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Informative Inventory Report

Czechia

2026

Submission under the UNECE Convention on Long-range Transboundary Air Pollution

Reported inventories 1990–2024

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Subtitle

Emission inventories from the base year of the protocols to the year 2024

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This report describes methodologies of emission inventory compiling used in Czechia. The report is compiled under the UNECE Convention on Long range Transboundary Air Pollution, as well as the Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants (NEC Directive), in accordance with the EMEP/EEA air pollutant emission inventory guidebook.

Informative Inventory Report Czechia 2026

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Abbreviations

AAP	Annual Average Population
A/C	Air-conditioning
AD	Activity Data
BP	Biogas Plant
CCR	Czech Car Registry
CDV	Transport Research Centre
CeHO	Centre for Waste Management
CEI	Czech Environmental Inspectorate
CENIA	Czech Environmental Information Agency
CHMI	Czech Hydrometeorological Institute
CNG	Compressed Natural Gas
COPERT	Computer Programme to calculate Emissions from Road Transport
CS	Country Specific
CZ	Czechia
CZ Biom	Czech Biomass Association
CZBA	Czech Biogas Association
CZSO	Czech Statistical Office
ČD	České dráhy
EEA	European Environment Agency
EFs	Emission Factors
EIA	Environmental Impact Assessment
EMEP	European Monitoring and Evaluation Programme
EIG	Emission inventory guidebook
EMRT	EEA Emission Review Tool
FAME	Fatty Acid Methyl Esters
FRS CR	Fire Rescue Service of the Czechia
GDP	Gross domestic product
HDV	Heavy Duty Vehicle
IEA	International Energy Agency
IFR	Instrument Flight Rules
IPR	Integrated Pollution Register of the Environment
ISOH	Waste Management Information System
ISPOP	Integrated System for Fulfilment of Reporting Duties
LCP	Large Combustion Plants
LDV	Light Duty Vehicle
LPG	Liquefied Petroleum Gas
LPS	Large Point Sources
LTO	Landing/Take-off
MoI	Ministry of Industry and Trade
MoA	Ministry of Agriculture
MoE	Ministry of the Environment
MoT	Ministry of Transport
MSW	Municipal Solid Waste
NACE	Statistical Classification of Economic Activities
NECD	National Emission Reduction Commitments Directiv
NECP	National Energy and Climate Plan of the Czechia

NACP	National Emission Reduction Program of the Czechia
NR	Not Reported
PaMs	Politics and Measures
PC	Passenger Car
REZZO	Register of Emissions and Stationary Sources of air pollution
SCR	Selective Catalytic Reduction
SOE	Summary Operation Evidence
SPE	Summary Operation Records
STK	Technical Control Station/Technical Inspection Station
SVUOM	National Research Institute for the Protection of Materials
SWDS	Solid Waste Disposal Sites
TCS	Database of Technical Control Stations
TERT	Technical Expert Review Team
TGM WRI	T. G. Masaryk Water Research Institute
ÚCL	Civil Aviation Authority of the Czechia
UKZUZ	Central Institute for Supervising and Testing in Agriculture
VFR	Visual Flight Rules
VUZT	Research Institute of Agricultural Technology
WaM	Scenario with Additional Measurements
WM	Scenario with Measurements
WMP	Waste Management Plan

Executive Summary

Czechia acceded to The Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe (UNECE/CLRTAP) and has been a member of the EU since 2004 [1]. These commitments create the obligation to report annual emission data. The report includes a description of the emission estimation methodology.

Since 2019, selected documents related to emission inventory processing has been made available online in the form of electronic attachments e-ANNEX (see under section “Dokumenty EMEP”).

As a part of the UNECE/CLRTAP and under the NEC Directive, Czechia annually reports data on air pollutants (AP) [1], [2]. The report covers the following pollutants, see ANNEX I:

- main pollutants: nitrogen oxides (NO_X as NO_2), non-methane volatile organic compounds (NMVOC), sulphur oxides (SO_X as SO_2), ammonia (NH_3);
- particular matter: particulate matter (PM) with diameters approx.10 micrometres PM_{10} and fine particular matter $PM_{2.5}$, which are smaller than 2.5 micrometres, total suspended particulate (TSP), black carbon (BC);
- carbon monoxide (CO);
- priority heavy metals (HMs): Lead (Pb), Cadmium (Cd) and Mercury (Hg);
- additional heavy metals (HMs): Arsenic (As), Chromium (Cr), Copper (Cu), Nickel (Ni), Selenium (Se), Zinc (Zn)
- persistent organic pollutants (POPs): polychlorinated dibenzodioxins/dibenzofurans (PCDD/PCDF), hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs). PAHs consist of benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene, and Indeno (1,2,3-cd) pyrene.

Emissions are reported in accordance with the structure of the EMEP/EEA air pollutant emission inventory guidebook (EIG). Emission factors (EFs) were applied under EMEP/EEA EIG 2023 [3].

Main updates presented in IIR 2026

In 2025, a new QAQC methodology was implemented at CHMI. The sectors prepared in CHMI were checked using the new tools. New QAQC processes are primarily used to perform routine and consistent checks and to identify errors. For more information see the e-ANNEX under the section “QA/QC”.

Chapter X. Reporting of gridded emissions and LPS were updated based on reporting for data 2023 submitted 1. 5. 2025.

Accepted TERT recommendation under the NECD review and other recalculations are presented in the Chapter XII.

Significant emission trends in Czechia

At ORLEN Unipetrol RPA s.r.o., Litvínov, emissions from petroleum refining and related chemical production increased due to operating conditions that required the combustion of sulphur-containing process gases in flares. This was reflected primarily in SO_X emissions, which according to the data reported under E-PRTR, increased year-on-year by more than 4.8 kt.

Emissions from highway construction, reported under NFR 2A5b, are calculated for the year in which new highway sections are opened to traffic. In 2024, a total of 134 km of highways were completed. The calculated emissions of more than 12 kt of TSP contributed to the year-on-year increase in total emissions.

Share of categories in Czechia in 2024

The sector of residential heating (NFR 1A4bi) contributes significantly to air pollution, specifically $PM_{2.5}$ emissions (76.0%), PM_{10} emissions (53.4%), CO emissions (69.6%) and benzo[*a*]pyrene (92.3%). The decisive share of the public sector energy (NFR 1A1a) prevailed in emissions of SO_X (32.8%) and Hg (48.6%).

The Passenger cars - 1A3bi (20.4%), Public electricity - 1A1a (18.4%), Inorganic N-fertilizers – 3Da1 (9.3%), Heavy duty vehicles and buses - 1A3biii (7.8%) and other sources belong to Transport, Stationary combustion sources or Agriculture created more than 80% of total NO_X emissions. Agriculture (NFR 3D and 3B) is the main source of ammonia emissions, whose share of total emissions is more than 80%.

The figures below present trends in the main pollutant emissions from 1990 to 2024.

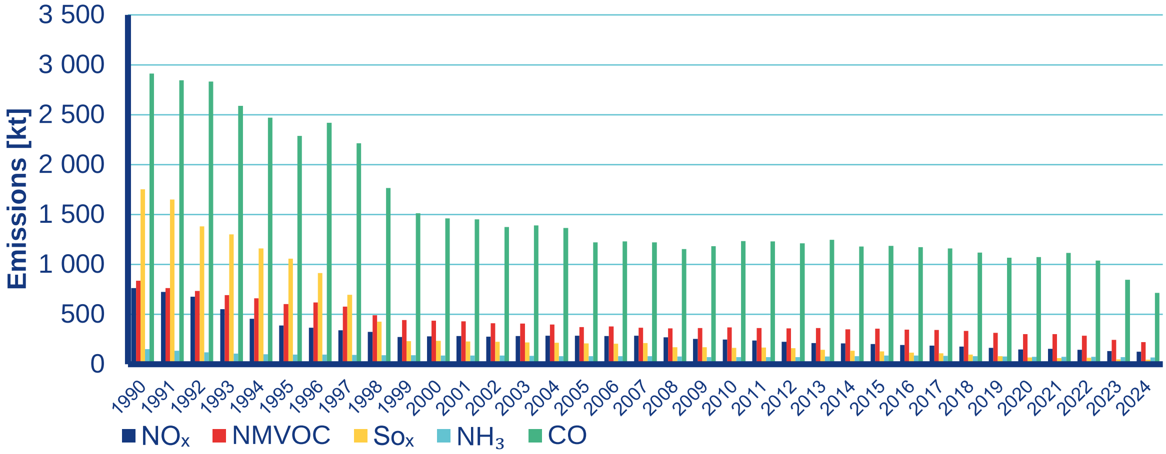

Figure 1 Total emissions of main pollutants, 1990–2024

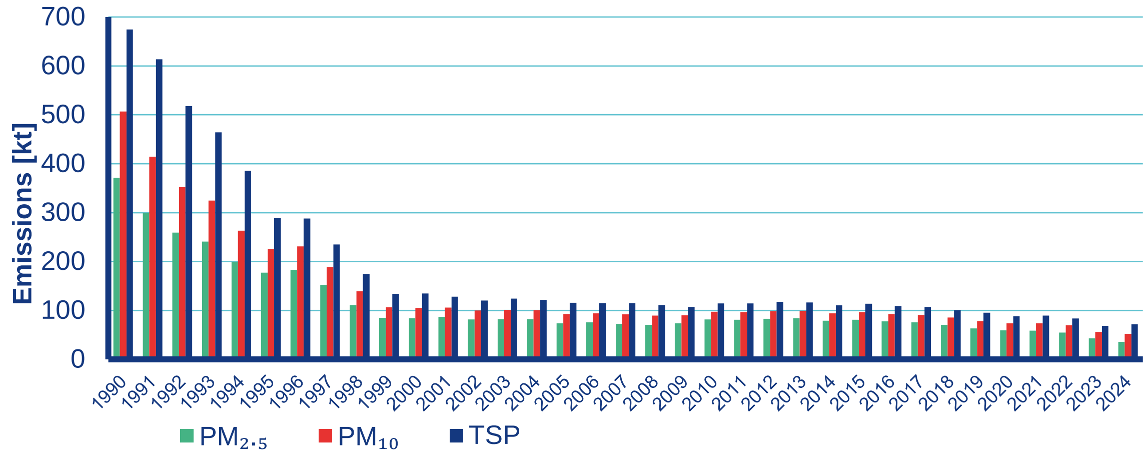

Figure 2 Emissions of particular matter, 1990–2024

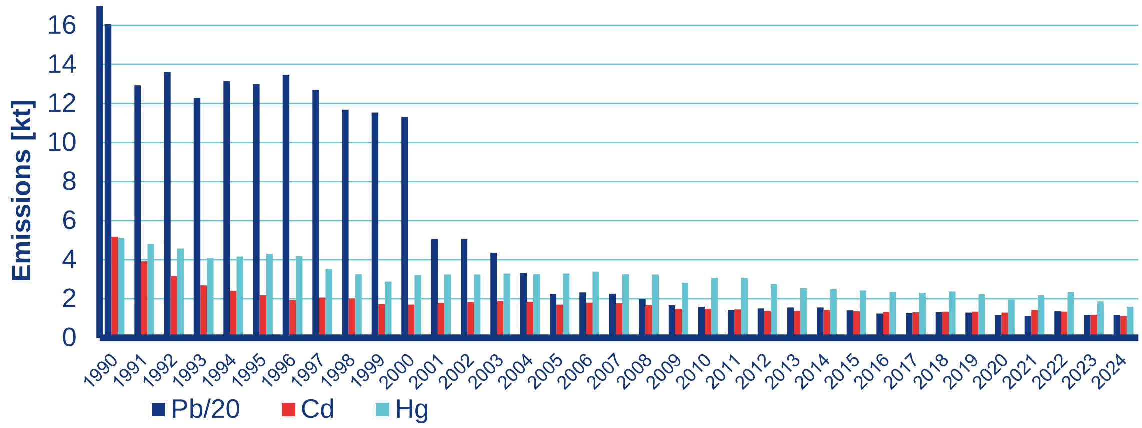

Figure 3 Emissions of heavy metals, 1990–2024

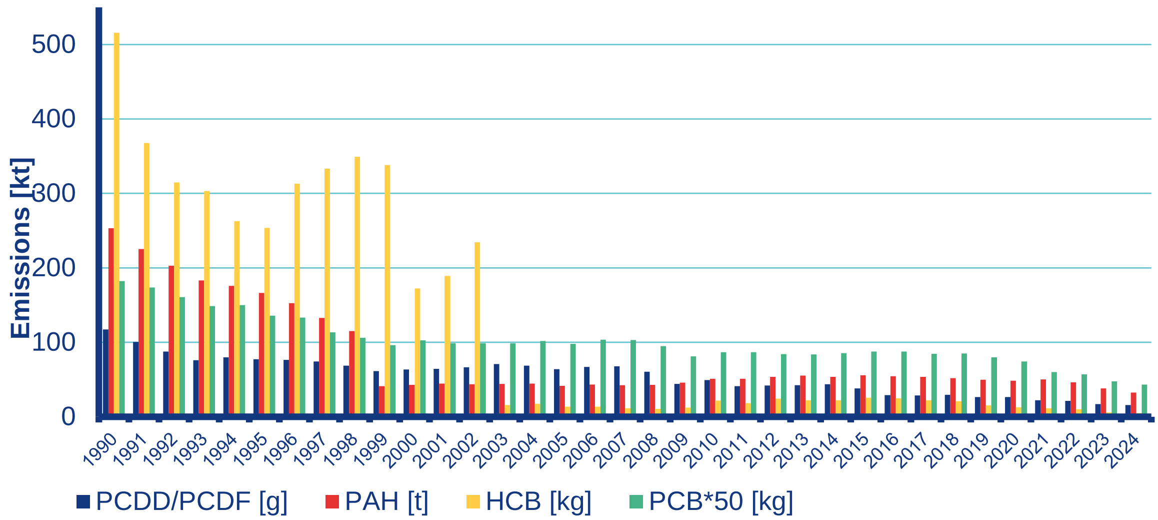

Figure 4 POPs emissions, 1990–2024

I. Introduction

Date of the last revision: 15 March 2026

I.1 National Inventory Background

UNECE/CLRTAP was negotiated in 1979 and is an important instrument for preventing the long-range transfer of air pollution [1]. The Convention has a framework character: the contractual reduction of air pollution is achieved through protocols adopted under the Convention. Eight protocols have been adopted. Czechia acceded to the Convention on 1 January 1993 and is a party to all eight protocols.

- Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe. It was agreed upon in 1984 and entered into force on 28 January 1988.
- Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30%. It was agreed upon in 1985 and entered into force on 2 September 1988.
- Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes. It was agreed in Sofia in 1988 and entered into force on 14 February 1991.
- Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes. It was adopted in 1991 and entered into force on 29 September 1997.
- Protocol on Further Reduction of Sulphur Emissions. It was agreed upon in Aarhus in 1994 and entered into force on 5 August 1998.
- Protocol on Heavy Metals. It was adopted in 1998 and entered into force on 29 December 2003. The protocol provides a framework for modelling the long-range transport of heavy metals (cadmium, lead and mercury) and their accumulation in soil, water, river and sea sediments, etc.
- Protocol on Persistent Organic Pollutants (POPs). It was adopted in 1998 and entered into force on 23 December 2003.
- Protocol to Abate Acidification, Eutrophication and Ground-level Ozone. It was adopted on 30 November 1999 and entered into force on 17 May 2005.

The current CLRTAP development strategy focuses primarily on increasing ratifications and on revising the last three protocols, i.e. the revision of the Protocol on Heavy Metals, Protocol on Persistent Organic Pollutants and Protocol to Abate Acidification, Eutrophication and Ground-level Ozone. An important task is to strengthen the implementation of these protocols and the emission reporting by the Parties, including its verification and control.

According to the Guidelines for Estimating and Reporting Emission Data, each party must report annual national emission data for pollutants by nomenclature for reporting (NFR) source category and submit an informative inventory report using the latest version of the reporting templates to the Convention Secretariat.

I.2 Institutional arrangements

Date of the last revision: 15 March 2026

CHMI, under the supervision of the MoE, is designated as the coordinating and managing organisation responsible for the compilation of the national inventory, projection and reporting of its results.

Inventories and projections were prepared with the external help of:

- Transport Research Centre (CDV), Brno and MOTRAN, which compiled the inventory and projection for NFR 1A3 Road and non-road Transport.
- Czech Agrifood Research Center (CARC) Prague, which compiled the inventory and projection in NFR 3 Agriculture and NFR 1A4cii non-road Agricultural and Forestry mobile sources.
- National Research Institute for the Protection of Materials, Ltd. (SVUOM), Prague, which compiled the NFR 2D Solvent Use inventory.
- Charles University Environment Centre, Prague, which compiled the projection for NFR 1A1, 1A2 and 1A4.

The list of sectorial experts responsible for preparing the inventory is presented in Table I.1.

Table I.1 Institution arrangement

Sector	Author	Institution	E-mail
Energy	Ilona Dvořáková Pavel Machálek Miloslav Modlík*	CHMI MoI*	ilona.dvorakova@chmi.cz pavel.machalek@chmi.cz miloslav.modlik@mpo.gov.cz*
Transport	Leoš Pelikán Zuzana Kačmárová	CDV	leos.pelikan@cdv.cz zuzana.kacmarova@cdv.cz
Industrial processes	Ilona Dvořáková Pavel Machálek	CHMI	ilona.dvorakova@chmi.cz pavel.machalek@chmi.cz
Agriculture	Martin Dědina	CARC	martin.dedina@carc.cz
Waste	Ilona Dvořáková	CHMI	ilona.dvorakova@chmi.cz
HMs, POPs emissions	Pavel Machálek	CHMI	pavel.machalek@chmi.cz
NMVOC emissions from Industry	Hana Geiplová	SVUOM	geiplova@svuom.cz
GRIDDED emissions	Pavel Machálek Ondřej Vlček	CHMI	pavel.machalek@chmi.cz ondrej.vlcek@chmi.cz
LPS	Ilona Dvořáková	CHMI	ilona.dvorakova@chmi.cz
Projections	Jiří Dufek Martin Dědina Lukáš Rečka Dali Tsintskiladze Laxton Saarikivi Risto Juhana Alfiya Kassymova	 CHMI CDV CARC CUE	jiri.dufek@motran.info martin.dedina@carc.cz lukas.recka@cuni.cz dali.laxton@czp.cuni.cz ristojuhana.saarikivi@chmi.cz alfiya.kassymova@chmi.cz
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I.3 Inventory preparation process

Date of the last revision: 15 March 2026

The Czech emission inventory is carried out under the National Law for the Prevention of Air Pollution and Reduction of Air Pollution from 2012. This include Act 201/2012 Coll. on Air Protection Act and Regulation 415 /2012 Coll. on the Permitted Level of Pollution and its ascertainment and on implementing of certain provisions of the Air Protection Act [4].

The information is stored in the Register of Emissions and Stationary Sources (REZZO), maintained by the Czech Ministry of the Environment (MoE). This emission database, used for archiving and presenting data on stationary and mobile sources of air pollution, is, under the applicable law (Section 7 of the Air Protection Act), part of the Air Quality Information System (ISKO) operated by CHMI. Air pollution sources are divided into individually monitored sources, and sources monitored as area sources.

Since 2013, following changes in the categorisation of sources according to Annex 2 of the Air Protection Act, REZZO sources have been newly defined (Table I.2).

Table I.2 The categorisation of pollution sources

Category	Type of source	Origin of emissions	Category
REZZO 1	Stationary plants for fuel combustion with a nominal heat input of 0.3 MW or higher, waste incinerators, and other specified sources, including technological combustion processes and industrial production	Reported emission data	Individually monitored sources – reported emissions
REZZO 2	Stationary plants for combustion of fuels with a nominal heat input of up to 5 MW inclusive, combusting liquid or gas fuels and service stations or facilities for transporting and storing petrol fuel	Calculated from reported activity data (fuel consumption and calorific capacity, gasoline distribution) and emission factors	Individually monitored sources – emissions calculated from the reported data and emission factor
REZZO 3	Combustion of fuels with a total thermal input lower than 0.3 MW, non-specified technological processes (domestic solvent use, building and agricultural activities)	Calculated from activity data obtained, e.g. from the Census, production and statistical energy surveys, and emission factors	Sources monitored collectively
REZZO 4	Road, railway, water and air transport of persons and EMEP/EEA EIG, tyre and brake wear, road abrasion and evaporation from fuel systems of vehicles using petrol, non-road vehicles and machines used in the maintenance of green spaces in parks and forests etc.	Calculated from activity data obtained, e.g. from road traffic census, the register of vehicles etc. and emission factors	Sources monitored collectively

This classification corresponds to the methodology used for compiling the emission inventory. Individually monitored sources REZZO 1 and REZZO 2 are mainly represented in categories NFR 1A (except mobile sources and 1A4bi), NFR 1B (except 1B1a and 1B2av), and in most of the categories NFR 2A (except 2A5b), 2B and 2C. Data reported for the Solvent Use sector are used only for NMVOC emission estimates. The entire inventory for NFR 2D (except 2D3b and 2D3c) is generated through model calculation. Emissions from waste combustion and cremations (NFR 5C1) are also monitored individually.

In other sectors, the emissions are calculated using emission factors and activity data. This applies to residential heating (NFR 1A4bi), all categories of mobile sources (NFR 1A3, except gas transport 1A3ei), part of NFR 1B, NFR 2A5b, and agricultural machinery (NFR 3).

I.4 Methods and data sources

Date of the last revision: 15 March 2026

The emission inventory of air pollutants in Czechia is prepared to fulfil reporting requirements. Calculations are based on a combined methodology. In addition to reported primary emission data from operators of sources, other information (fuel consumption, production, etc.) is also used to estimate emissions in certain sectors. A significant part of emissions is estimated based on statistically monitored and reported information and available emission factors.

The 2026 submission presents:

- Submission (1990–2024) of emissions in all categories
- A detailed description of the methodology and emission sources
- Notation keys for emissions and activity data were thoroughly revised and updated in NFR tables.
- Updates according to TERT recommendation presented in Chapter XII. The table of NECD review is also presented in the e-ANNEX.
- Chapter X. Reporting of gridded emissions and LPS were updated based on reporting for data 2023 submitted 1. 5. 2025.

Some changes in the use of notation keys; see e-ANNEX (NE_Notation_key_analysis_CZ2024)

I.4.1 Emissions from Individually Monitored Sources - Stationary Sources

Under Section 17 (Obligations of an Operator of a Stationary source), paragraph 3, the Air Protection Act, the operators of stationary sources listed in Annex 2 to this Act are obliged to keep operational records containing constant and variable information about the stationary source, describing the named source and its operation, as well as information on inputs and outputs from the named source. They are also required to disclose data each year summarising the operational records through the Integrated System for Notification Obligations (ISPOP). Reporting through this system has been mandatory since 2010. The ISPOP data are subsequently submitted to the REZZO 1 and REZZO 2 database. Annex 11 to Regulation 415/2012 Coll. Sets out the requirements for summary operating records.

Operators are obliged to provide emission data on pollutants emitted into the air from stationary source for each reported calendar year in which the operator of the stationary source, pursuant to Section 6(1) of the Act, has the stated obligation to determine emissions. Emission limit values are set out in Annexes 2–8 (specific) and Annex 9 (general) to Regulation 415/2012 Coll. Furthermore, specific emission limits, as well as the methods, conditions and frequency for determining pollution levels, may be stipulated for any pollutant in an operating permit issued by regional authorities. The manner and frequency of measuring or calculating pollution levels, and the scope, manner, and conditions for recording, verifying, evaluating, and storing the results of pollution level determination, are laid down in Regulation 415/2012 Coll. Part Two (Ascertainment of Pollution Level and Evaluation of Fulfilment of Emission Limits). According to the Tier 3 approach, emissions reported by the operators for their sources are preferred.

The use of emissions reported by source operators does not, in some cases, correspond to EMEP/EEA EIG [3], namely in categories where operated stationary sources do not reach the set threshold of named sources. Only for natural gas consumption are sufficient data enable emission calculation based on total fuel consumption.

Significant year-to-year changes for some very low emissions (usually less than 0.001 kt) may be caused by the methodology used for reporting data in categories with named sources. These emissions mostly result from annual one-time measurements conducted to demonstrate compliance with emission limits, where pollutant concentrations may depend on current equipment conditions, the fuel burned, material inputs, or abatement efficiency.

Emissions of pollutants for which operators are not required to determine pollution levels are calculated for each source in the emission database based on reported activity data and emission factors (Tier 1 or 2). Emission factors for stationary combustion sources are classified according to the type of fireplace and nominal thermal output. As activity data, fuel consumption is expressed in $t \cdot year^{-1}$, $thousand \cdot m^3 \cdot year^{-1}$, or the calorific capacity of fuel in $GJ \cdot year^{-1}$ is used. For other sources, emission factors are related to the amount of product in tonnes.

To determine PM_{10} and $PM_{2.5}$ emissions, emission factors expressed as a percentage of PM fraction in total suspended particulate (TSP) emissions are used. If a source is equipped with abatement technology, the particle share depends on the separation principle of that technology. For combustion sources without any abatement, particle shares are determined according to fuel type. For other sources, the origin of TSP is a key factor [5].

Monitored emissions, or emissions calculated on the basis of activity data, from individually monitored sources are used, in particular, for the following main categories – NFR 1A1, 1A2, 1A4 (except 1A4bi), 1B (except 1B1a and 1B2av), 2A (except 2A5b), 2B (except 2B1), 2C, 2I, 2L and 5 (except 5A). In addition, this approach is applied to category NFR 1A3ei and NFR 2D3c (Asphalt Roofing). Detailed information on selected categories is provided in e-ANNEX (REZZO-NFR_code.xlsx). Two exceptions apply to emissions of heavy metals and POPs: in some categories, emissions are adopted as reported, while in others they are calculated based on activity data or other statistical information on production facilities in specific product categories (for details, see Chapters III and Executive Summary). This category includes emission of coal sorting and drying, mainly in sorting plants producing coal for household consumption, coke plants, and wood coal production facilities. Emissions from coal sorting plants are usually based on the one-time measurement of suction devices. Emissions from wood coal production are measured during facility commissioning, and specific production emissions are subsequently used for annual reporting.

In addition to the categories mentioned above, the REZZO register also include emissions from solvent-using sources (NFR 2D3d to 2D3i). More than 4000 sources (such as painting and degreasing plants, printing plants etc.) produce over 7.8 kt of NMVOC emissions. These data are not used directly, however given the large number of non-monitored facilities and the area-source character of emissions from protective and decorative coating activities, they are used to derive more accurate estimates of total VOC emissions for each NFR 2D category (see Chapter IV.4).

Sources in NFR 5A are monitored in a similar manner. Permits for these sources generally include an obligation to determine TSP emissions. However, these sources are currently not used for emission inventory in NFR 5A, which is compiled using the Tier 1 methodology (see Chapter VI).

Emission Factors used

As stated above, the emission of the most important point sources is reported in Summary Operational Evidence (SOE). However, part of emissions is calculated using national emission factors. In particular, NMVOC emissions from combustion sources (boilers, piston engines and other sources) are included. Furthermore, $PM_{2.5}$ and PM_{10} emissions are calculated as a fraction of TSP-reported emissions. A similar approach is applied to emissions of heavy metals and POPs. In further calculations, emission factors from the EMEP/EEA EIG are used[3]. Additional information is provided in the following chapters.

Activity Data used

Activity data for individually monitored sources are usually obtained from reported SOE data. This includes fuel consumption of various fuels and their calorific values, recalculated to the heat content of the fuel (NFR 1A1, 1A2 a 1A4). Activity data presented in categories NFR 2A, 2B, 2C, 2H, and partly NFR 2D are taken from statistical data. Correct estimation of relevant activity data for organic solvent-using sources remains problematic, and completion of these data is expected in future reporting years. Activity data for NFR 5 are partly taken from reported data (waste combustion) and partly from statistical data. Detailed information on some categories is provide in the e-ANNEX.

I.4.2 Emissions from Collectively Monitored Sources

Stationary air pollution sources monitored collectively are registered in REZZO 3. They include:

- emissions from local household heating
- fugitive TSP emissions from construction activities
- emissions from coal, oil and natural gas mining
- food production and agricultural activities
- ammonia emissions from livestock breeding
- emissions from mineral fertiliser application
- VOC emissions from fuel distribution and from use of organic solvents

With the exception of emissions from local household heating, emissions from these sources are calculated solely using data obtained within from national statistical monitoring. Potential year-to-year changes are usually related to the development of the relevant indicators. By contrast, year-to-year changes in emissions from local household heating depend primarily on the characteristics of the heating season, expressed by the number of degree days, and on changes in the composition of combustion units. The calculation of emissions from local household heating is based mainly on the results of the Population and Housing census (SLDB). In 2023, a complete recalculation of emissions for the entire period since 1990 was carried out. The recalculation was based on newly compiled shares of individual boiler types derived from linked outputs of the ENERGO survey 2008, 2015 and 2021 and sales statistics from 1970.

Data of mobile sources registered in REZZO 4 are also monitored collectively. This category includes emissions from road, rail, water and air transport, as well as non-road vehicles (machines used in agriculture, forestry and construction industry, military vehicles, etc.). The database also includes emissions from tyres and brakes, road abrasion and evaporation emissions calculated from transport performance data. Since 1996, the Transport Research Centre (CDV) has complied the emission balances for mobile sources based on fuel sales data provided by the Czech Association of Petroleum Industry and Trade (ČAPPO); since 2000, data from Czech Statistical Office (CZSO), and CDV's own emission factors have also been used. CARC processes datasets on emission from mobile sources in agriculture and forestry. Consistent time series of emissions in the transport sector from 1990 onwards were reported for the first time on 15 February 2018. For road transport, the COPERT V emissions model was introduced by CDV in 2018. For non-road transport (NFR 1A4cii), the composition of the tractor and non-road machinery fleet and the related emissions were comprehensively revised in 2018 and 2024.

Emissions from area-monitored sources are reported mainly under NFR 1A3, with the exception of categories NFR 1A3ei and 3B. These also include other categories of mobile sources (NFR 1A2gvii, 1A4aii, 1A4bii and 1A4cii), coal mining (NFR 1B1a), distribution of fuel (NFR 1B2av), construction and demolition (NFR 2A5b) and solid waste disposal on land. Some area sources are also partially included under NFR 2D (Use of solvents).

Emission Factors used

Emissions from collectively monitored sources are calculated using emission factors. In some cases, national emission factors based on measurements of large group of sources (notably NFR 1A4bi) are preferred. For NMVOC emission in the category of Solvent use, both EMEP/EEA EIG emission factors (e.g., households use, NFR 2D3a) and national-specific emission factors (e.g. NFR 2D3d), derived from long-term reported data on solvent use, applied abatement techniques, and reported emissions, are applied. Detailed information on selected categories is provided in the e-ANNEX.

Activity Data used

Emissions from collectively monitored sources are calculated using activity data available on publicly accessible CZSO web pages (e.g. metal production and raw materials, agricultural production data, census ENERGO 2021, data from technical inspection of operated cars, waste data ISOH etc.). Some data are prepared directly by CZSO for the emission inventory (e.g. fuels sold), while other statistical data are used (e.g. customs statistics for estimating emissions from solvent use). More detailed information is provided in the following chapters, with selected category-specific data available in the e-ANNEX.

I.4.3 The Condensable Component of PM_{10} and $PM_{2.5}$ (Emission Factors)

Generally, emissions from individually monitored sources do not include a condensable component due to Czech legislation. TSP is measured using a heated apparatus, where a temperature is higher than the dew point of the exhaust gas (typically 70–160 °C). This applies mainly to NFR 1A1 and NFR 1A2 sources.

For collectively monitored sources, national emission factors for household heating (NFR 1A4bi) are based on sampling performed in the dilution tunnel at a temperature of approximately 40 °C. As a result, these EFs include a high proportion of the condensable component. Emissions from transport, calculated using the COPERT are also determined using dilution methods (including dilution tunnels or systems that dilute the sample after collection), and therefore include the condensable component.

I.4.4 Inventory preparation timetable

Table I.3 Preparation timetable

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Annual Reporting of Operators				Emission database ISKO & Basic data checks																				
Data of Czech Armed Forces																								
Agricultural Data - VÚZT																								
Reported Data Checks and Processing - CHMI																								
Industrial Processes - Solvents											Data for solvents available in October													
Public Electricity Sector - CZSO											Publication of energetic balance on 15.11. (IEA)													
Agricultural Data - CZSO																								
Transport Data - CDV																								
Waste Sector Data													Waste data available in January											
Finalization of Emission Inventory																								
Submission to CLRTAP																								
International Review UNECE															International review									

The collection of data from individually monitored sources is tied to the legal reporting deadline for the SOE 31 March. By the end of April, the first data in XML format are available in the central ISPOP database. During May, the submissions are checked, and in June, correction notifications are sent if data are missing or incorrect. A complete download of the submitted data, including additional or correction reports, is carried out in September. Additional announcements and corrections can still be processed at the beginning of December. The total number of operating sites may vary. Between 2000–2010, it typically fluctuated around 22 000, while currently it is approximately 17 000. Some sources or groups of sources are reported as a single entry (e.g. a cascade of gas boilers) and emissions or fuel consumption data by roughly 40 000 records a year.

Data processing in December and January focuses mainly on verifying the correctness of NFR assignments and the appropriate composition of emissions. If emissions are reported in a category where they are not expected, they are reassigned to the correct category (e.g. NO_X and CO reported at a VOC abatement site using solvents are shifted to NFR 1A2 or 1A4). The result of this processing is the total sum of category emissions, including individually monitored sources.

For emissions from of area-monitored sources in most categories, routine methodology procedures are applied, relying on timely activity data collected or publication by official authorities such as CZSO, Ministry of Industry and Trade (MIT) (fuel data, production facilities data), Ministry of Agriculture (MoA) (livestock and other indicators) and CHMI (number of degree days). Collection and processing of these data occur from May to December, with emission calculations for each category performed in January.

The final stage of data processing at the beginning of February involves is the emission sector specialists (transport, agriculture, solvent use) reviewing the emissions and completing the reporting template. New data are analyzed in comparison with the previous year. The IIR texts are finalized and translated into English in February and early March.

I.5 Key categories

The Key category analysis of the Czechia inventory is carried out according to the Tier 1 method described in the EMEP/EEA Guidebook. According to these guidelines, a key category is an emission category that significantly influences a country’s inventory in terms of the absolute level of emissions. Key categories are identified by summing emission categories in descending order of magnitude until they account for more than 80% of the total emissions.

National emissions have been disaggregated into the categories reported in the National Format Report; the level of details varies by pollutant to reflect specific national circumstances in 2024. The trend analysis has also been carried out for the years 1990, 2005 and 2024. The results are presented in Chapter II Key trends.

The main source of pollution in 2024 was NFR category 1A4bi (Residential stationary). This category ranked first for nine pollutants (NMVOC, $PM_{2.5}$, PM_{10}, TSP, CO, PAH, HCB, PCDD/PCDF, Cd). The second most frequent key category was 1A1a (Public electricity and heat production), which ranked first for two pollutants (SO_X and Hg) and was also significant for several others. No significant events affecting emissions occurred in 2024.

I.6 QA/QC and Verification methods

Date of the last revision: 15 March 2026

Quality Control (QC) is a system of routine technical activities used to measure and control the quality of the inventory as it is being developed.

Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the preparation of the emission inventory.

The air pollutant emission inventory process is a part of the Air Quality System and Management in Czechia. According to § 7 of the Air Quality Act 201/2012 Coll., and based on collected data, MoE performs the emission inventory, which includes the total amounts of air pollutants emitted into the atmosphere in the previous year as well as emission projections for the coming years. CHMI is authorised to monitor the air quality in Czechia. The emission inventory process is legally linked to the other air quality and integrated pollution prevention and control bodies, including Czech Environmental Inspectorate and regional authorities.

I.6.1 QC procedures

The basic principle of emission inventory processing in Czechia consists of a dual system, including processing reported data of individual facilities (emissions or activity data enabling emissions calculations) and emission calculations based on national statistics. Despite significant differences between these approaches, quality control procedures are similar to a large extent. They are based on thorough methodology preparation of each annual inventory, including the preparation of processing time schedules, the allocation of sectoral responsibilities to individual editors, consideration of new requirements or results of performed revisions, and fulfilment of quality control (QC) plan. The actual control procedures include, for example, data completeness checks (mainly for individually monitored sources), a consistent approach to necessary expert estimates and thorough documentation of all emission inventory input data as well as procedures for processing final results. These results of quality control checks and procedures are documented.

The use of templates for data processing allows for straightforward checking of data units and calculations, and their continued use ensures data consistency. Templates also preserve calculations and linkages from lower reporting levels, thereby eliminating human error in transcription of numerical or textual values. An additional internal template-based QC method is used to check the temporal consistency of reported data, as well as to identify data that may have remained unchanged from previous reporting years, either as a result of template reuse or oversight during the data seeding. This method is also used to identify unusual trends in parameters such as activity data.

Gaps in data and the use of special symbols resulting from these gaps are documented and explained in IIR within the relevant chapters. The report content, including descriptions of activity data, emission factors, other estimation parameters, and categories, is reviewed and updated as needed during the annual revision of the template for the current reporting year. Similarly, the bibliography used for this report is reviewed to ensure consistency with the sources currently used in the preparation of both data and methodologies.

A new approach applied since 2018, reflecting Stage 3 recommendations and EMRT review, includes changes in methodology for sectorial emission inventory in cases where full completeness of individually collected data needs to be ensured. In such cases, sufficiently precise activity data are still available to enable the calculation of emissions representative of the entire sector. These results replace individually reported data initially selected for emission inventory compilation, by instead using national statistical data and emission factors recommended by the EMEP/EEA EIG [3]. Key sector whose emission inventories are currently based on individually reported emission data will undergo detailed review in future reporting periods, and modifications to data selection for emission inventory processing will be implemented where necessary.

During data selection for emission inventory processing, data up-to-dateness and completeness are checked. Data from the national statistics authority are verified to ensure they are current. Similarly, the ISPOP system used for reporting individual emission data for the emission inventory is regularly checked.

The procedure for processing individual data includes import of each report into the national emission database EDA, including the generation of a LOG entity that identifies reports which, due to some errors, could not be taken over for further emission inventory processing. Such reports must be corrected by the source operator, resubmitted and subsequently imported into the EDA database. The list of imported facilities is compared with the list of reports provided by the ISPOP operator. Random checks of the correctness of data transfer into the EDA database are also performed.

All individually received data are checked using internal tests to verify completeness of reported emissions. Their correctness is assessed in particular with respect to not exceeding the expected upper emission thresholds. Likewise, the completeness and correctness of reported activity data used for emission calculations of fuels and products are checked. The results of these checks are communicated to the source operator, and the implementation of corrections is supervised. Where necessary, the supervision authority (environmental inspectorate) is contacted to oversee the correcting procedure carried out by the source operator.

The processing of reported emissions and activity data is performed using automatic procedures implemented in the national EDA database. These procedures are regularly reviewed and updated. However, the classification of national categories does not usually allow for an unambiguous allocation of each reported emission to a specific sector. Therefore, final processing of emission datasets is carried out in MS Excel. Any manual intervention to the automatic allocation to NFR sectors are documented. In the final dataset, comprising more than 50 thousand items per year, a summary of individually reported or calculated emissions by sector is produced.

Collectively monitored sources in certain sectors (Transport, Agriculture and Residential sector) are processed using advanced MS Excel or simple table-based calculations incorporating activity data, emission factors, and resulting emissions. All tables are checked for calculation completeness and logical correctness. In the event of any errors, correction are made prior to finalising the reporting or through resubmission.

The conversion of emission data, whether reported or calculated, is carried out directly in MS Excel. File linking is used to reduce discrepancies during the completion of reporting files. However, several errors occurred in previous reporting periods. These errors were caused by incorrect placement of emission data in specific rows hidden while further processing, insufficient checking, or incorrect linking to the files containing annual summary data or to incorrect reporting period. To prevent such issues, a test version was subsequently locked to prevent modification of linking formulas during further processing.

An additional testing method has been applied since 2025. Based on data submitted in the previous year, it compares that data with the data to be reported, checking for changes in numerical values as well as changes to special labels or notation keys. This comparison is used to identify possible discrepancies in the new data, such as misplaced symbols or large differences in submitted numerical values. The implemented method uses automated comparison of standardized report files instead of manual checking, which carries a higher risk of human error. The method allows for completeness checks and reuse in subsequent years. In addition, it provides an easy overview of implemented changes and recalculations in reported categories. The MS Excel file used for this comparison is available in e-ANNEX.

Since 2025, a new QC method has begun to be implemented to check the consistency of data over time, beyond the basic checks previously applied. Implied emission factors are used (emission data divided by activity data), with the entire time series being evaluated, along with automated tools for outlier detection. Similar method is used for particulate matter fractions. Identified changes – especially outliers – are explained where possible. These explanations are added to e-ANNEX and will later be incorporated into the report itself once the method is fully implemented. The MS Excel files used are available in e-ANNEX.

In the IIR, individual tables are created that incorporate summary or specific reporting values. Given the large scale of the document, correct value setting could only be performed for selected tables and charts.

The reproducibility of individual calculations and data transfers is ensured by storing primary files containing activity data and emission factors, as well as files with intermediate or final calculations. When necessary, a textual record of calculations is also prepared.

For simultaneous work by sector solvers or air pollutants experts, documentation related to sectors solved by the main contributor (CHMI), including partial and final files archived on a shared drive, is regularly backed up and archived after the end of the reporting period. Similar data storage procedures are applied by external solvers.

I.6.2 QA procedures

Due to the insufficient expert capacity, review procedures at the national level have not yet been established. The emission inventory team uses recommendations and results of international reviews.

I.7 General uncertainty evaluation

Date of the last revision: 15 March 2026

In the preparation of emission inventories in Czechia, data are mainly obtained from operators of stationary air pollutant sources, statistical data from the CZSO (e.g. data on fuel consumption, number of vehicles and livestock, and areas of cultivated land), or from the Population and Housing census (information on household heating). These data are combined with emission factors and other relevant data sources.

From the above overview, it is clear that the emission data used to compile the inventory vary in quality. Emissions of individual point sources based on measurements are determined with lower uncertainty than emissions calculated using statistical data. The uncertainty of emissions from point sources is below 5% (e.g. emissions from large combustion sources), while the uncertainty of emission using model (e.g. emissions from household heating and exhaust emissions from transport) ranges between 25% to 30%. The uncertainty of emissions estimated using statistical data and predefined emission factors is assessed according to the EMEP/EEA EIG methodology and ranges from 50% to 200% (this approach is used, for example, to estimate emissions from solvent use, animal production, and non-combustion emissions from transport) [3].

I.8 General assessment of completeness

I.8.1 Sources Not Estimated (NE)

Notation key: “**NE”** (Not Estimated) is used for emissions from existing sources of compounds that have not been estimated. Where “NE” is applied in the inventory, the Party should indicate why the emissions could not be estimated. For applying of the “NE” notation key generally follows the recommendations provided in the emission factor tables of the EMEP/EEA EIG [3].

The “NE” notation key table is available in the appendix e-ANNEX.

I.8.2 Sources Included Elsewhere (IE)

Notation key: “**IE”** (included elsewhere) is used for emissions from sources of compounds that are estimated but reported a different source category elsewhere in the inventory rather than in the expected source category.

Table I.4 Sources included elsewhere

NFR s	Long name	Reason for IE
1A3aii(i)	Domestic aviation LTO (civil)	1990–1995 included in 1A3ai(i)
1A4aii	Commercial/institutional: Mobile	1990–1997 included in 1A3b
1A4bii	Residential: Household and gardening (mobile)	1990–1997 included in 1A3b
1A4ci	Agriculture/Forestry/Fishing: Stationary	NH_3 1990–2014 included in 1A4ai
1A5a	Other stationary (including military)	1990–2015 included in 1A4ai
1B2c	Venting and flaring (oil, gas, combined oil and gas)	1990–1999 included in 1B2aiv
2A2	Lime production	PM 1990–1999 included in 1A2f

2A3	Glass production	PM 1990–1999 included in 1A2f
2A6	Other mineral products	NO_X, SO_X 1990–1999 included in 1A2f
2B6	Titanium dioxide production	Main, PM 1990–1999 included in 1A2c
2C1	Iron and steel production	HCB included in 1A2a; Main, PM, CO 1990–1999 in 1A2a
2C3	Aluminium production	PM 1990–1999 included in 1A2a
2C4	Magnesium production	PM 1990–2001 included in 1A2a
2C5	Lead production	SO_X included in 1A2b; PM 1990–1999 included in 1A2b
2C6	Zinc production	PM included in 1A2b
2D3c	Asphalt roofing	CO included in 1A2f; all 1990–1999 included in 1A2f
2H1	Pulp and paper industry	Main, PM, CO 1990–1999 included in 1A2d; NO_X, CO included in 1A2d
5C1bi–5C1biv	Waste incineration	included in 1A1a
I_Off road	(projection only)	included in 1A3biii

II. Key trends

Date of the last revision: 15 March 2026

The Key trends chapter summarizes distributions of main monitored pollutants in the Czechia in 2024 sorted by trend NFR categories. The emission of most observed emissions the Nitrogen oxides (NO_X as NO_2), Volatile organic compounds (NMVOC), Sulphur oxides (SO_X as SO_2), Ammonia (NH_3), Particular matter (PM), Total suspended particles, Carbon oxide (CO), Heavy metals (Cd, Hg, Pb) and POPs (PAHs, HCB, PCDD/PCDF) are presented in chapters down below.

II.1 Emissions of the key pollutants in 2024

Air pollution is related to the economic and socio-political situation, environmental knowledge, and development of technology. Emissions levels mostly depend on static sources, especially from categories REZZO 1 and 2, see Table I.1 Institution arrangement Table I.1. REZZO 1 and 2 sources have been major polluters in the past. However, in the 21st century, people invented and started applying several measuring devices, filtering tools and other abatements to diminish the pollution from the combustion gases. The Czechia and the European Union also strictly control emissions sources. Strict conditions for REZZO 1 and 2 reduce emissions, which can be transported by the atmosphere for a long range.

Although REZZO1 and 2 have emission limits, the required air quality still needs to be achieved. Stricter monitoring should be applied to REZZO 3 and 4 for better air quality results.

II.1.1 Nitrogen oxides (NO_X as NO_2)

In Czechia, the NO_X emissions have decreased since 1990 (763.83 kt) because of heavy industry´s lower activity and technological evolution. In 2005, the NO_X emission level was 286.34 kt, and in 2024, the total NO_X emission was 124.90 kt. The emission ceiling in 2024 was fulfilled.

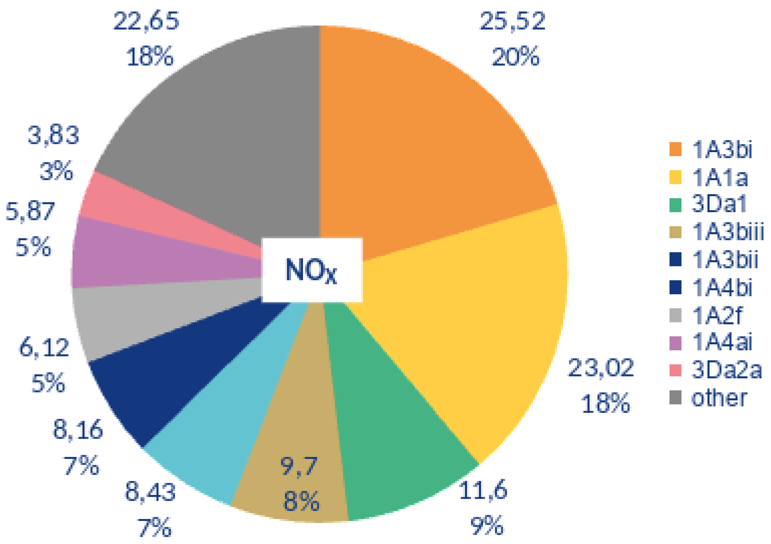


Figure II.1 The Key Trends of NFR categories for Nitrogen oxides in 2024. The share of emissions is presented in kt and%

II.1.2 Volatile organic compounds (NMVOC)

The NMVOC emission level in 1990 was 837.49 kt. In 2005, the NMVOC emission level was 373.04 kt, and in 2024, 220.05 kt of NMVOC was recorded. The emission ceiling was fulfilled.

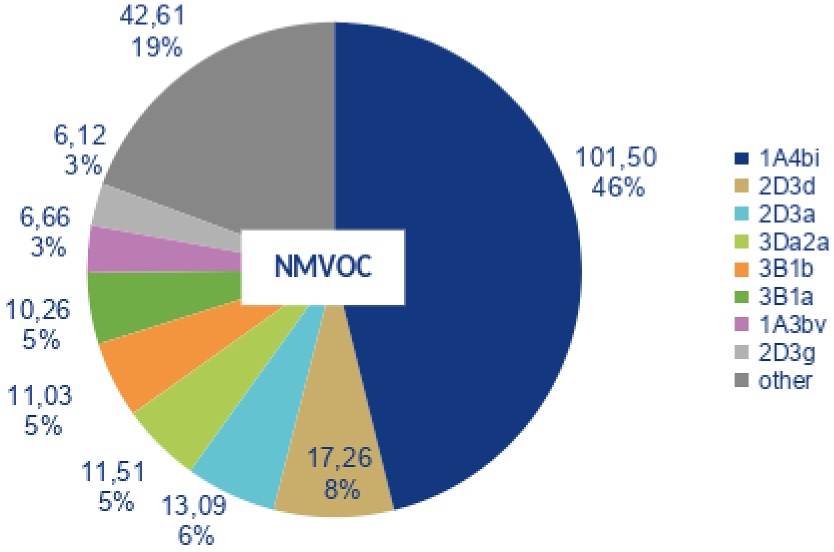


Figure II.2 The Key Trends of NFR categories for Volatile organic compounds in 2024. The share of emissions is presented in kt and%

II.1.3 Sulphur oxide (SO_X as SO_2)

In Czechia, due to the shutdown of old power stations and the application of depressurization in power generation, SO_X emissions have shown a steep decreasing trend over time. In 1990, the SO_X emission level was 1753.82 kt. In 2005, the SO_X emission level was 208.47 kt, and in 2024 the total SO_X emission was 43.83 kt. The emission ceiling was fulfilled.

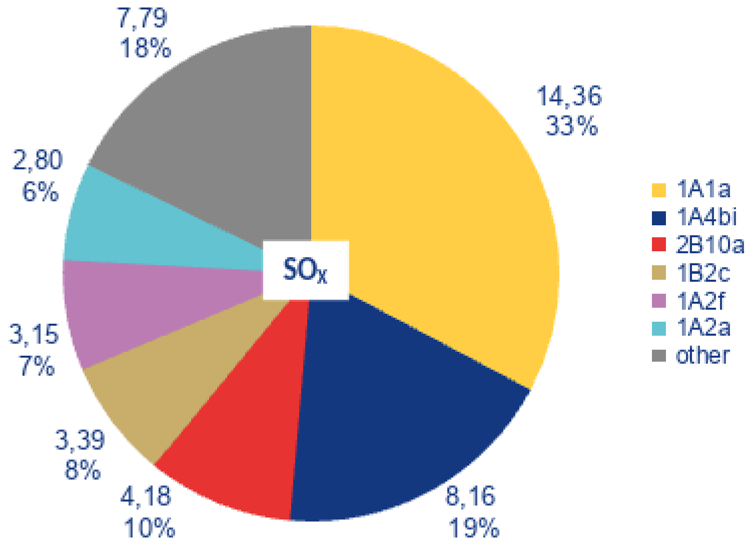


Figure II.3 The Key Trends of NFR categories for Sulphur oxide in 2024. The share of emissions is presented in kt and%

II.1.4 Ammonia (NH_3)

The NH_3 emission level in 1990 was 151.68 kt. In 2005, the NH_3 emission level was 80.98 kt, and in 2024, 68.56 kt of NH_3 was recorded.

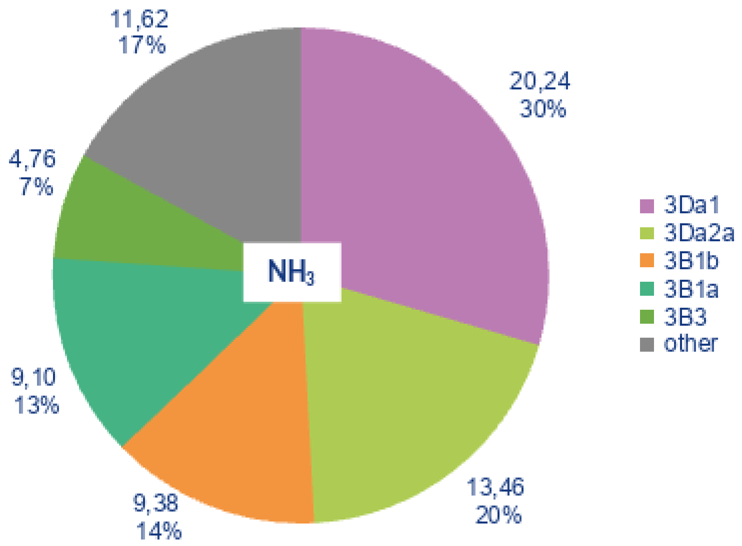


Figure II.4 The Key Trends of NFR categories for Ammonia in 2024. The share of emissions is presented in kt and%

II.1.5 Particulate matter (PM) and Total Suspended Particles (TSP)

The $PM_{2.5}$ emission level in 1990 was 371.34 kt. In 2005, the $PM_{2.5}$ emission level was 73.64 kt and in 2024 the total $PM_{2.5}$ emission was 35.49 kt. The emission ceiling was fulfilled.

The emission level in 1990 was 506.60 kt of PM_{10} and 674.27 of TSP. In 2024, 51.66 kt of PM_{10}, and 71.43 kt of TSP were recorded.

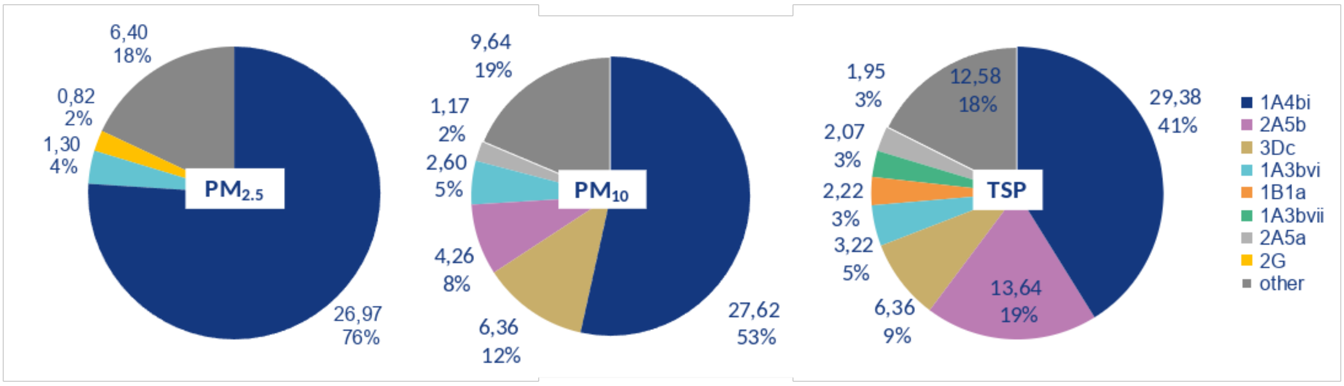


Figure II.5 The Key Trends of NFR categories for PM and TSP in 2024. The share of emissions is presented in kt and%

II.1.6 Carbon oxide (CO)

The CO emission in 1990 was 2,912.24 kt and in 2024 was 715.43 kt.

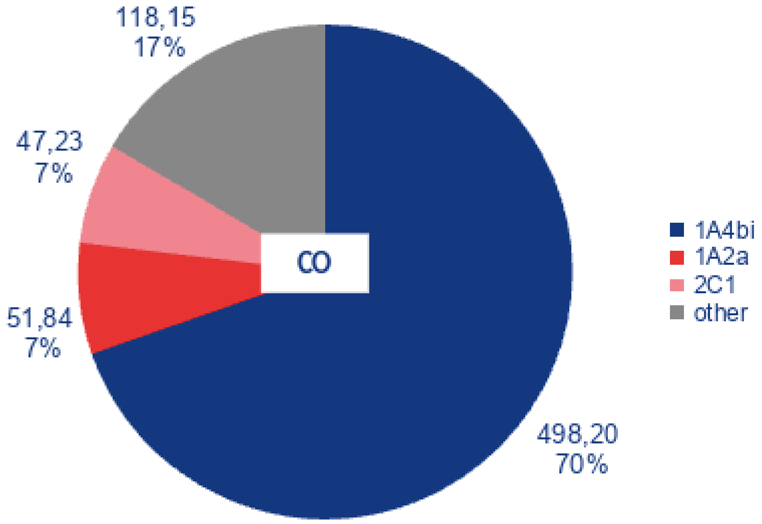


Figure II.6 The Key Trends of NFR categories for CO in 2024. The share of emissions is presented in kt and%

II.1.7 POPs: PAHs, HCB and PCDD/PCDF

The PAH emission level in 1990 was 253.09 t, HCB was 515.68 kg, and PCDD/PCDF was 117.16 g I-TEQ. In 2024, the PAH emission level was 32.76 t, HCB was 4.97 kg and 15.86 g I-TEQ of PCDD/PCDF were recorded.

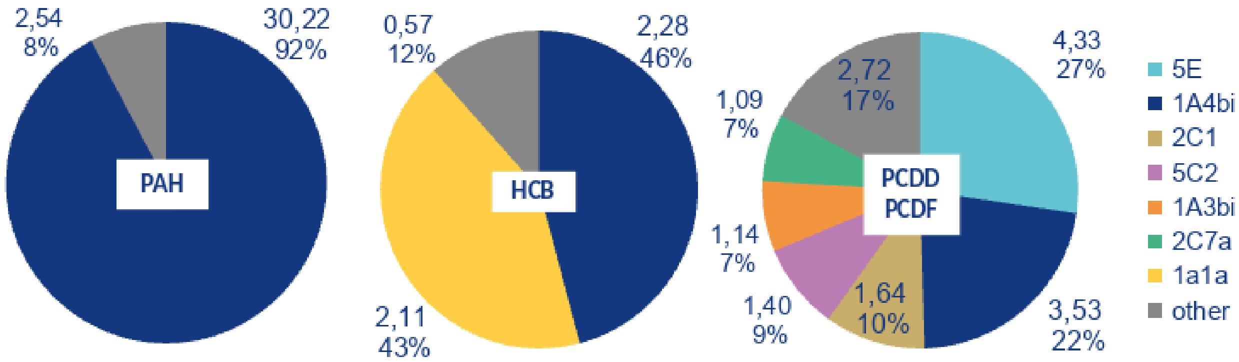


Figure II.7 The Key Trends of NFR categories for PAH, HCB, PCDD/PCDF in 2024. The share of emission is presented in t, kg, g I-TEQ and%

II.1.8 Heavy metals – Cadmium (Cd), Mercury (Hg), Lead (Pb)

The Cd emission level in 1990 was 5.17 t, Hg was 5.09 t, and Pb was 321.21 t. In 2024, 1.11 t of Cd, 1.58 t of Hg and 23.14 t of Pb were recorded.

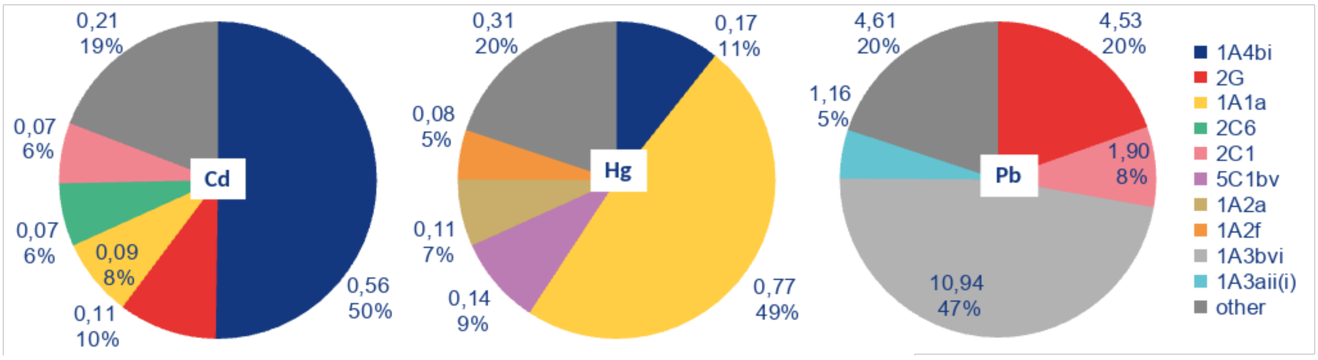


Figure II.8 The Key Trends of NFR categories for Cd, Hg and Pb in 2024. The share of emission is presented in t and%

II.2 The overview of emissions

The regulation of air pollutants in Czechia has undergone significant transformations since 1990. In 1991, Act No. 309/1991 Coll. on Air Protection, supplemented by Act No. 389/1991 Coll. on State Administration in Air Protection and Charges for Air Pollution, was introduced in the history of Czechoslovakia (later the Czechia). Following the dissolution of Czechoslovakia in 1993, the Czechia assumed international commitments under the Convention on Long-range Transboundary Air Pollution (CLRTAP) and adopted eight additional international protocols, including the Protocol on Further Reduction of Sulphur Emissions and the Protocol on Heavy Metals.

As a result, emission limits and fees per ton for SO_2, NO_x, and $PM_{2.5}$ were implemented, becoming effective in 1998. These measures were designed to prepare emission sources for new operational conditions. During this period, the national economy was restructured, industrial facilities were modernized, and many factories either closed or significantly reduced operations. For instance, production in the iron and steel sector declined substantially between 1992 and 1994. In the electricity and heat production sector, outdated boilers were either decommissioned or modernized. Between 1993 and 1998, coal-fired power plants underwent desulphurization, while smaller combustion sources, such as heating plants and boiler houses, gradually transitioned from solid and liquid fossil fuels to natural gas. Additionally, more pollutants became subject to emission charges, and fee rates for emissions increased, resulting in a significant reduction in emissions from major stationary sources classified under REZZO 1 and REZZO 2.

In 2002, Act No. 309/1991 Coll. on Air Protection was replaced by Act No. 86/2002 Coll. on Air Protection, complemented by Act No. 86/2002 Coll. on Air Quality and Act No. 76/2002 Coll. on Integrated Prevention (IPPC). These laws introduced new regulatory frameworks aligning national regulations with the best available techniques (BAT) and established the Integrated Pollution Register (IPR). Czechia's accession to the European Union in 2004 brought additional international environmental legislation into force, including the Aarhus Convention on Access to Information, regulations under the European Environment Agency (which consolidates data through EIONET), and the European Pollutant Release and Transfer Register (E-PRTR).

Before 2005, Czechia was among the largest air polluters in Europe. However, air quality has significantly improved due to the implementation of new laws and amendments. Act No. 86/2002 Coll. on Air Protection was replaced by Act No. 201/2012 Coll., which was further amended by Act No. 64/2017 Coll. to align with newly adopted regulatory measures. Additionally, Act No. 25/2008 Coll. on the Integrated Pollution Register and the introduction of the Integrated Environmental Reporting System (IERS) have proven to be effective long-term measures for air quality improvement. In 2016, IERS underwent modifications, and in 2019, the EU E-PRTR regulation came into effect. Furthermore, national strategic documents have been developed to summarize current policies and emission regulations, as well as their implementation for the future. The National Emission Reduction Program of the Czechia (NACP) was updated in 2019 and again in 2023 to reflect ongoing regulatory developments and strategic objectives. In 2019, the National Energy and Climate Plan of the Czechia (NECP) was developed, with a subsequent update in 2026. This plan plays a crucial role in shaping both current and future energy policies. Czechia has implemented numerous regulatory documents addressing emissions control, with detailed information compiled in the NACP 2024 (updated version of this program is planned in 2026) [6].

The emissions of regulated pollutants have remained relatively stable over the past five years, with only minor fluctuations. Stricter regulations and limits in the energy sector, fully enforced in 2020 (the regulation 415/2012 Coll.), along with the replacement of outdated boilers in residential buildings and government funding for renovation and boiler replacement programs, have made pollution levels less sensitive to growth in industry, agriculture, population, and other related activities. Compared to the previous year, monitored emissions have either decreased or remained stable.

To further strengthen air quality regulations, an updated version of Czechia's Act No. 201/2012 Coll. on Air Protection entered into force in 2025.

III. Energy (NFR 1)

Date of the last revision: 15 March 2026

This sector includes all combustion emissions (stationary and mobile). Furthermore, it includes fugitive emissions from the energy sector. The emission data from this sector are based on operator-reported emissions or calculations.

Stationary sources operators listed in Annex 2 of Act 201/2012 Coll. are obliged not to exceed the emission limits set and fulfil other operating permit conditions. For stationary combustion sources, these obligations are obligatory for all combustion sources exceeding the rated thermal input of 0.3 MWt.

Specific emission limit values for stationary combustion plants are stated in Annex 2 to Regulation 415/2012 Coll. They are set for SO_X, NO_X, TSP and CO and depend on rated thermal input and type of fuel used (Tier 3). The PM_{10} and $PM_{2.5}$ emissions are determined based on information on abatement equipment and fuel type. The ammonia emissions are calculated using emission factors (equipment below 5 MW input) and at some sources with $DeNO_X$ technology reported by the source operator. For inventorying of HMs and POPs, please refer below.

Operators of specific sources must also measure some of the other pollutants by law (Annex 4 to Act. 201/2012 Coll.)

Furthermore, limits for the other pollutants are set in operating permits of individual sources. Emissions of obligatorily monitored pollutants unavailable for a concrete source in a certain year are calculated using the emissions reported in the nearest year and activity data (own emission factors). Emissions of pollutants that are not reported are calculated from activity data (total annual amount of energy input in TJ) and emission factor in $mg \cdot GJ^{-1}$. The total annual amount of energy input is calculated from fuel consumption and net calorific values; operators also report them in summary operating records. Czech emission factors are predominantly based on either own measurements and partly taken from the EMEP/EEA EIG, version 2023 (Tier 2) [3].

Emissions of road-mobile sources are estimated according to recommendations in the COPERT model; for non-road machinery, we mainly use emission factors of EMEP/EEA EIG and activity data of national statistics [3].

The sectors are the most important sources in key categories for emissions of SO_X (NFR 1A1a – 39.2%, NFR 1A4bi – 23.3%), NO_X (NFR 1A3bi – 19.7%, NFR 1A1a – 19.3%), NMVOC (NFR 1A4bi – 51.1%), CO (NFR 1A4bi – 69.7%), TSP (NFR 1A4bi – 55.7%), PM_{10} (NFR 1A4bi – 63.7%), $PM_{2.5}$ (NFR 1A4bi – 81.3%), Pb (NFR 1A3bvi – 39.7%), Hg (NFR 1A1a – 62.3%), Cd (NFR 1A4bi – 49.6%, NFR 1A1a – 12.5%), PCDD/PCDF (NFR 1A4bi – 24.4%, NFR 5E – 23.4%), PAHs (NFR 1A4bi – 93.4%) and HCB (NFR 1A4bi – 52.3%, 1A1a – 38%).

III.1 Large stationary sources (NFR 1A1; 1A2; 1A3e; 1A4)

This chapter covers emissions of the most important group of combustion sources like power generation (public and industrial), heat generation for district heating and technological combustion processes in the industry, like solid fuels transformation or for production and processing of metals, raw materials, chemicals etc.

Information about combustion processes in the sector of services (NFR 1A4ai), agriculture (NFR 1A4ci), military (NFR 1A5i) and household (NFR 1A4bi) are given in Chapter III.1.2.

The criterion for source allocation to NFR 1A1a is the nominal thermal input and classification NACE. Combustion plants represent NFR 1A1a for producing public electricity and heat with total rated thermal input equal to or greater than 50 MW (according to aggregation rules according to article 29 of the Directive 2010/75/EU on Industrial Emissions – IED), regardless of the type of the used fuel. These sources are classified according to IED as Large Combustion Plants – LCP. This sector is characterised by a relatively small number of operation units (57 in 2024).

Emissions from facilities for waste incineration with heat recovery are also allocated in this sector according to good practice (EMEP/EEA EIG, see Chapter VI.4.1) [3].

NFR 1A1b includes fuel combustion in boilers and process furnaces on the production unit. NFR1A1c covers coal heat treatment (coke ovens, briquetting plants and drying). NFR 1A3e includes only emissions from gas transport.

Distribution of the combustion sources into NFR 1A2a to 1A2gviii is done according to the NACE classification of the source operator. Combustion sources for heat production or power generation are being categorised according to NACE classification in the metal industry (NACE 24), chemical industry (NACE 20 a 21), paper production (NACE 17 and 18) and food production (NACE 10, 11 and 12). Raw material production and processing sites (NACE 07, 08, 09, 23, 41 and 42) are collected in NFR 1A2f and other activities in the processing industry (for instance, 13–16, 22, 25–33) in NFR 1A2gviii. These are specifically divided among NFR categories of sources where processing combustion – processing heating etc., take place. In the e-ANNEX is placed a link between the NFR category and classification according to Czech laws: in connection of controls performed by TERT technological sources with the combustion of fuel were significantly changed in allocation emissions of NO_X and CO (or other emissions from fuel combustion). These emissions were, in most cases, transferred from NFR categories 2A and 2C to 1A2f, 1A2a or 1A2b. This also applies to NO_X and CO emissions from electric furnaces (especially in producing glass, cast iron and non-ferrous metals). NFR 1A2a includes HCB emissions from sintering belts (NFR 2C1 Iron and steel production). Other emissions from sintering belts (also for NO_X, SO_X, TSP, Hg and PCDD/PCDF) are reported by source operators, and other reported emissions are calculated. All emissions are classified in NFR 1A2a in the calculation system because their distribution according to the NFR categories would be technically demanding in the Czech point sources inventory system and could lead to errors. For further details, please see e-ANNEX.

The development of fuel bases for stationary sources divided into aggregated sectors (GNFR) in 1990–2024 is illustrated below in Figure III.1 to Figure III.3.

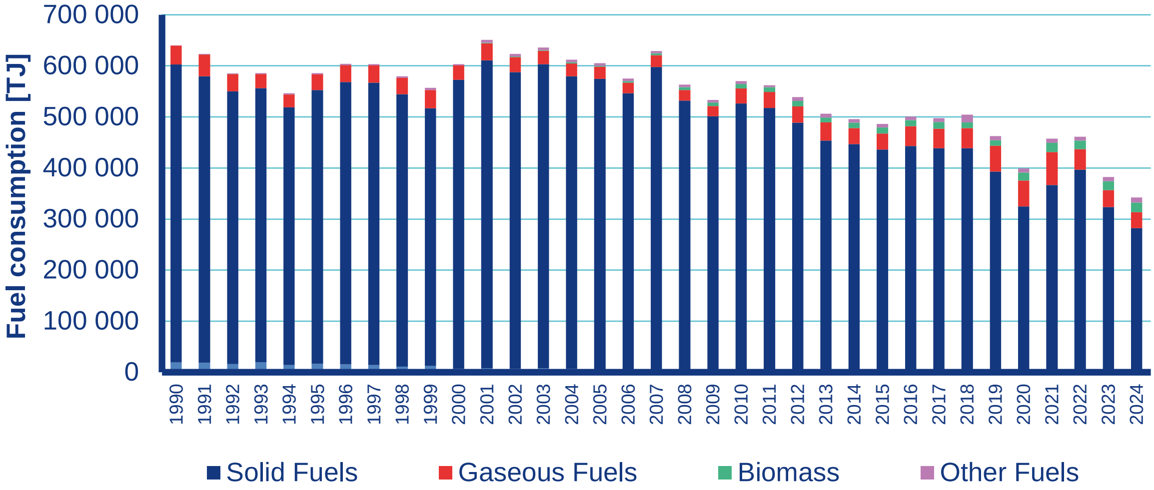


Figure III.1 Fuel consumption for GNFR sector A_PublicPower, 1990–2024

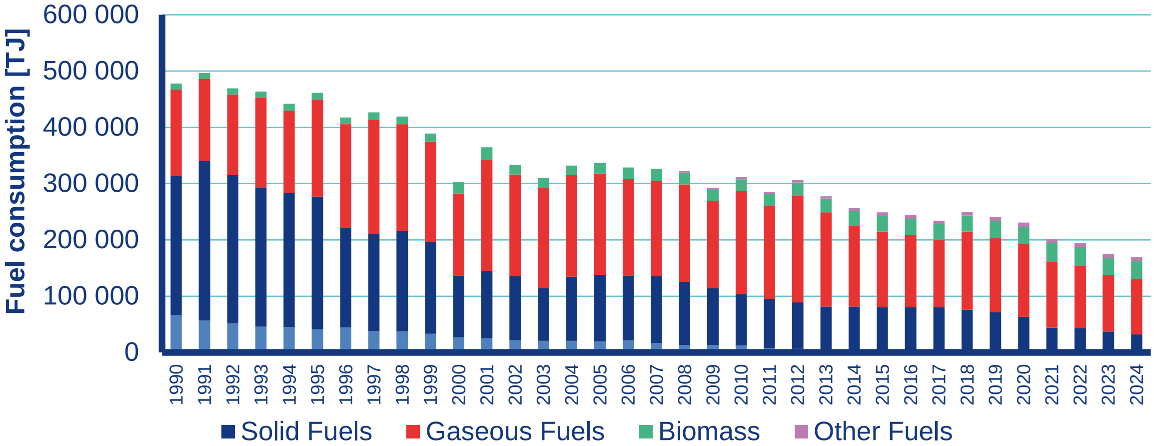


Figure III.2 Fuel consumption for GNFR sector B_Industry, 1990–2024

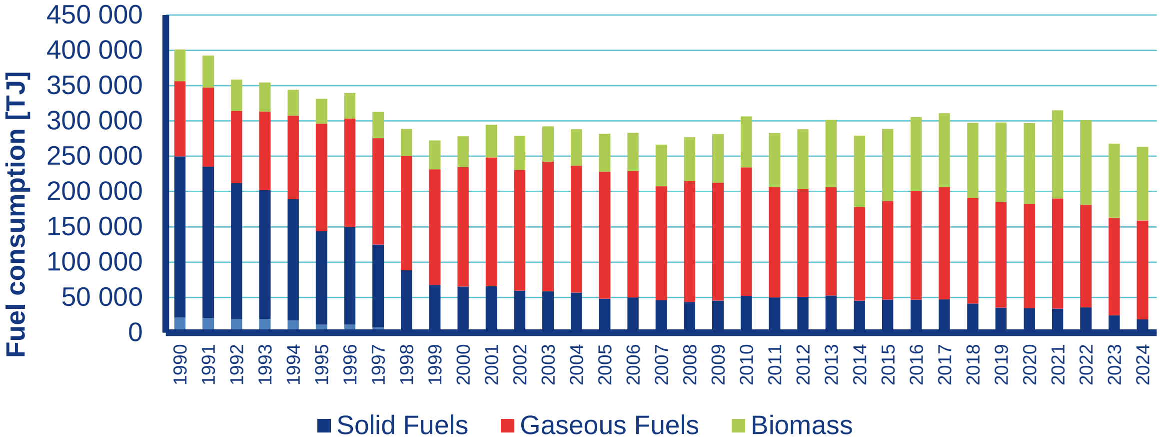


Figure III.3 Fuel consumption for GNFR sector C_OtherStationaryComb, 1990–2024

Since the 1990s Czech refineries have undergone rapid development due to increasing production capacities as well as the need to meet ever more restrictive requirements of environmental laws. The development of crude oil consumption is presented in the chart below (Figure III.4).

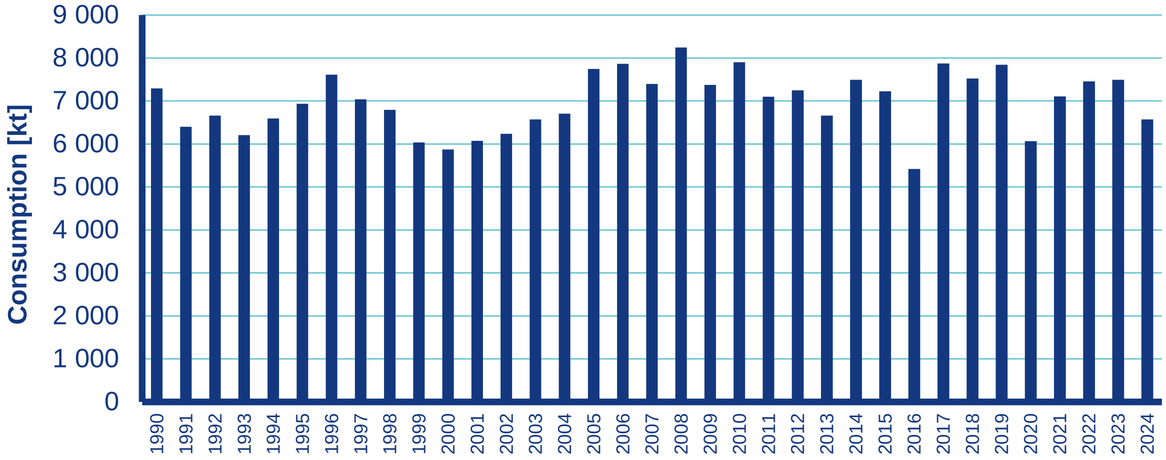


Figure III.4 Crude oil consumption, 1990–2024

Crude oil refining is essential to the economy of Czechia, not only due to the production volumes reached but also to its broader significance (ensuring energy safety and the close connection with the third most important manufacturing sector: the chemical industry). Operational accidents in both refineries Litvínov and Kralupy caused a strong decrease in 2016. Distribution of emissions from processes operated in refinery Litvínov and follow-up emissions from petrochemical processing of petroleum products was revised and transfers of SO_X, NO_X and NMVOC emissions were made in some years between NFR1A1b, 1A2c, 1B2aiv, 1B2c and 2B10a. For further details, please, see e-ANNEX.

There was only one technology for coal gasification in Czechia in the former town gas facility Sokolovská uhelná near a lignite mine. After purification, the generated gas was combusted to power production. The facility terminated gas generation in 2020. Three coke plants operate in the Ostrava region, producing mainly metallurgy coke.

Sources for district heating with rated thermal input from 0.3 MW and less than 50 MW are included in NFR 1A4ai (Commercial/institutional: Stationary) and 1A4ci (Agriculture/Forestry/Fishing: Stationary).

III.1.1 Emission factors and calculations

The fuel base consists mainly of solid fuels, which are burned primarily in dry-bottom and fluidised bed boilers. Solid fuels are represented mainly by pulverised brown coal (approx. 70%) and pulverised hard coal (approx. 10%), followed by various types of biomass (wood and other biomass). In addition to solid-fuel boilers in this category, oil-fired and gas-fired boilers, burning mainly natural gas, are represented. Natural gas and fuel oils are also stabilising in solid-fuel boilers. These plants' specific emission limit values are stated in Annex 2 to Regulation 415/2012 Sb. (see e-ANNEX). Their emission limit values can be set in operating permits of individual sources; in the case of all LCP sources, it is an integrated permit according to Act 76/2002 Coll. on integrated prevention.

Emissions of pollutants that are not reported are calculated from activity data (total annual amount of energy input in TJ) and emission factor in $mg \cdot GJ^{-1}$ (see e-ANNEX). The methodology is the same for all stationary sources in categories 1A1, 1A2, 1A3ei, 1A4ai and 1A4ci. The average national emission factor (8 g·GJ^{-1}, determined using the declared emissions) was used to calculate NH_3 emissions for categories in which biomass is burned in boilers with an input of up to 5 MW. For categories not assuming operation of equipment with rated thermal input below 5 MW, we use notation key NA for ammonia emission. For NFR 1A2a, the TSP and PM emissions have lowered significantly since 2016 due to the installation of modern bag filters.

In the e-ANNEX are placed EFs for calculating HMs and POPs emissions for boilers in category 1A1, 1A2, 1A4ai, 1A4ci and specific technologies. EFs were not used in category NFR 1A1a.

The specific calculation is performed for emissions of NFR 1A1c. The procedure of calculation recommended in a research report (KONEKO marketing, spol. s r. o., Ing. Neužil) is described in e-ANNEX.

III.1.2 Uncertainties and QA/QC procedures

According to national laws, emissions for large stationary sources of NFR 1A are determined based on continuous or periodic measurements that comply with European laws (IED, MPCD and previous directives). The uncertainty of the sum of emissions from those sources is below 5%; see also Chapter I.7 General uncertainty evaluation.

QA/QC for NFR 1A1a is the same as in the case of other stationary point sources; see also Chapter I.6.

In addition to these general checks, further validation mechanisms take place under international reporting performed annually since the reporting period 2003 according to valid European laws. It includes information about the annual emissions of SO_X, NO_X and TSP and activity data (heat supplied).

Data are being submitted via the EIONET (European Environment Information and Observation Network) system, which is subjected to further checks. Since 2013, data have been inserted via a web form with an implemented control mechanism, specifically focusing on filling out required items and desired numeric formats.

Before making the completed form accessible to the public, automatic validation checking possible errors preventing from submission is to be activated. Additionally, warning about possible errors that cannot prevent the submission also occurs, but the inserted data are to be checked.

The following checks take place:

- basic data completeness
- unequivocal naming of plants
- consistency of plant ID and name over time
- location check (coordinates)
- E-PRTR ID (in case threshold values are exceeded and the source must report to the EPRTR registry)
- rated thermal input value
- plausibility of fuel input
- share in overall reported emissions
- SO_X (as SO_2), NO_X (as NO_2) and TSP emission outlier test:

- a significant difference in reported and expected SO_X (as SO_2), NO_X (as NO_2) and TSP emissions
- consistency with emission trends at the national level.

III.1.3 Planned improvements

No improvements are planned, and the chapter is considered to be final.

III.2 Smaller and area stationary sources (NFR 1A4 and 1A5)

Combustion sources for heat production or power generation are being categorized according to NACE classification in NFR 1A4ai District heating (NACE 35), NFR 1A4ci Agriculture/Forestry/Fishing (NACE 01–03) and tertiary sector (Commercial/institutional - self-employment, offices, public health, education etc.). In a specific way, there are then divided among NFR sectors of sources where processing combustion – processing heating, drying of agricultural products etc. take place. Military combustion sources are allocated in NFR 1A5a. The methodology for NFR 1A4ai and 1A4ci is the same as in the case of NFR 1A1a (see Chapter III.1). Natural gas consumption in NFR 1A4ai with thermal input below 0.3 MW is calculated as subtraction of natural gas consumption of all individually and collectively monitored sources from total natural gas consumption in Czechia (data obtained from the CZSO).

Residential sources in NFR 1A4bi belong among collectively monitored sources and they are described in the next part of the chapter. NFR 1A4bi includes emissions from local household heating, cooking and water warming. The emission inventory is prepared at the Tier 2 approach.

Fuel consumption is being ascertained by CZSO which hands over the data via international questionnaires to EUROSTAT and other institutions. These data represent basic input for emission inventory (Figure III.5). The consumption of individual coal fuels is being taken over directly from the international questionnaire CZECH_COAL in natural units. The caloric values, stated summary in this questionnaire under the item “For other uses”, do not correspond to real calorific values of coal fuels distributed to households. The recalculation of energy units was therefore done using caloric values annually ascertained by statistical census among fuel producers in the structure of deliveries for power generation, industry and population [7]. This census also discovers other quality characteristics of coal fuels – ash, sulphur and carbon content. From biomass consumption stated in the CZECH_REN questionnaire, there was according to the statistical census of MIT segregated consumption of briquettes and pellets [8]. For recalculation of LPG consumption from natural units (questionnaire CZECH_OIL) to energy units the calorific value 45.9 $MJ \cdot kg^{-1}$ was used. Data about the consumption of gaseous fuels for emission inventory are taken over directly from the energy balance of EUROSTAT.

Data about the distribution of total fuel consumption according to combustion equipment type (e-ANNEX), the structure of combustion equipment in households, share of wet wood combustion and other parameters had been discovered by statistic census ENERGO 2021. The overview of combustion equipment structure in the period 1990–2021 was prepared by combining these results with other statistics (SLDB, ENERGO 2021, sales of boilers). The significant change in the heating equipment ratio is in Table III.1, where the data from ENERGO 2015 and ENERGO 2021 are compared.

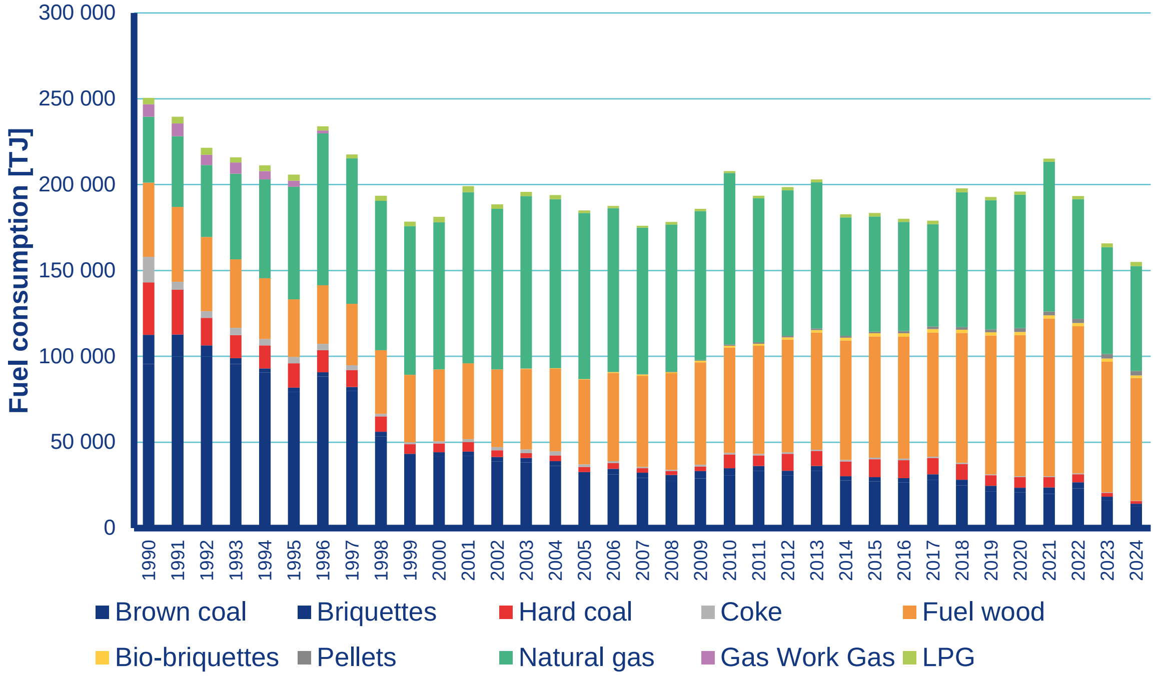


Figure III.5 Fuel consumption in sector local heating of households, 1990–2024

Table III.1 Distribution of solid fuel consumption according to the type of heating equipment in 2021 - change of heating equipment ratio

Installation type/fuel type	ENERGO	Over-fire boilers	Under-fire boilers	Automatic boilers	Gasification boilers	Stoves/fireplaces
[%]						
Brown coal	2015	23	31	33	9	5
	2021	6	45	36	9	4
Briquettes	2015	53	22	6	5	14
	2021	35	37	6	12	10
Hard coal	2015	53	15	23	6	5
	2021	23	35	31	8	3
Coke	2015	88	9	1	0	2
	2021	77	8	13	0	2
Wood - dry	2015	31	17	4	19	29
	2021	34	14	4	22	26
Wood - wet	2015	32	14	3	13	38
	2021	30	14	9	8	39
Bio-briquettes	2015	17	9	5	11	59
	2021	24	9	3	11	53
Pellets	2015	0	1	56	0	44
	2021	6	1	40	3	50

III.2.1 Emission factors and calculations

Emission factors for solid fuels combustion (NFR 1A4bi) were derived from results of VEC VŠB measurement at nominal heat rating for all monitored pollutants. The values were set for over-fire boilers, under-fire boilers, gasification boilers and automatic boilers. For category stoves, grates and cookers there were used same values of emission factors as for over-fire boilers (similar mode of combustion). The methodology modified in 2023 uses a combined emission factor for the operation of boilers and heating plants in reduced and nominal output mode, based on the Stage III recommendations from 2022. Representation of emission factors for reduced performance in the entire period incl. assumption until 2030 is shown in Table III.2.

Table III.2 Distribution of solid fuel consumption according to the type of heating equipment in 2021 - change of heating equipment ratio

Parameters for calculation / Year		1990	2000	2005	2020	2025	2030
The volume of dry wood		until 2016 = 85%			since 2020 = 92%		
				[%]			
Share of reduced output for boilers, stoves and fireplaces	Over–fire boilers	98	98	97	95	30	0
	Under–fire boilers	98	98	97	95	8	3
	Automatic - boilers	100	90	90	87	85	82
	Gasification boilers	100	86	73	48	36	23
	Stoves and fireplaces	100	100	96	90	88	85
Share of heaters without Eco-design		100	100	100	100	80	60

These adjustments significantly affected the entire emission inventory of the Residential: Stationary sector. More detailed information is provided in the e-ANNEX.

Emission factors for other fuels were taken over from EMEP/EEA EIG and Methodology Instruction of CME. The overview of emission factors for emission inventory in the household heating sector and more information about combustion measurements of VEC VŠB are available in e-ANNEX.

Ammonia emissions from combustion in equipment below 5 MW until 2014 are performed solely from total fuel consumption and emissions are reported only in NFR 1A4ai. For data since 2015, ammonia emissions are calculated in individual categories 1A2 and 1A4. The emission factor for biomass and boilers with an input of up to 5 MW was calculated as an average from the emission factors of the European countries which do not use Guidebook emission factor values. The average value of the NH_3 emission factor is 5.2 $g \cdot GJ^{-1}$.

In 2024, during the NECD review, a question regarding the calculation of NH_3 emissions, which was not above the threshold of significance, was raised. TERT noticed that the “IE” notation key was used before year 2014 (1990-2014). TERT also asked for clarification regarding the use of EF. In response to this issue Czechia states that before 2014 NH_3 emissions were calculated under NFR 1A4ai. National EF were used until 2021. From 2022 proportionally reduced EF have been used. Czechia also stated that a national research ARAMIS is ongoing. Within this project more than ten experimental measurements of NH_3 emissions from biomass combustion in boilers and heaters with a capacity below 50kW were carried out. The results show significant variability, which made it impossible to evaluate EF. Based on these findings new research was commissioned to identify alternative analytical methods for reliable measurements that will not been influenced by the presence of other pollutants. The results of this research are expected to be available by the end of 2026. Therefore, EF updates are planned to the 2027.

Based on the ENERGO 2021 survey results and other surveys, the proportion of burned dry wood was determined. The ratio 85% for dried (dry) wood and 8% for non-dried (wet) wood is used for the period 1990–2015. The ratio of 92% for dried (dry) wood and 8% for non-dried (wet) wood is used for the entire period 2020–2022 and the emission projection. Between 2016 and 2019 a smooth change of ratios is applied.

From the first measurement results of newly sold boilers [9], the NMVOC emission factor for newly sold filling boilers was determined. For further details, please see e-ANNEX.

The condensable component of PM emissions

Detailed description in Chapter I.4.3. The table of the condensable component is given in e-ANNEX.

III.2.2 Uncertainties and QA/QC procedures

The chapter will supplied later.

III.2.3 Planned improvements

Currently, an extensive verification of the emission factors of older boilers is conducted. The measurements of newly sold boilers and stoves are in progress at the same time. The results will be processed for reporting in 2026 or 2027.

III.3 Transport (NFR 1A3)

Transport chapter was prepared by CDV, Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery subchapter by VÚZT. For purposes of emissions calculations, all vehicles are differentiated according to transport mode and vehicle category. Vehicle categories in road transport are further differentiated based on the fuel used, segment and emission standard that the vehicle must meet. The vehicle categories in non-road transport are not so detailed.

Activity data (AD) and main emission factors for all transport modes are described in the further text and presented in figures and tables. National emission factor is noted as country-specific (CS).

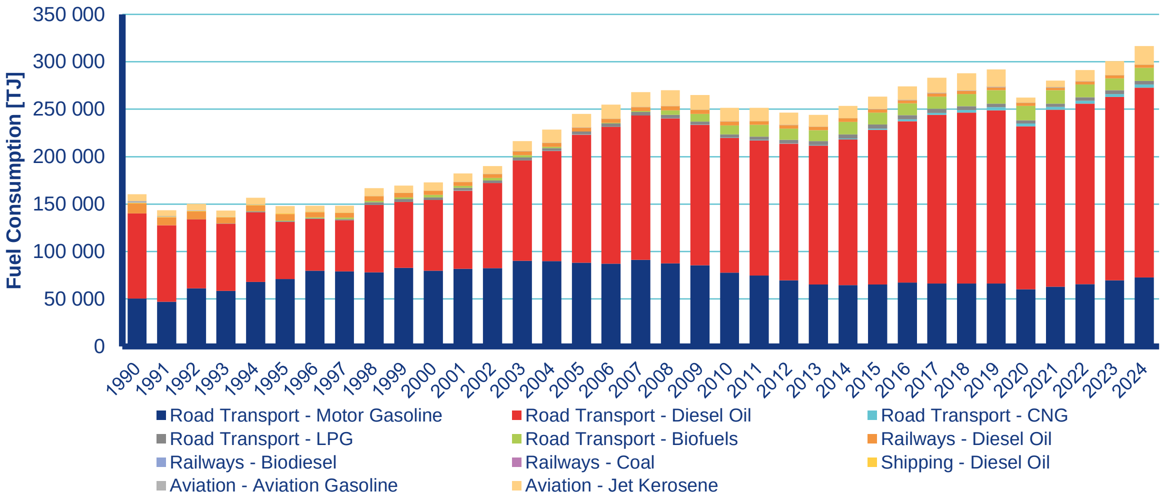


Figure III.6 Annual fuel consumption by all modes of transport, 1990–2024

In Czechia, the most significant category in transport sector is road transport. Emission estimations were made for the following vehicle categories: passenger cars (PCs), light-duty vehicles (LDVs), heavy-duty vehicles (HDVs), buses and L-category. The vehicle categories were further broken down by type of fuel, segment and emission standard according to COPERT 5 (see more details in Road Transport chapter).

The general upward trend in fuel consumption in the Czechia is consistent with developments observed across Europe. A temporary decline occurred during the economic crisis between 2009 and 2013. Following this period, fuel consumption increased again and continued to rise until 2019.

In 2020 and 2021, overall fuel consumption dropped markedly as a consequence of the COVID-19 pandemic. The reduction resulted from a sharp decline in activity across all modes of transport, with aviation being most affected. In 2022, total fuel consumption in the transport sector returned to levels comparable to those before the pandemic. In the following years, fuel consumption continued to increase and reached the highest level in 2024 in the entire time series.

III.3.1 Road Transport (NFR 1A3b)

This chapter provides an overview and basic information about road transport subcategories. More detailed information about specific subcategories is to be found in the respective subchapters. The content and structure of these subchapters are not uniform as every subcategory has different important information to point out.

The appropriate distribution of vehicles is necessary to assign a relevant emission factor. NFR 1A3b Road Transport is split into seven subcategories:

- 1A3bi Passenger cars
- 1A3bii Light-duty vehicles
- 1A3biii Heavy-duty vehicles and buses
- 1A3biv Mopeds & motorcycles (L-category)
- 1A3bv Gasoline evaporation
- 1A3bvi Automobile tyre and brake wear
- 1A3bvii Automobile road abrasion

For estimation of road transport emissions, COPERT 5.9 model on Tier 3 level was used. COPERT is based on EMEP/EEA EIG 2023 [3]. The model is being updated regularly (usually a new version each year). Crucial input for emission calculations in COPERT 5 are country-specific activity data – number of vehicles, average annual mileage, and total annual mileage assigned to corresponding vehicle categories.

Other important variables are:

- CS meteorological information,
- EU average information about driver behaviour (trip length, trip duration, average speed on different roads, etc.),
- technical parameters of vehicles (technologies for emissions reduction, A/C in vehicles, tank size, number of axles, etc.),
- fuel quality and composition of fuel,
- calorific value of fuels (from CZSO).

This is only a brief summary. Full description of the COPERT 5 program is to be found in COPERT documentation. Detailed methodology of COPERT 5 application in Czechia is described in Pelikán, Brich 2017 and Pelikán, Brich 2018 [10].

Activity data

AD for COPERT program are being gained from two large databases – Czech Car Registry (CCR) and Database of Technical Control Stations (TCS). CCR contains information about number and technical details of vehicles registered in particular categories in CZ. TCS defines annual traffic performance for a particular vehicle. By combining these two databases, it is possible to obtain a number of vehicles, average annual mileage, total annual mileage and lifetime cumulative activity for all COPERT categories which are relevant in CZ. Results are in full accuracy four years before the actual reported year. The reason is that new vehicles in CZ must undertake the first technical control four years after registering in CCR. To get accurate average annual mileage and emissions estimates, it is necessary to recalculate results four years retrospectively every year.

The method for activity data calculation was developed by Brich in 2014 and certified by Czech Ministry of Transport [11]. It's constantly being updated. The last improvement was performed in 2024 in order to better approximate estimated traffic performance to reality. Non-operated vehicles were excluded from vehicle activity calculations. As a non-operated vehicle is considered a vehicle which doesn’t have technical control registered in the last 10 years. From such vehicles, only the ones with VIN code linkable to data in Database of Technical Control Stations were marked as unambiguously non-operated. This approach was applied to passenger cars, light duty vehicles, heavy duty vehicles and buses. For motorcycles, all non-operated vehicles were deducted because most of Euro 3 and older motorcycles don’t have VIN code and if the above-mentioned approach was used, it would cause unreasonably high mean activity in these subcategories.

Calculated AD along with other above-mentioned input variables are then entered into COPERT 5 which calculates fuel consumption and emissions for all vehicle categories. Final fuel consumption is automatically aligned to total fuel consumption on national level as per CZSO.

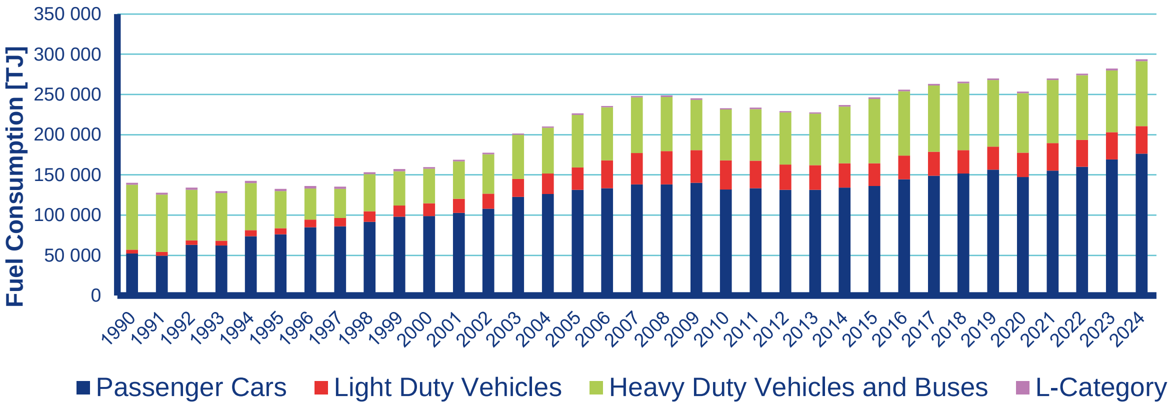


Figure III.7 Annual fuel consumption by road transport, 1990–2024

Figure III.7 shows trend in fuel consumption by particular vehicle categories in years 1990–2024. General rising trend of fuel consumption by PCs and LDVs in Czechia is in line with the trend across Europe. There is an obvious influence of economic crisis between 2009 and 2013 on fossil fuels consumption. From 2014, a significant increase in main fossil fuel consumption started again. In 2017, almost 10% lower prices of diesel and gasoline fortified the further increase of fossil fuels consumption. The increase was interrupted with an one-off break in 2020 due to COVID-19 pandemic.

The consumption of gasoline fluctuated around 90 000 TJ from 2003 to 2009, but then it was significantly declining until 2014 when it fell under 65 000 TJ. This decline was caused by the downward trend in average fuel consumption of modern passenger cars. From 2015 to 2023, gasoline consumption has been fluctuating between 65 000–68 000 TJ. Exceptions are years 2020 and 2021 influenced by COVID-19 situation when gasoline consumption was lower.

Diesel fuel consumption was steadily growing from 2000 to 2008. In the following years, it was oscillating around 145 000 TJ due to the economic crisis. A steep increase started in 2014 and was related to economic growth and growing popularity of diesel PCs. Year 2020 was influenced by COVID-19 situation when diesel consumption dropped to 171 416 TJ. In 2021, it sharply increased to 186 576 TJ and the growth has been continuing since then.

Bioethanol was almost not used, and biodiesel was only used in a small share in Czechia before 2008. Bioethanol started to be added to all gasoline in the amount of 2% since 1 January 2008.

The share of bioethanol as a renewable resource in gasoline reached 4.1% in 2010 and the share of fatty acid methyl esters (FAME) in diesel oil reached 6% in 2010 and both values didn't change for more than 10 years. Lower taxes for blends with high percentage of biodiesel were implemented in 2015. This allowed the increase of biodiesel consumption which reached more than 12 600 TJ in 2020. The highest consumption of bioethanol was before COVID pandemic in 2019 (3 078 TJ), but it shows no specific long-term trend. Total share of biofuels in overall road transport fuel consumption was quite stable thorough the years (5% in average). In 2022, the end of mandatory blending of biocomponents was approved by Czech government and this caused a decrease in both biodiesel and bioethanol consumption. In 2024, the mandatory share of bioethanol in gasoline was increased from 5% to 10% in the Czechia as part of the implementation of European Renewable Energy Directive III. As a result, bioethanol consumption rose sharply–by almost 50% compared with 2023.

CNG buses have been used from 1994 and CNG PCs from 2006 in the Czechia. The steep increase of CNG consumption in 2012 was caused by subsidies from public resources to encourage the use of CNG buses. Other subsidies were determined for CNG LDVs and PCs which were used by local authorities what resulted in steady increase of CNG consumption, and it is continuing to the present (3 262 TJ in 2024). LPG consumption was continuously growing until 2016. After 2016, there was a slight decrease most likely caused by low prices of diesel and gasoline, and also thanks to the introduction of new alternative fuels in the last years. Since 2022, LPG consumption has been rising again due to overall fuel consumption rise as well as rising prices of diesel and gasoline**.** LPG consumption reached 3 723 TJ in 2024.

Emission factors

Emission factors are derived from the COPERT 5.9 model and correspond to Tier 3 methodology. The COPERT approach is fully consistent with the 2023 EMEP/EEA EIG [3]. In general, the EFs consist of hot EFs, cold EFs, and they vary according to vehicle category and driving mode (urban, rural, and highway). Final EFs also depend on additional parameters, which differ by pollutant:

- Hot emission factors – for engine operating at normal temperature, relevant for all pollutants,
- Cold emission factors – for cold engine after start, relevant for all pollutants,
- Tyre, brake and road abrasion – PM, heavy metals,
- Lubricant consumption – relevant for SO_X and heavy metals,
- Additional influence of A/C – relevant for SO_X and heavy metals,
- Mileage degradation – relevant for NO_X, CO and NMVOC.

Emissions

Emissions were calculated based on the fuel consumption in all COPERT vehicle categories which are relevant in CZ. COPERT separately calculates emissions from hot engines, cold engines, emissions originated from A/C and SCR usage (diesel cars) and emissions originated from lubricant consumption during burning processes. Emissions from lubricants combusted in 2-stroke moped and motorcycle engines are reported within 1A3biv subcategory as per the EMEP/EEA EIG [3] and COPERT methodology.

Emissions of NO_X, NMVOC, and CO from road transport have shown a continuous decrease. This trend is primarily attributed to the widespread introduction of catalytic converters, improvements in engine technology resulting from progressively stricter emission standards, and the improved quality of fuels. SO_X shows a strong dependence on increasing fuel quality in terms of sulphur content. SO_X emissions have a significant downward trend which is slightly influenced by increases in fuel consumption. The share of PM emissions from fuel combustion is decreasing because of technical development. In brake, tyre and road abrasion, technical development is not so progressive and emission production is more dependent on vehicle activity. Pb emissions are strongly dependent on fuel consumption and Pb content in fuel. A general overview of trends in emissions of NO_X, NMVOC, PM and CO for road transport in years 1990–2024 are presented in the figures below.

NO_X emissions were decreasing until 2002 (see Figure III.8). An increase in emissions after this year was related to economic growth, a shift from gasoline to diesel passenger cars and light-duty vehicles and an increase in traffic performance, especially of heavy-duty vehicles. There was a significant increase in traffic performance of passenger cars and light-duty vehicles too. However, improvement of NO_X reduction technologies stopped the increase of NO_X emissions, especially in the PCs subcategory. From 2006, overall NO_X emissions were decreasing because of a less intense increase of traffic performance in all categories except for diesel passenger cars. In 2016, the steep decrease in NO_X emissions slowed down because of economic growth and lower prices of fuels compared to previous years. From 2018, we can see a bigger decrease in NO_X emissions caused by a decrease in traffic performance of LDVs, HDVs and buses. Generally, the main emitters of NO_X emissions are diesel passenger cars and heavy-duty vehicles. In 2021, NO_X emissions slightly increased due to an increase in traffic performance after COVID-19 pandemic, but the decrease again continued in the following years.

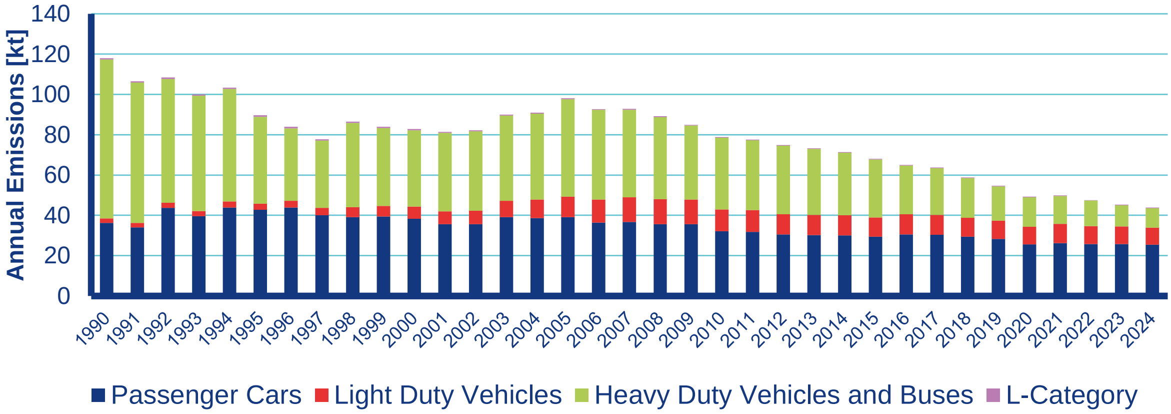


Figure III.8 Annual emissions of NO_X from road transport, 1990–2024

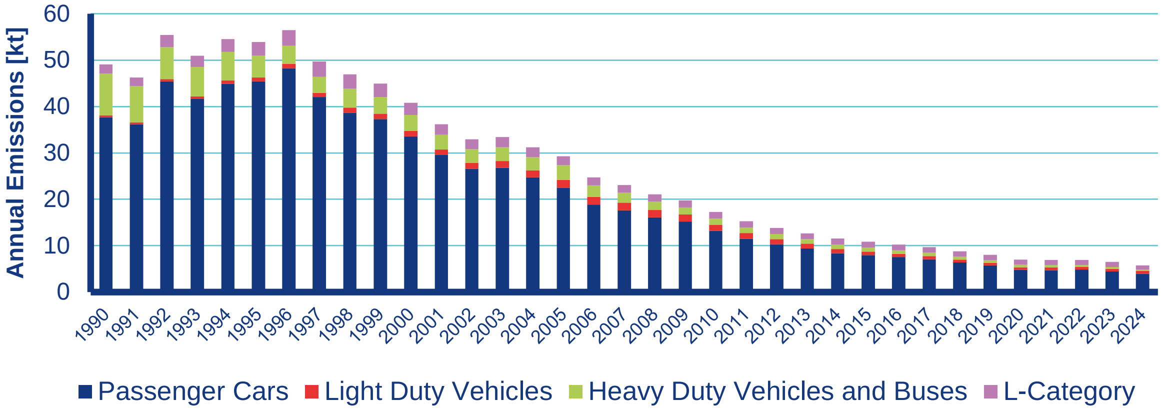


Figure III.9 Annual emissions of NMVOC from road transport, 1990–2024

Figure III.9 shows a constantly decreasing trend in NMVOC exhaust emissions after 1996 related mainly to the decrease in traffic performance of gasoline-fuelled cars and the enhancement of emission control technologies. In 2015, the decrease in NMVOC emissions slowed down because of economic growth and lower prices of gasoline compared to previous years. Especially, 2-stroke motorcycles do not have such advanced emission control technologies what is related to a relatively big share of NMVOC emissions production compared to traffic performance. The next reason is that motorcycle fleet in CZ was quite old, especially in the '90s. The further decrease of NMVOC exhaust emissions after 2018 is caused by a decrease in traffic performance of the largest emitters – gasoline-fuelled vehicles. NMVOC exhaust emissions continued to decrease also in 2024.

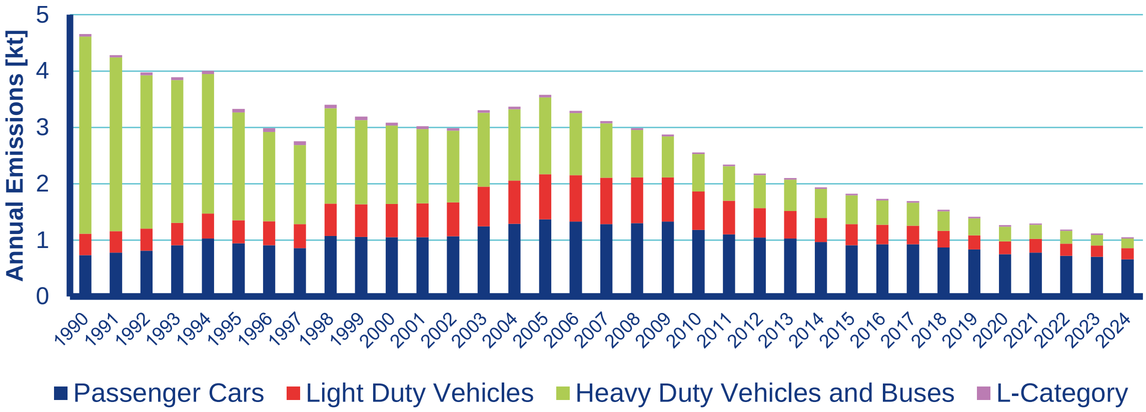


Figure III.10 Annual emissions of $PM_{2.5}$, PM_{10} and TSP from road transport – exhaust emissions, 1990–2024

Figure III.10 represents exhaust emissions of particulate matter (PM). In road transport, all PM emissions are considered as $PM_{2.5}$ because of the combustion technology which mostly emits this type of PM. Emission factors contain both filterable and condensable components as the measurement procedure regulated for vehicle exhaust PM mass characterisation requires that samples are taken at a temperature lower than 52 °C (at this temperature, PM contains a large fraction of condensable species). PM emissions were decreasing until 1997. The trend in emission production by road transport after this year is unsteady as it's dependent on changing traffic performance and economic situation. A continual decrease started in 2006 after implementation of Euro 4 (IV) standard with a significantly lower PM limit. At present, the main emitters of PM are passenger cars. In the '90s, passenger cars, light-duty vehicles, heavy-duty vehicles and buses were approximately on the same level. Due to the enhancement of particulate filter technologies and lower pressure of exhaust gases in HDVs', buses' and partly in LDVs' engines, the share of PM emissions from these categories has been significantly decreasing especially after 2010. In the case of buses, low PM production was influenced by significant subsidies from public resources to encourage the use of CNG buses after 2012. In 2024, we can see further decrease of PM exhaust emissions in all road transport categories in comparison with the previous year.

Figure III.11 shows a steady downward trend in CO emissions for all categories since 1997. The trend in emission production before this year is unsteady – dependent on changing traffic performance, and economic and political situation. Decreasing emission production is mostly related to the modernization of car fleet in CZ and removal of old passenger cars (pre-Euro).

Another factor is a decrease in traffic performance of gasoline cars which are the main emitters of CO. Combustion in 2-stroke engines produces extremely high emissions of CO and motorcycles don't have such advanced emission control technologies what is related to a relatively big share of CO production compared to traffic performance. The next reason is that the motorcycle fleet in CZ was quite old, especially in the '90s. 4-stroke motorcycles have much lower emission production and their growing share in motorcycle fleet has improved the emission behaviour of the motorcycle category in the last years. In 2024, CO emissions decreased in all road transport categories.

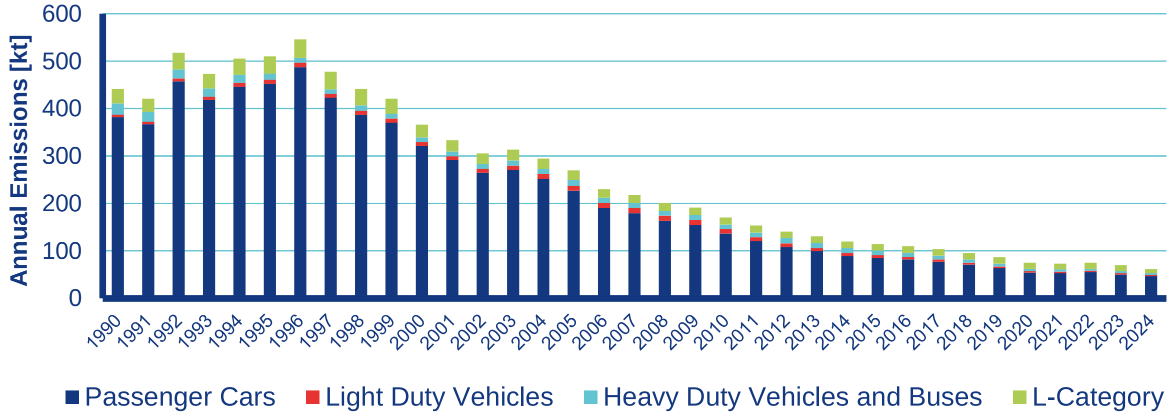


Figure III.11 Annual emissions of CO from road transport, 1990–2024

III.3.1.1 Passenger Cars (1A3bi)

- gasoline pre-Euro
- gasoline Euro 1–6
- gasoline hybrid Euro 4-6
- gasoline PHEV Euro 6
- diesel conventional
- diesel Euro 1–6
- diesel PHEV Euro 6
- LPG bifuel conventional, Euro 1-6
- CNG bifuel Euro 4-6
- battery electric Euro 6

Activity data

The general rising trend of fuel consumption by PCs is in line with the trend across Europe (see Figure III.12). In 2008, economic crisis started in Czechia and influenced overall fuel consumption. The fuel consumption dropped significantly in 2010, but it increased already the following year. Due to a renewal of economic growth, the overall fuel consumption reached in 2014 a similar level as it was in years before the crisis. The most significant decrease was noted in gasoline consumption during the crisis period. After 2015, it fluctuated around 65 000 TJ except for the pandemic years 2020 and 2021 when it was lower. Diesel oil consumption wasn't influenced by the economic crisis, nor by the COVID-19 situation so much. It has been steadily increasing since 1997 and reached almost 86 000 TJ in 2019. It slightly dropped the next year, but jumped to almost 90 000 TJ in 2021 and has been growing since then. Figure III.12 shows a growing share of diesel oil compared to gasoline. The reason is the growing popularity of diesel cars because of their lower fuel consumption and the lower price of diesel oil (especially in the warm part of the year) compared to gasoline cars.

From 2008, biofuels started to be used on a larger scale in Czechia. Till then, there was almost no bioethanol used and biodiesel was only used in a very small share. The consumption of biofuels by passenger cars was increasing in years 2008–2020. It exceeded a value of 8 000 TJ in 2020, but then it was decreasing in the next three years. In 2022, the end of mandatory blending of biocomponents was approved by Czech government and this caused a decrease in both biodiesel and bioethanol consumption. In 2024, the mandatory share of bioethanol in gasoline was increased from 5% to 10% in the Czechia as part of the implementation of European Renewable Energy Directive III. As a result, bioethanol consumption rose sharply– by almost 50% compared with 2023.

CNG buses have been operated in the Czechia since 1994, while CNG PCs began to appear from 2006. A marked increase in CNG consumption occurred from 2012 following the introduction of subsidy programmes supporting CNG PCs used by local authorities. Despite this growth, the share of CNG in total PC fuel consumption has remained low, reaching only 0.7% in 2024. The years 2020 and 2021 show a clear decline in CNG use as a result of reduced transport activity during the COVID-19 pandemic. Consumption decreased again in 2023, reflecting the discontinuation of support schemes for CNG passenger cars and a substantial rise in CNG prices associated with the war in Ukraine. In 2024, CNG consumption increased compared with the previous year, indicating a partial recovery.

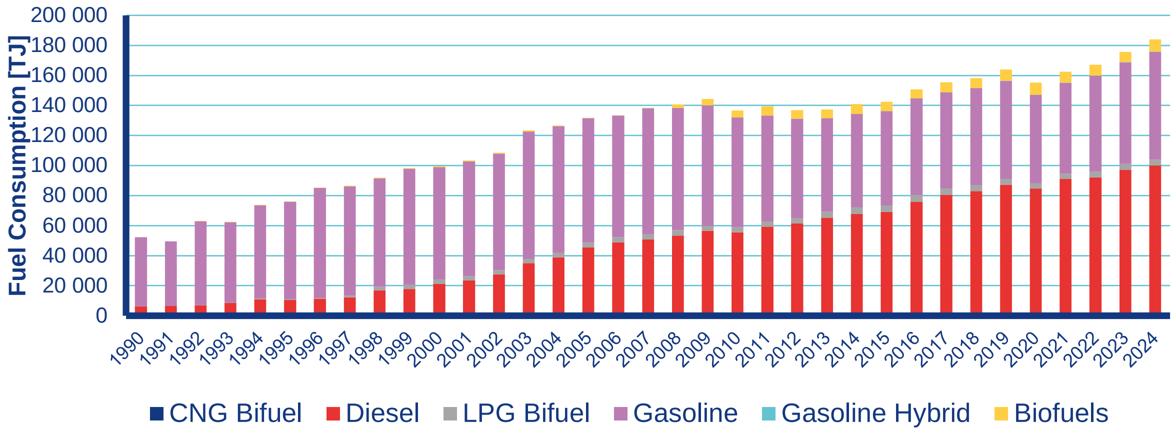


Figure III.12 Annual fuel consumption by passenger cars, 1990–2024

Emission factors

Implied EFs for selected pollutants are presented in this subchapter. PCs are a key category for NO_X emissions and were also a key category for CO emissions up to 2015. Emission factors are derived from the COPERT 5.9 model and correspond to Tier 3 methodology. Implied EFs for the most important fuels (gasoline and diesel) were extracted from COPERT (see Figure III.13 and Figure III.14).

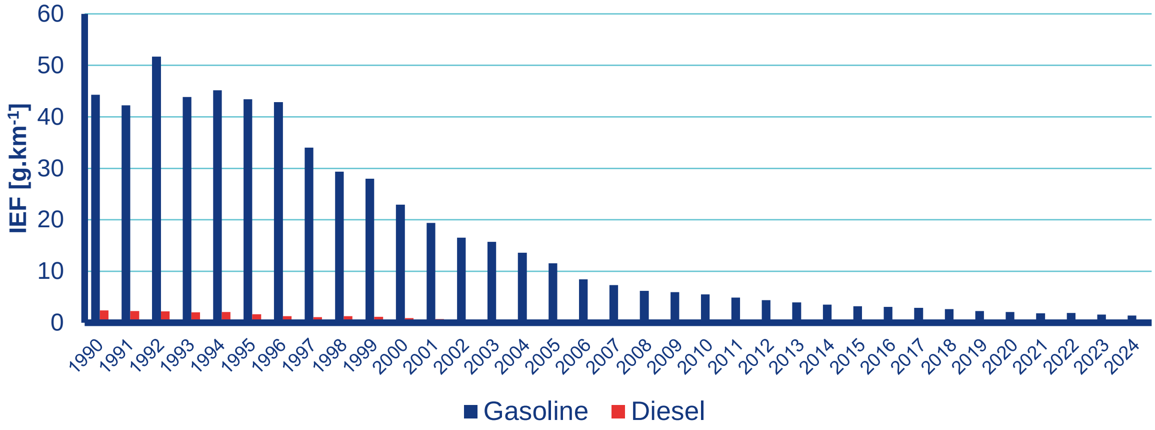


Figure III.13 CO implied emission factors for passenger cars, 1990–2024

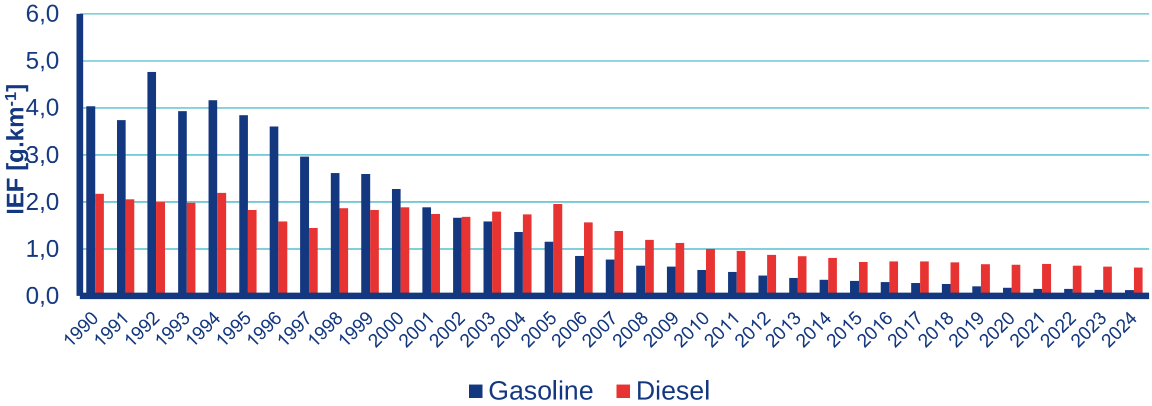


Figure III.14 NO_X implied emission factors for passenger cars, 1990–2024

Emissions

Emission values for all pollutants are reported in the national inventory files (NFR) available at EMEP Centre on Emission Inventories and Projections website. A brief description of PC emissions is included in the Road Transport Emissions subchapter.

III.3.1.2 Light-Duty Vehicles (1A3bii)

- gasoline conventional
- gasoline Euro 1–6
- diesel conventional
- diesel Euro 1–6
- battery electric Euro 6

LDV activity data and overall fuel consumption are described in the Methodology and results subchapter. Diesel oil is the predominant fuel in this category, with an average share of 84% of total LDV fuel consumption over the 1990–2024 period.

LDV emissions for all pollutants are reported in the national inventory files (NFR).

LDVs are a key category for NO_X emissions. NO_X implied EFs are displayed in Figure III.15. Emission factors are derived from the COPERT 5.9 model and correspond to Tier 3 methodology. Implied EFs for the most important fuels (gasoline and diesel) were extracted from COPERT.

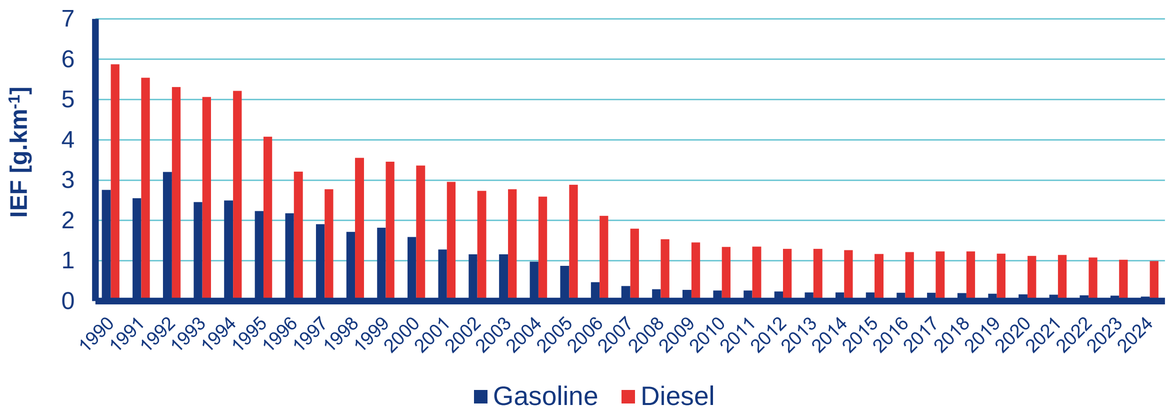


Figure III.15 NO_X implied emission factors for light-duty vehicles, 1990–2024

III.3.1.3 Heavy-Duty Vehicles and Buses (1A3biii)

- HDVs:
    - gasoline conventional
    - diesel conventional
    - diesel Euro I-VI
    - CNG Euro VI
- Buses:
    - diesel conventional, Euro I-VI
    - diesel hybrid Euro VI
    - biodiesel conventional, Euro VI
    - CNG EEV, Euro I-VI
    - battery electric Euro VI

Activity data for HDVs and buses, as well as overall fuel consumption, are briefly described in the Methodology and results subchapter. Diesel oil is the dominant fuel in this category, accounting for 99% of total fuel consumption throughout the 1990–2024 period.

HDV emissions for all pollutants are reported in the national inventory files (NFR). A brief description of NO_X, NMVOC and PM emissions from this category is included in the Emissions subchapter.

HDVs and buses are a key category for NO_X emissions. NO_X IEFs are shown in Figure III.16. Emission factors are derived from the COPERT 5.9 model and correspond to Tier 3 methodology. Implied EFs for the most important fuels (gasoline and diesel) were extracted from COPERT.

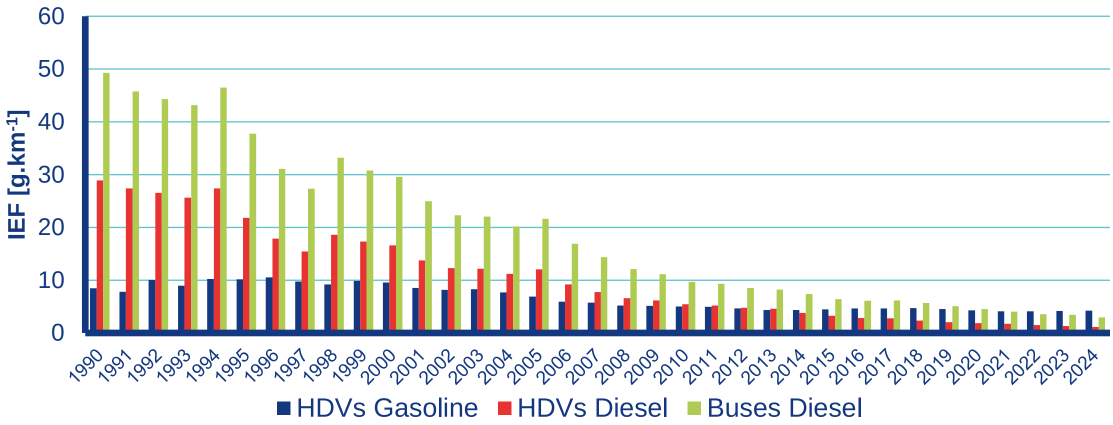


Figure III.16 NO_X implied emission factors for heavy-duty vehicles and buses, 1990–2024

III.3.1.4 Mopeds and Motorcycles (1A3biv)

Activity data for mopeds and motorcycles (L-category) and overall fuel consumption are briefly described in the Methodology and results subchapter. The main fuel used in CZ is gasoline with share of more than 99% of total fuel consumption in this category in the 1990-2024 period. Emission values for all pollutants produced by mopeds and motorcycles are reported in the national inventory files (NFR). A brief description of NO_X, NMVOC and PM emissions from L-category is included in the Methodology and results subchapter. Mopeds and motorcycles do not constitute a key category for any pollutant; therefore no detailed description of implied emission factors is provided in this subchapter.

III.3.1.5 Gasoline evaporation and abrasion (NFR 1A3bv, 1A3bvi and 1A3bvii)

NMVOC emissions in subcategory 1A3bv were estimated using the Tier 3 methodology implemented in the COPERT 5.9 model. Gasoline evaporation was incorporated into the calculation. For evaporative emission estimation, statistical data on the number of vehicles equipped with and without emission control systems were used. The Tier 3 method is based on several input parameters, including fuel vapour pressure, vehicle tank size, fuel tank fill level, canister size, diurnal temperature variation, and cumulative mileage.

For estimating emissions from tyre, brake, and road abrasion, the COPERT 5.9 model was also applied. A Tier 2 method was used, as no Tier 3 for these sources has yet been developed.

Emission factors and calculations

All processes which account for in the evaporative emission calculation are shown in Figure III.17. Activity data for relevant subcategories are displayed in Figure III.18. The main sources of evaporative NMVOC emissions are gasoline passenger cars and motorcycles.

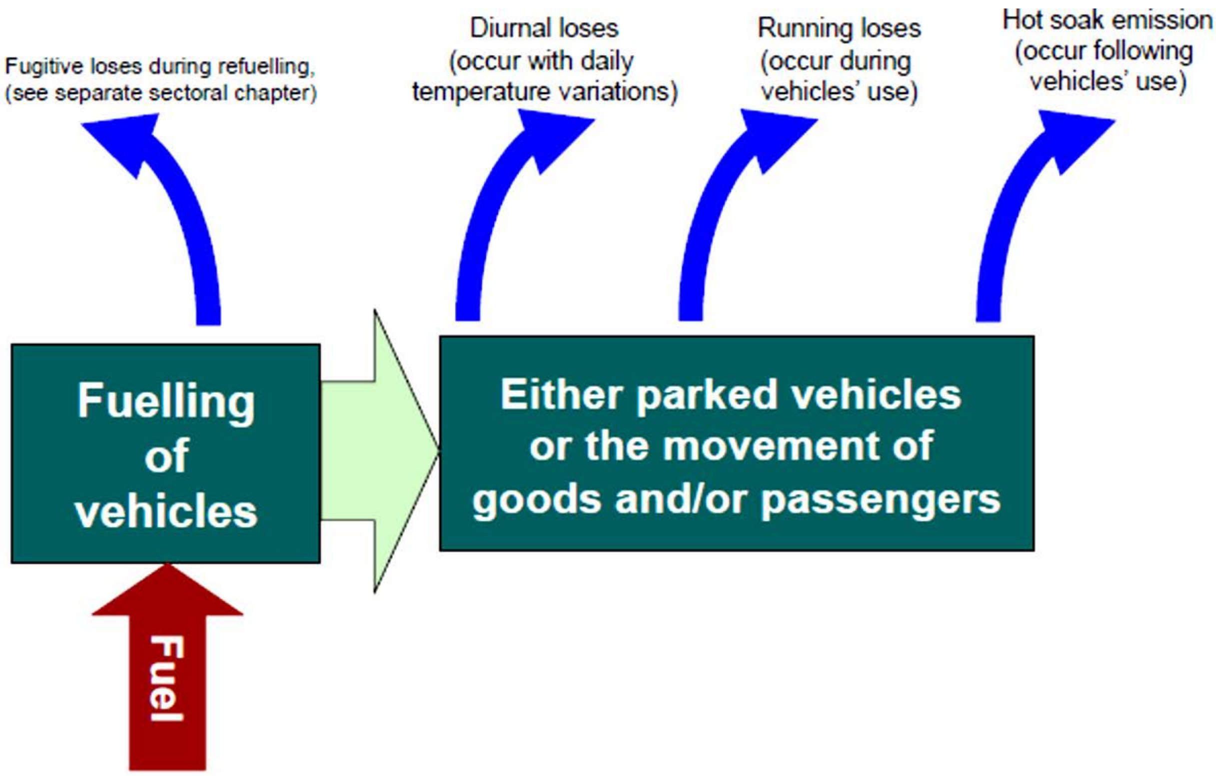


Figure III.17 Processes resulting in evaporative emissions of NMVOC (source: EMEP/EEA EIG 2023 [3])

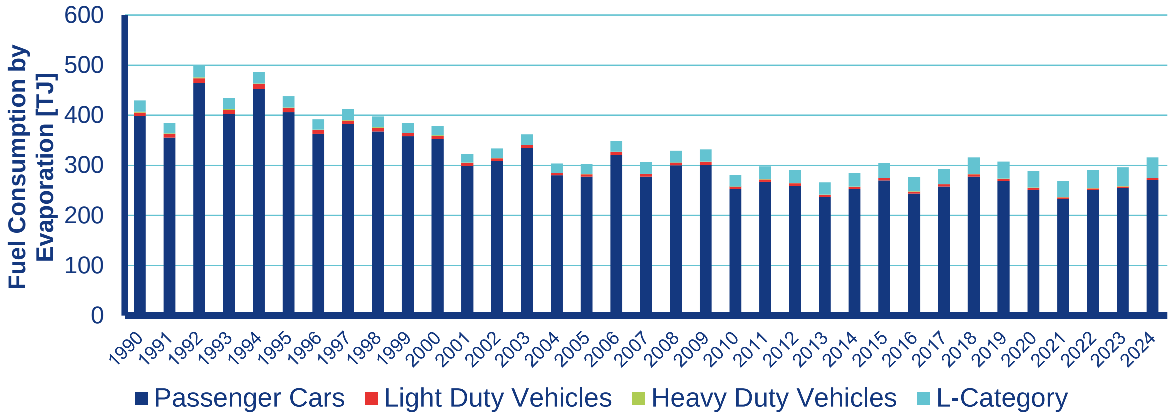


Figure III.18 Annual fuel consumption by evaporation in road transport, 1990–2024

Key activity data for abrasion is the traffic performance of car fleet in Czechia (see Figure III.19). The development of traffic performance after 1990 and its decrease due to the economic crisis in 2008–2013 is clearly seen in the graph below. From 2014, traffic performance started to increase steeply again with an one-off break in 2020 due to COVID-19 situation. The increase continued in 2024 too.

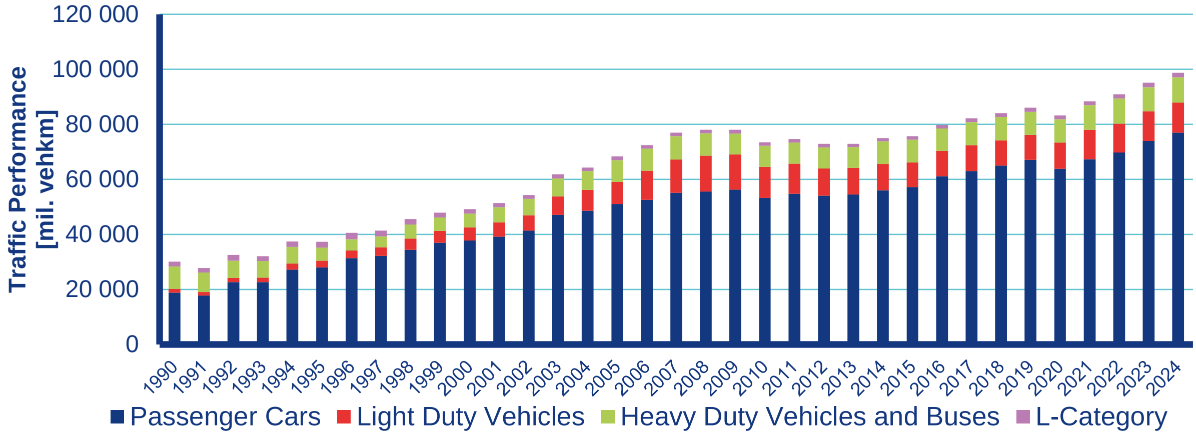


Figure III.19 Annual traffic performance in road transport, 1990–2024

Implied EFs of pollutants from tyre, brake and road abrasion (PM_{10} and Pb) are presented in this subchapter. Emission factors are derived from the COPERT 5.9 model and correspond to Tier 2 methodology. Implied EFs for all vehicle categories were extracted from COPERT (see Figure III.20 and Figure III.21).

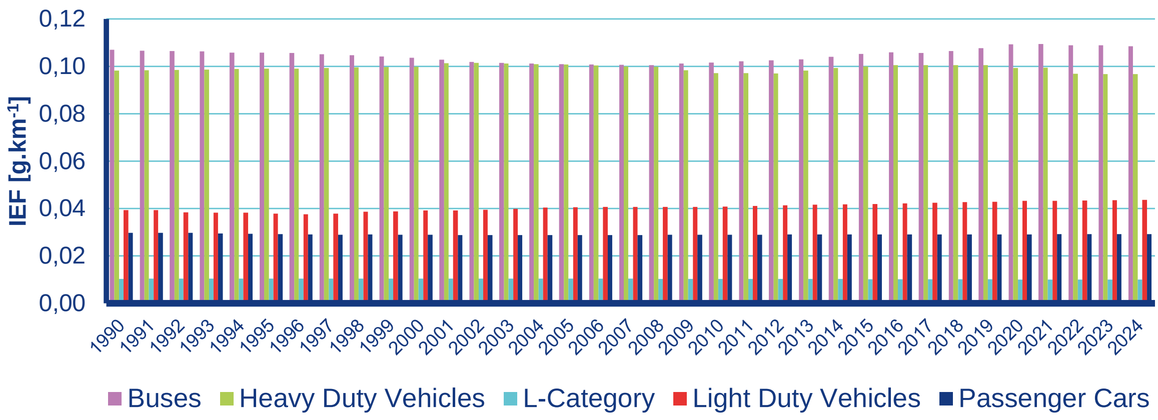


Figure III.20 PM_{10} implied emission factors from tyre, brake and road abrasion, 1990–2024

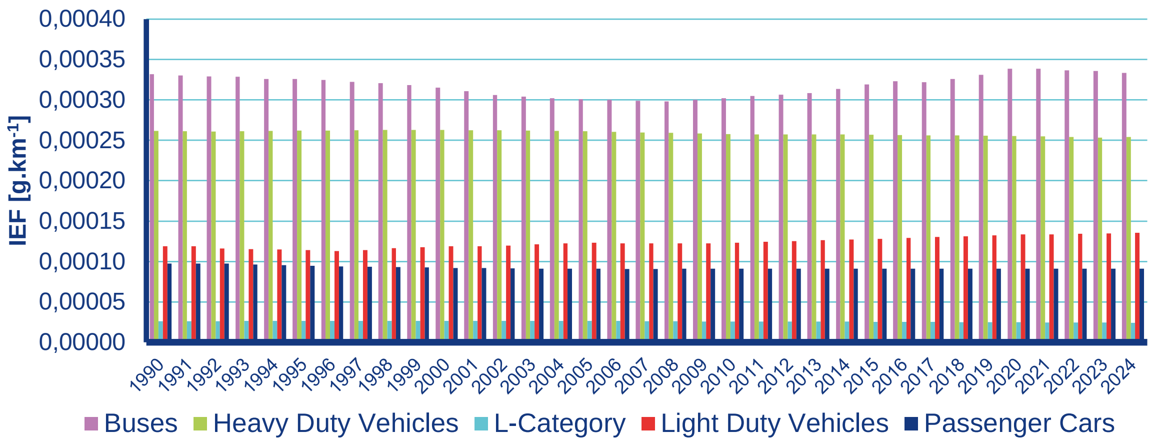


Figure III.21 Pb implied emission factors from tyre, brake and road abrasion, 1990–2024

Emission values for all pollutants produced from evaporation and tyre, brake or road abrasion are reported in the national inventory files (NFR).

Planned improvements

No major improvements are planned.

III.3.2 Non-road transport (NFR 1A3a, 1A3c, 1A3d)

This chapter contains information about emissions from aviation, railways and inland navigation. Emissions from pipeline transport (NFR 1A3e) are described in Chapter III.1 Large stationary sources.

Combustion processes in air transport are very different from those in land and water transport. This is caused by its operation in a wider range of atmospheric conditions (namely by substantial changes in atmospheric pressure, air temperature and humidity). These variables are changing vertically with altitude and horizontally with air masses. In NFR 1A3a, emissions from both national (domestic) and international civil aviation are reported with respect to distinctive flight phases: the LTO (Landing/Take-off: up to 3 000 feet) and the cruise (above 3 000 feet). Emissions from military aircraft and helicopters used for public and private purposes are also included in this category.

The Czech railway sector is undergoing a long-term modernization process aimed at making electricity the primary energy source for rail transport. The total volume of transport declined which was caused by a significant drop in freight transport. In the recent years, the share of electric traction has stayed approximately at the value 86% of total railway traffic volumes.

Inland navigation includes goods transport on navigable parts of rivers (Vltava, Labe) and leisure boats on rivers, channels and reservoirs.

III.3.2.1 Civil aviation

For IFR flights, bottom-up data from EUROCONTROL were used in time series 2005 to present year. Time series 1990–2004 was estimated by extrapolation of EUROCONTROL fuel consumption with the help of fuel consumption from Czech Oil questionnaire provided by CZSO. CO_2 and N_2O emissions were calculated based on EUROCONTROL implied emission factors, CH_4 emissions based on 2006 IPCC Guidelines. IFR LTO/cruise ratios were obtained from EUROCONTROL.

For VFR flights, the ratio between LTO and cruise phases was provided by the Civil Aviation Authority (CAA) based on expert judgement, as no database of VFR flight characteristics is available for the Czechia. The ratio for helicopters was also obtained from CAA. For VFR flights, EFs from Table 3.10 of the 2023 EMEP/EEA EIG [3] were used, and for helicopters, EFs from Table 3.11 of the same guidebook were applied. The respective LTO/cruise ratios and EFs were then applied to fuel consumption data for VFR flights and helicopters obtained from the CZSO.

Army air force emissions are included in the aviation subsector. Activity data for military flights are based on a CZSO estimate. Fuel consumption of jet kerosene used by military flights has been reported since 2002. EFs from Table 3.11 of the 2023 EMEP/EEA EIG [3] were applied to fuel consumption of army air force.

To ensure comparability of statistics, fuel consumption of aviation is aligned to jet kerosene and aviation gasoline consumption on national level as per Czech Oil questionnaire.

Table III.3 Ratio of fuel usage between LTO and cruise flight mode in 2024

Subsector	Flight mode	Ratio
1A3a (IFR, domestic)	LTO	0.31
	CRUISE	0.69
1A3a (IFR, international)	LTO	0.13
	Cruise	0.88
1A3a (VFR, helicopters)	LTO	0.90
	Cruise	0.10
1A3a (army flights)	LTO	0.25
	CRUISE	0.75

Activity data were gained from CZSO and EUROCONTROL. Data were divided between LTO and cruise flight mode according to ratio which is stated in the Table III.3. Data for domestic aviation and international aviation were gained from EUROCONTROL (IFR flights) and CZSO (VFR flights, helicopters and army flights).

The method for VFR flights, helicopters and army air force is on Tier 1 level. The main pollutants for IFR flights based on EUROCONTROL are on Tier 3 level. Other pollutants are still on Tier 1 level, but the emission factors were actualized according to the newest version of EMEP/EEA EIG [3]. EF method for the most significant pollutants and EFs are provided in Table III.4.

Table III.4 EF method used and EFs for the most significant pollutants for IFR domestic and international flights in the current year (g·kg^{-1})

Subsector	Method CO	Method NO_X	Method NMVOC	EF CO	EF NO_X	EF NMVOC
Domestic Jet Kerosene LTO	Tier 3	Tier 3	Tier 3	14.0	13.4	4.9
Domestic Jet Kerosene Cruise	Tier 3	Tier 3	Tier 3	6.5	13.0	1.2
Domestic Gasoline LTO	Tier 3	Tier 3	Tier 3	785.9	8.5	25.5
Domestic Gasoline Cruise	Tier 3	Tier 3	Tier 3	782.8	12.9	16.9
International Jet Kerosene LTO	Tier 3	Tier 3	Tier 3	8.5	14.5	1.2
International Jet Kerosene Cruise	Tier 3	Tier 3	Tier 3	2.5	13.7	0.3
International Gasoline LTO	Tier 3	Tier 3	Tier 3	854.0	6.1	22.2
International Gasoline Cruise	Tier 3	Tier 3	Tier 3	930.5	10.1	16.7

III.3.2.2 Railways

Railway power stations used for the generation of traction electricity are classified under the stationary component of the energy sector (NFR 1A1a) and are therefore not included in the following analysis. With regard to energy inputs used by trains, diesel fuel is the only significant source aside from electric power. Coal-fuelled locomotives are operated solely for recreational purposes, and their contribution to overall emissions is negligible.

In general, diesel fuel consumption by railways has a slightly decreasing trend from 2000. The only exception were years 2005–2008. After this period, diesel fuel consumption fell under 4 000 TJ per year because of economic crisis and replacement of diesel-powered locomotives with electric ones. In 2023, diesel consumption was 2 926 TJ.

The CZSO has been providing coal consumption data since 2005 (lignite used for historical rides). In previous submissions, coal consumption for the years 1990–2004 was estimated; however, as these values cannot be verified, they are now reported as 'NE'. From 2005 to 2017, 1 kt of lignite was combusted annually. Since 2014, bituminous coal has also been used. Total coal consumption has been decreasing since 2018, with a more pronounced decline during the COVID-19 pandemic years (2020–2021). This downward trend is primarily due to the cessation of lignite use from 2018 onward.

In 2023 submission, new methodology for calculation of railway emissions from diesel oil (Pelikán et al., 2021, [12]) was introduced which increased detail and accuracy of calculation from Tier 1 to Tier 2 level as per EMEP/EEA EIG 2023 [3] for most of the pollutants. Based on the new activity data obtained from Czech Railway Administration (Správa železnic), České dráhy (ČD) and CZSO, national diesel fuel consumption statistics were broken down by locomotive type to apply three different sets of emission factors. There are three diesel locomotive categories:

- line-haul locomotives,
- shunting locomotives,
- rail-cars.

Calculation of railway emissions from diesel consists of three main steps:

1. Rail traffic performance calculation – Average traffic performance of line-haul locomotives and rail-cars is calculated based on the latest available data from Správa železnic for profile weeks in the given year. In each category, the five most frequent locomotives and their share of rail traffic performance in brtkm was defined. Final value is weighted traffic performance of these locomotives. Shunting locomotive traffic performance is based on the study Perůtka et al., 2020 [13]. The latest data for shunting locomotives are available for year 2022.
2. Calculation of traction diesel consumption – Specific traction diesel consumption is calculated for each locomotive category. Final traction diesel consumption is a product of activity data and specific traction diesel consumption. Based on this value, share of each locomotive category on the total rail diesel fuel consumption given by CZSO is set.
3. EFs application – Tier 2 or Tier 1 EFs according to EMEP/EEA EIG 2023 [3] are applied on final diesel consumption calculated for each category.

Emission factors

Railway transport is not a key category for any pollutant. Emission factors for diesel oil are Tier 2 for the following pollutants: NO_X, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, and CO. EFs for the rest of the pollutants are on Tier 1 level. EFs for coal are on the Tier 1 level according to EMEP/EEA EIG 2023 [3] which recommends using EFs for 1A2 Combustion in manufacturing industries and construction. Some emission factors (Hg, As, benzo(a)pyrene, benzo(b)fluoranthene) are not provided in a corresponding chapter in EMEP/EEA EIG. According to the recommendation from EMEP/EEA EIG 2023 [3], Tier 1 EFs for HDVs were applied in case of missing EFs. In Table III.5, there are presented EFs for the most significant pollutants produced by railways and their calculation methods.

Table III.5 EF method used and EFs for the most significant pollutants for railways in the current year

Locomotive type	Fuel type	Method CO	Method NO_X	EF CO	EF NO_X
Line-haul	Diesel Oil	Tier 2	Tier 2	18.0 $g{\cdot}kg^{-1}$	63.0 $g{\cdot}kg^{-1}$
Shunting	Diesel Oil	Tier 2	Tier 2	10.8 $g{\cdot}kg^{-1}$	54.4 $g{\cdot}kg^{-1}$
Rail-cars	Diesel Oil	Tier 2	Tier 2	10.8 $g{\cdot}kg^{-1}$	39.9 $g{\cdot}kg^{-1}$
Steam	Coal	Tier 1	Tier 1	931.0 $g.GJ^{-1}$	173.0 $g{\cdot}GJ^{-1}$

III.3.2.3 Navigation

Primary data on fuels available in CZSO or in other statistics do not allow a proper differentiation into national and international navigation on inland waterways in the Czechia. Due to this fact and also because share of the international navigation is very low, all activity data are allocated to NFR 1A3dii National navigation (shipping).

CZSO only provides data about diesel oil fuel consumption in national navigation. There is no national source on petrol consumption data in the required detail and structure, therefore only emissions produced from vessels with diesel engines are calculated. Electric vessels are also not considered as the emissions are generated during electricity production, so they are to be reported within stationary sources, similarly as in rail transport.

In 2025 submission, a new methodology for calculation of emissions from national navigation (Kačmárová and Pelikán, 2024, [14]) was applied. This allowed to increase detail and accuracy from Tier 1 to Tier 2 level for most of the pollutants. Based on the new data about installed engine power obtained from Czech State Navigation Administration (SPS), the fleet was divided into three categories in accordance with Tier 2 technology specific approach as per EMEP/EEA EIG 2023 [3]:

- vessels with slow-speed diesel engines,
- vessels with high-speed diesel engines (small and recreational boats),
- vessels with steam turbines.

Activity data

CZSO have been providing data about diesel oil consumption since 1997. The data before 1997 are based on the CZSO expert judgement. Total fuel consumption by domestic navigation is very low (129 TJ in 2024). It is divided into the above-mentioned vessel categories based on their percentual share on the total installed engine power. Emissions are calculated with the help of emission factors for each category (see below).

Emission factors

Navigation is not a key category for any pollutant. EFs are only applied to diesel oil due to unavailability of data for other fuels. EFs for the following pollutants are on Tier 2 level as per EMEP/EEA EIG 2023 [3]: NO_X, CO, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC.

Emission factors for heavy metals and PAHs are not provided in the EMEP/EEA EIG. Therefore Tier 1 EFs for HDVs were used for inland navigation as well. EFs for the most significant pollutants produced by navigation and their calculation methods are presented in Table III.6.

Table III.6 EF method used and EFs for the most significant pollutants for inland navigation in the current year ($g \cdot kg^{-1}$)

Vessel type	Fuel type	Method CO	Method NO_X	EF CO	EF NO_X
Slow-speed	Diesel Oil	Tier 2	Tier 2	3.24	45.82
High-speed	Diesel Oil	Tier 2	Tier 2	17.34	27.47
Steam	Diesel Oil	Tier 2	Tier 2	3.84	6.12

Planned improvements

No major improvements are planned.

III.3.3 Other non-road mobile sources & machinery (NFR 1A2gvii, 1A4, 1A5)

This chapter contains information about emissions from operation of machines (e.g., mining and construction machines like excavators, caterpillars and loaders, transport inside industrial areas, gardening), agriculture and forest machines and consumption of gasoline and diesel oil in further sectors (services, integrated rescue system and military).

The biggest contribution to emissions comes from the operation of agricultural machinery (1A4cii), mainly represented by tractors. The key step for emission data revision in 2021 was the opening of the non-road vehicles database running together with the road vehicles database by the Czech Ministry of Transport. Data were sorted according to age and engine power into groups of tractors according to relevant efficiency for categorization into Stage I-V.

Estimates of emissions from non-road mobile sources were calculated for diesel oil and jet kerosene in NFR 1A4aii. In 1A4cii, diesel oil and gasoline are consumed, in 1A4bii gasoline only. The operation of agricultural machinery (NFR 1A4cii) covers a major part of fuel consumption of small combustion, other subcategories are negligible. AD regarding other fuels potentially used in Czechia are not available.

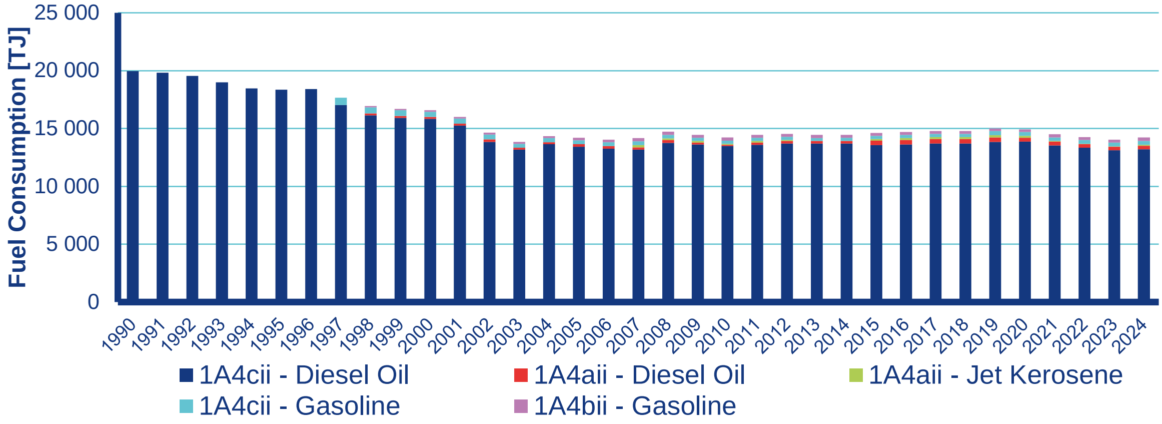


Figure III.22 Annual fuel consumption by non-road mobile machinery, 1990–2024

Activity data on fuel consumption for each category were prepared based on the CZSO statistical census. The decrease in the consumption of diesel fuel used for the operation of agricultural machinery in the NFR category 1A4cii between 2020 and 2021 was caused by the revision of the consumption of diesel fuel used in the cultivation of selected agricultural crops. Fuel consumption has been affected by modern trends in crop cultivation within the framework of precision agriculture and the shift from classic tillage methods to modern no-till methods of cultivation.

III.3.3.1 Mobile combustion in manufacturing industries and construction

Emission factors for main pollutants are Tier 2 and they are used according to EMEP/EEA EIG 2023 [3]. The exceptions are emissions of SO_X and Pb. Those are country-specific and based on the content of pollutants in fuels. Heavy metals and PAHs were calculated on Tier 1 level. Mobile combustion in manufacturing industries and construction is not a key category for any pollutant. Table III.7 shows the EFs and EF method used. Tier 1 EFs are constant in time, therefore they are not presented in the table. The table contains CS EFs and Tier 2 EFs which are changing in time.

Table III.7 EF method used and EFs for the most significant pollutants for non-road mobile machinery in the construction and other industries in the current year ($g \cdot kg^{-1}$)

Subsector	Fuel type	Method CO	Method NO_X	EF CO	EF NO_X
1A2gvii	Diesel Oil	Tier 2	Tier 2	6.02	1.57

III.3.3.2 Commercial/Institutional/Residential

Mobile machinery is defined as all machinery equipped with a combustion engine which is not primarily intended for transport on public roads, and which is not attached to a stationary unit. The most important utilization of mobile machinery is:

- 1A4aii Commercial/Institutional: Mobile
- 1A4bii Residential: Household and Gardening: Mobile
- 1A4cii Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery

This subchapter does not include agricultural machinery emissions. These are described in the subchapter Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery (see below).

Gasoline-driven lawnmowers used for gardening are included in 1A4bii. Tractors, harvesters, chain saws, gasoline off-road vehicles and other machinery used in agriculture and forestry are in the subcategory 1A4cii. Since agriculture emissions are the most important, more attention is paid to them. Mobile sources reported under NFR 1A4 (non-road mobile) represent versatile equipment and means of transport like diesel non-road machinery (e.g., forklifts).

Emission factors for main pollutants are Tier 2 EMEP/EEA EIG 2023 [3]. Exceptions are emissions of SO_X and Pb. Those are country-specific and based on the content of pollutants in fuels. Heavy metals and PAHs are calculated on Tier 1 level. Emission factors of diesel agriculture and forest machines are based on emission measurements done in the past years for each type of vehicle for various performance parameters. In Table III.8, there are presented CO, NO_X and NMVOC EFs and their calculation methods.

Table III.8 EF method used and EFs for the most significant pollutants for non-road mobile machinery in the current year ($g \cdot kg^{-1}$)

Subsector	Fuel type	Method CO	Method NO_X	Method NMVOC	EF CO	EF NO_X	EF NMVOC
1A4aii	Diesel Oil	Tier 2	Tier 2	Tier 2	6.02	1.57	0.54
	Jet Kerosene	Tier 2	Tier 2	Tier 2	6.02	1.59	0.53
1A4bii	Gasoline	Tier 2	Tier 2	Tier 2	736.58	3.92	62.37
1A4cii	Gasoline	Tier 2	Tier 2	Tier 2	736.58	3.92	62.37

III.3.3.3 Military

Basically, all military ground transport fuelled by diesel oil is included in this category. There is no military navigation (1A5biii) in Czechia.

Activity data for NFR 1A5b are obtained from the CZSO. Diesel oil consumption decreased between 1999 and 2005. In the subsequent years, consumption rose and reached approximately 390 TJ in 2008. After 2008, diesel use remained relatively stable, with a decline to 344 TJ in 2013, followed by a period of similar levels up to 2021, when consumption increased to more than 400 TJ. During the most recent three years, consumption has again fluctuated around 390 TJ.

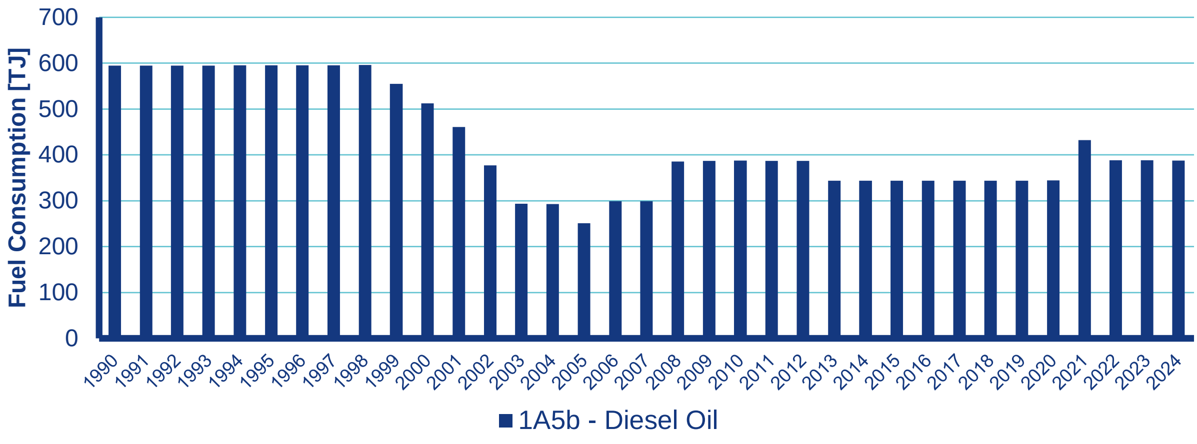


Figure III.23 Annual fuel consumption by other mobile sources, 1990–2024

Emission factors for main pollutants are Tier 2 and they are used from the EMEP/EEA EIG 2023 [3]. Exceptions are emissions of SO_X and Pb. Those are country-specific and based on the content of pollutants in fuels. Heavy metals and PAHs are calculated on the Tier 1 level. Other mobile sources are not a key category for any pollutant. EFs for the most significant pollutants produced by other mobile sources and their calculation methods are presented in Table III.9.

Table III.9 EF method used and EFs for the most significant pollutants for other mobile sources in the current year ($g \cdot kg^{-1}$)

Subsector	Fuel type	Method CO	Method NO_X	EF CO	EF NO_X
1A5b	Diesel Oil	Tier 2	Tier 2	6.02	1.59

III.3.3.4 Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery

In past, calculated relevant emissions occurring during the operation of agricultural machinery (mostly tractors) were relatively high in comparison with other countries and other sectors using similar types of diesel engines. This fact was also highlighted as part of the TERT review process in 2021. This was the reason for a detailed review of the emission factors and activity data used to calculate emissions from the operation of agricultural machinery. This review was initiated in 2021 during the preparation of the national emission inventory for 2022. An updated calculation method was provided in 2024 as part of the TERT review process. Emission data for wood processing tools (wood cutting) are available from 1997 onwards.

The key step for activity data revision was the opening of the road and non-road vehicles database of tractors registered in the Central Register of Motor Vehicles of the Ministry of Transport of the Czechia. From this database, it is currently possible to determine the exact age of tractors, power classes, and thus the possibility to assign the relevant emission factors according to the relevant stage for categorization into Stages I-V. During 2023, an investigation and analysis of historical data was also carried out, which would allow such a precise breakdown of tractors to be carried out back to 1990 or at least to the year 2000 in order to transparently determine the possible production of emissions in 2005. Unfortunately, historical data for the period 1990-2010 are not available for such a detailed breakdown, so cooperation was initiated with the Czech Association of Agricultural Machinery Importers. The aim was to reconstruct the state of agricultural machinery as much as possible based on data monitored by the association since its establishment in 1994.

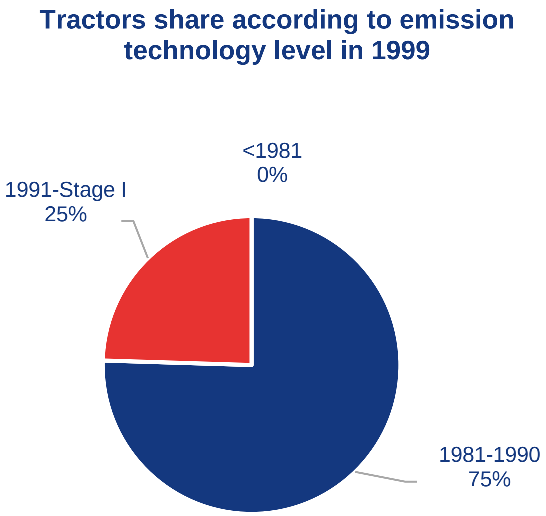
Another update of the composition of the structure of tractors operated in the Czechia was carried out at the beginning of 2026.

Activity data

As mentioned above activity data on fuel consumption have been providing by the CZSO. Active data on the number of tractors, their age, or year of manufacture, and performance category are available for 2021 and beyond in the Central Register of Motor Vehicles database of the Ministry of Transport of the Czechia. For the calculation of historical emissions, the data collected by the CZSO in 1999 (Mechanization and equipment in agriculture as of 1.2.1999) were used as the official available activity data.

Figure III.24 shows the evaluation of technology levels in terms of the division of tractors better said their engines into individual emission classes (stages) for the assignment of the relevant emission factors. The evaluation is carried out for the year 1999 characterizing historical data and for the year 2024 characterizing the modern present.

As can be seen from these pictures, in 1999, the first emission limits were applied to 25% of tractors in operation, when the engines of these tractors were already partially classified under Stage I. On the contrary, in 2024, approximately 35% of tractors meeting the highest Stage IV and V emission classes were in operation in the Czechia. This positive trend is of course also reflected in a reduction in pollutant emissions.



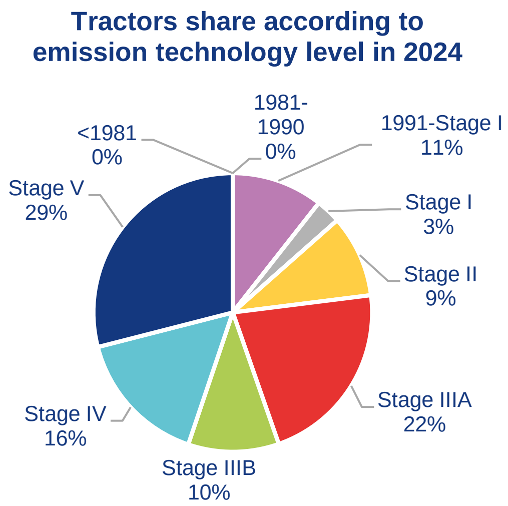


Figure III.24 Share of tractors by year of production

In Figure III.24, the share of tractors structured according to rated engine power is shown. In 1999, approximately 79 thousand tractors were registered in operation. As can be seen from the pictures, these were mainly tractors of lower performance classes. Approximately 77% of tractors used engines with an output between 37-75 kW. In 2024, only about 65 thousand tractors were registered in operation in the Czechia, which is a decrease of about 30%. On the contrary, a clear trend in the increase in their performance is visible for these tractors. About 50% of tractors use engines with an output of over 75 kW and about 20% of them even with an output of over 130 kW. In 1999, tractors with an output of over 130 kW were quite exceptional.

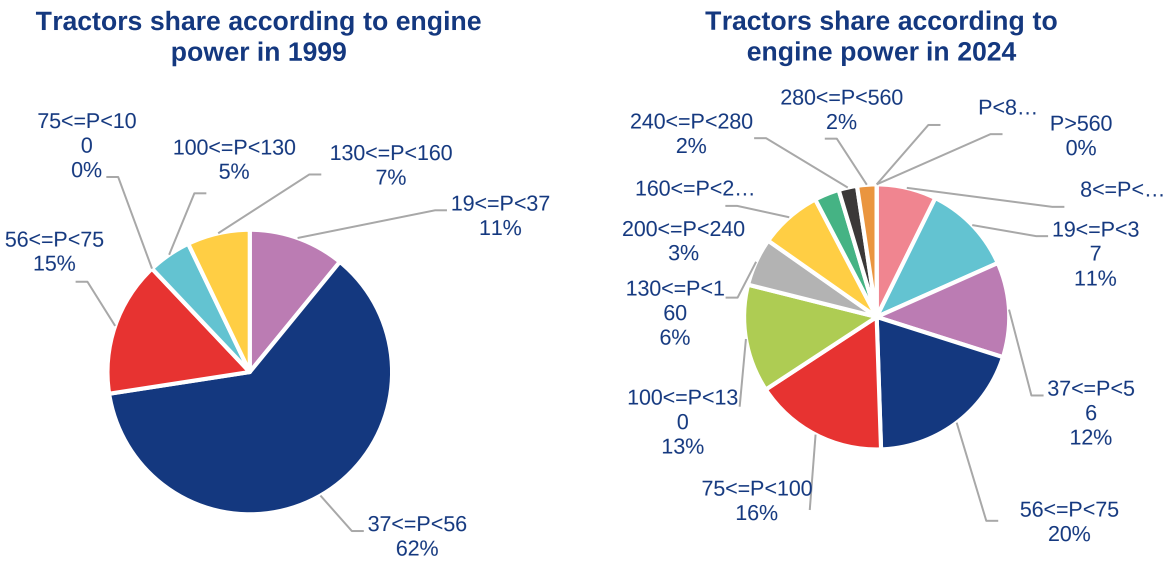


Figure III.25 Share of tractors [%] according to rated engine power [kW]

Emission factors

Mobile agricultural machinery is a key source of NO_X (as NO_2) and CO. This category of mobile machinery is also an insignificant source of NMVOC and TSP. For national estimation of the mentioned emissions produced by agricultural machinery in Czechia, the Tier 3 emission factors given in Table 3.6 of the EMEP/EEA 2023 Non- Road mobile sources and machinery are used. To calculate other emissions such as CH_4, NH_3, heavy metals and others, Tier 1 emission factors are used. This means that emissions are calculated based on fuel consumption.

An important factor in calculating these NOx, CO, PM and NMVOC emissions according to Tier 3 is the knowledge of the annual use of agricultural machinery (number of operating hours). According to expert judgement based on consultancy with representative of the Czech Association of Agricultural Machinery Importers and Producers covering all important tractors labels (John Deer, Case, Class, Deutz – Fahr, Fendt, Zetor and so on) annual working hours for tractors and other agricultural machinery used in agriculture for crop production can be divided as follows. For years since 2021, for 0–5-year-old diesel tractors the number of annual working hours is assumed to be 600 – 650. For 6–10-year-old tractors the annual working hours slightly decrease from 490-600 hours. For 11-15 -year-old tractors the annual working hours decrease from 280-380 hours. These tractors are used either on smaller fields or they serve as a stan-by source in case of failure of new modern tractors used as a grates power sources on the farms. For 16-20 -year-old tractors the annual working hours decrease on 130-280 hours and these tractors are already used especially on small farms. Their power does not already correspond to current requirements for aggregation with new modern and huge agricultural machinery. Tractors older than 20 years are used sporadically. It means their annual working hours are assumed on the level of 40-130 hours. The number of operating hours divided into individual categories of tractors according to their age corresponds to the consumption of fuels used in each tractor category and corresponds with total consumption of fuels used in NFR 1.A.4.c ii recorded by CZSO pro relevant year.

The emissions from non-road machinery increase as engines become older, and the deterioration factor expresses the emission factor increase during the entire engine lifetime, relative to the basis emission factor. From tab. 3.11 of the EMEP/EEA 2023 a relevant deterioration factors for diesel machinery relative to average engine life time was used.

The load factor used for diesel tractors of 0.5 was based on recommendations from several sources of information. These sources are 1) Winter and Nielsen - Fuel use and emissions from non-road machinery in Denmark from 1985-2004 - and projections from 2005-2030, Tab. 15 page 31. 2) European Inventory Calculations for Agricultural (Ag) and Construction Equipment (CE) Applications of Diesel-Powered Non-Road Mobile Machinery (NRMM). Page 2 (available on-line https://ec.europa.eu/docsroom/documents/1632/attachments/1/translations/en/renditions/native) and 3) The 2007 Technical Review of the NRMM Directive 1997/68/EC as amended by Directives 2002/88/EC and 2004/26/EC page 75 (available on-line https://circabc.europa.eu/sd/d/d11bead9-9201-449b-aa1c-e006905ee241/Final%20Report%20NRMM%20Review%20Part%20II.pdf).

Transient operation adjustment factors for diesel machinery were used according to tab. 3.14 of EMEP/EEA 2023.

The revision of emissions of the mentioned pollutants was carried out by calculating emissions in 1999 and 2021 using the same methodological procedure. A linear fit of the values was performed between these years. In the e-ANNEX 1A4cii the entire calculation procedure, including the activity data and emission factors used, is attached.

III.3.3.5 Planned improvements

No major improvements are planned.

III.3.4 Uncertainties

Uncertainties for the transport sector were calculated in accordance with Chapter A.5 "Uncertainties" of EMEP/EEA EIG 2023 [3] and assessed for the entire 1990–2024 time series for all reported categories. The uncertainty estimates for national transport-sector emissions for individual pollutants are presented in Table III.10.

Table III.10 Uncertainty data for Transport sector (NFR 1A3) from uncertainty analysis

Emission	Base Year Emissions (2000)	Year Emissions (2024)	Combined Uncertainty as% of Total National Emissions in Year 2024
	[kt]	[kt]	[%]
NO_X	93.08	53.94	25.69
NMVOC	44.37	7.23	34.33
SO_X	3.48	0.53	32.16
NH_3	1.33	0.89	127.22
TSP	5.99	5.58	31.53
BC	1.95	1.04	27.61
CO	398.47	77.04	37.94
HMs	0.25	0.14	145.65
POPs	4.03E-09	3.16E-09	119.36
PAHs	2.52E-04	5.67E-04	118.60

III.4 Fugitive emissions from fuels (NFR 1B)

The source category Solid fuels (1B1) consists of three sub-source categories:

- 1B1a Coal mining
- 1B1b Coal transformation
- 1B1c Other

The source category Oil fuels (1B2) consists of the next sub-source categories:

- 1B2a Oil extraction, refining/storage and distribution of oil product
- 1B2b Gas extraction
- 1B2c Venting and flaring
- 1B2d Other fugitive emissions from energy production

The modified emission calculation of NFR 1B1a is shown in e-ANNEX. This calculation was made in accordance with last TERT recommendations. The NFR 1B1 deals with fugitive emissions from coal mining, handling, transformation and other sources. In Czechia, there are mined bituminous coal and lignite. Lignite is mined in open-cast mining, and bituminous coal is from underground mining. Since the 1990s, coal mining has significantly lowered, and coal imports have grown. Lignite is mainly mined in North-West Bohemia, and bituminous coal is mined in Silesia (northeast of Czechia), as part of the Silesian basin. An important input for metallurgical production is the coke production located near bituminous coal mining in Ostrava and Třinec. The only facility for coal gasification (Sokolovská uhelná) ended its activity in 2020 and switched to standard coal combustion. The trend of lignite and bituminous coal mining is apparent in Figure III.26.

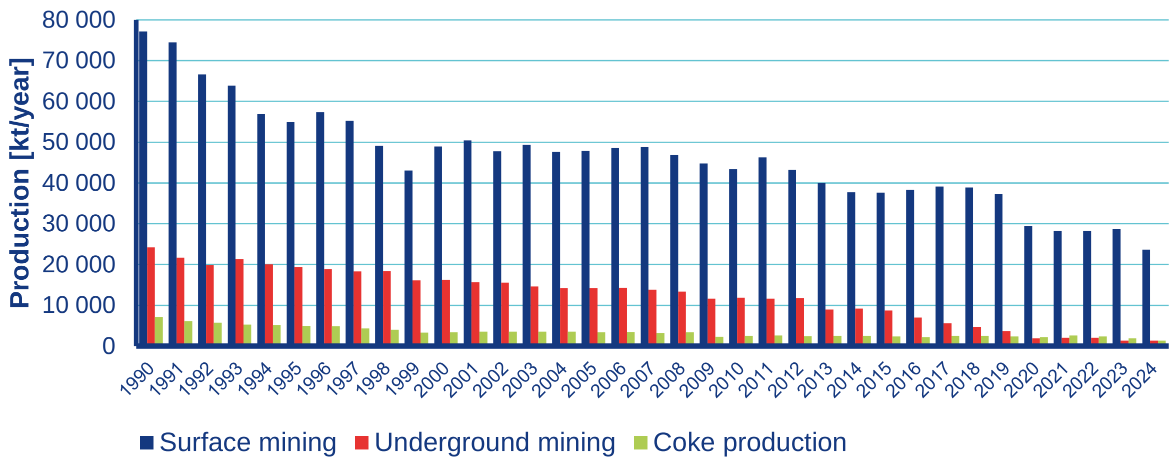


Figure III.26 Surface and underground mining (COAL) and coke production (kt·year^{-1})

NFR 1B1c includes coal sorting and drying emissions, mainly in sorting plants producing coal for household consumption, coke plants and wood coal production emissions.

Category 1B2 deals with fugitive emissions from Oil extraction, refining/storage and distribution of oil products. There are only limited deposits of oil and gas in Czechia located in Southern Moravia, so the fossil fuels import plays an important role in foreign trade. Oil processing to fuels takes place in two refineries (Litvínov and Kralupy nad Vltavou) with consequent petrochemical facilities.

The distribution network of fuels includes 4000 public petrol stations and approximately 2500 stations not accessible to the general public (mostly for distribution of diesel fuel) or with limited access. Multi-purpose petrol stations prevail, and the number of stations with biofuels and other fuel distribution (mainly CNG) grows.

NMVOC emissions from oil drilling come from oil storage and filling railway transport tanks. Due to low amounts, emissions from accompanying oil gas and carbon gas from bituminous coal are omitted. The most significant emission comes from refinery oil processing. It includes oil as well as oil product storage (NMVOC emissions), catalytic converters regeneration (emission of NO_X and SO_X) and refinery flaring (emission of NO_X and SO_X). Emissions from consequent petrochemical processing of oil products and flaring are allocated in NFR 2B10a.

III.4.1 Emission factors and calculations

In Czechia, there are mined bituminous (underground) and lignite coal. Lignite is mined mainly in open-cast mining and bituminous coal in underground mining. Emission factors for quantifying particulate emissions from lignite mining are taken from EMEP/EEA EIG, Tier 2, Table 3-3 Open cast mining [3]. The necessary activity data (hole drilled) are not available to calculate emissions from deep mining, however, negligible emissions are assumed.

Emission factors for primal manipulation with mined lignite (import and export) come from EMEP/EEA EIG, Tier 2, Table 3-7 [3]. Emission estimation from bituminous coal mining regards only manipulation with coal and through import and export. Detailed calculation is given in e-ANNEX.

NMVOC emissions from surface coal mining are not tied to a specific air stream, making monitoring the amount of escaping gas into the air significantly more complex. Therefore, an expert estimate is used for calculating NMVOC emissions from surface mining, due to geological conditions, the gas content in the North Bohemian coal basin is low. The EF for NMVOC was estimated at 0.075 $kg \cdot Mg^{-1}$. The EF for NMVOC from underground coal mining was estimated at 0.56 $kg \cdot Mg^{-1}$.

For NFR 1B1b, solid fuel transformation source operator reported emissions are used (coke production and gasification). Emissions from the coke production process are being ascertained according to a unified methodology of quantifying emissions from coking plants (see e-ANNEX).

Emissions for coal sorting plants NFR 1B1c are usually based on the one-off measurement of suction devices. Wood coal production emissions are being measured while putting the facility in operation, and specific production emissions are being used for annual reporting.

NFR 1B2 presents reported emissions excluding only emissions from oil fuels distribution calculated based on total diesel oil and petrol consumption of CZSO and emission factors. Refinery emissions may fluctuate depending on the product´s demand, sulphur content and the current operating conditions of each facility. Higher emissions in 2016 were caused mainly by shutting down some parts of petrochemical production due to an accident in the ethylene unit in August 2015.

Followed emission factors are used for calculating emissions in NFR 1B2av: Emissions from diesel oil are using EF 16.8 $g \cdot t^{-1}$ for the whole time series. For petrol distribution in 1990–1992, was used EF 1022 $g \cdot t^{-1}$ (without regeneration). Until 1998, according to law, we assumed successive installation of stage 1 and 2 regeneration, and from 1999 onwards, EF 70 $g \cdot t^{-1}$ was used.

Due to changes in integrated permits in refineries (Claus plants and flares) and petrochemical processes, there were changes in 2014 to the obligation to monitor and report emissions of combustion flares. According to the agreement with the source operator, the emissions of SO_X and NO_X were reported according to E-PRTR regulation. These were used to complete reported emissions (NFR 1B2c and partly 2B10a).

Distribution of emissions from processes operated in refinery Litvínov (mainly tail gas disposal) and follow-up emissions from petrochemical processing of petroleum products was revised, and transfers of SO_X, NO_X and NMVOC emissions were made in some years between NFR categories 1A1b, 1A2c, 1B2aiv, 1B2c and 2B10a. NMVOC emissions for NFR 1B2aiv for 1990 and 1991 were calculated using the implied emission factor from 1992 (approx. 3 kt NMVOC). Detailed information on some categories is given in e-ANNEX.

The inventory of fugitive NMVOC emissions in the gas industry includes a balance of gas leakages in the whole chain from extraction to import, storage, compression stations and distribution to end users. The performed inventory is closely linked to GHG (CH_4) inventory in the appropriate sector. National emission factors by IPCC balance and NMVOC emission were calculated as a long-term share of higher hydrocarbons in natural gas at 4.02% (w).

III.4.2 Uncertainties and QA/QC procedures

The chapter will supplied later.

III.4.3 Planned improvements

Data of the amount of a burned auxiliary natural gas and the amount of burned refinery gases will be supplemented in the following years. These data will be supplemented in cooperation with refinery operators. Thus that modification will lead to precision of calculation TSP, PM and VOC emissions.

IV. Industrial processes (NFR 2)

Date of the last revision: 15 March 2026

For emission estimates from industrial processes in Czechia, a combined system described in Chapter I.4 is used. Emissions from industrial processes listed in Annex 2 to Act No. 201/2012 Coll. are monitored. Emissions from these sources over the whole period are determined by the source operators themselves, who carry out authorized measurements or, in exceptional cases, calculations using emission factors. Unless emissions from sources listed in Annex 2 are determined (e.g. NFR 2B1 Ammonia production) or are determined only for more important sources (e.g. NMVOC emissions in NFR 2H2 Food processing), the inventory is compiled using EMEP/EEA EIG methodology. Emissions from processes not listed in Annex 2 (e.g. 2A5b Construction and demolition) are inventoried according to methodologies contained in the EMEP/EEA EIG, except for solvent use emissions (mainly NFR 2D3a), for which the EMEP/EEA EIG methodology is also applied. Emissions in NFR 2D Solvent use are estimated in a specific way, where emissions of significant sources are monitored in detail through annual SOE reporting, while household emissions and sources not covered by Annex 2 account for the majority of total emissions. These emissions are determined based on a material balance calculations using statistics on production and imports, data from the largest producers and users, and other relevant information. Many industrial processes belong to key categories. Some facilities in the industrial processes sector may be part of LPS reporting [3].

Annual emissions closely depend on key industrial production indicators (e.g. steel, clinker) as well as on economic (GDP), which correlate with industrial indicators, including passenger car production linked to other production sectors in Czechia. Activity data for the most important production facilities are based on the REZZO database, in cooperation with CZSO, and the Czech Lime Association and Czech Cement Association. In 2024, the reported activity data was harmonized with GHG reporting.

In 2024, there was a further decline in industrial production. Compared to 2021, the largest decline in the Manufacture of basic metals (by 28.6%), followed by the Mining and quarrying (by 22.1%), Printing and reproduction (18.2%) and the Manufacture of other non-metallic mineral products (15.6%). A decrease of approximately 10% was also recorded in the Manufacture of chemicals and chemical products and Manufacture of textiles.

.The year-on-year decrease in emissions from individually monitored REZZO 1 sources is attributable to a decline in production or stagnation in most industrial sectors. The shutdown of primary metallurgical operations at the Liberty Ostrava, a.s. site has resulted in a decrease in emissions both in sector 2C1 and in combustion sources under sector 1A2a. This mainly concerns a reduction in CO emissions by more than 28 kt overall. At ORLEN Unipetrol RPA s.r.o., Litvínov, emissions from petroleum refining and related chemical production increased due to operating conditions that required the combustion of sulphur-containing process gases in flares. This was reflected primarily in SO_2 emissions, which according to the data reported under E-PRTR, increased year-on-year by more than 4.8 kt.

Road construction emissions are largely determined by the amount of earthmoving that occurs at a site. Almost all roadway construction involves extensive earthmoving and heavy construction vehicle travel, causing emissions to be higher than found for other construction activities. The US EPA tier 1 method (used in Czechia) only considers new road or lane construction, and does not address road renovation activities. Emissions are calculated for the year in which new highway sections are opened to traffic. In 2024, a total of 134 km of highways were completed. The calculated emissions of more than 12 kt of TSP contributed to the year-on-year increase in total emissions.

The following chapters describe the method used to assign sources listed in Annex 2 to NFR categories and other sources monitored collectively. Unless stated otherwise, emissions of all reported substances were determined by the source operators themselves using Tier 3 approach.

The emission sources belong to key categories:

Emissions	NFR category	Share
SO_X	2B10a	9.5%
NMVOC	2D3d and 2D3a	13.7% (in total)
CO	2C1	6.6%
$PM_{2.5}$	2G	2.3% (Tobacco, Fireworks)
TSP	2A5b 2A5a	19.4% 2.7%
Pb	2G (Fireworks) 2C1	19.6% 8.2%
Cd	2G (Tobacco) 2C6 2C1	10% 6.4% 6.2%,
PCDD/PCDF	2C1	10.3%

The following chapters describe the calculation methods for subsectors. In 2022, the methodologies for classifying NO_X, NMVOC, SO_X and CO emissions from the processing of mineral raw materials and the production and processing of metals were adjusted. Until 2020, emissions of NO_X, NMVOC, SO_X and CO from processes related to the processing of mineral raw materials and the production and processing of metals that were not directly associated with melting furnaces (e.g. glass vats and smelting in non-ferrous metals production) were reported under the categories NFR 2A6 and NFR 2C7c. For 2021, these emissions were reported for the first time in NFR 1A2f (emissions from combustion processes related to glass production, NFR 2A3) and NFR 1A2b (emissions from the combustion processes related to the processing of non-ferrous metals, NFR 2C2 to 2C7a). The reallocation of emissions from NFR 2C7c and NFR 2A6 in historical reports will be carried out in the next reporting period. More detailed information is provided in the e-ANNEX.

IV.1 Mineral products (NFR 2A)

Industrial processing of mineral raw materials represents a broad group of activities that incorporates significant sources of emissions. Fuel combustion emissions from raw materials processing are included in NFR 1A2f, while processing emissions are divided among NFR 2A1–2A6. NFR 2A5a Mining of raw materials (excluding coal) was one of the key sources of TSP in 2024 (2.7%). Activity data for the most important production facilities are based on the REZZO database, in cooperation with CZSO, the Czech Lime Association, and the Czech Cement Association.

Cement and Lime production installations fall under individually monitored sources. National EFs based on measurements carried out in glassworks in Czechia were used to determine HMs emissions from glass production up to 1995 (see Table IV.1). In subsequent years, emissions reported by individual installations were used to determine total emissions. More details of individually monitored sources can be found in Chapter I.4. This is described in the Chapter I.4 on individually monitored sources.

Table IV.1 Emission factors used to determine emissions from the glass production

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se
	$g \cdot t^{-1}$ glass							
1990–1995*	9.034	0.191	0.004	0.597	0.567	0.010	0.676	2.14
from 1996**	1.700	0.130	0.003	0.190	0.230	0.007	0.490	0.800

* Country-specific EFs

** EMEP/EEA EIG [3]

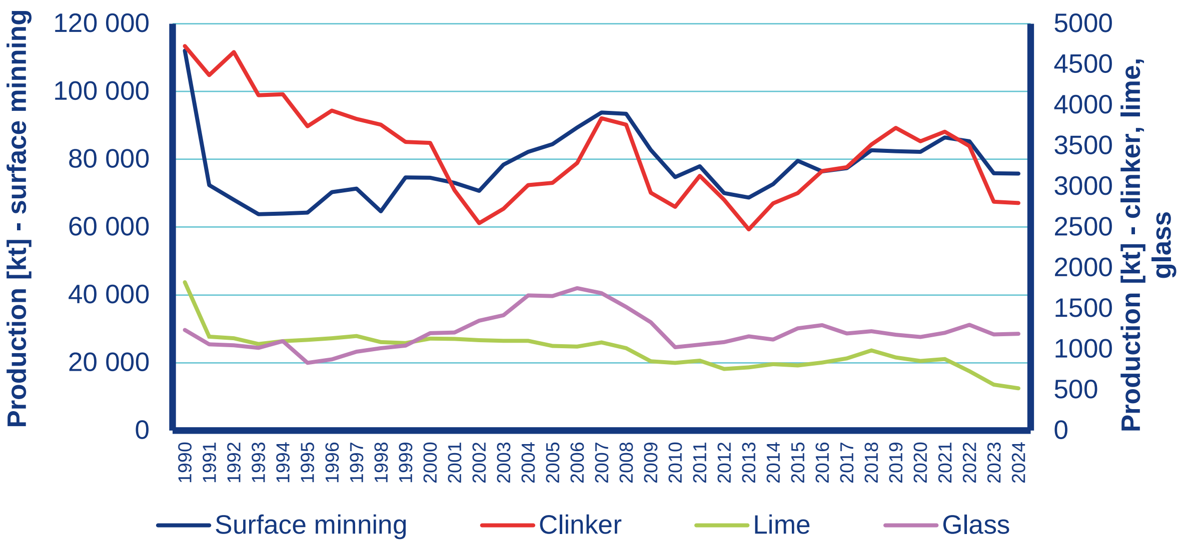


Figure IV.1 Surface mining (non-fuels) clinker, lime and glass production, 1990–2024

The methodology of emission monitoring is long-term constant for all sectors and is based, except for NFR 2A5b Construction and demolition, on reported source emissions underlying annual reporting duty. Annual measured emission concentrations show large (sometimes orders of magnitude) differences, leading to irregular emissions reported by operators. As part of the operation permit for all rotary clinker kilns, there is the possibility of waste co-combustion. Emissions of heavy metals and POPs for waste co-combustion cannot be separated from process emissions and are therefore reported in NFR 1A2a. Should emissions of raw material and product handling be exhausted by managed exhaust they are based on one-time measurements in prescribed intervals. For raw material mining in NFR 2A5a and recycling lines of construction wastes (allocated in NFR 2A6) emissions are mainly ascertained by calculation using emission factors.

In the period 1990–2002 there was a significant decrease in the production of construction materials. In the period 2000–2003 six factories producing cement and six factories producing lime operated in Czechia. Since 2004 their number in both fields has dropped to five. All cement factories produced cement clinker in rotary furnaces using a dry process with preheating. Lime is produced in rotary or shaft furnaces. Currently, there are 6 lime production facilities (exclusive facilities which are part of sugar factories). The production of glass is an energy-intensive high-temperature activity producing emissions caused by oxidation of combustion air and vaporization of compounds contained in raw materials present in molten glass mixtures. There are approx. 60 operational glass works that melt glass in Czechia at present. The Czech glass and costume jewellery industry uses two energy sources – natural gas and electric energy. Electricity dominates in the field of processing, and natural gas dominates in the field of melting. However, electricity is widely used also for melting, which is a certain speciality of Czechia. Emissions TSP, SO_X, NO_X (as NO_2), CO, VOC a NH_3 from processes involved in melting (incl. electric furnaces) and from combustion during the processing and refinement of glass, being ascertained by one-time or continuous measurement, were assigned to NFR 1A2f. Emissions of PM, TSP and HMs from the preparation of molten glass mixtures and other processes were comprised under NFR 2A3. Production of ceramic products through firing, in particular roofing tiles, bricks, fire-resistant blocks, facing tiles, ceramic wares or porcelain in Annex 2 to No. 201/2012 Coll. were comprised under NFR 1A2f. Emissions from the preparation and mixing of materials were comprised under NFR 2A6. Similarly, emissions from non-combustion processes by other processing of minerals including glass fibres and other isolants are included in NFR 2A6 according to recommended procedures, only ascertained emissions TSP, PM, BC and HMs are allocated in categories 2A2 to 2A5b. Because other pollutants (NO_X, NMVOC, SO_X, NH_3 and CO) are emitted at many sources related to mining, production, processing and treatment of mineral materials, emissions of them are reported in NFR 2A6 or 1A2f if fuel consumption is reported. Their relatively higher amount since about 2014 corresponds to changes in legislation and conditions for emission ascertaining during the operation of sources.

Table IV.2 Mapping of NFR 2A1-2A6 sources categories to main Annex 2 source categories

NFR code	Classification pursuant Annex 2 to No. 201/2012 Coll.*
2A1	5.1.1. Handling raw materials and products
2A1	5.1.2. Production of cement clinkers in rotary furnaces; 5.1.3 Other technological equipment for cement production
2A2	5.1.4. Lime production in rotary furnaces; 5.1.5. Lime production in shaft furnaces and other furnaces
2A5a	5.11. Quarrying and stone processing, refined stone production, mining, treatment, and processing of gravel (natural and artificial) with a projected output of over 25 $m^3 \cdot day^{-1}$
2A6	5.9. Production of composite glass fibres with the use of organic binders
2A6	5.5. Production of glass, fibre, glass products, enamel, and sintered glass for glazing and glass for jewellery processing

*processes without fuel

The most significant emissions are generated from the mining sector (excluding fuels). Mining in Czechia has a very long tradition ranging over many centuries. The products extracted through the mining industry serve today as inputs for many very important industries, for example: power generation, building and construction industry, ceramics, glass industry, chemical industry, food industry and other specific sectors.

Until 1994, emissions from the NFR 2A5a were not ascertained and the raw material extraction estimate was carried out using the construction production index back to 1990. Since 1995 these emissions have been ascertained and mineral resource extraction also comes from toll-priced sources. Until 2002, all mining sites were included among the listed sites. Since 2002, emissions have only mining sites with a capacity exceeding 25 $m^3 \cdot day^{-1}$, but they account for the largest share. Emissions are calculated by source operators using emission factors related to the amount of raw materials consumed, which corresponds to the Tier 1 level. In 2008, the legislation that brought about the change in the obligatory reported emissions was amended in 2008, however, it was not possible to make sufficiently accurate estimates to allow data synchronization between 2008 and 2009. Since 2016, calculations have been carried out in a more detailed manner, covering individual technological operations, incl. the use of abatement technology (i.e. Tier 2 level). The emission factors are published by MoE in the Bulletin.

NFR 2A5b comprises fugitive emissions TSP, PM_{10} and $PM_{2.5}$ from the construction of residential, non-residential buildings (e.g. hotels, shopping centres, schools, etc.) and highways (IIR 2024). The emission inventory does not comprise emissions from the construction of transport infrastructure and industrial objects. The statistics do not provide information about demolitions. In Czechia, these data are processed by the Czech Statistical Office, which maintains a database of floor areas of residential buildings going back to 1997 and of non-residential buildings since 2005. For this reason, emissions from NFR 2A5b, calculated from statistical data, have been reported only since 2005. The trend of cement production was used to estimate emissions in 1990–2004. Data on the length of completed sections of highways in individual years were taken from the information system of the The Road and Motorway Directorate of the Czechia.

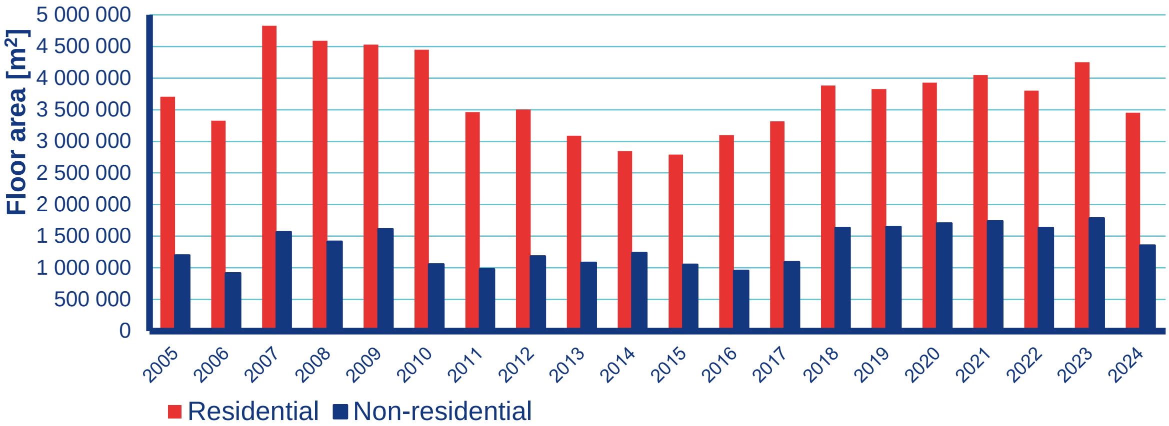


Figure IV.2 Building floor area, 2005–2024

IV.1.1 Emission factors and calculations

Calculation based on emission factors is used only to estimate emissions in NFR 2A5b. To calculate these emissions, emission factors from the CEIP/EMEP database were used.

Table IV.3 Emission factors for building construction

Poll.	Residential buildings	Non-residential buildings	Unit
TSP	0.21515	0.12268	$kg \cdot m^{-2}$

PM_{10}	0.10757	0.06134	$kg \cdot m^{-2}$
$PM_{2.5}$	0.01075	0.00613	$kg \cdot m^{-2}$

The method of calculating emissions from highway construction is given in the e-ANNEX. For some categories, source operators use their calculation and annual emission reporting using emission factors stated in the Bulletin of the Ministry of Environment. For further detail please see e-ANNEX.

IV.1.2 Uncertainties and QA/QC procedures

The general principles of uncertainty evaluation and QA/QC are described in Chapter I.7 and Chapter I.7. The detailed information will be supplied later.

IV.1.3 Planned improvements

No improvements are planned.

IV.2 Chemical industry (NFR 2B)

The chemical industry represents one of the largest industrial branches in Czechia with a production of a wide range of organic and inorganic substances. The chemical industry can be divided into fundamental chemistry, crude oil processing, pharmaceuticals, rubber industry and plastics processing as well as paper production. Products of the chemical industry are mostly inputs for other industrial branches. Emissions of combustion processes in this sector are being reported in NFR 1A2c. Process emissions for named sorts of production include NFR 2B1, 2B2 and 2B6. Titanium dioxide is produced by the sulphate process (PRECHEZA, a. s.). Process emissions for the production and processing of other inorganic substances, the whole production and processing of organic substances are included in NFR 2B10a, where the largest emissions (mainly SO_X and NMVOC) are reported. There are no production facilities in Czechia for NFR 2B3, 2B5 and 2B7. There is no information about any sources allocation in NFR 2B10b Storage, handling and transport of chemical products and we assume that these activities take place in areas of the above-mentioned production facilities and are included in reported emissions. Activity data of main productions are based on the REZZO database and CZSO data (Figure IV.3).

NFR 2B does not belong to key categories. The methodology of emission monitoring is long-term constant for all sectors except for the NFR 2B1 Ammonia production and 2B2 Nitric acid production, based on reported emissions of sources with annual reporting obligation. Emissions of these sources are being determined based on one-time measurements of the source operators in prescribed intervals.

An important component of the chemical industry is refineries, which ensure the basic processing of crude oil and the production of petrochemical products. Emissions from the production of sulphur from crude oil (the Claus process) are reported under NFR 1B2aiv. The Claus process is also used in the production of sulphur for tar processing. Emissions from these processes are comprised under NFR 2B10a.

Chlorine production by amalgam electrolysis is a source of Hg emissions. Emissions of other heavy metals take place for example by the production of phosphoric acid by thermic method, in the production of accumulator fillings or agents for galvanic plating and metallurgy. Emissions of PCDD/PCDF are being monitored in the production of dichloromethane and vinyl chloride. Emissions of PAHs occur in the production and processing of tar.

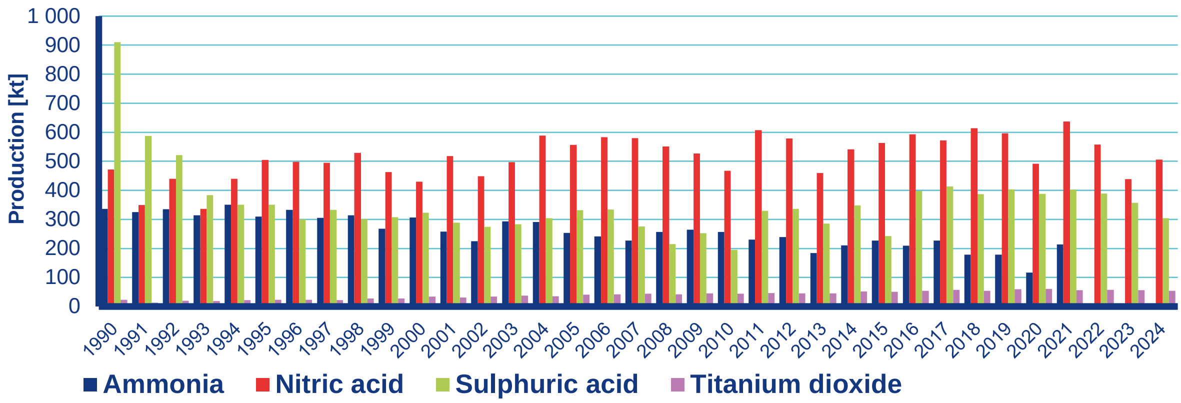


Figure IV.3 Ammonia, sulphuric acid, nitric acid and titanium dioxide production, 1990–2024

IV.2.1 Emission factors and calculations

Emission factors are used only for the calculation of emissions in NFR 2B1 and 2B2. To calculate the emissions, emission factors were taken from the EMEP/EEA EIG [3]. Detailed information on some categories is given in e-ANNEX.

IV.2.2 Uncertainties and QA/QC procedures

The chapter will be supplied later.

IV.2.3 Planned improvements

No improvements are planned.

IV.3 Metal production (NFR 2C)

This sector includes primary metal production, metal processing, foundries and surface treatment of metals, plastics and non-metal objects. Metal production, namely iron and steel production belong long-time to most significant emission sources in Czechia. According to the recommended practice, emissions from production technology processes using fuels (production of iron and steel) are reported in NFR 2C1. Other processes namely direct process heating of mean-products and products, air, gas and raw material heaters are allocated in NFR1A2a. There is no information available for sources allocated in NFR 2C7d Storage, handling and transport of metal products and we assume that these activities take place in areas of the above-mentioned production facilities and are included in reported emissions.

IV.3.1.1 Iron and steel production (NFR 2C1)

In NFR 2C1 there are identified key categories (CO – 7.3%, Pb – 12.1%, Cd – 7.3% and PCDD/PCDF – 11.9%). The methodology of monitoring emissions of main pollutants for all sectors is long-term constant and based, except for CO emissions in NFR 2C1 Iron and steel production, on reported emissions of sources underlying annual reporting obligation. Emissions of NO_X, SO_X, PM and CO (sinter plant, pig iron) are being namely assessed by one-time measurement in prescribed intervals. Annually measured emission concentrations show large (sometimes orders of magnitude) differences, leading to irregular emissions reported by operators. For further detail please see e-ANNEX.

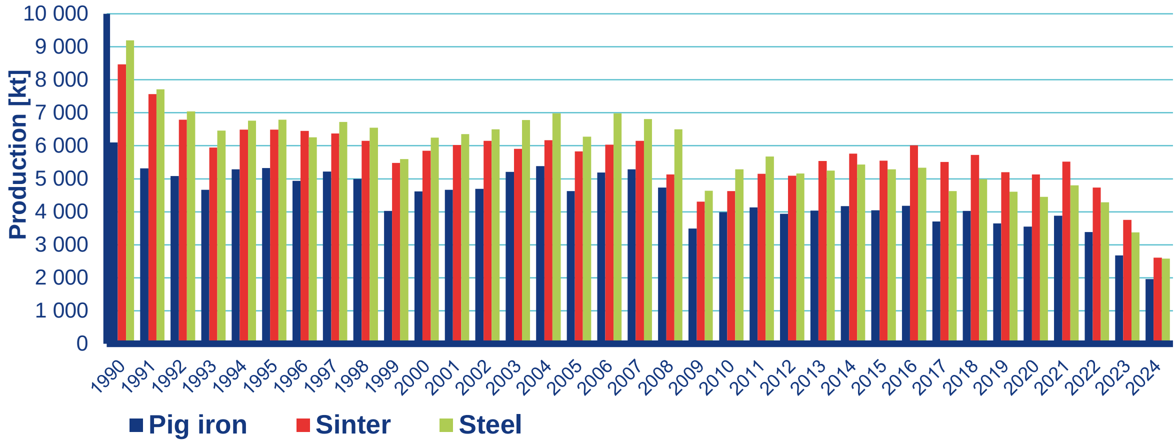


Figure IV.4 Pig iron, steel and sinter production, 1990–2024

Emissions of CO from open hearth furnace steel plants have been calculated from 2014 based on steel production and emission factors assessed by source operators as several-year measurements. NMVOC emissions are calculated using EFs from EMEP/EEA EIG [3]. Emissions of HMs and POPs are calculated based on emission factors set from Table IV.6 to Table IV.9. Activity data were collected on the REZZO database and sectorial statistics HŽ a.s.

HCB emissions from sintering belts are reported as a part of NFR1A2f and therefore use the 'IE' symbol for HCB emissions in NFR 2C1. Emissions from sintering belts (also for NO_X, SO_X, TSP, Hg and PCDD/PCDF) are reported by source operators, and other reported emissions are calculated. In the calculation system, all emissions are classified in NFR 1A2a, because their distribution according to the NFR categories would be technically demanding in the Czech point sources inventory system and could lead to errors.

In Czechia, there were three works with integrated metals production (VÍTKOVICE, a. s., Liberty Ostrava, a. s., TŘINECKÉ ŽELEZÁRNY, a. s.), which comprises the production of coke, processing of iron ore, the production of agglomerate, production of pig iron in blast furnaces and production of steel. Since the production facility of VÍTKOVICE, a. s. was close to a housing estate and high abatement technology costs, the production ended in 1998. Other factories started with the production of steel in electric arc furnaces. Production of coke, sinter and pig iron at Liberty Ostrava was definitively terminated during the year 2023. Steel production was shut down for the entire year 2024.

IV.3.1.2 Non-ferrous metal (2C2-2C7c)

In Czechia non-ferrous metals (namely copper, lead, magnesium, aluminium and zinc) are made only by recasting secondary raw materials. The amount of lead and aluminium produced increases every year. Besides these sources, there is a large number of foundries of non-ferrous metals, especially aluminium. An overview of sources and their assignment to NFR is presented in Table IV.4. Emission inventory in this sector is being performed based on one-time measurements in prescribed intervals according to recommended procedures, only ascertained emissions TSP, PM, BC, HMs and some POPs are allocated in categories NFR 2C2 to 2C7a. Because other pollutants (NO_X, NMVOC, SO_X, NH_3 and CO) are emitted at many sources related to the production, processing and treatment of metals, emissions of them are reported in NFR 2C7c or 1A2f if fuel consumption is reported.

Table IV.4 Mapping of NFR 2C2-2C7a sources categories to main Annex 2 source categories

NFR code	Classification pursuant Annex 2 to No. 201/2012 Coll.*
Metallurgy of nonferrous metals	
2C7c	4.7. Ore dressing for nonferrous metals
Production or smelting of nonferrous metals, casting alloys, remelting products, refining, and casting production	
2C3–2C7c	4.8.1. Transportation and handling of charge or product
2C3–2C7c	4.8.2. Furnace aggregates for the production of nonferrous metals
2C3–2C7c	4.10. Smelting and casting of nonferrous metals and alloys thereof
2C7c	4.11. Aluminium processing with rolling mill

*processes without fuel

IV.3.1.3 Ferroalloys production (2C2)

Ferroalloys are alloys that contain less than 50% iron and one or more elements. They are used mainly for steel production. In Czechia, only one production plant falls into this category, whose obligation is to report emissions of basic pollutants. Information on HMs and POPs emissions is not available. The EMEP/EEA EIG also does not offer EF for HMs and POPs, so we do not estimate these emissions.

IV.3.1.4 Aluminium production (2C3)

Emissions from aluminium foundries are determined from the reported activity data. HCB emissions are calculated using the recommended EF 5. Since 2002 HCB emissions have not been expected due to the prohibition of HCB precursor (hexachloroethane) to degas the aluminium melt.

IV.3.1.5 Magnesium production (2C4)

The plant engaged in the recycling and production of magnesium in Czechia is only the company Crown Metals CZ s.r.o. (previously Magnesium Elektron CZ s.r.o.). Emissions are determined from the emissions reported by the operator.

IV.3.1.6 Lead production (2C5)

Emissions are determined from the emissions reported by the operators.

IV.3.1.7 Zinc Production (2C6)

Only one company in Czechia is engaged in the secondary processing of zinc. It is Ekozink Praha, s .r. o. It was founded with the aim of ecological processing of zinc waste from hot dip galvanizing. Emissions of the main pollutants are classified in NFR1A2b. The reporting obligation only applies to Zn emissions. Other HMs and POPs emissions are calculated from EF in EMEP/EEA EIG [3].

IV.3.1.8 Copper production (2C7a)

Only one company in Czechia is engaged in the secondary processing of zinc. It is Měď Povrly a. s. Emissions from other productions (crucible furnaces), which are part of plants with other non-ferrous metal productions, were transferred to NFR 2C7c. As, Ni, PCDD/PCDF and PCB emissions were calculated using emission factors from EMEP/EEA EIG [3]. For emissions of the other pollutants, reported data registered in the emission database (REZZO) were used.

IV.3.1.9 Nickel production (2C7b)

At present, nickel is not processed in Czechia.

IV.3.1.10 Other metal production (2C7c)

This category includes emissions from copper and copper alloy plating, galvanic nickel plating, chromium plating, zinc plating, zinc alloy plating, etc. These processes tend to emit heavy metals and other pollutants. The only exception there is the hot zinc coating reported under NFR 2C6. Emission inventory in the sector of surface treatment is based on one-time measurements within prescribed intervals. Activity data are not being reported in statistics. More detailed information including selected emission and activity data, emission factors and calculations for NMVOC are presented in the e-ANNEX. Technological processes that precede surface treatment are mechanical pre-cleaning of surfaces and degreasing. Mechanical pre-treatment of surfaces produces emissions of TSP, which are a mixture of abrasives and particles of the underlying material. This group of sources includes finishing and polishing, abrasive blasting and deburring or tumbling. Emissions from these sources were included under NFR 2L (see Table IV.5). Some processes of degreasing use solvents, and emissions from them are reported under sector 2D3e.

IV.3.1.11 Storage, handling and transport of metal product (2C7d)

There is no information available for sources allocated in this category and we assume that these activities take place in areas of the above-mentioned production facilities and are included in reported emissions.

Table IV.5 Mapping of NFR 2C7c sources categories to Annex 2 source categories

NFR code	**Classification pursuant Annex 2 to No. 201/2012 Coll.**
Surface treatment of metals and plastics and other non-metallic objects and processing thereof	
2L; 2C7c**	4.12. Surface treatment of metals and plastics and other non-metallic objects and processing
2C7c	4.13. Metal machining (grinding mills and machining shops) and plastics with a total electrical consumption of over 100 kW
2C7c	4.14. Welding of metallic materials with a total electrical consumption equal to or greater than 1000 kVA
2C7c	4.15. Spraying of protective coatings made of molten metals with a projected output of less than or equal to 1 t of coated steel per hour
2C7c	4.16. Spraying of protective coatings made of molten metals with a projected output of greater 1 t of coated steel per hour
2C7c	4.17. Hot zinc coating

*processes without fuel

**processes without plating bath

IV.3.2 Emission factors and calculations

For emission inventory of heavy metals and POPs during pig iron casting emission factors based on the measurement results had been set.

Table IV.6 Casting (blast furnace) – emission factors

Abatement	Pb	Cd	Hg	As	Zn	BaP	BbF	BkF	InP	PAHs	PCDD/PCDF
	[mg·t^{-1}]										[µg I-TEQ·t^{-1}]
Dry ESP	52	6	48	4.5	1729	0.09	0.53	0.25	0.11	1	0.01
Bag filter	11.1	1.29	0.66	1.5	79.66	0.03	0.18	0.08	0.04	0.33	0.01

Emissions of TSP, SO_X and NO_X in tandem furnaces and oxygen converters are being measured once a year. The fluctuation of SO_X emission is related to the use of different amounts of heavy fuel oil in the process of iron production (carbon content balancing). NMVOC emissions are calculated using emission factors for sinter, iron and steel production stated in EMEP/EEA EIG – Tier 2. CO emissions in tandem furnaces are being estimated by an emission factor of 7043 g·t^{-1} of produced steel while CO emissions of oxygen converters are being balance estimated based on operating measurement. For emission inventory Pb, Cd, Hg, As, PCDD/PCDF, PAHs and PCBs are being based on national emission factors (see Table IV.7 and Table IV.8). Emissions of other pollutants reported under UN CLRTAP are being estimated based on emission factors according to EMEP/EEA EIG – Tier 2 [3].

Table IV.7 Tandem furnaces – emission factors

Pb	Cd	Hg	As	BaP	BbF	BkF	InP	PAHs	PCBs	PCDD/PCDF
[mg·t^{-1}]									[µ g·t^{-1}]	[µg I-TEQ·t^{-1}]
854.15	34.39	24.54	5.98	0.03	0.18	0.07	0.04	0.31	30	1.43

Table IV.8 Oxygen converters – emission factors

Pb	Cd	Hg	As	BaP	BbF	BkF	InP	PAHs	PCBs	PCDD/PCDF
[mg·t^{-1}]									[µ g·t^{-1}]	[µg I-TEQ·t^{-1}]
549.75	9.46	7.65	1.94	0.47	5.84	1.98	0.25	8.53	30	0.08

Emissions of TSP, NO_X (as NO_2) and CO for electric arc furnaces are being monitored by one-time measurement once a year. National emission factors for PCDD/PCDDF had been set at 0.144 µg I-TEQ·t^{-1} and for emissions of PCBs 2.2 µg·t^{-1}. Emissions of other pollutants according to UN CLRTAP are based on EMEP/EEA EIG – Tier 2 emission factors [3].

Siemens-Martin furnaces used to be operated in Czechia until 2001. The resulting emissions depend namely on the sort of input (pig iron or metal scrap), the sort of fuel used and production intensification by oxygen. One-time measurement of TSP, SO_X, NO_X and CO emissions for this type of furnace used to take place once a year. For an inventory of other pollutants required by UN CLRTAP emission factors according to EMEP/EEA EIG – Tier 2. The emission factor for Pb according to EMEP/EEA EIG 300 $g \cdot t^{-1}$ of steel was adapted to a more real value of 30 $g \cdot t^{-1}$ of steel [3].

National emission factors have only been set for the emission inventory of heavy metals and POPs for cupola ovens.

Table IV.9 Cupola furnaces – emission factors

Pb	Cd	Hg	As	BaP	BbF	BkF	InP	PAHs	PCBs	PCDD/PCDF
[$mg \cdot t^{-1}$]									[$\mu g \cdot t^{-1}$]	[μg I-TEQ$\cdot t^{-1}$]
149.80	5	7	12	0.50	2.67	1.21	0.18	4.55	1023.02	0.48

For copper production, the emissions of As, Ni, PCDD/PCDF and PCBs were calculated using emission factors from EMEP/EEA EIG. For emissions of the other pollutants, reported data registered in the emission database (REZZO) were used. For further detail please see e-ANNEX.

IV.3.3 Uncertainties and QA/QC procedures

The chapter will be supplied later.

IV.3.4 Planned improvements

No improvements are planned.

IV.4 Solvent use (NFR 2D)

Category Solvent use belongs to the key sources of NMVOC emissions (19.5% in 2023). It covers various technological activities from all the monitored sources. This chapter describes solvents and other product use. Using solvents and products containing solvents leads to emissions of non-methane volatile organic compounds (NMVOC) into the atmosphere (NFR 2D3a, 2D3d-i). Although the EMEP/EEA EIG methodology recommends verifying Hg emissions from fluorescent tubes, there is currently no data to quantify Hg emissions.

Emissions of NMVOC, PM and TSP from the production and use of Hot Mix Asphalt and emulsified asphalt are included in NFR 2D3b according to EMEP/EEA EIG [3]. All types of asphalt production emissions are reported annually by source operators in Summary Operation Records. The asphalt production processes also cover combustion sources. Therefore, all emissions from hot processes are regarded in NFR 1A2f.

Reported emissions in NFR 2D3c (NMVOC and PM) especially come only from annual reports in Summary Operation Records. Technological heating emissions from this process are reported in NFR 1A2f.

The investigation of asphalt producers shows that applied technological procedures prevent the PAHs emission from the asphalt blowing. Therefore, the symbol NE was used as in the case of the other emissions (NFR 2D3g).

Emission inventories for solvents are based on model estimates. Emissions were calculated under stated NFR sectors. Solvent emissions model is based on estimations of amount of using solvents, production volume, and solvent-containing products trade. All relevant solvents must be estimated or at least represent more than 90% of the total pollutant emission.

The main activities leading to emissions in the Solvent Use sector are coatings application in industry and households, degreasing and other applications of solvent-containing products (such as printing) and the use of adhesives. Emissions of NMVOC also arise from the manufacturing and use of paints in the pharmaceutical, plastic, leather and textile industries, wood preservation, glass fibre production, use of household and solvent-containing detergents and extraction of fats and oils. The range of monitored categories is shown in the table below.

Table IV.10 Activities and emissions reported from the solvent and other product use sector

NFR	Source	Description
Paint application		
2D3d	1. Decorative coating application	Includes emissions from paint application in construction and buildings and domestic use.
	2. Industrial coating application	Includes emissions from paint application in car repairing and manufacturing of automobiles, coil coating, boat building, wood coating and other industrial paint applications.
	3. Other coating application	Emissions in this sector include car components production, containers, tins and barrels, aircraft, coating of plastics etc. This sector includes painting on-site (bridges, buildings).
Degreasing and dry cleaning		
2D3e	Degreasing	Includes emissions from degreasing, electronic components manufacturing and other industrial cleaning.
2D3f	Dry cleaning	Includes emissions from dry cleaning.
Chemical products		
2D3g	Chemical products	Includes emissions from polyurethane, polystyrene foam and rubber processing, paints, inks and glues manufacturing, textile finishing, leather tanning and other use of solvents.
Other product use		
2D3b	Road paving with asphalt	Solvents emissions from construction and repairs of roads, pavements and other solid surfaces.
2D3c	Asphalt roofing	NMVOC emissions from production of asphalt roofing materials
2D3h	Printing	Solvents emissions from printing industry.
2D3a	Domestic solvent use including fungicides	NMVOC emissions from the use of personal care, adhesive and sealant and household cleaning products; The amount of emissions for 2020 and 2023 also includes estimated emissions related to using disinfectants against COVID-19

2D3i	Other product use	Includes emissions from oil extraction, application of glues and adhesives, preservation of wood, Glass and Mineral Wool production, use of tobacco, other solvent use, and emissions PM and TSP from oil extraction.

Category Solvent use belongs to the key sources of NMVOC emissions with a share of 26.5%. It covers various technological activities from all the monitored categories. The Solvent application registers the most numerous technological equipment among point-monitored sources (almost 4000 installations, including one or more equipment such as paint boxes, degreasing baths, printing machines, and others.). Unlike the EU Directive, the lower limits for including these resources among the individually monitored sources are significantly lower. These limits often start at 0.6 t of the yearly projected solvent consumption. Thousands of other sources, particularly in the decorative painting and surface maintenance sector, are below the limit, and households also produce a significant part of the emissions.

Emission inventories for solvents are based on model estimates, as direct and continuous emissions are only measured from limited sources. The model for calculating the total amount of used solvent is used, and emissions are calculated for industrial sectors, households for the stated NFR sectors, and individual pollutants. Solvents emission modelling is based on estimating the amount of used solvents, knowledge of production volume, and solvent-containing products trade. All relevant solvents must be estimated or at least represent more than 90% of the total pollutant emission.

The motor industry, one of the essential industries in Czechia, applies a significant proportion of paints and solvents. Passenger cars are produced in three major car facilities - Škoda Auto, owned by the Volkswagen Group, Toyota Motor Manufacturing Czechia and Hyundai. Trucks are manufactured only by Tatra. F.X. MEILLER and Schwarzmüller which mainly manufactures truck accessories. Iveco Czechia and SOR Libchavy are focused on the production of buses. There are also many major suppliers in Czechia for the domestic and foreign automotive industry. Škoda Transportation produces trams, locomotives and train sets.

The printing industry in Czechia is at a high level, comparable to the advanced countries. The most used technique was offset in the past. In 2004, according to the survey, it was about 80% of the polygraph´s output. In the years to come, no such detailed investigation has already been carried out. However, it is possible to assume an increase in the share, especially for digital printing, to 50% and a significant decrease in offset printing below 30%. Like in Europe, digital print and electronic media cause a drop in demand for some types of ink (such as printing labels, books, and printed matters). Paints and coatings protect materials and significantly increase the durability of many objects. Regarding vehicles, coatings serve as corrosion protection. Paint application for industrial goods is decisively affected by the economic situation of individual countries. Architectural paints are the largest application area of paints and coatings. Residential construction has a rising demand for facade and interior wall paints, and it is forecasted that about 58% of all paints and coatings will be utilized in construction. Another important application is the transportation segment. Besides the division by various application areas, the paints and coatings are mainly based on acrylics, vinyl, alkyd, epoxy, polyurethane (PUR), and polyester.

The smallest share of emissions includes producing asphalt roofing materials and road paving with cutback asphalt and asphalt emulsions.

In 2013–2014, an external evaluation was carried out by our external contractor (SVUOM) to assess the estimation of NMVOC emissions from scattered sources, including NMVOC emissions from solvents and other products. Emissions were estimated based on the volume of production or other activity indicators by calculating the amount of emissions using emission factors. In addition to the EMEP/EEA EIG, national emission factors were used for some categories based on data reported by individually monitored sources [3].

IV.4.1 Emission factors and calculations

Emissions are estimated using top-down data (from CZSO, MoI, National Associations, and data collected from REZZO) and bottom-up data from inquiries in solvent consumption and expert technical estimations.

Emissions from point sources were gathered from the web-based air emissions data system for point sources (ISPOP). Emissions for diffuse sources are calculated from the data received from the CZSO using international emission factors and expert opinions. The statistical statement of the Customs Administration of Czechia is a significant source of data and information. For emissions in NFR 2D3a is used recommended emission factor of 1.2 kg/capita/year according to EMEP/EEA EIG Tier 1 [3]. It was not yet possible to implement the recommended ESIG data into the calculation methodology. During 2024 and 2025, efforts focused on collecting background data for the implementation of the Tier 2 methodology. In cooperation with the CZSO, data of the production in Czechia, as well as products imports and exports were compiled. The shares of VOCs in individual product categories were estimated, and in cooperation with SHMI experts, the proportion of NMVOC emitted emissions was determined. Due to significant year-on-year fluctuations, the new NMVOC inventory was not finalized in 2025. The recalculated data will be presented after the completion of the research, most likely in 2027.

Emissions from the application of paints produced by companies which are members of the Association of Paint Manufacturers of Czechia are estimated by an expert, who compiles national statistics on the annual sales of paint products of its members. The paint sales and product statistics are divided into decorative (DIY/architectural) and industrial sectors. For these two sectors, the statistics are further divided into subgroups of several products and surfaces to be painted, such as “waterborne decorative indoor paints” or “solvent-borne decorative indoor paints”. For each of these subgroups, the expert estimated the average NMVOC content and average density.

For NMVOC pollutants or products, a mass balance is formulated:

$$consumption = (production + import) - (export + destruction(disposal))$$

The CZSO collects data on the production, import and export amounts of solvents and solvent-containing products. Data and trends in the production of many branches were been gained from published Panorama of the Manufacturing Industry. MoI elaborates on the publication by cooperating with the CZSO and the Confederation of Industry. This yearbook aims to provide expert advice on the development and achievements of the manufacturing industry and present the results of industrial companies operating in Czechia. They are also a solid basis for monitoring production and predicting further developments.

Emission factors are based on the values stated in EMEP/EEA EIG and adjusted on a country-specific basis according to the assessment of some individual sectors [3]. Emission factors could be also defined from surveys of specific industrial activities or aggregated factors from industrial branches or sectors. In some sectors, corresponds emission factor with the VOC

Solvents Directive (Czech series of acts, mainly Act. No201/2012 Co. and Regulation No 415/2012 Co.). Furthermore, emission factors may be characteristic of certain products' use patterns.

Capture and destruction (abatement) of solvents lower the pollutant emissions must be, in principle, estimated for each pollutant in all industrial activities and all uses of pollutant-containing products.

Unfortunately, confidentiality creates a lack of activity data in some branches. In these cases, Czechia used expert estimation, often based on earlier data.

More detailed information, including activity data, emission factors and emission estimates for NMVOC inventory by different sub-categories, are presented in the e-ANNEX.

Emissions from asphalt production are reported by operators. These emissions are related to hot processes, so they are listed in NFR 1A2f. In NFR 2D3b emissions of TSP and PM were calculated only from asphalt use activities. These emissions were determined proportionally according to NMVOC emissions. The emission factors in the EIG correspond to the production and use processes together. Therefore the ratio of TSP/NMVOC and PM/NMVOC emissions cannot be used to avoid overestimation. Thus, for the estimation of TSP and PM emissions, the average ratios of PM/NMVOC and TSP/PM emissions were chosen according to the reporting of countries that do not use EF according to EMEP/EEA EIG - see e-ANNEX.

TSP emissions from oil extraction, which are part of the reported SPE data, were reported in NFR 2B10a in previous years. Based on the recommendation, these emissions were moved to NFR 2D3i. It concerns the period from 2000. In previous years, data on TSP emissions were not reported and the amount of processed oils is not available either. Emissions have been replaced by the NO symbol for this reason. PM emissions were added according to the proportion recommended in EMEP/EEA EIG.

IV.4.2 Uncertainties and QA/QC procedures

The calculations of NMVOC emissions from solvent use were done in several steps. As a first step, the number of solvents used and the solvent emissions were calculated. To determine the number of solvents used in Czechia in the various applications, a bottom-up and a top-down approach were combined. A study (Neuzil et al. 2014; Machalek et al. 2015) described emission estimates based on the bottom-up approach. Emissions of volatile organic compounds from individually monitored sources included in the REZZO 1 database are calculated by a procedure which is directly set out by the Czech law (415/2012 Coll., Annex 5) for the protection of air quality, where it was adopted from the COUNCIL DIRECTIVE 1999/13/EC on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations, Annex III. The calculation entails the ascertainment of emissions usually released in a controlled manner and the calculation of uncontrolled fugitive emissions entering the atmosphere. The resulting total combined uncertainty concerning the estimate of fugitive emissions, using the formula presented above, amounts to 13%. All the calculations tend to give results closer to the lower bound of the given range, and the real uncertainty can be somewhat higher. However, it follows from the nature and the principle of calculating fugitive emissions of NMVOC that this ascertainment is based on the balance method, which generally provides relatively accurate results. The total uncertainty should not exceed the threshold of 15%, provided that the input data correspond to reality.

The basic approach to emission inventories, the top-down balance method, utilizes results from emissions reported to the REZZO database, especially to ascertain the rate of capture and destruction of VOC contained in the products used. Suppose a product containing VOC is used in an installation without an end technology for reducing output concentrations of VOC or for their complete or partial regeneration. In that case, the total amount of VOC gets released into the atmosphere. The uncertainty associated with ascertaining emissions from these sources is related solely to the accuracy of the activity data and, of course, also with the proportion of VOC contained in them. The uncertainty concerning emissions derived from statistical data and predefined emission factors based on the consumption of VOC in products is estimated, according to the EMEP/EEA EIG methodology, to range from 50 to 200% [3].

IV.4.3 Planned improvements

Emissions of NFR 2D3a will be recalculated under Tier 2 during further following years. Updates in other categories of solvent use (NFR 2D3d-2D3i) are either planned. The first part of the project, focused on the transition from the Tier 1 to Tier 2 methodology for the key 2D3a category, was implemented in cooperation with CZSO in 2024. Products containing solvents were identified in households. In 2025, data were collected from the National Product Statistics (PRODCOM) and from the data of customs statistics on imports and exports of goods. Due to significant year-to-year fluctuations for some important products (including de-icing agents), it will be necessary in 2026 to consult the PRODCOM data collection methodologies with CZSO staff in order to create consistent time series of underlying data for the calculation of NFR 2D3a emissions at the Tier 2 level.

IV.5 Other product use (NFR 2G)

NFR 2G in Czechia includes the following activities: use of fireworks, use of tobacco and use of shoes. All activity data was obtained from the national statistics of the Czech Statistical Office.

The use of fireworks during various festive occasions in Czechia was in recent years very popular. Started 2020, their consumption started to decline, mainly due to a ban of fireworks in some public spaces and also due to the COVID-19 pandemic, in 2022, on the contrary, consumption increased strongly (see Figure IV.5). Almost all fireworks used here are assumed to be imported since the CZ has no known significant producer of fireworks. Activity data were found in the External Trade Database in the cross-border concept (available online). The database can be searched based on year and commodity code according to customs nomenclature (available online). In this case, combined nomenclature KN (8) and commodity code 36041000 (Fireworks) was selected. Data are available from 1999.

Tobacco consumption shows a moderate decrease (see Figure IV.6) mainly caused by a complete ban on smoking in public areas (including restaurants, cafes, pubs and bars) and the rise in prices of tobacco products. Activity data for tobacco combustion were obtained from Catalogue of Products (Food Consumption) – available online – Table 2, in which is listed yearly cigarette consumption per capita. Data is available until 2020, from 2021 it is not published due to unreliability. The necessary information was estimated using various research reports (publications of National Institute of Public Health, Report on Tobacco, Nicotine and Related Products in the Czechia 2024). Emissions were calculated assuming that one cigarette contains 1 g of tobacco (EMEP/EEA EIG, version 2023 [3]).

On the other hand, production of shoes decreased significantly compared to the 1990s, most of the shoes are imported at present (see Figure IV.7). Production of shoes was obtained from Public Database – Manufacture of selected industrial products (main aggregates) – available online. Data are available from 1993.

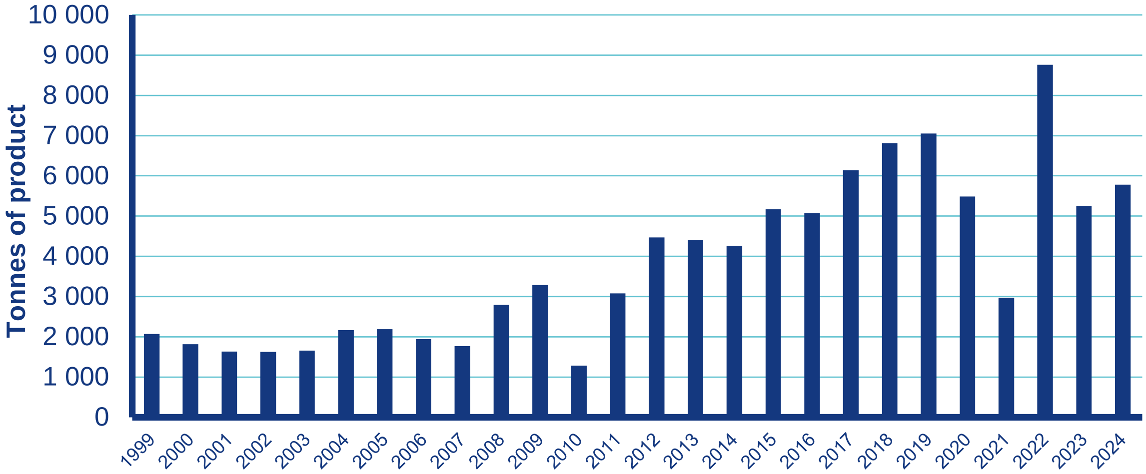


Figure IV.5 The fireworks import, 1999–2024

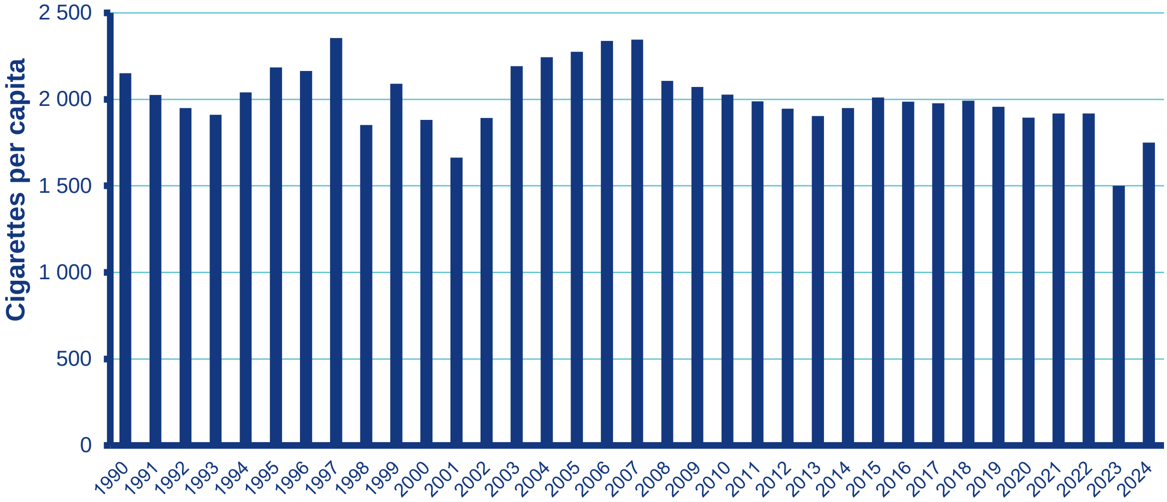


Figure IV.6 Tobacco smoking, 1990–2024

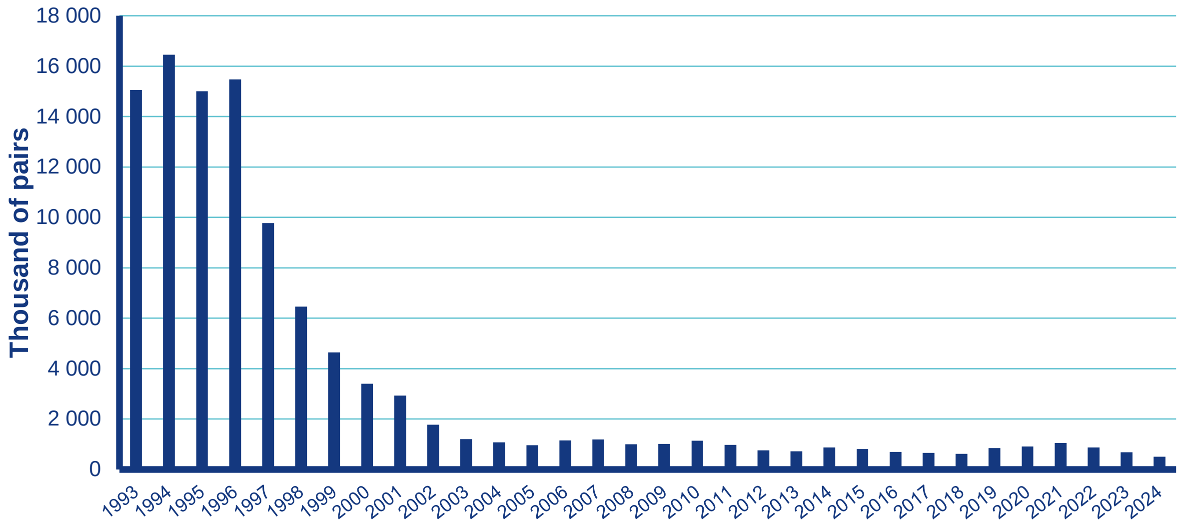


Figure IV.7 Shoes production, 1993–2024

IV.5.1 Emission factors and calculations

For all groups of processes, emission factors from EMEP/EEA EIG, version 2023, were used [3]. They are listed in tables 3-13 to 3-15. In all cases, it is a Tier 2 approach.

IV.5.2 Uncertainties and QA/QC procedures

Emissions for NFR 2G are calculated based on official statistics and default emission factors, uncertainty is therefore estimated from 50 up to 200%, see also Chapter I.7. Planned improvements

No improvements are planned, the chapter is considered to be final.

IV.6 Other industry production and wood processing (NFR 2H; 2I)

The consumer industry has a long-standing tradition in Czechia. Textile, shoe or food products have, in the past, been a significant part of the exported goods. However, after the privatization in 1990, a certain number of enterprises' production was reduced or completely stopped. At present, in the beverages branch, the major beer production capacity is represented by several large factories, dozens of smaller and almost 400 mini-breweries. In the field of wood processing, the production of pulp is significant, but much of the wood is exported without further processing. The trend of pulp production is shown in Figure IV.8. For the 2022–2024 the notation key “C” was used.

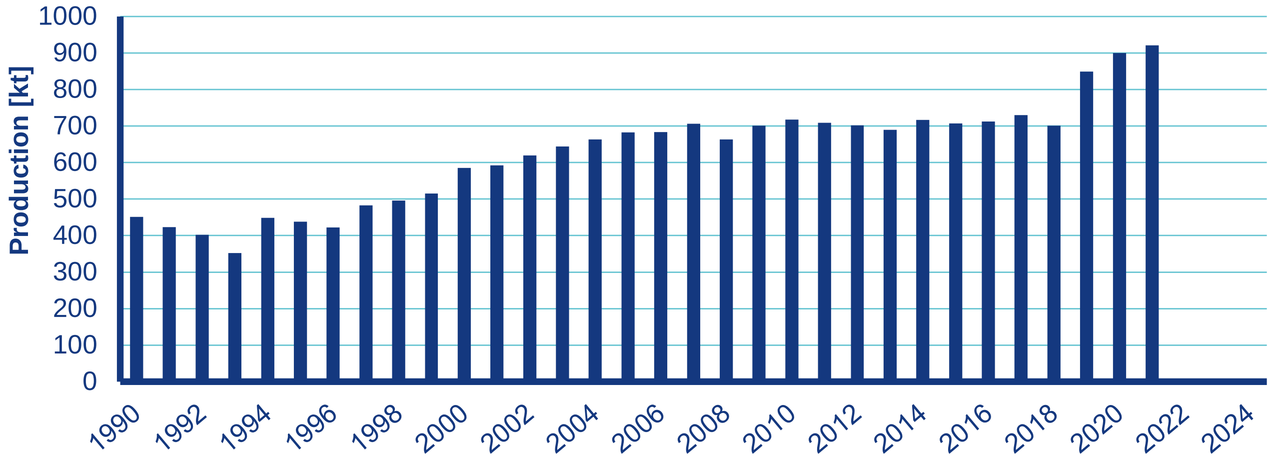


Figure IV.8 Pulp production, 1990–2022

There are currently two large production plants for pulp production. Sulphate pulp is produced at Mondi Štětí. Sulphite pulp for the paper industry was produced by Lenzig Biocel Paskov until 2012, and since 2015 there has been a transition from paper pulp production to chemical pulp for the production of viscose fibres. The biggest wood processing plant producing OSB boards and other products is Kronospan Jihlava. There is a long tradition of sugar production, currently producing almost the same quantity as before 1990 at seven sugar factories.

The definition of sources according to the national classification usually includes the entire production process not divided into partial processes. By the recommended practice, emissions from combustion processes are reported in categories 1A2d, 1A2e or 1A2gviii.

IV.6.1 Emission factors and calculations

EMEP/EEA EIG, emission factors for NFR 2H2 were used [3]. Detailed information on some categories is given in e-ANNEX.

IV.6.2 Uncertainties and QA/QC procedures

The chapter will supplied later.

IV.6.3 Planned improvements

No improvements are planned, the chapter is considered to be final.

IV.7 Other (NFR 2J and 2K; 2L)

Czechia is the Party of the Stockholm Convention and fulfils its obligations. While acceding to the Convention there were ascertained data about emissions and use of POPs (NFR 2J and 2K).

The system of emission inventory in Czechia enables the allocation of most individually monitored sources into specific NFR categories. Emissions of sources that could not be allocated to other NFR categories are allocated in NFR 2L even though there are not in some cases emissions solely attributed to bulk material handling (2L Other production, consumption, storage, transportation or handling of bulk products).

IV.7.1 Emission factors and calculations

For NFR 2J and 2K there is used notation key “NO” (not occurring), e.g. categories or processes within a particular source category that do not occur within a Party.

In NFR 2L there are stated emissions reported in Summary Operational Evidence (SOE) of individually monitored sources. Emission factors therefore are not used in this category.

IV.7.1.1 Production of POPs (2J)

This chapter deals with the production of persistent organic pollutants (POPs) and pesticides. Neither the twelve initial POPs under the Stockholm Convention (Aldrin, Dieldrin, Chlordane, Toxaphene, Mirex, Endrin, Heptachlor, Hexachlorobenzene (HCB), Polychlorinated biphenyls (PCBs), DDT, Polychlorinated dibenzo-p-dioxins (PCDD), Polychlorinated dibenzofurans (PCDF)) nor PAHs are produced in Czechia

IV.7.1.2 Consumption of POPs and heavy metals (2K)

None of the twelve initial POPs under the Stockholm Convention (Aldrin, Dieldrin, Chlordane, Toxaphene, Mirex, Endrin, Heptachlor, Hexachlorobenzene (HCB), Polychlorinated biphenyls (PCBs), DDT, Polychlorinated dibenzo-p-dioxins (PCDD), Polychlorinated dibenzofurans (PCDF)) are consumed/on sale in Czechia.

IV.7.1.3 Other production, consumption, storage, transportation or handling of bulk products (2L)

The emission specification according to EMEP/EEA EIG includes emissions from other production, consumption, storage, transport or handling of bulk products. Emission reported in NFR 2L can be allocated as "Other production" and comes from the Emission database [3]. NFR 2L includes all emissions in processes without fuel combustion that are not allocated in previous categories.

This paragraph includes emissions specified in EMEP/EEA EIG as other production, consumption, storage, transport or handling of bulk products [3].

Emissions reported in NFR 2L belong to sources specified as "Other production" and come from the reported emissions of Summary operation evidence (SOE). NFR 2L includes all emissions from processes without fuel combustion not allocated to any of previous categories, namely: Production or processing of synthetic polymers and composites, surface treatment of metals, plastics and other non-metallic items and other processing and other stationary sources not allocated elsewhere (e.g. hygiene products, feed material production etc.).

The conditions of emission reporting are set by national law for this category. Annex 8 to decree 415/2012 Sb. includes emission limits for some national categories given in the overview of emission limits of selected pollutants. For these emissions one-time measurements are performed that are used for calculations of annual emissions based on relevant activity data. The most important emission comes from the category Production and processing of other synthetic polymers and production of composites, Surface treatment of metals and plastics and other non-metallic objects and processing and Other sources (e.g. cooling installation).

The emissions related to storage, transport or handling of products are sometimes included in emissions from a certain production. This concerns only metallurgy areas, and in some cases where the operation conditions are set by Integrated permit according to IPPC directive. For other facilities, material transport or handling the emissions are not calculated mainly due to unavailable appropriate activity data.

IV.7.2 Uncertainties and QA/QC procedures

The chapter will supplied later.

IV.7.3 Planned improvements

No improvements are planned.

V. Agriculture (NFR 3)

Date of the last revision: 15 March 2026

The agricultural sector consists of the following categories:

- 3B Manure management
- 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
- 3Dc Farm-level agricultural operations including storage, handling and transport of agricultural products
- 3De Cultivated crops
- 3Df Use of pesticides
- 3F Field burning of agricultural residues

An overview of the main pollutants occurring in agriculture is shown in Table V.1.

Table V.1 Overview of main pollutants occurring in NFR 3B and 3D

NFR Code	NO_X (as NO_2)	NMVOC	SO_X (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC
3B	x	x		x	x	x	x	
3Da1	x			x				
3Da2a	x			x				
3Da2b	x			x				
3Da2c	x			x				
3Da3	x			x				
3Da4				x				
3Dc					x	x	x	
3De		x						

In Czechia, NFR 3F field burning of agricultural residues is not allowed by the law on air protection. It means emissions occurring from this category are not considered in the IIR.

In NFR 3B and 3Da2a, all emissions of monitored pollutants decreased between 1990 and 2024 due to significant animal population reduction, especially in cattle and pigs breeding. While milk production per head has increased, animal numbers decreased. In the case of pig production number of rearing pigs and sows also decreased rapidly in the last decade. In future, a slight increase in pig production in Czechia is expected.

In NFR code 3Da1, ammonia and NO_X emissions have decreased between 1990 and 2024 (approx. 27%).

The agricultural sector is responsible for more than 97% of NH_3 emissions in Czechia. The main sources of ammonia emissions in Czechia represent manure management (category 3B) with a 37% share in total ammonia emissions, followed by inorganic N fertilizers application (category 3Da1) with a 34% share and animal manure application to soils (category 3Da2a including 3Da3) by 22% of share. Other sources of ammonia emissions, such as the application of other organic fertilizers and sludge to the soil or ammonia emissions from harvest residues, account for a total of 6% of agricultural emissions.

Other non-agricultural sources are a biological treatment of waste – composting (category 5B1), municipal and industrial waste incineration (category 5C1a and 5C1bi), residential: Stationary (category 1A4bi), chemical industry, transport and others. These non-agricultural sources represent approximately 3% share of total ammonia emissions in Czechia.

Figure V.1 shows the distribution of sources of NH_3 emission from the agricultural sector for 2024 in Czechia.

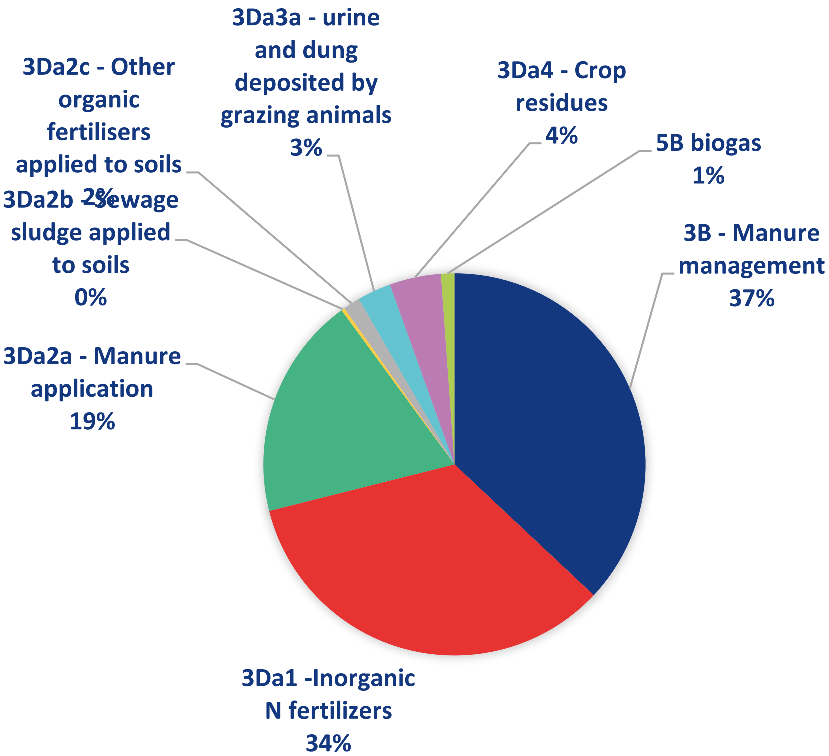


Figure V.1 NH3 emissions from the agricultural sector, 2024

Besides, NH_3 agriculture in Czechia contributes to other main pollutants such as NO_X, NMVOC, PM and TSP. Table V.2 shows the agricultural contribution of total national emissions of the mentioned pollutants.

Table V.2 Agricultural contribution to total emissions of NO_X, NMVOC, NH_3, PM and TSP (year 2024)

	Emissions					
	NO_X (as NO_2)	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP
National total [kt]	124.90	220.06	68.56	35.50	51.77	71.66
Agriculture [kt]	17.49	38.25	66.31	0.79	7.88	11.24
Agricultural share [%]	14.00	17.38	96,72	0.02	15.22	15.68

The mineral and organic manure application is the most significant agricultural contributor to total NO_X emissions (approximately 13% of total). The remaining less than 1% of NO_X is related to emissions from livestock breeding. The agricultural share of NMVOC emissions accounts for 17%, and cattle breeding (categories 3B1a and 3B1b) contributes to the total NMVOC emissions by approximately 9%. PM_{10} and TSP from category 3Dd Farm-level agricultural operations, including storage, handling and transport of agricultural products, represent the most significant sources of emissions from agriculture. They contribute to approximately 15% and 16% of total emissions, respectively. Extra-large cattle, pigs and poultry farms characterise Czech agriculture. The e-ANNEX NFR-3B-1 shows the share of animals bred on farms (agricultural holdings) by size group of cattle, pigs and poultry (data from 2000 and 2020). Table V.3 shows the share of number of dairy cattle farms and the share of dairy cattle by the size of groups [15].

Table V.3 Number of dairy cattle farms, share of breed dairy cattle by size groups (ČMSCH, a.s. 2024, [16]

Cattle farms		
Amount of dairy cattle (heads)	Share of farms (%)	Share of bred cattle (%)
1–10	59.4.	1.1
11–50	10.3	2.4
51–200	10.8	10.5
201–500	12.5	37.7
501-1000	5.8	35.1
More than 500	1.1	13.3

In Czechia, dairy cattle were bred on 3 172 farms in 2024. However, only 29.4% of cattle farms (618 intensive livestock farms) have kept approximately 85% of the total dairy cattle amount in Czechia. The following chapters describe the method of calculation for subsectors.

V.1 Livestock breeding - Manure management (NFR 3B), Animal manure applied to soil (NFR 3Da2a), urine and dung deposited by grazing animals (NFR 3Da3)

Within the category manure management, the following subcategories are distinguished:

- 3B1a Dairy cattle
- 3B1b Non-dairy cattle
- 3B2 Sheep
- 3B3 Swine
- 3B4a Buffalo
- 3B4d Goats
- 3B4e Horses
- 3B4f Mules and asses
- 3B4gi Laying hens
- 3B4gii Broilers
- 3B4giii Turkeys
- 3B4giv Other poultry
- 3B4h Other animals (rabbits)

Animals in NFR 3B4a (buffalo) and 3B4f (mules and asses) are not kept as livestock in Czechia. Therefore, these subcategories are not estimated.

The number of animals is a key activity data for emissions inventory calculation relating to manure management (NFR 3B), animal manure applied to soil (NFR 3Da2a), urine, and dung deposited by grazing animals (NFR 3Da3). The number of animals was taken from an annual agricultural census from the official statistics (CZSO). The number of animals is considered as an average annual production. Table V.4 shows trends of the livestock population in the period 1990–2024.

Table V.4 Livestock population, 1990–2024 (thousands of heads)

	Cattle	Swine	Sheep	Poultry	Horses	Goats
1990	3 360	4 569	430	27 165	27	41
1995	1 989	4 016	165	21 872	18	45
2000	1 582	3 594	84	25 968	24	32
2005	1 351	2 719	140	25 372	21	13
2010	1 319	1 846	200	24 838	30	22
2015	1 366	1 555	231	22 508	33	27
2020	1 340	1 546	203	24 247	38	29
2021	1 360	1 493	183	23 808	33	25

2022	1 390	1 329	174	23 760	37	24
2023	1 370	1 362	179	21 953	37	29
2024	1 398	1 422	180	25 878	37	26

Trends in the livestock populations in the key categories (cattle, swine) determine emissions trends in the agricultural sector. The cattle population in 2024 corresponded to only 42% of the population in 1990, and the swine population in 2024 corresponded to even less - only 31% of the initial population.

V.1.1 Emission factors and calculations

All used activity data for NH_3, NO_X and NMVOC emissions inventories are in accord with the latest data used for greenhouse gas (GHG) inventories (submission 2026) and with the Gross nitrogen balance per hectare of utilised agriculture area for the Czechia (Eurostat) as a result of activities focusing on unification of national data used for calculation of all inventories (GHG, NH_3, NO_X, NMVOC and Gross nitrogen balance).

To estimate NH_3, NO_X and NMVOC emissions from animal breeding, the Tier 2 approach according to the 3B Manure management EMEP/EEA EIG has been used since 2020 (first submission 2021) [3].

To calculate ammonia and NO_X emissions according to Tier 2, the Manure management N-flow tool developed by Aether Ltd. 2019 under contract to the EEA was used [17].

V.1.1.1 Activity data

The number of livestock

Tier 2 uses a mass-flow approach based on the concept of a flow of TAN through the manure management system. According to 3B Manure management EMEP/EEA EIG, the first step is to define the homogeneous livestock subcategories concerning feeding, excretion and age/weight range [3]. The e-ANNEX NFR-3B-2 shows a number of animals allocated on relevant subcategories used for inventory calculation. The source of these data is the Czech Statistical Office. This allocation has been used for the all-time series from 1990 to 2024. It includes 43 different livestock categories divided on weight and age. These data are used for defining relevant NFR categories and as input data for the Manure management N-flow tool.

Values of N-excretion (Nex)

The emission of NH_3 and NO_X from manure management is calculated based on nitrogen excreted from livestock. Nex value in all animal categories, except dairy cattle, had been based on the national data for typical animal mass (TAM), Eq. 10.30 IPCC 2006 Gl. and the default excretion rate (Table 10.19, IPCC 2006 Gl. In dairy cattle's case, the excreted nitrogen calculation depends on milk production, which has been increasing in the Czechia since 1990. Therefore, Nex rate value for the entire time series was taken from OECD reporting (the documentation provided by the Czech Agrifood Research Centre team). The country-specific values of Nex were derived from the national legislation Decree No. 377/2013 Coll. on the storage and use of fertilizers. The use of the updated coefficients was supported mainly by the need to synchronize input data used to evaluate the nitrogen flows in agriculture to increase the methodological level of reporting the nitrogen balance, greenhouse gas emissions and pollutants for the Czechia in terms of the requirements of international organizations. Since 2021, these values are also jointly used for calculating GHG emissions and Gross nitrogen

Balance (for Eurostat). The e-ANNEX NFR-3B-3 presents all revised Nex used for calculating NH_3 and NO_X inventories.

V.1.1.2 Agricultural Waste Management System (AWMS)

There are four main Manure Management systems defined in Czechia according to Table 10.18 (IPCC 2019) [18].

1. Anaerobic digester

2. Liquid system

3. Solid storage

4. Pasture/Range/Paddock

The use of manure in anaerobic digesters is relevant for cattle, swine and poultry manure. The operation of anaerobic digesters began in 2001. Currently, 399 biogas power stations are operated in the Czech agriculture. The significant accruement of biogas power stations occurred between 2008 and 2013.

The specific structure of Czech animal breeding (mostly in factory farming) allows building anaerobic digesters close to farms to consume daily manure production efficiently without manure storage. The number and capacity of anaerobic digesters have remained at their maximum value since 2014. In the same way, animal waste management systems (AWMS) are used for N_2O, CH_4, NH_3 and NO_X emission estimations. Based on a statistical survey of the amount and types of biomasses used for anaerobic digestion in 2018, the AWMS for cattle, swine and poultry categories have been updated. The overview of used AWMS per individual animal categories is provided in the e-ANNEX NFR-3B-4.

Values of feed intake and values of excreted volatile solids

Emissions of NMVOC occur from silage, manure in livestock housing, outside manure stores, field application of manure and grazing animals. Feeding cattle with silage has been identified as the largest source of NMVOC in agriculture. Values of feed intake in MJ (average gross energy intake) are basic activity data for calculating NMVOC originating from dairy and non-dairy cattle. These data values presented in NIR for GHG inventory are used as a source. These data are available in the e-ANNEX NFR_3B_5; likewise, values of excreted volatile solids are used to calculate NMVOC originating from all livestock categories other than cattle. Moreover, the calculation of NMVOC is also dependent on ammonia emissions originating from animal housing, manure storage, manure application and livestock grazing. These ammonia emissions are downloaded from the Manure management N-flow tool for all livestock categories.

V.1.1.3 Ammonia emissions factors

Housing

For calculating ammonia emissions national inventory with the assistance of the Manure management N-flow tool default EF presented in Table 3.9. 3B EMEP/EEA EIG have been used [3].

Manure storage

Depending on the housing type, livestock manure is collected solid or slurry. This share is primary input data to the Manure management N-flow. According to Czech law 201/2012 on air protection, all slurry tanks must be covered by a fixed or floating cover or a natural floating cover to reduce ammonia emissions into the air.

Manure application

The Czech Statistical Office confirmed trends in faster incorporation of manure into the soil based on data published in April 2018 in the "Farm Structure Survey – 2016" and in September 2021 in the "Integrated Farm Survey - 2020" [19]. Table V.5 presents a share of low ammonia application techniques.

Table V.5 Manure consumption by application technique (CZSO 2022)

Manure application techniques	Manure applied (tons)	Share (%)
Broadcast		
No incorporation	2 994 173	15.4
Incorporation within 4 hours	2 174 620	11.2
Incorporation between 4 and 24 hours	10 826 971	55.5
Band-spread		
Trailing hose	2 394 88	12.0
Trailing shoe	336 783	1.7
Injection		
Shallow / open-slot	537 289	2.8
Deep / closed-slot	282 397	1.4

Presented values show that 85% of manure was applied by low ammonia emissions techniques defined in the Options for Ammonia Abatement: Guidance from the UNECE Task Force on Reactive Nitrogen [20]. Approximately 15% of manure was applied and incorporated into the soil immediately by injection or within 4 hours, where ammonia abatement effect is on the level of 80–90 in case of injection and on the level of 45–65% in case of incorporation of manure into the soil within 4 hours. Share of manure incorporation within 24 hours represents 56% of the total amount of applied manure with ammonia abatement effect at 30%, similar to utilization of band spreading with a share of 14%. Based on these facts, possibly 85% of all manure has been applied by technique with abatement effects on ammonia emissions of at least 30%.

Ammonia emissions from manure application are registered under NFR code 3Da2a and from grazing animals under NFR code 3Da3.

Abatement measures

According to the Options for Ammonia Abatement: Guidance from the UNECE Task Force on Reactive Nitrogen, ammonia abatement effects were incorporated into the inventory. Mitigation measures were included directly in the N-flow tool calculation program as an extension of the original program. The extension of the original program was created as a result of the specific contract No 070201/2020/831771/SFRA/ENV.C.3 - Capacity building for Member States regarding the development of national emission inventories led by the Ricardo Energy & Environment, a trading name of Ricardo Nederland BV, under contract to the European Commission dated 28 May 2018. Reducing measures regarding manure storage and its application to the soil was considered for the Czechia. Penetration rates of used abatement measures and related comments are available in the e-ANNEX NFR-3B-6.

NO$_X$ emission factors

For calculation of NO$_X$ (as NO$_2$) emissions inventory with the assistance of the Manure management N-flow tool default EF presented in Table 3.10. 3B EMEP/EEA EIG have been used [3].

NMVOC emission factors

Since 2020 emissions of NMVOC have been calculated using the Tier 2 approach. For calculating NMVOC emissions inventory, default EFs presented in Table 3.11 for dairy cattle, and other cattle and Table 3.12 for livestock categories other than cattle of 3B EMEP/EEA EIG have been used [3].

PM emission factors

The estimation of PM emissions is based on the Tier 1 approach according to the 3B EMEP/EEA EIG [3]. For calculating PM$_{2.5}$, PM$_{10}$ and TSP emissions inventories, default EFs presented in Table 3.5 of the EMEP/EEA EIG have been used. These emissions include primary particles in the form of dust from housings. The inventory includes PM emissions from cattle, swine, poultry, horses, sheep and goats. The number of grazing days is taken into account. Each category of animals has been multiplied by default specific emission factor.

NH$_3$, NO$_X$ and NMVOC emissions

Trends in ammonia, NO$_X$ and NMVOC emissions originating from manure management are presented in Figure V.2 and from manure application and animal grazing in Figure V.3.

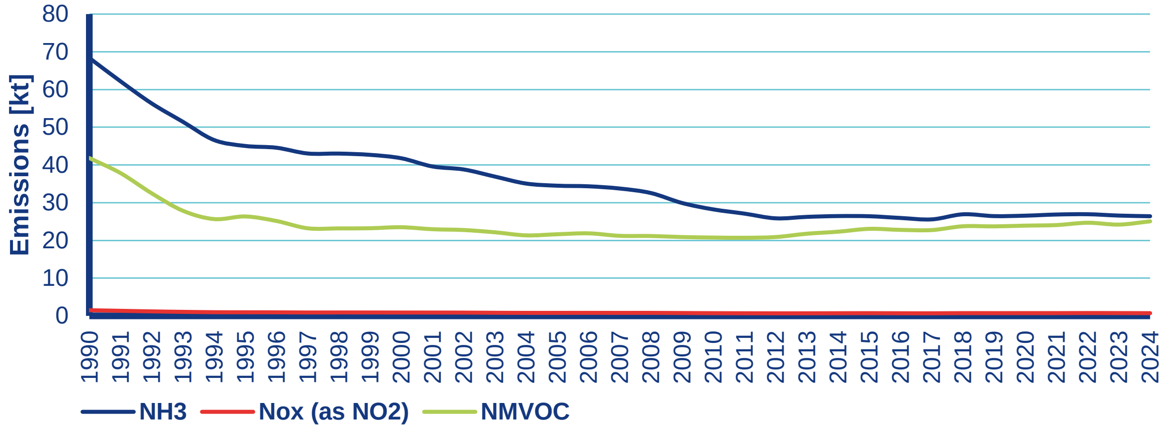


Figure V.2 NH$_3$, NO$_X$ and NMVOC emissions originating from manure management, 1990–2024

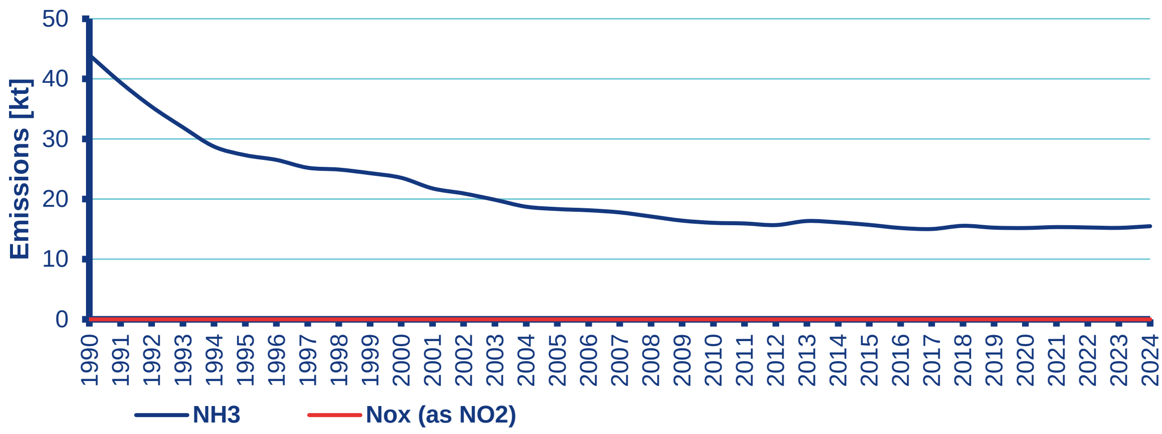


Figure V.3 NH_3 and NO_X originating from manure application, urine and dung deposited by grazing animals, 1990–2024

V.1.2 Uncertainties and QA/QC procedures

There needs to be more data available to assess the uncertainty of the calculations. The same calculation system has been used for the whole series.

V.1.3 Planned improvements

There are planned following issues:

- Regular verification of the compliance of the input data used for the inventory of NH_3, GHG emissions and the inventory of the gross nitrogen balance with the expert group for greenhouse gases and the calculation of the nitrogen balance.
- Incorporate ammonia abatement techniques following BATs utilization in housing pigs and poultry into inventory calculation.
- Verification of animal feed properties.

V.2 Crop production and agricultural soils - Inorganic N fertilizers (NFR 3Da1)

For the Inorganic N-fertiliser (also includes urea application) sector (NFR 3Da1), emissions of NH_3 and NO_X are estimated. As seen in fig. V.1 emissions of NH_3 from inorganic fertilisers contribute 34% of the total ammonia emissions from the agricultural sector, and emissions of NO_X contribute 64% of the total NO_X emissions from the agricultural sector in 2024. Trends in inorganic fertilisers' consumption are presented in Table V.6. Source of these data is CZSO [21].

Table V.6 Consumption of inorganic fertilisers (CZSO)

Agricultural production year	Consumption (tonnes of nutrients)			
	Fertilizers, total	Nitrogenous (N)	Phosphorous (P_2O_5)	Potassium (K_2O)
1994/95	279 238	212 988	39 834	26 416
1999/00	279 918	206 576	43 083	31 097
2004/05	301 864	223 684	47 083	31 097
2006/07	320 042	237 875	49 034	33 133
2007/08	278 198	221 667	35 218	21 313

2008/09	281 484	225 982	35 078	20 424
2009/10	303 927	238 554	39 991	25 382
2010/11	318 225	248 024	43 001	27 199
2011/12	337 764	261 216	47 053	29 495
2012/13	353 989	268 892	50 847	34 250
2013/14	357 668	270 023	52 005	35 641
2014/15	385 739	292 750	54 401	38 589
2015/16	380 659	285 739	56 194	38 725
2016/17	374 995	281 271	54 969	38 755
2017/18	365 071	274 305	52 595	38 171
2018/19	360 414	267 676	55 656	37 083
2019/20	343 049	256 521	51 617	34 911
2021/22	299 452	228 661	40 617	29 957
2022/23	295 303	231 198	38 787	25 630
2023/24	297 747	229 263	41 660	26 825
2024/25	301 383	233 493	40 699	27 191

The highest consumption of inorganic N-fertilisers was in the agricultural production year 2014/2015. Since 2016/2017, consumption of these fertilisers has decreased.

V.2.1 Emission factors and calculations

For national estimation of NH_3 emissions from consumption and application of inorganic N-fertilisers, the Tier 2 approach has been used according to the 3.D Crop production and agricultural soils guidebook [3]. Tier 2 is not available to estimate NO_X, which means the Tier 1 approach has been used.

V.2.1.1 Activity data

The IFASTAT database has been used as a key source of basic activity data regarding the amount of inorganic N-fertiliser consumption. In this context is very important to underline that these data express the quantity of fertilizers sold, which are assumed to equal the amounts applied. Since the 2022 submission, storage effects have been approximated by applying a moving average to the sales data (moving cantered three-year average, for the last year a two-year average). It results in the smoothing of extreme values and redistribution of emissions between neighbouring years.

In the e-ANNEX NFR-3D-1 consumption of different inorganic N-fertilisers is presented. According to this database, the total consumption of inorganic N-fertilisers mentioned in the Table V.6 is divided into the consumption of Ammonium nitrate (AN), Ammonium phosphates (AP), Ammonium sulphate (AS), Calcium ammonium nitrate (CAN), NK Mixtures, NPK Mixtures, NP Mixtures, N solutions, Other straight N compounds and Urea. Differences in the methodological approach of data collection cause differences in total consumption data on inorganic N-fertilizers between the IFASTAT database, the EUROSTAT database, the Czech Statistical Office (CZSO) and FAOSTAT. The IFASTAT database expresses the consumption of mineral fertilizers used in the economic year (e.g. 2023/2024), while the data in the FAOSTAT and EUROSTAT databases are in the calendar year (2023).

NH_3 emissions factors

Since the 2023 submission, the emission factors are listed in the tab. 3.2 of the 3D EMEP/EEA EIG 2023 were used for individual groups of mineral fertilizers. A ‘normal’ pH of 7.0 or below was considered [3].

NO_X emissions factors

NO_X emissions from inorganic N-fertilizers are calculated by default EF in Table 3.1 of the 3D EMEP/EEA EIG for all inorganic N-fertilizers [3].

NH_3 and NO_X emissions

The e-ANNEX NFR-3D-2 presents a share of different types of inorganic N-fertilisers on total ammonia emissions from inorganic N-fertilisers consumption in 2024 is presented. In 2024 ammonia emissions from Urea and N solutions based mainly on urea reached a proportion of the total ammonia emissions from inorganic N-fertilisers consumption at 29% and 22%, respectively. In the e-ANNEX NFR-3D-2 are also presented trends in ammonia emissions originating from different types of inorganic N-fertilisers. Ammonia emissions from the consumption of urea and urea-based fertilisers are decreasing. Ammonia emissions from the consumption of urea and urea-based fertilizers are slowly decreasing. However, in the Czechia, it was expected that after the adoption of legislation aimed at the obligation to incorporate urea immediately after its application into soil, the downward trend in urea consumption would be significantly higher. The significantly slower decline in the consumption of urea-based fertilizers compared to nitrate-based fertilizers is a consequence of the current energy crisis, when urea-based fertilizers are more affordable on the market, rather than nitrate-based fertilizers.

A new law has imposed measures for the low-emission urea application since July 1, 2022, in the Czechia. According to the Options for Ammonia Mitigation Guidance principles from the UNECE Task Force on Reactive Nitrogen, the measure represents a low ammonia emissions option focused on urea-based fertilisers. The law does not allow surface application of urea-based inorganic N-fertilisers without rapid incorporation into soil or application of urea-based inorganic N-fertilisers untreated by urease inhibitor. Consequently, ammonia emissions from urea application could decrease by 70%. The results of the implementation of this measure have been included in the national emission inventory since 2023

The e-ANNEX NFR-3D-7 lists the penetration rates of individual abatement technologies used in urea application. These are the application of urea with urease inhibitors (effect on reducing ammonia emissions by 70% compared to surface application of urea without inhibitors) and immediate incorporation of urea into the soil (effect on reducing ammonia emissions by 65% compared to surface application of urea without incorporation). Then, the specific default EF for urea can be reduced.

As part of the preparation of the Czech national report on compliance with the requirements of Article 31(2) - (4) of Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources (REDII) submitted to the European Commission - Energy, Climate Change, Environment for its assessment and approval, an update of typical greenhouse gas emissions from the cultivation of agricultural raw materials was carried out. The update of typical greenhouse gas emissions from the cultivation of selected agricultural crops also included an assessment of the penetration rate of reduction technologies used to reduce ammonia emissions from urea application.

The Czechia has made considerable efforts to collect data aimed at identifying especially the types and applied doses of mineral fertilizers and organic fertilizers for individual crops from agricultural enterprises. This was preceded by the amendment of decree 377/2013, where in paragraph 9 it is stated "Agricultural entrepreneurs who are obliged to keep records according to § 9 paragraphs 7 and 8 of the Fertilizers Act in electronic form, focused on records of the use of fertilizers, auxiliary soil substances, of plant bio stimulants, substrates and treated sludge, they hand it over to the institute electronically in the form of automated data output via an electronic application accessible on the Ministry's website". Central Institute for Supervising and Testing in Agriculture was entrusted with the collection, validation, and basic evaluation of data. According to Act No. 156/1998 on Fertilizers, all agricultural enterprises managing an area larger than 20 ha were obliged to provide the required data for the year 2022. This obligation did not apply to very small businesses and farms.

A detailed evaluation of the data aimed at determining the actual doses of mineral and organic fertilizers used in practice, used in the cultivation of individual crops, including an evaluation of the structure of the mineral fertilizers used, was carried out by the Research Institute of Agricultural Engineering, p. r. i. - the processor of the national emission inventories of ammonia and pollutants originating from agriculture within the research project QK21020121 "Determination and balance of specific greenhouse gas emissions originating from growing and post-harvest processing of agricultural crops", supported by the Czech Ministry of Agriculture.

Detailed evaluation of the doses and structure of fertilizers used in the cultivation of all selected crops is processed for all NUTS 3 regions of the Czechia. The input data on the used doses of individual types of mineral and organic fertilizers comes directly from the fertilization records of agricultural enterprises operating in the relevant region. Data are available on the applied amount of the respective fertilizer, on the applied doses of the respective nutrients and the area of the crop to which these fertilizers were applied. Application rates of individual fertilizers per one hectare of cultivated crop were subsequently calculated from these values. Data are available on the application of nitrogenous, phosphoric and potassium fertilizers and the application of calcareous substances. The e-ANNEX NFR-3D-7 shows the distribution of urea used in individual NUTS 3 regions and penetration rates of abatement measures. The e-ANNEX NFR-3D-8 provides a method for reporting the reducing effects on ammonia emissions from the use of urea with the addition of urease inhibitors in the Czechia.

Trends in NH_3 and NO_X emissions originating from inorganic N-fertiliser consumption (in kt) are presented in Figure V.4. As can be seen, there was a significant decrease in ammonia emissions between 2022 and 2024. This decrease is due to the inclusion of the reduction measures regarding to urea application introduced and implemented in practice.

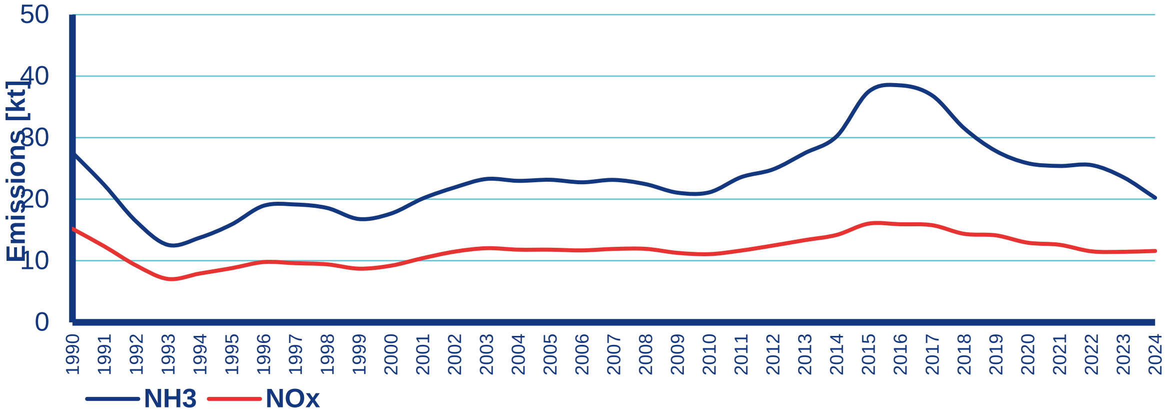


Figure V.4 NH_3 and NO_X emissions originating from inorganic N-fertilisers consumption, 1990–2024

V.2.2 Uncertainties and QA/QC procedures

There needed to be more data available to assess the uncertainty of the calculations. The same calculation system has been used for the whole series.

V.2.3 Planned improvements

No improvements are planned, and the chapter is considered to be final.

V.3 Crop production and agricultural soils - Sewage sludge applied to soils (NFR 3Da2b), Other organic fertilisers applied to soils (including compost) (NFR 3Da2c) and Crop residues applied to soils (NFR 3Da4)

For the sectors, Sewage sludge applied to soils (NFR 3Da2b), Other organic fertilisers applied to soils (including compost) (NFR 3Da2c) and Crop residues applied to soils (NFR 3Da4) emissions of NH_3 and NO_X are estimated. NH_3 from these sectors contribute approx. by 6% of the total ammonia emissions from the agricultural sector. Emissions of NO_X contributed 4% of the total NO_X emissions from the agricultural sector in 2024.

V.3.1 Emission factors and calculations

The Tier 1 approach has been used for national estimation of NH_3 emissions from Sewage sludge applied to soils (NFR 3Da2b), Other organic fertilisers applied to soils (including compost) (NFR 3Da2c) and Crop residues applied to soils (NFR 3Da4), according to the 3.D Crop production and agricultural soils [3].

V.3.1.1 Activity data

According to the Tier 1 methodology, emissions of NH_3 and NO_X are calculated as a multiplication of the amount of N applied into the soil and the default emission factor. The source of activity data regarding sludge application and compost production is the Czech Statistical Office. The average N-content in sewage sludge is assumed to be 3.66 kg N per kg dry matter [22] and 0.55 N per kg dry matter in composts in Czechia [23]. In Table V.7 and in

Year	Amount of sludge applied on soil (tons of DM)	N-content (%)	N applied on soil (tons of N)
1990	6 841	3.66	253
2000	28 615	3.66	1 058
2005	34 467	3.66	1 275
2010	60 639	3.66	2 243
2020	63 064	3.66	2 333
2021	66 082	3.66	2 445
2022	63 260	3.66	2 340
2023	63 266	3.66	2 341
2024	43 067	3.66	1 593

Table V.8 amount of N from sludge, composts and plant share of digestate applied on soil is presented.

Table V.7 Activity data used to estimate NH_3 and NO_X from sewage sludge, 1990–2024

	Amount of sludge applied on soil (tons of DM)	N-content (%)	N applied on soil (tons of N)
1990	6 841	3.66	253
2000	28 615	3.66	1 058
2005	34 467	3.66	1 275
2010	60 639	3.66	2 243
2020	63 064	3.66	2 333
2021	66 082	3.66	2 445
2022	63 260	3.66	2 340
2023	63 266	3.66	2 341
2024	43 067	3.66	1 593

Table V.8 Activity data used to estimate NH_3 and NO_X from composts and plant share of digestate, 1990–2024

	Number of applied composts (tons of DM)	N-content (%)	N applied on soil (tons of N)	N applied on soil from plant share of digestate (tons of N)
1990	28 000	0.55	154	-
2000	26 664	0.55	147	150
2005	47 260	0.55	259	940
2010	70 333	0.55	386	5 920
2020	145 599	0.55	801	11 710
2021	145 710	0.55	801	11 850
2022	140 980	0.55	775	11 670
2023	137 000	0.55	777	11 520
2024	140 000	0.55	770	12 040

The calculation of ammonia emissions from plant residues was performed for the first time in the entire time series for submission in 2023. All activity data used for the calculation are listed in the e-ANNEX NFR-3D_3Da4_NH3_FCR - IPCC.

NH_3 emissions factors

For calculating ammonia emissions originating from sewage sludge applied to soils and other organic fertilizers applied to soils (including compost), default EFs are presented in the tab. 3.1 of the 3D EMEP/EEA EIG has been used [3]. For calculating of ammonia emissions originating from crop residues left in fields default EFs presented also in the 3D EMEP/EEA EIG have been used [3].

NO_X emissions factors

Ammonia emissions from sewage sludge applied to soils and other organic fertilizers applied to soils (including compost) are calculated by default EFs from Tab. 3.1 in the 3D EMEP/EEA EIG [3].

NH_3 and NO_X emissions

Figure V.5 presents trends in NH_3 and NO_X emissions originating from sewage sludge applied to soils and other organic fertilizers applied to soils (including compost) and emissions from crop residues in 1990–2024 (in kt).

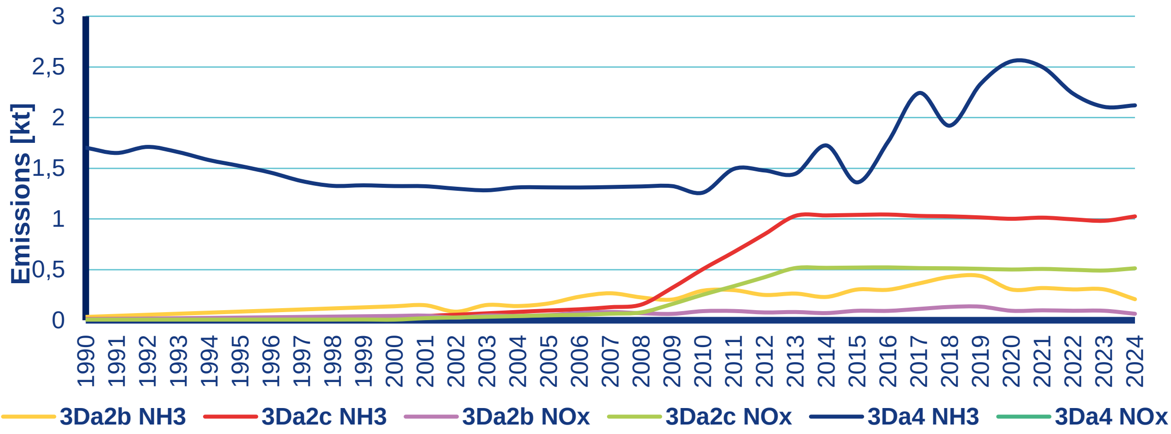


Figure V.5 NH_3 and NO_X emissions from sewage sludge applied to soils and other organic fertilizers applied to soils (including compost) and crop residues left on fields, 1990–2024

V.3.2 Uncertainties and QA/QC procedures

There needed to be more data available to assess the uncertainty of the calculations. The same calculation system has been used for the whole series.

V.3.3 Planned improvements

No improvements are planned, and the chapter is considered to be final.

V.4 Crop production and agricultural soils – farm-level agricultural operations including storage, handling and transport of agricultural product (NFR 3Dc)

NFR 3Dc comprises fugitive emissions of $PM_{2.5}$ and PM_{10} produced by agriculture during soil cultivation, harvesting of crops and their subsequent cleaning and drying. It can be assumed that emissions produced during field operations are composed mainly of inorganic soil particles, during harvesting mainly of organic plant remains, and in some cases of spores of moulds etc. Emissions depend on the crop, soil type, soil cultivation method, and climatic conditions before and during farming operations. NFR 3Dc contributed 0.01% and 9% of the total $PM_{2.5}$ and PM_{10} emissions in 2023. Cropped areas of individual crops divided at the Nomenclature of Territorial Units for Statistics (NUTS 3) have been obtained from the annual report of the Czech Statistical Office. The main focus has been on areas of monitored cereals such as wheat, rye, barley and oats, which are grown on approximately 55% of arable land. The area taken up by cereal crops has been subtracted from the total area of arable land, which gives the area of arable land on which root crops, vegetables, oilseeds, fodder plants, etc., are grown.

V.4.1 Emission factors and calculations

Activity data

The Tier 2 approach has been used for the NFR 3Dc soils to estimate $PM_{2.5}$ and PM_{10} emissions. According to the Tier 2 methodology, PM_{10} and $PM_{2.5}$ are calculated as the product of cropped areas of individual crops and emission factors of individual field operations emitting dust particles. The source of activity data regarding the sowing area of crops is the Czech Statistical Office. The e-ANNEX NFR-3D3 shows trends in the utilisation of agricultural areas and areas under crops (as of 31st May of the relevant year).

$PM_{2.5}$ and PM_{10} emissions factors

Tables 3.5 and 3.7 in 3D EMEP/EEA EIG for the region with wet climatic conditions present default EFs for calculating $PM_{2.5}$ and PM_{10} emissions inventories [3]. For rape default EF for crop cultivation utilisation of different tillage practices (conventional tillage - mouldboard plough or disc ploughland, conservation tillage - low tillage) has been considered to obtain a more precise calculation of PM emissions from the agricultural operation. The share of zero tillage (direct seeding) is only 1.5% in Czechia and was omitted in the calculation. Soil cultivation, the area taken up by cereal crops in each region, was divided into thirds. For one-third of cereals farmed using the minimization approach, the emission factor for soil cultivation was factored in twice; for the remaining area, it was factored in four times, as was the case for areas classified as other arable lands. In the case of permanent grasslands, the emission factor for the operation Harvesting was factored in twice. The total emission of PM_{10} or $PM_{2.5}$ for a given region is determined by the sum of individual emissions of PM for individual operations and crops. The e-ANNEX NFR-3D-4 shows the share of used tillage methods in 2010, 2016 and 2023, including PM emission calculations. In Table V.9 frequency of farming operations during the year for individual types of crops is presented.

Table V.9 Frequency of farming operations during the year for individual types of crops

Crop	Soil cultivation		Harvesting	Cleaning	Drying
	Conventional tillage	Conservation tillage			
Wheat	4	2	1	1	1
Rye	4	2	1	1	1
Barley	4	2	1	1	1
Oat	4	2	1	1	1
Other arable	4	-	-	-	-
Grass	1	-	2	0	0

$PM_{2.5}$ and PM_{10} emissions

Figure V.6 shows trends in $PM_{2.5}$ and PM_{10} emissions from farm-level agricultural operations, including storage, handling and transport of agricultural products (in kt). In the time series of the production of PM emissions, a significant decrease can be seen in 2003. This decrease was caused by lower cereal production in 2003. Cereal production, especially wheat, was lower by approx. 15% compared to 2002 and approx. 35% lower than in 2004. According to EMEP GB, the production of cereals is most closely related to the production of PM emissions. The e-ANNEX NFR-3D-5 Crop yield shows the yields of individual crops in the entire time series.

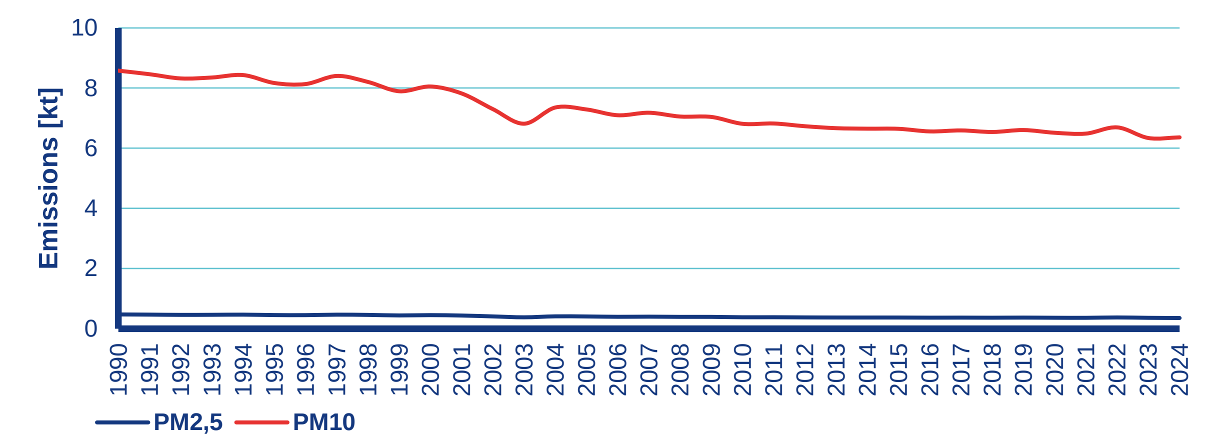


Figure V.6 $PM_{2.5}$ and PM_{10} emissions originating from farm-level agricultural operations including storage, handling and transport of agricultural products, 1990-2024

V.4.2 Uncertainties and QA/QC procedures

There needed to be more data available to assess the uncertainty of the calculations. The same calculation system has been used for the whole series.

V.4.3 Planned improvements

No improvements are planned, and the chapter is considered to be final.

V.5 Crop production and agricultural soils – cultivated crops (NFR 3DE)

For NFR 3De cultivated crops, NMVOC emissions are estimated. For NFR 3De cultivated crops, NMVOC emissions are estimated. NFR 3De contributed less than 1% of the total NMVOC emissions production in 2024

V.5.1 Emission factors and calculations

Czechia uses emission factors from 3D EMEP/EEA EIG. The Tier 2 method is used for MNVOC emissions of selected crops (wheat, rye, barley, oats, rape, grain maize, perennial fodder crops – pasture and grass). Tier 1 values from Table 3.3 have been used for the other crops [3].

Activity data

According to the Tier 2 methodology, emissions of NMVOC are calculated as the harvest crop yield multiplication and relevant emission factors. The Czech Statistical Office provides activity data regarding harvested crops and per-hectare crop yields. Trends of yields of harvested crops are in the e-ANNEXNFR-3D-5. All activity data used for calculating the all-time series and NMVOC calculation are in the e-ANNEXNFR-3D-6.

NMVOC emissions factors

In Table V.10 NMVOC are emissions factors used for the calculation of NMVOC from cultivated crops in 2024.

Table V.10 Emissions factors for selected cultivated crops

Crop	EEA / EMEP EF	Year fraction emitting
	kg NMVOC / kg DM / hour	
Wheat	2.60×10^{-8}	0.3
Rye	1.41×10^{-7}	0.3
Barley	2.60×10^{-8}	0.3
Oats	2.60×10^{-8}	0.3
Rape	2.02×10^{-7}	0.3
Grain maize – other grain	2.60×10^{-8}	0.3
Perennial fodder crops - pasture	1.03×10^{-8}	0.5
Grass land 15°C	1.03×10^{-8}	0.5

NMVOC emissions

The trend in NMVOC emissions originating from cultivated crops (in kt) is presented in Figure V.7.

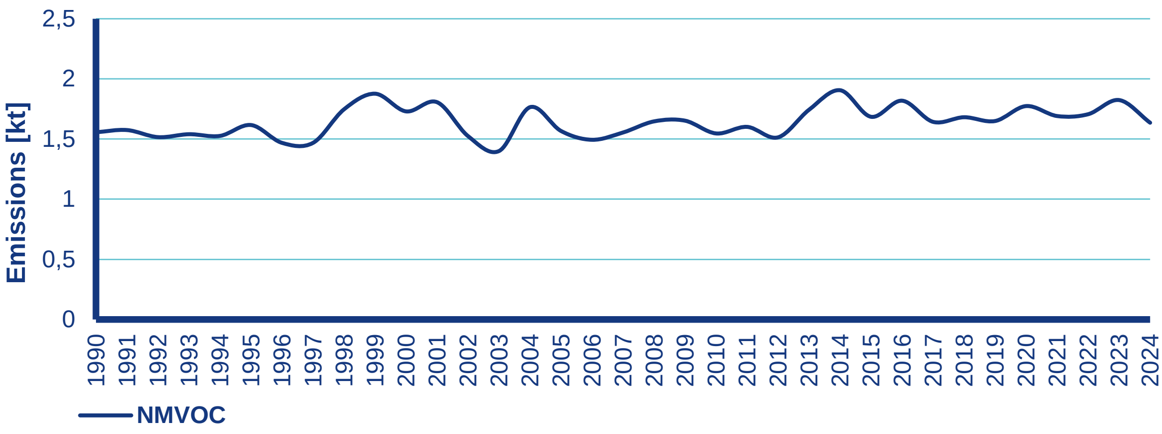


Figure V.7 NMVOC emissions originating from cultivated crops, 1990–2024

V.5.2 Uncertainties and QA/QC procedures

There needs to be more data available to assess the uncertainty of the calculations. The same calculation system has been used for the whole series.

V.5.3 Planned improvements

No improvements are planned, and the chapter is considered to be final.

V.6 Other (NFR 3Df, 3F and 3I)

In Czechia NFR 3F field burning of agricultural residues is not allowed. Thus, emissions occurring from this category are not considered in the IIR.

The CZSO, in cooperation with the Central Institute for Supervising and Testing in Agriculture (UKZUZ), monitor pesticide consumption following Regulation (EC) No 1185/2009 of the European Parliament and the Council of 25 November 2009 concerning statistics on pesticides. The monitoring scale is specified in Annex III of the Regulation. Treatment of straw with NH_3 to increase its value as a feed for ruminant livestock is not common practice in Czechia. Therefore, emissions of NH_3 from the NFR 3I are omitted in the IIR.

V.6.1 Emission factors and calculations

The Tier 1 approach is used to estimate HCB emissions from 3Df use of pesticides according to the 3.D.f-3.I Use of pesticides and limestone 2024 [3].

Activity data

HCB is calculated as the multiplication of used pesticides and relevant emission factors. The source of activity data regarding pesticide use is the Central Institute for Supervising and Testing in Agriculture (UKZUZ), available at the website of UKZUZ [24]: e-ANNEX NFR-3Df shows all activity data used for calculation of HCB in all-time series since 1999.

HCB emissions factors

Table V.11 shows HCB emissions factors used for the calculation of HCB originating from the use of pesticides.

Table V.11 Emissions factors for selected pesticides

Active Substances	1990	1995	2000	2005	2010	2015
	mg·kg^{-1}	mg·kg^{-1}	mg·kg^{-1}	mg·kg^{-1}	mg·kg^{-1}	mg·kg^{-1}
Altrazine	2.5	1	1	1	not used	not used
Clopyralid	2.5	2.5	2.5	2.5	2.5	2.5
Chlorothalonil	300	300	40	10	40	40
DCPA, Dacthal, Chlorthaldimethyl	1000	1000	40	40	not used	not used
Endosulfan	0.1	0.1	0.1	0.1	not used	not used
Lindane	100	50	50	50	not used	not used
Pentachloronitrobenzene (PCNB), Quintozene	500	500	500	not used	not used	not used
Picloram	50	50	50	50	50	50
Propazine	1	1	1	not used	not used	not used
Simazine	1	1	1	not used	not used	not used
Pentachlorophenol (PCP)	50	50	50	not used	not used	not used

HCB emissions

Figure V.8 presents trends in HCB emissions from the use of pesticides (in kt).

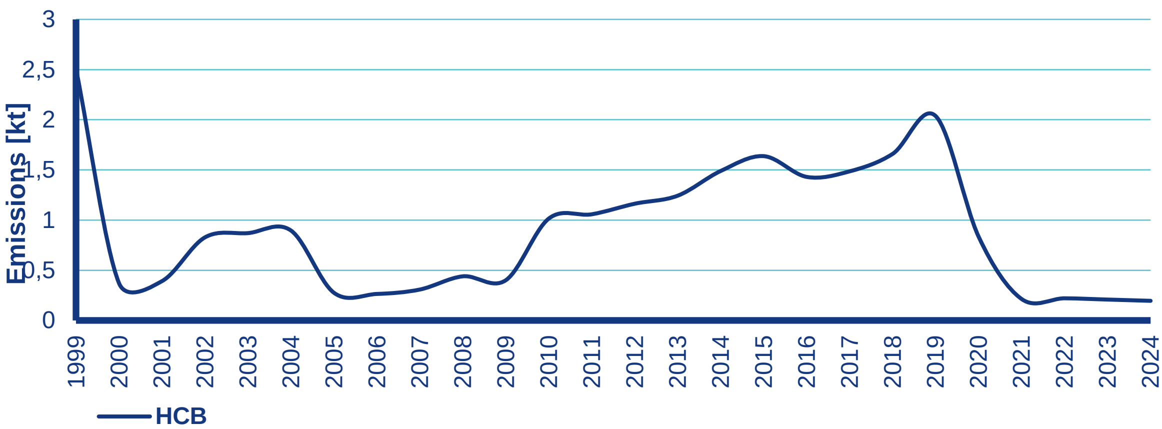


Figure V.8 HCB emissions originating from used of pesticides, 1999–2023

V.6.2 Uncertainties and QA/QC procedures

There needed to be more data available to assess the uncertainty of the calculations. The same calculation system has been used for the whole series.

V.6.3 Planned improvements

No improvements are planned, and the chapter is considered to be final.

VI. Waste (NFR 5)

Date of the last revision: 15 March 2026

This sector includes both individually monitored sources (NFR 5B2, 5C1a–5C1bv, 5E – Biodegradation and solidification facilities and Sanitation facilities) and collectively monitored sources (NFR 5A, 5B1, 5C2, 5D1–5D2, 5E – Car and buildings fires). Links between the NFR category and classification according to Czech law are listed in Table VI.1 below.

Table VI.1 NFR categories and Czech classification for NFR 5 Waste

NFR code	Longname	Classification pursuant Annex 2 to Act 201/2012 Coll.
5A	Biological treatment of waste - Solid waste disposal on land	2.2. Dumps which accept more than 10 t of waste per day or have a total capacity of over 25 000 t
5B1	Biological treatment of waste - Composting	2.3. Composting facilities and biological waste treatment facilities with a projected capacity equal to or greater than 10 tons per fill or greater than 150 tons of processed waste per year
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	3.7. Biogas production
5C1a	Municipal waste incineration	2.1. Thermal waste processing in incinerators
5C1bi	Industrial waste incineration	2.1. Thermal waste processing in incinerators
5C1bii	Hazardous waste incineration	2.1. Thermal waste processing in incinerators
5C1biii	Clinical waste incineration	2.1. Thermal waste processing in incinerators
5C1biv	Sewage sludge incineration	2.1. Thermal waste processing in incinerators
5C1bv	Cremation	7.15. Crematoriums
5C1bvi	Other waste incineration (please specify in the IIR)	Unspecified in Annex 2 to Act 201/2012 Coll.
5C2	Open burning of waste	Unspecified in Annex 2 to Act 201/2012 Coll.
5D1	Domestic wastewater handling	2.7. Wastewater treatment plants with a projected capacity per 10 000+ equivalent residents
5D2	Industrial wastewater handling	2.6. Wastewater treatment plants; facilities intended for the operation of technologies producing wastewater which cannot be assigned to equivalent residents at a quantity greater than 50 m^3/day
5D3	Other wastewater handling	Unspecified in Annex 2 to Act. 201/2012 Coll.
5E	Other waste (please specify in IIR)	2.4. Biodegradation and solidification facilities
		2.5. Sanitation facilities (elimination of oil and chlorinated hydrocarbons from contaminated soil) with a projected oil output of greater than 1 t of volatile organic compounds, inclusive

The sources belong to key categories only for Hg – NFR 5C1bv (9%) PCDD/PCDF – NFR 5E Car and building fires (27.3%) and NFR 5C2 (8.9%). The increase in Hg emission from cremations in 2020 and 2021 was caused by high mortality due to the COVID-19 pandemic.

According to statistics of CZSO (available online) and Catalogue of Products (available online), at present, the crucial trend in waste management is the effort to move towards a circular economy where material flows are closed in long time cycles and the emphasis is put on waste prevention, reuse of products, recycling and conversion to energy instead of extraction of raw materials and increasing landfilling.

Total waste generation, in which the largest share (96% in 2024) is held by the generation of non-hazardous waste, reached 40.2 million tons in 2024, which represents a year-on-year decrease of roughly 6%. Municipal waste generation increased in the period 2023–2024 by 8.9% to 5.9 million tons.

A declining trend has long been observed in the generation of hazardous waste (in the period 2022–2024 it dropped to a total of 1.5 million tons).

According to statistics from the Czech Environmental Information Agency (CENIA), total waste treatment is dominated by waste recovery, particularly material, the proportion of which has long been increasing (see Figure VI.1).

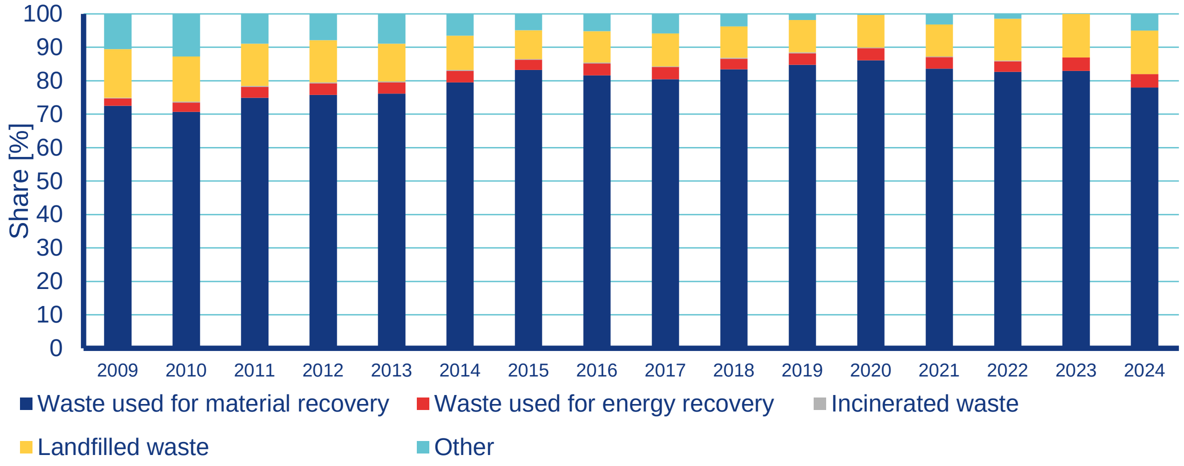


Figure VI.1 Proportion of selected waste treatment methods in the total waste generation, 2009–2024

The following chapters describe the method of calculation for sub-sectors.

VI.1 Biological treatment of waste – Solid waste disposal on land (NFR 5A)

This category describes emissions from municipal solid waste disposal in landfills. These sources are only a minor source of air pollutant emissions excluding NMVOC.

In the inventory system of Czechia are monitored facilities for the landfilling of solid municipal waste listed in Annex 2 to Act 201/2012 Coll. (2.2. Dumps which accept more than 10 t of waste per day or have a total capacity of over 25 000 t). Emissions from these facilities are not registered by the REZZO database. Only for some facilities are reported emissions from flaring for emergency combustion of collected landfill gas.

Activity data (amount of landfill waste) were taken from the Waste Management Information System (ISOH). This is a country-wide database information system containing data about the production and management of waste as well as information about facilities for their treatment and removal**.** From 2002 until 2006 the ISOH database was operated for MoE by the T. G. Masaryk Water Research Institute (TGM WRI), one of whose parts were the Centre for Waste Management (CeHO). Since 2007 the operator of the ISOH database is CENIA**.** The basic source for aggregated information on waste production and treatment is data on annual reports from originators and authorized persons sent to the ISPOP. This database can be queried by year, area, treatment method and waste catalogue number. The whole republic and all types of waste were chosen in this case.

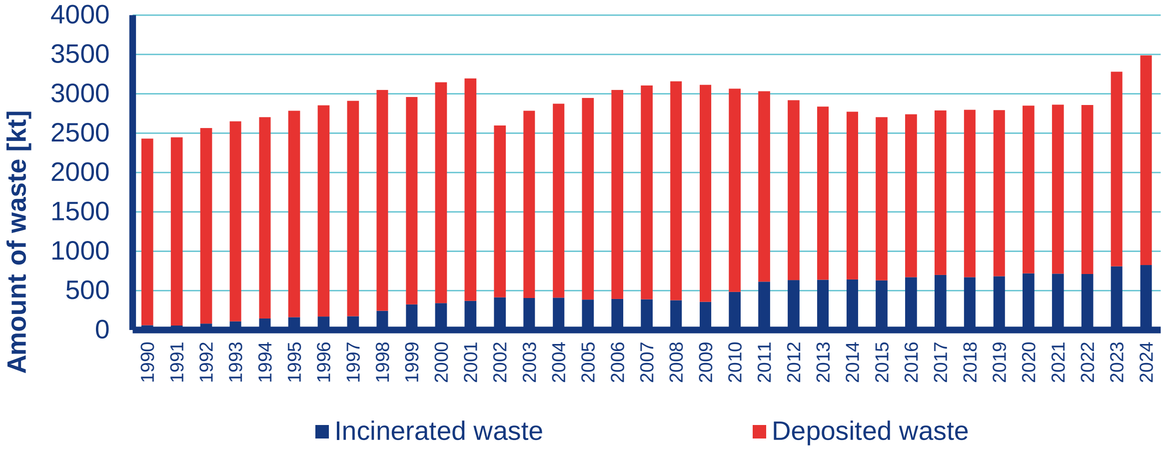


Figure VI.2 Comparison of the amount of deposited and incinerated municipal waste, 1990–2024

Figure VI.2 presents the actualized amounts of deposited and incinerated solid municipal waste in the monitored time frame. Amounts of deposited waste were obtained also from ISOH, but only waste with catalogue number 20 03 01 (municipal waste) was selected. The proportion of landfilled waste is notably high although in the last years, it has been decreasing slightly in favour of incineration (see also chapter – NFR 5C1a). According to State Energy Policy and Decree 352/2014 Coll. (see e-ANNEX), on the Waste Management Plan of Czechia for the period 2015–2024, the amount of deposited municipal waste will continue to decrease together with the increase of fees until it will be completely terminated in 2024. Emissions from deposited waste change depending exclusively on its amount.

VI.1.1 Emission factors and calculations

Czech national legislation does not specify emission limit values or technical conditions of operation for this category. Emission factors for TSP, PM_{10} and $PM_{2.5}$ were taken from the EMEP/EEA EIG, version 2023, (Tier 1 approach) [3]. Annual amount of landfilled mineral waste was used as activity data. They were obtained from Eurostat database, where are available data for years 2010, 2012, 2014, 2016, 2018, 2020 and 2022. Using the total amount of landfilled waste, the proportion of mineral waste was calculated, which in all cases was approximately 10%. This ratio was multiplied by the total amount of waste landfilled in the remaining years throughout the time series 1990–2024. This procedure is described in more detail in Chapter VIII.

NMVOC emissions for all years were calculated using the methodology recommended by TERT. This methodology was developed to estimate an NMVOC EF based on CH_4 emissions reported in the framework of the UNFCCC reporting. To do so, the CH_4 emission ratio per tonne of disposed waste (based on Czech UNFCCC 2020 reporting) was used, converted into a volume of CH_4 per tonne of disposed waste (using the molecular volume of CH_4) and then into a volume of biogas per tonne of disposed waste (applying the fraction of CH_4 in biogas F = 50%) and then the fraction of NMVOC in biogas (5.65 g/m^3 of landfill gas), presented in the note at the bottom of table 3-1, chapter 5A of the EMEP/EEA EIG, version 2023, was applied [3].

VI.1.2 Uncertainties and QA/QC procedures

Emissions for NFR 5A are calculated based on official statistics and default emission factors, uncertainty is therefore estimated from 50 to 200%, see also Chapter I.7.

VI.1.3 Planned improvements

No improvements are planned, and the chapter is considered to be final.

VI.2 Biological treatment of waste – Composting and Anaerobic digestion at biogas facilities (NFR 5B)

Composting is a biological method of utilising biowaste which under controlled conditions transforms biowaste into compost through aerobic processes and microbial activity. This process does not produce any emissions of monitored pollutants, only malodorous compounds.

According to Annex 8 to Regulation No 415 /2012 Coll., point 1.1. (Composting plants and equipment for biological modification of waste with a projected capacity greater or equal to 10 tonnes per one batch or greater than 150 tonnes of the processed waste per year) for these plants no emission limit is set, only technical conditions of operation:

a) Feeding bunkers have closed construction with the chamber for vehicles, for open halls, and during unloading of collecting vehicles with waste; gases must be exhausted and collected into facilities for cleaning waste gases.
b) Condensed vapours and water produced during the composting process (maturing of composts) may be used for the construction of open and not covered composting plants for watering of compost only in cases that they will not increase the dust load of the surrounding environment.
c) Waste gases from the maturing of composts in closed halls of composting plants are collected into facilities for cleaning of waste gases.

Activity data (amount of composted waste) were obtained from ISOH. For detailed information about this country-wide database, see Chapter VI.1. Activity data have been available since 2005. Historical activity data for 1990−2004 were estimated using various information sources – expert article by association CZ Biom (available online), publication of CENIA (available online), statistical yearbooks of CZSO and CENIA. Calculated NH_3 emissions are below the threshold of significance. Emissions of the other pollutants, reported by operators, were removed.

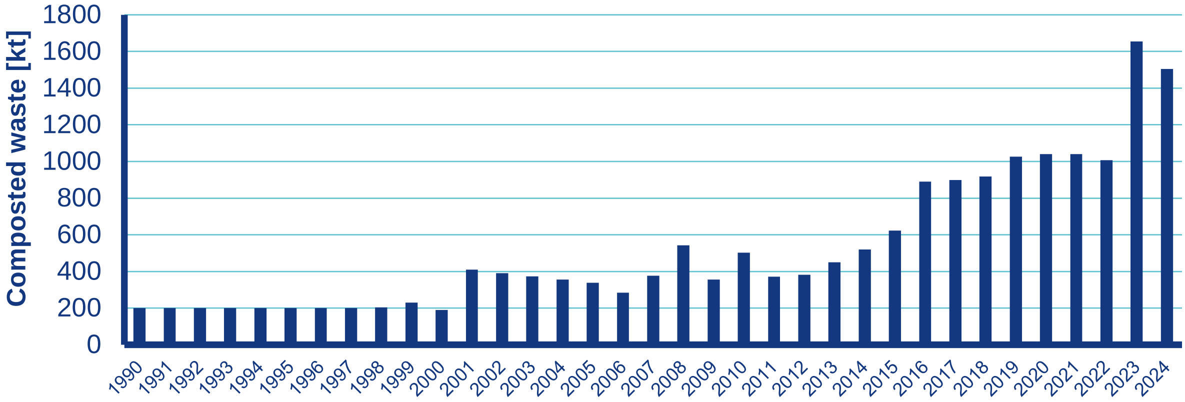


Figure VI.3 The trend in the waste composting, 1990–2024

As is shown in Figure VI.3 it is evident, that its amount has increased significantly recently due to mainly rising interest in the minimization of waste and its ecological utilization. Emissions of NH_3 depend exclusively on activity data because the composition of composted waste is almost constant.

In a biogas station, single-step fermentation (decomposition) transforms organic compounds into biogas. Anaerobic fermentation is a biological process of decomposing organic matter which takes place without the presence of air. It naturally occurs in nature, e.g. in bogs, on the bottoms of lakes or in waste dumps. During this process, a mixed culture of microorganisms gradually decomposes organic matter. In 2024, 356 biogas stations in operation were registered in the REZZO database.

Czech national legislation does not specify emission limit values or technical conditions of operation for this category. Due to the hermetisation, the biogas plants are not expected any release of air emissions. The small amounts of emissions of NO_X, NMVOC, SO_X, NH_3, $PM_{2.5}$, PM_{10}, TSP and CO reported by operators in this category come from emergency flares burning the excessive biogas. These emissions are included in various sectors according to NACE classification, mostly in 1A4ai.

Data for NFR 5B2 were supplied by VUZT. Activity data were obtained from the websites of the association CZBA (available online). Here is a freely accessible map of biogas plants (BP), which contains information about starting date of operation and power (heat and electric). They are divided into agricultural BP (397), BP in landfills (58), industrial BP (21) and BP in water treatment plants (98). Based on these data, the gradual commissioning of agricultural BP. Table VI.2 illustrates the year of commissioning, number of BP and cumulative installed electric power for agricultural BP.

Table VI.2 Commissioning of agricultural biogas plants

Year of commissioning	Number of agricultural BP	Cumulative installed electric power [MW]
2001	2	1.760
2002	7	5.452
2003	0	5.452
2004	0	5.452
2005	1	6.550
2006	5	10.149
2007	7	15.887
2008	32	39.250
2009	43	76.442
2010	42	11.3057
2011	72	17.5393
2012	127	284.297
2013	59	319.264
2014	0	319.264

The highest increase in BP number was achieved in the period 2008–2013. Since 2014, their number remained constant. This fact is also shown in Figure VI.4 below.

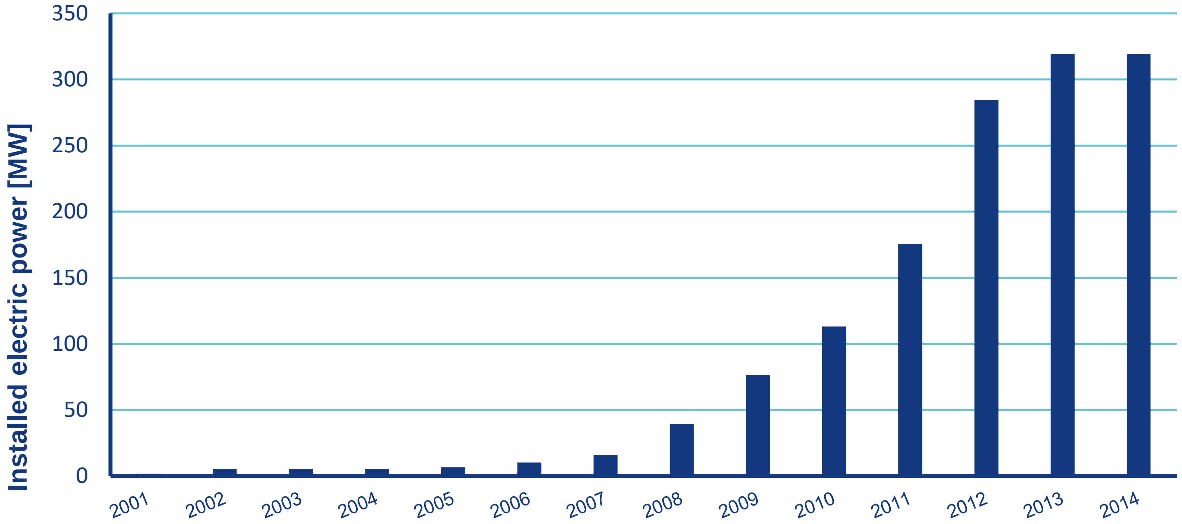


Figure VI.4 Installed electric power of agricultural biogas plants, 2001–2014

Activity data of non-agricultural biogas plants in Czechia are not available. Considering that the number of different types of biogas stations listed in the IIR (p. 89) shows that agricultural ones are predominant, NH_3 emissions from other types can be considered negligible. On the recommendation of TERT, Czechia will make efforts to obtain data on the input materials to non-agricultural biogas plants in the next years (e.g. with cooperation with CENIA).

VI.2.1 Emission factors and calculations

Emissions of NH_3 for NFR 5B1 Composting were calculated using emission factor from EMEP/EEA EIG, version 2023 (Tier 2) [3].

Emissions of NH_3 for NFR 5B2 Anaerobic digestion at biogas facilities were calculated only for agricultural biogas plants and were calculated using the Manure management N-flow tool, used to calculate NH_3 emissions for the NFR 3B Manure management.

VI.2.2 Uncertainties and QA/QC procedures

Emissions of NH_3 for NFR 5B are calculated based on official statistics and default emission factor, uncertainty is therefore estimated from 50 up to 200%, see also Chapter I.7.

VI.2.3 Planned improvements

For category 5B2, Czechia will make efforts to obtain data on the input materials to non-agricultural biogas plants in the next years (e.g. with cooperation with CENIA).

VI.3 Waste incineration (NFR 5C1a–5C1biv)

In these categories, there are included all installations for thermal treatment of waste (municipal, industrial, clinical, sewage sludge). The NFR 5C1bii (Hazardous waste incineration) is not considered separately; incineration of hazardous waste is included in NFR categories 5C1bi and 5C1biii.

Most facilities use heat generated by waste incineration. For smaller incinerators, there are most common heating of own objects (hospitals, factories etc.) and warming of water. The larger facilities supply heat to the public networks, alternatively working on the principle of the cogeneration cycle, which provides heat and electricity production.

The database of installations for the thermal treatment of waste in Czechia (Register of waste incinerators and co-incinerators) has been maintained since 2002 by legal requirements. Information from this register is made available to the public on the website of the Czech Hydrometeorological Institute. CHMI makes the following information accessible to the public (available online):

Monthly updated review of waste incineration and co-incineration facilities

Information for this review is obtained from the periodic report of the Czech Environmental Inspectorate. The following information is monitored: change of operator or source name, technological modifications, changes in the composition of waste, source shutdown or start of operation. These reports also provide information about the performed measurements and compliance with emission limits. Some summary information (especially the amount of incinerated waste) is obtained from summary operating records. They are made public in the form of synoptic tables which contain following data: identification data (region, name of operator, name of facility, identification number (IČ), identification number of the operating unit (IČP), address of operator, address of facility) and operating data (putting into operation, capacity in tonnes per year, amount of waste incinerated in last three years in tonnes per year, emission limit values compliance and appropriate comments about operating changes, performed measurements etc.).

Yearly updated geographical navigator

The geographic navigator presents overall annual information about facilities for the incineration and co-incineration of waste, which are obtained from summary operating records.

These are the following: identification number (IČ), name of the facility, address of the operator, address of the facility, putting into operation, types of waste incinerated, nominal capacity, amount of waste incinerated in tonnes per year, number and brief description of incineration lines, enumeration of equipment for reducing emissions, annual emissions of all pollutants reported.

Evidence of permits for waste incineration and co-incineration

This website is updated based on information from regional authorities, which have been issuing permits since 1. 1. 2003.

The types of permits are the following:

Permits according to § 17 paragraphs 1 and 2 of Act 86/2002 Coll. – permits issued until 1. 9. 2012.

Permits according to § 11 paragraph 2 d) of Act 201/2012 Coll. – permits issued after 1. 9. 2012.

Integrated permits according to § 13 paragraph 3 of Act 76/2002 Coll. – for plants meeting certain criteria (primarily capacity constraints) within the categorization according to Annex 1 to Act 76/2002 Coll.

Data from the Register of waste incinerators are utilized in emission inventory. Co-incineration plants which are in Czechia only cement kilns cannot be included in emission inventory because the largest share of emissions does not come from waste incineration but from the production of cement clinker. The amount of waste incinerated in rotary furnaces for the production of cement clinkers is included in the activity data of NFR1A2f as other fuels.

The emission inventory shows that the share of emissions of all pollutants in the total number is very low. Therefore, thermal treatment of waste has great potential, both economic and environmental.

There are currently four facilities for the energetic utilisation of waste in Czechia. Three of them: Pražské služby, a. s. – Factory 14, Facility for energetic utilisation of waste Malešice, SAKO Brno, a. s. – Division 3 ZEVO and TERMIZO a. s. – Incinerator of municipal waste Liberec were operated throughout the whole monitored timeframe 1990–2024. All the facilities reach a high degree of energetic efficiency; efficiency values and the formula used for their calculation are presented in Supplement 12 to Act 185/2001 Coll. On waste (60% or 65% depending on the operation permit issue date). This case concerns the utilisation of wastes in ways listed under code R1 in Supplement No. č. 3 to the same Act. Such facilities should not be referred to as incinerators but as facilities for energetic utilisation of waste.

The trend showing amounts of municipal and other waste incineration in the years 1990–2024 is illustrated in Figure VI.5 and Figure VI.6.

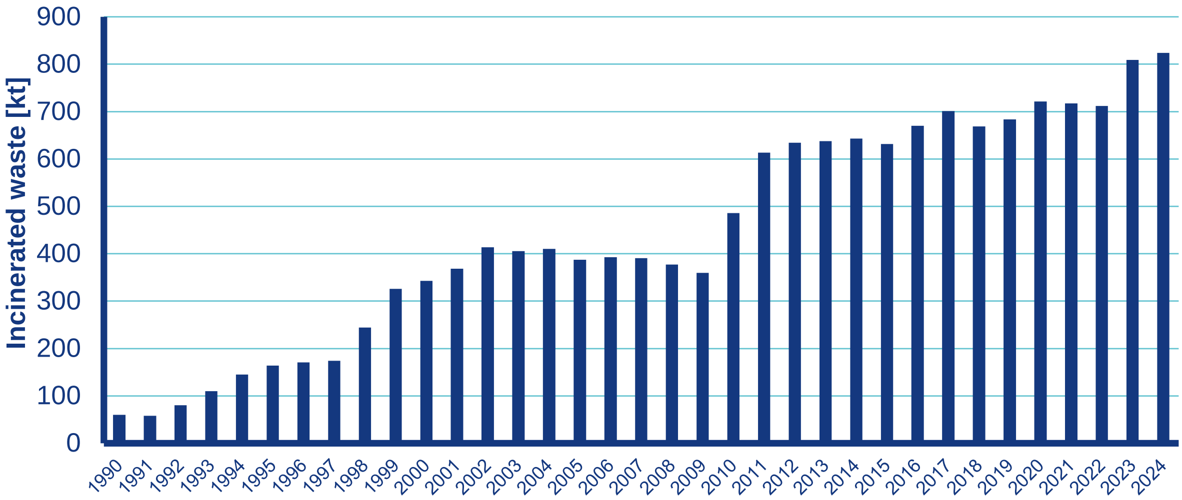


Figure VI.5 Municipal waste incinerated, 1990–2024

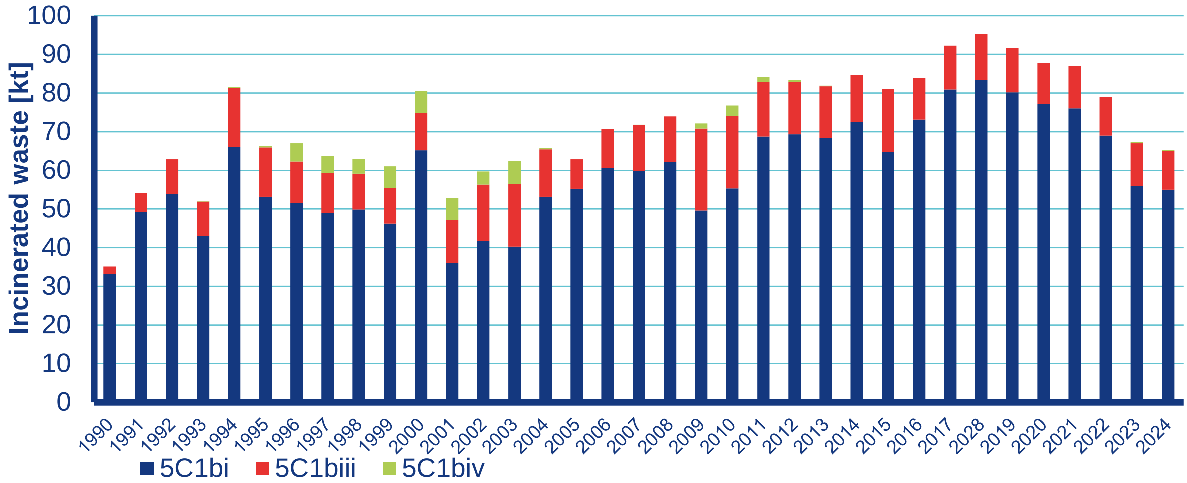


Figure VI.6 Other waste incinerated, 1990–2024

It is clear from Figure VI.5 that the amount of incinerated municipal waste has significantly increased in the last few years. The reason is the increasing preference for incineration to landfilling. From the economic perspective, the use of waste for generating heat is highly beneficial because it leads to savings of fossil fuels. Next, there is the ecological perspective. One aspect is the reduction of the volume of waste deposited in landfills. Energetic utilisation of municipal waste reduces its volume by about 90% and its weight by about 70%. Most importantly, emission limits for incinerators are very low compared to emission limits for other facilities for the production of heat or electricity, comparable only to limits imposed for sources burning natural gas. Incineration of waste therefore significantly reduces the amount of pollutants exhausted into the atmosphere. For instance, in the facility, SAKO Brno, a. s., an extensive reconstruction took place in the years 2009–2010, which also increased the capacity to incinerate waste. The reconstruction mentioned above explains the decrease in waste amount in 2009 when the plant was shut down.

Emissions of all pollutants in the period 2002–2024 show high consistency and mainly depend on the amount of waste. In the summer of 2016, a new facility was put into operation: Plzeňská teplárenská, a. s. – Facility for energetic utilisation of waste Chotíkov. This is related to the increase in emissions of all pollutants reported, in particular PCDD/PCDF. During testing operation installation of all necessary technologies for reducing emissions gradually took place. After its completion emissions were reduced again, noticeable decrease is apparent in inventorying starting in 2018.

In comparison with above mentioned period, 1990–2001 data show significant extremes. This can mainly be explained by the varying amounts of sources and waste composition. Several smaller sources were operated for example in laundries, dry cleaners and residential heating. Moreover, the obligation to have a permit for waste incineration, which sets emission limits and operating conditions, including requirements for measurement and equipment to reduce emissions entered into force only after the legislation in 2002.

It is apparent from Figure VI.6 that the predominant type in the whole reporting period is industrial waste. The amount of all types was very variable, especially in the period 1990–2001. Number of the facilities was also variable, most of them were in 1992–1996. Most hospitals had their incinerator as well as more facilities were operated in factories in various branches (food processing, metallurgy, chemical industry etc.). Also, the composition of waste varied the same as in NFR 5C1. This fact is also reflected in the variable amount of emissions of all pollutants.

In the period 2002–2024, following the adoption of the new legislation, the slightly increasing trend in the amount of incinerated waste was stabilized. A relatively large decrease in the number of facilities occurred between the years 2003 and 2005. This was caused by the fact that many of these facilities would not be able to meet demanding emission limits and operational requirements without undergoing extensive reconstruction. Their operation was therefore terminated. On the other hand, numerous facilities underwent modifications leading to a lowering of emissions. In 2017, the capacity of two incinerators of industrial waste was increased, which was reflected in its quantity.

VI.3.1 Emission factors and calculations

The methodology for particular reported categories is the same. According to Annex 2 to the Air Protection Act, waste incineration plants are ranked among specified stationary sources and they are registered within the REZZO 1 category. The emission inventory preparation in periods 2000–2024 and 1990–1999 was different and is therefore described for each period separately.

VI.3.1.1 Methodology for the period 2000–2024

For emission inventory, the majority of data on pollutants is obtained from the Summary operation records (Tier 3). The respective pollutants are listed in Annex 4 to Regulation 415/2012 Coll., which sets specific emission limit values according to Annex VI to the Directive 2010/75/EU, on industrial emissions. The following substances are reported in the Summary operation records: NO_X, NMVOC, SO_X, TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni and PCDD/PCDF. In addition, NH_3 emissions are reported in the case of its use in the selective non-catalytic reduction of nitrogen oxides, therefore it has an emission limit set to reduce its emissions. Emissions of obligatory pollutants for concrete sources unavailable in some years, are calculated using the emissions reported in the nearest year and activity data (specific manufacturing emission). The remaining pollutants which are included in the emission inventory and not reported are calculated using emission factors and activity data, i. e. the amount of waste incinerated in tonnes per year. Czech emission factors for waste incineration are predominantly based on their measurements (POPs), partly they were taken from the EMEP/EEA EIG, version 2023, Tier 1 (Zn, Se). PM_{10} and $PM_{2.5}$ emissions are determined based on information about TSP abatement equipment. BC emissions amount to 3.5% of $PM_{2.5}$ in all categories [3].

A summary of used emission factors of heavy metals and POPs not reported for categories 5C1a–5C1biv is presented below.

Table VI.3 Emission factors of heavy metals and POPs not reported used for categories 5c1a–5c1biv

NFR	Zn	Se	B(a)P	B(b)F	B(k)F	I(1,2,3-cd)P	HCB	PCBs
[mg·t^{-1}]								
5C1a	24.5	11.7	0.7	3.15	3.15	0.10666	0.15	0.0000156
5C1bi	NE	NE	0.6923	3.03845	3.03845	0.10666	0.139	4.150757
5C1biii	NE	NE	0.6923	3.03845	3.03845	0.10666	0.04559	1.726015
5C1biv	NE	NE	0.6923	3.03845	3.03845	0.10666	0.139	4.150757

VI.3.1.2 Methodology for the period 1990–1999

Fundamental for the inventorying was also the data of summary operational records (SOE). According to the legislation of that time the emission limits were set until 1998 for the first time (see Chapter II.1). The reporting pollutants therefore were not available in full range.

The initial data were available emissions and activity data (the amount of waste incinerated) in 1990–2001. This period was chosen due to the new legislation valid since 2002 (Act 86/2002 Sb.). For each waste incinerator, the emission consistency of each pollutant for a full-time series was performed and unreal values were calculated using activity data. Based on this data emission factors were calculated for all pollutants of the summary operating database. Emission factors gained were grouped by NFR categories. Zero, distant and implausible values were eliminated and from the remaining, the average values were calculated. These emission factors were compared to EMEP/EEA EIG and found comparable in order of magnitude [3]. Based on these values there were calculated all missing emissions of all reported air pollutants. The remaining pollutants which are included in the emission inventory and not reported (Zn, Se, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, Indeno (1,2,3-cd) pyrene, HCB, PCBs, PM_{10}, $PM_{2.5}$ and BC) are calculated according to the methodology used for the period 2000–2021.

Specific emission factors set for purposes of emission inventory for the categories 5C1a–5C1biv in 1990–1999 are presented below in Table VI.4 and Table VI.5.

Table VI.4 Emission factors of basic pollutants for categories 5C1a–5C1biv, 1990–1999

NFR	TSP	SO_X	NO_X	CO	TOC
	[kg·t^{-1}]				
5C1a	2.413	1.579	2.403	3.572	1.077
5C1bi	3.824	3.736	6.064	5.507	0.949
5C1biii	3.969	4.632	5.760	4.004	1.650
5C1biv	0.396	2.722	4.662	5.772	8.693

Table VI.5 Emission factors of reported heavy metals and PCDD/PCDF for categories 5C1a–5C1biv, 1990–1999

NFR	Pb	Cd	Hg	As	Cr	Cu	Ni	PCDD/PCDF
	[mg·t^{-1}]							
5C1a	529	94	104	273	57	178	201	0.001
5C1bi	18 993	639	1 602	3 911	5 284	3 834	1 031	0.030
5C1biii	11 838	3 264	3 520	4 856	1 092	4 967	1 633	0.033
5C1biv	18 993	639	1 602	3 911	5 284	3 834	1 031	0.030

Emissions reported in categories 5C1a–5C1biv include emissions from fuels used (it is possible due to low consumption). As additional fuel natural gas is mostly used, to a lesser extent liquid fuels.

Most of the facilities in Czechia use heat generated by waste incineration. For smaller incinerators, there are most common heating of own objects (hospitals, factories etc.) and warming of water. The larger facilities supply heat to the public networks, alternatively working on the principle of the cogeneration cycle, which provides heat and electricity production. For this reason, emissions and activity data for all plants in categories 5C1a–5C1biv were allocated under 1A1a (see also Chapter III.1). All sources in NFR 5C1a are facilities for energetic utilisation of waste (see also Chapter VI.3), notation key “NO” was therefore used in the entire time series. In the case of other categories utilization of heat is not so clear, notation key “IE” was used.

VI.3.2 Uncertainties and QA/QC procedures

According to national legislation, emissions for stationary sources belonging to NFR 5C1a–5C1biv are determined based on continuous or periodic measurements that comply with European legislation (IED and previous directives). The uncertainty of the sum of emissions from those sources is below 5%, see also Chapter I.7.

VI.3.3 Planned improvements

No improvements are planned, and the chapter is considered to be final.

VI.4 Cremation (NFR 5C1bv)

This sector mainly covers the atmospheric emissions from the incineration of human bodies, organs and remains in a crematorium. Incineration of animal carcasses is also considered here.

Furnaces for incinerating animal remains are usually installed in large animal farming facilities or crematoria for pets. There are currently about 30 facilities in operation in the country.

There are two main types of crematoria: crematoria powered by gas or oil and crematoria powered by electricity. Liquid fuels are used almost nowhere in Czechia. Most cremation furnaces in use are powered by natural gas and have been made by TABO-CS Ltd. The exhausts produced during cremation in the main chamber are drawn through side mixing chambers with inlets of secondary air into final combustion chambers. Secondary and tertiary air facilitates an effective final combustion process which eliminates pollutants in line with requirements for environmental protection.

The contribution of emissions from the incineration of human bodies and carcasses to the total national emissions is thought to be relatively insignificant except for Hg.

The emissions of all polluting substances depend exclusively on the number of cremations and are comparable throughout the monitored time frame. These are the total emissions including emissions from fuels used that are minor due to low consumption.

The share of cremations has increased rapidly in the monitored period, it has stabilized since 2005. Moreover, cremations of pets were started only in 2003. This increasing trend is illustrated also in Figure VI.7. A sharp increase in cremations in 2020 and 2021 was caused by high mortality due to the COVID-19 pandemic.

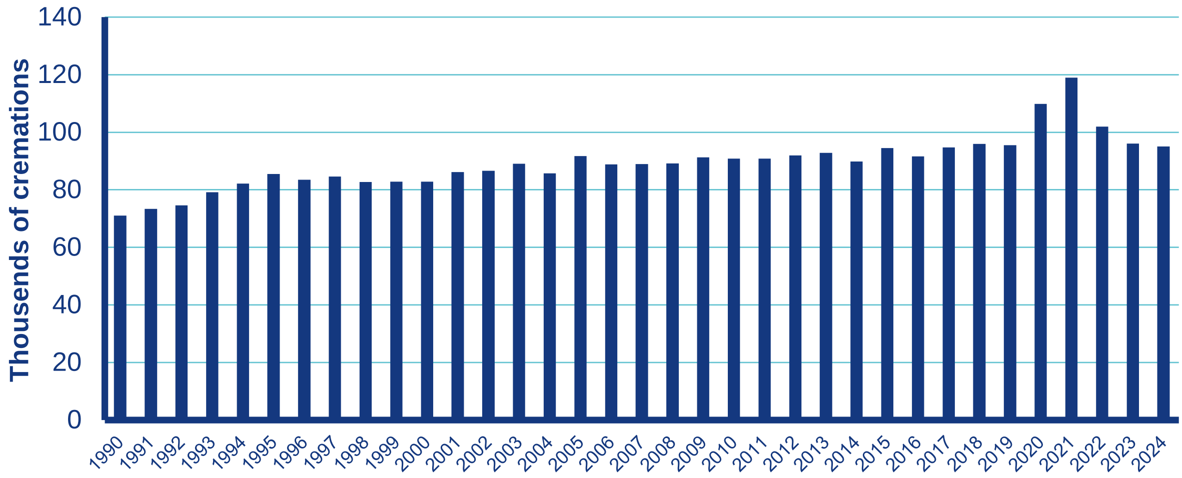


Figure VI.7 The cremation, 1990–2024

VI.4.1 Emission factors and calculations

Emission limits for cremation are set by Annex 8 to Regulation 415/2012 Coll., Point 6.13. Crematoria. They are set for TSP, NO_X (as NO_2), CO and NMVOC. The same emission limits are also applicable to facilities incinerating exclusively animal remains including parts of them.

Emissions of these pollutants are reported in the Summary operation records, as well as SO_X, whose emission limits are specified in the permits of individual sources (Tier 3). They are determined by periodic measurements with intervals once every three calendar years. Because emissions in category REZZO 2 have been available since 1995, for additional calculation of earlier years there had been calculated emission factors for the above-specified pollutants which had been calculated additionally based on activity data. An overview of emission factors is presented in the following Table VI.6.

Table VI.6 Emission factors for basic pollutants in NFR 5c1v, 1990–1994

Pollutant	Value	Unit
TSP	0.031	kg/body
SO_X	0.022	kg/body
NO_X	0.321	kg/body
CO	0.059	kg/body
NMVOC	0.006	kg/body

The PM_{10} and $PM_{2.5}$ emissions are determined by the type of technology and fuel used.

Emissions of heavy metals and POPs from the incineration of human bodies are calculated using emission factors and activity data. This concerns the following substances: Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/PCDF, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, HCB and PCBs.

National emission factors for heavy metals including Hg were determined based on the study “Emission factors setting and imission contribution of a stationary source for subsidy application of Operation programme the Environment" (see e-ANNEX), performed by the company Technical services for air protection Prague, a. s. in 2014. This study is focused on setting emission factors for various technologies, cremation is one of them. Emission factors were stated by a combination of research of literary resources and measurements provided on plants in CR. In the case of crematoriums, measurements were provided on eleven representative plants equipped with typical abatement technologies (usually gas combustion in the flame). The proposed emission factors are identical to those stated in the EMEP/EEA EIG, version 2023 [3].

Numbers of cremations in the given year were used as activity data. Shares of cremations in the total number of funerals in the entire reporting period have been obtained from the Study of the Institute of Sociology of the Czech Academy of Science (see e-ANNEX), and are presented below. This share has stabilized at about 85% since 2005. The number of deaths was taken from the website of CZSO. Incineration of animal tissues was not included in the balance of heavy metals, which also applies to activity data.

Table VI.7 Shares of cremations in the total number of funerals

Year	Share of cremations [%]
1920	0.37
1925	2.09
1930	3.32
1935	4.04
1940	5.01
1945	8.11
1950	11.60
1955	19.63
1960	24.26
1966	45.54
1970	39.00
1975	45.00
1980	64.40
1986	53.54
1990	55.22
1995	72.50
2000	75.94
2005	84.66
2008	84.72

VI.4.2 Uncertainties and QA/QC procedures

According to national legislation, emissions of TSP, NO_X, CO, NMVOC and SO_X for stationary sources belonging to NFR 5C1bv are determined based on periodic measurements. The uncertainty of the sum of emissions from those sources is below 5%. Emissions of other pollutants are calculated based on official statistics and default emission factors, uncertainty is therefore estimated from 50 to 200%, see also Chapter I.7.

VI.4.3 Planned improvements

No improvements are planned, and the chapter is considered to be final.

VI.5 Other waste incineration and Open burning of waste (NFR 5C1bvi and NFR 5C2

There are no facilities belonging to the NFR 5C1bvi in Czechia. This category includes e .g. small waste oil burners used in motor garages; whose operation was terminated.

NFR 5C2 includes e .g. open burning of crop residues, wood, leaves, straw or plastics. According to § 16 paragraph 4 of Act 201/2012 Coll. only dry plant matter uncontaminated by chemical substances may be burned in an open fireplace. The municipality may issue a decree to establish the conditions for burning dry plant material in open fireplaces for its disposal or place a ban on its burning.

According to § 19 of Regulation 415/2012 Coll. dry vegetable waste is not classified as waste but as biomass. On recommendation and for better comparability of total national inventories, emissions were calculated using the area of utilized land and EFs corresponding to Tier 1 of EIG.

However, we would like to point out that this procedure does not correspond to the real way of processing plant residues because open burning occurs only rarely (e.g. in orchards). According to Forests of the Czechia (owner of 86% area of all state forests), the burning of forest residues is not allowed. They are used for wood chip production or sold for energy use (e. g. publication available online). Agricultural residues from arable land are principally ploughed in as fertilizer on site. Annual information on the real amount of incinerated material is not registered.

Czechia considers the current calculated emissions to be overestimated and proposes to use the symbol “NE”, i.e. emissions of very little importance.

Activity data (types of utilised land) were obtained from the website of the CSO, Public Database – Utilised agricultural area (available online) Table. 02.02 – Lands by species. The trend in types of utilised land in the period 1990–2024 is illustrated below in Figure VI.8. Here are shown all types of utilised land, for calculation of emissions only selected types were used (see Chapter VI.5.1).

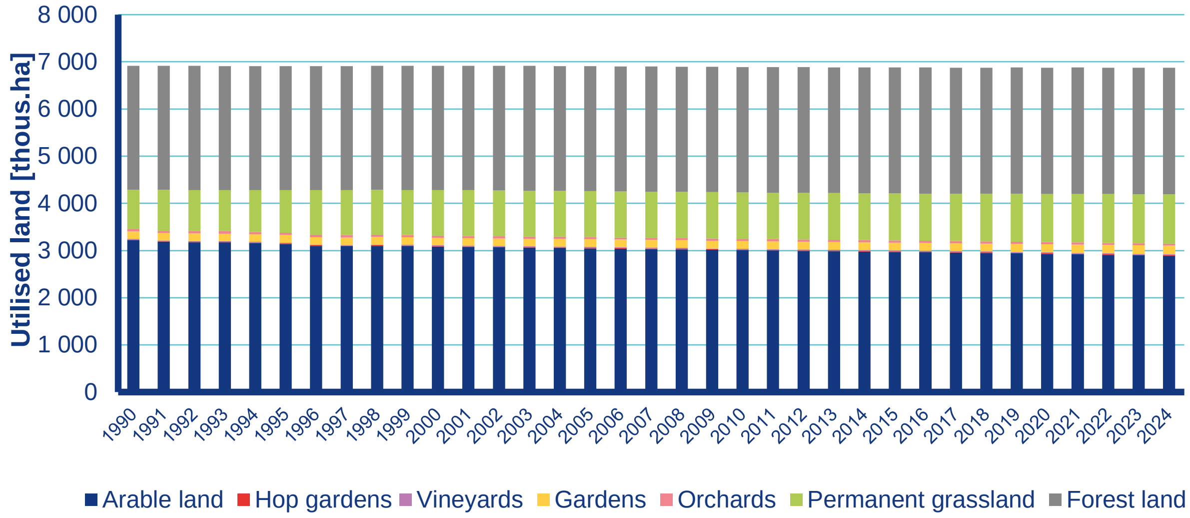


Figure VI.8 Utilised land, 1990–2024

VI.5.1 Emission factors and calculations

Emissions for 5C2 were calculated according to EMEP/EEA EIG, version 2023 [3], (Tier 1). Areas in forestry, orchard and arable farming (excluding agricultural residues after harvesting classified as NFR 3F) were taken into account, assuming that the amount of burned waste is 25 kg per hectare. A relevant table containing detailed activity data and calculations is given in e-ANNEX (file NFR-5C2).

VI.5.2 Uncertainties and QA/QC procedures

Emissions for NFR 5C2 are calculated based on official statistics and default emission factor, uncertainty is therefore estimated from 50 up to 200%, see also Chapter I.7.

VI.5.3 Planned improvements

No improvements are planned, and the chapter is considered to be final.

VI.6 Wastewater handling (NFR 5D1–5D3)

Wastewater treatment is the process of removing contaminants from wastewater, both municipal and industrial. Wastewater treatment plants are only an insignificant source of NMVOC. They are divided mainly by the type of purification process: mechanical, biochemical and chemical. Large plants generally combine more purification processes. Further cleaning takes place in so-called recipient, i. e. natural watercourse. Discharge of wastewater into recipients is governed by Act 254/2001 Coll. (Water Act) and by its implementing regulations.

For wastewater treatment plants (both domestic and industrial), only the technical condition of operation is set in Annex 8 to Regulation 415/2012 Coll., points 1.4. and 1.5. This technical condition is the same for both categories and reads as follows:

To reduce emissions of polluting materials with disturbing odour, the use of measures for reducing emissions of these matters, e.g. performing exhaustion of waste gases into the facility for reducing emissions, covering of pits and conveyers, closing of objects, and regular removal of sediments of organic nature from equipment for pre-treatment of wastewater. The trend in the amount of discharged wastewater is illustrated below.

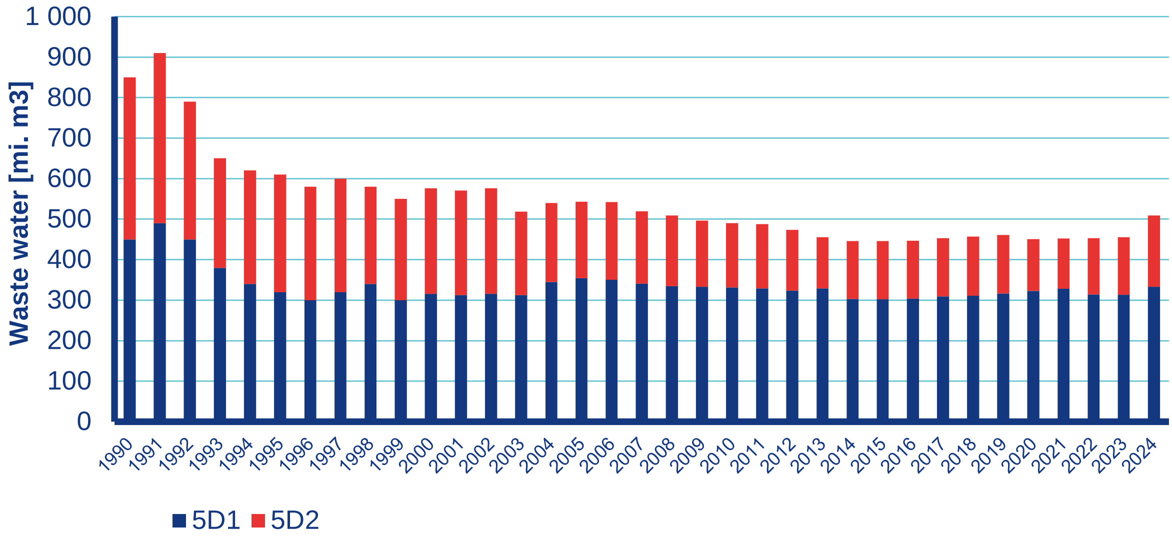


Figure VI.9 Wastewater handling, 1990–2024

NH_3 emissions from dry toilet use were included in the category 5D1 in the whole time series. The trend in the amount of population using dry toilets is shown in the figure below.

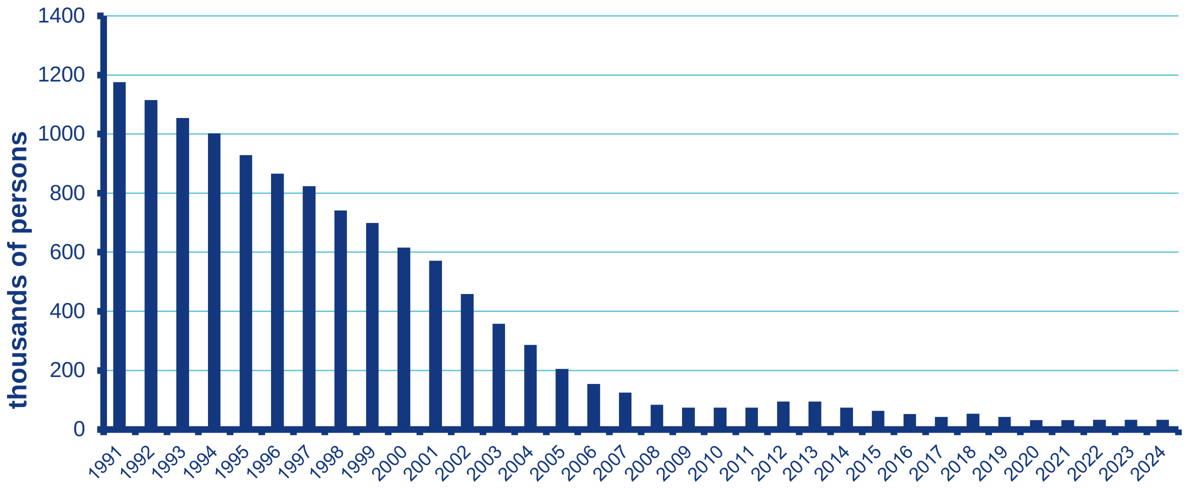


Figure VI.10 Dry toilettes, 1990–2024

VI.6.1 Emission factors and calculations

In the Summary operation records are reported emissions of NO_X, NMVOC, SO_X, NH_3, $PM_{2.5}$, PM_{10}, TSP and CO originating from flares. These emissions were removed from NFR 5D1–5D2 and included in 1A4ai (5D1) and different industrial sectors according to NACE classification (5D2).

Activity data for NMVOC emissions, i.e. the amount of wastewater discharged into the sewerage system, were obtained from the public database of CZSO. Data are available in the division mentioned above since 2003, only the total amount in the years 2000–2002 is known. Activity data for the historical period 1990–1999 were estimated based on a document of CZSO (Wastewater discharged into public sewers), see e-ANNEX. Data 2000–2002 were specified using the average ratio between subcategories 5D2 and the total amount of discharged wastewater in 1990–1999.

Activity data for NH_3 emissions (percentage of the population using dry toilets) were obtained from CZSO statistics and related links (EUROSTAT, Population census 2011).

Emission factors for NMVOC and NH_3 were adopted from EMEP/EEA EIG, version 2023 (Tier 1) [3]. Activity data for sector 5D3 are not available.

A relevant table containing detailed activity data and calculations is given in e-ANNEX (file NFR-5D).

VI.6.2 Uncertainties and QA/QC procedures

Emissions of NMVOC for NFR 5D are calculated based on official statistics and default emission factor, uncertainty is therefore estimated from 50 up to 200%, see also Chapter I.7.

VI.6.3 Planned improvements

No improvements are planned, the chapter is considered to be final.

VI.7 Other waste (NFR 5E)

This sector includes biodegradation and solidification facilities and sanitation facilities. The facilities mentioned above reduce the danger that waste poses to the environment. In addition, car and building fires are included in this category.

Biodegradation is a process of breaking down oil and organic pollution from contaminated wastes. It takes advantage of natural bacterial strains which perform natural decomposition of contaminants. Solidification is a technological process of waste treatment involving their stabilisation by suitable additives which reduce the possibility that dangerous elements and compounds might get eluted from the matrix of the waste.

For biodegradation and solidification facilities, only the technical condition of operation is set in Annex 8 to Regulation No 415 /2012 Coll., point 1.2.: In the case of processing materials which can produce emissions of polluting materials with disturbing odour, technical-organisational measures must be ensured for the reduction of these materials, e.g. covering biodegradation areas and collection of waste gases into facilities for the cleaning of waste gases. In open landfills, it is possible to reduce emissions of solid pollutants into the atmosphere, for example, by situating them in leeward positions or by watering and misting.

The sanitation facilities are used to the elimination of oil and chlorinated hydrocarbons from contaminated soil. They are mainly used for the clean-up of old ecological burdens**.** Annex 8 to the Regulation No 415 /2012 Coll., point 1.3. sets NMVOC emission limit value for elimination of oil and chlorinated hydrocarbons from contaminated soil) with a projected output of greater than 1 t of volatile organic compounds, inclusive, operated ex-situ.

By EMEP/EEA EIG, accidental fires of cars and buildings are included in this category [3]. Emissions of particulates, some heavy metals and PCDD/PCDF are predominantly emitted.

Activity data (number of fires) were obtained from the Statistical Yearbooks of the Fire Rescue Service of Czechia (FRS CR). They have been available since 1991 and are accessible online to the public. Also since 2004 are the Yearbooks of FRS CR available online in English.

Activity data for the remaining year 1990 were supplemented according to 1991.

Fire numbers of cars, apartment buildings, detached houses and industrial buildings are illustrated below.

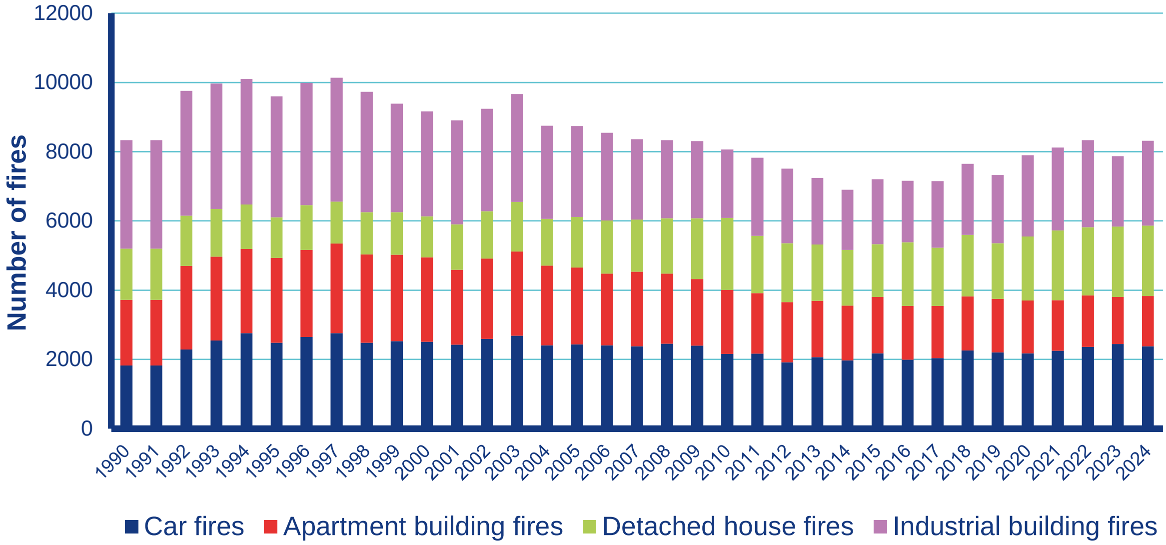


Figure VI.11 Fires, 1991–2024

Accidental fires of cars and buildings are mostly caused by negligence (smoking, incorrect heater operation, manipulation with burning ashes, ignition of food by cooking, incorrect handling, etc.) or technical failures. Atmospheric conditions (drought, direction and speed of wind, etc.) also have a great impact. The decreasing trend indicates mainly the influence of escalating fire prevention.

VI.7.1 Emission factors and calculations

In the category biodegradation and solidification facilities and sanitation facilities, only a small amount of emissions of NO_X (as NO_2), NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP a CO is emitted. Emissions of NO_X (as NO_2), NMVOC, NH_3 and TSP are reported in the Summary operation records (Tier 3). The PM_{10} and $PM_{2.5}$ emissions are determined on the base of the type of technology.

For emission inventorying emission factors from EMEP/EEA EIG, version 2023, in division into EFs for fires of cars, apartment buildings, detached houses and industrial buildings were used (Tier 2) [3]. An overview of used emission factors is presented below.

Table VI.8 Emission factors for car and buildings fires

Pollutant	Unit	Car fire	Apartment building fire	Detached house fire	Industrial building fire
TSP	kg/fire	2.3	43.78	143.82	27.23
PM_{10}	kg/fire	2.3	43.78	143.82	27.23
$PM_{2.5}$	kg/fire	2.3	43.78	143.82	27.23
Pb	g/fire	NE	0.13	0.42	0.08
Cd	g/fire	NE	0.26	0.85	0.16
Hg	g/fire	NE	0.26	0.85	0.16
As	g/fire	NE	0.41	1.35	0.25
Cr	g/fire	NE	0.39	1.29	0.24
Cu	g/fire	NE	0.91	2.99	0.57
PCDD/PCDF	mg/fire	0.048	0.44	1.44	0.27

A relevant table containing detailed activity data and calculations is given in e-ANNEX (file NFR-5E_car and building fires).

VI.7.2 Uncertainties and QA/QC procedures

Emissions for individually monitored sources (biodegradation and solidification facilities and sanitation facilities) are only reported in the Summary operation records and are based on calculations. Uncertainty will be estimated later.

Emissions for car and building fires are calculated based on official statistics and default emission factors, uncertainty is therefore estimated from 50 up to 200%, see also Chapter I.7

VI.7.3 Planned improvements

No improvements are planned, the chapter is considered to be final.

VII. Other and natural emissions

Date of the last revision: 15 March 2026

There is no active volcano on the territory of Czechia, there are only residues of volcanic activity from various periods of the geological past (about 20 extinct volcanoes), therefore symbol “NO” was used.

In the case of forest fires, CO and NMVOC are emitted predominantly. To a lesser extent, emissions of NO_X, NH_3, SO_X and particulates are produced.

VII.1 Forest fires (NFR 11B)

Activity data (hectares of burned area) were obtained from the Statistical Yearbooks of Fire Rescue Service of Czechia (FRS CR). They have been available since 1996 and are accessible to the public online. Figure VII.1 illustrates the development of forest areas affected by fire in 1996–2024.

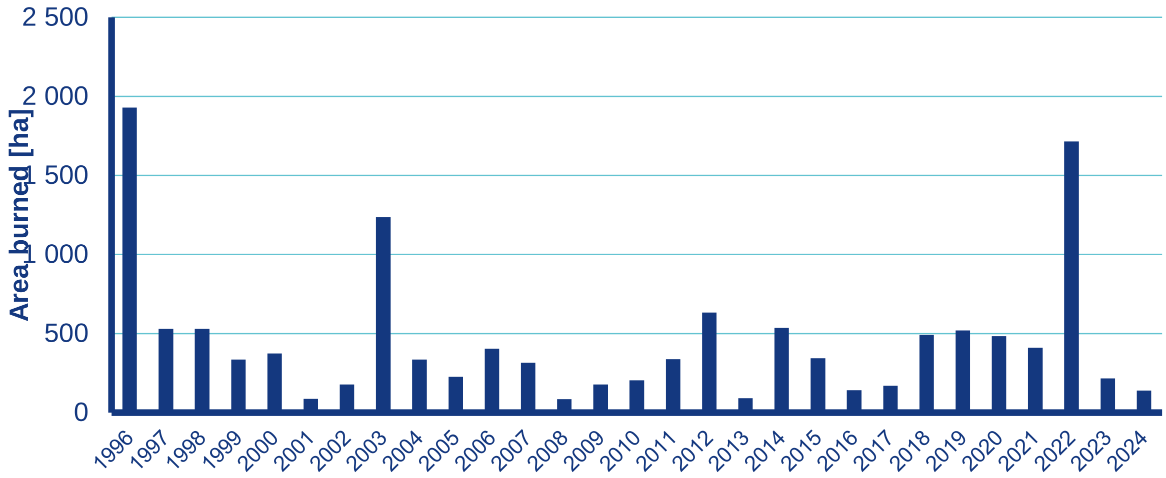


Figure VII.1 Forest fires, 1996–2024

The size of forest areas affected by fire depends mainly on atmospheric conditions (drought, hot weather, precipitation, direction and speed of the wind, etc.). Forest fires can be caused either by natural origin (lightning strikes, self-ignition) or by negligence (smoking, setting fire in the wild). The great increase in burned area in 2022 is caused by forest fire in Bohemian Switzerland National Park in the period 23. 7.–12. 8. 2022.

VII.1.1 Emission factors and calculations

For emission inventorying emission factors from the EMEP/EEA EIG, version 2023, were used (Tier 2) [3]. In the case of Czechia, EFs for temperate forests were chosen.

For the period 1996–2023, emissions of NO_X, CO, NMVOC, SO_X and NH_3 were calculated. For these pollutants, emission factors in kg/ha are stated. Emission factors for particulates including BC are stated in $g{\cdot}kg^{-1}$ of wood, these data are not available.

VII.1.2 Uncertainties and QA/QC procedures

Emissions for NFR 11B are calculated based on official statistics and default emission factors, uncertainty is therefore estimated from 50 up to 200%, see also Chapter I.7.

VII.1.3 Planned improvements

No improvements are planned, the chapter is considered to be final.

VIII. Recalculations and improvements

Date of the last revision: 15 March 2026

VIII.1 General recalculations in 2026

The full set of data for the period 1990–2024 in NFR format 2019-1 is reported in 2026. Several other corrections to the reported data 1990–2023 were performed below, see Table VIII.1.

Table VIII.1General recalculations in 2026

Period	**NFR**	**Emissions**	**Detail**
2023	1A1a	HMs, POPs	In accordance with the TERT recommendation, improper consumption of other fuels was corrected. The correct value was included in the 2026 submission.
2023,2024	1A1b	SO_X, Cd	There was a mistake that occurred when HMs and POPs emissions from the refinery oil incinerations were doubled in the years 2022 and 2023. This mistake was corrected in the 2026 resubmission. SO_2 emissions are reported by source operators within summary operating records.
2023	1A2a	Hg	Wrongly added values were corrected.
2023	1A2c	HMs, POPs	In accordance with the TERT recommendation, wrongly added consumption of other fuels was corrected. The correct value was included in the 2026 submission.
2023	1A2gviii	HMs, POPs	Wrongly added values were corrected.
1990-2023	1A3	all emissions	New EF from COPERT were used and subsequent recalculations were provided (see Chapter VIII.1.1_).
2009-2014	1A3aii(i)	Pb	Wrongly added values were corrected.
2023	1A4ai	HMs, POPs	Wrongly added values were corrected.
2022-2023	1A4aii	NMVOC	NMVOC emissions were corrected.
1990-2023	1A4bi	PCDD/PCDF	In accordance with the TERT recommendation, wrongly added consumption of other fuels was corrected. The correct value was included in the 2026 submission
2021-2023	1A4bi	emissions	Emissions and activity data were corrected.
2022-2023	1A4bii	NMVOC	NMVOC emissions were corrected.
2022-2023	1A4cii	NO_X, NMVOC, PM	Recalculation based on changes in Machinery share was provided.
2022-2023	1A5b	NMVOC	NMVOC emissions were corrected.

1990-2024	2B2	$PM_{2.5}$ and BC	In accordance with the TERT recommendation, the notation key “NA” has been applied to $PM_{2.5}$ and BC emissions.
2023	2D3c	$PM_{2.5}$, PM_{10}, TSP, NMVOC	Emissions for one plant producing asphalt roofing materials were added.
1990-2023	2H2	individual PAHs	In accordance with the TERT recommendation, notation keys “NA” were replaced by “NE”.
1990-2023	3Da2a	NH_3, NMVOC	Recalculation based on changes in activity data was provided.
2022-2023	3Da2c	NH_3	Correction of activity data regarding the amount of N applied in compost was provided.
1990-2023	3Da3	NMVOC	Recalculation based on changes in activity data was provided.
2022-2023	3Dc	PM	Recalculation based on changes in activity data was provided. Detailed description is stated in Chapter VIII.1.2.
1990-2023	5A	$PM_{2.5}$, PM_{10}, TSP	Under TERT recommendation, data were corrected according to Eurostat database. Detailed description is stated in Chapter VIII.1.3.
2022-2023	5B2	NH_3	Small correction of NH_3 emissions was provided.

Several minor corrections caused by TERT – detailed in e-ANNEX.

VIII.1.1 Transport (NFR 1A3)

Fuel densities for all fuels were updated in line with the Czech technical standard ČSN EN ISO 14083 (2023) [25].

Road Transport (NFR 1A3b)

A new version of the COPERT programme (updated from 5.8.1 to 5.9.2) was used to calculate emissions from road transport. Following this update, the entire 1990–2024 time series was recalculated. The methodological changes include:

- revision of fuel consumption for LDVs running in liquid fuels,
- update of VOC emission factors of diesel LDVs,
- update of VOC, CO, NO_X, EC (Energy Consumption), NH_3, PM emission factors of diesel HDVs & coaches,
- revision of PM and PN emission factors from brake wear,
- revision of NMVOC compounds of LDVs.

Several software enhancements and bug fixes were also implemented in COPERT 5.9.2; please refer to the COPERT website for the full list of updates.

Activity data for the last four years were updated and, consequently, the years 2020–2023 were recalculated. This follows from the methodology for deriving traffic performance data (for details, see chapter 'Road Transport'). As a result, the 2021–2024 data should be considered preliminary.

Recalculation of AD for L-category due to the update of vehicle stratification in the new COPERT version and exclusion of non-operated motorcycles. AD harmonization in the entire time series 1990–2024.

Diesel consumption for 2023 was updated based on the latest IEA data.

Navigation (NFR 1A3d)

Corrected calculation of PAH, HCB and PCB emissions due to error in calculation formula.

Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery (NFR 1.A.4cii)

The revision of activity data sources for calculating emissions from the operation of agricultural machinery *(NFR 1.A.4.c ii)* was completed in 2024. The calculation methodology was changed by moving to the Tier 3 level. NOx, NMVOC, CO and PM emissions were recalculated in the entire time series from 1999 to 2023. At the beginning of 2026, a review of the composition of agricultural machinery, or rather tractors, was carried out based on current data from the Ministry of Transport of the Czech Republic. This led to a reassessment of activity data and a recalculation of emissions for 2022 and 2023. Table VIII.2 shows the effects of recalculations on NOx, NMVOC, CO and PM emissions between submission 2025 and 2026.

Table VIII.2 The comparison of submissions 2025 and 2026 for NO_X, NMVOC, CO and PM

	NO_X emissions [kt]		NMVOC emissions [kt]		CO emissions [kt]		PM emissions [kt]	
	2022	**2023**	**2022**	**2023**	**2022**	**2023**	**2022**	**2023**
2025 submission	2.864	2.78	0.327	0.318	2.621	2.567	0.191	0.186
2026 submission	2.627	2.31	0.313	0.29	2.575	2.47	0.164	0.13
Difference [%]	-8.29	-17.09	-4.25	-8.75	-1.76	-3.59	-14.46	-29.83

VIII.1.2 Agriculture

In agriculture, the most significant changes in values compared to the previous data submission concerned mainly ammonia emissions from the application of mineral fertilizers and ammonia emissions from the application of livestock manure. For mineral fertilizers, a correction of the incorrectly used emission factor was made. For livestock manure, a revision of the penetration of ammonia-reducing technologies was made.

VIII.1.2.1 NH_3 and NO_x emissions

3B Manure management

No recalculations

3Da1 Inorganic N-fertilisers

In October 2025, a change was detected in the activity data on the consumption of individual types of mineral fertilizers recorded by the international IFASTAT database. In 2025, an error was detected in the calculations of ammonia emissions from the application of mineral fertilizers. For the fertilizer "Other straight N compounds", the emission factor according to GB from 2019 was incorrectly used instead of from 2023. The change in activity data concerned the years 1990-2023. Table VIII.3 shows the effects of recalculations on NH_3 between submission 2025 and 2026.

Table VIII.3 Comparison of NH_3 emissions from mineral N fertilisers of the submissions 2024 and 2025

NH_3 emissions [kt]	1990	2000	2005	2010	2020	2022	2023
2025 submission	28.124	17.833	23.549	21.845	28.264	27.214	23.327
2026 submission	27.850	17.669	23.165	21.125	25.854	25.555	23.586
Difference [%]	-1.933	-0.920	-1.631	-3,296	-8.527	-6.097	+1.110

The change in activity data led to a decrease in reported ammonia emissions from mineral fertilisers consumption by 0.92–8.572%.

3Da2a Animal manure applied to soils

The change in activity data was prompted by the findings and recommendations of TERT in 2025. For category 3Da2a Animal manure applied to soil, for pollutant NH3 in the period 1990–2012 TERT recommends that Czechia revise its estimate by updating the penetration rate using linear interpolation from 0% to 30% – considering the year when data first became available (observation CZ-3Da2a-2025-0001). Furthermore, the TERT recommends that Czechia revise its estimate by updating the penetration rate using linear interpolation from 0% to 60%, taking into account the first available data and the assumed year when the technique stated to be used for the entire period from 1990 to 2010 (observation CZ-3Da2a-2025-0002). For this reason, a recalculation of ammonia emissions in the entire time series 1990-2023 was also carried out for category 3Da2a. Table VIII.4 shows the effects of recalculations on NH_3 between submission 2025 and 2026.

Table VIII.4 Comparison of NH3 emissions from animal manure applied to soils of the submissions 2025 and 2026

NH_3 emissions [kt]	1990	2000	2005	2010	2015	2020	2022	2023
2025 submission	31.113	18.147	14.349	12.902	13.618	13.272	13.290	13.233
2026 submission	41.823	21.789	16.700	14.038	13.824	13.272	13.293	13.234
Difference [%]	+34,42	+20.07	+16.39	+8.81	+1.52	0	+0.02	+0.01

The change in activity data after the update of activity data led to an increase in reported ammonia emissions by 0.01–34.42%. After recalculation, the largest increases in ammonia emissions were reported between 1990 and 2005.

3Da2b Sewage sludge applied to soils

No recalculations

3Da2c Other organic fertilisers applied to soils

For category 3Da2c Other organic fertilisers applied to soil, the amounts of compost used on agricultural lands were revised for 2022 and 2023. These changes did not result in any significant changes in the emission inventories of NH3 and NOx. Table VIII.5 shows the effects of recalculations on NH_3 between submission 2025 and 2026

Table VIII.5 Comparison of NH3 and NOx emissions from Other organic fertilisers applied to soils 2025 and 2026

NH_3 emissions [kt]	2022	2023		NOx emissions [kt]	2022	2023
2025 submission	0.992	0.984		**2025 submission**	0.496	0.492
2026 submission	0.996	0.982		**2026 submission**	0.498	0.491
Difference [%]	+0.4	-0.2		**Difference [%]**	+0.4	-0.2

3Da3 Urine and dung deposited by grazing animal

No recalculations

3Da4 Crop residues left to soil

No recalculations

VIII.1.2.2 NMVOC emissions

3B Manure management

No recalculations

3Da2a Animal manure applied to soil

NMVOC emissions are closely linked to ammonia emission factors in calculations. A change in ammonia emission factors associated with the application of livestock manure causes a change in NMVOC calculations for NFR category 3Da2a Animal manure applied to soil. For this reason, a recalculation of NMVOC emissions in the entire time series 1990-2023 was also carried out. Table VIII.6 shows the effects of recalculations on NMVOC between submission 2025 and 2026.

Table VIII.6 Comparison of NMVOC emissions from animal manure applied to soils of the submissions 2025 and 2026

NH_3 emissions [kt]	1990	2000	2005	2010	2015	2020	2022	2023
2025 submission	22.329	12.802	11.675	10.830	10.861	11.009	11.362	11.115
2026 submission	27.103	14.235	12.335	10.884	10.822	11.012	11.363	11.118
Difference [%]	+21.38	+11.19	+5.67	+0.50	-0.40	+0.03	+0.01	+0.03

The change in activity data after the update of activity data led to an increase in reported NMVOC emissions by 0.01–21.38% especially in years 1990–2005.

3Da3 Urine and dung deposited by grazing animals

The values were also revised for the NFR category 3Da3 Urine and dung deposited by grazing animals. Table VIII.7 shows the effects of recalculations on NMVOC emissions between submission 2025 and 2026.

Table VIII.7 Comparison of NMVOC emissions from urine and dung deposited by grazing animals 2025 and 2026

NH_3 emissions [kt]	1990	2000	2005	2010	2015	2020	2022	2023
2025 submission	0.047	0.034	0.032	0.040	0.041	0.041	0.044	0.043
2026 submission	0.056	0.038	0.035	0.042	0.041	0.041	0.044	0.043
Difference [%]	+20.09	+11.09	+8.32	+4.56	+0.68	+0.01	+0.01	+0.01

The change in activity data after the update of activity data led to an increase in reported NMVOC emissions by 0.01–20.09% especially in years 1990–2005.

3De Cultivated crops

No recalculations

VIII.1.2.3 PM emissions

3B Manure management

No recalculations

3Dc Crop production and agricultural soils – farm-level agricultural operations including storage, handling and transport of agricultural product

For this category, the values of the use of no-till farming methods on agricultural land for 2022 and 2023 were revised. This led to a change in activity data. Table VIII.8 shows the effects of recalculations on PM emissions between submission 2025 and 2026.

Table VIII.8 Comparison of PM emissions from Crop production and agricultural soils – farm-level agricultural operations including storage, handling and transport of agricultural product 2025 and 2026

PM_{10} emissions [kt]	2022	2023
2025 submission	0.382	0.365
2026 submission	0.375	0.363
Difference [%]	+1.84	-0.671

VIII.1.3 Biological treatment of waste – Solid waste disposal on land (NFR 5A)

Emission factors for TSP, PM_{10} and $PM_{2.5}$ were taken from the EMEP/EEA EIG, version 2023, (Tier 1 approach) [3]. Under TERT recommendation, annual amount of landfilled mineral waste was used as activity data. They were obtained from Eurostat database, where are available data for years 2010, 2012, 2014, 2016, 2018, 2020 and 2022. Following waste categories were selected: Mineral waste from construction and demolition, Other mineral wastes (W122+W123+W125), soils, Dredging spoils and Mineral wastes from waste treatment and stabilised wastes. Using the total amount of landfilled waste, the proportion of mineral waste was calculated, which in all cases was approximately 10%. This ratio was multiplied by the total amount of waste landfilled in the remaining years throughout the time series 1990–2024. Comparison of submissions 2025 and 2026 for $PM_{2.5}$, PM_{10} and TSP is showed in Table VIII.9

Table VIII.9 The comparison of submissions 2025 and 2026 for $PM_{2.5}$, PM_{10} and TSP

Year	$PM_{2.5}$ [t]		PM_{10} [t]		TSP [t]	
	2024 submission	2025 submission	2024 submission	2025 submission	2024 submission	2025 submission
1990	0.261	0.026	1.731	0.173	3.659	0.366
1991	0.263	0.026	1.743	0.174	3.685	0.369
1992	0.273	0.027	1.813	0.181	3.834	0.383
1993	0.280	0.028	1.856	0.186	3.925	0.392
1994	0.282	0.028	1.870	0.187	3.952	0.395
1995	0.288	0.029	1.913	0.191	4.045	0.405
1996	0.295	0.030	1.959	0.196	4.141	0.414
1997	0.301	0.030	1.999	0.200	4.227	0.423
1998	0.308	0.031	2.047	0.205	4.328	0.433
1999	0.290	0.029	1.921	0.192	4.062	0.406
2000	0.308	0.031	2.046	0.205	4.326	0.433
2001	0.311	0.031	2.063	0.206	4.361	0.436
2002	0.250	0.025	1.657	0.166	3.504	0.350
2003	0.232	0.023	1.538	0.154	3.252	0.325
2004	0.202	0.020	1.339	0.134	2.831	0.283
2005	0.171	0.017	1.134	0.113	2.398	0.240
2006	0.166	0.017	1.103	0.110	2.333	0.233
2007	0.163	0.016	1.083	0.108	2.290	0.229
2008	0.164	0.016	1.088	0.109	2.300	0.230
2009	0.155	0.016	1.030	0.103	2.178	0.218
2010	0.142	0.009	0.943	0.057	1.995	0.121
2011	0.128	0.013	0.848	0.085	1.793	0.179
2012	0.125	0.010	0.832	0.068	1.759	0.143
2013	0.114	0.011	0.758	0.076	1.603	0.160
2014	0.109	0.012	0.721	0.079	1.525	0.167
2015	0.106	0.011	0.702	0.070	1.485	0.148
2016	0.107	0.014	0.709	0.090	1.499	0.190
2017	0.112	0.011	0.743	0.074	1.570	0.157
2018	0.118	0.009	0.781	0.061	1.651	0.130
2019	0.119	0.012	0.792	0.079	1.673	0.167
2020	0.124	0.011	0.824	0.072	1.742	0.151
2021	0.127	0.013	0.840	0.084	1.776	0.178
2022	0.149	0.021	0.990	0.139	2.092	0.294
2023	0.147	0.015	0.974	0.097	2.059	0.206

This recalculation concerns only PM emissions, NMVOC emissions are calculated differently using the procedure described in EMEP/EEA EIG, see also Chapter VI.1.1. Total amount of landfilled waste was reported as activity data.

IX. Projections

Date of the last revision: ***15 March 2025***

The Czechia must comply with the NEC Directive 2016/2284/EU, which mandates the reduction of air pollutant emissions. This directive sets stricter national emission limits for the periods 2020–2029 and from 2030 onwards. The national emission limits established for 2020–2029 are identical to the commitments made by Member States under the revised Gothenburg Protocol (2012 revision) [2], [26]. These commitments are outlined in Tables A and B of Annex II. The total commitments of Czechia are presented in Table IX.1.

The national emissions ceilings were determined based on the conditions outlined in Article 4 of NEC Directive 2016/2284/EU, which sets annual limits on anthropogenic emissions. The ceilings for primary pollutants were calculated excluding NO_X and NMVOC emissions from NFR categories 3B and 3D, as specified in paragraph 3.d of the directive. These exclusions pertain to nitrogen oxides and non-methane volatile organic compound emissions from activities classified under the 2014 Nomenclature for Reporting (NFR) as 3B (manure management) and 3D (agricultural soils) [2].

The year 2022 was used as the base year for the emission projections processed in 2025. For most categories, the same methodologies were applied as in the projections published in 2023. Commitments effective from 2020 are incorporated into the projections.

The projection report provides updated emissions estimates for NO_X (as NO_2), NMVOC, SO_X (as SO_2), NH_3, and $PM_{2.5}$ across various sectors, including Energy (NFR 1A1 and 1A2), Transport (NFR 1A3), Combustion sources (NFR 1A4), and Other combustion sources (NFR 1A5). Additionally, it includes Fugitive emissions from fuels (NFR 1B), Agriculture (NFR 3), and Waste (NFR 5). The projections were developed using the principles and methodologies described in the EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2023 (EMEP/EEA EIG) [3]. Typically, projections are modelled using two scenarios: WM (With Existing Measures) and WAM (With Additional Measures).

However, the projections were developed under the WM scenario, despite the fact that the NH_3 emission ceiling was not fulfil. The WAM scenario was not included because an update of the National Emission Reduction Program of the Czechia (NERP) [6] is required. This document is essential for future legislative development and emission reduction planning. The Czechia applied an adjustment for NH_3 in NFR 3Da1. The projections would published in 2027, the WAM scenario will be included, based on the updated NERP. The Czechia fulfil the NO_X, SO_X, NMVOC, and $PM_{2.5}$ commitments for 2025 and 2030.

The projections were presented in a revised Annex IV format, where the data are presented in the same way as inventory data. The pollutants NO_X (as NO_2), NMVOC, SO_X (as SO_2), NH_3 and $PM_{2.5}$ was projected for 2025, 2030, 2040, and 2050. Black Carbon (BC) was not projected, due to insufficient data for several NFR categories.

Table IX.1 Commitments under NEC Directive 2016/2284/EU

		NO_X (as NO_2)*		NMVOC*		SO_X (as SO_2)		NH_3		$PM_{2.5}$	
Emission [kt]	**2005**	268.8		338.1		208.5		75.4		73.6	
	2020	129.8		265.1		67.1		69.4		59.2	
Projection [kt]	**2025**	93.9		178.4		40.3		68.5		33.4	
	2030	72.7		150.9		27.4		64.9		26.4	
Reduction from 2005 to 2020, 2025 and 2030		**%**	**kt**	**%**	**kt**	**%**	**kt**	**%**	**kt**	**%**	**kt**
	2020	-35	-94.1	-18	-60.9	-45	-93.8	-7	-5.3	-17	-12.5
	2025	-49	-131.7	-34	-115.0	-55	-114.7	-14	-10.6	-38	-28.0
	2030	-64	-172.0	-50	-169.1	-66	-137.6	-22	-16.6	-60	-44.1
Ceiling [kt]	**2020**	174.7		277.3		114.7		70.2		61.1	
	2025	137.1		223.2		93.8		67.9		45.6	
	2030	96.8		169.1		70.9		61.6		29.4	

** The emissions from the NFR3 are not included*

IX.1 Methodology Introduction

Emission categories were divided into five groups. The emissions from each category were calculated separately. Different organizations participated in the report preparation. Each described sector was prepared separately and used methods available in the following chapters. Final emissions projections were taken from organization authors and compiled into the Annex IV template. The formation of total emissions, according to the WM projection, is shown in Table IX.2.

Table IX.2 Sectors and participants of Czech projections

Sector	Organisation prepared projection	The organisation provided input data
Energy	CUEC, CHMI	CHMI, CZSO, MZP
Residential	CHMI	CHMI, CZSO
Industry	CHMI	CHMI, CZSO
Transport	Motran s.r.o.	CDV, MoT, CZSO
Agriculture	VUZT	MoA, CZSO
Waste	CHMI	CHMI, MZP, CZSO

IX.2 The Projection summary in the context of commitments

Ceilings 2025

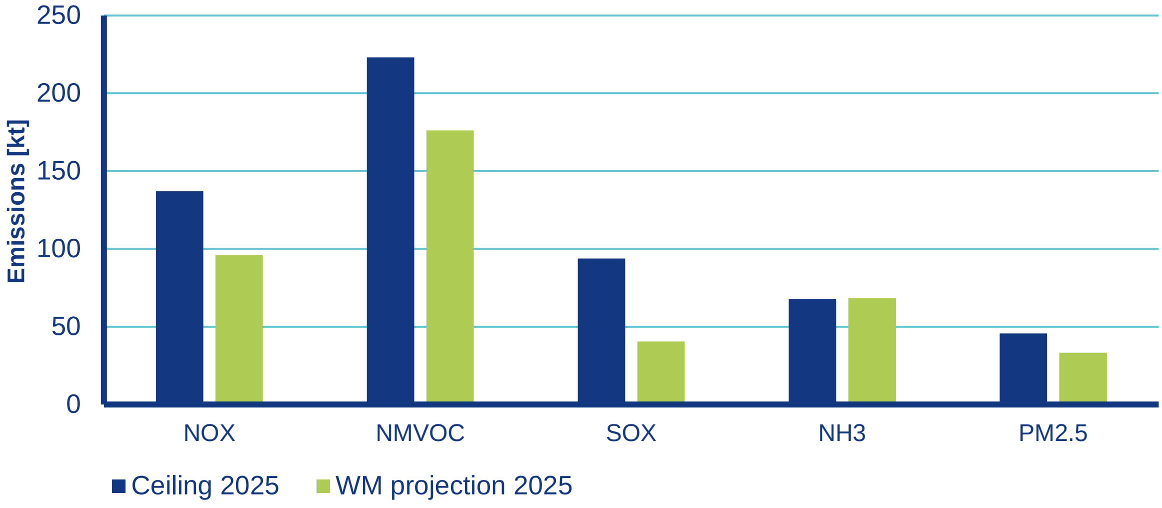


Figure IX.1 Czech Commitments 2025

In 2025, Czechia achieve the emission ceilings for all pollutants under the WM scenario, except the NH_3. The NH_3 emission exceeds by 0.35 kt.

Ceilings 2030

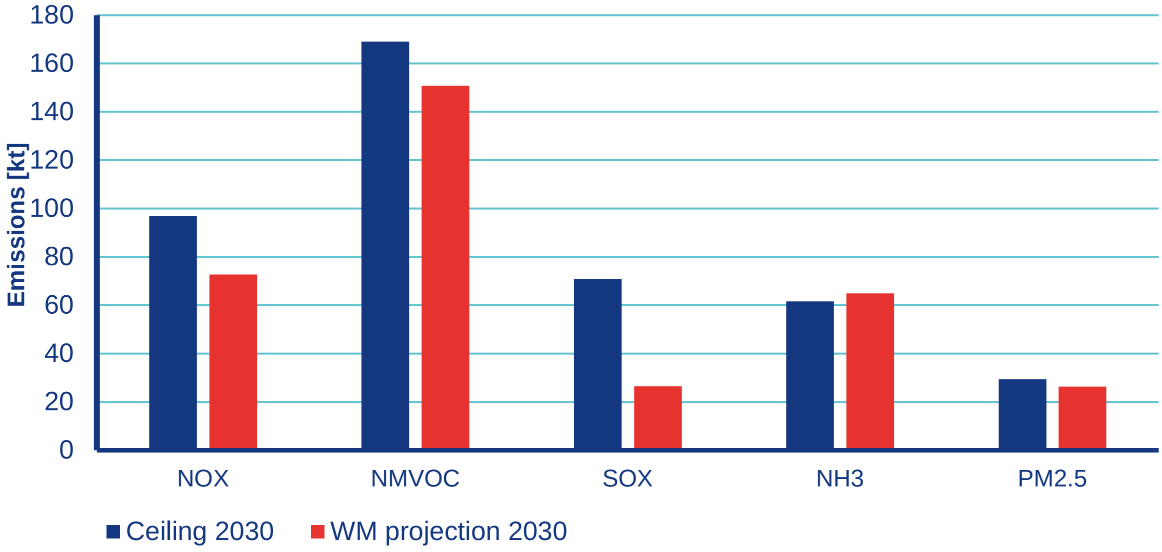


Figure IX.2 Czech Commitments 2030

In 2030, Czechia achieve the emission ceilings for all pollutants under the WM scenario, except NH_3. The NH_3 emission exceeds by 3.23 kt.

IX.2.1 Share of Projected Emissions in 2025 and 2030

The WM scenario shows the distribution of emissions in NFR categories in 2025 and 2030. The presented data based on Annex IV.

NO_X (as NO_2)

The total emission of NO_X (as NO_2) will decrease from 115.4 kt in 2025 to 90.41 kt in 2030.

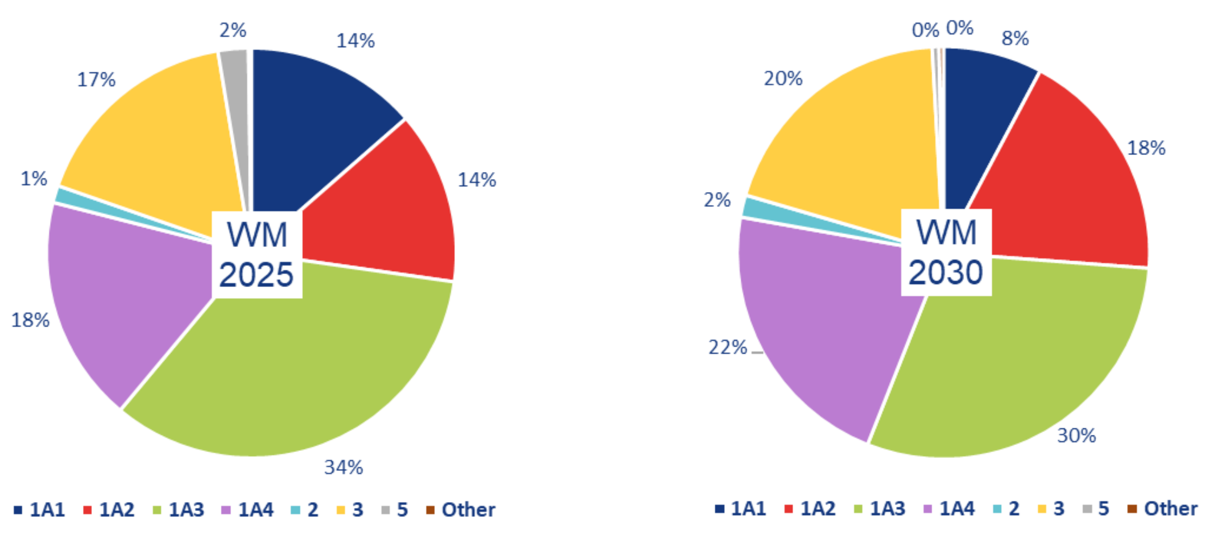


Figure IX.3 NO_X (as NO_2) share

NMVOC

The total emission of NMVOC will decrease from 213.09 kt in 2025 to 188 kt in 2030.

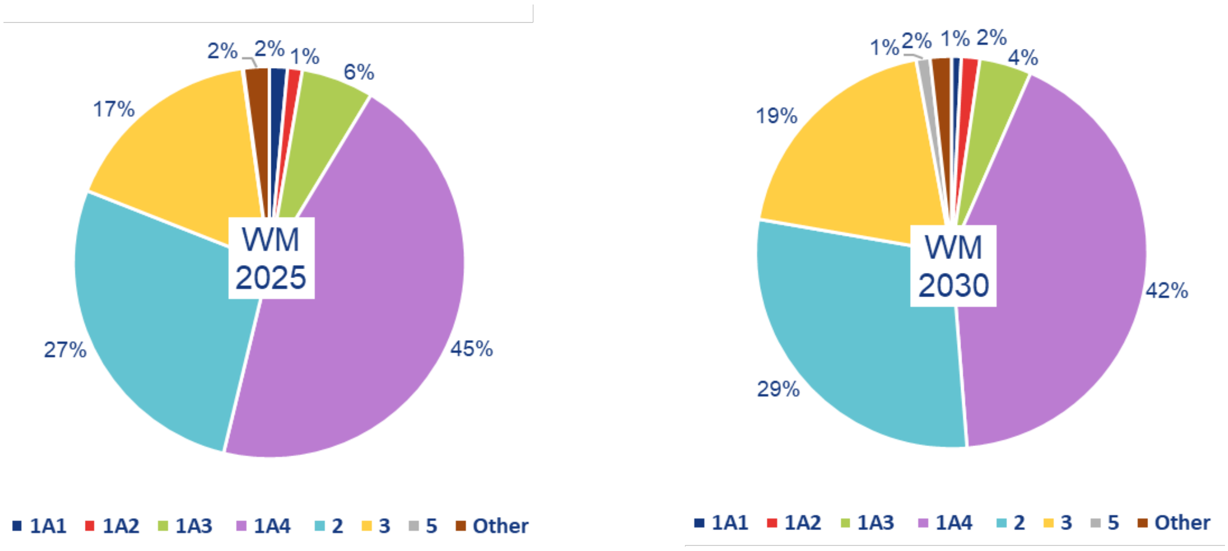


Figure IX.4 NMVOC share

SO_X (as SO_2)

The total emission of SO_X (as SO_2) will decrease from 40.6 kt in 2025 to 26.4 kt in 2030.

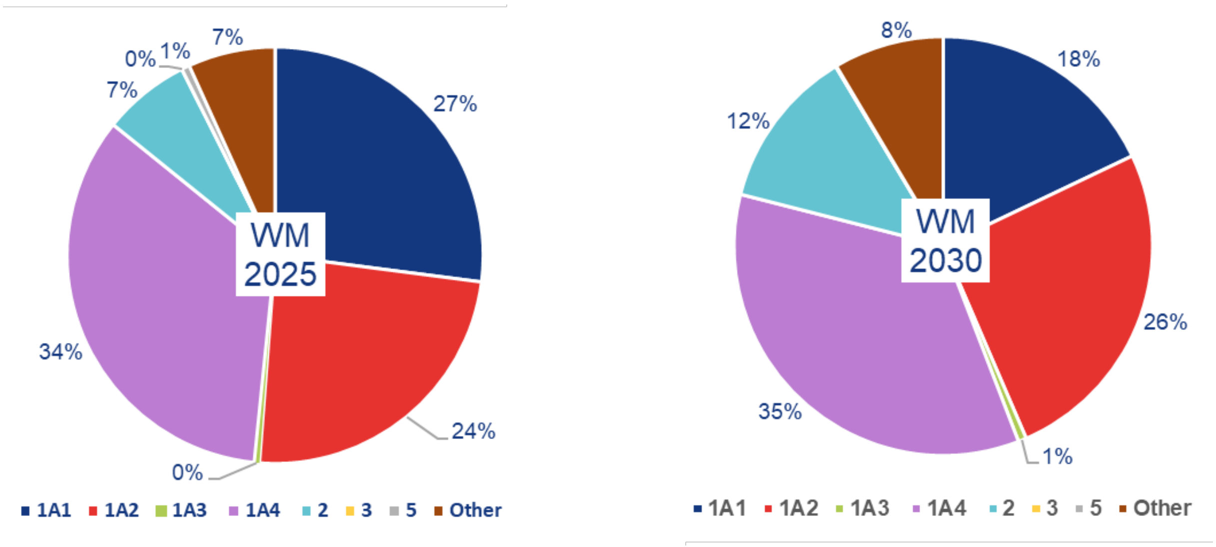


Figure IX.5 SO_X (as SO_2) share

NH_3

The total emission of NH_3 will decrease from 68.3 kt in 2025 to 64.8 kt in 2030.

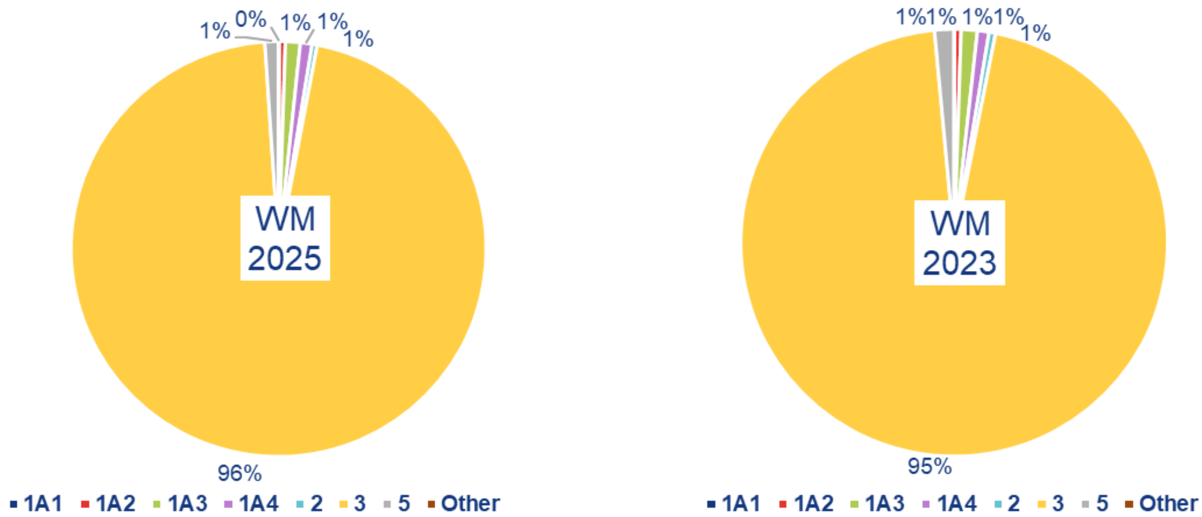


Figure IX.3 NH_3 share

$PM_{2.5}$

The total emission of $PM_{2.5}$ will decrease from 33.4 kt in 2025 to 26.4 kt in 2030.

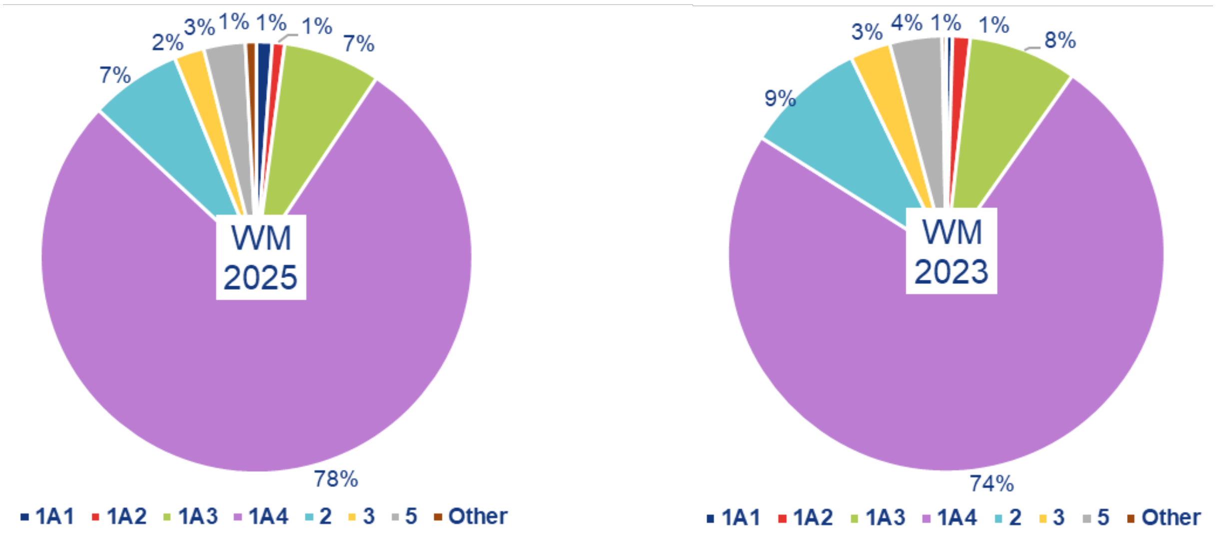


Figure IX.4 $PM_{2.5}$ share

IX.2.2 Projected trend of emission 2025-2050

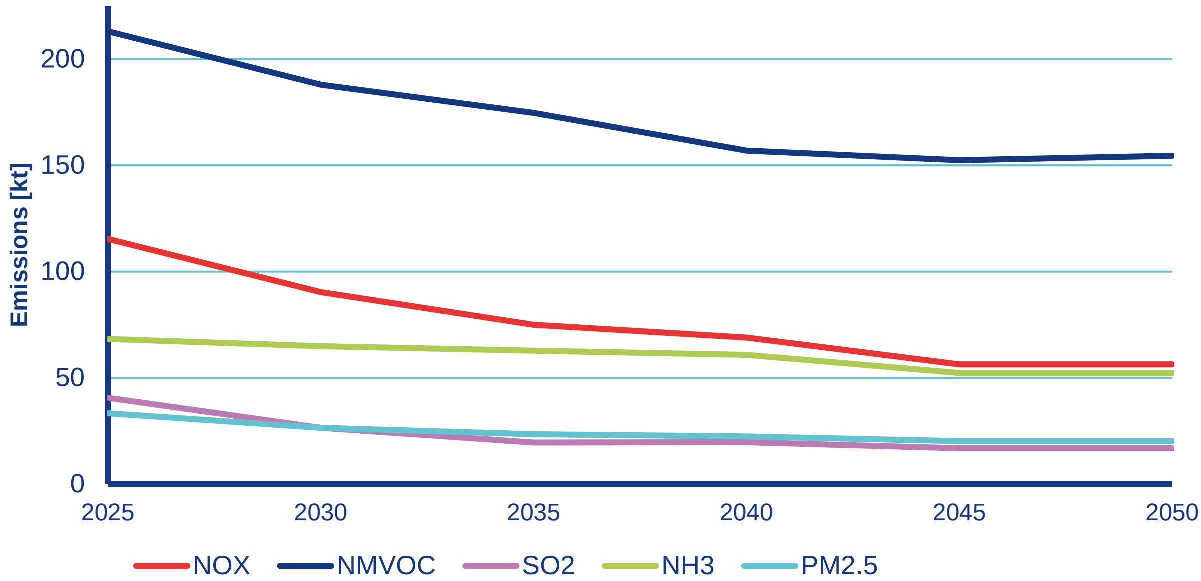


Figure IX.5 Czech Emissions by WM Scenario

IX.2.3 Energy – NFR 1A1, 1A2

Input data were provided under Act No. 201/2012 Coll. Air Protection, combustion sources are divided into 3 main groups [4]:

- Combustion sources with a total rated thermal input exceeding 50 MW. Which fall under the Industrial Emissions Directive (LCP- Large Combustion Plants under the Industrial Emissions Directive)
- Other combustion sources underlying Annex 2 of the Act No. 201/2012 Coll. Air Protection.

- Combustion sources not underlying Annex 2 to the Act on Households and other sources (natural gas combustion only).

The primary background material consisted of such data:

- The REZZO 1 and 2 databases (Register of emissions and sources of air pollution) containing the reported data of sources by operators covered by Annex 2
- Household fuel consumption data contained in IEA (International Energy Agency questionnaires)
- Data on natural gas consumption is calculated as the difference between the total consumption of natural gas and the partial consumption of listed sources and households.

The detailed description is explained in IIR Chapter III.1 (Large combustion plants) [27]. Projections of 1A1 and 1A2 are based on the TIMES-CZ model.

The projections preparation in the 1. Energy sector in the current submission reflects a transition to complete preparation of projection by TIMES-CZ model [28], [29].

TIMES-CZ is a technology-rich, bottom-up, cost-optimizing integrated assessment model built within the generic and flexible TIMES (The Integrated MARKAL-EFOM System) model generator's General Algebraic Modelling System (GAMS) code. TIMES has been developed and maintained within the Energy Technology System Analyses Program (ETSAP) by the International Energy Agency (IEA) [30]. TIMES searches for an optimal solution for an overall energy mix that will satisfy exogenously given energy service demand with the least total discounted costs in a given timeframe with a perfect foresight principle [31].

TIMES-CZ is based on the Czech region of the Pan-European TIMES PanEu model developed by the Institute of Energy Economics and Rational Energy Use at the University of Stuttgart [32]. Also it is regionalized into 14 regions of Czechia, its base year is updated to 2019 and the model structure is modified by individual data of EU ETS facilities. The year 2019 was selected as the base year of the model to avoid bias by the pandemic year 2020. The modelling horizon spans from 2019 to 2050, split into two 2 and six 5 year-time steps. A year is divided into 12 time slices, 4-seasonal and 3-day levels (day, peak and night). GHG emissions (CO_2, CH_4 and NO_2) and other pollutants (SO_2, NO_X, NMVOC and PM) are included in the model.

Scenario assumptions

The following scenario`s assumptions were applied for the analytical basis of the SEP and the NCEP prefinal versions in 2024. The same assumptions are applied to the emission projection in the current submission. Only the three assumptions were updated for the emission projection: 1) recent data purchases of boilers and heat pumps and the expected replacement rate of current boilers and stoves have been incorporated into the TIMES-CZ model based on the CHMI sector 1A4b model; 2) the minimum share of renewable energy in transport in 2030 was updated based on the latest results of the TACR MOSUMO research project; and 3) the share of renewable electricity applied to the minimum share of renewables in transport is now specific to each scenario.

The resource adequacy was validated for the WAM scenario of NCEP pre-final versions in 2024. The WAM scenario in the current submission follows this validation.

Activity data:

The activity is common for WM and WAM scenarios. The projection of industrial physical production is based on outputs from the E3ME model. Additionally, consultations regarding steel, lime, and chemicals were held with the Confederation of Industry of the Czechia (SP ČR) in March 2024. Steel production assumes that Liberty Ostrava will renew production by 2025 at the latest. According to companies' investment plans, electric arc furnaces will begin to be installed in 2030.

Table IX.3 Physical production index of industrial sectors

Industry sector	2019	2025	2030	2035	2040	2045	2050	Source/note
Steel	1	0.983	1.055	1.082	1.083	1.120	1.117	E3ME/by SP ČR
Cement	1	1.001	1.087	1.108	1.191	1.196	1.200	E3ME
Lime	1	1.000	1.022	1.027	1.047	1.049	1.100	E3ME/by SP ČR
Glass	1	1.001	1.176	1.200	1.200	1.200	1.200	E3ME
Machinery	1	1.050	1.088	1.115	1.140	1.143	1.150	E3ME
Chemicals	1	1.042	1.083	1.125	1.167	1.208	1.250	E3ME/by SP ČR

EUA and fuel prices

Assumptions of EUA and fuel prices are taken from Recommended parameters for reporting on GHG projections in 2025 (DG Climate Action, 2024).

Table IX.4 Applied EUA, EUR2023/t CO_2

	WAM		**WM**
	ETS1	ETS2	ETS1
2025	95		95
2030	95	60	95
2035	140	167	100
2040	290	275	100
2045	430	382	160
2050	490	490	190

Table IX.5 Assumed fossil fuel prices, EUR2023

	Oil			Gas (NCV)		Coal	
	€/GJ	€/toe	€/boe	€/GJ	€/toe	€/GJ	€/toe
2025	12.4	520	76	9.4	394	4.1	172
2030	13.9	582	85	9	377	4	169
2035	15.4	645	94	8.2	344	3.8	161
2040	15.8	663	97	10.1	422	3.8	160
2045	17.2	718	105	9.9	412	4	166
2050	19.7	825	121	9.6	403	4	166

Nuclear capacity development

The lifespan of the existing Dukovany Nuclear Power Plant with an installed capacity of 2040 MW is expected to last until the end of 2045 (EDU1 510 MWe), until 2046 (EDU2 510 MWe and EDU3 510 MWe), and until 2047 (EDU4 510 MWe) in both scenarios. The operation of the Temelín Nuclear Power Plant is expected to end by 2060 (ETE1 1100 MWe) and 2062 (ETE2 1100 MWe).The final energy service demand is based on the National Energy Climate Plan (NECP) [33].

Assumptions specific to WM scenario

Hydrogen:

The WM scenario does not include hydrogen imports. There is no target for RFNBO hydrogen in the WM scenario.

Nuclear capacities and PV and wind potential

An 1100 MW reactor will be introduced in 2040, with the possibility of additional installations based on model results.

Photovoltaic Potential:

By 2030: 6 GWe

By 2050: 21 GWe

Wind Power Potential:

By 2030: 0.7 GWe

By 2050: 3.5 GWe

Energy savings in buildings

The energy savings potential in buildings corresponds to the Baseline Scenario of the Building Renovation Strategy (MIT, 2020).

IX.2.3.1 Assumptions specific to WAM scenario

Hydrogen:

Hydrogen import potential is assumed at 36.7 TWh with a price of 60 EUR/MWh in 2050. From 2040, it is assumed that direct combustion of hydrogen in households will be possible, i.e. gas boilers will also be adapted for direct combustion of hydrogen. The assumptions about the available amount of hydrogen for import to the Czechia and its price are based on the documents of the Ministry of Industry and Trade for the preparation of updates to the Hydrogen Strategy prepared in cooperation with industry representatives. These documents present a gradual increase in the available amount of hydrogen for import to the Czechia. From 2035, all 3 pipeline routes are proposed – from the west (6 GW), north (6 GW) and south (3 GW), with a gradual increase in available hydrogen for import in total from 24 PJ (200 kt) in 2035 to 132 PJ (1,100 kt) in 2050. In addition to imported pipeline hydrogen, the possibility of importing hydrogen in the form of ammonia is assumed only for industrial consumption. The price of imported ammonia is lower than in the case of pipeline hydrogen and the quantity is limited by the current industrial hydrogen consumption of 11.6 PJ (96 kt). (Ministry of Industry and Trade, 2024)

In 2030, 8 thousand tons in the industry and 1% in the transport sector are assumed, for a total of roughly 20,000 tons of RFNBO hydrogen.

Nuclear capacities and PV and wind potential

Nuclear capacity development:

A 1100 MW reactor will be introduced in 2036, 2039, and 2041.

A 350 MW Small Modular Reactor (SMR) will be installed in 2035, with the possibility of additional SMR installations based on model results.

Photovoltaic Potential:

By 2030: 10.1 GWe

By 2050: 26.1 GWe

Wind Power Potential:

By 2030: 1.5 GWe

By 2050: 5.5 GWe

Energy savings in buildings

The energy savings potential in buildings corresponds to the Hypothetical Scenario of the Building Renovation Strategy (MIT, 2020).Scenario results – activity data

The results of the modelling reflect the given assumptions. As a result of decreasing electricity net export and the high price of EUA, the input of hard coal and lignite for heat and power generation decreases sharply. Renewable energy sources and natural gas are the main substitutes for hard coal and lignite in heat and power generation. In both the WM and WAM scenarios, the trend in 1A1 shows a shift from fossil fuels to renewable and nuclear energy, with electricity imports playing a role, especially in the WM scenario.

For 1A1a (Public electricity and heat production), the total energy input decreases until 2030 due to reduced electricity exports. The input of combustion fuels in 1A1a also decreases. However, the total energy input rises again, reaching 70,421 PJ in the WM scenario and 17 PJ in the WAM scenario by 2050. Significant changes are observed in the use of lignite, hard coal, natural gas, solar, and wind energy. See Table IX.6 for details.

The WM and WAM scenarios show different trends in A2, particularly in the consumption of gaseous fuels. In the WM scenario, gaseous fuel consumption increases around 2030 and stabilizes at approximately 160 PJ per year until 2050, due to a shift in heat production to natural gas. Conversely, in the WAM scenario, gaseous fuel consumption gradually decreases, reaching 37 PJ by 2050. See Table IX.7 for details.

Table IX.6 Fuel input 1A1 [TJ]

	Period	liquid fuels	solid fuels	gaseous fuels	biomass	other fuels
WM	2025	113	178947	72226	16700	3016
	2030	18	40729	79929	14348	5016
	2035	8	20947	67766	14578	4756
	2040	8	16793	51109	14708	4596
	2045	0	4758	48654	14273	4259
	2050	0	4264	46458	12884	4018
WAM	2022	934	394202	82455	18685	1334
	2025	146	147351	68509	16700	2815
	2030	17	66542	32800	15401	5000
	2035	7	0	21474	14539	4750
	2040	0	0	13228	13209	4500
	2045	0	0	10005	972	4250
	2050	0	0	20993	382	4000

Table IX.7 Fuel input in 1A2 [TJ]

	Period	liquid fuels	solid fuels	gaseous fuels	biomass	other fuels
WM	2025	3948	29914	84656	39791	7252
	2030	1968	22857	120557	39314	9678
	2035	1318	11245	119888	37920	2105
	2040	1654	16442	126061	36039	275
	2045	1822	20161	119312	38695	137
	2050	1961	15234	116733	39843	0

WAM	2022	8255	41455	96207	33665	10315
	2025	3931	29914	84437	39126	7249
	2030	1803	16423	89681	35339	9624
	2035	3283	5930	93275	30998	3187
	2040	3072	9920	68869	45429	0
	2045	4995	9214	54895	45501	0
	2050	4995	10358	37430	34306	0

Emissions for NOx, SOx, PM and VOC were calibrated for years 2019 and 2022 based on REZZO.

Calculated emissions were summarized and added to template Annex IV.

IX.2.4 Transport - NFR 1A3

The basic approach was to obtain the time series of activity data (vehicle fleet, fuel consumptions. annual numbers of new and scrapped vehicles. transport volumes and performances, etc.), and then to analyze possible future development in the field of transport demand, vehicle fleet, modal split and the development and introduction of new vehicle technologies, more responsible to the protection of air quality and environment.

From the analysis of input data, the future time series of emission productions were calculated. In addition, the analysis of the efficiency of individual policies and measures was made. The possible emission reduction was the output of this analysis. These reductions were subtracted from total future emission mass, depending on the type of scenario: with existing measures (WM) and with additional measures (WAM). The WAM scenario is not required.

The approach for emission reduction calculations was updated. This update is related to the reduction of greenhouse gas emissions. In 2019, new Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO_2 emission performance standards for new passenger cars and for new light commercial vehicles was adopted. By this Regulation, the CO_2 emissions from new cars should decrease by 15% in 2025 and 37.5% in 2030 compared to 2021 year. The CO_2 emissions from new vans should decrease by 15% in 2025 and 31% in 2030 compared to the 2021 year.

These standards are defined for the new car fleet of every car manufacturer (with some exceptions). It will influence emissions of “traditional” pollutants like NO_X, CO, NMVOC and others as well. Future vehicle fleets and kilometers composition were modelled to meet these standards. Resulted vehicle composition contains more zero-emission vehicles than in the WM scenario. The percentage of zero-emission vehicles in the fleet is set to get a weighted average to values of the above-mentioned percentage.

Also, the projection of emissions from transport takes into account further reduction of heavy duty vehicles and buses emissions. In order to fit targeted emissions reduction specified in EC Directive No. 1242/2019 is supposed that the diesel trucks and buses will be gradually replaced by electric and hydrogen ones.

Further emission reduction was calculated by the impact of other measures. For example, new vehicles with purer emission standards, and demand–influencing measures (investment in railway and combined transport infrastructure, road toll and others) influence harmful emission production as well.

Road and non-road transport - NFR 1A3a-d

Emission projections from the Transport sector were made by experts from MOTRAN Research s.r.o~~.~~. The results of the projection were elaborated in the R-project. The Department of Strategy and International Cooperation in Energy (MIT) provided activity data including expected changes in the share of consumption of individual transport fuels.

The emission projection comes from the official Czech transport forecast defined in the analytical parts of the Transport policy of the Czechia for the period 2021–2027 with a view to 2050. For analytical parts of Transport Policy the national Czech transport model was used. It comes from the prediction of demography and economy as well as the export and import of freight. Forecasts of energy consumption split to individual fuels, done by MIT. It is another important input for the model of emissions projections in transport.

Transport and energy forecasts are a base for the calculation of more detailed activity data for emissions projection. These data are further disaggregated into more detailed vehicle categories by fuel used and Euro Standards emission limits. The emission projections model has now 121 transport categories, which differ from each other in transport mode, fuel used and emission limits, which a vehicle must meet (by a year of manufacture).

Up to now, emissions datasets from road transport have been processed in a model COPERT. Detailed inputs for the COPERT model were obtained from the data outputs of the Technical Inspection Stations (STK) linked to the Vehicle Register data. CDV Brno (Transport Research Centre, Brno) provided the evaluation of the dynamic trends.

The underlying data for emission projections were time series including fleet composition, mileage and derived fuel consumption, annual number of new and discarded vehicles, total volumes and transport performance. Analysis was based on the possible future development in demand for transport including vehicle allocation and modal split, development and operation of new environment-friendly vehicles.

Activity data and emission factors have been structured according to the COPERT 5 model. Results from model COPERT recently contain 441 categories of road vehicles, which are different by type of transport, fuel, engine volume for passenger transport, vehicle weight for freight and EURO emission standards. These data were aggregated in an emissions projection model to less detailed vehicle categories.

By multiplying these activity data emission factors related to the distance travelled, emission projections were calculated. Analysis of the effectiveness of individual current or future policies and measures was carried out to the projections too.

Table IX.8 COPERT appropriative NFR names

COPERT names	NFR Code	Long name
Aircraft's freight	1A3a.c.d.e	Off-road transport
Aircraft's passenger	1A3a.c.d.e	Off-road transport
Boat freight	1A3a.c.d.e	Off-road transport
Boat passenger	1A3a.c.d.e	Off-road transport

Buses	1A3biii	R.T. Heavy-duty vehicles
Heavy duty trucks	1A3biii	R.T. Heavy-duty vehicles
L - category	1A3biv	R.T. Mopeds & Motorcycles
Light commercial vehicles	1A3bii	R.T. Light duty vehicles
Passenger cars	1A3bi	R.T. Passenger cars
Trains freight	1A3a.c.d.e	Off-road transport
Trains passenger	1A3a.c.d.e	Off-road transport

Table IX.9 COPERT results (from 2025 these are results of the emission projection model)

Transport mode	**Vehicles**					
Year	2019	2020	2025	2030	2040	2050
Buses	15823	13092	20336	21755	23164	23568
Heavy duty trucks	139855	125061	157489	184705	208286	233064
L - category	1147200	899572	1305157	1330187	1374151	1387402
Light commercial vehicles	578176	543646	596121	699127	788359	882141
- gasoline	84515	81157	74755	78977	70922	64066
- diesel	493661	452934	513020	590141	595983	599169
- other	0	9555	8346	30009	121454	218906
Passenger cars	5889714	5530582	6595502	6721985	6944198	7011161
- gasoline	3466557	3132046	3838961	3882374	3488421	3054803
- diesel	2285218	2212567	2525854	2407873	2036170	1689489
- other	137939	185969	230687	431738	1419607	2266869
Total	7770768	7111953	8674605	8957759	9338158	9537336

Table IX.10 COPERT results (from 2025 these are results of the emission projection model)

Transport mode	**NO_X [kt]**					
Year	**2019**	**2020**	**2025**	**2030**	**2040**	**2050**
Buses	2.75	2.62	2,17	1,59	0,96	0,58
Heavy duty trucks	10.04	10.04	7,92	6	4,06	2,99
L - category	0.06	0.05	0,13	0,09	0,02	0,02
Light commercial vehicles	10.08	8.98	7,62	6,23	3,65	2,47
- gasoline	0.12	0.09	0,05	0,03	0,01	0,01
- diesel	9.96	8.89	7,57	6,2	3,64	2,47
- other	0.00	0.00	0	0	0	0
Passenger cars	29.05	25.63	16,3	9,5	3,73	2,34

- gasoline	4.11	3.38	2,68	1,6	0,88	0,76
- diesel	24.74	22.06	13,51	7,79	2,72	1,45
- other	0.20	0.19	0,11	0,11	0,12	0,13
Total	51.98	47.33	34,14	23,41	12,42	8,4

Table IX.11 COPERT results (from 2025 these are results of the emission projection model)

Transport mode	**NMVOC [kt]**					
Year	**2019**	**2020**	**2025**	**2030**	**2040**	**2050**
Buses	0.09	0.09	0,06	0,05	0,04	0,03
Heavy duty trucks	0.39	0.29	0,35	0,29	0,25	0,21
L - category	0.89	0.30	1	0,73	0,25	0,22
Light commercial vehicles	0.55	0.46	0,34	0,2	0,05	0,02
- gasoline	0.21	0.19	0,09	0,05	0,02	0,01
- diesel	0.34	0.27	0,25	0,14	0,03	0,01
- other	0.00	0.00	0	0	0	0
Passenger cars	11.15	9.43	6,57	3,85	1,93	1,46
- gasoline	10.28	8.69	5,95	3,43	1,55	1,08
- diesel	0.57	0.45	0,46	0,23	0,06	0,03
- other	0.30	0.30	0,16	0,19	0,31	0,35
Total	13.07	10.57	8,32	5,12	2,52	1,94

Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery - NFR 1A4cii

The prediction of emissions from the operation of agricultural machinery is carried out until 2030. Based on the current regular renewal of tractors in agricultural enterprises, it can be expected that by 2030 tractors will be used predominantly with engines meeting Stage V. The figure shows an estimate of the structure of tractors according to the technological level in 2030. To predict the development of emissions, the use of fuels based on conventional diesel with a biocomponent of 7% was taken into account.

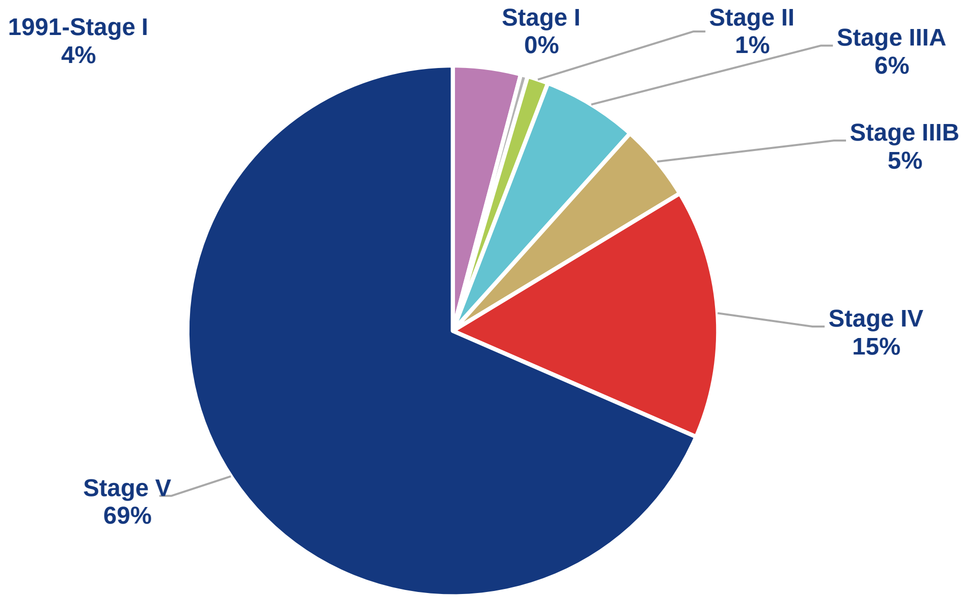


Figure IX.6 Share of tractors by emission technology level

The prediction of emissions development after 2040 assumes that only tractors with Stage 5 emission technology level will be in operation, powered by new types of fuels, for example based on HVO (Hydrotreated Vegetable Oil).

IX.2.5 Combustion sources - NFR 1A4

Combustion of fuels in households for heating, hot water preparation and cooking are generally combustion sources with a nominal heat input of up to 300 kW known as unlisted sources. According to Act No. 201/2012 Coll. on air protection, unlisted sources are monitored collectively based on statistical data for inventorying emissions. Register of Emissions and Stationary Sources (REZZO) classifies unlisted sources in the category REZZO 3. The methodology for inventorying emissions from these sources based on the results of the Census of Population, Houses and Dwellings has been developed by the Czech Hydrometeorological Institute (CHMI) since the 1990s and was used in an updated form until 2017 [34]. A revision of emission inventories in 2017 [35] according to the Directive of the European Parliament and the Council (EU) 2016/2284 and the results of the statistical survey ENERGO 2015 [36] led to a new methodology for inventorying emissions from combustion in households [37]. The revision required improving the completeness of the data and the unification of reporting data according to the Convention on Long-Range Transboundary Air Pollution (CLRTAP) and the United Nations Framework Convention on Climate Change (UNFCCC). The model was based on the original methodology of the CHMI modified according to the results of the ENERGO 2015 survey, which for the first time mapped fuel stocks and fuel equipment in households in the Czechia in detail. Model using national emission factors determined at the nominal thermal output of the boilers. Only in the air quality modelling were national emission factors determined in the case of reduced thermal output of boilers applied in isolated cases.

In the current methodology compiled in 2023, the calculation procedures from the previous methodology completed in 2018 were largely adopted [37]. Significant changes have been made to some key parameters affecting the overall emissions calculation. Mainly changes were in the representation of individual types of boilers in the time series since 1990, which is partially reflected in the assumption of the future composition of boilers until 2025 and the following years. These adjustments and the newly determined proportion of dried wood were carried out based on the evaluation of data from the new ENERGO 2021 survey [38].

Another change in the methodological approach is related to the comments of the team of emission experts [39], [40], who checks of the reported data. Based on the CEIP request, there were changes in the emission factors used. In previous years, emission factors were determined at the nominal thermal output of boilers and heaters were used as a basic set. The new methodology uses primarily emission factors corresponding to operation at reduced output. Therefore, only combustion sources with an adequate storage tank have emission factors with the nominal heat output for the entire period of operation. The representation of boilers with storage tanks was based on the evaluation of the reported data of the Report on the Technical Condition and Operation Control (RTCOC) forms.

Input Data

Projection of emissions in 1A4 is based on the projected fuel consumption, in the relevant scenario - WM or WAM. The scenario assumptions and the TIMES-CZ model are detailed in Chapter IX.2.1. The residential assumptions regarding the total mix of boilers follow the methodology outlined below for both the WM and WAM scenarios.

The three tables below present the fuel combustion data for the 1A4ai, 1A4bi1, and A4ci sectors, derived from the cost optimization in the TIMES-CZ model.

Table IX.12 Fuel combustion in sector 1A4ai [TJ]

	Period	liquid fuels	solid fuels	gaseous fuels	biomass	other fuels
WM	2022	3837	3315	40206	6999	2330
	2025	611	3798	53442	6566	541
	2030	1102	930	58406	7214	523
	2035	1453	365	60283	12513	523
	2040	382	317	64444	19829	0
	2045	382	317	70286	22517	9
	2050	382	316	82066	21556	19
WAM	2022	2611	3315	40206	7355	2330
	2025	604	3712	51834	6858	541
	2030	1066	912	46534	9819	523
	2035	910	0	37949	12452	523
	2040	382	0	30258	16007	0
	2045	382	0	18833	14326	0
	2050	5	0	7889	13209	0

Table IX.13 Fuel combustion in sector 1A4bi [TJ]

	Period	solid fuels	gaseous fuels	biomass
WM	2025	27732	80745	79519
	2030	21801	61957	79160
	2035	11680	62167	74166
	2040	11181	55921	73870
	2045	5346	55588	76827
	2050	1000	56900	76655
WAM	2025	20085	71389	79097
	2030	13260	43125	78833
	2035	0	35904	83648
	2040	0	17649	63735
	2045	0	13884	52354
	2050	0	13280	42065

Table IX.14 Fuel combustion in sector 1A4ci [TJ]

	Period	liquid fuels	solid fuels	gaseous fuels	biomass
WM	2025	122	55	725	16319
	2030	120	45	726	16506
	2035	104	33	715	17373
	2040	97	23	726	8472
	2045	89	12	730	7326
	2050	79	0	729	7842
WAM	2025	122	55	725	16319
	2030	110	43	697	16669
	2035	106	0	715	17373
	2040	96	0	708	6611
	2045	80	0	711	7129
	2050	15	0	641	7579

Methodology
The total mix of boilers was calculated. The mix was based on:

- The prohibition on sales of 1st and 2nd class boilers from 1st January 2014

- The prohibition on sales of 3rd class boilers from 1st January 2018 (part of the burning boilers may meet Class 3 parameters. so they will run also after 2024)
- The prohibition of operation of 1st and 2nd class boilers after the year 2022 (projections are based on the ideal state of fulfilment of the legislative requirement to prohibit the operation of 1st and 2nd class boilers after 2024 was considered)

If the source operator replaced an older solid-fuel combustion plant, with a modern solid-fuel system, the same fuel type should be used. Also in a case of biomass combustion. The old Energy sources which use coal, must be gradually replaced by biomass fuels. Especially in the case of gas boiler installations. Especially in areas lacking gas pipelines or heat distribution from heating plants, old boilers will have to be replaced with new ones due to the closing of coal mines. A fuel consumption forecast indicates that the consumption of brown coal will be reduced and partially replaced by natural gas and renewable sources, primarily by biomass. However, the consumption of the black coal will stay similar.

Projection of emissions following the new emission balance of fuel combustion in households

The above-mentioned adjustments to the methodology for calculating emissions from fuel combustion in households are also reflected in the results of the emissions projection until 2030 and subsequent years. The change in the boiler stock affects the most significantly the projections of emissions from fuel combustion in households. The current boiler change in Czech households is mainly a result of the legislatively mandated termination of the operation of non-ecological boilers (Act No. 201/2012 Coll. § 17). The projection therefore includes a requirement that from September 1, 2024, only boilers that meet the conditions listed in Annex No. 11 of the Air Protection Act will be able to be operated. Another important factor influencing the emission projection is the assumption of the development of fuel consumption: the reduction and gradual termination of coal consumption and increasing the share of biomass and non-emission heating methods.

IX.2.6 Other combustion sources - NFR 1A5

Emissions from the operation of military vehicles and aircraft are included in the NFR 1A5. The Emissions are low. A fuel consumption trend was used as activity data, which was taken from CZSO and reported by the Ministry of Defence and Armed Forces. A trend of this consumption is manifested as, for example, emergency aid during floods. Therefore is difficult to project the development in the future. For Projections the data registered in 2023 were used.

The NFR 1A5a follows the trend in the NFR 1A4ai, because the stationary sources in the NFR 1A5a have many similarities with the tertiary sector.

IX.2.7 Fugitive emissions from fuels - NFR 1B

The projection for the NFR 1B category was calculated separately for each NFR category.

For all categories, the 2025 projection was used as inventory data from 2023, because no significant changes in category 1B are expected in the next two years. The projections for 2030, 2035, and 2040 were calculated only for the main NFR categories that contribute the most to emissions in 1B, as a base year was used 2022.

The projection for 1B1a in 2030, 2035, and 2040 was calculated using the Tier 1 methodology and emission factors from the EMEP/EEA EIG [3] Activity data for coal were extracted from the National Energy and Climate Plan of the Czechia (NECP) [31], where the projection data were calculated using the TIMES-CZ model. In 2030 and 2035, minimal coal mining is projected, and by 2040, coal mining in Czechia is expected to cease entirely. Although coal mining is ending, some handling and transportation are projected to continue until 2040, particularly due to the use of coal as fuel in Residential stationery, such as old boilers, which new ones are consecutively replacing. The projection has been calculated as a continuous decrease from 2025 to 2040. In 2040 zero values are expected.

The projections for NFR 1B2av and 1B2b follow a consecutively decreasing, with an expectation of reaching zero emissions by 2050. This trend is supported by the CO_2 commitments in the transport sector (Chapter IX.2.3), where a 50% reduction in emissions is expected by 2030, with full carbon neutrality in the transport sector by 2050. The projected emissions should reflect this policy, as the demand for fuels is expected to decline. The projection of NFR 1B2aiv was based on the projected liquid fuel consumption in the transport sector (1A3), reflecting its trend from the base year 2022 onward.

The projection for NFR 1B2c is problematic, as venting and flaring are not standard procedures and depend significantly on factory conditions (ex. reconstruction, defects and low consumption). The projections are presented as an average of emissions over the last five years of inventory data (2018–2022).

The projection for 2050 was not calculated or emission was not presented due to low numbers and height deviation. For 1B categories is the lack of sufficient information on future developments, additionally, an overall attenuation in these categories is expected.

IX.2.8 Industrial Processes and Product Use - NFR 2

Projections of Industrial Processes and Product Use were calculated under the forecast of further industrial production. Forecasts were provided basically by MoI. Emissions of the base year were taken from the Czech emissions inventory. Detailed description, including all changes were been made in Czechia is shown in Chapter IV. Emission factors were used according to EMEP/EEA EIG [3].

Input data

Calculations were based on activity data, which were described in Chapter IV and forecasts provided by MoI. Other economic based factors, as a population forecast or gross domestic product were obtained from CZSO. The population forecast is shown in Figure IX.7 [41].

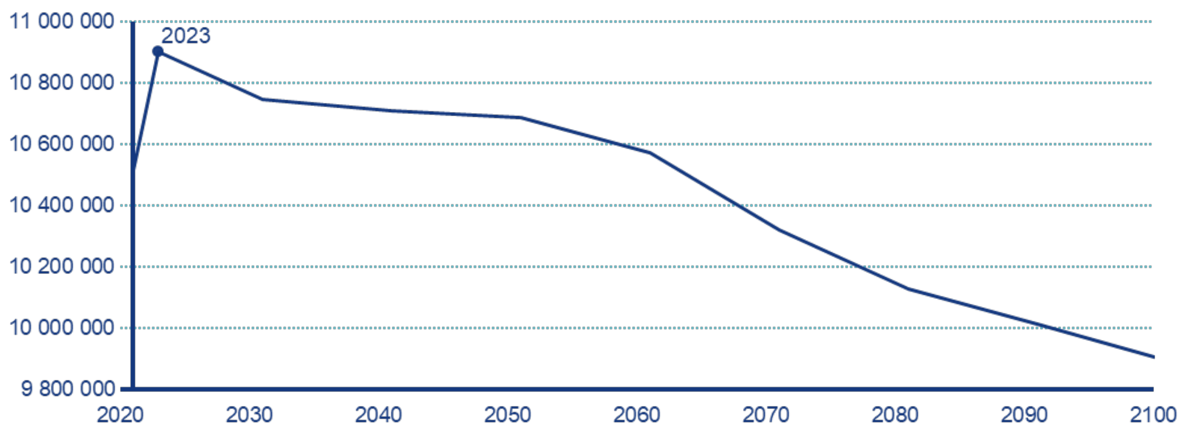


Figure IX.7 Population forecast

The total population of the Czech Republic is expected to have a declining trend in the long-term perspective. Starting from a population of 10.91 million at the beginning of 2025, it is expected to decrease to 10.70 million by 2030.

Industrial production will grow relatively slowly; however, growth is expected in certain sectors, such as the production of other transport vehicles, railway vehicles, and automobiles, the production of computers, electronic and optical instruments, and small aircraft. It is also expected that pharmaceutical production will shift from Asia to Europe. In construction, a higher demand is expected, along with improved development in construction activities in the coming years, due to the overall better economic situation. After a decline in the civil engineering and building construction segments in previous years, a slight increase is expected.

Methodology

Projections of sectors with a major emission contribution were calculated by using forecasts in industry. Sectors with a minor emissions contribution were derived based on general economic growth factors in the manufacturing industry. Trends analyses and the analyses of PAMs were either provided. Nevertheless, a big margin of uncertainty is still exist.

Projections for NFR 2D3 in the coming years

For the estimation of emissions in the following years, trends related to developments in individual subcategories were used. For example, a decline is expected in the Printing and Coating applications sector. On the other hand, the Chemical products sector is expected to see a slight increase due to new materials replacing metals and wood

I.1.1 Agriculture - NFR 3

The projection on emissions of air pollutants originating from agriculture is regularly updated in line with new knowledge because of new emission sources, changes in emission factors or changes in the agricultural production conditions, e.g. changes regarding the legislation and regulation. Past TERT recommendations prompted changes in the methodological procedure for calculating pollutant emissions.

Many of these changes have led to revisions and recalculations of historical emissions inventories in the past few years (especially from 2020). These changes were reflected in the deviations in the values compared to the projections published in previous reports. Some changes can also lead to a revision in the historical emission inventory; therefore, some deviations are apparent compared to the projection scenarios published in previous reports.

The current projection of pollutant emissions from agriculture is based on the most recent values in the 2024 data submission. It fully reflects recalculations in the historic emissions reported in this report.

IX.2.8.1 Manure management (NFR 3B), Animal manure applied to soil (NFR 3Da2a), Urine and dung deposited by grazing animals (NFR 3Da3)

The number of animals is a key activity data for emissions inventory calculation relating to manure management (NFR 3B), animal manure applied to soil (NFR 3Da2a), urine, and dung deposited by grazing animals (NFR 3Da3). The historical number of livestock from 2005 to 2023 was taken from an annual agricultural census from the official statistics (CZSO). The e-ANNEX NFR-3B-2 shows several animals allocated on relevant subcategories used for inventory calculation for the all-time series. No other category of livestock is monitored and recorded. The future estimated number of animals is based on the updated values of the number of livestock resulting from the official Strategy of the Ministry of Agriculture until 2030, approved by the government of the Czechia. The number of animals is considered as an average annual production. Table IX.15 shows the trends of the livestock population in the period 2005-2050.

Table IX.15 Livestock population, 2005–2050

Period	Cattle	Swine	Sheep	Poultry	Horses	Goats
2005	1 351	2 719	140	25 372	21	13
2010	1 319	1 846	200	24 838	30	22
2015	1 366	1 555	231	22 508	33	27
2020	1 340	1 546	203	24 247	38	29
2022	1 390	1 329	174	23 747	37	29
2023	1 370	1 362	179	21 937	37	29
2025	1 406	1 500	170	25 311	35	25
2030	1 437	1 500	165	26 744	35	25
2035	1 478	1 500	165	26 744	35	25
2040	1 486	1 500	165	26 744	35	25
2045	1 486	1 500	165	26 744	35	25
2050	1 486	1 500	165	26 744	35	25

No increase in the number of livestock compared to the current state is expected for 2023, 2040 and 2050. No significant decrease in their number is expected either. The priority of the current strategies of the Ministry of Agriculture of the Czechia is to at least maintain the current numbers of livestock, especially the numbers of dairy cows and pigs.

NH_3 reducing technology

According to Options for Ammonia Abatement: Guidance from the UNECE Task Force on Reactive Nitrogen implementation of NH_3 reducing technology in manure storage and applications are already used in inventory and is also used in the projection. The technologies included in the inventory and this projection is the tight lid, plastic sheeting and natural crust in case of slurry storage and band spreading - trailing hose, shoe, slurry injection, incorporation immediately by ploughing, incorporation after 4 hours and incorporation within 24 hours in case of application of slurry and manure. Current penetration rates of used abatement measures are available in the e-ANNEX NFR-3B-6. These penetration rates were not changed for the emission prediction calculation.

Emission factors and calculations

To calculate the prediction of ammonia and NO_X emissions, the same Tier 2 calculation methodology based on the mass flow of TAN through the manure management system was used to calculate the emission balance. The Manure Management N-flow tool was used. Default EF is presented in Table 3.9. 3B EMEP/EEA EIG reduced by mitigating measures have been used. Emissions of NMVOC have been calculated using the Tier 2 approach. For calculating NMVOC emissions prediction, default EFs presented in Table 3.11 for dairy cattle, and other cattle and Table 3.12 for livestock categories other than cattle of 3B EMEP/EEA EIG have been used. The estimation of PM emissions is based on the Tier 1 approach according to the 3B

EMEP/EEA EIG. For calculating $PM_{2.5}$, PM_{10} and TSP emissions predictions, default EFs presented in Table 3.5 of the EMEP/EEA EIG have been used [3].

NH_3, NO_X and NMVOC

Trends of prediction in NH_3, NO_X and NMVOC emissions originating from manure management are presented in Figure IX.8 and from manure application and animal grazing in Figure IX.9.

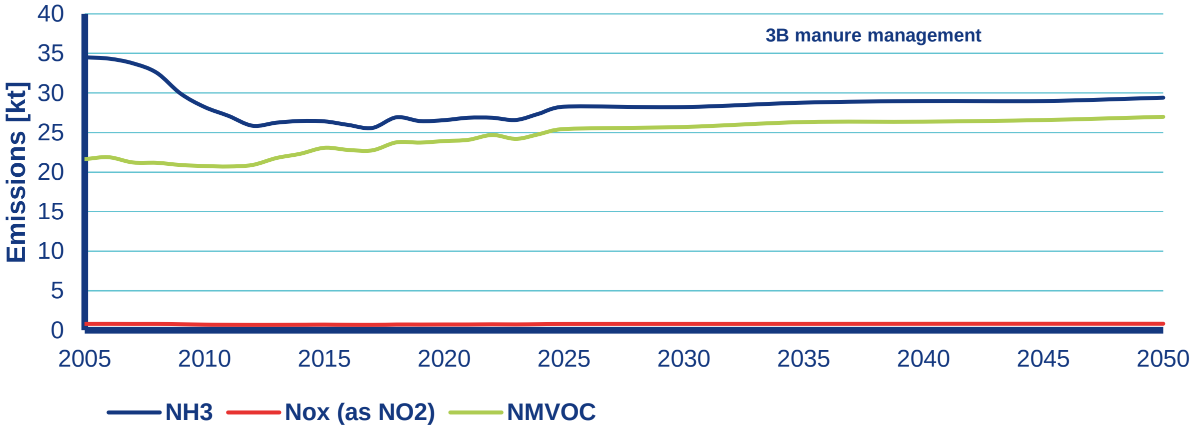


Figure IX.8 NH_3, NO_X and NMVOC emissions originating from manure management, 2005–2050

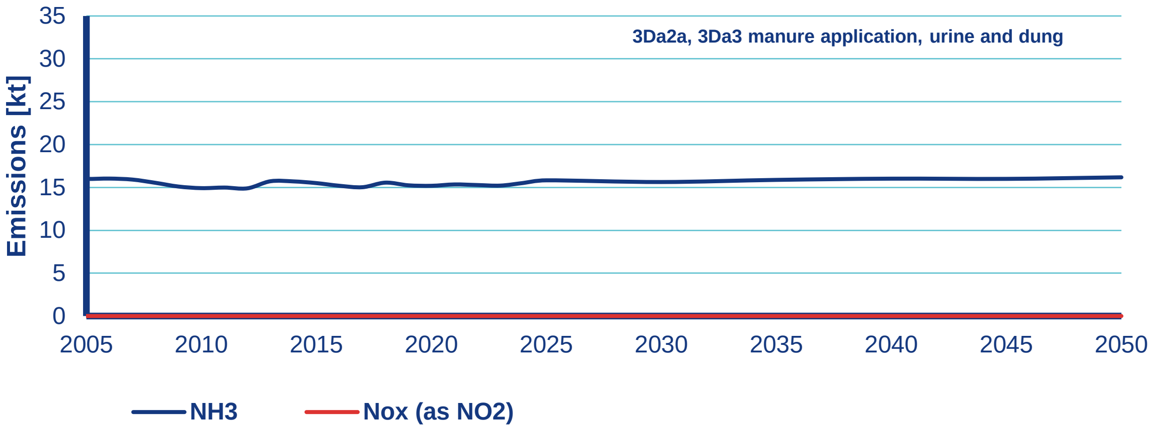


Figure IX.9 NH_3 and NO_X originating from manure application, urine and dung deposited by grazing animals, 2005–2050

The total ammonia emissions related to livestock farming are expected to decrease by approximately 18% by 2030 compared to 2005. A slight increase of approx. 1% in 2030 compared to 2005 is expected for total NO_X emissions related to livestock farming. An increase of approx. 16% can also be expected for total NMVOC emissions in 2030 compared to 2005.

IX.2.8.2 Crop production and agricultural soils (inorganic N fertilisers application) - NFR 3Da1, sewage sludge applied to soils - NFR 3Da2b, other organic fertilisers applied to soils (including compost) - NFR 3Da2c

Consumption of nitrogen mineral fertilizers is one of the key sources of ammonia and NO_X emissions from agriculture (NFR 3Da1). The increase in their consumption was associated with a significant decrease in the number of farm animals and the production of farmyard manure. The highest consumption of nitrogen mineral fertilizers, especially urea, was recorded in the production year 2015– 2016 and has been decreasing since then. The consumption of sludge and compost used for fertilizing agricultural land is not very significant and does not belong to the key sources of emissions. The historical consumption of N inorganic fertilizers from 2005 to 2023 was taken from the IFASTAT database. The future consumption of N inorganic fertilizers is based on a study prepared by the Institute of Agricultural Economics and Information (IAEI), the expert center for the agricultural economy, food, agricultural advice and information established by the Czech Ministry of Agriculture.

Fertilizers and the international obligations resulting from, for example, the "Farm to Fork" agreement are considered in future consumption of N inorganic fertilizers. Table IX.16 shows the trends of N inorganic fertilizer consumption in 2005–2050.

Table IX.16 N inorganic fertilizers consumption, 2005–2050 [kt of N]

	2005	2010	2015	2020	2023	2025	2030	2035	2040	2045	2050
Ammonium nitrate(AN)	10.0	10.0	5.5	2.2	3.26	4.14	3.6	3.15	2.79	2.47	2.25
Ammonium phosphates (AP)	4.0	5.0	4.5	4.7	2.73	2.85	2.48	2.17	1.92	1.71	1.55
Ammonium sulphate(AS)	19.0	17.0	9.1	1.2	2.37	3.49	3.04	2.66	2.35	2.09	1.90
Calcium ammonium nitrate (CAN)	108.0	90.0	98.5	106.4	74.71	142.69	124.08	108.57	96.162	85.305	77.55
NK Mixtures	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NPK Mixtures	11.5	4.0	14.8	12.3	7.53	12.33	10.72	9.38	8.31	7.37	6.70
NP Mixtures	3.0	7.0	4.0	0.1	3.74	3.22	2.80	2.45	2.17	1.93	1.75
N solutions	84.0	87.0	150.1	53.3	62.99	54.28	47.20	41.30	36.58	32.45	29.50
Other straight Ncompounds	2.5	15.0	31.6	36.8	0.24	1.56	1.36	1.19	1.05	0.94	0.85
Urea	47.0	60.0	126.3	79.3	80.02	78.84	68.56	59.99	53.13	47.13	42.85
Total	**289.0**	**295.0**	**444.4**	**296.3**	**309.5**	**303.24**	**263.84**	**230.86**	**204.48**	**181.39**	**164.9**

For the year 2030, compared to 2023, the consumption of nitrogenous inorganic fertilizers is expected to decrease by approx. 9%, among other things, due to the fulfilment of obligations arising from the European Green Deal, the introduction of so-called regenerative and carbon agriculture, or a reduction in the consumption of inorganic fertilizers to reduce the carbon footprint of cultivated crops.

NH_3 reducing technology

In 2021, an amendment to Decree No. 377/2013 on the storage and use of fertilizers came into force in the Czechia, which imposes an obligation to immediately incorporate urea into the soil or use urea with urease inhibitors only. According to Options for Ammonia Abatement:

Guidance from the UNECE Task Force on Reactive Nitrogen, the measure represents a low ammonia emissions option focused on urea-based fertilizers. This ammonia abatement measure could decrease ammonia emissions from urea applications by 70%. This measure has been incorporated into prediction since 2025. Penetration rates of used abatement measures are available in the e-ANNEX NFR-3D-7. These penetration rates have already been used for the emission inventory calculation submission 2025.

Emission factors and calculations

For national estimation of NH_3 emissions from consumption and application of inorganic N-fertilizers, the Tier 2 approach according to the 3.D Crop Production and Agricultural Soils Guidebook has been used [3]. For NOx emissions, Tier 2 is not available, therefore a Tier 1 approach was used. The same methods were used to calculate the prediction of NH_3 and NO_X emissions. Default EF is presented in Table 3.2. 3D EMEP/EEA EIG for each inorganic N-fertilizer group has been used. For urea, from 2025, measures leading to the reduction of ammonia emissions were considered, thereby reducing the recommended emission factor.

NH_3 and NO_X

Trends of prediction in NH_3 and NO_X emissions originating from inorganic N-fertilizers application are presented in Figure IX.10.

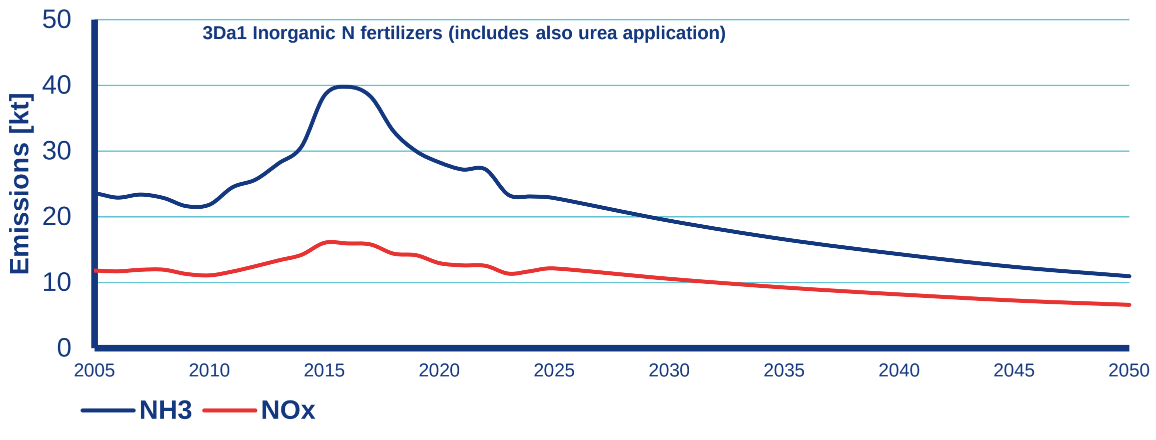


Figure IX.10 NH_3 and NO_X emissions originating from inorganic N-fertilizers application, 2005-2050

Total NH_3 emissions related to inorganic N-fertilizers application are expected to decrease by approximately 18% by 2030 compared to 2005. This reduction should be achieved because of gradually reducing the consumption of mineral fertilizers and putting reduction measures for urea-based fertilizers into practice. A similar emission reduction of 10% in 2030 compared to 2005 is also expected for NO_X emissions.

No significant change in the total emissions of NH_3 and NO_X from the application of sewage sludge (NFR 3Da2b) and other organic fertilizers (compost and digestate NFR 3Da2c) is expected in the future compared to the current state, which would affect the predictions of these emissions.

IX.2.8.3 Crop production and agricultural soils – farm-level agricultural operations, including storage, handling and transport of agricultural products (NFR 3Dc)

The area of cultivated crops is a key activity data for emissions inventory calculation relating to manure management (NFR 3Dc). The historical data regarding cultivated crop areas from 2005 to 2023 was taken from an annual agricultural census from the official statistics (CZSO). The e-ANNEX NFR- 3D-3 shows utilized agricultural areas and areas under crops. The future estimated area of cultivated crops is based on the official Strategy of the Ministry of Agriculture until 2030, approved by the government of the Czechia. Table IX.17 shows selected crops' cultivated area trends in 2005–2050.

Table IX.17 Cultivated area of selected crops, 2005-2050 (thousands ha)

	2005	2010	2015	2023	2025	2030	2035	2040	2045	2050
Wheat	820	834	830	817	853	821	834	669	762	766
Rye	47	30	22	25	27	26	27	21	24	25
Barley	522	389	366	321	355	342	347	278	317	319
Oat	52	52	42	43	63	60	61	49	56	56

Emission factors and calculations

The Tier 2 approach has been used for the NFR 3Dc soils to predict $PM_{2.5}$ and PM_{10} emissions. Tables 3.5 and 3.7 in 3D EMEP/EEA EIG for the region with wet climatic conditions present default EFs for calculating $PM_{2.5}$ and PM_{10} emissions predictions [3].

PM

The emission of PM from field operations is calculated by the area of cultivated crops multiplied by the number of operations and emission factors for each crop type and type of operation. Operations are divided into soil cultivation, harvesting, cleaning and drying. The expected trend in changes in the soil cultivation method was considered in the calculations of PM emissions projections. This trend should lead to higher use of no-till technologies than current tillage methods. Table IX.18 shows the trends of the share of the tillage method.

Table IX.18 Trends of share of tillage method, 2020–2040

Share of tillage method in the year	Conventional (deep ploughing or disc ploughing)	Minimization (shallow ploughing)	No-tillage (direct seeding)
2020	67%	32%	1%
2030	58%	32%	10%
2040	33%	32%	35%
2050	30%	35%	35%

Trends of prediction in PM emissions originating from farm-level agricultural operations, including storage, handling and transport of agricultural products, are presented in Figure IX.11.

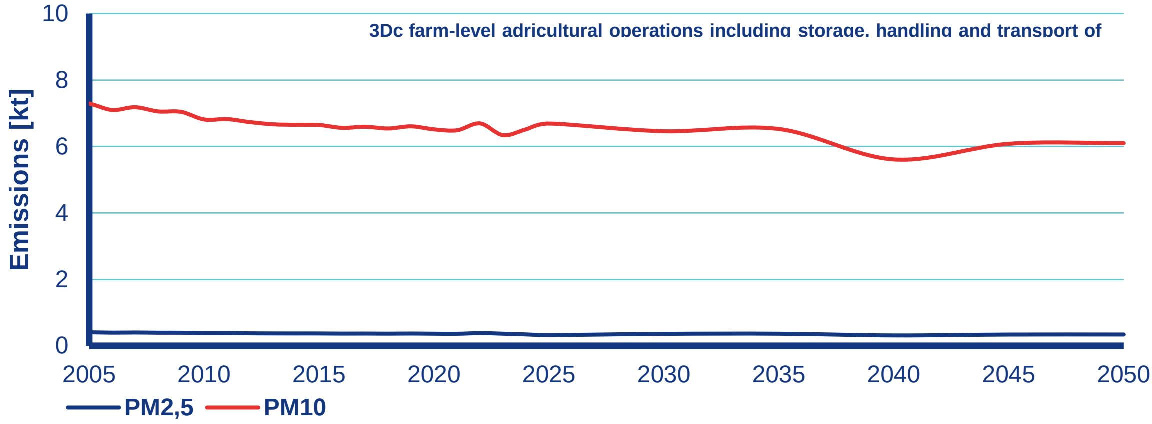


Figure IX.11 PM emissions originating from farm-level agricultural operations including storage, handling and transport of agricultural, 2005-2050

The expected change in the tillage method could decrease PM_{10} emissions by approx. 11% in 2030 compared to 2005. A similar reduction can be expected for PM $_{2.5}$ emissions.

IX.2.9 Waste - NFR 5

The waste sector (IPCC guidelines sector No. 5) in the Czechia is separated into four distinctive categories. The dominant category is NFR 5A, emissions from solid waste disposal sites. The NFR 5A is a limited source range of emissions (NMVOC, and $PM_{2.5}$).

The second source category is an NFR 5B. This source category consists mainly of composting and up to a small degree of anaerobic digestion of waste. Composting produces a small amount of NH_3. In NFR 5B2 Anaerobic digestion at biogas facilities, NH_3 emissions are estimated.

The third category is NFR 5C. NFR 5C is allocated for the Energy sector. Waste incineration produces usable energy. In NFR 5C, only hazardous and industrial waste incineration is accounted for. This category comprises a wide ray of pollutants such as NO_X, NMVOC, SO_X, $PM_{2.5}$ and BC.

The last category is NFR 5D. The category includes public and private wastewater treatment plants and industrial counterparts and is the source of NH_3 and NMVOC.

Main assumptions about future activities comes from the WMP (Waste Management Plan) of the Czechia. Key assumptions in the current WMP14 are: “The developed forecasts of municipal waste (MW) production imply that municipal waste production between 2013 and 2024 will decline slightly. It can be seen that based on these assumptions, due to the diversion of materially recoverable components of municipal material waste (MMW), in the years 2013-2024, a decrease in landfilling occurs, compensated by a significant increase in material recovery of MW, by the development of composting and anaerobic digestion, and last but not least, by energy recovery“. The WMP is updated every 10 years. The new WMP25 is not yet published and was not available for preparing the 2025 projections. Hence, this submission is still using the WMP14 assumptions.

These assumptions have yet to materialize fully. Landfill municipal solid waste has slightly increased. Waste treatment options of material recovery, energy recovery, and composting options exceeded their assumptions. However, this positive development was overshadowed by the steady increase in total generated municipal solid waste. Waste projections keep the WMP assumption that, over time, the municipal landfill waste will decrease due waste management policies. Also obligations and targets from the EU directives regarding waste, notably from the Circular Economic Package (CEP) and the Landfill Directive, are incorporated to waste projection estimations as underlying assumptions, in which the estimations are based on up to year 2050. The WMP, the CEP and the Landfill Directive include legislation and policies to reduce waste generation, reduce the amount of landfilled waste and impose restrictions to landfill recyclable waste. On the other hand, legislation promotes material recovery, recycling and energy recovery.

The primary methodological approach to emissions estimation in all categories is an equation multiplying the emission factor by activity data. Any change in methodology is noted explicitly in the specific category. The main source of emission factors is EMEP/EEA EIG [3]. Below are descriptions of underlying assumptions and driver info by the category.

In the category 5A, the estimates are based on assumption from the WMP that the activity data i.e. landfilled municipal solid waste (MSW) decreases over time. The decreasing AD has been then multiplied by the implied emission factor from 2024 to produce estimates for 2023-2050.

In the category 5B1, the estimates are based on assumption from the WMP that the activity data decreases only slightly. The AD estimate is multiplied by the EMAP Tier 1 emission factor to produce estimates for 2023-2050.

In the category 5C, the previous emission factor is applied for NO_X and NMVOC. It is in connection with emission factors from EMEP/EEA EIG. Emission factors for SO_X and NH_3 were assumed from EMEP/EEA EIG 2016. In the subcategory 5C1bv, the newest population projections from the Eurostat has been considered. The main driver for the estimates is amount of corpses. Emission estimates in the category 5C1bv are following the projected AD fluctuations, but in overall has an increasing trend from 2022 to 2050. The assumption that the ratio of burial and cremation begins to change, will be taken into account in the next submission. In the subcategory 5C2, Czechia assumes a slightly decreasing AD for the amount of open burned waste.

In the category 5D and 5E, driver for the latest estimations is based on population projections. The emission estimates first increase and then decrease following the population trend.

X. Reporting of gridded emissions and LPS

Date of the last revision: 15 March 2026

According to the UNECE Convention on Long-Range Transboundary Air Pollution as well as under the NEC Directive parties are obligated to report gridded emissions and large point sources (LPS). Being in line with the revised 2014 CLRTAP Reporting Guidelines (ECE/EB.AIR.125) both datasets shall be reported every four years from 2017 onwards for the year x-2.

Last submission (data for reporting year 2023) was provided 1. 5. 2025. In accordance with the requirements the more detailed description of basic information on the methodology used for LPS & gridded data in Czechia was prepared and submitted. Next submission (data for reporting year 2027) will be carried out by 1. 5. 2029.

X.1 Emission gridding in GNFR structure for EMEP grid

Remark: Gridded data comply summary data reported in 2017.

The preparation of gridded emissions for the year 2019 required extension of expert team for the sphere of GIS applications (IDEA ENVI, Ltd.). The data have been adjusted to the new “EMEP grid” referring to a 0.1° × 0.1° latitude-longitude projection. Emissions of individually monitored sources are being taken over into EMEP grid using coordinates of individual chimneys (approx. 50 thousand items) and emissions of collectively monitored sources are being splitted using area criterions among national totals reported in IIR. The mandatory reporting of gridded emissions includes the following pollutants: SO_X, NO_X, NH_3, NMVOC, CO, PM_{10}, $PM_{2.5}$, Pb, Cd, Hg, PCDD/PCDF, PAHs, HCB and PCBs. The following chapter describes the GIS based method and the proxy data, which was used for the allocation of national emissions to the EMEP Grid.

Czechia coverage site “new EMEP grid” is shown in Figure X.1. Presentation of selected emission data in GRID structure is a part of e-ANNEX.

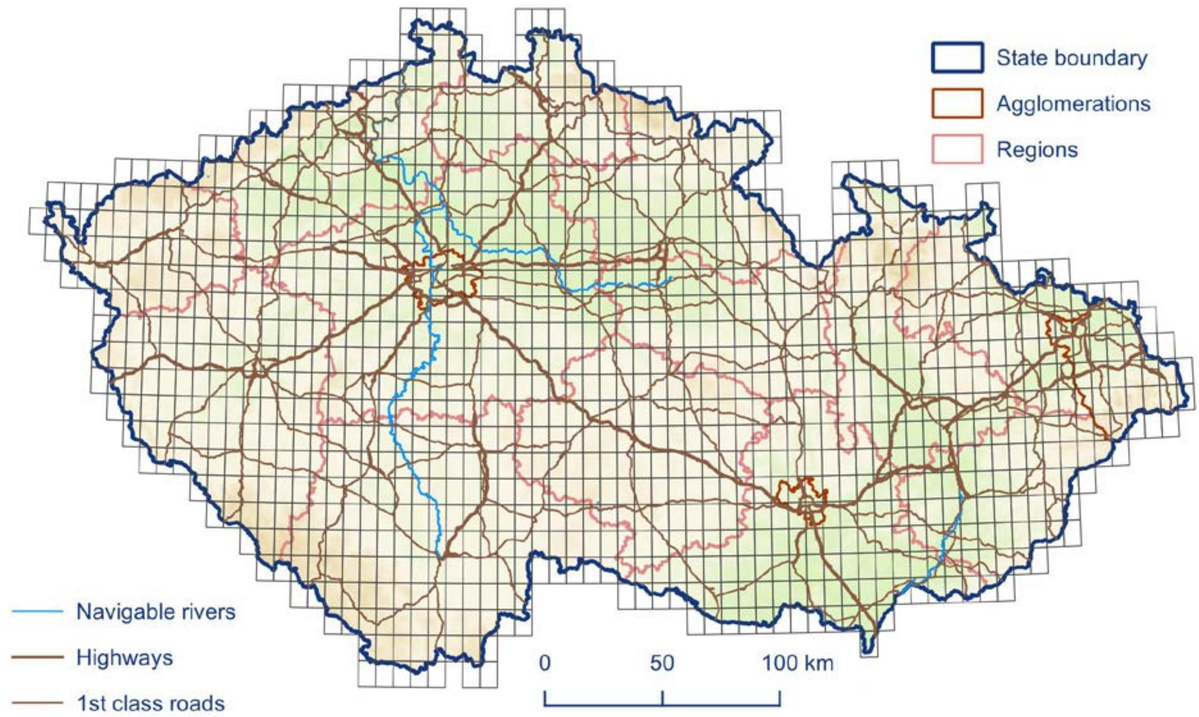


Figure X.1 EMEP Grid Czechia – allocation of regions, highways network and rivers

X.1.1 Individually monitored sources – power generation, industry, waste combustion etc.

Each significant individually monitored source in emission database REZZO is identified besides by defined chimney coordinates. Less important sources are located by address site in RUIAN registry. Integral part of application for reporting preparation there also is the unique location of each source coordinates in EMEP grid. The processing of individually monitored sources therefore takes place in two steps:

- GNFR code allocation for each individually monitored source using previous NFR code allocation used for emission reporting.
- Summary emission of each GNFR at the level of each EMEP grid element, namely 0.1° x 0.1° grid cell.

X.1.2 Collectively monitored sources

For each source group the gridding take place into EMEP grid by using GIS. For some groups of sources, for example road transport, further information like 5-year transport census is being used for EMEP gridding. For emission distribution by use of solvents at smaller facilities (printing houses, car repair shops etc.) a specific model using number of inhabitants in town and villages is being applied. Emission allocation to each EMEP grid element takes place at most of categories at the lowest NFR level and consequently sum at GNFR level either using other categories of collectively monitored sources or sum of individually monitored sources is being done.

X.1.3 Location using number of inhabitants, household heating model and construction works

The criterion of number of inhabitants in town and villages was used for emission distribution in 2D category – organic solvent use, paints and adhesives use in households by assessment of location size and its allocation considering number of communal service facilities for categories of non-industrial use of organic solvents, paints, adhesives and other VOC containing substances. Furthermore this criterion is being used for emission distribution for part of non-road transport (NFR 1A2gvii, 1A4aii, 1A4bii a 1A5b).

For significant category of household heating 1A4bi that is part of GNFR C-Other Stationary Combustion, national emission calculation model for household heating (see Figure X.1) is being applied. Emissions of each community or part of larger city are being allocated to central point of the built-up area of the community or part of it (in number of 6392) being attributed to individual part of EMEP grid.

For emissions from construction activities, data on the areas of newly completed buildings divided by individual municipalities and the lengths of completed highway sections localized into the EMEP grid were used.

X.1.4 Location using GIS layers

Emissions of following categories are being allocated by specific GIS layers:

- Road transport emission using road network layer (accumulated routes of approx. 70% of road vehicles and uncounted routes); passenger, load and bus transport are being assessed separately
- Emissions of other means of transport (railways, water routes)
- Emissions of agricultural and forest machinery (NFR 1A4cii)
- Emissions of manure application (NFR 3Da1) and agricultural works (NFR 3Dc)
- Emissions of waste from solid waste disposal on land (NFR 5A)

Emissions of following categories are being distributed by specific location methodology:

- Air transport emissions (LTO cycle) according public airport location
- Coal mining emissions (brown coal and hard coal) by assuming average emission for each part of EMEP grid in coal mining locations
- Emissions of livestock farming using case study
- Emissions of minerals mining using Mineral information system (SurIS) (NFR 2A5a)

X.2 LPS data

X.2.1 Source characteristic

Large Point Sources (LPS) are defined as facilities whose emissions within one operation unit exceed at least one of the threshold values for the 14 pollutants identified in Table 1 of the EMEP Reporting Guidelines (SO_X, NO_X, CO, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, Pb, Cd, Hg, PAHs, PCDD/PCDF, HCB, PCBs). Large Combustion sources with rated thermal input greater than 300 MW are also included. LPS are registered in Integrated Pollution Register of the Environment (IPR). It is an electronic structured database about environmental pollution from the industrial and agricultural facilities accessible to the public on the website irz.cz.

X.2.2 Methodology for LPS

LPS are ranked among specified stationary sources and they are registered within the REZZO 1 category. Data on pollutants was obtained from the Summary operation records. These emissions were strictly compared with those in IPR. If some difference was ascertained, total emissions from IPR were used. NH_3 emissions for GNFR K_AgriLivestock are not registered by the REZZO database, they were obtained directly from IPR. Source coordinates (latitude and longitude) and LPS names were also taken over from IPR. Individual sources of operation unit were aggregated according to GNFR sector and stack height classes listed in Table 2 of the EMEP Reporting Guidelines. LPS emissions were used directly in the emission inventory.

X.2.3 LPS in Czechia

For 2023, Czechia reported emissions from 416 IPR facilities divided into 510 LPS. The largest share is livestock production (66%), followed by industry (17%) and public electricity and heat production (11%).

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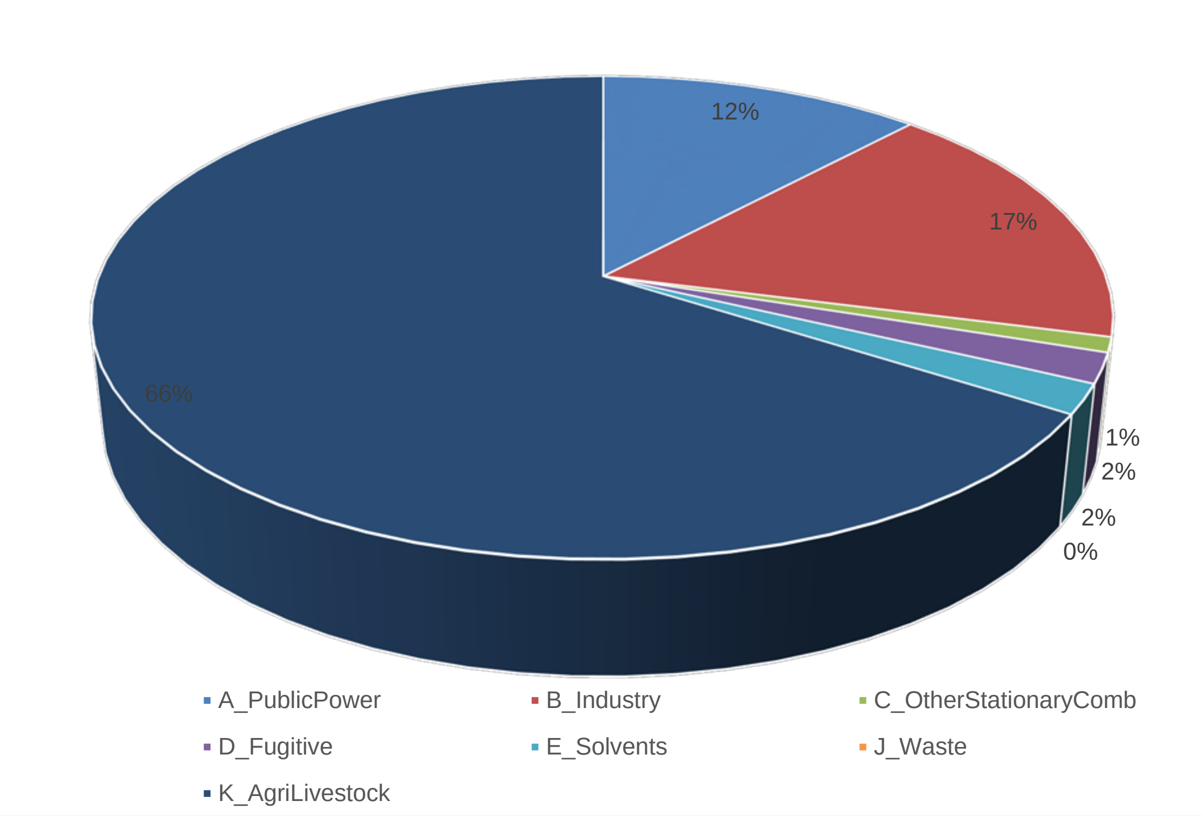

Figure X.2 Share of GNFRs in the total LPS number in 2023

The shares of national emissions covered by LPS emission in sorting from the highest are listed below in Table X.1

Table X.1 Shares of LPS emissions in national totals

Pollutant	Share [%]
Hg	66.19
SO_X (as SO_2)	64.01
NO_X (as NO_2)	28.51
PCDD/PCDF	23.97
Cd	16.28
CO	12.61
NH_3	9.44
Pb	7.70
PM_{10}	1.47
NMVOC	1.45
$PM_{2.5}$	1.14

Following Table X.2 illustrates the shares of individual GNFR categories in total LPS emissions.

Table X.2 Shares of individual GNFR categories in total LPS emissions

Pollutant	A [%]	B [%]	C [%]	D [%]	E [%]	J [%]	K [%]
NO_X (as NO_2)	65.34	34.07	0.01	0.58	0.00	0.01	0.00
NMVOC	0.00	20.80	0.00	4.42	74.79	0.00	0.00
SO_X (as SO_2)	58.55	32.01	0.62	8.78	0.00	0.01	0.00
NH_3	0.26	4.00	0.00	0.00	0.00	0.00	95.75
$PM_{2.5}$	80.00	16.83	0.00	3.16	0.00	0.00	0.00
PM_{10}	66.44	23.05	0.00	10.51	0.00	0.00	0.00
CO	4.63	95.36	0.00	0.01	0.00	0.00	0.00
Pb	0.00	100.00	0.00	0.00	0.00	0.00	0.00
Cd	55.59	44.41	0.00	0.00	0.00	0.00	0.00
Hg	82.52	17.48	0.00	0.00	0.00	0.00	0.00
PCDD/PCDF	23.14	76.86	0.00	0.00	0.00	0.00	0.00

It is apparent that the highest shares in national totals have Hg and SO_X emissions which originate predominantly from public electricity and heat production, as do emissions of NO_X, Cd, Hg, PM_{10} and $PM_{2.5}$. The main source of CO and Pb emissions are industrial processes, in the case NH_3 emission is it livestock production, NMVOC emissions come mainly from solvent use. There were no PAHs, HCB and PCBs emissions for LPS sources in 2023.

XI. Adjustments

Date of the last revision: 15 March 2026

XI.1 New adjustment for NH_3 in the year 2024

Czechia applied for an adjustment under the UNECE in the 2024 submission that was approved by the CEIP in 2024. The reason for submitting the request for an adjustment was the conclusion that the Party could not have expected and foreseen significant changes between the NH_3 emission factors from the EEA/EMEP 2019 Guidebook and the EEA/EMEP 2023 Guidebook used for calculating ammonia emissions from inorganic nitrogen fertilizers (including urea) (3Da1), which led to a large increase in these emissions. The ERT therefore recommends that the EMEP Steering Body ACCEPT this adjustment application from Czechia. An overview of the summary information on the submitted application is shown in Table XI.1.

Table XI.1Summary Information on the Submitted Application in 2024

Reasons for adjustment application (Decision 2012/3, para 6)	Emission factors used to determine emissions levels for a particular source category (i.e. 3Da1 Inorganic N fertilisers (includes urea)) for the year in which emissions reduction commitments are to be attained are significantly different than the emission factors applied to this category when emission the reduction commitments were set.
Pollutant for which adjustment is applied for	NH_3.
Sector/Pollutant for which adjustment is applied for	Inorganic N fertilizers (includes urea) (3Da1) pollutant: NH_3.
Year(s) for which inventory adjustment is applied	2020 -2022
Date of notification of adjustment to the Secretariat	16 February 2024
Date of submission of supporting documentation	15 March 2024
Resubmission of the adjustment application	25 April 2024

The impact of the adjustment on the NH_3 emission inventories of Czechia for the years 2020-2022 in kilotons is detailed in Table XI.2.

Table XI.2 Impact of adjustments on the NH3 emission inventories of Czechia for the years 2020-2022 in kilotonnes

	Unit	2005	2020	2021	2022
ERC	**% of 2005**		**7%**	**7%**	**7%**
ERC unadjusted	(kt)		77.20	77.20	77.20
NT for Compliance unadjusted	(kt)	83.01	80.02	79.65	77.95
Gap to ERC unadjusted.	**(%)**		**-4%**	**-3%**	**-1%**
ERC adjusted	(kt)		73.90	73.90	73.90
Adjusted NT for Compliance	(kt)	79.46	72.56	71.72	72.91
Gap to ERC adjusted.	**(%)**		**2%**	**3%**	**1%**
Impact of Adjustment on NT for Compliance	(kt)	-3.55	-7.46	-7.93	-5.04

https://www.ceip.at/fileadmin/inhalte/ceip/4_adjustments/adj-2024/cz_review_adj_appr_2024.pdf

XI.2 Application for adjustment

In 2026, an application for adjustment was submitted for ammonia emissions originating from the NFR 3Da1 category - Inorganic N fertilizers (includes urea) in the entire time series from 2005 to 2022. According to the current emission inventory reported as of 15 February 2026, the required reduction in NH_3 emissions for 2023 and 2024 has been achieved. In 2025, an error was detected in the calculations of ammonia emissions from NFR category 3Da1, which also affected the calculation of values for the already approved adjustment from 2024. For the fertilizer "Other straight N compounds", the emission factor according to Guidebook from 2019 was incorrectly used instead of Guidebook from 2023. Methods used for the calculation of emissions for the years 2005 – 2024 are the same as in the year the adjustments were approved. The submitted adjustment aims to correct this error in the calculations. An overview of the summary information on the submitted application is shown in Table XI.3.

Table XI.3 Summary Information on the Submitted Application in 2026

Reasons for adjustment application (Decision 2012/3, para 6)	Correction of calculation error of previously approved values
Pollutant for which adjustment is applied for	NH_3.
Sector/Pollutant for which adjustment is applied for	Inorganic N fertilizers (includes urea) (3Da1) pollutant: NH_3.
Year(s) for which inventory adjustment is applied	2005-2022
Date of notification of adjustment to the Secretariat	15 February 2026
Date of submission of supporting documentation	15 February 2026

The impact of the adjustment on the NH_3 emission inventories of NFR 3Da1 for the years 2005-2024 in kilotons is detailed in Table XI.4.

Table XI.4 Impact of adjustments on the NH3 emission inventories of NFR 3Da1 for the years 2005-2022 in kilotons

Status of Adjustment	Pollutant	NFR Code	Year	Unadjusted Activity data	Adjusted activity data	AD Revision (%)	Unit of EF (kt/AD)	Unadjusted EF	Adjusted EF	EF Revision (%)	Unadjusted Emissions (kt)	Adjusted emissions (kt)	Adjustment (kt)	Units
Previously Approved Application	NH3	3Da1	2005	295,233	295,233	0%	g NH3 (kg N ;	77,04	50,91	-34%	23,165	20,001	-3,1638	ktonnes
Previously Approved Application	NH3	3Da1	2020	323,500	323,500	0%	g NH3 (kg N ;	77,04	50,91	-34%	25,854	20,584	-5,2697	ktonnes
Previously Approved Application	NH3	3Da1	2021	315,067	315,067	0%	g NH3 (kg N ;	77,04	50,91	-34%	25,407	20,105	-5,3020	ktonnes
Previously Approved Application	NH3	3Da1	2022	288,533	288,533	0%	g NH3 (kg N ;	77,04	50,91	-34%	25,555	20,001	-5,5537	ktonnes

XII. 2025 NECD inventory review (under Directive (EU) 2016/2284)

Date of the last revision: 15 March 2026

25 observations for Czechia were under the scope by the Technical expert review team (TERT) in review 2025. The complete overview of observations with assessments and recommendations of TERT and the following responses is presented below. Follow-up to the Final Review Report 2025 is set out in Recommendation-TERT-IIR-2025 (see e-ANNEX).

Most of the recommendations were taken into account in the 2026 reporting, while the remaining ones are expected to be resolved in 2027. In particular, this concerns the transition to Tier 2 for sector 2D3a (see Chapter IV), as well as the update of emission calculations for sector 1A4bi, which is related to an ongoing research project that is being finalized.

Observations listed in review report are shown in tab.

Observation	Recommendation	Response
CZ-2D3a-2017-0001	The TERT recommends that Czechia include the corrected estimate in the next submission.	This year, the second phase of the study, focusing on the transition from Tier 1 to Tier 2, should be implemented. Its successful incorporation into the inventory depends on the availability of activity data monitored by the Czech Statistical Office. If these data can be obtained in sufficient detail by the end of 2025, an emission inventory recalculation will be carried out. If the study's completion is delayed, we will use the data submitted in the PTC for reporting in 2026.
CZ-1A1b-2025-0003	The TERT recommends that Czechia include the corrected emissions in the 2026 submission.	Thank you for this finding. There was a mistake that occurred when emissions from the refinery oil incinerations were doubled in the years 2022 and 2023. This mistake will be corrected in the resubmission.
CZ-1A1a-2025-0002	The TERT recommends that Czechia correct the error in the calculation and include recalculated values for HMs and POPs in the 2026 submission.	Thank you for this finding. In 2023 reporting, emissions were mistakenly calculated using average EF for that year instead of the long-term national EF for some incinerations, particularly for sector 1A1a. These average factors are highly variable for some sources burning coal fuels. This error will be corrected in the 2026 reporting, and the emissions of (HMs and POPs will be recalculated).
CZ-1A4ci-2024-0001	The TERT recommends that Czechia evaluate the outcome of the ARAMIS project and make effort to improve the methodology, and if	Thank you for your follow-up question. Please find the attachment. The attached table shows NH_3 emissions from NFR 1A4ci for several biomass burning boilers

	necessary, update the description and timeline for improvement in the 2026 IIR under planned improvements.	with an output of up to 5 MW. These emissions are very low. As mentioned above, the ARAMIS project is still ongoing. Therefore, we would prefer not to provide any recalculations for fuel consumption in historical years until the project is completed.
CZ-3Da2a-2025-0002	The TERT recommends that Czechia enhance transparency by providing detailed information on how penetration rates for the period from 2012 to 2023 were developed and based on what data. Regarding the penetration rate for the period from 1990 to 2010, the TERT recommends that Czechia revise its estimate by updating the penetration rate using linear interpolation from 0% to 60%, taking into account the first available data and the assumed year when the technique stated to be used. Alternatively, Czechia should provide robust justification demonstrating that the constant penetration rate of 60% is appropriate for the entire period from 1990 to 2010.	The subsidy program was provided and monitored by the State Environmental Fund. Between 2011 and 2012, approximately 305 projects focused on reducing ammonia emissions for manure application were supported with a total investment of EUR 43 million. The purchase of slurry spreaders and plows for faster incorporation of organic fertilizers was supported. Before this subsidy title, modern application technologies were not even offered in the Czechia. This measure could therefore be assessed as a successful introduction of modern reduction technologies. On the other hand, no official evaluation of the effects on reducing ammonia emissions has yet been carried out. Plowing organic fertilizers into the soil as soon as possible after application has always been common practice on large farms in the Czechia, therefore, after consultation with the Ministry of Agriculture, a penetration rate of 60% was chosen. However, no official data is available until 2016. It is not possible to officially document a fact that took place 35 years ago. Similarly, no input data was found for determining the percentage reduction in ammonia emissions as part of setting emission ceilings. It can be assumed that the emission ceilings and expected emission reductions were determined on the basis of some survey of the technologies used around 1990.

CZ-3Da2a-2025-0001	The TERT recommends that Czechia revise its estimate by updating the penetration rate using linear interpolation from 0% to 30% - taking into account the year when data first became available and the assumed year the technique began to be used, or alternatively, provide robust justification demonstrating that the constant penetration rate of 30% is appropriate for the entire 1990–2012 period.	Yes, the Czechia uses and consults data on various manure application techniques collected within the Integrated Agricultural Survey published by Eurostat and the Czech Statistical Office since 2016. As evidence of the use of individual methods of manure application (abatement technology penetration rate), the Czechia uses the data provided on the website of the Czech Statistical Office in calculating the national emission balance, see https://csu.gov.cz/produkty/integrated-farm-survey-2020 tab. 16 and https://csu.gov.cz/produkty/farm-structure-survey-2016 tab. 2021. With regard to the original question posed to TERT regarding the lack of transparency regarding the penetration rate applied for the "dairy cattle manure incorporated within 24 hours" technique for the period 1990–2012 and with regard to future calculations of national emission balances, the Czechia needs to know TERT's opinion that the described method of accounting for abatement technologies is correct and, if not, how to resolve the situation. The Czechia understands that it is important to provide verified and trustworthy data sources from a data transparency perspective. However, it is difficult to find data that no one was monitoring 20 years ago. For example, the Estonian IIR does not provide any data on the reduction technologies used before 2005. Should we proceed in a similar way?
CZ-3B-2025-0004	The TERT recommends that Czechia improve transparency by providing data on GEI, VS, and the values of Frac_of_maxsilage and Fracsilage_store used to estimate NMVOC emissions for the entire reporting period in their 2026 IIR.	The input data containing GE values are taken from the National Greenhouse Gas Emission Inventory. There is also a description of the calculation methodology on page 245. The truth is that the current version of e-Annex does not contain data on GE values. The data for calculating NMVOC emissions are provided in the attached xlsx. file.

CZ-3B-2025-0002	The TERT recommends that Czechia improve transparency by providing a complete time series of the shares of swine livestock farmed in different housing systems, along with the corresponding reference sources in time for the next submission.	The text on page 86 expresses the fact that the Research Institute of Agricultural Technology carried out an evaluation of housing systems in pig farms falling under the Integrated Pollution Prevention and Control (IPCC) legislation already in 2012. However, these findings could not be reflected in the national emission inventory calculated according to TIER 2 based on excreted nitrogen.
CZ-2H2-2025-0001	The TERT recommends that Czechia follow up on their intention to report emissions for individual PAHs for category 2H2 Food and Beverages Industry in the 2026 submission, and document the approach within the IIR.	Thank you for this notice. The expert study was prepared at a time when emission factors (EFs) for individual PAHs were not available. Czechia will update the data used for calculating emissions and include the revised values in the next report.
CZ-2B2-2025-0001	The TERT recommends that Czechia remove the reporting of PM2.5 emissions from NFR category 2B2, Nitric Acid Production, instead replacing this with the notation key 'NE' as advised in the 2023 EMEP/EEA Guidebook; the TERT further recommends Czechia to report PM10 and TSP emissions as 'NE' to remain consistent with regards to consistent reporting between linked pollutants.	Thank you for this notice. We follow the Guidebook methodology (Chapter 2B), in which only potential emissions of the $PM_{2.5}$ fraction are reported in Table 3-3 (notation key “NE”). For TSP and PM_{10} emissions, the notation key “NA” is used. In an expert study from a previous period, an emission factor (EF) of 10,000 g/Mg of HNO_3 production was proposed for TSP emissions– i.e., the same as for NO_X emissions. However, since this EF is not included in the Guidebook and particulate emissions are not reported in the national database, the value for $PM_{2.5}$ emissions will be replaced with the notation key “NE”.
CZ-2A5a-2022-0001	The TERT reiterates the 2024 recommendation that Czechia include in the forthcoming IIR the results of the expert study concerning the PM2.5 and PM10 emissions of 2005, and that action is taken to improve the time series consistency of PM2.5 and PM10 emissions.	Thank you for this question. The information provided on page 174 should have been removed from Chapter XII, as it is outdated. Although the study was prepared in 2023, its recommendations for adjusting the calculation methodologies could not be implemented or used to recalculate emissions due to personnel constraints. Therefore, this study is not included in the e-Annex documents. If the personnel situation allows, the recommendations from the expert study will be incorporated into the 2026 reporting.
CZ-1B1b-2025-0001	The TERT recommends that Czechia implement emission estimates for pollutants not being measured using Tier 1 or higher methodology, and include a description in the IIR.	Thank you for your follow-up question. We apologize, but unfortunately, we are not currently able to complete the table provided in the attachment. Due to time constraints and the limited timeframe, the

		expert is not able to fill in the table at this moment.
CZ-1A2c-2025-0001	The TERT recommends that Czechia correct the emissions in the 2026 submission and consider extending the QA/QC procedures to avoid similar issues.	Thank you for your follow-up question. We apologize, due to time constraints and the limited timeframe, the expert is not able to provide the emission calculation and fill in the table. Nevertheless, we acknowledge that a mistake has occurred during the data transfer, and we will correct it in the next submission. We either have checked the total share of emissions from that category, and would like to note that this category does not fall under the Key Category. Thank you for your understanding.
CZ-1A4bi-2023-0001	The TERT recommends that Czechia continue to follow the progress of the research project, provide an update on progress in the 2026 IIR and implement the results in full in the 2027 submission.	The research project aimed at updating national emission factors for residential combustion is currently ongoing and will continue throughout the second half of 2025. Therefore, we regret to inform that it will not be possible to implement the results in the 2026 submission. However, we can confirm that the results are expected to be available in time for the 2027 submission. We also plan to use the updated emission factors to recalculate the time series for the 1A4bi Residential: Stationary category, and align it with the updated emission projections accordingly. This will allow us to improve the transparency and accuracy of the inventory and ensure better consistency with national conditions and technologies used.
CZ-1A1a-2021-0001	The TERT recommends that Czechia correct the activity data in the 2026 submission.	Czechia confirms that the correct value is 7577 TJ, we forgot to change it in 2022. It will be fixed in 2026 submission.
CZ-0A-2023-0001	The TERT recommends that Czechia carry out the uncertainty evaluation in time for the 2026 submission and in line with the 'Guidelines for Reporting Emissions and Projections Data under the Convention on Long-range Transboundary Air Pollution'. The guidance clearly states that: 'Parties shall quantify uncertainties in their emission estimates using the most appropriate methodologies available, taking into account guidance provided in the EMEP/EEA Guidebook.	Czechia understands the need to increase the transparency of reported emission estimates by assessing uncertainties. Unfortunately, the current staff situation still does not allow for the inclusion of uncertainty assessments in other sectors. We expect partial improvements in the coming year.

	Uncertainties should be described in detail the IIR.'	

List of Figures

List of Tables

References

[1] UNECE, 'Convention on Long-range Transboundary Air Pollution', 1979. [Online]. Available: https://unece.org/sites/default/files/2021-05/1979%20CLRTAP.e.pdf

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