is based on replacing high emissions boilers by new ones that are more energy-efficient.

Introduction of differentiated registration fees for different categories of devices – promotion of more environmentally friendly devices.

Connect households using wood or coal to natural gas - The policy under consideration is one where households currently using old stoves will be required by law to connect to a gas network but with a subsidy provided for doing so.

Fuel standards - mandating the use of wood that has a moisture content of less than 25%.

Introduction a "control system" (based on the Czech model) – each household that uses solid fuel would have an obligation to have their device regularly inspected.

Awareness-raising campaigns and education.

Manure storage and application to soil - Currently, the legislative requirements related to the reduction of ammonia emissions from agricultural activities only apply to large farms. The aim of the measure is to extend the obligation to comply with the requirements related to ammonia emission reduction to all medium-sized farms.

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 comparison to the absolute values of emission targets.

***Table 9.6**: WEM scenario emission projection trends and targets*

TOTAL EMISSIONS OF SLOVAKIA (kt)	2005	2015	2020	2025	2030	*TARGET 2020*	*TARGET 2030*
NO_X	103.30	72.32	62.00	60.78	60.68	*66.11*	*51.65*
NMVOC	151.17	93.04	87.27	81.83	76.34	*123.96*	*102.79*
SO_X	86.00	66.75	22.27	20.20	19.87	*36.98*	*15.48*
NH_3	37.94	32.04	25.30	25.18	25.41	*32.25*	*26.56*
$PM_{2.5}$	34.35	17.15	17.23	16.07	15.05	*21.98*	*17.52*

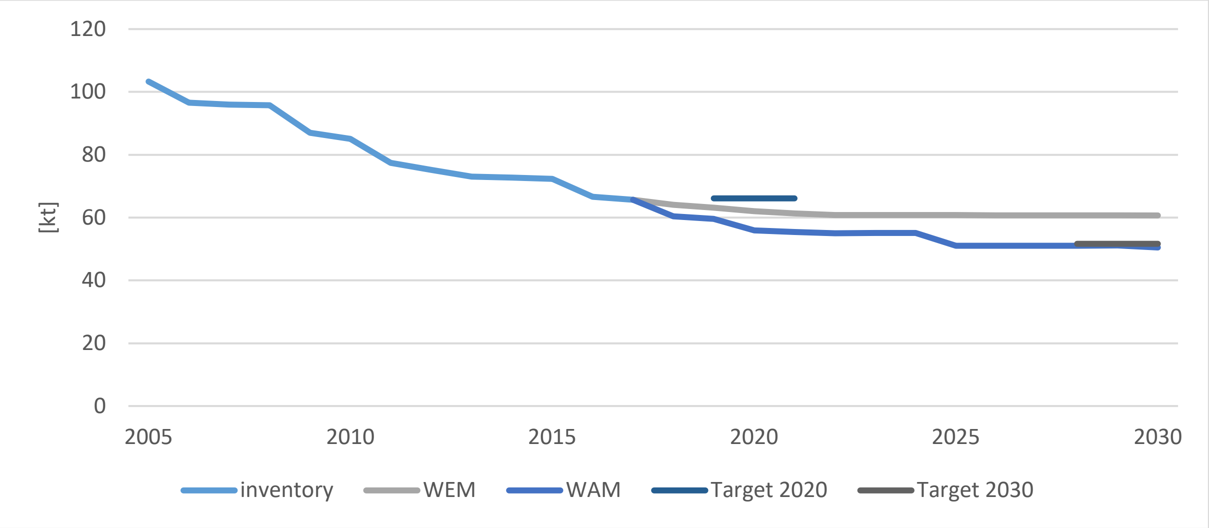
***Table 9.7**: WAM scenario emission projection trends and targets*

TOTAL EMISSIONS OF SLOVAKIA (kt)	2005	2015	2020	2025	2030	*TARGET 2020*	*TARGET 2030*
NO_X	103.30	72.32	55.89	51.07	50.46	*66.11*	*51.65*
NMVOC	151.17	93.04	86.32	80.15	74.44	*123.96*	*102.79*
SO_X	86.00	66.75	22.02	17.07	16.75	*36.98*	*15.48*
NH_3	37.94	32.04	24.56	24.47	24.70	*32.25*	*26.56*
$PM_{2.5}$	34.35	17.15	16.57	14.63	12.93	*21.98*	*17.52*

NO_X emissions

Figure 9.2 shows a general view on trends of emissions NO_X and estimated emissions projections based on encountered measures. Emissions slightly decrease and achieving the 2030 target will be very tight even in WAM scenario.

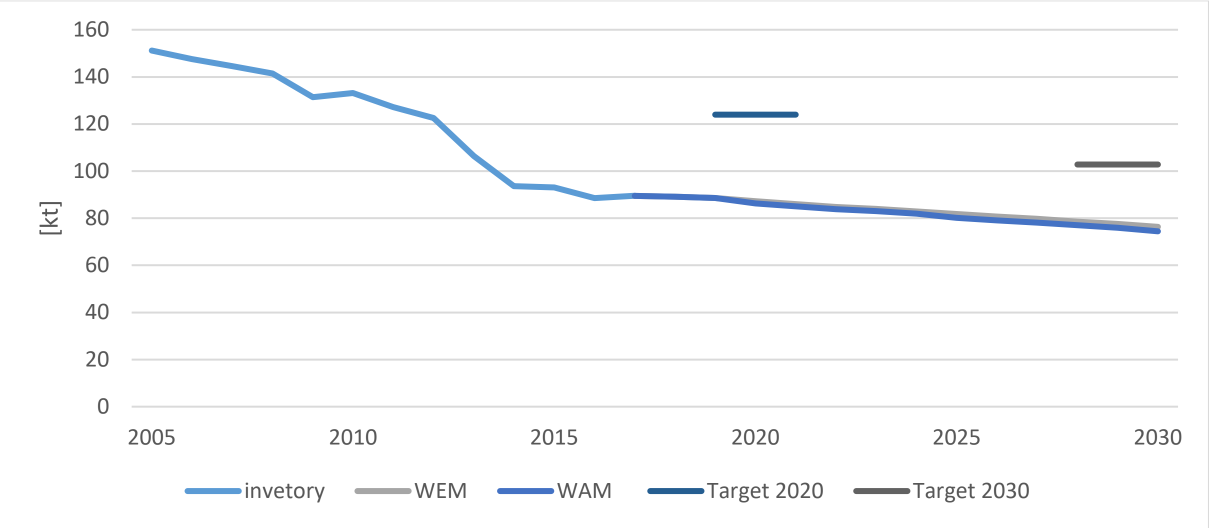
__Figure 9.2__: Emission projections trends for pollutant NO_X



NMVOC emissions

Figure 9.3 shows a general view on trends of NMVOC emissions and estimated emissions projections based on encountered measures. Emissions show overall decreasing trend and the 2030 target should be achieved in both scenario.

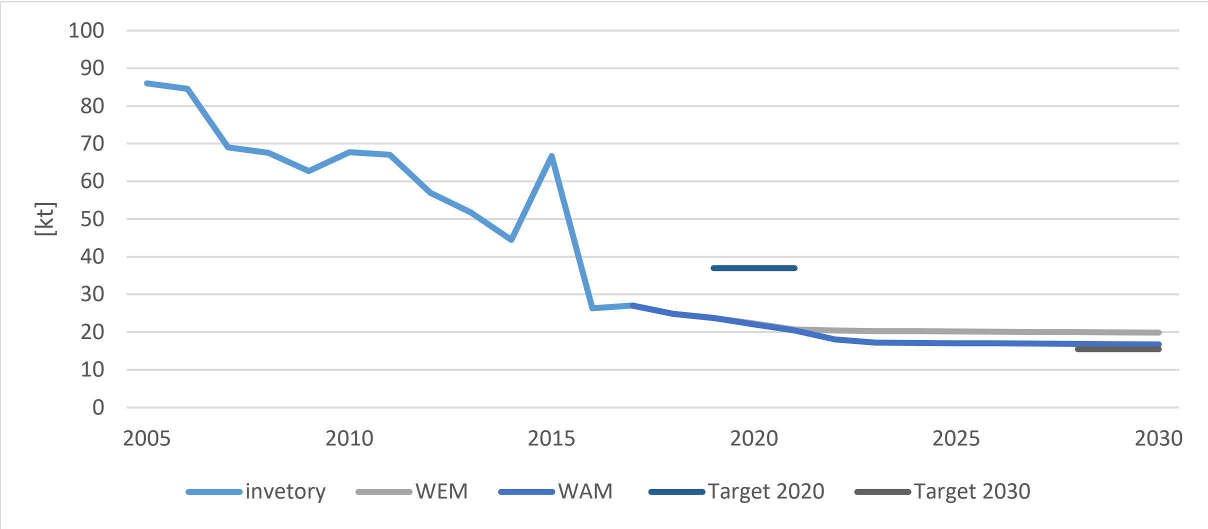
__Figure 9.3__: Emission projections trends for pollutant NMVOC



SO_X emissions

Figure 9.4 shows the general view on trends of SO_X emissions. According estimated data will Slovakia need to implement more effective measures for reaching the 2030 target.

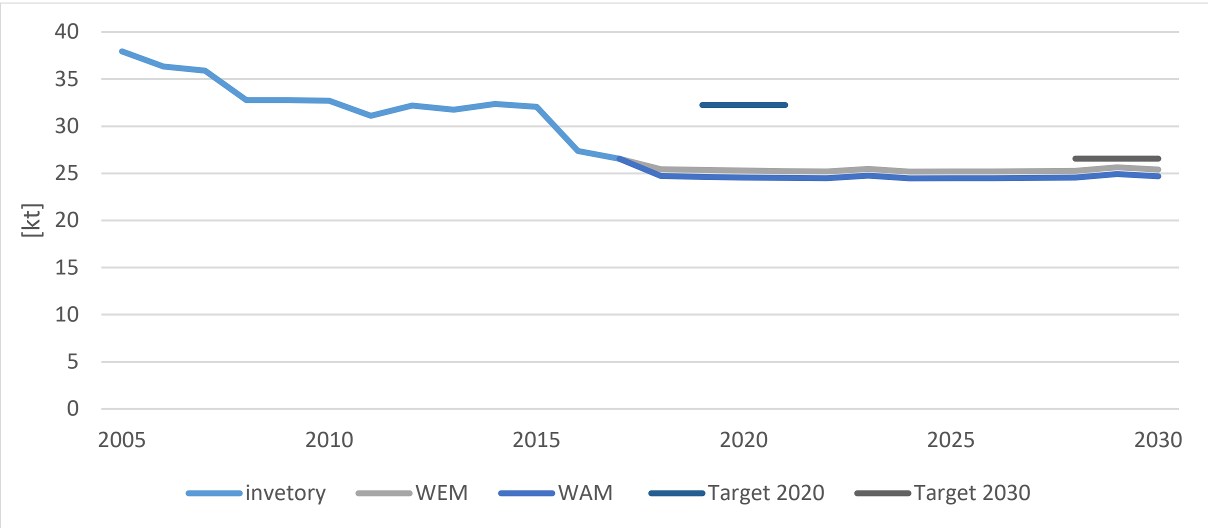
Figure 9.4: *Emission projections trends for pollutant SO_X*



NH_3 emissions

Figure 9.5 shows a relative stable trend in ammonia emissions. Achieving the 2030 target will be hard even in WAM scenario.

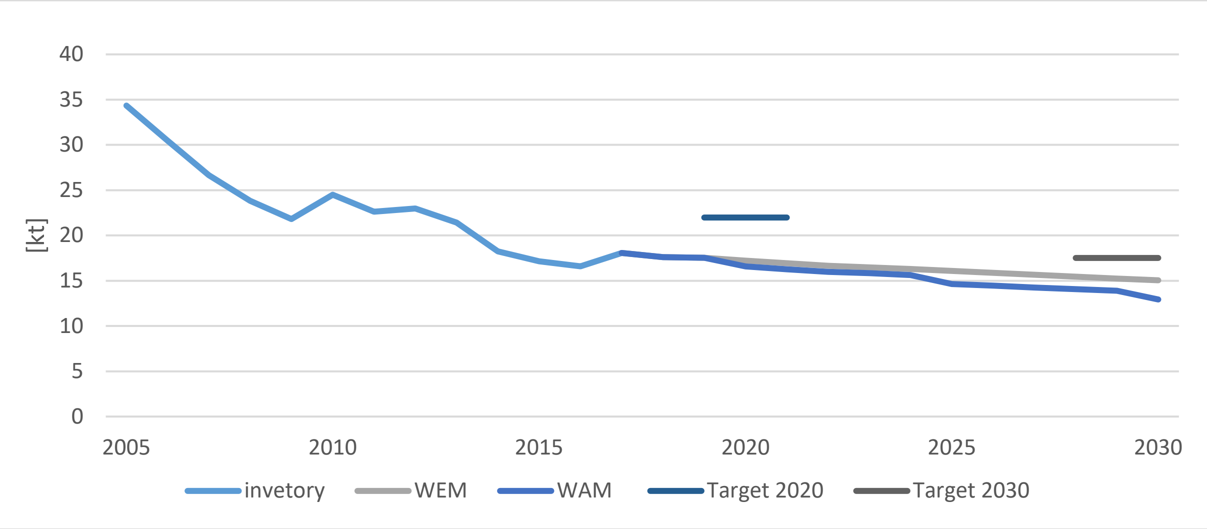
Figure 9.5: *Emission projections trends for pollutant NH_3*



$PM_{2.5}$ emissions

Figure 9.6 shows the estimated trend of $PM_{2.5}$ emissions. This is a key pollutant and the future target achievement mainly depends on development in the household a transport sector. For now, trends of emissions seems to be in the margin of target 2030.

Figure 9.6*: Emission projections trends for pollutant $PM_{2.5}$*



9.5 SECTORAL RESULTS – ENERGY

The modelling of emission projections in Energy sector was based on results from model MESSAGE and actualization was made by taking account results of sectoral trends and development from new CPS model. The outputs from modelling were determined also by reduction potential of measures to reduce emissions.

Next figures and tables shows trends of emissions for individual pollutants.

NO_X emissions

Figure 9.7*: Emission projections trends for pollutant NO_X in sector Energy*

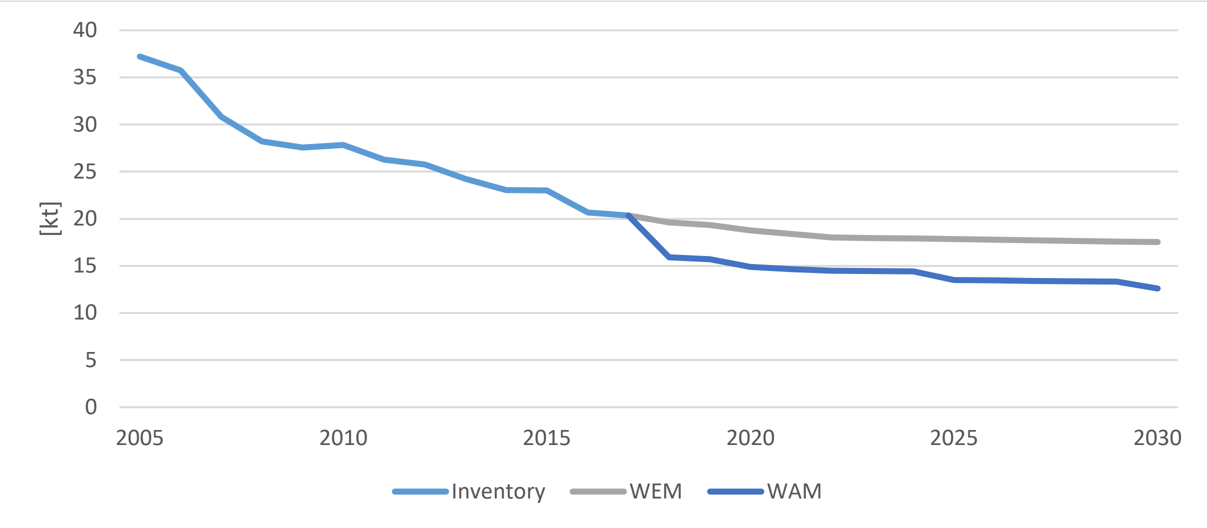


Table 9.8: *NO_X emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030
1A1	19.00	13.03	8.48	5.41	4.99	4.90
1A2	9.20	6.13	5.09	4.12	3.99	4.12
1A4	8.82	8.54	8.97	8.49	8.08	7.69
1A5	0.20	0.13	0.48	0.75	0.79	0.82
1B	0.00	0.00	0.00	0.00	0.00	0.00
1 Energy	**37.21**	**27.84**	**23.02**	**18.77**	**17.84**	**17.53**

WAM	2005	2010	2015	2020	2025	2030
1A1	19.00	13.03	8.48	2.04	2.00	1.99
1A2	9.20	6.13	5.09	4.12	3.99	4.12
1A4	8.82	8.54	8.97	7.98	6.71	5.66
1A5	0.20	0.13	0.48	0.75	0.79	0.82
1B	0.00	0.00	0.00	0.00	0.00	0.00
1 Energy	**37.21**	**27.84**	**23.02**	**14.90**	**13.49**	**12.60**

NMVOC emissions

Figure 9.8: *Emission projections trends for pollutant NMVOC in sector Energy*

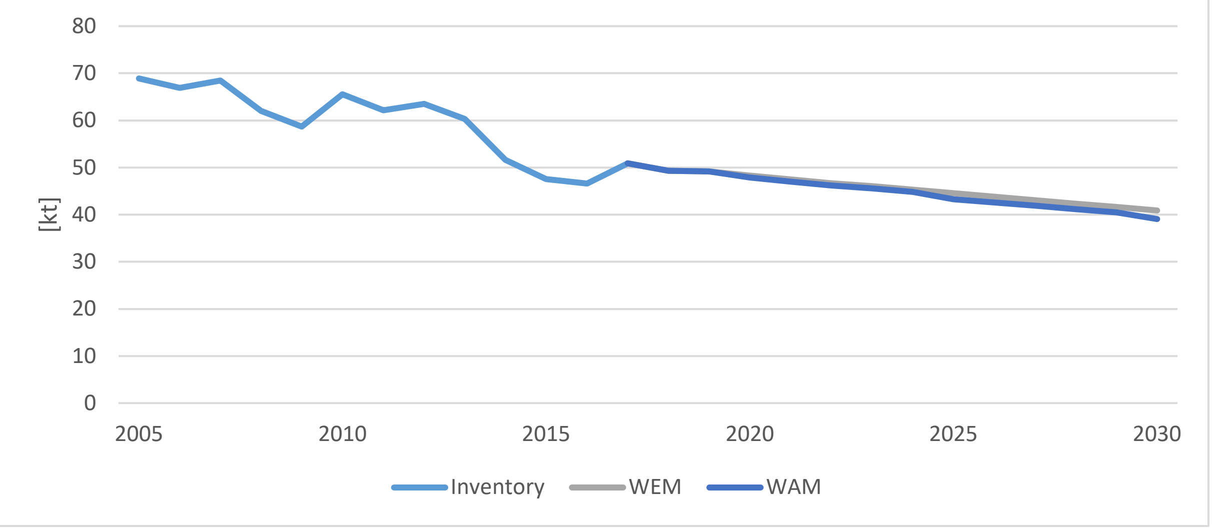


Table 9.9: *NMVOC emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030
1A1	2.34	1.51	1.45	1.06	1.03	1.02
1A2	0.14	0.20	0.29	0.35	0.36	0.38
1A4	58.39	56.12	39.16	40.71	37.06	33.48
1A5	0.03	0.03	0.33	0.48	0.50	0.53
1B	8.01	7.69	6.33	5.72	5.58	5.47
1 Energy	**68.906**	**65.551**	**47.560**	**48.324**	**44.537**	**40.885**

WAM	2005	2010	2015	2020	2025	2030
1A1	2.34	1.51	1.45	1.06	0.99	0.98
1A2	0.14	0.20	0.29	0.35	0.36	0.38
1A4	58.39	56.12	39.16	40.27	35.86	31.71
1A5	0.03	0.03	0.33	0.48	0.50	0.53
1B	8.01	7.69	6.33	5.72	5.58	5.47
1 Energy	**68.906**	**65.551**	**47.560**	**47.882**	**43.298**	**39.070**

SO_X emissions

***Figure 9.9**: Emission projections trends for pollutant SO_X in sector Energy*

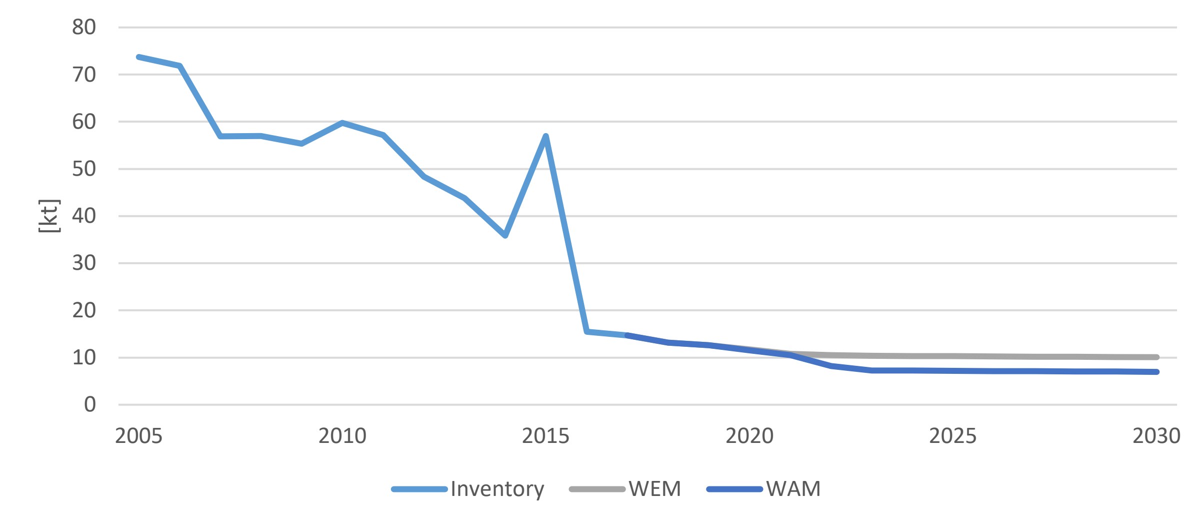


***Table 9.10**: NO_X emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030
1A1	60.576	52.746	52.037	7.533	6.317	6.257
1A2	9.410	4.582	2.833	1.974	1.900	1.937
1A4	3.427	2.361	1.901	1.877	1.694	1.509
1A5	0.318	0.101	0.212	0.374	0.379	0.384
1B	0.000	0.000	0.000	0.000	0.000	0.000
1 Energy	**73.731**	**59.789**	**56.982**	**11.758**	**10.290**	**10.086**
WAM	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
1A1	60.576	52.746	52.037	7.533	3.441	3.381
1A2	9.410	4.582	2.833	1.974	1.900	1.937
1A4	3.427	2.361	1.901	1.626	1.443	1.259
1A5	0.318	0.101	0.212	0.374	0.379	0.384
1B	0.000	0.000	0.000	0.000	0.000	0.000
1 Energy	**73.731**	**59.789**	**56.982**	**11.508**	**7.163**	**6.960**

NH_3 emissions

***Table 9.11**: NH_3 emissions in sector Energy*

WEM	2005	2010	2015	2020	2025	2030
1A1	0.077	0.032	0.047	0.063	0.060	0.059
1A2	0.015	0.018	0.011	0.025	0.027	0.028
1A4	2.046	2.074	1.309	1.393	1.331	1.272
1A5	0.004	0.002	0.002	0.001	0.001	0.001
1B	0.006	0.006	0.006	0.005	0.005	0.005
1 Energy	**2.149**	**2.132**	**1.375**	**1.488**	**1.424**	**1.365**

$PM_{2.5}$ emissions

Households (1A4) are dominant contributor to $PM_{2.5}$ emissions.

Figure 9.10: *Emission projections trends for pollutant $PM_{2.5}$ in sector Energy*

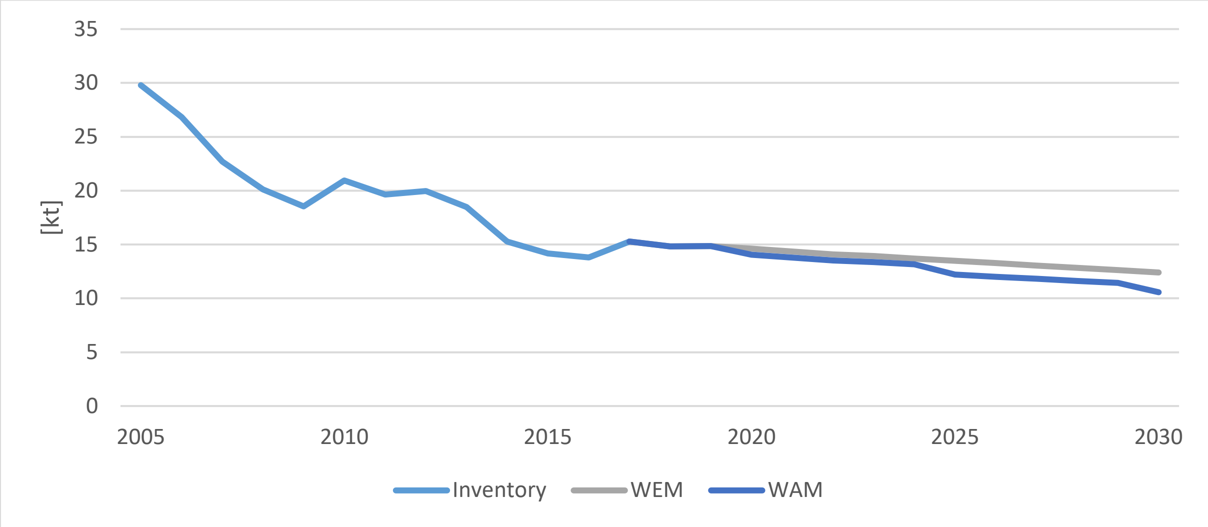


Table 9.12: *$PM_{2,5}$ emissions in sector Energy*

WEM	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
1A1	8.00	0.89	0.67	0.35	0.32	0.32
1A2	0.69	0.38	0.21	0.22	0.23	0.25
1A4	20.96	19.55	13.18	13.85	12.74	11.65
1A5	0.02	0.01	0.02	0.10	0.10	0.10
1B	0.12	0.11	0.10	0.10	0.10	0.10
1 Energy	**29.79**	**20.94**	**14.18**	**14.61**	**13.48**	**12.40**
WAM	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
1A1	8.00	0.89	0.67	0.35	0.29	0.28
1A2	0.69	0.38	0.21	0.22	0.23	0.25
1A4	20.96	19.55	13.18	13.30	11.49	9.84
1A5	0.02	0.01	0.02	0.10	0.10	0.10
1B	0.12	0.11	0.10	0.10	0.10	0.10
1 Energy	**29.79**	**20.94**	**14.18**	**14.06**	**12.21**	**10.57**

9.6 SECTORAL RESULTS – TRANSPORT

NOx emissions

***Figure 9.11**: Emission projections trends for pollutant NO_X in sector Transport*

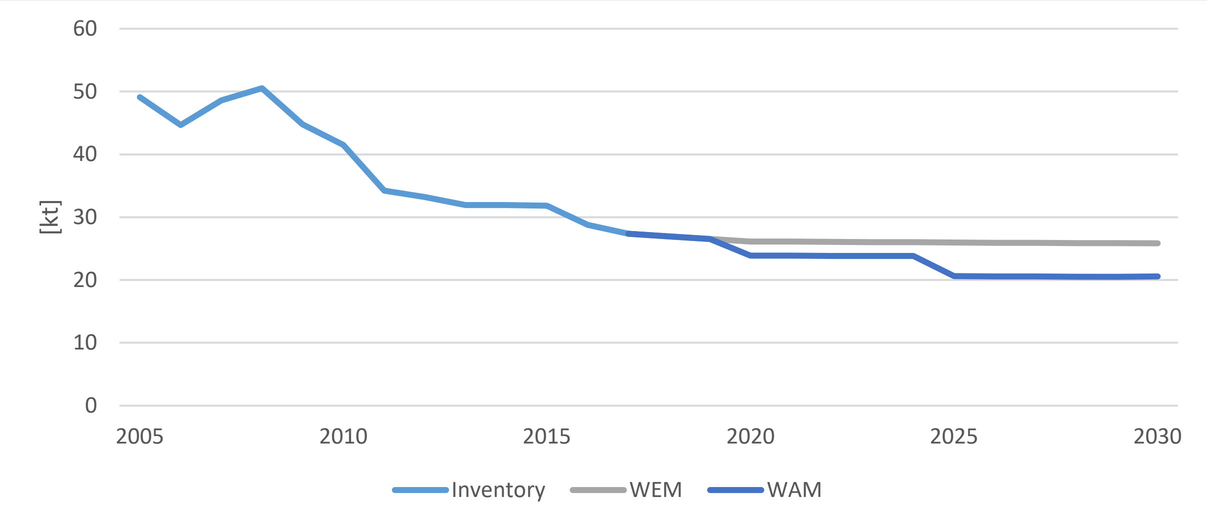


***Table 9.13**: NO_X emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030
1A3b road	43.273	36.815	29.282	23.769	23.474	23.207
1A3acde non-road	5.821	4.711	2.545	2.362	2.497	2.636
1A3	**49.094**	**41.527**	**31.827**	**26.132**	**25.972**	**25.844**

WAM	2005	2010	2015	2020	2025	2030
1A3b road	43.273	36.815	29.282	21.538	18.122	17.943
1A3acde non-road	5.821	4.711	2.545	2.362	2.497	2.636
1A3	**49.094**	**41.527**	**31.827**	**23.901**	**20.620**	**20.579**

NMVOC emissions

***Figure 9.12**: Emission projections trends for pollutant NMVOC in sector Transport*

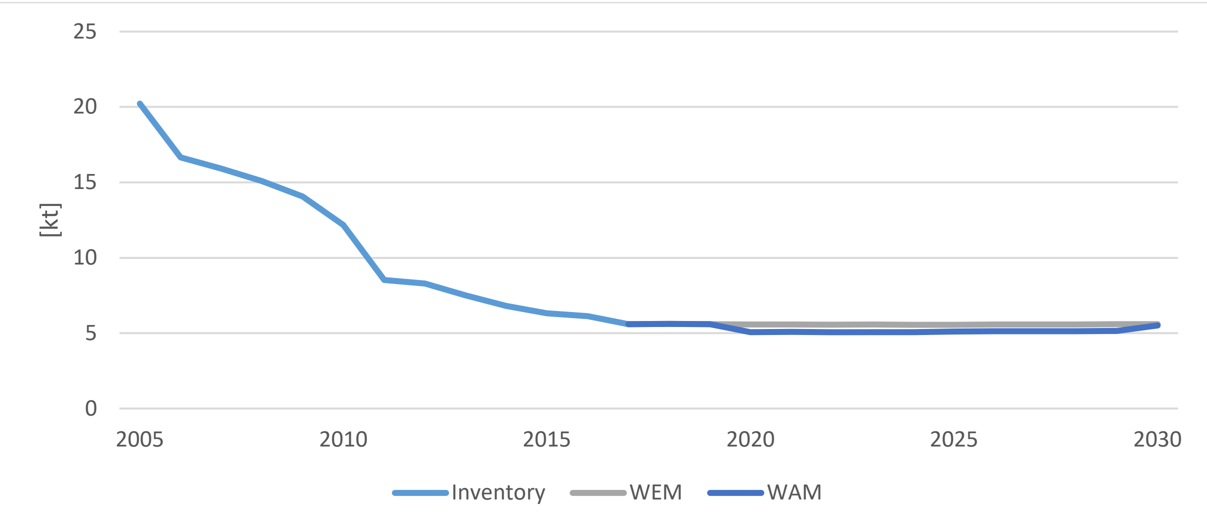


***Table 9.14**: NMVOC emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030
1A3b road	19.830	11.817	5.920	5.186	5.162	5.182
1A3acde non-road	0.395	0.357	0.394	0.388	0.399	0.412
1A3	**20.225**	**12.174**	**6.314**	**5.573**	**5.561**	**5.594**

WAM	2005	2010	2015	2020	2025	2030
1A3b road	19.830	11.817	5.920	4.680	4.717	5.097
1A3acde non-road	0.395	0.357	0.394	0.388	0.399	0.412
1A3	**20.225**	**12.174**	**6.314**	**5.068**	**5.116**	**5.509**

SO_X emissions

***Table 9.15**: SO_X emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030
1A3b road	0.193	0.029	0.031	0.037	0.039	0.042
1A3acde non road	0.012	0.221	0.186	0.126	0.126	0.126
1A3	**0.205**	**0.250**	**0.217**	**0.163**	**0.165**	**0.168**

NH_3 emissions

***Table 9.16**: NH_3 emissions in sector Transport*

WEM	2005	2010	2015	2020	2025	2030
1A3b road	0.526	0.468	0.366	0.369	0.369	0.369
1A3acde non road	0.000	0.000	0.000	0.000	0.000	0.000
1A3	**0.526**	**0.469**	**0.366**	**0.369**	**0.369**	**0.369**

$PM_{2.5}$ emissions

***Figure 9.13**: Emission projections trends for pollutant $PM_{2.5}$ in sector Transport*

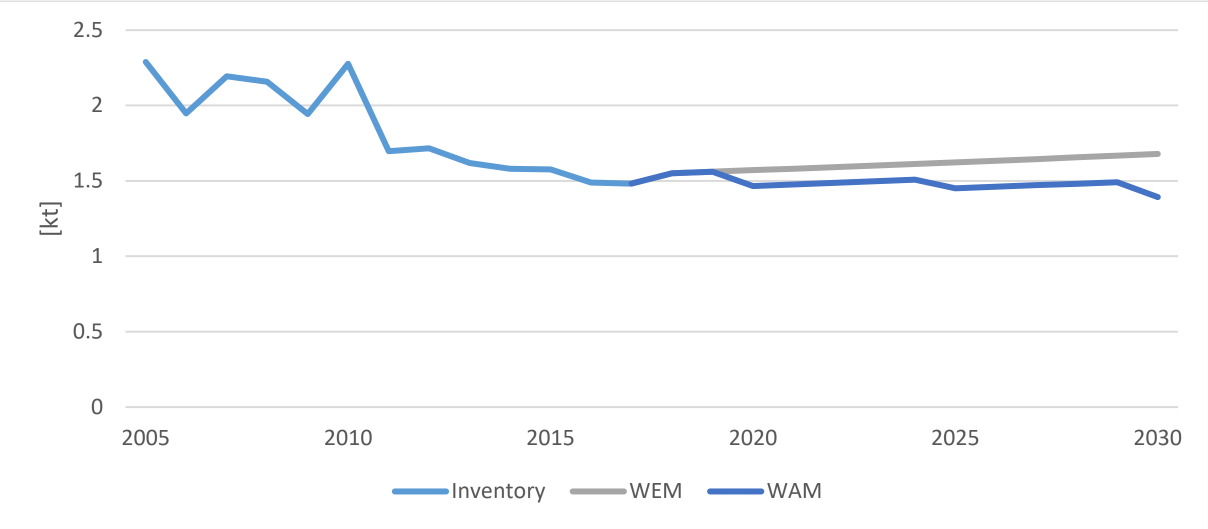


__Table 9.17__: $PM_{2.5}$ emissions in sector Transport

WEM	2005	2010	2015	2020	2025	2030
1A3b road	2.241	2.179	1.485	1.491	1.538	1.590
1A3acde non road	0.048	0.098	0.091	0.080	0.084	0.089
1A3	**2.289**	**2.277**	**1.576**	**1.571**	**1.623**	**1.679**

WAM	2005	2010	2015	2020	2025	2030
1A3b road	2.241	2.179	1.485	1.386	1.368	1.304
1A3acde non road	0.048	0.098	0.091	0.080	0.084	0.089
1A3	**2.289**	**2.277**	**1.576**	**1.466**	**1.452**	**1.393**

9.7 SECTORAL RESULTS – INDUSTRY

NO_X emissions

__Figure 9.14__: Emission projections trends for pollutant NO_X in sector Industry

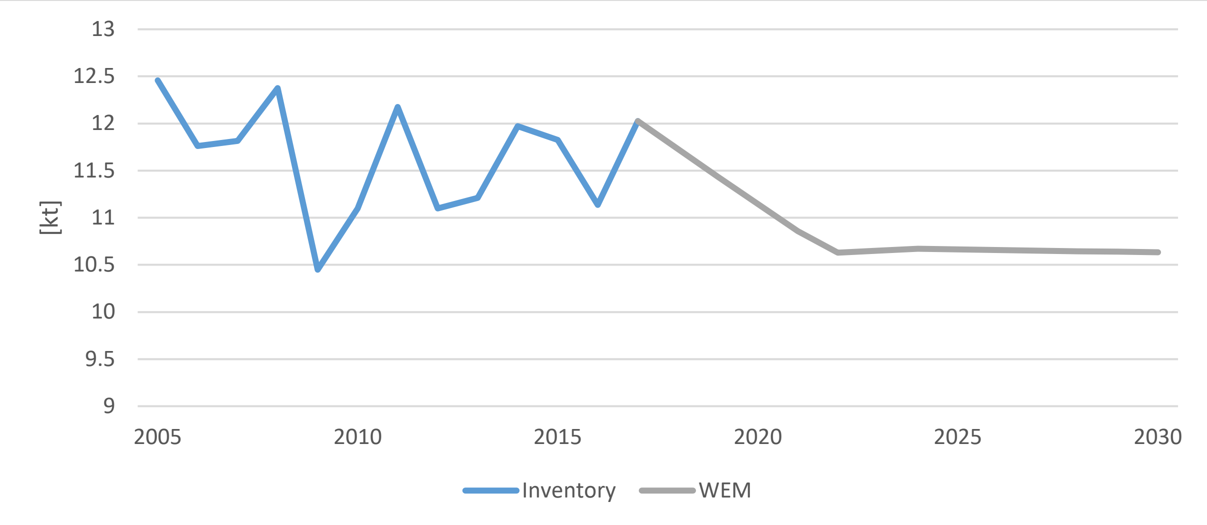


__Table 9.18__: NO_X emissions in sector Industry

WEM	2005	2010	2015	2020	2025	2030
2A	5.44	4.86	4.83	4.60	4.63	4.66
2B	1.10	0.64	1.02	1.01	0.97	0.99
2C	4.92	4.88	5.01	4.51	4.01	3.96
2D, H	0.04	0.02	0.02	0.02	0.02	0.02
2 I,J,K,L	0.96	0.69	0.95	1.01	1.03	1.01
2 Industry	**12.46**	**11.10**	**11.83**	**11.15**	**10.66**	**10.63**

NMVOC emissions

***Figure 9.15**: Emission projections trends for pollutant NMVOC in sector Industry*

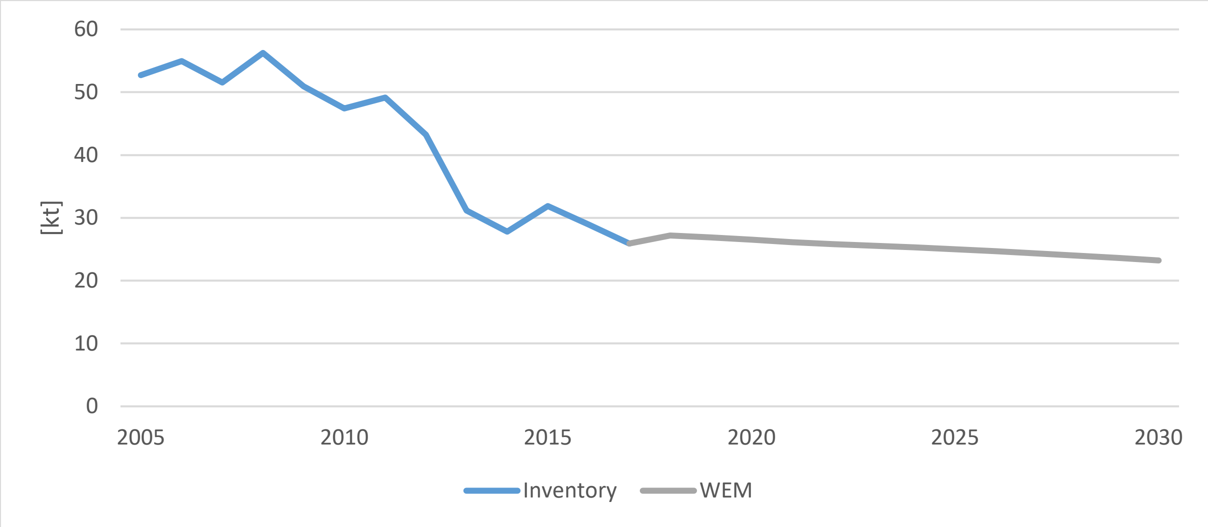


***Table 9.19**: NO_X emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030
2A	0.224	0.243	0.259	0.300	0.302	0.304
2B	3.182	1.994	2.200	1.876	1.823	1.848
2C	0.777	0.661	0.794	0.741	0.660	0.650
2D, H	47.627	43.861	27.752	22.664	21.201	19.340
2 I,J,K,L	0.913	0.683	0.850	0.929	1.006	1.080
2 Industry	**52.723**	**47.442**	**31.856**	**26.511**	**24.992**	**23.223**

SO_X emissions

***Figure 9.16**: Emission projections trends for pollutant SO_X in sector Industry*

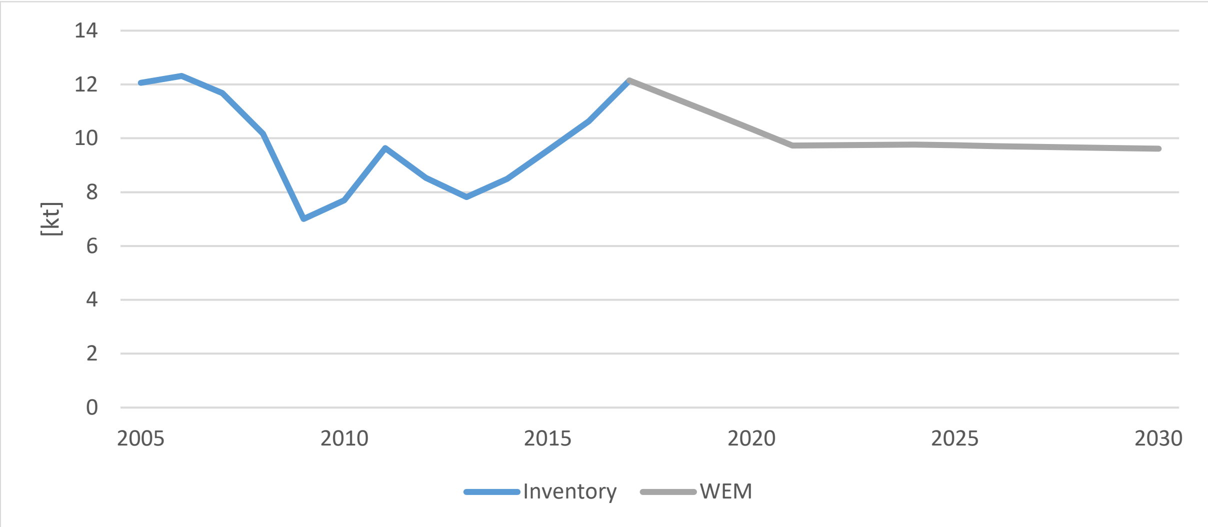


***Table 9.20**: SO_X emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030
2A	0.98	0.64	0.70	0.71	0.72	0.72
2B	1.08	1.20	1.37	1.43	1.43	1.42
2C	9.87	5.79	7.32	8.01	7.39	7.27
2D, H	0.02	0.03	0.03	0.04	0.05	0.05
2 I,J,K,L	0.11	0.05	0.13	0.16	0.16	0.15
2 Industry	**12.06**	**7.71**	**9.55**	**10.35**	**9.74**	**9.62**

NH_3 emissions

***Table 9.21**: NH_3 emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030
2A	0.005	0.014	0.049	0.067	0.068	0.068
2B	0.217	0.066	0.090	0.147	0.155	0.159
2C	0.006	0.004	0.004	0.003	0.003	0.003
2D, H	0.103	0.037	0.035	0.036	0.036	0.037
2 I,J,K,L	0.006	0.000	0.008	0.010	0.011	0.012
2 Industry	**0.337**	**0.121**	**0.186**	**0.263**	**0.273**	**0.278**

$PM_{2.5}$ emissions

***Figure 9.17**: Emission projections trends for pollutant $PM_{2.5}$ in sector Industry*

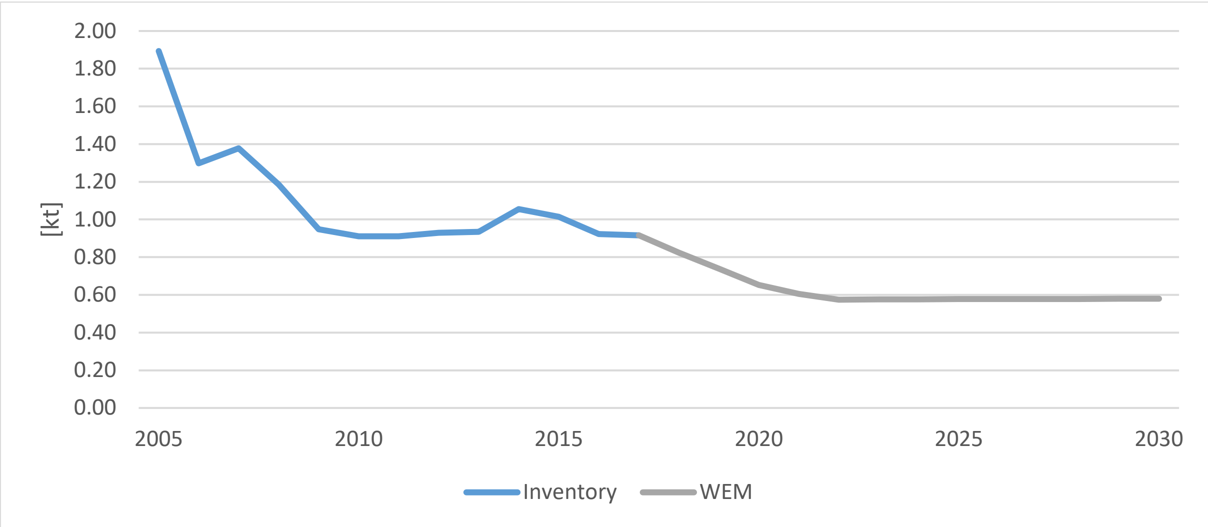


***Table 9.22**: $PM_{2.5}$ emissions in sector Industry*

WEM	2005	2010	2015	2020	2025	2030
2A	0.30	0.16	0.17	0.11	0.11	0.11
2B	0.21	0.08	0.15	0.08	0.04	0.04
2C	0.63	0.40	0.45	0.21	0.17	0.17
2D, H	0.67	0.24	0.23	0.23	0.24	0.24
2 I,J,K,L	0.08	0.02	0.01	0.01	0.01	0.01
2 Industry	**1.89**	**0.91**	**1.01**	**0.65**	**0.58**	**0.58**

9.8 SECTORAL RESULTS – AGRICULTURE

Sector agriculture is a dominant contributor of NH3 emissions and also significant contributor of NO_X and NMVOC emissions.

NO_X emissions

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 9.18**: Emission projections trends for pollutant NO_X in sector Agriculture*

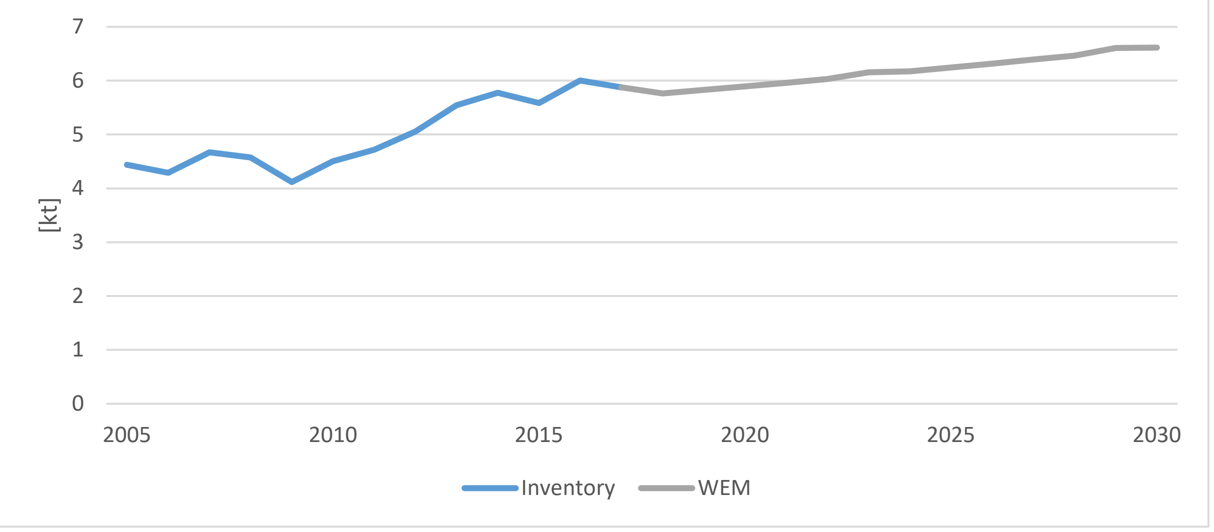


***Table 9.23**: NO_X emissions in sector Agriculture*

WEM	2005	2010	2015	2020	2025	2030
3B	0.013	0.011	0.010	0.009	0.009	0.009
3D	4.423	4.494	5.575	5.884	6.236	6.606
3 Agriculture	**4.436**	**4.505**	**5.586**	**5.893**	**6.245**	**6.615**

NMVOC emissions

NMVOC emission projections were prepared using 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 Ordinance of the Government of the Slovak Republic No 410/2012 Coll.

***Figure 9.19**: Emission projections trends for pollutant NMVOC in sector Agriculture*

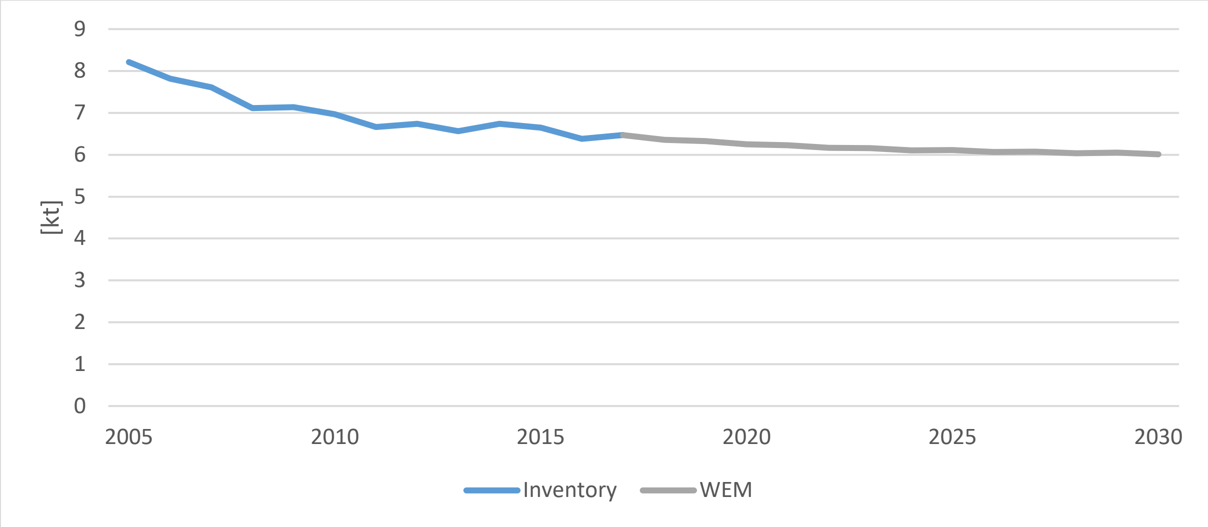


***Table 9.24**: NMVOC emissions in sector Agriculture*

WEM	2005	2010	2015	2020	2025	2030
3B	5.948	4.987	4.751	4.270	4.185	4.085
3D	2.264	1.981	1.895	1.977	1.928	1.926
3 Agriculture	**8.212**	**6.968**	**6.646**	**6.247**	**6.112**	**6.011**

NH_3 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.

***Figure 9.20**: Emission projections trends for pollutant NH_3 in sector Agriculture*

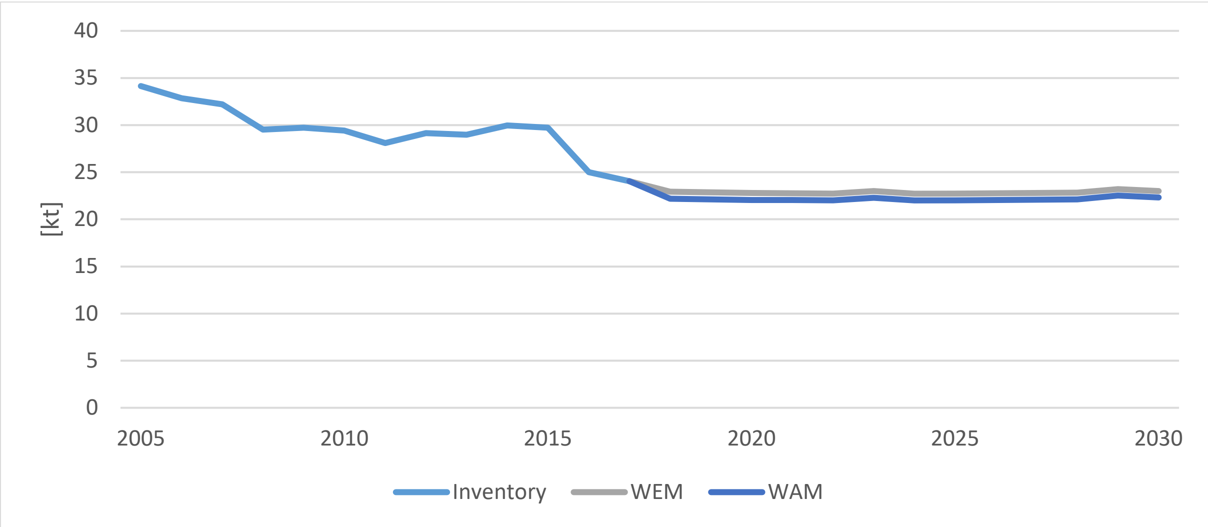


***Table 9.25**: NH_3 emissions in sector Agriculture*

WEM	2005	2010	2015	2020	2025	2030
3B	12.45	10.29	9.83	6.75	6.52	6.39
3D	21.69	19.14	19.88	16.05	16.22	16.62
3 Agriculture	**34.14**	**29.43**	**29.71**	**22.80**	**22.73**	**23.01**

WAM	2005	2010	2015	2020	2025	2030
3B	12.45	10.29	9.83	6.75	6.52	6.39
3D	21.69	19.14	19.88	15.31	15.50	15.91
3 Agriculture	**34.14**	**29.43**	**29.71**	**22.06**	**22.02**	**22.31**

$PM_{2.5}$ emissions

3.D 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 PMs emission category. After 2019, the trend has stagnated character.

***Table 9.26**: $PM_{2.5}$ emissions in sector Agriculture*

3	2005	2010	2015	2020	2025	2030
3B	0.151	0.130	0.123	0.111	0.108	0.107
3D	0.069	0.070	0.070	0.095	0.093	0.093
3 Agriculture	**0.220**	**0.201**	**0.193**	**0.206**	**0.201**	**0.200**

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.

NO_X emissions

***Table 9.27**: NO_X emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030
5 Waste	0.100	0.096	0.056	0.052	0.053	0.053

NMVOC emissions

***Table 9.28**: NMVOC emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030
5 Waste	1.102	1.067	0.668	0.614	0.630	0.627

SO_X emissions

***Table 9.29**: SO_X emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030
5 Waste	0.008	0.006	0.004	0.004	0.004	0.004

NH_3 emissions

***Table 9.30**: NH_3 emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030
5 Waste	0.786	0.535	0.408	0.381	0.383	0.384

PM$_{2.5}$ emissions

***Table 9.31**: PM$_{2.5}$ emissions in sector Waste (kt)*

WEM	2005	2010	2015	2020	2025	2030
5 Waste	0.152	0.179	0.188	0.192	0.192	0.191

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ANNEXES

Last update: 13.3.2020

ANNEX I: KEY CATEGORY ANALYSIS

Table A1.1: *Level assessment of the key categories analysis of air pollutants in the Slovak Republic in 2018 (cumulative total at least 80%)*

NOx	1A3biii (17%)	1A3bi (16%)	3Da1 (8%)	1A2f (6%)	1A1a (5%)	2C1 (5%)	1A3bii (5%)	1A4bi (4%)	1A4ai (4%)	1A2a (4%)	1A4cii (3%)	1A1b (2%)	1A3c (2%)
SOx	1A1a (22%)	2C1 (22%)	2C7c (14%)	1A1b (10%)	2B10a (7%)	1A2a (7%)							
NH_3	3Da2a (44%)	3Da1 (15%)	3B4gi (8%)	3B1b (6%)	3B1a (5%)	3B4gii (5%)							
NMVOC	1A4bi (37%)	2D3d (13%)	2D3a (8%)	1B2b (8%)	1B1a (5%)	2D3e (3%)	1A3bi (3%)	3B1a (2%)	1A3bv (2%)	1A4ai (2%)			
PM_{10}	1A4bi (58%)	3Dc (10%)	2A5b (4%)	1A3bvi (3%)	1A3bi (2%)	1A3bvii (2%)	1A4ai (2%)						
$PM_{2.5}$	1A4bi (74%)	1A3bi (3%)	1A3bvi (2%)	1A4ai (2%)									
BC	1A3bi (53%)	1A3bi (16%)	1A3bii (7%)	1A3biii (7%)									
CO	1A4bi (42%)	2C1 (30%)	1A3bi (8%)										
Pb	2C1 (74%)	2C7a (5%)	1A2a (4%)										
Cd	2C7a (51%)	1A2d (13%)	1A4bi (10%)	2C1 (6%)									
Hg	2C1 (41%)	1A1c (15%)	1A4bi (10%)	1A1a (8%)	1A2a (7%)								
As	2C1 (66%)	1A1a (15%)											
Cr	2C1 (86%)												
Cu	1A3bvi (61%)	2C7a (21%)											
Ni	2C7a (35%)	2C1 (23%)	1A1a (12%)	1A3di(ii) (6%)	1B1b (6%)								
Se	1A1a (73%)	2A3 (14%)											
Zn	2C1 (35%)	1A2d (16%)	2D3i (15%)	1A4ai (7%)	1A4bi (6%)	1A2gviii (6%)							
DIOX	2C1 (32%)	5C1biii (17%)	1A4bi (10%)	1B1b (10%)	1A2gviii (7%)	1A2a (4%)	5E (4%)						
PAHs	1A4bi (42%)	2C3 (23%)	2C1 (12%)	1A2a (7%)									
HCB	1A4bi (58%)	1A1a (23%)											
PCB	2C1 (73%)	1A2a (9%)											

Table A1.2: *Trend assessment of the key categories analysis of air pollutants in the Slovak Republic in 2018 (cumulative total at least 80%)*

NOx	1A1a (24%)	1A3biii (22%)	1A3ei (7%)	1A3c (6%)	3Da1 (5%)	2C2 (4%)	1A2a (3%)	1A2d (3%)	1A4bi (3%)	1A1b (3%)
SOx	1A1a (46%)	1A4bi (21%)	1A2d (10%)	1A1b (7%)						
NH_3	3D2a (46%)	3B3 (14%)	3B1b (13%)	3Da1 (9%)						
NMVOC	1A4bi (58%)	1A3bi (6%)	2D3g (6%)	2D3h (5%)	2D3d (5%					
PM_{10}	1A4bi (75%)	1A1a (7%)								
$PM_{2.5}$	1A4bi (79%)	1A1a (7%)								
BC	1A4bi (77%)	1A3biii (8%)								
CO	1A4bi (71%)	1A3bi (18%)								
Pb	1A1a (50%)	1A3bi (20%)	2C1 (14%)							
Cd	1A1a (42%)	2C7a (28%)	1A2d (7%)	1A4bi (6%)						
Hg	1A1a (40%)	5C1biii (26%)	1A4bi 14%)							
As	1A1a (35%)	1A4bi (29%)	2C1 (22%)							
Cr	2C1 (61%)	1A4bi (20%)								
Cu	1A3bvi (39%)	2C7a (15%)	1A3biii (14%)	1A3bi (11%)	2G (5%)					
Ni	1A3dii (24%)	2C7a (22%)	1A1a (11%)	1A4bi (9%)	1A3di(ii) (8%)	2C1 (6%)				
Se	1A1a (78%)	2A3 (11%)								
Zn	2D3i (20%)	2C1 (20%)	1A2d (15%)	1A4ai (13%)	1A2gviii (9%)	1A3bvi (6%)				
DIOX	1A1a (68%)	5C1biii (30%)								
PAHs	1A4bi (81%)									
HCB	1A4bi (93%)									
PCB	2C1 (39%)	1A2d (14%)	1A3c (12%)	1A4bi (9%)	1A4ai (8%)					

Note: Different colours used to highlight sectors - 1, 2, 3, 5

Table A1.3: *Final ranking of Key Categories for the year 2018 – Contributions per pollutant for Level Assessment (LA) and Trend Assessment (TA) in %*

NFR	NOx		SOx		NH_3		NMVOC		$PM_{2.5}$		PM_{10}		CO		BC		Pb		Cd		Hg		As		Cr		Cu		Ni		Se		Zn		DIOX		PAHs		HCB		PCB		SUM	RANK
	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	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA		
1A1a	5	24	22	46						7		7						50		42	8	40	15	35					12	11	73	78				68			23				574	3
1A1b	2	3	10	7																																							22	18
1A1c																					15																						15	26
1A2a	4	3	7														4				7														4		7				9		45	13
1A2d		3		10															13	7													16	15								14	78	9
1A2f	6																																										6	39
1A2gviii																																	6	9	7								22	19
1A3bi	16						3	6	3	79	2		8	18	16			20										11															182	4
1A3bii	5														7																												12	29
1A3biii	17	22													7	8												14															68	10
1A3bv							2																																				2	47
1A3bvi									2		3																61	39						6									114	6
1A3bvii											2																																5	40
1A3c	2	6																																								12	20	20
1A3di(ii)																													6	8													14	28
1A3dii																														24													24	8
1A3ei		7																																									7	35
1A4ai	4								2		2																						7	13								8	36	15
1A4bi	4	3		21			37	58	74		58	75	42	71	53	77			10	6	10	14		29		20				9			6		10		42	81	58	93		9	1079	1
1A4cii	3																																										3	45
1B1a							5																																				8	32
1B1b																													6						10								16	12
1B2b							8																																				8	34
2A3																															14	11											25	27
2A5b											4																																12	30
2B10a			7																																								7	27
2C1	5		22										30				74	14	6		41		66	22	86	61			23	6			35	20	32		12				73	38	680	2
2C2		4																																									4	44
2C3																																					23						23	17
2C7a																	5		51	28							21	15	35	22													177	5
2C7c			14										6																														20	21
2D3a							8																																				8	33
2D3d							13	5																																			18	22
2D3e							3																																				3	46
2D3g								6																																			6	38
2D3h								5																																			5	41
2D3i																																	15	20									35	16
2G																												5															5	42
3B1a					5		2																																				7	37
3B1b					5	13																																					18	23
3B3						14																																					16	24
3B4gi					8																																						12	31
3B4gii					5																																						5	43
3Da1	8	5			15	9																																					37	14
3Da2a					44	46																																					90	7
3Dc											10																																17	25
5C1biii																						26													17	30							73	11
5E																																			4								4	51
	81	80	82	84	82	82	81	80	81	86	81	82	86	89	83	85	83	84	80	83	81	80	81	86	86	81	82	84	82	80	87	89	85	83	84	98	84	81	81	93	82	81		

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 2018 - 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	-	-	-	17 169	-	-	-	-	-	-	-
Import	4 232	79 780	28 570	6 801	8 615	322	308	-	-	-	-
Export	-	-	-	-	141	-	-	1 808	-	-	-
Stock Changes	841	325	-2 202	-492	-2 486	19	-	-	-	-	-
Gross Inland Consumption	**5 073**	**80 105**	**26 368**	**23 478**	**5 988**	**341**	**308**	**-1 808**	**-**	**-**	**-**
Transformation Input	**2 260**	**80 105**	**14 220**	**22 313**	**47 452**	**114**	**-**	**-**	**1 059**	**1 717**	**359**
Electricity Production - Thermal Equipment	2 260	-	14 220	22 267	-	114	-	-	1 059	1 711	334
of which: Public	2 260	-	11 889	22 233	-	114	-	-	-	-	-
Autoproducers	-	-	2 331	34	-	-	-	-	1 059	1 711	334
Nuclear Plants	-	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	61 417	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	18 688	-	-	47 452	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	46	-	-	-	-	-	6	25
Transformation Output	**-**	**-**	-	**-**	**44 938**	**-**	**-**	**1 808**	**12 207**	**20 632**	**4 078**
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	44 938	-	-	1 808	12 207	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	20 632	4 078
Refineries	-	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	**-**	**-**	-	**-**	-	**-**	**-**	**-**	-	-	-
Product Transferred	**-**	**-**	-	-	-	-	-	-	-	-	-
Backflows from Petrochemical Sector	**-**	**-**	-	-	-	-	-	-	-	-	-
Consumption of the Energy Sector	**-**	**-**	**-**	**11**	**-**	**-**	**-**	**-**	**3 572**	**11 058**	**-**
Distribution Losses	**-**	**-**	**-**	**11**	**-**	**-**	**-**	**-**	**50**	**801**	**758**

1st continuation

	Anthracite	*Coking Coa l*	*Other Bituminous Coal*	*Brown Coaland 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	**2 813**	**-**	**12 148**	**1 143**	**3 474**	**227**	**308**	**-**	**7 526**	**7 056**	**2 961**
Final Non - Energy Consumption	**1 078**	**-**	**-**	**-**	**1 243**	**-**	**-**	**-**	**-**	**-**	**-**
of which: Chemical Industry	**-**	**-**	-	-	-	-	-	-	-	-	-
Final Energy Consumption	**1 735**	**-**	**12 148**	**1 143**	**2 231**	**227**	**308**	**-**	**7 526**	**7 056**	**2 961**
Industry	**1 735**	**-**	**8 729**	**458**	**2 118**	**-**	**-**	**-**	**7 526**	**7 056**	**2 961**
of which: Iron and steel	1 682	-	7 615	-	1 016	-	-	-	7 526	7 056	2 961
Non - ferrous metals	-	-	-	-	113	-	-	-	-	-	-
Chemical	-	-	-	-	-	-	-	-	-	-	-
Non - metallic minerals	53	-	1 114	-	904	-	-	-	-	-	-
Mining and quarrying	-	-	-	23	-	-	-	-	-	-	-
Food, beverages and tobacco	-	-	-	366	85	-	-	-	-	-	-
Textile and leather	-	-	-	-	-	-	-	-	-	-	-
Pulp, paper and print	-	-	-	-	-	-	-	-	-	-	-
Mach. and transport equipment	-	-	-	69	-	-	-	-	-	-	-
Not elsewhere specified	-	-	-	-	-	-	-	-	-	-	-
Transport	-	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Other Sectors	**-**	**-**	**3 419**	**685**	**113**	**227**	**308**	**-**	**-**	**-**	**-**
of which: Households	-	-	699	480	28	57	-	-	-	-	-
Agriculture	-	-	-	11	-	-	-	-	-	-	-
Commercial and public services	-	-	2 720	194	85	170	308	-	-	-	-

2nd constinuation

	Natural Gas	*Crude Oil and NGL*	*Refinery Feedstock*	*Refinery Gas*	*LPG*	*Naphta*	*Gasoline*	*Kerosene*
Primary Production	3 248	294	7 807	-	-	-	-	-
Import	152 871	228 323	175	-	3 082	5 148	9 094	87
Export	-	210	-	-	3 772	-	45 032	2 252
Stock Changes	14 580	-336	-	-	-46	396	-1 010	43
Gross Inland Consumption	**170 699**	**228 071**	**7 982**	**-**	**-736**	**5 544**	**-36 948**	**-2 122**
Transformation Input	**27 105**	**228 071**	**30 907**	**223**	**-**	**-**	**-**	**-**
Electricity Production - Thermal Equipment	19 078	-	-	223	-	-	-	-
of which: Public	17 271	-	-	-	-	-	-	-
Autoproducers	1 807	-	-	223	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-
Refineries	-	228 071	30 907	-	-	-	-	-
Heat Production	8 027	-	-	-	-	-	-	-
Transformation Output	**-**	**-**	**-**	**14 731**	**8 280**	**17 468**	**62 386**	**4 114**
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-
Refineries	-	-	-	14 731	8 280	17 468	62 386	4 114
Heat Production	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	**-6 498**	**-**	**22 925**	**-**	**-46**	**-9 064**	**-**	**-**
Product Transferred	-6 498	-	13 815	-	-	-	-	-
Backflows from Petrochemical Sector	-	-	9 110	-	-46	-9 064	-	-
Consumption of the Energy Sector	**9 174**	**-**	**-**	**11 104**	**-**	**-**	**-**	**-**
Distribution Losses	**3 371**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

3rd continuation

	Natural Gas	*Crude Oil and NGL*	*Refinery Feedstock [1/]*	*Refinery Gas*	*LPG*	*Naphta*	*Gasoline*	*Kerosene*
Final Consumption	**124 551**	**-**	**-**	**3 404**	**7 498**	**13 948**	**25 438**	**1 992**
Final Non - Energy Consumption	**18 905**	**-**	**-**	**-**	**5 336**	**13 948**	**-**	**-**
of which: Chemical Industry	18 905	-	-	-	5 336	13 948	-	-
Final Energy Consumption	**105 646**	**-**	**-**	**3 404**	**2 162**	**-**	**25 438**	**1 992**
Industry	**37 185**	**-**	**-**	**3 404**	**138**	**-**	**-**	**-**
of which: Iron and steel	6 533	-	-	-	-	-	-	-
Non - ferrous metals	1 390	-	-	-	-	-	-	-
Chemical	5 630	-	-	3 404	-	-	-	-
Non - metallic minerals	4 274	-	-	-	46	-	-	-
Mining and quarrying	2 016	-	-	-	46	-	-	-
Food, beverages and tobacco	3 545	-	-	-	-	-	-	-
Textile and leather	487	-	-	-	-	-	-	-
Pulp, paper and print	1 877	-	-	-	-	-	-	-
Mach. and transport equipment	8 375	-	-	-	46	-	-	-
Not elsewhere specified	3 058	-	-	-	-	-	-	-
Transport	**243**	**-**	**-**	**-**	**1 472**	**-**	**25 438**	**1992**
Other Sectors	**68 218**	**-**	**-**	**-**	**552**	**-**	**-**	**-**
of which: Households	46 845	-	-	-	322	-	-	-
Agriculture	799	-	-	-	46	-	-	-
Commercial and public services	20 574	-	-	-	184	-	-	-

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	40 638	934	364	2 747	387	2 222	7 459	130	4 405	4 579
Export	72 812	3 005	3 799	9 091	215	252	1 604	-	-	8 739
Stock Changes	-295	-162	81	-646	-	-	-	-	-175	-126
Gross Inland Consumption	**-32 469**	**-2 233**	**-3 354**	**-6 990**	**172**	**1 970**	**5 855**	**130**	**4 230**	**-4 286**
Transformation Input	**-**	-	**121**	**2 868**	**-**	**-**	**-**	**-**	**-**	**-**
Electricity Production - Thermal Equipment	-	-	121	2 868	-	-	-	-	-	-
of which: Public	-	-	121	-	-	-	-	-	-	-
Autoproducers	-	-	-	2 868	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-
Heat Production	-	-	-	-	-	-	-	-	-	-
Transformation Output	**117 366**	**2 842**	**3 515**	**15 958**	**-**	**-**	**-**	**-**	**1 923**	**5 336**
Electricity Production - Thermal Equipment	-	-	-	-	-	-	-	-	-	-
of which: Public	-	-	-	-	-	-	-	-	-	-
Autoproducers	-	-	-	-	-	-	-	-	-	-
Nuclear Plants	-	-	-	-	-	-	-	-	-	-
Coke Ovens	-	-	-	-	-	-	-	-	-	-
Blast Furnaces	-	-	-	-	-	-	-	-	-	-
Refineries	117 366	2 842	3 515	15 958	-	-	-	-	1 923	5 336
Heat Production	-	-	-	-	-	-	-	-	-	-
Exchanges and Transfers, Backflows	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Product Transferred	-	-	-	-	-	-	-	-	-	-
Backflows from Petrochemical Sector	-	-	-	-	-	-	-	-	-	-
Consumption of the Energy Sector	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1 923**	**-**
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	**84 897**	**609**	**40**	**6 100**	**172**	**1 970**	**5 855**	**130**	**4 230**	**1 050**
Final Non - Energy Consumption	**-**	**528**	**-**	**-**	**172**	**1 970**	**5 855**	**130**	**2 342**	**1 050**
of which: Chemical Industry	-	528	-	-	-	-	-	-	-	1 050
Final Energy Consumption	**84 897**	**81**	**40**	**6 100**	**-**	**-**	**-**	**-**	**1 888**	**-**
Industry	**968**	**-**	**40**	**6 100**	**-**	**-**	**-**	**-**	**1 888**	**-**
of which: Iron and steel	-	-	-	-	-	-	-	-	-	-
Non - ferrous metals	-	-	-	-	-	-	-	-	-	-
Chemical	-	-	-	6 100	-	-	-	-	-	-
Non - metallic minerals	84	-	-	-	-	-	-	-	1 888	-
Mining and quarrying	126	-	-	-	-	-	-	-	-	-
Food, beverages and tobacco	42	-	-	-	-	-	-	-	-	-
Textile and leather	-	-	-	-	-	-	-	-	-	-
Pulp, paper and print	-	-	40	-	-	-	-	-	-	-
Mach. and transport equipment	463	-	-	-	-	-	-	-	-	-
Not elsewhere specified	253	-	-	-	-	-	-	-	-	-
Transport	**81 402**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Other Sectors	**2 527**	**81**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
of which: Households	-	-	-	-	-	-	-	-	-	-
Agriculture	2 527	-	-	-	-	-	-	-	-	-
Commercial and public services	-	81	-	-	-	-	-	-	-	-

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	160 480	299	376	-	37 999	1 161	6 228	6 784	22	12 924	2 106	-	6 968	263 865
Import	-	-	-	76	251	-	-	410	-	-	-	44 741	4 488	641 239
Export	-	-	-	-	494	-	-	-	-	-	-	31 486	4 280	188 992
Stock Changes	-	-	-	-	-410	-	-	-28	-	-	-	-	141	8 012
Gross Inland Consumption	**160 480**	**299**	**376**	**76**	**37 346**	**1 161**	**6 228**	**7 166**	**22**	12 924	2 106	**13 255**	**7 317**	**724 124**
Transformation Input	**158 563**	**-**	**318**	**-**	**18 005**	**1 071**	**4 982**	**78**	**-**	**-**	**-**	**-**	**-**	**641 911**
Electricity Production - Thermal Equipment	-	-	-	-	15 489	932	4 977	78	-	-	-	-	-	85 731
of which: Public	-	-	-	-	7 907	-	1 350	-	-	-	-	-	-	63 145
Autoproducers	-	-	-	-	7 582	932	3 627	78	-	-	-	-	-	22 586
Nuclear Plants	158 563	-	-	-	-	-	-	-	-	-	-	-	-	158 563
Coke Ovens	-	-	-	-	-	-	-	-	-	-	-	-	-	61 417
Blast Furnaces	-	-	-	-	-	-	-	-	-	-	-	-	-	66 140
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	258 978
Heat Production	-	-	318	-	2 516	139	5	-	-	-	-	-	-	11 082
Transformation Output	**-**	**-**	**-**	**29 396**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**81 004**	**-**	**447 982**
Electricity Production - Thermal Equipment	-	-	-	20 200	-	-	-	-	-	-	-	27 569	-	47 769
of which: Public	-	-	-	17 684	-	-	-	-	-	-	-	16 740	-	34 424
Autoproducers	-	-	-	2 516	-	-	-	-	-	-	-	10 829	-	13 345
Nuclear Plants	-	-	-	-	-	-	-	-	-	-	-	53 435	-	53 435
Coke Ovens	-	-	-	-	-	-	-	-	-	-	-	-	-	58 953
Blast Furnaces	-	-	-	-	-	-	-	-	-	-	-	-	-	24 710
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	253 919
Heat Production	-	-	-	9 196	-	-	-	-	-	-	-	-	-	9 196
Exchanges and Transfers, Backflows	**-1 917**	**-2**	**-**	**1 919**	**-**	**-**	**-**	**-**	**-22**	-12 924	**-2 106**	**15 052**	**-7 317**	**0**
Product Transferred	-1 917	-2	-	1 919	-	-	-	-	-22	-12 924	-2 106	15 052	-7 317	0
Backflows from Petrochemical Sector	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Consumption of the Energy Sector	**-**	**-**	**-**	**4 704**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**11 497**	**-**	**53 043**
Distribution Losses	**-**	**-**	**-**	**3 207**	**27**	**-**	**-**	**-**	**-**	**-**	**-**	**4 446**	**-**	**12 671**

End of table

	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
Final Consumption	**-**	**297**	**58**	**23 480**	**19 314**	**90**	**1 246**	**7 088**	**-**	**-**	**-**	**93 368**	**-**	**464 481**
Final Non - Energy Consumption	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**52 557**
of which: Chemical Industry	-	-	-	-	-	-	-	-	-	-	-	-	-	39 767
Final Energy Consumption	**-**	**297**	**58**	**23 480**	**19 314**	**90**	**1 246**	**7 088**	**-**	**-**	**-**	**93 368**	**-**	**411 924**
Industry	**-**	**-**	**-**	**2 634**	**16 349**	**-**	**4**	**7 088**	**-**	**-**	**-**	**46 060**	**-**	**152 441**
of which: Iron and steel	-	-	-	-	306	-	-	-	-	-	-	9 148	-	43 843
Non - ferrous metals	-	-	-	-	-	-	-	-	-	-	-	9 108	-	10 611
Chemical	-	-	-	477	16	-	-	1 050	-	-	-	3 460	-	20 137
Non - metallic minerals	-	-	-	158	4	-	-	6 002	-	-	-	2 783	-	17 310
Mining and quarrying	-	-	-	-	1	-	-	-	-	-	-	259	-	2 471
Food, beverages and tobacco	-	-	-	290	84	-	-	-	-	-	-	1 764	-	6 176
Textile and leather	-	-	-	47	4	-	-	-	-	-	-	468	-	1 006
Pulp, paper and print	-	-	-	1318	13 756	-	2	-	-	-	-	2 848	-	19 841
Mach. and transport equipment	-	-	-	127	238	-	2	36	-	-	-	11 430	-	20 786
Not elsewhere specified	-	-	-	217	1 940	-	-	-	-	-	-	4 792	-	10 260
Transport	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2 117**	-	**112 664**
Other Sectors	**-**	**297**	**58**	**20 846**	**2 965**	**90**	**1242**	**-**	**-**	**-**	**-**	**45 191**	-	**146 819**
of which: Households	-	268	-	17 450	1 654	-	-	-	-	-	-	18 342	-	86 145
Agriculture	-	-	29	37	355	-	884	-	-	-	-	864	-	5 552
Commercial and public services	-	29	29	3 359	956	90	358	-	-	-	-	25 985	-	55 122

ANNEX IV: ADDITIONAL INFORMATION ON METHODOLOGY

ANNEX IV includes additional information on methodology used in the NEIS database.

NEIS database is the National Emission Information System for air pollutants (NOX, 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 NEIS was set into the 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.

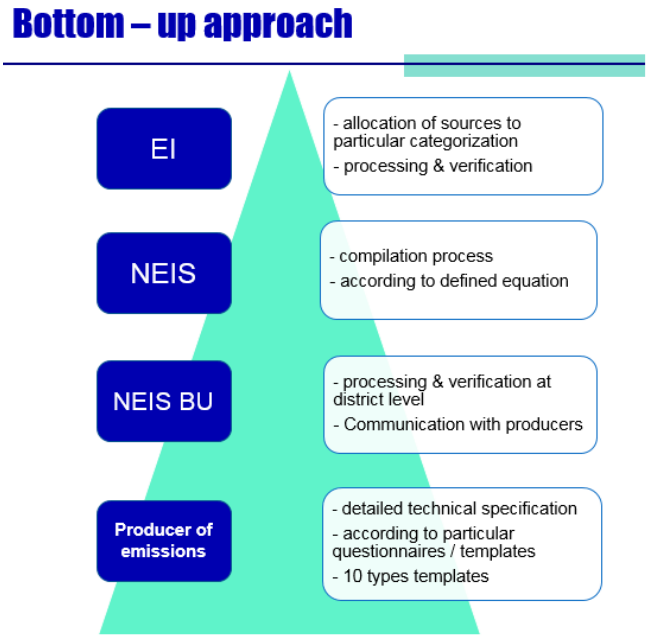
The last changes within the improvement of the NEIS were carried out from December 2013 until August 2015. Within the scope of the recent Project 'Internetization of NEIS, a browser interface was developed. The aim was to enable sending the yearly obligatory report electronically right to the database 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*

1989	• REZZO – joint dB for Czechoslovakia – fist plain evidence of industrial pollution sources
1998	• Pilot project of NEIS in cooperation of the Ministry of Environment of SR , SHMU and the developer company Spirit-informačné systémy a.s. • Project PHARE/AIR/30
2000	• NEIS was put into the operation • Replaced an old system REZZO
2001	• 1st collection and processing of data at Department of Emissions and Air Quality Monitoring of the SHMU • Central database • Verification
2001-2004	• Directive 2001/81/ES has entered into force • Partial developing task of the system improvement was supported from the DANCEE (Danish fond)
2005-2010	• System was extended with additional obligatory entries, significant structural changes in database
2011-2012	• Algoritm for calculation of PM_{10} and $PM_{2.5}$ developed - applicable only for data 2005 and newer due to the database structure
2013-2015	• Project 'Internetization of NEIS': a browser interface for operators was developed, with aim to enable sending the yearly obligatory report electronically right to the database, a part of the project: the system was harmonized with IED • Algoritm for automatized assignement of NFR sectoral codes to the air pollution sources in NEIS

The emissions of air pollutants (NO_X, SO_X, NMVOC, NH_3, TSP, PMi and HM) are recorded and calculated on yearly bases in NEIS database. The data collection of air pollutants and emission inventory preparation is performed by 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 name and content of surveyed data. The forms 1- 5 require identification data of operators, sum of emissions and fees for operator and individual sources of 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 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

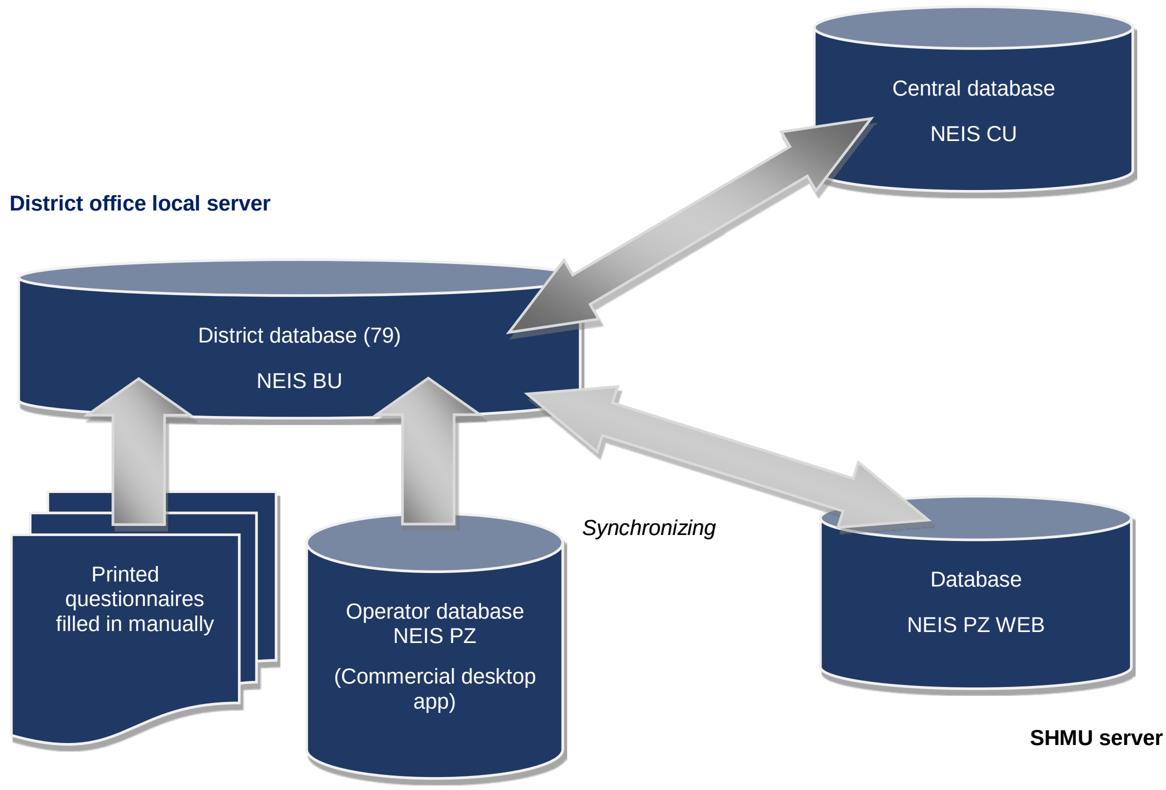
In the year 2016 the system contained 905 (750 of it in operation) large sources

- 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
  - In year 2016 the system contained 12 982 (10 642 of it in operation) 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 complex 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[7],
- 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.

[7] 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 (about 13 000 x 18 years = 195 000) expected the development of the methodology for automatized re-assignment of sectoral codes to the individual sources. The accessible timeline in NEIS (2000-2018) 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 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 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

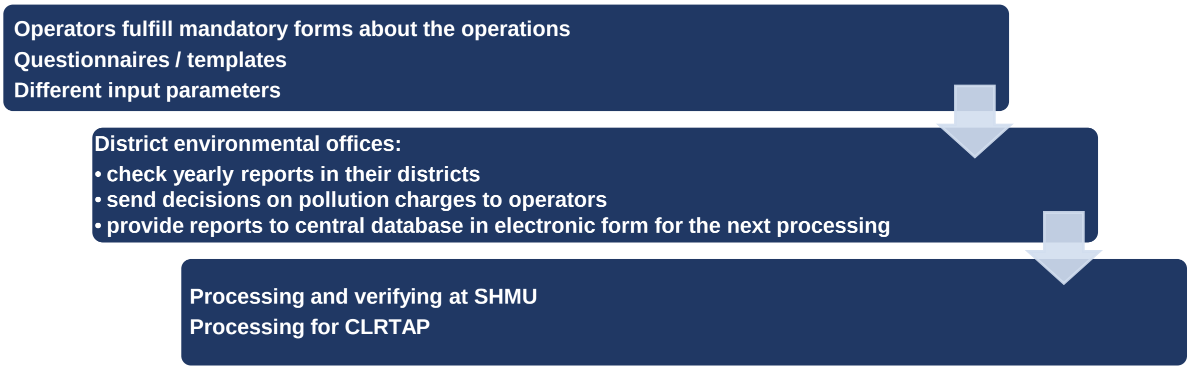
The sources below 0.3 MW (category 1A4bi – Residential: Stationary plants) are defined as small sources. These are not registered as individual point sources. The emission balance is being processed centrally (NEIS CU - central unit) and it is based on:

- 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 process of emissions inventory compilation using the NEIS database*



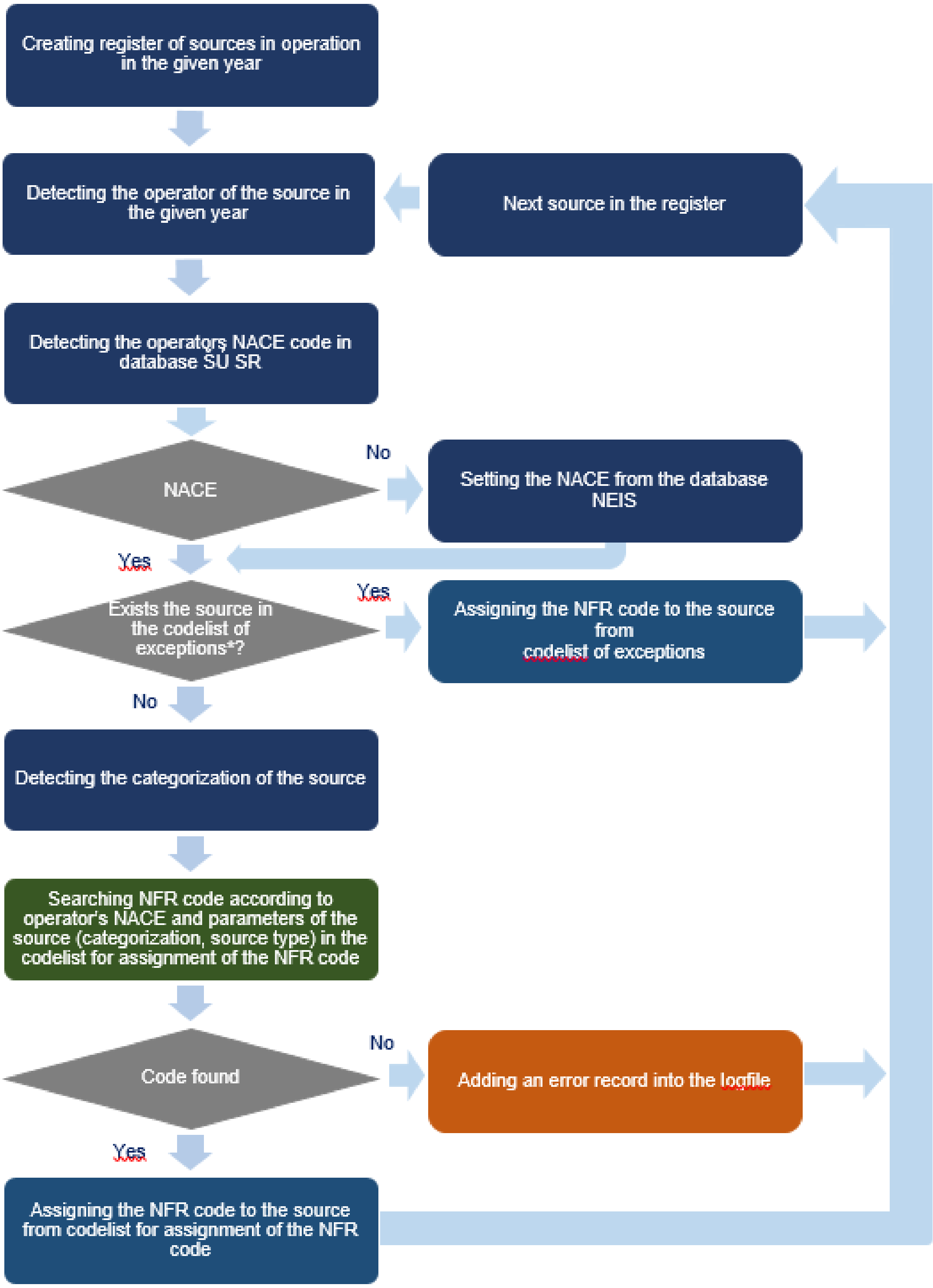
A4.4 VERIFICATION PROCESS OF NEIS DATA

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 particular year for each source in registry. NEIS is highly variable for determination of emissions according to approved permission on operation and technical condition of installation. There are several manners for compilation of combustion emissions.

Emission compilations for energy in NEIS:

1.	Continuous measurement
2.	Calculation using representative concentration and volume of flue gas

$$Em\ [t] = (1-\eta/100) * c\ [mg/m^3] * V\ [tis.m^{-3}] * 10^{-6}$$

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

$$Em\ [t] = (1-\eta/100) * q\ [kg/hod] * t\ [hod] * 10^{-3}$$

Where

η = Effectiveness of abatement technology or separator

q = mass flow

t = number of operational hours for related year

4.	Calculation using emission factor and amount of fuel

$$Em\ [t] = (1-\eta/100) * EF\ kg/t * AD\ t * 10^{-3}$$

$$Em\ [t] = (1-\eta/100) * EF\ kg/mil.m^3 * AD\ tis.m^3 * 10^{-6}$$

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

$$Em\ [t] = (1-\eta/100) * EF\ kg/GJ * AD\ GJ * 10^{-3}$$

$$Em\ [t] = (1-\eta/100) * EF\ kg/kWh * AD\ kWh * 10^{-3}$$

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 content of AP in fuel and amount of fuel

$$Em\ [t] = (1-\eta/100) * EF\ kg/t * AP\ \% * AD\ t * 10^{-3}$$

$$Em\ [t] = (1-\eta/100) * EF\ kg/mil.m^3 * AP\ \% * AD\ tis.m^3 * 10^{-6}$$

$$Em\ [t] = (1-\eta/100) * EF\ kg/t * AP\ mg/kg * AD\ t * 10^{-9}$$

$$Em\ [t] = (1-\eta/100) * EF\ kg/mil.m^3 * AP\ mg/kg * AD\ tis.m^3 * 10^{-12}$$

Where

η = Effectiveness of abatement technology or separator

EF = Emission Factor

AP = Content of Air Pollutant expressed as 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

$$Em\ [t] = (1\text{-}\eta/100) * EF\ kg/t * AP\ \%\ in\ dry\ matter * 1\text{-}W/100 * AD\ t * 10^{-3}$$

Where

η = Effectiveness of abatement technology or separator

EF = Emission Factor

AP = Content of ash, sulphur or other compound in dry matter expressed as percentage

W = humidity of material

AD = Quantity of fuel

8.	Calculation using emission factor related to calorific value

$$Em\ [t] = (1\text{-}\eta/100) * EF\ kg/GJ * NCV\ GJ/t * AD\ t * 10^{-3}$$

$$Em\ [t] = (1\text{-}\eta/100) * EF\ kg/GJ * NCV\ GJ/tis.m^3 * AD\ tis.m^3 * 10^{-3}$$

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

$$Em\ [t] = (1\text{-}\eta/100) * EF\ kg/GJ * AP\ \% * NCV\ GJ/t * AD\ t * 10^{-3}$$

$$Em\ [t] = (1\text{-}\eta/100) * EF\ kg/GJ * AP\ \% * NCV\ GJ/tis.m^3 * AD\ tis.m^3 * 10^{-6}$$

$$Em\ [t] = (1\text{-}\eta/100) * EF\ kg/GJ * AP\ mg/kg * NCV\ GJ/t * AD\ t * 10^{-9}$$

$$Em\ [t] = (1\text{-}\eta/100) * EF\ kg/GJ * AP\ mg/kg * NCV\ GJ/tis.m^3 * AD\ tis.m^3 * 10^{-12}$$

Where

η = Effectiveness of abatement technology or separator

EF = Emission Factor

AP = Content of Air Pollutant expressed as 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

$$Em\ [t] = (1\text{-}\eta/100) * EF\ kg/GJ * AP\ \% * 1\text{-}W/100 * NCV\ GJ/t * AD\ t * 10^{-3}$$

Where

η = Effectiveness of abatement technology or separator

EF = Emission Factor

AP = Content of ash and sulphur in dry matter expressed as percentage

W = humidity of material

AD = Quantity of fuel

99.	Other manner of determination

In data processing, is taken specific information on abatement technologies and their effectiveness in 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 comply 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_{2016} and in comply with requirements of the respective of working group for emission inventory (UN ECE Task Force on Emission inventory) and methodology is based on IIASA's report[8].

Automated calculation of emissions PM_{10} and $PM_{2.5}$ was technically implemented in 2011[9] in db. NEIS according the study[10] . 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 methodology of calculation inventory of PM_{10} and $PM_{2.5}$. National inventory is base to 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. 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 separator, the calculation of total emissions PM_{10} and $PM_{2.5}$ is taken to NFR tables

Emissions are distinguish 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 the additives. The final amount of released air pollutants demand of 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							

8 hhttp://www.iiasa.ac.at/web/home/research/researchPrograms/air/ir-02-076.pdf
9 Správa k riešeniu úlohy „Systém pre prepočet emisií TZL na emisie PM10 a PM2.5, SPIRIT informačné systémy
10 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.m^3 gaseous fuel**					
		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
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	4.7	0.8	0.132	0.108
			(0.004)				
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/m^3
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
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

TYPE OF SEPARATOR	NAME
M - wet absorption	M - with organic solvents
M - wet absorption	M - with recirculation of liquid
M - wet absorption	M - other
AD,SP - absorption and combustion	AD - adsorption of gas-solids bed, instable adsorbent
AD,SP - absorption and combustion	AD - adsorption of gas-fluid. Adsorbent bed
AD,SP - absorption and combustion	AD - gas-continuous adsorption moving bed ad
AD,SP - absorption and combustion	SP - Gas combustion - thermal three-stage (burner, mixer, aggravation), linear. Burner
AD,SP - absorption and combustion	SP - Combustion of gases - thermal three-stage, tunnel incinerator
AD,SP - absorption and combustion	SP - Gas Combustion - thermal three-stage, jet incinerator
AD,SP - absorption and combustion	SP - Combustion of gases - thermal in the sand bed
AD,SP - absorption and combustion	SP - Gas-catalytic combustion - solid bed (tapes, rods, bricks, pellets ...)
AD,SP - absorption and combustion	SP - Combustion of gas-catalytic-fluid bed (metals and their compounds on carriers)
DS - DESOX	DS - DESOX-lime-limestone wet scrubbing-WS
DS - DESOX	DS - DESOX - injection of lime milk into the flue gas-SDA
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[11]	PRIORITY CRITERIA KEY CATEGORY	PRIORITY CRITERIA OVER EMISSION 2%	REVIEW RECOMMENDATION	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.	To be implemented following the timetable in **ANNEX X.**
SK-1A1b-2018-0001	Transparency	No	No	**1A1b Petroleum refining:** The TERT recommends that Slovakia update the notation key to 'IE' in the next submission and document this transparently in the IIR.	Implemented/IIR ver. 1 **Chapter 3.4.3.2, p. 62**
SK-1A1b-2019-0001	Accuracy	Yes	Yes	**1A1b Petroleum Refining, PAHs:** The TERT recommends that Slovakia include the revised estimate for PAHs in its 2020 NFR and IIR submission.	Implemented/IIR ver. 1 **Chapter 3.4.3.4, p. 62**
SK-1A2b-2019-0001	Transparency	Yes	No	**1A2b Stationary Combustion in Manufacturing Industries and Construction: Non-ferrous Metals, HCB:** The TERT recommends that Slovakia explains the methodology for secondary copper production in the IIR including emission factors and activity data. The TERT also recommends that Slovakia changes the notation key for 2C3 – HCB to 'NE'. The TERT also recommends, that Slovakia reports HCB emissions from secondary copper production under the respective category 2C7a and PCDD/F and PCB emissions from aluminium production under the respective category 2C3 instead of reporting it under category 1A2b.	Implemented/IIR ver. 1 Chapter 3.5.3.4, p. 82
SK-1A3b-2018-0001	Transparency	No	No	**1A3bi-iv lubricant consumption calculation:** The TERT recommends that this improvement is carried out for	Implemented/IIR ver. 1 **Chapter 3.6.4.2, p. 132**

[11] If is criterion TCCCA, please select option - transparency, consistency, comparability, completeness or accuracy

SERIAL NO	PRIORITY CRITERIA TCCCA[11]	PRIORITY CRITERIA KEY CATEGORY	PRIORITY CRITERIA OVER EMISSION 2%	REVIEW RECOMMENDATION	IMPLEMENTED
				inclusion in the 2019 submission or plans are made to carry out these improvements in the following year.	
SK-1A3b-2018-0002	Transparency	No	No	**1A3b Road Transport/liquid fuel/ Pb from year 2000 onwards:** The TERT recommends that Slovakia clarifies in the next IIR submission the sources of the Pb emission factors and makes clear whether the emissions in 1A3b are due to the fuel only or also include the lubricant contribution according to the source of factors used.	Implemented/IIR ver. 1 **Chapter 3.6.4.2, p. 132**
SK-1A3b-2018-0003	Transparency	No	No	**1A3diii Road Transport: Heavy Duty Vehicles/Cd between 1999 and 2000, 1A3biv Road Transport: Mopeds & Motorcycles/ Cd between 1994 and 1995:** The TERT recommends that Slovakia looks again at the fleet composition, activity data and emission factors it uses for calculation of heavy metal emissions and either addresses any irregularities in the time series or provides a clear explanation of their cause in the next IIR submission. The TERT also understands the difficulty Slovakia has in finding detailed historical activity data to enable recalculations in COPERT 5, but recommends to continue trying to obtain this data or make assumptions to get a realistic time series trend as an improvement for the 2019 or 2020 submission.	Implemented/IIR ver. 1 **Chapter 3.6.4.2, p. 132**
SK-1A3b-2018-0004	Consistency	No	No	**Hg in 1990-1999 1A3bvi:** To ensure time series consistency and inventory completeness, the TERT recommends reporting emissions for all 1A3bi-iv sources for years 1990-1999 using the relevant activity data used for other pollutant emission estimates for these years and the same Hg emission factors as from 2000 for submission in the next 2019 inventory.	Implemented/IIR ver. 1 **Chapter 3.6.4.2, p. 132**
SK-1A3b-2018-0005	Consistency	No	No	**1A3b Road Transport/liquid fuels/1990-2016/PAHs, Dioxins:** The TERT did not find this explanation of new cars very clear and recommends that Slovakia looks again at the fleet composition, activity data and emission factors it uses for calculation of emissions of these POPs and either addresses any irregularities in the time series or provides a clear explanation of their cause in the next IIR submission. The TERT also understands the difficulty Slovakia has in finding detailed historical activity data to enable recalculations in COPERT 5, but recommends to continue trying to obtain this data or make assumptions to get a realistic time series trend as an improvement for the 2019 or 2020 submission.	Implemented/IIR ver. 1 **Chapter 3.6.4.2, p. 132**

SERIAL NO	PRIORITY CRITERIA TCCCA[11]	PRIORITY CRITERIA KEY CATEGORY	PRIORITY CRITERIA OVER EMISSION 2%	REVIEW RECOMMENDATION	IMPLEMENTED
SK-1A3bi-2019-0001	Transparency	No	No	**1A3bi Road Transport: Passenger Cars, NOX, Pb, $PM_{2.5}$:** The TERT recommends that Slovakia includes thorough information on the performed recalculations in the next IIR submission (2020).	Implemented/IIR ver. 1 **Chapter 3.6.4.4, p. 136**
SK-1A3bii-2019-0001	Transparency	No	No	**1A3bii Road Transport: Light Duty Vehicles, NOX:** The TERT recommends that Slovakia includes thorough information on the performed recalculations in the next IIR submission (2020).	Implemented/IIR ver. 1 **Chapter 3.6.4.4, p. 136**
SK-1A3biii-2019-0001	Transparency	No	No	**1A3biii Road Transport: Heavy Duty Vehicles and Buses, NOX:** The TERT recommends that Slovakia includes thorough information on the performed recalculations in the next IIR submission (2020).	Implemented/IIR ver. 1 **Chapter 3.6.4.4, p. 136**
SK-1A3bv-2018-0001	Transparency	Yes	No	**1A3bv Road Transport: Gasoline Evaporation/liquid fuel/years 2000-2016 of NMVOC:** The TERT recommends that to improve transparency, some explanation of the time series including comments on the temperature data used in the calculations are provided in the next submission of the IIR.	Implemented/IIR ver. 1 **Chapter 3.6.4.3, p. 136**
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 partly/IIR ver. 1. To be fully implemented following the timetable in **ANNEX X.** **Chapter 3.7.2.4, p. 151.**
SK-1A4bi-2018-0001	Transparency	No	No	**1A4bi Residential Stationary:** The TERT recommends that Slovakia review the time series data and make any necessary amendments in the 2019 submission, or include transparency information if the trend remains.	Implemented/IIR ver. 1 **Chapter 3.7.4.2, p. 158**
SK-1A4bi-2018-0002	-	Yes	No	**1A4bi Residential: Stationary, Cd, Hg:** The TERT recommends that Slovakia implement the Tier 2 methodology for the 2019 submission.	Implemented/IIR ver. 1 **Chapter 3.7.4.2, p. 158**
SK-1A4bi-2019-0001	Accuracy	Yes	Yes	**1A4bi Residential: Stationary, POPs:** The TERT recommends that Slovakia include the revised estimate of POPs in its 2020 NFR and IIR submission. Furthermore, the TERT recommends that Slovakia revises the time series for PCBs	Implemented/IIR ver. 1 **Chapter 3.7.4.4, p. 159**
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	Implemented partly/IIR ver. 1 **Chapter 3.7.7.2, p. 167**

SERIAL NO	PRIORITY CRITERIA TCCCA[11]	PRIORITY CRITERIA KEY CATEGORY	PRIORITY CRITERIA OVER EMISSION 2%	REVIEW RECOMMENDATION	IMPLEMENTED
				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.	
SK-1B2aiv-2018-0001	Completeness	No	No	**1B2aiv Fugitive Emissions Oil:** The TERT recommends that Slovakia correct the notation key in the next submission from NA to IE.	Implemented/IIR ver. 1 **Chapter 3.8.5.3, p. 183**
SK-1B2d-2019-0001	Completeness	No	No	**1B2d Other Fugitive Emissions From Energy Production, Hg**: The TERT recommends that Slovakia changes the notation key for category 1B2d to 'NO' in its future submission.	Implemented/IIR ver. 1 **Chapter 3.8.9.1, p. 185**
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 X.**
SK-2A1-2019-0001	Accuracy	Yes	Yes	**2A1 Cement production, Cd, Hg, Pb:** The TERT is aware that the guidebook will be updated before the next submission and thus recommends Slovakia to review their inventory against the 2019 version of the Guidebook.	Partly implemented/IIR ver .1 **Chapter 4.4.2.4, p. 196**
SK-2B10a-2018-0002	Transparency	Yes	No	**Recalculation explanation:** The TERT recommends that Slovakia finishes the update of the chapter and publishes it in the next submission.	Implemented/IIR ver. 1 **ANNEX IX.**
SK-2C1-2018-0002	-	Yes	No	**Reported 'NE/HCB/Tier 1 method and EF available:** The TERT recommends that Slovakia include the revised estimate for HCB in its 2020 NFR and IIR submission.	Implemented/IIR ver. 1 **Chapter 4.6.2.4, p. 229**
SK-2C7a-2019-0001	Completeness	No	No	**2C7a Copper Production, Cd:** The TERT agrees with the explanation provided by Slovakia and recommends that Slovakia includes the updated notation key NO) for the years 1990,1999 and 2000 in the next submission.	Implemented/IIR ver. 1 **Chapter 4.6.8.4, p. 242**
SK-2C7a-2019-0002	Completeness	Yes	Yes	**2C7a Copper Production, Cd, Hg, Pb:** The TERT thus recommends Slovakia to revise their Tier 2/Tier 3 EFs in this category, and to provide transparent information on their sources and apply default EFs for Tier 2 where no country specific EF is available, and also revise the reported data for Cd and Hg for 1990, as Cd is reported as 'NA' and emissions	Implemented partly/IIR ver. 1 **Chapter 4.6.8.4, p. 242**

SERIAL NO	PRIORITY CRITERIA TCCCA[11]	PRIORITY CRITERIA KEY CATEGORY	PRIORITY CRITERIA OVER EMISSION 2%	REVIEW RECOMMENDATION	IMPLEMENTED
				of Hg are unusually high. The TERT would also like to link this recommendation to that made in SK-1A2b-2019-0001 and recommend Slovakia to make sure that emissions are correctly allocated and not double counted.	
SK-2C7c-2018-0001	Transparency	Yes	No	**Recalculation explanation:** The TERT notes that this issue does not relate to an over- or under-estimate and recommends that Slovakia provides a detailed explanation on the reallocation of emissions in its next submission.	Implemented/IIR ver. 1 **ANNEX IX.**
SK-2D3a-2019-0001	Accuracy	Yes	Yes	**2D3a Domestic Solvent Use including Fungicides, NMVOC:** The TERT recommends that Slovakia should calculate NMVOC emissions from 2D3a Domestic solvent use including fungicides using a tier 2 or tier 3 method for inclusion in next years' inventory submission.	To be implemented in the next submission. Slovakia will obtain activity data for this source at the end of the year 2020
SK-2D3d-2018-0001	Transparency	Yes	No	**2D3d Coating Applications for NMVOC emissions for 2010 and 2015:** The TERT notes that this issue does not relate to an over- or under-estimate and recommends the member state to include the description in its next submission.	Implemented/IIR ver. 1 **Chapter 4.7.2.2, p. 225**
SK-2D3g-2018-0001	Accuracy	Yes	No	**PAHs, for the entire time series**: The TERT recommends that Slovakia review their inventory against the 2019 version of the Guidebook and update the benzo(a)pyrene emissions in NFR 2D3g before their next submission (based on the 2019 version of the Guidebook).	To be implemented. This issue needs further analysis to avoid double-counting
SK-2D3h-2018-0001	Transparency	Yes	No	**Recalculation explanation:** The TERT recommends that Slovakia: a) include in its next submission a detailed description of the specific printing processes which are included in this category, the method to estimate the emissions and AD and EF, if used; b) include evidence that all the installations are included in the estimate; i.e. the large sources that are reported via NEIS as well as the smaller sources; c) include a clear explanation for the decrease in emissions since 2011 with reference to the legislation, the abatement efficiency applied to the estimate and the abatement technologies applied.	To be implemented. Short clarification: **Chapter 4.7.8.4, p. 62**
SK-3B-2019-0001	Accuracy	Yes	Yes	**NH_3, Manure management:** The TERT recommends that Slovakia provides more detail on the abatement used including references for the share of production with abatement and information on how large changes were achieved between 2005 and 2016. Furthermore, the TERT recommends Slovakia to take into account the extra nitrogen in the manure for storage and field application when NH3	To be implemented/IIR ver. 1 **ANNEX VI, Chapter A6.3**

SERIAL NO	PRIORITY CRITERIA TCCCA[11]	PRIORITY CRITERIA KEY CATEGORY	PRIORITY CRITERIA OVER EMISSION 2%	REVIEW RECOMMENDATION	IMPLEMENTED
				emissions are reduced in animal housing and document this transparently in the IIR.	
SK-3B1a-2019-0001	Transparency	Yes	No	**NMVOC, Manure management:** The TERT recommends that Slovakia corrects the calculation of NMVOC emission from dairy cattle corresponding to parameters provided to the TERT during the 2019 NECD review and to include information on the variables used (MJ, NH_3 emission, Frac-silage storage, Frac-silage) in the 2020 submission.	Implemented/IIR ver. 1 **Chapter 5.8.6, p. 311**
SK-3B4e-2019-001	Accuracy	No	No	**$PM_{2.5}$, Manure management, Horses:** The recommends that Slovakia corrects switched emission factors for gorats and horses.	Implemented/IIR ver. 1 **Chapter 5.8.5, p. 309**
SK-3Da1-2019-0001	Accuracy	Yes	Yes	**NH_3, Agricultural soils:** The TERT recommends that Slovakia calculates NH3 emissions from 3Da1 Inorganic N-fertilizer using a tier 2 method for inclusion in next years' inventory submission. Furthermore, the TERT recommends Slovakia to provide transparent information on how the total fertilizer use has been allocated to individual fertilizer types.	Implemented/IIR ver. 1 **Chapter 5.9.3, p. 320**
SK-3De-2019-0001	Transparency	Yes	No	NMVOC, Agricultural soils: The TERT recommends that Slovakia implements the Tier 2 calculation to estimate NMVOC for 3BDe for the crops where Tier 2 is available and using the Tier 1 for the remaining crops in the next submission and include information in the IIR on the cultivated area distributed on different crop types.	Implemented/IIR ver. 1 **Chapter 5.10.1, p. 327**
SK-3Df-2019-0001	Completeness	Yes	No	**HCB, Agricultural soils:** The TERT recommends Slovakia to include HCB emissions from 3Df in the 2020 submission.	Implemented/IIR ver. 1 **Chapter 5.12, p. 330**
SK-5D2-2019-0001	Transparency	No	No	**5D2 Industrial wastewater handling, NH_3, NMVOC:** The TERT agreed with the explanation provided by Slovakia and recommends that Slovakia corrects the corresponding chapters in the IIR in the 2020 submission..	Implemented/IIR ver. 1 **Chapter 6.8.2.2, p. 366**

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 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 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[12] Coll. on air and Decree of the Ministry of the Environment of the Slovak Republic No 410/2012 Coll[13]. 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 NEIS database is not possible to fully implement into the national emission inventories due to valid of the legislation. In addition, ammonia emissions for goats and turkeys missing entirely in the database due to lack of law. The best practice for the NH_3 estimation is nitrogen budget. Nitrogen budget is 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.

[12] Act of the Ministry of the Environment of the Slovak Republic no.137/2010 Coll. Of 3 March 2010
[13] 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_{2016} using country-specific parameters and national input data from the ŠU SR[14]. The ŠU SR not dispose of official information about abatements. Therefore, in the NEIS, as mentioned above, the abatement information from farms are available. The declines are available for the 2010-2017 time series, but only 2016 and 2017 were implemented, due to the incomplete database.

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. 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:

$$\mathrm{Emissions}_{\mathrm{NH_3\ without\ abatments}} = \mathrm{E} * \mathrm{P}_{\mathrm{abatements}}$$

$$\mathrm{Emissions}_{\mathrm{NH_3 with\ abatement}} = \mathrm{Emissions}_{\mathrm{NH_3 without\ abatement}} - (\mathrm{Emissions}_{\mathrm{NH_3 without\ abatementn}} * \mathrm{K}_{\mathrm{reduction}})$$

Where: $\mathbf{Emissions}_{\mathbf{NH_3 with\ abatement}}$= emissions after application of abetments v Gg, $\mathbf{K}_{\mathbf{reduction}}$= abatement efficiency $\mathbf{Emissions}_{\mathbf{NH_3 without\ abatement}}$= 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 2020 submission. We plan to implement a more sophisticated estimation system on 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-VUŽV). Final emissions base on bottom-up approach will be implemented in the Air quality modelling (***Figure A6.1***). This is the long-term plan for our inventory. We plan to finalise this work after 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*[15]

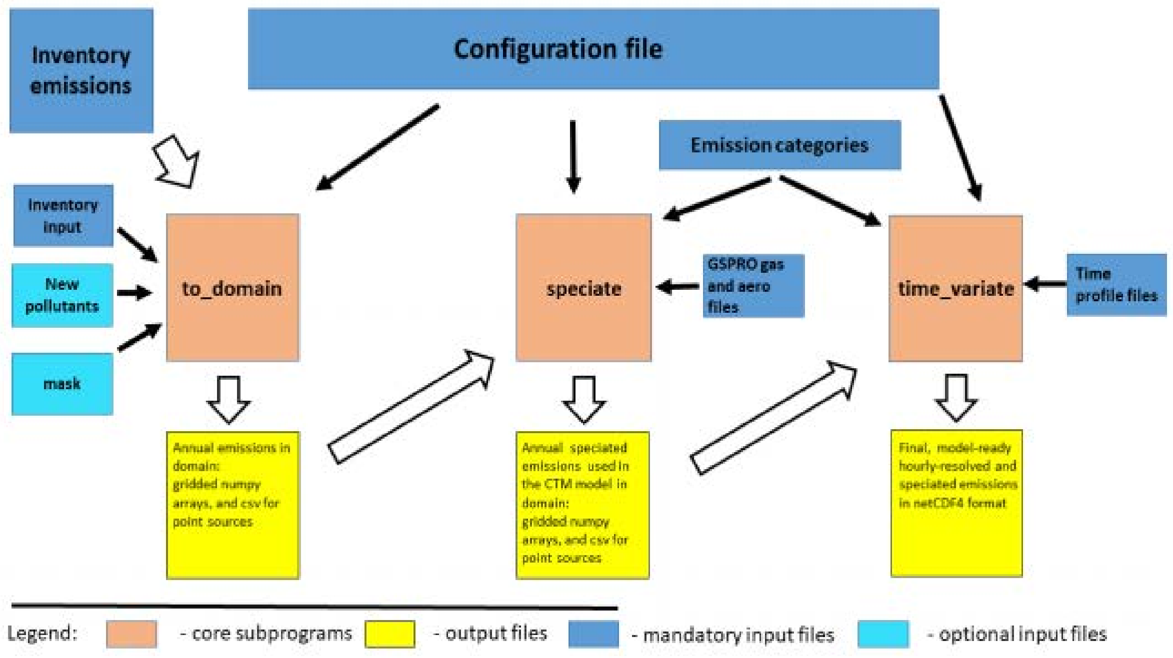


Table A6.2: Long-term plan for implementation

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	Will be implemented
Submission 2021	Implementation of mitigation measures	Will be implemented
Submission 2021	Data conversion on grid data and quality control	Will be implemented
Submission 2022	Finalisation a presentation of data	Will be implemented

[15] *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*

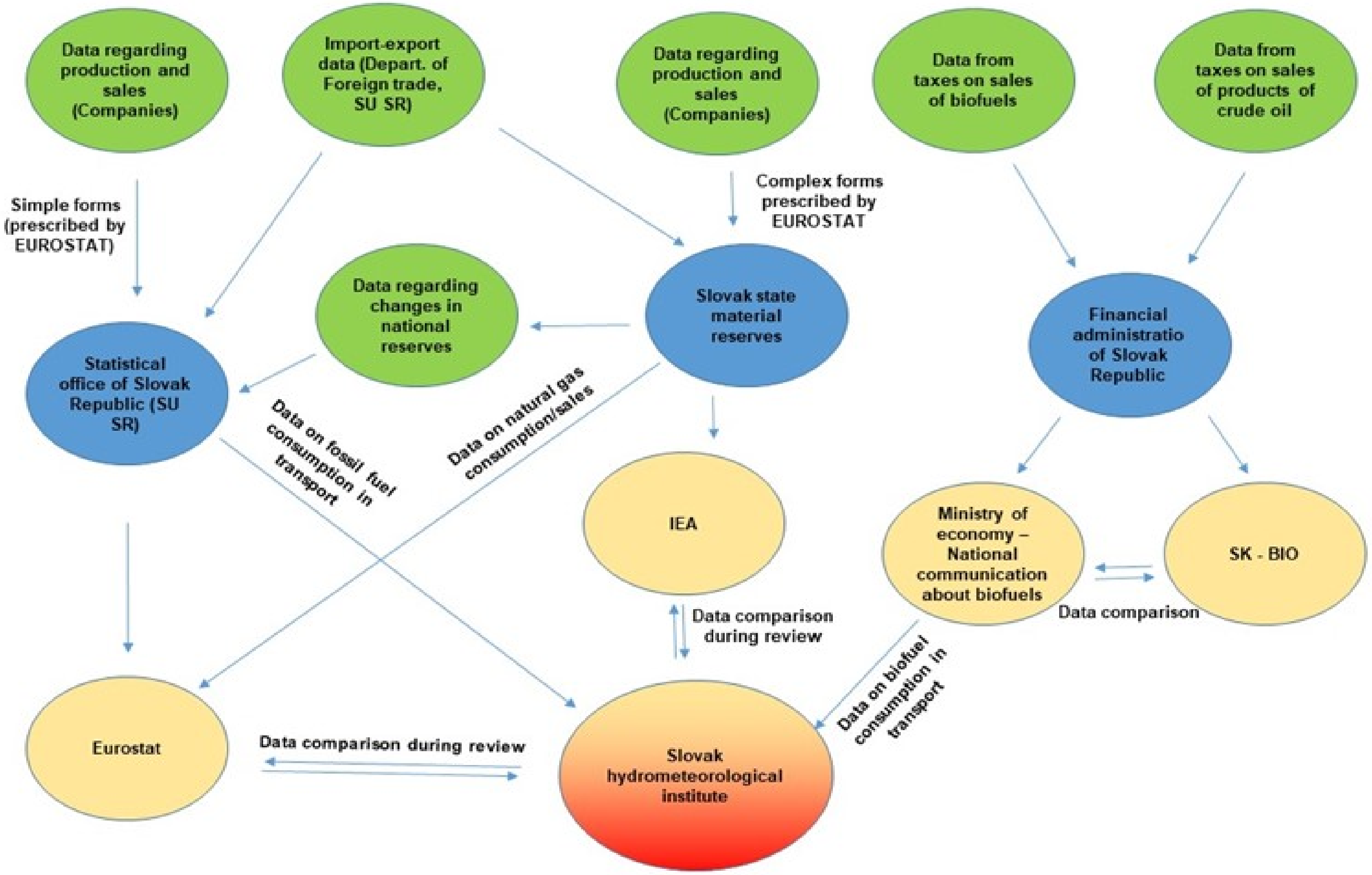
ABATEMENTS	DAIRY CATTLE	NON-DAIRY CATLE	SHEEP	BREEDING SWINE	MARKET SWINE	HORSES	LAYING HENS	BROILERS	TURKEYS
Biogas station	0.11%	0.07%	0.00%	0.00%	0.18%	0.00%	0.00%	0.00%	0.00%
Additives in the feeding ration	0.06%	0.25%	0.00%	0.88%	0.90%	0.00%	0.37%	0.57%	0.00%
Storage of manure with covering	14.69%	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)*



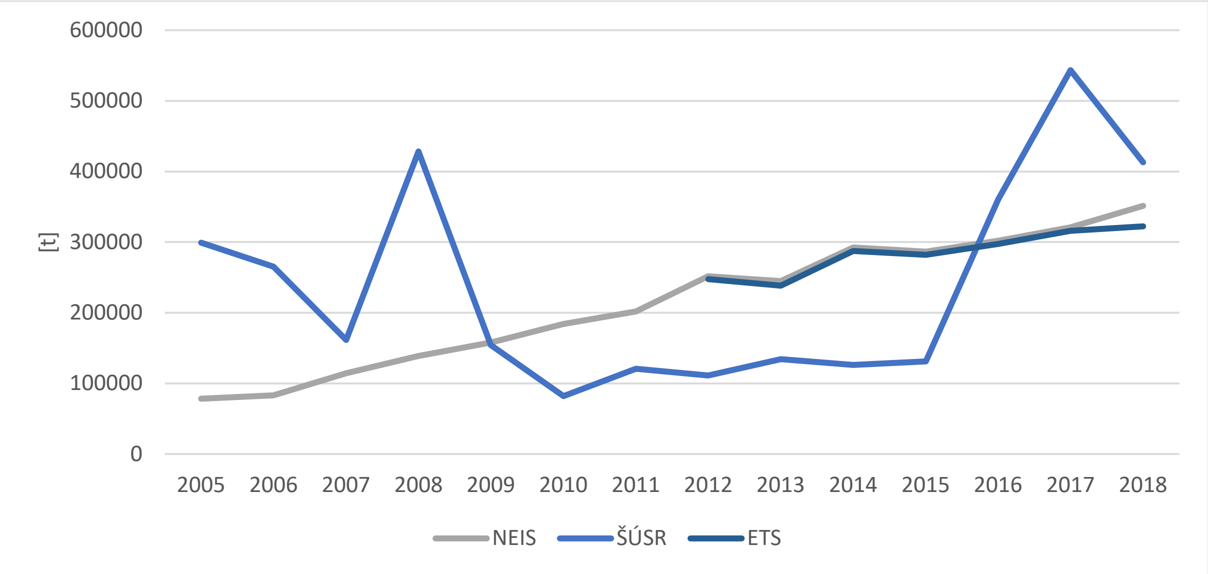
ANNEX VIII: JUSTIFICATION OF THE ACTIVITY DATA SOURCE FOR WASTE INCINERATION

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 Slovak Ministry of Environment (MoE SR) on the year basis. According to information provided by MoE SR, these data are based only on waste production and also only 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 type of waste incinerated are available in the database from the year 2005.

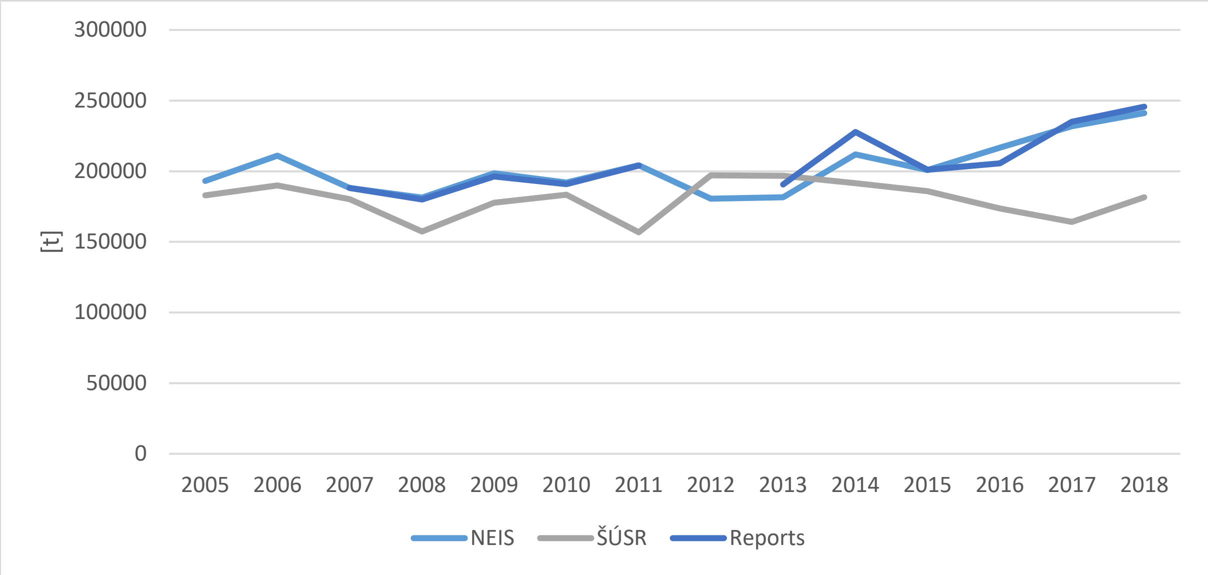
By comparison of the statistical, NEIS and ETS data for incineration of waste with energy recovery (co-incineration in cement and lime production plants) significant differences were recorded. Amounts of industrial waste incinerated according to statistical data is much higher compared to ETS or waste data. ETS (available since 2012) and NEIS data are similar in trend and absolute amounts (see ***Figure A8.1***). This can be caused by different definition of waste in national legislation or same waste can be recorded more than once after some sort of pre-treatment (for example sterilisation) under another waste catalogue number. NEIS database also contains sources which 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 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 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.*

Figures bellow show significant difference of 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*

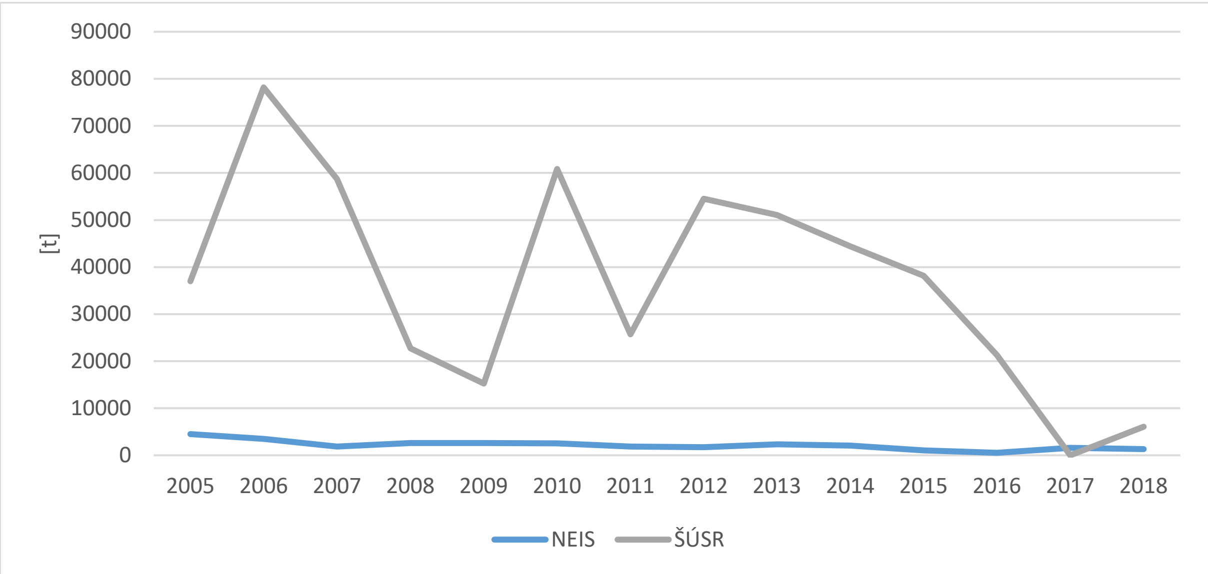
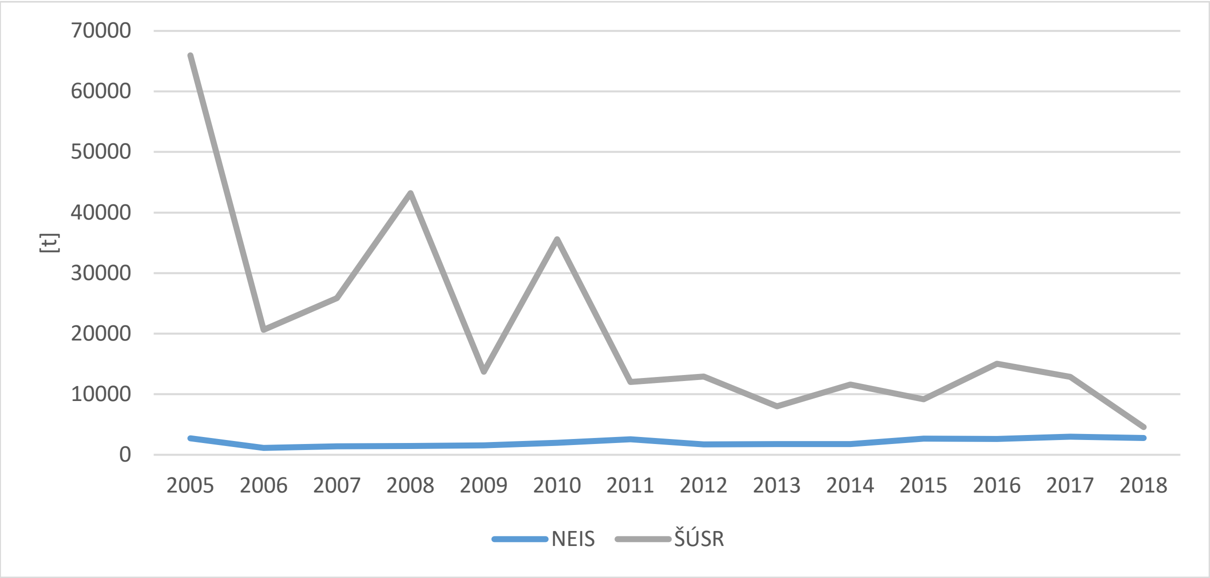


Figure A8.4: *Comparison of data of clinical waste incinerated (without energy recovery) from ŠÚ SR and NEIS database*



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 NEIS database, as they are comparable with other sources of data as well as they are regularly checked in

ANNEX IX: REALLOCATION OF SOURCES

Many categories were reallocated in 2018. They were originally incorporated into 1Axxx when fuel was burned in a particular source.

After a major revision, the distinction in the majority of categories of whether the source is incinerated or not (i.e. whether it is purely technological or incineration in progress) has been abolished. The abolition of the distinction 'with fuel - without fuel' means that the source in the process of allocating the sectoral code receives the same code in both cases. And the "updated" code is from revision 2A / 2B / 2xx - so the emissions of these sources have declined in the original energy sectors and added to the revised industry sectors.

Table A9.1: *Reallocation of sources in the sector industry in 2018*

<table>
<tr><th rowspan="2">CATEGORY NAME</th><th colspan="2">2017 ALLOCATION</th><th colspan="2">2018 RELLOCATION</th></tr>
<tr><th>COMBUSTION SOURCES.</th><th>NON-COMBUSTION SOURCES.</th><th>COMBUSTION SOURCES.</th><th>NON-COMBUSTION SOURCES.</th></tr>
<tr><td>MANUFACTURE AND PROCESSING OF METALS</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Treatment, roasting, sintering of ferrous metal ores and handling of these materials in powder form</td><td>1A2a</td><td>2C1</td><td>2C1</td><td>2C1</td></tr>
<tr><td>Production of pig iron in blast furnaces with projected production capacity in t / h</td><td>1A2a</td><td>2C1</td><td>2C1</td><td>2C1</td></tr>
<tr><td>Production of steel, eg converters, Siemens-Martin furnaces, double-stack tandem furnaces, electric furnaces, März-Böhler furnaces, with projected production capacity in t / h</td><td>1A2a</td><td>2C1</td><td>2C1</td><td>2C1</td></tr>
<tr><td>Ferrous metal foundries - production of cast iron and cast iron products with projected production capacity in t / d</td><td>1A2a</td><td>2C2</td><td>2C2</td><td>2C2</td></tr>
<tr><td>Metallurgical secondary production and processing of metals, for example, rolling mills, presses, forge shops, wire mills, hardening furnaces and other heat treatment plants:
(a) rolling mills with projected crude steel production in t / h
(b) forging workshops with projected thermal energy consumption
-> 20 MW and the design power of hammers in kJ per hammer
- ≤ 20 MW and the design power of hammers in kJ per hammer
(c) pressing and heat treatment of non-ferrous metals with projected production in t / h</td><td>1A2a</td><td>2C1</td><td>2C1</td><td>2C1</td></tr>
<tr><td>Treatment of ores of non-ferrous metals and handling of these materials in powder form</td><td>1A2b</td><td>2C7c</td><td>2C7c</td><td>2C7c</td></tr>
<tr><td>Manufacture of non-ferrous metals and their alloys with each other and with ferro-alloys from ores, concentrates or secondary raw materials by metallurgical, chemical or electrolytic processes</td><td>1A2b</td><td>2C7c</td><td>2C7c</td><td>2C7c</td></tr>
<tr><td>Melting of non-ferrous metals including alloying, remelting and refining of scrap metal with projected melting capacity in t / d:
(a) for lead and cadmium
(b) for other non-ferrous metals</td><td>1A2b</td><td>2C7c</td><td>2C7c</td><td>2C7c</td></tr>
<tr><td rowspan="10">Metal surface treatment, coating services and related activities, except organic solvent treatment and powder coating
Finishes:
(a) using electrolytic processes with a designed bath volume in m^3
(b) using chemical procedures with a designed bath volume in m^3
(c) deposition of metal or alloy layers and coatings of metals and their alloys other than melt steel with a projected deposition capacity in kg / h
(d) the deposition of metal or alloy layers and coatings of</td><td>1A2a</td><td>2C7c</td><td>2C7c</td><td>2C7c</td></tr>
<tr><td>1A2b</td><td>2C7c</td><td>2C7c</td><td>2C7c</td></tr>
<tr><td>1A2a</td><td>2C7c</td><td>2C7c</td><td>2C7c</td></tr>
<tr><td>1A2b</td><td>2C7c</td><td>2C7c</td><td>2C7c</td></tr>
<tr><td>1A2gviii</td><td>2C7c</td><td>2C7c</td><td>2C7c</td></tr>
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</table>

CATEGORY NAME	2017 ALLOCATION		2018 RELLOCATION	
	COMBUSTION SOURCES.	NON-COMBUSTION SOURCES.	COMBUSTION SOURCES.	NON-COMBUSTION SOURCES.
metals and their alloys other than crude steel by flame, electro-arc, plasma or other means with a projected deposition capacity in kg / h (e) application of protective coatings of molten metals with raw steel inlet with projected deposition capacity in t / h (f) anodic oxidation of aluminum materials (g) application of non-metallic coatings, such as enamels and other similar coatings, with a projected application capacity in m^2 / h Related activities: (h) abrasive cleaning (blast cleaning), excluding cassette installations, with a projected capacity of machined material in m^2 / h (i) thermal cleaning: with a baking chamber volume in m^3, or - operation in h / year j) electrolytic-plasma cleaning, degreasing and polishing with projected capacity in dm^2 / h				
MANUFACTURE OF NON - METAL MINERAL PRODUCTS				
Processing of asbestos and production of asbestos - containing products	1A2gviii	2L	2H3	2H3
Production of cement with projected production capacity of cement clinker in t / d	1A2f	2A1	2A1	2A1
Production of lime with projected production capacity in t / d	1A2f	2A2	2A2	2A2
Magnesium oxide production from magnesite and production of basic refractory materials with projected production capacity in t / d	1A2f	2A6	2C4	2C4
Bituminous mixing plants and bitumen mixing plants with projected production capacity of the mixture in t / h	1A2gviii	2D3b	2D3b	2D3b
Installations for melting mineral substances including melt processing and production of mineral fibers with projected melting capacity in t / d	1A2f	2A6	2A6	2A6
Production of glass, glass products and glass fibers with projected melting capacity in t / d	1A2f	2A3	2A3	2A3
Manufacture of ceramic products by firing, in particular tiles, bricks, tiles, porcelain, ceramics, stoneware and refractory materials according to: the projected production capacity in t / d, or - the volume capacity of the furnaces in m^3 at a charge density above 300 kg / m^3	1A2f	2A6	2A6	2A6
Production of lightweight non-metallic mineral products with projected production capacity in m^3 / d	1A2f	2A6	2A6	2A6
Quarries and related stone processing	1A2f	2A5a	2A5a	2A5a
Extraction and processing of silicate raw materials and other raw materials for the production of construction materials or of other industrial materials except construction sand and gravel in the wet state	1A2f	2A5a	2A5a	2A5a
Production of unburnt masonry materials and prefabricated products with projected production capacity in m^3 / h	1A2f	2A6	2A6	2A6
Industrial production of concrete, mortar or other building materials with projected production capacity in m^3 / h	1A2f	2A6	2A6	2A6
CHEMICAL INDUSTRY				
Extraction of crude petroleum and related transport and storage	1A5a	1B2ai	1B2ai	1B2ai
Extraction and storage of natural gas	1A5a	1B2b	1B2b	1B2b
Pumping distribution warehouses and separate pumping equipment for fuels, lubricants, petrochemical products and other organic vapor pressure fluids according to Annex No 3, second part of point 2.2, except for liquefied hydrocarbon gases and compressed natural gas, according to: installed aggregate storage volume in m^3, or - the projected or actual annual turnover in m^3, whichever is greater	1A5a	2B10b	2B10b	2B10b
Manufacture of synthetic rubber	1A2c	2B10a	2B10a	2B10a

CATEGORY NAME	2017 ALLOCATION		2018 RELLOCATION	
	COMBUSTION SOURCES.	NON-COMBUSTION SOURCES.	COMBUSTION SOURCES.	NON-COMBUSTION SOURCES.
Manufacture of basic plastic materials based on synthetic and natural polymers, excluding synthetic rubber	1A2c	2B10a	2B10a	2B10a
Manufacture of simple hydrocarbons j. linear or cyclic, saturated or unsaturated, aliphatic or aromatic	1A2c	2B10a	2B10a	2B10a
Production of organic halogenated compounds	1A2c	2B10a	2B10a	2B10a
Manufacture of oxygen-containing organic compounds	1A2c	2B10a	2B10a	2B10a
Manufacture of sulfur-containing organic compounds	1A2c	2B10a	2B10a	2B10a
Manufacture of nitrogen-containing organic compounds excluding urea	1A2c	2B10a	2B10a	2B10a
Production of phosphorus-containing organic compounds	1A2c	2B10a	2B10a	2B10a
Production of organometallic compounds	1A2c	2B10a	2B10a	2B10a
Manufacture of plant protection products and biocides	1A2c	2B10a	2B10a	2B10a
Manufacture of rubber auxiliary products	1A2c	2B10a	2B10a	2B10a
Production and processing of viscose	1A2c	2B10a	2B10a	2B10a
Manufacture of cellulose and its derivatives, including processing of waste into products from such manufacture	1A2d	2H1	2H1	2H1
Manufacture of paints, varnishes, printing inks, adhesives with projected consumption of organic solvents in t / year	1A2c	2D3g	2D3g	2D3g
Production of pharmaceutical products with projected consumption of organic solvents in t / year	1A2c	2D3g	2D3g	2D3g
Manufacture of inorganic gaseous substances and compounds except ammonia	1A2c	2B10a	2B10a	2B10a
Production of inorganic acids	1A2c	2B2	2B2	2B2
	1A2c	2B10a	2B10a	2B10a
Manufacture of inorganic hydroxides	1A2c	2B10a	2B10a	2B10a
Manufacture of inorganic salts, except fertilizers	1A2c	2B10a	2B10a	2B10a
Manufacture of non-metals, metal oxides and other similar inorganic compounds such as sodium, calcium, silicon, phosphorus, silicon carbide, calcium carbide	1A2c	2B10a	2B5	2B5
Production of sulfur	1A1b	2B10a	2B10a	2B10a
	1A1c	2B10a	2B10a	2B10a
Production of ammonia	1A2c	2B1	2B1	2B1
Urea production	1A2c	2B10a	2B10a	2B10a
Manufacture of fertilizers based on nitrogen, phosphorus and potassium - single or combined, excluding urea	1A2c	2B10a	2B10a	2B10a
Manufacture of inorganic pigments, refining and bleaching preparations	1A2c	2B10a	2B10a	2B10a
Manufacture of industrial explosives	1A2c	2B10a	2B10a	2B10a
Production and processing of carbonaceous materials: (a) production of charcoal with projected production in kg / d (b) production of soot (c) firing of carbonaceous materials, including impregnation (d) mechanical treatment of carbonaceous materials	1A2c	2A6	2B10a	2B10a
Rubber production and processing: - projected consumption of organic solvents in t / year - manufacture of raw rubber compounds - projected processing of the rubber compound in kg / h	1A2c	2D3g	2D3g	2D3g
Production of soaps, detergents and cosmetics with projected production capacity in kg / h: a) detergents b) cosmetics	1A2c	2B10a	2B10a	2B10a
Industrial extraction of vegetable oils and animal fats and refining of vegetable oils with projected consumption of organic solvents in t / year	1A2c	2G	2D3i	2D3i
Production and processing of paper and board with projected output in t / d	1A2d	2H1	2H1	2H1
Manufacture of waterproofing materials and floor coverings	1A2c	2D3c	2D3c	2D3c
Industrial processing of plastics: (a) production of fibers with projected capacity in t / year	1A2c	2D3g	2D3g	2D3g

CATEGORY NAME	2017 ALLOCATION		2018 RELLOCATION	
	COMBUSTION SOURCES.	NON-COMBUSTION SOURCES.	COMBUSTION SOURCES.	NON-COMBUSTION SOURCES.
(b) manufacture of film and other products with projected amount of polymer processed in kg / h (c) processing of styrene-added polyester resins or amine epoxy resins, for example, the manufacture of boats, trolleys, automotive parts, with projected raw material consumption in kg / d (d) processing of aminoplasts or phenolic resins with projected raw material consumption in kg / d (e) manufacture of polyurethane products with projected consumption of organic solvents in t / year f) production of expanded plastics, such as expanded polystyrene, with projected consumption of organic blowing agents in t / year				
Manufacture, recovery and disposal of electric accumulators and monocouples	1A2gviii	2H3	2C5	2C5
Petrol filling stations according to projected annual turnover or actual annual turnover in m3 / year	1A5a	1B2av	1B2av	1B2av
Other chemical products not listed, including the processing of raw materials and intermediate products - breakdown according to 2.99	1A5a	2L	1A2gviii	2B10a
	1A2d	2H1	1A2gviii	2B10a
	1A2c	2B10a	1A2gviii	2B10a
	1A2gviii	2L	1A2gviii	2B10a
	1A5a	2L	1A2gviii	2B10a
WASTE MANAGEMENT AND CREMATORIES				
Waste water treatment plants with projected treatment capacity by population equivalent: (a) municipal waste water treatment plants (b) industrial waste water treatment plants	1A5a	5D1	5D1	5D1
	1A5a	5D2	5D2	5D2
Other Waste Treatment and Treatment Equipment and Technologies - the breakdown referred to in paragraph 2.99	1A5a	2L*	1A5a	2H3
OTHER INDUSTRY AND EQUIPMENT				
Painting shops in the automotive industry with projected consumption of organic solvents in t / year	1A5a	2D3d	2D3d	2D3d
Surface treatment of road vehicles with total projected consumption of organic solvent in t / year: (a) in the manufacture of small series cars (b) the initial coating of road vehicles with materials intended for the after-treatment of vehicles, if the activity is carried out outside the production line; including coating of trailers and semi-trailers (c) car repair - spraying of cars	1A5a	2D3d	2D3d	2D3d
Coating on surfaces, painting with projected consumption of organic solvents in t / year: (a) metals and plastics, including surfaces of ships, aircraft, rolling stock; textiles, fabrics, foils, paper (b) for coiled wires (c) for winding belts of metallic materials	1A5a	2D3d	2D3d	2D3d
Degreasing and cleaning of surfaces of metals, electrical components, plastics and other materials including removal of old paints with organic solvents with projected consumption in t / year: a) organic solvents according to § 26 par. 1 (b) other organic solvents	1A5a	2D3e	2D3e	2D3e
Dry cleaning of textiles, bleaching and dyeing of textiles and other fibrous materials, such as flax, cotton, jute, according to: (a) projected consumption of organic solvents in t / year (b) the projected quantity in t / d of bleached or dyed fabrics or fibers	1A5a	2D3f	2D3f	2D3f
Adhesive application - gluing of other materials except wood, wood products and agglomerated materials, leather and footwear production, with projected consumption of organic solvents in t / year	1A5a	2G	2D3i	2D3i
Polygraphy according to projected consumption of organic solvents in t / year: (a) publishing rotogravure printing (b) other rotogravure printing (c) thermal rotary offset	1A2d	2D3h	2D3h	2D3h

CATEGORY NAME	2017 ALLOCATION		2018 RELLOCATION	
	COMBUSTION SOURCES.	NON-COMBUSTION SOURCES.	COMBUSTION SOURCES.	NON-COMBUSTION SOURCES.
d) flexography (e) painting and laminating techniques (f) rotary screen printing on textile, cardboard (g) other printing techniques, such as cold offset, sheet and other				
Application of powder coatings without the use of organic solvents with projected powder consumption in t / year	1A5a	2G	1A5a	1A5a
Industrial wood processing: (a) mechanical processing of lump wood with a projected amount of wood processed in m^3 / d (b) mechanical treatment of disintegrated wood, such as sawdust, wood chips, shavings, chips, with a projected amount of processing in m3 / d (c) production of agglomerated sheet materials with projected consumption of polycondensation adhesives in dry matter in t / year	1A2gviii	2I	2I	2I
Treatment and surface treatment using organic solvents, including ancillary activities such as cleaning, according to the projected consumption of organic solvents in t / year: (a) the application of adhesives (b) laminating wood and plastics c) coating (d) impregnation				
Manufacturing and processing of leather: (a) manufacture of leather with a projected quantity of products in t / d (b) processing of leather except footwear production, painting and other coating of leather, with projected consumption of organic solvents in t / year	1A2gviii	2L	2D3i	2D3i
Manufacture of footwear with projected consumption of organic solvents in t / year	1A2gviii	2G	2D3g	2D3g
Slaughterhouses with projected live weight capacity in t / d at a monthly average (a) poultry, lagomorphs (b) domestic ungulates (c) other (eg fish)	1A2e	2H2	1A2e	1A2e
Sugar factories with projected production capacity of sugar in t / h	1A2e	2H2	1A2e	1A2e
Canning and other food processing plants with projected production capacity in t / d: (a) meat products (b) plant products (on average per quarter)	1A2e	2H2	1A2e	1A2e
Distilleries with a projected production capacity of 100% alcohol in t / year	1A2e	2H2	1A2e	1A2e
Breweries with projected production in hl / year	1A2e	2H2	1A2e	1A2e
Food mills with projected power in t / h	1A2e	2H2	1A2e	1A2e
Production of industrial feed and organic fertilizers with projected output in t / h	1A2gviii	2H3	2B10a	2B10a
Dryers for agricultural and food products with projected power in t / h, or - combustion of fuels in combustion plants with rated thermal input in MW	1A4ci	2L	1A4ci	1A4ci
Roasting installations with projected capacity in kg / h: (a) coffee, coffee beans (b) cocoa beans or nuts	1A2e	2H2	1A2e	1A2e
Smokers for food products with projected smoking capacity in kg / week	1A2e	2H2	1A2e	1A2e
Production of felt and processing of other fibrous biomass with projected capacity of processed raw material in t / d	1A2gviii	2H3	1A2gviii	1A2gviii

ANNEX X: TIMETABLE FOR METHODOLOGY IMPROVEMENT OF REPORTING OG HEAVY METALS AND PERSISTENT ORGANIC POLLUTANTS IN SECTROS INDUSTRY AND ENERGY

TASK	OUTCOME	TIMECHEDULE	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	**To be 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**