Integrated reporting on greenhouse gas policies and measures and on projections in the Czech Republic

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Title: Integrated reporting on greenhouse gas policies and measures and on projections in the Czech Republic

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EXECUTIVE SUMMARY

The Czech Republic is a Party to the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and the Paris agreement. Under these international agreements it is committed to provide annually information on its national anthropogenic greenhouse gas (GHG) emissions by sources and removals by sinks for all GHGs not controlled by the Montreal Protocol. As a member of the European Union, the Czech Republic has reporting obligations also under the Regulation (EU) No 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council, and Regulation (EU) No 2021/1119 of the European Parliament and of the Council, establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law').

The Czech Republic also biannually fulfils obligations to Regulation (EU) No 2018/1999 by submitting *Reporting on policies and measures and of projections of anthropogenic greenhouse gas emissions by sources and removals*. The reporting is organized and supported by the Czech Hydrometeorological Institute (CHMI) and the Ministry of Environment (MoE). The projections encompass two scenarios "with existing measures" (WEM) and "with additional measures" (WAM) according to guidelines published in the document FCCC/CP/1999/7, part II UNFCCC *Reporting Guidelines on National Communication,* and further in the above-mentioned EU documents. The reference year for both scenarios is the latest year for which emission estimates are available. In this case, the latest reported year is 2022. The projection years are 2025, 2030, 2035, 2040, 2045, and 2050. In December 2024 the EU asked Members States to prepare projections up to the year 2055. Since the projections reporting was prepared during the second half of the year 2024, it was nearly completed by that time. Collecting all the input data requires significant time, which is not available during the December to March time frame. For this reason, the projections are prepared up to 2050. Furthermore, this aligns the projections with the current National Energy and Climate Plan.

1. Policies and Measures

The Ministry of the Environment is responsible for compliance with the UNFCCC, the Kyoto Protocol and the Paris Agreement in the Czech Republic. The climate change agenda is addressed primarily within the Department of Energy and Climate Protection, which also serves as the National Focal Point for the Convention, Protocol and the Paris Agreement. Having in mind the cross-sectoral nature of climate change, which affects many other departments, the Ministry of the Environment is responsible primarily for the drafting of national policies in areas of mitigation and adaptation. Individual State departments (Ministries), such as the Ministry of the Environment, Ministry of Industry and Trade, Ministry of Transport, Ministry of Agriculture, Ministry of Regional Development etc. are then responsible for the drafting and implementation of sector-specific policies and measures aiming to reduce emissions of greenhouse gases and/or adapt to climate change impacts, according to the nature of the measures.

Since 2000, an integrated and complex system of strategic and operational planning has gradually been created, which is further modified in line with different international commitments of the Czech Republic whether assumed pursuant to post-Kyoto processes or EU policies and legislation. Legislative measures lay down rules for institutional responsibilities for coordination and implementation of various programmes and impose obligations for their regular evaluation.

A wider strategic framework is created primarily by the following documents:

- Czech Republic 2030 (adopted by the Czech Government in 2017)
- National Reform Programme (updated annually, last update in 2024)
- Regional Development Strategy 2021+ (adopted in 2019)

The most important strategic documents with direct or demonstrable indirect effect on greenhouse gas emissions are:

- State Environmental Policy of the Czech Republic 2030 with a view to 2050
- Climate Protection Policy of the Czech Republic
- National Emission Reduction Programme
- National Energy and Climate Plan of the Czech Republic
- Strategy on Adaptation to Climate Change in the Czech Republic
- National Action Plan on Adaptation to Climate Change
- State Energy Policy
- National Action Plan for Clean Mobility
- Waste Management Plan for 2025–2035
- Czechia’s National Recovery and Resilience Plan
- State Forest Policy until 2035

1.1 Cross-cutting policies and measures

1.1.1 Climate Protection Policy of the Czech Republic

The Policy defines GHG reduction targets for 2020 and 2030. It also includes indicative trajectories and objectives for 2040 and 2050. In addition to the 2030 target, the EU and its Member States committed to the objective of a climate-neutral EU by 2050. This objective was agreed by the European Council in December 2019 and communicated in March 2020 as the EU's long-term low GHG emissions development strategy under the Paris Agreement. The binding objective of climate neutrality by 2050 is enshrined in the European Climate Law, which entered into force in July 2021. Further, the Policy defines policies and measures for specific sectors on the national level.

The Government adopted the Climate Protection Policy of the Czech Republic in March 2017 and this document replaced the National Programme to Abate the Climate Change Impacts in the Czech Republic (2004). This Policy reflects significant recent developments at the EU, international and national level. The long-term perspective for a gradual transition to low-emission development until 2050 was included in such a governmental document for the first time. The Strategic Impact Assessment of the Policy was carried out and completed with an affirmative statement in January 2017.

The Climate Protection Policy sets specific targets and measures for particular sectors on the national level to fulfil greenhouse gas reduction targets resulting from international agreements as well as EU legislation. This Policy should contribute to a gradual transition to low-emission development until 2050. The Policy further sets primary and indicative emission reduction targets, which should be reached in a cost-efficient manner. Measures are proposed in the following key areas: Energy, final energy consumption, industry, transport, agriculture and forestry, waste, science, research development, and voluntary tools.

The Policy also outlines some economic aspects for the greenhouse gas reductions on the national level. The European structural and investment funds represent the main source of financing in the programming period of 2014-2020. Another key financial source is represented by the auction revenues generated by the EU ETS. The Policy was evaluated in 2021 and based on this evaluation the Policy will be updated by 2023 to reflect the new Fit for 55 package and the legally binding target of climate neutrality of the EU by 2050 set by the European Climate Law.

The European Climate Law also contains the 2030 climate target of reducing domestic emissions by at least 55% compared to 1990. It constitutes a net target, meaning that removals of CO_2 from the atmosphere are taken into account, although the total amount of removals which can be counted towards the achievement of the target is limited to a maximum of 225 Mt CO_2eq. Additionally, the European Climate Law sets out the process for developing the 2040 climate target, considering an indicative greenhouse gas budget for 2030 to 2050. Based on a detailed impact assessment and the advice of the European Scientific Advisory Board on Climate Change, on 6 February 2024, the European Commission presented its 2040 climate target communication and recommended reducing the EU's net GHG emissions by 90% by 2040 relative to 1990.

Czechia also communicated its own long-term strategy under the Paris Agreement, presenting a vision to achieve climate neutrality by 2050 through a fair transition encompassing all sectors of the economy. This strategy mentions seven strategic priorities, including reaping the full benefits of the bioeconomy and creating essential carbon sinks.

The achievement of the 2040 target will require further deployment of carbon capture, substantial reductions in GHG emissions in the land sector, and a fully developed carbon management industry by 2040. Carbon capture will need to cover all emissions from industrial processes and deliver sizable carbon removals. In addition, high levels of production and consumption of e-fuels will be necessary to further decarbonize the energy mix. Finally, the European Climate Law requires the EU and Member States to adopt adaptation strategies and sets out the rules for assessing progress toward the climate targets.

Type of policy: Regulatory

Implementing entity: Ministry of the Environment (Government)

Period of implementation: 2018-2050

Implemented in scenario: WAM

Mitigation impact: Reduction of EU's net greenhouse gas emissions by at least 55% by 2030 compared to 1990 and reaching EU-wide climate neutrality by 2050.

1.1.2 European Union Emission Trading System (EU ETS)

The EU ETS is one of the most important economic tools to reduce GHG emissions. The scheme for GHG emission allowance trading within the Community is established in Directive 2003/87/EC, as amended. The legislation is transposed into the Czech legal system by Act 383/2012 Coll. on conditions for trading of emission allowances, as amended.

The system is implemented in several phases. Phase 4 of the EU ETS implementation was launched in 2021 and will last until 2030. The annual reduction factor was increased to 2.2%, equal to the amount by which the emissions cap will decrease each year. From 2024-2027, the reduction factor is set at 4.3% per year, and from 2028 onwards at 4.4% per year. Moreover, a cap rebasing is set to take place twice, withdrawing 90 million allowances in 2024 and an additional 27 million in 2026.

Type of policy: Economic

Implementing entity: Ministry of the Environment (Government)

Period of implementation: 2005-2040

Implemented in scenario: WEM

From 2024, maritime transport emissions were brought under the system. Freely allocated allowances to the manufacturing industry are meanwhile being phased out over the current period, starting from 2026. These measures combined are set to bring an overall emission reduction in the EU ETS-covered sectors of 62% by 2030 compared to 2005.

As mentioned above, In the Czech Republic, the EU ETS is controlled via Act No. 383/2012 Coll., on conditions of trading with greenhouse gas emission allowances. This Act defines what facilities are subject to the system and the rights and obligations of operators. Operators monitor their emissions, report to the Ministry of the Environment and receive allowances. Part of the allowances is allocated free of charge; the remainder may be bought at the marketplace or in auctions. Allowances exist and can be transferred between allowance accounts within the registry, which is administered by the Czech electricity and gas market operator OTE, a.s.

As of 2040, approximately 230 facilities participated in the system. The volume of emissions covered by the trading system in the Czech Republic represented approximately 48.7% of total greenhouse gas emissions in the Czech Republic in 2022 (average share for the whole EU was about 38%). Monitored greenhouse gases include CO_2 and N_2O.

In 2023, facilities covered by the EU ETS emitted 46.67 Mt CO_2 eq. In comparison with 2005, there has been a reduction of emissions by 43.4%. Table 1-1 below shows verified emissions from individual activities and their share in total GHG emissions.

As regards aviation, under EU ETS all airlines operating in the EU are required to monitor, report, and verify their emissions, and to surrender allowances against those emissions. The airlines receive tradable allowances covering a certain level of emissions from their flights per year. The latest revision of the EU ETS Directive brought about some substantive changes. These include the following:

- Free allocation to aircraft operators will be reduced by 25% in 2024 and by 50% 2025, moving to full auctioning for the sector by 2026.
- The Commission is establishing an MRV system for non-CO2 aviation effects to apply from 2025. By the end of 2027, the Commission will deliver a report on the results and if appropriate, will make a legislative proposal to address non-CO2 effects of aviation.
- In 2026, the Commission will carry out an assessment of CORSIA to determine if it is sufficiently delivering on the goals of the Paris Agreement. The assessment will evaluate whether CORSIA has been strengthened and its level of coverage of international aviation emissions.

As CO_2 emissions from aviation have been included in the EU ETS, the main carbon pricing instrument for aviation in Europe and the first large emissions trading scheme, this measure is described in detail as a cross-cutting measure in the relevant chapter.

Each aircraft operator performing flights included in the EU ETS scope is assigned to the administrations of one of the EU Member States as determined by the aircraft operator list which is published annually by the European Commission. The overview of EU ETS coverage in the Czech Republic is included in the Table 1-1 below.

Table 1-1: EU ETS verified emissions 2005-2023 [kt CO_2 eq.]

Activity/year	2005	2010	2015	2020	2021	2022	2023
Combustion facilities	65.47	63.40	54.59	42.78	45.24	45.64	37.28
Refineries of mineral oils	1.00	1.05	0.93	0.80	0.96	0.90	0.95
Raw iron or steel	9.67	5.96	5.61	5.29	5.71	4.94	3.90
Production of coke	0.14	0.07	0.00	0.00	0.00	0.00	0.00
Production and processing of ferrous metals	0.07	0.10	0.11	0.09	0.10	0.09	0.08
Secondary aluminium	0.00	0.00	0.02	0.02	0.02	0.02	0.02
Cement and lime	3.85	3.35	3.46	3.92	4.03	3.69	2.98
Manufacture of glass	0.81	0.67	0.72	0.72	0.74	0.72	0.68
Production of ceramic	0.73	0.41	0.38	0.41	0.42	0.42	0.26
Production of mineral wool	0.00	0.04	0.06	0.05	0.06	0.06	0.05
Production of pulp	0.09	0.07	0.02	0.02	0.02	0.02	0.01
Production of paper or cardboard	0.33	0.15	0.13	0.12	0.13	0.12	0.11
Chemical industry	0.29	0.32	0.56	0.39	0.39	0.35	0.30
Other	0.00	0.00	0.06	0.07	0.07	0.07	0.07
Total CO_2 eq EU ETS emissions	82.45	75.58	66.65	54.68	57.87	57.04	46.67
Total CO_2 eq emissions (without LULUCF)	149.31	140.54	129.24	113.39	118.78	117.08	–
Share of CO_2 eq EU ETS emissions in total emissions [%]	55.22	53.78	51.57	48.22	48.72	48.72	–

Source: MoE

Mitigation impact: The estimate of EU ETS´ impact on emissions on the demand side is a result of a simulation model based on energy prices (derived from fuel prices without and with CO_2 price) and cost curves of emission reducing measures. For the demand side, the calculation involves emissions reduction of projects realized in frame of transitional free allocations of emission permits. The main assumptions are that the EU ETS directly influences about 41% of final energy consumption in the industrial sector, and indirectly about 75% heat consumers and 100% electricity consumers. Having in mind that the State Energy Policy envisages the elimination of most coal power plants and their replacement by nuclear power plants between 2030 and 2040, the gains from EU ETS are rather low. The following table shows a drop of GHG emissions caused by energy savings and changes in use of individual energy carriers. Table 1-2 and Table 1-3 show annual emissions savings from realized and planned investments from the year 2015 onwards.

Table 1-2: Expected emissions reduction of EU ETS on the demand side

Emissions reduction [kt CO_2]	2025	2030	2035
Households	535	892	1194
Services	447	656	877
Industry	568	842	1127
Total	1 551	2 390	3 198

Source: MoE

Table 1-3: Total expected emissions reduction of EU ETS

	2025	2030	2035
Total emissions reduction [kt CO_2]	3 424	6 624	7 432

Source: MoE

Additional information: It is expected that the EU ETS policy together with the Industrial Emissions Directive has forced emission polluters to not only phase-out or reconstruct (e.g. installation of new boilers) some less efficient and outdated facilities but also to switch to cleaner fuels like natural gas or biomass.

Sectors: Energy sector (public and industrial), industrial technologies (refineries, chemical sector, metallurgy, coking plants, lime production, cement, glass-making, ceramics, paper and cellulose), aviation, maritime

Greenhouse gas coverage: CO_2, N_2O

1.1.3 Effort Sharing Legislation (Effort Sharing Regulation)

Similarly to EU ETS, the EU Effort Sharing Regulation in its current shape and form provides a regulatory framework for emissions reductions between 2021 and 2030. It is based on a series of national targets covering GHG emissions of each Member State, which are out of the scope of the original ETS, i.e. transport (except aviation), buildings, agriculture (excluding LULUCF) and waste. The regulation was adopted in 2018 and has undergone further changes in 2022 as part of the “Fit for 55” legislative package.[1] As a result of the amendments, which put forward more stringent national targets, the ESR-covered emissions in the EU are expected to drop by at least 40% by 2030 as compared to 2005 levels. The ESR translates this commitment into binding annual greenhouse gas emission targets for each MS based on the principles of fairness, cost-effectiveness, and environmental integrity. For Czechia, this amounts to a reduction of 26% between 2005 and 2030 (as opposed to 14% before the 2022 revision of the legislation). In 2022, the total amount of ESR-covered emissions for Czechia was 60.63 Mt CO_2

[1] Fit for 55 – The EU’s plan for a green transition, https://www.consilium.europa.eu/en/policies/fit-for-55/.

eq. The annual progress towards the national targets under the Effort Sharing Legislation is assessed by comparing effort sharing sector GHG emission levels with the relevant annual targets under the legislation. To achieve compliance under the ESR, Member States are permitted to use flexibility options to a certain extent. Under Article 9(2) of the ESR, any debit (i.e., excess emissions) under the LULUCF Regulation in the period 2021 to 2025 is automatically deducted from Member States' AEAs under the ESR first compliance period.

Type of policy: Regulatory, Economic

Implementing entity: Ministry of the Environment

Period of implementation: 2021-2030

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures).

Sectors: Cross-sectoral

Greenhouse gas coverage: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6

1.1.4 Governance of the Energy Union and Climate Action

The overall governance of the Energy Union and the EU climate action is set by a dedicated regulation (EU) 2018/1999 of the European Parliament and the Council, which entered into force in 2018. Its goals include implementing measures towards meeting the EU 2030 energy and climate targets in line with the Paris Agreement. On its basis, all Member States are expected to draft and periodically update their National Energy and Climate Plans (NECP). Czechia has submitted the final version of its plan before the end of 2019, setting a series of targets for 2030.32 The updated plan responding to the new EU legislative developments including the Fit for 55 package was about to be approved before the end of 2024. Moreover, the Governance regulation also requires Member States to submit their long-term climate strategies, which Czechia did in the form of the Climate Protection Policy described above.

Type of policy: Regulatory

Implementing entity: Ministry of the Environment (Government)

Period of implementation: 2021–2050

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures).

Sectors: Cross-sectoral

Greenhouse gas coverage: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6

1.1.5 Climate Protection Policy of the Czech Republic

The Government adopted the Climate Protection Policy of the Czech Republic in March 2017, replacing the National Programme to Abate the Climate Change Impacts in the Czech Republic (2004). The Policy reflects significant recent developments at the EU, international and national levels. The Strategic Impact Assessment of the Policy was carried out and completed with an affirmative statement in January 2017.

The Policy defines GHG reduction targets for 2020 and 2030 while also including indicative trajectories and objectives for 2040 and 2050. Further, the Policy defines policies and measures for specific sectors on the national level in order to fulfil greenhouse gas reduction targets resulting from international agreements as well as EU legislation. The Policy aims to contribute to a gradual transition to a low-emission development until 2050. The Policy further sets primary and indicative emission reduction targets, which should be reached in a cost-efficient manner. Measures are proposed in the following key areas: energy, final energy consumption, industry, transport, agriculture and forestry, waste, science, research development, and voluntary tools.

Primary emission reduction targets

- Greenhouse gas reduction of 32 Mt CO_2 eq. by 2020 compared to 2005
- Greenhouse gas reduction of 44 Mt CO_2 eq. by 2030 compared to 2005

Indicative emission reduction targets

- Indicative target of 70 Mt CO_2 eq. of emitted greenhouse gases by 2040
- Indicative target of 39 Mt CO_2 eq. of emitted greenhouse gases by 2050

The Policy also outlined some economic aspects of GHG reductions on the national level. The European structural and investment funds represented the main source of financing in the programming period of 2014-2020. Another key financial source was represented by the auction revenues generated by the EU ETS.

The Policy was evaluated in 2021. A comprehensive update of the Policy and the underlying emission scenarios was drafted in 2023-2024, taking into account the Fit for 55 legislative package. At the time of writing, the updated document was pending a government approval.

Type of policy: Regulatory

Implementing entity: Ministry of the Environment (Government)

Period of implementation: 2017-2030

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures)

Sectors: Energy, Transport, Industrial Processes, Agriculture, LULUCF, Waste, Cross-cutting

Greenhouse gas coverage: CO_2, CH_4, N_2O, SF_6, NF_3

1.1.6 Act No. 201/2012 Coll., on Air Protection

Act 201/2012 Coll., on Air Protection is the cornerstone of the legislative framework in this area. Its objective is to prevent or limit air pollution so as to reduce health risks, lower the environmental burden of substances discharged into the air and harming ecosystems and set conditions allowing for the regeneration of the affected environment. The Act transposes a number of EU Directives in the area of air protection, regulates required ambient air quality and its monitoring obligations of source operators, defines emission limits and other operational conditions for stationary source operators.

The Act further transposes certain parts of Directive 2010/75/EU on industrial emissions (the Industrial Emissions Directive, IED), which sets stricter emission limits for selected basic pollutants and requires the use of the best available techniques (BAT). The IED aims at minimizing pollution from various industrial sources. The operators of industrial installations operating activities covered by Annex I of the IED are required to obtain an integrated permit from the authorities in the EU countries. The permit conditions including emission limit values must be based on the use of BAT. The BAT conclusions (documents containing information on the emission levels associated with BAT) serve as a reference for setting permit conditions. Certain parts of the IED are implemented into the Czech legislation also by Act 76/2002 Coll., on Integrated Prevention and Pollution Control (see below).

Type of policy: Regulatory

Implementing entity: Ministry of the Environment (Government)

Period of implementation: Since 2002

Implemented in scenario: WEM

Mitigation impact: The expected GHG savings are shown in the following table.

Sectors: Energy, Industrial Processes, Agriculture, Waste

Greenhouse gas coverage: CO_2, N_2O, CH_4

Table 1-4: Expected emissions reduction of IPPC (IED)

	2025	2030	2035
Emissions reduction [kt CO_2]	2 746	2 746	2 746

Source: CHMI

1.1.7 National Emissions Reduction Programme

The National Emissions Reduction Programme (NERP) is the fundamental conceptual material in the area of air quality and reduction of emissions from sources of air pollution. It is implemented on the basis of Article 8 of Act 201/2012 Coll., on Air Protection. The first Programme was adopted in 2007 and its latest version was approved in December 2023. The Programme complies with the requirements set by the Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants for so called national air pollution control programmes (Article 6 of the Directive). The main objective of the NERP is to meet the national emission reduction commitments applicable from 2020 to 2029 and from 2030 onwards, as laid down by the Directive.

For the implementation of the Programme a set of 3 priority measures, 11 subsidiary measures and 6 cross-sectional measures has been introduced at the national level directly aimed to reduce emissions and to improve air quality. Each of these measures is assigned to a central authority of the state administration to oversee its accomplishment. For the priority measures the effect of their implementation on the emission reduction was quantified. The measures are to be implemented in the public energy sector and household heating sector, in the transport sector and agriculture sector, predominantly in the form of legislative changes and economic instruments. Following the requirements of Directive 2016/2284, the implementation of measures set by the NERP and achievement of its goals is evaluated regularly on a biennial basis.

Type of policy: Regulatory

Implementing entity: Ministry of Environment (Government)

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures)

Sector: Energy, Industrial processes and product use, Transport, Agriculture

Greenhouse gas coverage: CH_4, N_2O, CO_2

1.2 Policies and Measures in Energy sector

Policies and Strategies

1.2.1 Energy excluding 1.A.3 Transport

1.2.1.1 State Energy Policy

The State Energy Policy (SEP) is the main strategic document for the energy sector in the Czech Republic. The Policy is cross-sectional and it serves as the framework document for the national level. The current SEP was approved by the Government in May 2015, replacing the previous SEP from 2004. The SEP is codified in Act 406/2000 Coll., on Energy Management. The time horizon of SEP is 25 years, with expected evaluation at least every five years and annual assessments of implementation measures. According to the aforementioned legislation, the SEP is binding for the government and state institutions and sets targets until 2040. In 2024, a draft update of the SEP was prepared, in line with the updates of the NECP and Climate Protection Policy and reflecting key recent developments in both energy and climate policy. This update would extend the time horizon of this document from 2040 to 2050. However, at the time of writing, the adoption of the updated SEP was still pending.

The main purpose of the SEP is to ensure a reliable, secure and environmentally-friendly supply of energy to meet the needs of the population and economy of the Czech Republic, at competitive and acceptable prices under standard conditions. It should also secure an uninterrupted energy supply in crisis situations to the extent necessary to ensure the functioning of the main components of the state and the survival of the population. The SEP (2015) has three strategic objectives– security of energy supply, competitiveness, and sustainability. These three strategic objectives are further translated into more concrete strategic priorities of the energy sector in the Czech Republic, namely i) balanced energy mix; ii) savings and efficiency; iii) infrastructure and international cooperation; iv) research, development and innovation; and v) energy security.

A new SEP and the actualization of the National Climate Energy Plan (NCEP) were prepared during the first half of 2024. The new SEP's time horizon is until 2050. However, neither of these documents was approved by mid-November 2024. Therefore, the emission projection is based on prefinal versions of these documents, namely their analytical bases modeled by the TIMES-CZ model. The scenario assumptions are described in the section 2.2.1.1.

Type of Policy: Regulatory

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: 2015-2050

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures)

Sector: Energy, Transport, Industrial Processes

Greenhouse gas coverage: CO_2

Legislative Instruments

1.2.1.2 Act No. 406/2000 Coll., on energy management

This Act transposes the relevant EU legislation including Directive 2009/28/EC on the promotion of the use of energy from renewable sources and subsequently repealing Directives 2001/77/EC and 2003/30/EC, Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products, Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.

- The Act stipulates requirements for efficiency of energy use while also setting minimum energy performance standards for new buildings and for major renovations. It further introduces energy performance certificates in case of construction, major renovation, sales and rentals of buildings or its parts. It also includes energy performance requirements for electric appliances and introduces their certificates.
- The Act requires large enterprises with energy consumption of energy facilities more than 200 MWh per year to perform an energy audit. The SMEs are obliged to perform an energy audit if the energy consumption of their energy facilities is more than 5 000 MWh per year. The requirement to perform an energy audit also applies to government institutions, regions, municipalities and certain public organizations that have energy consumption of their energy facilities greater than 200 MWh per year. The obligation does not apply to enterprises that have the standard EN ISO 50001 established and certified.
- The Act sets professional requirements for energy specialists who process energy audits, and energy assessments, issue energy performance certificates and perform controls of heating and air-conditioning systems. It also introduces an obligation for electricity or thermal energy producers in newly-established installations, to provide for at least the minimum efficiency of energy use stipulated by an implementing legal regulation. This obligation evenly applies to installations for the production of electricity or thermal energy in which a change is introduced in previously completed structures. Owners are obliged to regularly perform checks of operating boilers, and heat distribution and air conditioning systems.

Type of policy: Regulatory

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: Since 2000

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures)

Sectors: Energy

Greenhouse gas coverage: CO_2

1.2.1.3 Directive 2012/27/EU on energy efficiency (Article 5)

According to Article 5 of the Directive, 3% of the total floor area of heated and/or cooled buildings owned and occupied by its central government has to be renovated each year to meet at least the minimum energy performance requirements. Member States are required to contribute to an EU-wide target of energy savings equivalent to 11.7% until 2030 as compared to the projected energy use (based on the 2020 reference scenario). On average, Member States are expected to achieve energy savings of 1.5% p.a. until 2030. This is based on the review of the Directive that entered into force in October 2023. The updated indicative national target for Czechia equals 669 PJ of cumulative energy savings until 2030, which is also reiterated in the draft updated NECP.

Type of policy: Regulatory

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: 2012-2030

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures)

Sectors: Energy

Greenhouse gas coverage: CO_2

1.2.1.4 Directive EU/2024/1275 on the energy performance of buildings (EPBD)

The Directive, introduced first in 2002, stipulates minimum requirements as regards the energy performance of new and existing buildings, and requires the certification of their energy performance and the regular inspection of heating and air conditioning and ventilation systems in buildings with an effective rated output greater than 70 kW. The Directive contributes to the objective of reducing GHG emissions by at least 60% in the building sector by 2030 compared to 2015, and achieving a decarbonised, zero-emission building stock by 2050. Moreover, the Directive envisages the gradual introduction of minimum energy performance standards for non-residential buildings based on national thresholds to trigger the renovation of buildings with the lowest energy performance. It also sets a binding target to increase the average energy performance of the national residential building stock by 16% by 2030 in comparison to 2020, and by 20-22% by 2035, based on national trajectories. The Directive should ensure a gradual phase-out of boilers powered by fossil fuels, starting with the end of subsidies to stand-alone boilers powered by fossil fuels from 1 January 2025. The latest revised version of EPBD entered into force in May 2024.

Type of policy: Regulatory

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: Since 2024 (previous Directive since 2002)

Implemented in scenario: WEM

Mitigation impact: Emission reduction effects are shown in Table 1-5 below.

Sectors: Energy

Greenhouse gas coverage: CO_2

Table 1-5: Emissions reduction expected from implementation of EPBD

	2025	2030	2035	2040
Emissions reduction [kt CO_2 eq.]	474	446	446	446

Source: CHMI

1.2.1.5 Act No. 165/2012 Coll., on supported sources of energy

The Act transposes the earlier Directive 2009/28/EC on the promotion of the use of energy from renewable sources. Its aim is to enhance the development of RES, secondary energy sources and the highly efficient combined production of electricity and heat as well as to contribute to the increasing RES share on final energy use in line with national targets. It regulates the public support provided to the generation of electricity, heat and bio-methane from RES, secondary energy sources, highly efficient combined production of electricity and heat and decentralized electricity generation. Over time, it has gone through a number of amendments to keep up with legislative and market developments, ensuring that the public support is efficient and reasonable. Notably, these lately included the setup of a regulatory framework for energy communities, enabling citizens and municipalities to become active prosumers and encouraging the creation of local energy markets.

Type of policy: Regulatory

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: Since 2013

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures)

Sectors: Energy

Greenhouse gas coverage: CO_2, CH_4

1.2.1.6 Directive (EU) 2018/2001 as regards the promotion of energy from renewable sources (RED)

In November 2023, an amending Directive (EU) 2023/2413 entered into force. Building on the 2009 and 2018 directives, the amending Directive introduces stronger measures to ensure that all possibilities for the further development and uptake of renewables are fully utilised. This will be key to achieving the EU's objective of climate neutrality by 2050 and to strengthen Europe's security of energy supply. It responds to the need to speed up the EU's clean energy transition, setting up an overall renewable energy target of at least 42.5% binding at EU level by 2030 – but aiming for 45%. To support renewables uptake in transport and heating and cooling, the revised directive converts into EU law some of the concepts outlined in the energy system integration and hydrogen strategies, published in 2020. These concepts aim at creating an energy-efficient, circular and renewable energy system that facilitates renewables-based electrification and promotes the use of renewable fuels including hydrogen, in sectors like transport or industry where electrification is not yet a feasible option. For these hard-to-electrify sectors, the directive sets new binding targets for renewable fuels of non-biological origin. As an important bottleneck to the deployment of renewables on the ground, permitting procedures will also be easier and faster both for renewable energy projects, including through shorter approval periods and the creation of 'renewables acceleration areas', and for the necessary infrastructure projects.

Type of policy: Regulatory

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: Since 2018 (previous Directive 2009)

Implemented in scenario: WEM

Mitigation impact: We attributed 50% of new installation of biomass and biogas CHPs and 100% of new installations in solar, wind and small hydro power plants to this measure. The emission reduction was calculated from expected electricity production and average system emission coefficient for electricity production.

Sectors: Energy

Greenhouse gas coverage: CO_2

Table 1-6: Emissions reduction expected from the introduction of preferential feed-in tariffs for electricity produced from RES

Emissions reduction [kt CO_2 eq.]	2025	2030	2035	2040
	3 873	4 047	3 610	3 191

Source: CHMI

1.2.1.7 Act No. 458/2000 Coll., on business conditions and public administration in the energy sectors (Energy Act)

The Act transposes relevant EU legislation[2], includes directly applicable EU legislation[3] and sets conditions for business, public administration and energy regulation (electricity, gas and heat) while also regulating the rights and obligations of natural persons and legal entities. It concerns the organization of business activities in the energy sector while maintaining economic competition, meeting the needs of consumers, and the rights of license holders and ensuring a safe, secure and stable supply of electricity, gas and heating at acceptable prices. A major update of the Energy Act is pending a conclusion of a parliamentary procedure at the time of this writing. The new legislation introduces the concept of an active customer, a new entity in the form of an energy community, and new activities in the electricity market such as aggregation, energy storage and the provision of flexibility. The resulting law should thus be in line with energy sector developments such as decentralisation of generation, greater involvement of renewable energy sources, electricity consumption management, increasing energy efficiency, energy storage and sector coupling.

Type of policy: Regulatory

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: Since 2000

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures)

Sectors: Energy

Greenhouse gas coverage: CO_2

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[2] Directive 2009/72/EC of the European Parliament and of the Council concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC.

Directive 2009/73/EC of the European Parliament and of the Council concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC.

Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC

Directive 2005/89/EC of the European Parliament and of the Council concerning measures to safeguard security of electricity supply and infrastructure investment.

Directive 2011/83/EU of the European Parliament and of the Council on consumer rights, amending Council Directive 93/13/EEC and Directive 1999/44/EC of the European Parliament and of the Council and repealing Council Directive 85/577/EEC and Directive 97/7/EC

[3] Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission network.

Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity.

Regulation (EC) No 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators.

Council Regulation No 617/2010 of 24 June 2010 concerning the notification to the Commission of investment projects in energy infrastructure within the European Union.

Regulation (EU) No 994/2010 of the European Parliament and of the Council of 20 October 2010 concerning measures to safeguard security of gas supply.

Financial Schemes and Programmes

1.2.1.8 State Program to Support Energy Savings and Use of Renewable Energy Sources (EFEKT)

The EFEKT is a national plan developed to promote measures to increase energy efficiency and to incentivize the use of renewable and secondary energy sources by the approved State Energy Policy and sustainable development principles. Specifically, it supports energy information distribution, awareness-raising activities, organization of public seminars, energy information centres and small investment actions leading to energy savings and the use of RES. The sectors covered are the state administration, local (municipalities) and regional governments, schools, social and health care facilities, private sector (undertakings), households and NGOs. The Programme was implemented during its initial run (since 2005) not only by the Ministry of Industry and Trade but also by ten other ministries. Since 2007, the programme has been renamed to EFEKT, and as such it has been fully implemented solely by MIT.

Type of policy: Economic (subsidies), Education, Information, Research

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: 2004-2016, since 2007 as the EFEKT Programme is implemented only by the Ministry of Industry and Trade

Implemented in scenario: WEM

Mitigation impact: The expected energy savings of the Programme EFEKT are shown in Table 1-7 and Table 1-8 below.

Sectors: Energy

Greenhouse gas coverage: CO_2

Table 1-7: Expected energy savings of programme EFEKT

	2025	2030	2035	2040
Energy savings [TJ]	298	298	298	298

Source: CHMI

Using emission factors, which respect changes in the fuel mix in power and heat generation and the final energy consumption, we obtain the following reductions in greenhouse gases emissions (Table 1-8).

Table 1-8: Expected emissions reduction of programme EFEKT

	2025	2030	2035	2040
Emissions reduction [kt CO_2 eq.]	20.10	19.29	17.72	15.07

Source: CHMI

Only new effects after 2015 are included in the tables.

1.2.1.9 State Programme on the Promotion of Energy Savings (EFEKT II and EFEKT III)

In 2016, the EFEKT programme was amended for the 2017-2021 period and renamed as State Programme on the Promotion of Energy Savings. The yearly budget was increased to CZK 150 mil. The so-called EFEKT II particularly aimed at soft measures such as promoting education and raising awareness in the area of energy savings, but also at smaller scale investment actions and pilot projects. The new programme did not support the use of renewable energy anymore and focused solely on energy efficiency measures. One of the most important supported areas of the programme was increasing energy efficiency in public lighting systems.

A continuation scheme was set up for 2022-2027, called EFEKT III. The programme financially supports the increase of energy efficiency through awareness-raising and educational activities, energy consultancy centres and expert training as well as energy management, providing only non-investment support. By doing so, it contributes to the energy efficiency target set by Directive 2012/27/EU on energy efficiency. The planned aggregate budget for the current operating period 2022-2027 is just under CZK 1 bn. The expected energy savings induced by this programme amount to 16.5 PJ on aggregate between 2021 and 2030.

Type of policy: Education, Advisory, Information, Research

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: 2017-2021, 2022-2027

Implemented in scenario: WEM

Mitigation impact: The expected programme energy savings are shown in the following Table 1-9

Sectors: Energy

Greenhouse gas coverage: CO_2

Table 1-9: Expected energy savings of programme EFEKT 2 and EFEKT 3

	2025	2030	2035	2040
Energy savings [TJ]	778	778	778	778

Source: CHMI

Using emission factors, which respect changes in the fuel mix in power and heat generation and the final energy consumption, we obtain the following reductions in greenhouse gases emissions (Table 1-10).

Table 1-10: Expected emissions reduction of programme EFEKT 2 and EFEKT 3

	2025	2030	2035	2040
Emissions reduction [kt CO_2 eq.]	52.58	50.46	46.35	39.43

Source: CHMI

1.2.1.10 New GREEN SAVINGS Programme 2013

The New Green Savings Programme 2013 was a subsidy program of the Ministry of the Environment (administrated by the State Environmental Fund) focused on energy savings and the use of renewable energy in single-family houses.

The program exclusively focused on the insulation of family houses in combination with the replacement of inefficient boilers using solid fuels. The program further supported the installation of solar systems for hot water.

Type of policy: Economic

Implementing entity: State Environmental Fund (Government)

Period of implementation: In 2013 only

Implemented in scenario: WEM

Mitigation impact: The expected programme energy savings are shown in the following Table 1-11

Sector: Energy, Residential

Greenhouse gas coverage: CO_2

Table 1-11: Expected energy savings of the New Green Savings Programme 2013

	2025	2030	2035	2040
Energy savings [TJ]	103	103	103	103

Source: CHMI

Using emission factors, which respect changes in the fuel mix in power and heat generation and the final energy consumption, we obtain the following reductions in greenhouse gases emissions (Table 1-12).

Table 1-12: Expected emissions reduction related to energy savings of the New Green Savings Programme 2013

	2025	2030	2035	2040
Emissions reduction [kt CO_2 eq.]	4.35	4.05	3.76	3.42

Source: CHMI

1.2.1.11 New Green Savings Programme

This funding scheme is a follow-up of the previously implemented Green Savings Program. It is implemented by the State Environmental Fund of the Czech Republic and it aims at the improvement of energy performance of single- and multi-family buildings (insulation, replacement of old inefficient boilers by new boilers using e.g. biomass; installation of heat pumps and solar systems for hot water). It is generally considered the most successful and most effective programme in this area, and has served as a template for similar schemes abroad. Between 2014 and 2021, it has had over 74 thousand recipients and disbursed 16 bn CZK. In the past, it was funded directly from national EU ETS revenue. Since 2021, it has been funded via the National Recovery Plan (i.e. from the Recovery and Resilience Facility), and after its conclusion, it will be funded by the Modernization Fund. The recipients of support can claim up to 50% of eligible expenses.

Type of policy: Economic

Implementing entity: State Environmental Fund (Government)

Period of implementation: 2014-2030

Implemented in scenario: WEM

Mitigation impact: The expected programme energy savings are shown in the following Table 1-13

Sector: Energy, Residential

Greenhouse gas coverage: CO_2

Table 1-13: Expected energy savings of the New Green Savings Programme 2014–2020

	2025	2030	2035	2040
Energy savings [TJ]	9 074	9 074	9 074	9 074

Source: CHMI

Using emission factors, which respect changes in the fuel mix in power and heat generation and the final energy consumption, we obtain the following reductions in greenhouse gases emissions (Table 1-14).

Table 1-14: Expected emissions reduction related to energy savings of the New Green Savings Programme 2014–2020

	2025	2030	2035	2040
Emissions reduction [kt CO_2 eq.]	467.67	437.83	404.26	364.01

Source: CHMI

1.2.1.12 Programme PANEL / NEW PANEL / PANEL 2013 +

The Programme PANEL (NEW PANEL since 2009, PANEL 2013 + since 2013) supports complex renovation and upgrades of residential houses improving their value, lowering their energy intensity and fundamentally extending their lifetime. The program is managed by the State Investment Promotion Fund. Since 2013, the support has taken exclusively the form of low-interest discounted loans. Owners of apartment buildings are eligible for support, be it natural or legal persons, including municipalities. The supported activities include complex repairs of building malfunctions, repairs and renovation of common space, and modernization of apartments. In this context, the approved support may or may not have a direct impact on energy savings. The expected annual budget for the current period 2021–2026 is estimated to be about CZK 270 mil.

Type of policy: Economic

Implementing entity: State Housing Fund (Government)

Period of implementation: Since 2001, temporarily suspended in 2010, continues from 2013 and includes annual evaluation and budgeting exercise

Implemented in scenario: WEM

Mitigation impact: The expected programme energy savings are shown in the following Table 1-15

Sectors: Energy, Residential

Greenhouse gas coverage: CO_2

Table 1-15: Expected energy savings of the PANEL programme

	2025	2030	2035	2040
Energy savings [TJ]	204	204	204	204

Source: CHMI

Using emission factors, which respect changes in the fuel mix in power and heat generation and the final energy consumption, we obtain the following reductions in greenhouse gases emissions (Table 1-16).

Table 1-16: Expected emissions reduction related to energy savings of the PANEL programme

	2025	2030	2035	2040
Emissions reduction [kt CO_2 eq.]	16.05	15.54	14.58	13.29

Source: CHMI

1.2.1.13 Operational Programme Environment 2007-2013

The Operational Programme Environment 2007–2013 was focused on improving the quality of the environment in the Czech Republic. It was primarily focused on the public sector (e.g. municipalities, regions, organizations partly funded from the public purse, state enterprises, non-governmental non-profit organizations). However, in certain areas also business entities and natural persons were included as recipients of support. The Programme had eight priority axes. In terms of energy savings, the priority axis 3 was the most significant. This priority axis supported projects for the construction or reconstruction of facilities using renewable energy sources and cogeneration, and projects aimed at energy savings and the reuse of waste heat outside of the business sector. Priority axis 2 was also significant. It focused on improving air quality, which also resulted in reduction of energy consumption. According to the final programme report, the total certified costs reported to the EC of realized projects were EUR 1 069 mil.

Type of policy: Economic

Implementing entity: State Environmental Fund (Government)

Timeframe: 2007-2013

Implemented in scenario: WEM

Mitigation impact: The expected energy and GHG savings, including related to RES deployment, are shown in the following tables.

Sectors: Energy

Greenhouse gas coverage: CO_2

Table 1-17: Energy Savings of Operational Program Environment 2007–2013

	2025	2030	2035	2040
Energy savings [TJ]	824	824	824	824

Source: CHMI

Table 1-18: Emissions reduction related to energy savings of Operational Program Environment 2007–2013

	2025	2030	2035	2040
Emissions reduction [kt CO_2 eq.]	81.25	74.07	65.50	53.32

Source: CHMI

Besides energy savings, the programme supported the use of RES as well. The calculation of emissions savings uses amounts of electricity and heat produced from RES, again concerning the development of fuel mix used for electricity and heat production. The following Table 1-19 shows electricity and heat production from RES as indicated in the final programme report and the derived emission drops.

Table 1-19: Energy production from RES and reached emissions reduction of Operational Program Environment 2007–2013

	2025	2030	2035	2040
Electricity generation from RES [TJ]	2.3	2.3	2.3	2.3
Heat generation from RES [TJ]	242.3	242.3	242.3	242.3
GHG emissions reduction [kt CO_2 eq.]	23.8	22.2	20.4	17.9

Source: CHMI

1.2.1.14 Operational Programme Environment 2014-2020

The aim of the Operational Programme Environment 2014–2020 was to protect and improve the quality of the environment in line with the principles of sustainable development. Two priority axes relevant to GHG emission reductions were axis 2– Improvement of Air Quality and axis 5– Energy Savings. For the programming period 2014–2020 the total allocation was more than EUR 3 billion including about EUR 1 billion for activities improving air quality and energy efficiency. Priority axis 2 supported mainly the replacement of boilers burning solid fuels with more efficient low-emission boilers combusting biomass, liquid or gas fuels, and heat pumps. The priority axis 5 supported insulation and other energy efficiency measures in the public sector and promoted increased use of renewable energy sources. It also subsidized the construction of new public buildings in passive standard. The program projects were financed from the European Regional Development Fund (ERDF) and from the Cohesion Fund (CF). The expected program budget for energy savings and RES support was CZK 23.6 bn. (approx. EUR 908 mil.).

Type of policy: Economic

Implementing entity: Ministry of the Environment (Government)

Period of implementation: 2014–2020, all supported projects must be implemented by the end of 2023 at the latest.

Implemented in scenario: WEM

Mitigation impact: The expected energy and GHG savings, including related to RES deployment are shown in the following tables.

Sectors: Energy

Greenhouse gas coverage: CO_2

Table 1-20: Energy Savings of Operational Program Environment 2014–2020

Energy savings [TJ]	2025	2030	2035	2040
	4 740	4 740	4 740	4 740

Note: The table contains not only emissions drop resulting from higher efficiency of new boilers but also drop from switching from fossil fuels to RES, because RES were calculated as energy savings. Source: CHMI

Table 1-21: Emissions reduction related to energy savings of Operational Program Environment 20014–2020

Emissions reduction [kt CO_2 eq.]	2025	2030	2035	2040
	467.35	426.09	376.79	306.70

Source: CHMI

Table 1-22: Energy production from RES and reached emissions reduction of Operational Program Environment 2014–2020

	2025	2030	2035	2040
Electricity generation from RES [TJ]	7.9	7.9	7.9	7.9
Heat generation from RES [TJ]	150.0	150.0	150.0	150.0
GHG emissions reduction [kt CO_2 eq.]	15.7	14.6	13.3	11.6

Source: CHMI

1.2.1.15 Operational Programme Environment 2021-2027

The third edition of this Operational Programme offers an overall funding allocation of CZK 61 bn. for a broad range of projects, most of which promise a positive climate impact. There are six areas of support: energy savings (CZK 12.2 bn), renewable energy sources (CZK 7 bn), climate change adaptation (CZK 10.2 bn), water supply and sewage (CZK 14.1 bn), circular economy (CZK 7.1 bn), nature and pollution (CZK 10.6 bn). The overarching goal of the Programme is securing a quality environment for people’s lives, supporting a transition towards circular economy and efficient resource use, limiting negative impacts of human activities on the environment and climate, and mitigating the impacts of climate change. There is a broad number of potential recipients of funding including municipalities, businesses, state-established organisations, public institutions, research entities, natural persons or NGOs.

Type of policy: Economic

Implementing entity: Ministry of the Environment (Government)

Period of implementation: 2021-2027

Implemented in scenario: WEM

Mitigation impact: The expected GHG reduction amounts to 258kt CO_2eq by 2030.

Sectors: Energy, Industrial Processes and Product Use

Greenhouse gas coverage: CO_2

1.2.1.16 Integrated Regional Operational Programme (IROP)

The EU Integrated Regional Operational Programme (IROP) has existed since 2014 with the current programming period running from 2021 until 2027. In the preceding programming period, there was one priority that yielded energy savings: "Promoting energy efficiency, intelligent systems energy management and use of energy from renewable sources public infrastructures, including in public buildings and in housing", with a financial allocation of approximately CZK 17 bn. Currently, the Programme is divided into ten areas/specific targets. Out of those, the following two are relevant for the use of this report: green infrastructure of cities and municipalities (CZK 10.9 bn); clean and active mobility (CZK 20.4 bn). Revitalization of parks or the purchase of ZEV for public transport and construction of charging stations by municipalities are examples of projects that can earn support from these schemes.

Type of policy: Economic

Implementing entity: Ministry of Regional Development (Government)

Period of implementation: 2014-2027

Implemented in scenario: WEM

Mitigation impact: The expected energy and GHG savings of the 2014-2020 Programme are shown in the following tables.

Sectors: Energy

Greenhouse gas coverage: CO_2

Table 1-23: Expected energy savings of the Integrated Regional Operating Programme

Energy savings [TJ]	2025	2030	2035	2040
	3.168	3.168	3.168	3.168

Source: CHMI

Using emission factors, which respect changes in the fuel mix in power and heat generation and the final energy consumption, we obtain the following reductions in greenhouse gases emissions (Table 1-24).

Table 1-24: Expected emissions reduction related to energy savings of the Integrated Regional Operating Programme

Emissions reduction [kt CO_2 eq.]	2025	2030	2035	2040
	248.65	240.83	225.96	205.91

Source: CHMI

1.2.1.17 Operational Programme Prague – Growth Pole of the Czech Republic

The operational programme under the auspices of the City of Prague focuses on improving the energy performance of buildings and the technical equipment used to ensure the operation of municipal public and road transport, and the implementation of pilot projects to convert energy intensive municipal buildings into nearly-zero energy buildings. These measures fall within the priority axis 2: Sustainable mobility and energy savings. The expected annual budget for the period 2014-2020 is estimated to be about CZK 1.9 bill. (EUR 74.5 mill.)

Type of policy: Economic

Implementing entity: City of Prague

Period of implementation: 2014-2020

Implemented in scenario: WEM

Mitigation impact: The expected energy and GHG savings are shown in the following tables.

Sectors: Energy

Greenhouse gas coverage: CO_2

Table 1-25: Expected energy savings of the Operational Programme Prague Growth Pole

Energy savings [TJ]	2025	2030	2035	2040
	36	36	36	36

Source: CHMI

Using emission factors, which respect changes in the fuel mix in power and heat generation and the final energy consumption, we obtain the following reductions in greenhouse gases emissions (Table 1-26).

Table 1-26: Expected emissions reduction related to energy savings of the Operational Programme Prague Growth Pole

Emissions reduction [kt CO_2 eq.]	2025	2030	2035	2040
	3.51	3.20	2.83	2.30

Source: CHMI

1.2.1.18 JESSICA Programme

The programme offers long-term low-interest loans for the reconstruction or modernization of residential buildings. It is implemented by the Ministry of Regional Development. The programme is designed for all owners of residential houses:

- Municipalities
- Housing Cooperatives
- Other legal and natural persons owning a residential building
- Community of apartment owners
- Non-profit organizations for social housing.

The program focuses on:

- Insulation of internal structures and external cladding including replacement of windows and doors,
- Reconstruction of technical equipment (e.g. heating system, plumbing, heating, gas, water, air conditioning, elevators),
- Replacement or modernization of loggias, balconies, railings,
- Repairing static failures of supporting structures,
- Rehabilitation of foundations and waterproofing of substructures,
- Provision of modern social housing through renovation of existing buildings.

The expected annual budget for the period 2014-2020 is estimated to be about CZK 0.6 bn (EUR 23.1 mill.).

Type of policy: Economic

Implementing entity: Ministry of Regional Development (Government)

Period of implementation: 2014-2016

Implemented in scenario: WEM

Mitigation impact: The expected programme energy savings are shown in the following tables.

Sectors: Energy

Greenhouse gas coverage: CO_2

Table 1-27: Expected energy savings of the JESSICA programme

	2025	2030	2035	2040
Energy savings [TJ]	24	24	24	24

Source: CHMI

Using emission factors, which respect changes in the fuel mix in power and heat generation and the final energy consumption, we obtain the following reductions in greenhouse gases emissions (Table 1-28).

Table 1-28: Expected emissions reduction related to energy savings of the JESSICA programme

	2025	2030	2035	2040
Emissions reduction [kt CO_2 eq.]	1.91	1.85	1.74	1.59

Source: CHMI

1.2.1.19 ENERG Programme

The programme of the Ministry of Industry and Trade is focused on the provision of soft and interest-free loans for the implementation of projects improving energy performance in the business sector. The administrator of the financial instrument is the National Development Bank.

The budget for the programme was set to almost CZK 130 mil.

Type of policy: Economic

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: Since 2017

Implemented in scenario: WEM

Mitigation impact: The expected programme energy savings are shown in the following tables.

Sectors: Energy

Greenhouse gas coverage: CO_2

Table 1-29: Expected energy savings of the ENERG Programme

	2025	2030	2035	2040
Energy savings [TJ]	40	40	40	40

Source: CHMI

Using emission factors, which respect changes in the fuel mix in power and heat generation and the final energy consumption, we obtain the following reductions in greenhouse gases emissions (Table 1-30).

Table 1-30: Expected emissions reduction related to energy savings of the ENERG programme

	2025	2030	2035	2040
Emissions reduction [kt CO_2 eq.]	3.67	3.49	3.20	2.70

Source: CHMI

1.2.1.20 Operational Programme Enterprise and Innovation (OPEI): Eco-Energy

The Priority Axis 3 (Eco-Energy) of the OPEI supported by The Ministry of Industry and Trade (MIT) had seven priority axes (e.g. Development of firms, Innovation, Business development services, Technical assistance) out of which priority Axis 3 (Effective Energy or Eco-Energy) focused on energy savings and the use of RES (renewable energy sources), thus aiming at GHG reduction. The program aimed at reducing energy intensity in production processes, reducing fossil fuel consumption and increasing the use of renewable and secondary energy sources. The aid beneficiaries were not only small- or medium-sized, but also large enterprises.

The support also focused on the construction of new facilities for the generation and transmission of electricity and thermal energy generated from RES and on the reconstruction of existing production facilities to use renewable energy sources. Further support was provided for the modernization of existing energy production facilities to increase their efficiency and for the implementation of systems measuring and regulating energy. Further, modernization and loss reduction in the transmission of electricity to heat and the use of waste energy in industrial processes were encouraged.

According to the latest programme annual report, the eligible costs of realized projects were EUR 777.8 mill. The corresponding subsidies from the EU and national funds were EUR 303.3 mill.

Type of policy: Economic (subsidies)

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: 2007-2013

Implemented in scenario: WEM

Mitigation impact: The expected energy and GHG savings, including related to RES deployment are shown in the following tables.

Sectors: Energy, Manufacturing industries and construction, Agriculture

Greenhouse gas coverage: CO_2, CH_4, N_2O

Table 1-31: Energy savings of the OPEI programme

	2025	2030	2035	2040
Energy savings [TJ]	1 105	1 105	1 105	1 105

Source: CHMI

Using emission factors, which respect changes in the fuel mix in power and heat generation and the final energy consumption, we obtain the following reductions in greenhouse gases emissions (Table 1-32).

Table 1-32: Emissions reduction resulting from energy savings of the OPEI programme

	2025	2030	2035	2040
Emissions reduction [kt CO_2 eq.]	98.41	95.24	88.66	75.82

Source: CHMI

Besides energy savings, the programme supported the use of RES as well. The calculation of emissions savings uses amounts of electricity and heat produced from RES, again concerning the development of fuel mix used for electricity and heat production.

Table 1-33: Energy production from RES and corresponding emissions reduction of the OPEI programme

	2025	2030	2035	2040
Electricity generation from RES [TJ]	451.8	451.8	451.8	451.8
Heat generation from RES [TJ]	58.5	58.5	58.5	58.5
GHG emissions reduction [kt CO_2 eq.]	86.8	86.8	86.8	86.8

Source: CHMI

1.2.1.21 Operational Programme Enterprise and Innovation for Competitiveness (2014–2020)

The Operational Programme Enterprise and Innovations for Competitiveness (OP EIC) was focused on increasing the competitiveness of the Czech economy by supporting the business environment, promoting innovations in the production and services sectors, energy treatment and the development of ICT. EU funding allocation reached EUR 4.33 billion. Direct impact on effective energy management and use of renewable sources was apparent for Priority Axis 3 'Efficient energy management, development of energy infrastructure and renewable energy sources, support for the introduction of new technologies in the management of energy and secondary raw materials'. Priority Axis 3 covered 28.1% of the allocation of the OP EIC and was directly linked to the fulfilment of selected key objectives of the Europe 2020 strategy. The programme was financed by the European Regional Development Fund (ERDF) to support enterprises, mostly SMEs.

Type of policy: Economic (subsidies)

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: 2014-2020

Implemented in scenario: WEM

Mitigation impact: The expected programme energy savings are shown in the following tables.

Sectors: Energy

Greenhouse gas coverage: CO_2

Table 1-34: Expected energy savings of the programme Operational Programme Enterprise and Innovation for Competitiveness

	2025	2030	2035	2040
Energy savings [TJ]	13 030	13 030	13 030	13 030

Source: CHMI

Using emission factors, which respect changes in the fuel mix in power and heat generation and the final energy consumption, we obtain the following reductions in greenhouse gases emissions (Table 1-35).

Table 1-35: Expected emissions reduction resulting from energy savings of the programme Operational Programme Enterprise and Innovation for Competitiveness

	2025	2030	2035	2040
Emissions reduction [kt CO_2 eq.]	1160.04	1122.63	1045.09	893.72

Source: CHMI

Table 1-36: Expected energy production from RES and corresponding emissions reduction of the programme Operational Programme Enterprise and Innovation for Competitiveness

	2025	2030	2035	2040
Electricity generation from RES [TJ]	1 424.6	1 424.6	1 424.6	1 424.6
Heat generation from RES [TJ]	712.3	712.3	712.3	712.3
GHG emissions reduction [kt CO_2 eq.]	280.2	258.0	216.2	163.9

Source: CHMI

1.2.1.22 OP Technology and application for competitiveness (OP TAC) 2021 – 2027

The programme is primarily aimed at providing financial support to SMEs and large companies. Its principal aim is to increase the value added and productivity performed by Czech companies (especially SMEs) and to improve their standing in global value chains. It is financed from the European Regional

Development Fund. Among its five priorities, one is focused on supporting the transition towards a low-carbon economy and another on improving efficient resource management. The supported measures include reducing energy intensity of commercial buildings, increased use of RES, combined heat and power generation or heat pumps, energy accumulation, improving energy efficiency of production processes, development of intelligent energy systems or employing principles of circular economy. The overall financial allocation of the programme is approx. CZK 81.5 bn.

Type of policy: Economic

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: 2021-2027

Implemented in scenario: WEM

Mitigation impact: The expected energy savings amount to 3.575 TJ/year by 2029. The expected GHG savings amount to 639 kt CO2eq/year by 2029 as compared to the 2020 baseline.

Sectors: Energy

Greenhouse gas coverage: CO_2

1.2.1.23 Modernisation Fund

The Modernisation Fund is a dedicated funding programme to support 13 lower-income EU Member States in their transition to climate neutrality by helping to modernise their energy systems and improve energy efficiency. It was established by the revised EU ETS Directive in 2018 and has undergone a further update including an increase in allocation in the meanwhile. The Modernisation Fund is funded from revenues from the auctioning of 2% of the total allowances for 2021-30 under the EU ETS, 2.5% of the total allowances for 2024-2030, and additional allowances transferred to the Modernisation Fund by beneficiary Member States. In early 2021 the Czech government approved the programming document for the Modernisation Fund and first calls for project proposals were open in 2021. The Modernisation Fund was designed to be complementary to other national support programmes and operational programmes. In terms of its size, it is a key funding instrument for Czechia's decarbonisation efforts, potentially reaching a size of up to CZK 500 bn., depending on the EU ETS price. At the time of this writing, it consisted of eight programmes/thematic support schemes:

- Deployment of new RES
- Modernization of heating systems
- Energy efficiency and energy savings
- Modernization of transport
- Renewable gaseous and liquid fuels
- Modernization of energy networks
- Energy communities
- Innovative and complex projects

Type of policy: Economic (subsidies)

Implementing entity: Ministry of Environment (Government)

Period of implementation: 2021-2030

Implemented in scenario: WAM

Mitigation impact: The expected programme energy savings are shown in the following Table 1-37.

Sectors: Energy, Manufacturing industries and construction, Buildings

Greenhouse gas coverage: CO_2, F-gases, CH_4

Table 1-37: Expected GHG savings of the Modernisation Fund

Energy savings [TJ]	2025	2030	2035	2040

	4 375	17 500	17 500	17 500

Source: MoE

1.2.1.24 OP Just Transition

The Operational Programme Just Transition is a funding scheme established to disburse funds from the EU Just Transition Fund. In Czechia, projects from three coal regions in transition (Karlovarský, Moravskoslezský, Ústecký) are eligible for funding from this source. Its goal is to mitigate the impact of the transition process on the economy, on inhabitants and on the environment in those regions, which are expected to be most affected as a result of their dependence on fossil fuels or emission-intensive industrial processes. The specific priorities vary from region to region, based on the territorial just transition plan but include digitalization, innovations, upskilling or support for cultural and creative industries. The overall financial allocation for the Programme is CZK 42.7 bn.

Type of policy: Economic

Implementing entity: Ministry of the Environment (Government)

Period of implementation: 2021-2027

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures).

Sectors: Energy, Industry

Greenhouse gas coverage: CO_2, CH_4

1.2.1.25 National Recovery and Resilience Plan

Responding to the impacts of the COVID-19 pandemic, the EU Recovery and Resilience Facility was set up to mitigate the economic and social impact of the pandemic and make European economies and societies more sustainable and resilient. It finances reforms and investments aligned with EU priorities carried out in EU Member States from the start of the pandemic in February 2020 until 31 December 2026. It has a total budget of around EUR 650 billion. Member States were required to allocate in their national plans for spending RFF support at least 37% of their budget to climate measures and 20% to digital measures. According to Czech government data, the modified plan, which includes the REPowerEU chapter, devotes 43% of the allocated funds to measures in support of climate objectives. This includes substantial support for investments in energy efficiency (including in public buildings) and renewable energy including strengthening its integration in modernising distribution grids. Apart from that, more than EUR 1 bn is allocated to sustainable mobility projects, notably in low-emission vehicles for the business sector, improving railway infrastructure, and promoting electric charging stations and cycling pathways. Further areas of support include circular economy and sustainable forest management. The funding from the Plan is dependent on the meeting of pre-defined reform criteria.

Type of policy: Economic

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: 2021-2026

Implemented in scenario: WEM

Mitigation impact: N/A

Sectors: Energy, Transport, Industry, Forestry

Greenhouse gas coverage: CO_2, CH_4

1.2.2 Policies and Measures in 1.A.3 Transport

Policies and Strategies

1.2.2.1 National Action Plan for Clean Mobility

The National Action Plan for Clean Mobility (NAP CM) for the period 2015-2018 with an outlook until 2030 responds to Directive 2014/94/EU on the deployment of alternative fuels infrastructure. The Directive requires the development of a domestic policy framework to support the growth of the market with alternative fuels within the transport sector as well as the development of related infrastructure. The NAP CM focuses on electromobility, CNG, LNG, and partly also hydrogen technology (fuel cells). It sets out requirements for the construction of filling and charging stations between 2020 and 2030. The emphasis of the NAP CM is to strive mainly for technologies close to commercial use. NAP CM undergoes regular updates with the last one taking place in 2024. This update sets milestones for 2025, 2030 and 2035 as regards the rollout of the respective alternative fuels. Moreover, the intended rollout of ETS2 is presumed to be an important trigger for the development of alternative fuels.

Type of policy: Regulatory

Implementing entity: Ministry of Transport (Government)

Period of implementation: 2015-2030 and beyond

Implemented in scenario: WEM

Sectors: Transport

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures). Overall fossil fuel consumption in the transport sector is expected to drop by approx. 13 PJ annually from 2027 onwards, equivalent to a GHG reduction of approx. 0.9 Mt CO_2eq.

Greenhouse gases covered: CO_2

1.2.2.2 Czech National Cycling Development Strategy for 2013-2020

In May 2013, the Czech government approved this Strategy, aiming to increase urban cycling modal share to 10% by 2020 and up to 25% by 2025 while also enhancing cycling infrastructure. Further, the Strategy calls for cooperation among the state, the regional level, and the local level, as well as the private and voluntary sectors. The strategy was not prolonged or replaced after 2020.

Type of policy: Economic

Implementing entity: State Fund of Transport Infrastructure (Government)

Period of implementation: 2013-2030

Implemented in scenario: WEM

Sectors: Transport

Mitigation impact: The annual energy savings were estimated to be 585 TJ/year from 2020 with an annual budget of 150 million CZK.

Greenhouse gases covered: CO_2

Legislative Instruments

EU Level Instruments

Aviation

1.2.2.3 EU Emissions Trading System

Under the EU Emission Trading System (EU ETS), all airlines operating in Europe, European and non-European alike, are required to monitor, report, and verify their emissions, and to surrender allowances against those emissions. The airlines receive tradeable allowances covering a certain level of emissions from their flights per year. As CO_2 emissions from aviation have been included in the wider

EU ETS, the main carbon pricing instrument for aviation in Europe and the first large emissions trading scheme, this measure is described in detail as a cross-cutting measure in the relevant chapter.

1.2.2.4 ICAO Agreement and CORSIA

The International Civil Aviation Organization (ICAO) is a UN specialized agency to manage the administration and governance of the Convention on International Civil Aviation (Chicago Convention). ICAO cooperates with Member States and industry groups on international civil aviation Standards and Recommended Practices and policies in support of a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector. In 2016, there was an agreement among ICAO's 191 members to use an offsetting scheme called Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). CORSIA is implemented in three phases: a pilot phase (2021-2023), a first phase (2024-2026), and a second phase (2027-2035). In 2022, ICAO states parties adopted a net-zero 2050 global aspirational goal for international flight operations.

Type of policy: Regulatory

Implementing entity: Ministry of Transport, Ministry of the Environment in relation to EU legislation (Government)

Period of implementation: Since 2021

Implemented in scenario: WAM

Mitigation impact: The emission reduction has been calculated by subtraction of supposed energy saving from air transport-related total emissions. In the context of the Czech Republic, the total emission reduction of this measure is 5.9 kt. CO_2 eq. in 2035.

Sectors: Transport

Greenhouse gas coverage: CO_2

1.2.2.5 EU Regulation 2019/1242 on setting CO_2 emission performance standards for new heavy-duty vehicles

The Regulation sets CO2 emission performance requirements for new heavy-duty vehicles whereby the emissions of the Union fleet of new heavy-duty vehicles shall be reduced compared to the reference as follows:

- for the reporting periods from 2025 onwards by 15%;
- for the reporting periods from 2030 onwards by 30%, unless decided otherwise pursuant to the review referred to in Article 15 in the Regulation.

The reference CO2 emissions shall be based on the monitoring data reported pursuant to Regulation (EU) 2018/956 for the period from 1 July 2019 to 30 June 2020, excluding vocational vehicles.

Type of policy: Regulatory

Implementing entity: Ministry of Transport (Government)

Period of implementation: Since 2019

Implemented in the scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures).

Sectors: Transport

Greenhouse gas coverage: CO_2

1.2.2.6 EU Regulation 2019/631 on setting CO_2 emission performance standards for new passenger cars and for new light commercial vehicles

The EU Regulation 2019/631 of April 2019 sets CO_2 emission performance standards for new passenger cars and for new light commercial vehicles. It sets cost-effective CO_2 emission reduction targets for new light-duty vehicles up to 2030 combined with a dedicated incentive mechanism to increase the share of zero/low-emission vehicles. The aim of the Regulation is to ensure that the EU automotive industry maintains its technological edge also by strengthening its competitiveness and stimulating employment while ensuring better functioning of the internal market and aiming to fulfil the goals of the Paris Agreement. From 2020, this Regulation set an EU fleet-wide target of 95 g CO_2/km for the average emissions of new passenger cars and an EU fleet-wide target of 147 g CO_2/km for the average emissions of new light commercial vehicles registered in the Union. To help achieve the EU's climate targets, from 2025 onwards, stricter EU-wide fleet targets (WLTP) will apply: Cars: 93.6 g CO_2/km (2025-2029) and 49.5 g CO_2/km (2030-2034); Vans: 153.9 g CO_2/km (2025-2029) and 90.6 g CO_2/km (2030-2034). From 2035 onwards, the EU fleet-wide CO_2 emission target for both cars and vans is 0 g CO_2/km, corresponding to a 100% reduction.

Type of policy: Regulatory

Implementing entity: Ministry of Transport, Ministry of Industry and Trade (Government)

Period of implementation: Since 2019

Implemented in the scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures). Decrease of GHG emissions from transport and increased demand for electricity.

Sectors: Transport and Energy

Greenhouse gas coverage: CO_2

1.2.2.7 Directive 2009/33/EC on the promotion of clean road transport vehicles in support of low-emission mobility

The Directive 2009/33/EC has as its objectives the promotion and stimulation of a market for clean and energy-efficient vehicles and improving the contribution of the transport sector to the environment, climate and energy policies of the Union. The Directive applies to procurement through contracts for the purchase, lease, rent or hire-purchase of road transport vehicles awarded by contracting authorities or contracting entities or, for instance, through public service contracts having as their subject matter the provision of passenger road transport services in excess of a further to be defined threshold. The Directive 2009/33/EC was amended by the Directive (EU) 2019/1161, which among other things defined as 'clean vehicles' only zero-emission vehicles from 2026 onwards.

Type of policy: Regulatory

Implementing entity: Ministry of Regional Development (Government)

Period of implementation: Since 2019

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures).

Sectors: Transport

Greenhouse gas coverage: CO_2

1.2.2.8 Support of biofuels on the EU level

The quality of fuels used in transport is regulated by the Directive 2009/30/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions. By the end of 2020, suppliers should have gradually reduced life cycle greenhouse gas emissions by up to 10% per unit of energy from fuel and energy supplied. The Czech Act on Air Protection 201/2012 Coll. transposing the RES Directive sets the minimum share of biofuels in gasoline and diesel. Further, on the national level, the Government Decree 351/2012 Coll. sets sustainability criteria of biofuels, and The Law on Consumption Tax 453/2016 Coll. levies biofuels with a lower tax rate. The Directive also sets rules for the sustainable use of biofuels – greenhouse gas emissions from biofuels must be at least 35% lower than those of the fuel they replace. From 2017, this figure rose to 50% and from 2018 to 60% for biofuels produced in facilities that started production in 2017 or later.

Type of policy: Regulatory

Implementing entity: Ministry of Industry and Trade, Ministry of Transport

Period of implementation: Since 2009

Implemented in scenario: WEM

Mitigation impact: The mitigation impact of biofuels was calculated using a modification of emission factors per unit of energy. The resulting emission factor is a weighted average of emission factors of fossil part and bio part, where weights correspond to the percentage of these components blending, and to plans to increase bio components blending to petrol and diesel. The total emission reduction of this measure is 198 kt CO_2 eq. in 2035.

Sectors: Transport

Greenhouse gas coverage: CO_2

1.2.2.9 Support of electromobility on the EU level

Concerning the regulatory framework for the development of electromobility within the EU legislation, the key instrument is Regulation 2023/1804 on the deployment of alternative fuels infrastructure (and repealing an earlier 2014 Directive). The specific objectives of the Regulation are:

- to ensure minimum infrastructure to support the required uptake of alternative fuel vehicles across all transport modes and in all EU Member States to meet the EU's climate objectives;
- to ensure full interoperability of the infrastructure; and
- to ensure comprehensive user information and adequate payment options at alternative fuels infrastructure.

For publicly available electric recharging infrastructure for light duty road vehicles (cars and vans), the regulation sets out mandatory national fleet based targets. It also sets out distance-based targets for light duty and heavy-duty road vehicles on the TEN-T core and comprehensive network. It also requires EU Member States to ensure a number of recharging stations are in place for heavy-duty vehicles in urban nodes and in safe and secure parking.

Type of policy: Regulatory

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: Since 2017

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures).

Sectors: Transport

Greenhouse gas coverage: CO_2

National level

1.2.2.10 Promotion of biofuels and fuels quality on national level

The quality of fuels used in transport is regulated by the Directive 2009/30/EC amending Directive 98/70/EC. The Fuel Quality Directive 2009/30/EC has been implemented into the Czech legislation (with regards to GHG emissions) via the amendment to the Act on Air Protection 201/2012 Coll., which sets minimal shares of biofuels in gasoline and diesel in accordance with the EU Directive.

The Directive 2009/30/EC requires that the emission intensity of transport fuels falls to 10% by the end of the year 2020, at least 6% compared to the average emission levels. The Czech Government Decree

189/2018 Coll. sets sustainability criteria for biofuels and methodology for calculation greenhouse gas emission production from fuels while the Excise Tax Act 353/2003 Coll. Levies biofuels with a lower tax rate. The baseline shall be based on EU average life cycle GHG emissions per unit of energy from fossil fuel products in 2010. Reducing GHG emissions is likely to be achieved by harnessing biofuels and fuels with lower carbon content (e.g. natural gas).

Type of policy: Regulatory

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: Since 2009

Implemented in scenario: WEM

Mitigation impact: The mitigation impact of biofuels was calculated using a modification of emission factors per a unit of energy. The resulting emission factor is a weighted average of emission factors of fossil part and bio part, where weights correspond to the percentage of these components blending, and to plans to increase bio components blending to petrol and diesel. The total envisaged emission reduction of this measure is 198kt CO_2 by 2035.

Sectors: Transport, Energy

Greenhouse gas coverage: CO_2

1.2.2.11 Creating systems of combined freight transport

The use of multimodal transport systems is preferred to reduce the share of road transport in favour of those modes of transport that have less impact on the environment. Relevant measures, as described in the Transport Policy of the Czech Republic for 2014-2020 with the Prospect of 2050, seek to find effective and sustainable logistical solutions using the principle of co-modality with the view to support multimodal nature of transport, optimize the capacity of transport infrastructure and use of energy and make logistics services available to small and middle-sized businesses in industry, trade and agriculture.

Further, competitive multimodal transport chains for companies, using the railway and possibly waterborne transport with the objective to improve capacity utilization of the means of transport and reducing empty rides, reduction of heavy road transport, better cooperation and coordination among companies in the area of transport, support of small and middle-sized enterprises, and reduction of negative impacts on the environment, public health and transport safety. The support of railway transport shall be realized through investment programs for improvement of infrastructure, increasing of speed, promotion of intermodal (container) transport, construction of transship points and of logistic centers. The aim of the measure is to shift 30% of long distance freight transport from roads to railways (in trips over 300 km).

Type of policy: Regulatory

Implementing entity: 14 regions/regional authorities Period of implementation: There is no uniform period for all 14 regions. The plans are partly coordinated by the Ministry for Regional Development. Within the projections these measures are calculated until 2035.

Implemented in scenario: WEM

Mitigation Impact: The emission reduction will be achieved by the changed composition of fuel consumption, i.e. more alternative fuels and less petrol and diesel. Provided that no alternative fuels will be charged by excise tax, its consumption would increase while petrol and diesel consumption decreases equally. The total emission reduction of this measure is calculated at 38.4 kt CO_2eq by 2035.

Sectors: Transport

Greenhouse gas coverage: CO_2

Financial Schemes and Programmes

1.2.2.12 Operational Programme Transport

The current Operational Programme Transport 2021-2027 (OPT3) follows the two previous editions of this EU-sponsored funding scheme and represents the most important source of financing for the construction of transport infrastructure in the Czech Republic in the programming period. OPT3 is one of the largest operational programmes with an allocation of approx. EUR 4.9 bn. Its aim is to fulfil strategic investment needs and help solve key problems in the Czech transport sector. The Programme responds to the goals and requirements set by EU legislation and strategies as well as national strategies. Specifically, the aim is to finalize the backbone infrastructure and help regions access the Trans-European Transport Network (TEN-T), improve its quality and functionality, remove narrow areas in key infrastructure, and support sustainable mobility focusing on cities. Taking into account lessons learnt from the OPT1 and OPT2, the OPT3 targets its support at three priorities (apart from technical support): 1) European, national and regional mobility; 2) National road mobility ensuring TEN-T connectivity; 3) Sustainable municipal mobility. In its programming for sustainable transport, the funding scheme refers to the NAP CM mentioned above.

Type of policy: Economic

Implementing entity: State Fund of Transport Infrastructure (Government)

Period of implementation: 2007-2027

Implemented in scenario: WEM

Mitigation Impact: The annual CO_2 emission decrease was calculated from average emission coefficients of transport and annual energy savings estimated to 3 016 TJ/year from 2020.

Sectors: Transport

Greenhouse gas covered: CO_2

1.2.2.13 Economic and tax tools for road vehicles on national level

The objective of these tools is to promote the use of less polluting vehicles. They include the following rules:

- Act on Road Traffic 13/1997 Coll. and its amendments on the charging of the use of transport infrastructure for freight vehicles;
- Act on Road Tax 190/1993 Coll. and its amendments;
- Excise Tax Act 353/2003 Coll. supporting alternative fuels with lower CO_2 emissions (e.g. compressed natural gas– CNG, bio fuels– tax free).

Moreover, the Transport Policy of the Czech Republic for 2021-2027 with an outlook into 2050 contains a long-term vision for Czechia's transport system. It assumes that Czechia and its individual regions will be provided with a transport system that meets the requirements of transport needs in both passenger and freight transport, supports sustainable economic development and inclusive policy aimed at structurally disadvantaged regions and their inhabitants. At the same time, this transport system will meet the requirements in terms of sustainability, which means that it will be neutral in terms of impact on global (not only climate) changes (in terms of mitigation and adaptation), will have the least possible impact on public health, will have minimal impact on biodiversity, nature and landscape and will make a balanced use of natural resources based on renewables so as not to increase debt to future generations. It will therefore be necessary to meet the need for the mobility of people and things, the way in which these needs are provided must be influenced in such a way as to ensure sustainability in relation to further economic development.

Type of policy: Economic, Fiscal

Implementing entity: Ministry of Finance (Government)

Period of implementation: 2020-2030

Implemented in scenario: WAM

Mitigation Impact: The emission reduction will be achieved by the changed composition of fuel consumption, i.e. more alternative fuels and less petrol and diesel. Provided that no alternative fuels would be charged by excise tax, their consumption would increase while petrol and diesel consumption would decrease equally. The total emission reduction of this measure is calculated at 38.4 kt. CO_2eq. by 2035.

Sectors: Transport

Greenhouse gas coverage: CO_2

1.2.2.14 Other funding for clean mobility

As mentioned above, there are several other subsidy schemes funding clean mobility.

The Integrated Regional Development Programme entails a specific goal "Support of sustainable multimodal municipal transport in the context of the transition to a climate neutral economy", which supports i.a. the purchase of ZEV and low-emission vehicles for public transport, and the construction of charging and filling stations as well as the enhancement of multimodal transport. The overall funding allocation is CZK 20.4 bn.

Modernisation Fund is another key funding instrument as it includes a funding priority for clean transport, namely the purchase of ZEV and the construction of the required infrastructure. There are two sub-programmes, depending on the recipients of such support – either businesses or municipalities (when developing public transport). The former sub-programme is allocated 1.5% of the overall funding of the Modernisation Fund, while the latter is allocated 8.5%, which can reach up to approx. CZK 40 bn.

Type of policy: Regulatory, Economic

Implementing entity: Ministry of Regional Development, Ministry of the Environment (Government)

Period of implementation: As described above for the individual programmes.

Implemented in scenario: WEM

Mitigation Impact: N/A

Sectors: Transport

Greenhouse gas coverage: CO_2

1.2.2.15 Road toll

Since 2010, certain vehicles are subject to toll payment including vehicles over 3.5 tons. The charge level is derived from the type of vehicle, number of axles, and the time when the road is used.

Type of policy: Fiscal

Implementing entity: Ministry of Transport (Government)

Period of implementation: 2020-2035

Implemented in scenario: WAM

Mitigation Impact: The emission reduction has been calculated with a help of demand elasticity. Elasticity expresses how travel demand responds to transport price increases. The elasticity values for road transport were obtained from scientific literature. The total emission reduction of this measure is thus calculated to be 161.9 kt CO_2eq by 2035.

Sectors: Transport

Greenhouse gas coverage: CO_2

1.3 Policies and Measures in Industrial Processes and Product Use Sector

Policies and Strategies

The Czech Republic does not have one comprehensive industrial strategy or policy. Instead, it has more sub-strategies focused on specific areas. The Industry 4.0 document adopted by the Government in 2016 can also be understood as a partial strategy of industrial development in the Czech Republic. Another one would be the Economic Strategy of the Czech Republic, adopted in late 2024. These strategies focus on the relationship between industry and environmental protection. Those aspects that affect greenhouse gas emissions are described below.

Ozone layer protection

Policies and strategies adopted in the field of ozone layer protection were adopted back in 2004 and 2005. They were aimed at the timely phase out of certain uses, notably the CFCs in metered dose inhalers, HCFCs in the refrigeration and air conditioning (henceforth as "RAC") sector, and halons in the fire-fighting sector. The objective of all respective strategic documents was met, thus all those were made obsolete roughly by the year 2015. The only strategic document that has been recently "revived" is the one aimed at the use of halons in the fire-fighting sector. The Ministry of the Environment has adopted a new strategic document with the objective of collection/destruction/regeneration of the remaining halons being still installed in certain critical use applications. The underlying objective is the full phase-out of all critical use applications by the year 2040.

The implementation of the F-gas regulation is not subject to any strategic document. The national legislation implements both the F-gas and the Ozone Depleting Substances (henceforth "ODS") regulation with their main objectives:

- To make both regimes identical for the "end user ";
- To adhere strictly to the minimum EU requirements on the qualification of personnel and make them applicable both to the ODS and F-gasses in the same manner;
- To keep the recovery criteria of ODS and F-gases from refrigeration and firefighting equipment as strict as possible, beyond the EU legislation.

Legislative Instruments

1.3.1 Act No. 76/2002 Coll., on integrated pollution prevention and control, on the integrated pollution register (Integrated Prevention Act)

Integrated pollution prevention and control, abbreviated as IPPC, refers to the minimising of pollution from various industrial sources throughout the EU. The Integrated Prevention Act, transposes EU legislation, which initially meant the Directive 96/61/EC on Integrated Pollution Prevention and Control (IPPC). The current Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) was transposed into national legislation in 2013. The Act requires industrial and agricultural activities with a high pollution potential to obtain a permit; this permit can only be issued if certain environmental conditions are met so that the companies themselves bear responsibility for preventing and reducing any pollution they may cause. The IPPC Directive is based on several principles, namely an integrated approach, best available techniques (BAT) flexibility and public participation. In the area of greenhouse gas emissions, which are generated by the production and use of heat and electricity, the Act allows the regulator to apply the BAT concept, which should lead to increased energy efficiency of production. BAT includes technologies used as well as how a given facility is designed, built, operated, maintained and decommissioned. This Act also allows the application of emission limits or equivalent technical parameters, which are based on advanced technologies used in affected industrial sectors. Nevertheless, the possibility of imposing emission limits directly concerning greenhouse gas emissions remains limited by law on integrated prevention only for cases where it is required in order to prevent serious pollution at the site.

Type of policy: Regulatory

Implementing entity: Ministry of Environment (Government)

Period of implementation: Since 2002

Implemented scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures).

Sectors: Industrial Processes

Greenhouse gas coverage: CO_2**,** CH_4**,** HFCs, PFCs, SF_6

1.3.2 Regulation (EU) No. 2024/573 on fluorinated greenhouse gases

This EU Regulation, which entered into force in 2024, replaced an earlier regulation (EU) 517/2014. Its key measures include reducing hydrofluorocarbons (HFCs), expanding the quota system for HFCs in metered dose inhalers, stricter rules to prevent emissions, facilitating better monitoring, and capping EU production of all HFCs starting in 2025. All producers/importers/exporters of more than 100t CO_2eq of F-gases must communicate the relevant information via obligatory reporting.

Type of policy: Regulatory

Implementing entity: Ministry of the Environment (Government)

Period of implementation: 2025-2050

Implemented scenario: WEM

Mitigation impact: The main goal of the new F-Gas Regulation is to cut the EU's F-gas emissions over time towards zero by 2050, while aiming at a 90% reduction by 2030.

Sectors: Industrial Processes

Greenhouse gas coverage: HFCs, PFCs, SF_6

1.3.3 Act No. 73/2012 Coll., on ozone-depleting substances and fluorinated greenhouse gases, as amended

This Act regulates the rights and obligations of persons and the competence of administrative bodies in the field of ozone layer protection and climate system protection against negative effects of regulated substances and fluorinated greenhouse gases. Regarding ozone layer protection, the Act implements Regulation (EC) 1005/2009 on substances that deplete the ozone layer, as amended, and Regulation (EU) 517/2014 on fluorinated greenhouse gases (later replaced by Regulation (EU) 2024/573). A 2023 amendment of this act banned the use of single-use containers with F-gases and established a robust certification and evaluation procedure for handling and disposing of these substances.

Type of Policy: Regulatory

Implementing entity: Ministry of the Environment (Government)

Period of Implementation: Since 2012

Implemented Scenario: WEM

Mitigation impact: N/A

Sectors: Industrial Processes

Greenhouse gas coverage: HFCs, PFCs, SF_6

1.3.4 Directive 2006/40/EC relating to emissions from air conditioning systems in motor vehicles (MAC Directive)

Directive 2006/40/EC regulates the use of F-gases with GWP higher than 150 in passenger cars (M1) and light commercial vehicles' (N1) air conditioning. The directive consists of 3 phases, from which the last one entered force on 1st January 2017. Since then, the use of HFCs with GWP higher than 150 has been completely banned for new vehicles placed on the EU market.

Type of policy: Regulatory

Implementing entity: Ministry of Transport (Government)

Period of implementation: Since 2008

Implemented in a scenario: WEM

Mitigation impact: The overall mitigation impact was calculated by using market information for 2017. Car producers do not use F-gases (HFC-134a) for new cars intended for the EU market but HFC-134a is used for filling the air conditioning of cars for non EU countries. If the market situation remains stable in future, emissions from 1st fill are expected to decrease by 82% by 2035 compared to 2015. If the car producers switch to use of alternatives (HFO-1234yf) also for cars intended for non-EU countries the mitigation impact can be up to 100% by 2035 compared to 2015.

Sectors: Industrial Processes

Greenhouse gas coverage: HFCs

1.3.5 Kigali Amendment to the Montreal Protocol

The Kigali Amendment was agreed at the 28th Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer in October 2016. The Kigali Amendment adds to the Montreal Protocol the phase-down of the use of HFCs as substances with high GWP, which had largely replaced CFCs. The Amendment sets a different time schedules and methodology for baseline calculations for Article 5 and non-Article 5 Parties. Trade of HFCs with Parties that have not ratified the Amendment (non-Parties) will be banned from 1 January 2033.

Type of policy: Regulatory

Implementing entity: Ministry of the Environment (Government)

Period of implementation: 2019-2036

Implemented in scenario: WEM

Mitigation impact: The starting point for the phase down of the use of HFCs for non-article 5 parties including Czechia is 2019. Non-article 5 Parties should reduce the production/consumption of HFCs by 85% relative to the baseline which is calculated as the average production/consumption of HFCs in 2011-2013 plus 15% of HCFC baseline production/consumption, ending with an 85% reduction in 2036, measured against the same baseline.

Sectors: Industrial Processes

Greenhouse gas coverage: HFCs

1.4 Policies and Measures in the Agriculture sector

The concept of sustainable and multifunctional agriculture in the Czech Republic takes into account the reduction of greenhouse gas emissions and possible needs for adaptation measures, along with other environmental and socio-economic considerations. These objectives can be achieved either by applying tools of EU Common Agricultural Policy ("CAP") or through national measures.

The policies and measures in agriculture leading to GHG mitigation are based on prudent application of fertilizers, cultivation of cover crops, adoption of ecological and organic farming, implementation of modern and innovative technologies, monitoring the fermentation of crop residues, etc. Recently, agrarian policy has declared the goal of reducing nitrogen leaching and run-off. Important measures to reduce emissions of GHGs in agriculture include optimal timing of fertilization, the exact amount of fertilizer application to crop use and optimal (covered) storage of manure.

In practice, the CAP has a significant impact on the extent, orientation and profitability of agricultural activities. The CAP has been historically based on three fundamental principles – a common market for agricultural products based on common prices, preferences for agricultural production in EU countries as opposed to external competition, and financial solidarity – financing from common contribution-based funds. The implementation of the CAP can affect the trend in GHG emissions from agriculture (methane and nitrous oxide emissions) in both directions depending on the individual implemented measures, practices and policies in the Czech Republic.

Policies and Strategies and Financial Schemes

1.4.1 Strategy for Growth – Czech Agriculture and Food Sector within the Common Agricultural Policy of the EU after 2013

The Strategy laid down strategic development targets in the field of agriculture and food production for the Czech Republic. The long-term objective of the economically rational strategic level of production in the main agricultural commodities (dairy products, meat, etc.) was taken into account, also ensuring adequate market share for the production of processed agricultural and food products, especially those for which there is a potential for competitive production.

In the field of agriculture, the main objective was to contribute towards a long-term and sustainable basis for food security on the national and European level and to contribute to the energy self-sufficiency of the Czech Republic Out of the seven targets to this objective, several of them were closely linked to mitigation efforts – e.g., to develop the use of agricultural production and waste as renewable sources of energy, or to improve the impacts of agriculture on natural resources and, in times of climate change, to increase protection with regard to sustainable farming, comprehensive development, and landscape creation. The strategy was not renewed or replaced after 2020.

Type of policy: Fiscal

Implementing entity: Ministry of Agriculture (Government)

Period of implementation: 2013-2020

Implemented in scenario: WEM

Mitigation Impact: It is expected that GHG emissions reductions will reach approx. 300 kt CO_2eq by 2035.

Sectors: Agriculture

Greenhouse gas coverage: CH_4, N_2O, CO_2

1.4.2 Czech Rural Development Programme for 2014-2020

The Rural Development Programme (RDP) for the Czech Republic was formally adopted by the European Commission in May 2015, outlining the Czech priorities for using the nearly EUR 3.1 b.n of public money that was made available for the 7-year period 2014-2020. Regulation (EU) 2020/2220 prolonged the programming period until 2022 with the overall allocation reaching more than EUR 4.7 bn. (EUR 3.1 billion from the EU budget and EUR 1.7 bn. of national co-funding).

The RDP focused mainly on ensuring the sustainable management of natural resources and on encouraging climate friendly farming practices. Secondly, its aim was to increase the competitiveness of agriculture and forestry as well as that of the food industry. The RDP also supported organic farming, increased use of renewables, and afforestation of agricultural land. The RDP funded actions under six Rural Development Priorities and in the Czech context. Particular emphasis (including budgetary) was placed on Priority 4: Restoring, preserving and enhancing ecosystems related to agriculture and forestry.

Type of policy: Economic

Implementing entity: Ministry of Agriculture (Government)

Period of implementation: 2014-2020

Implemented in scenario: WEM

Mitigation impact: It is expected that GHG emissions reduction will reach approximately 357 kt CO_2eq in 2035.

Sectors: Agriculture, LULUCF

Greenhouse gas coverage: CO_2, CH_4, N_2O

1.4.3 CAP Strategic Plan

The ongoing CAP cycle of 2023-2027, which strives to make EU'S agriculture fairer and greener, is accompanied by a series of strategic plans drafted and published by the individual Member States, including Czechia's, which was adopted in late 2022. The Plan aims at ensuring the sustainable competitiveness and resilience of farms while improving the protection of natural resources and the climate. It substantially contributes to improving the redistribution of financial support to small- and medium-sized farms, strengthening the position of organic farming, and improving the vitality and quality of life in rural areas through investments. The total envisaged funding for 2023-2027 under the plan is just over EUR 8 bn., out of which EUR 5.6 bn. is provided from the EU budget. Approximately half of the overall sum should be handed out in direct payments, and just under half is allocated for rural development. At the same time, around EUR 2 bn. or 25% of the plan should be reserved for meeting either environmental and climate objectives under rural development, or for eco-schemes under direct payments. It is expected that the plan will help increase Czechia's already high share of organic production (from 15.6% to 21.3% of agricultural land) while improving animal welfare, and supporting training and advisory.

Type of policy: Economic, Regulatory

Implementing entity: Ministry of Agriculture (Government)

Period of implementation: 2023-2027

Implemented scenario: WEM

Mitigation Impact: N/A

Sectors: Agriculture, LULUCF

Greenhouse gas coverage: CO_2, CH_4, N_2O

1.4.4 Action Plan for the Development of Organic Farming 2021-2027

The aim of the Action Plan for the Development of Organic Farming for 2021-2027 ("AP") is to support the further growth of organic farming in Czechia. It is the fourth successive edition of such a plan. Organic farming ("OF") has been developing in the Czech Republic for more than 25 years. Areas such as legislation or inspection and certification systems are agreed on at a high level, but others are not yet sufficiently developed (e.g. organic food processing and sale, domestic organic food market, use of OF potential in the area of nature protection, research and innovation in OF, consultancy and education) and require systematic support. According to the Plan, by 2027 organic farming should be a fully developed sector with functioning trade relationships, stable demand and consistently supportive state policy.

Type of policy: Regulatory, Economic

Implementing entity: Ministry of Agriculture (Government)

Period of implementation: 2021-2027

Implemented scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures).

Sectors: Agriculture

Greenhouse gases coverage: CH_4, N_2O

1.4.5 Strategy of the Ministry of Agriculture of the Czech Republic with an Outlook Into 2030

The document is designed as an open living framework document and a fundamental basis for strategic management processes within the Ministry of Agriculture. It reiterates the long-term vision of the Ministry, which entails a competitive and sustainable Czech agriculture, forestry and water management. It openly acknowledges the risks posed by climate change and the need to go beyond an elementary cost-benefit analysis when striving for the protection of the environment and of natural resources. The priorities, objectives and actions of the Strategy are implemented via relevant programmes. The document was approved by the Czech Government in May 2016.

Type of policy: Regulatory

Implementing entity: Ministry of Agriculture (Government)

Period of implementation: 2016-2030

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures).

Sector: Agriculture

Greenhouse gas coverage: CH_4, N_2O

Legislative Instruments

1.4.6 Conditionality

Conditionality (formerly Cross-compliance) has been employed by the Czech Republic since January 2009. Based on this mechanism, direct payments and other selected subsidies can be granted only on the condition that a beneficiary meets the statutory management requirements addressing environment, public health, the health of animals and plants, and animal welfare, and the standards of Good agricultural and environmental conditions (GAEC). In the following years, the Conditionality mechanism underwent a number of updates reflecting the EU legislation; the requirements and evaluated standards were updated in line with the Common Agricultural Policy. From 2023 onwards, Conditionality has been an integral part of the Czech CAP Strategic Plan.

Type of policy: Regulatory

Implementing entity: Ministry of Agriculture (Government)

Period of implementation: 2009-2035

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures). The implementation of conditionality should reduce direct emissions from fertilizers (N2O) and emissions from enteric fermentation (CH4) by improving breeding management and sustaining a healthier animal population.

Sectors: Agriculture

Greenhouse gases coverage: CH_4, N_2O, CO_2

1.4.7 Nitrates Directive – Czech Republic's 4th Action Programme

The Nitrates Directive (91/676/EEC) generally requires EU Member States to:

- Monitor waters and identify waters which are polluted or are liable to be polluted by nitrates from agriculture;
- establish a code of good agricultural practice to protect waters from this pollution;
- promote the application by farmers of the code of good agricultural practice;
- identify the area or areas to which an action programme should be applied to protect waters from pollution by nitrates from agricultural sources;
- develop and implement action programmes to reduce and prevent this pollution in identified areas: action programmes are to be implemented and updated on a four-year cycle;
- monitor the effectiveness of the action programmes and report to the EU Commission on progress.

The Directive specifies the maximum amount of livestock manure which may be applied (as the amount of fertilizers containing nitrogen per hectare per year, i.e. 170 kg N/ha).

Subsequently, Czechia has drawn up a sequence of action programmes to transpose the Directive and reduce nitrate pollution. At the time of this writing, the 6th Action programme for 2024-2028 has just entered into force, offering a practical tool for introducing and fulfilling the requirements set by the Directive.

Type of policy: Regulatory

Implementing entity: Ministry of Agriculture (Government)

Period of implementation: 2016-2028

Implemented in scenario: WEM

Mitigation impact: Framework measure (mitigation impact is accounted for under specific measures)

Sector: Agriculture

Greenhouse gas coverage: N_2O

1.5 Policies and Measures in Land use, Land Use Change and Forestry sector

The land use, land use change and forestry (LULUCF) sector is linked to agriculture. Some of the policies listed above in the chapter on Policies and Measures in the Agriculture Sector are partly common for both sectors. Policies and measures in the LULUCF sector are generally focused on the sustainable use of natural resources, biodiversity preservation, and securing all functions and services these resources provide to society.

Despite numerous EU and pan-European policy processes that are linked to LULUCF, such as the Ministerial Conference on the Protection of Forests in Europe– FOREST EUROPE, Natura 2000 etc., none of those had been prescriptive in terms of CO_2, CH_4 and N_2O, emissions and removals. Their effect on the greenhouse gas balance of the LULUCF sector may be indirect, however, it is not practicably quantifiable.

Contrary, the more recently adopted EU Regulation 2018/841 (on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework) should represent a stronger normative incentive for action in the LULUCF sector. Specifically, it adopts a new accounting framework for forestry based on forest reference level (FRL). Setting FRL is mandatorily based on the continuation of forest management practices during the so-called Reference period of 2000-2009. These practices are projected for 2021-2030 with a limited possibility to exclude disturbances. Since Czech forestry was recently experiencing an unprecedented large-scale decline of spruce-dominated stands (and other species are endangered by recurrent drought), the adopted accounting framework becomes unfavourable for the national circumstances. What is more, the revised LULUCF regulation sets an aggregate EU target for natural sinks of 310 Mt CO_2eq, translated into targets for Member States for the period 2026-2030, which should also be reflected in their updated National Energy and Climate Plans.

Policies and Strategies

1.5.1 Nature Restoration Law – Regulation (EU) 2024/1991

The Nature Restoration Regulation provides for a general objective to put in place effective and area-based restoration measures that cover at least 20% of the EU's land and sea areas by 2030 and all ecosystems in need of restoration by 2050. The Regulation includes in its general objectives to contribute to achieving the EU's overarching objectives on climate change mitigation, climate change adaptation, land degradation neutrality and food security as well as meeting EU's international commitments. The Nature Restoration Law includes specific targets for terrestrial/coastal/freshwater ecosystems, marine ecosystems, urban ecosystems, rivers and floodplains, pollinators, agricultural ecosystems and forest ecosystems. Member States will be required to develop national restoration plans, which have to include the quantification of areas to be restored to reach restoration targets and indicative maps of potential areas to be restored. In doing so, Member States will identify synergies with climate change mitigation, climate change adaptation, land degradation neutrality and disaster prevention and prioritize restoration measures accordingly. They will also identify synergies with the national CAP Strategic Plan.

Type of policy: Regulatory

Implementing entity: Ministry of the Environment (Government)

Period of implementation: since 2024

Implemented in scenario: WEM

Mitigation Impact: N/A

Sectors: LULUCF, Agriculture

Greenhouse gas coverage: CO_2

1.5.2 State Forestry Policy until 2035

The most important category of the Czech LULUCF sector in terms of greenhouse gas emission balance is forest land. Forestry in the Czech Republic is primarily regulated by the Forest Act 289/1995 Coll. This instrument does not specifically target carbon balance but its provisions affect carbon budget and greenhouse gas emissions and removals indirectly in a number of ways.

Beyond this legislation, State forest policy until 2035 is the key national strategic document for forestry and forestry-related sectors. It includes specific measures that are or should be implemented to alleviate the envisaged impacts of climate change and extreme climatic conditions. These measures generally focus on creating more resilient forest ecosystems. They do so by promoting diversified forest stands using the greatest possible extent of natural processes, appropriate species composition and a variability of silvicultural approaches, reflecting the current international treaties, agreements, conventions and EU legislation.

Several of these recommendations are continuously being implemented according to Decree 298/2018 Coll., on elaborating regional plans of forest development and on the specification of management sets of stands. The Decree has increased the minimal share of improving and stabilizing tree species (newly including larch and Douglas fir) in the forest stands. It has also increased the financial support for improvement and stabilising species and introduced support for pioneer species to speed up forest regeneration. Provisions of this decree are implemented through regional plans of forest development.

Type of policy: Regulatory

Implementing entity: Ministry of Agriculture (Government)

Period of implementation: 2021-2035

Implemented in scenario: WEM

Mitigation Impact: The policies and measures listed above are among other goals directly aimed at GHG mitigation. However, the desired effect is only achievable in the long-term (up to a century) while in the near future, mitigation effects expected to be achieved by this program are considered marginal.

Sectors: LULUCF

Greenhouse gas coverage: CO_2

1.5.3 Czech Raw Material Policy for Wood

As a follow-up document on the State Forest Policy until 2035, in 2024, the new Czech Raw Material Policy for Wood was adopted by the government. It offers a novel approach insofar that wood is considered a strategic material, a renewable resource and an environmentally-friendly construction material. The key objective is to increase the added value of the wood processed in Czechia and ensure its more efficient use. Concretely, the Policy sets three priorities:

- to ensure sustainable long-term supply for the domestic wood- processing industry;
- to promote the use of wood as a renewable raw material in relevant sectors of the economy and everyday life;
- continuously increase the production of wood-based products with higher added value and long life cycle, and increase domestic consumption to scale up the use of raw timber and primary processed wood.

In practical terms, meeting the objectives set by this policy document goes hand in hand with the intended increase in the use of wood as a construction material. In fact, by 2035, up to ¼ of all new buildings for family housing buildings by 2035 should use wood as a primary construction material. The other objective is to increase the percentage of wood used in public buildings and refurbishment projects.

Type of policy: Regulatory

Implementing entity: Ministry of Industry and Trade (Government)

Period of implementation: since 2024

Implemented in scenario: WEM

Mitigation Impact: N/A

Sectors: LULUCF

Greenhouse gas coverage: CO_2

Legislative Instruments

1.5.4 Regulation (EU) No. 2018/841 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry into the 2030 climate and energy framework

To ensure the adequate contribution of the LULUCF sector to the achievement of the European Union’s emission GHG reduction target of at least 55% (formerly 40%) between 1990 and 2030, and to the long-term goal of the Paris Agreement, the LULUCF Regulation has established a robust accounting system for the different land accounting categories for the period 2021-2030 by 2006 IPCC Guidelines. The Regulation sets a binding commitment for each Member State to ensure that accounted emissions from land use are entirely compensated by an equivalent removal in the LULUCF sector (so called “no debit“ rule). For the key category of managed forest land, it has established accounting based on forest reference levels, which should disregard any new forestry policies adopted after 2009. The later revision of the regulation sets a new EU level target of increasing removals to -310 million tonnes of CO2eq in 2030. This target is distributed among the Member States and the respective target for the Czech Republic for 2030 is -1 228 kt CO_2eq. The Member States also need to comply with an aggregate carbon budget for 2026-2029.

Type of policy: Regulatory

Implementing entity: Ministry of Environment (Government)

Period of implementation: 2021-2030

Implemented in scenario: WEM

Mitigation impact: The LULUCF accounting framework provides incentives for maintaining and enhancing carbon sink. However, the mitigation impact is difficult to quantify.

Sector: LULUCF

Greenhouse gas coverage: CO_2, CH_4, N_2O

1.6 Policies and Measures in the Waste sector

Greenhouse gas emissions generated by the Czech waste sector have been growing due to organic carbon that is accumulated in landfills, an increasing amount of produced municipal solid waste (MSW) and unfavourable mix of MSW treatment options. Recently, this trend started to change and we observe a stagnation of emissions from landfills, which is a key source of GHG emissions from this sector, mainly due to enhanced landfill gas (LFG) capturing.

There is a potential for emission reductions in fulfilling the EU obligations of the Circular Economy Package (CEP) (COM/2015/0614) and other national measures with emission reduction effects related to the national common waste policy described in the Waste Management Plan 2014 (MWP 2014). Waste-to-energy measures will also affect industrial waste generated by other industries. Policies and measures in the waste sector aim at reducing the amount of produced waste, significant reduction of landfilled waste, minimising the accumulation of biodegradable waste in landfills, establishing and expanding separate collection systems for different waste streams (plastics, paper, glass, bio-waste, cardboard, metals, textile), promoting the energy use and digestion of non-recyclable waste, and improving landfill gas recovery.

The Czech waste legislation is largely based on the EU legislation. The EU legislation with a direct impact on GHG emissions from waste included the Landfill Directive (1999/31/EC) and the Waste Directive (2008/98/EU), both of which have been modified by the Circular Economy Package. The CEP and its revised legislative framework on waste has entered force in July 2018.

There are several policies that are not part of the waste legislation, which already have or will have an impact on GHG emissions from waste. Most of them are mentioned in the cross-sectoral section in this report. Nevertheless, it is important to highlight the EU ETS, the Climate & Energy Package and the Energy Taxation Directive, which provide direct and indirect support for LFG recovery and therefore significantly influence landfill emissions.

The largest public financial support for the waste management infrastructure comes from the State Environmental Fund of the Czech Republic (SEF). Operational Programme Environment (OPE) also contributes significantly to the expansion of the facility network; it is financed by the EU Cohesion Fund.

Policies and Strategies

1.6.1 Waste Management Plan of the Czech Republic for the period 2015-2024

A crucial strategic instrument in the context of waste management on the national level is the Waste Management Plan (WMP) for the period 2015-2024 adopted by the Government in December 2014. The WMP of the Czech Republic establishes, in accordance with the principles of sustainable development, the objectives, policies, and measures of waste management in the Czech Republic. The WMP is also the reference document for the development of regional Waste Management Plans. The binding part of WMP constitutes a mandatory basis for decision-making and other activities of the relevant administrative authorities, regions, and municipalities in the area of waste management. The WMP has been prepared for the period of 10 years and will be changed immediately following any fundamental change in the conditions under which it had been developed (e.g. new legislation on waste management affecting the waste management strategy, including the establishment of new objectives or the redefinition of existing objectives, policies, and measures).

From 2024, certain waste categories (recyclable and recoverable wastes) are prohibited from being deposited in landfills. For these categories, the landfilling fee will be gradually increased to achieve gradual decrease in the quantity of waste from the relevant categories deposited at landfills.

The defined objectives and targets set in the WMP 2015-2024 include, also in light of the European Directive 2008/98/EC on waste, the following:

- In relation to municipal waste, to introduce by the year 2015 separate collection at least for waste consisting of paper, plastic, glass, and metals; (from 2015 is obligatory separate collection of biodegradable municipal waste and from 2020 is obligatory separate collection of edible oils and fats);
- By 2020, the preparing for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households, shall be increased to a minimum of overall 50% by weight.
- To use mixed municipal waste (after sorting of materially recoverable components, hazardous substances and biodegradable waste) especially for energy recovery in facilities designed for this purpose in accordance with effective legislation;
- To reduce the maximum quantity of biodegradable municipal waste deposited at landfills in such a way, so that the share of this component would in 2020 account for maximum of 35% by weight of the total quantity of biodegradable municipal waste produced in 1995;
- To increase by the year 2020, to at least 70% by weight, the rate of preparing for re-use and the rate of recycling of construction and demolition waste and other types of their material recovery;
- Objectives are also set for packaging and packaging waste, separate collection of waste electrical and electronic equipment, waste batteries and accumulators, and for the processing of end-of-life vehicles and waste tyres.

At the time of this writing, a follow-up plan for the period 2025-2035 was being finalized. Moreover, a legislative proposal tabled by the Government on the establishment of a deposit system for PET bottles and cans, is being discussed by the Parliament.

The OPE 2014-2020 is a direct continuation of the above mentioned OPE 2007-2013 and it is also financed from the EU Cohesion Fund. The priorities of the project support in waste management are determined by the obligations set in the CEP (COM/2015/0614), the WMP and by the Programme of Waste Prevention of the Czech Republic. Waste management and material flows, environmental burdens and risks are covered by the OPE's Priority Axis 3. From the Priority Axis 3's overall budget of EUR 458.8 million, for example EUR 18.3 million is allocated for preventing municipal waste generation, EUR 42.7 million for preventing industrial waste generation, EUR 68 million for construction and modernization of waste collection, sorting and treatment facilities, EUR 103 million for material recovery of waste, EUR 53 million for energy recovery of waste and EUR 22.2 million for construction and modernization of hazardous waste management facilities.

The new current WMP includes modelling of the proposed and implemented measures and their impact on activity data – waste quantity and waste management practices. The result of this modelling was used as a basis for the projections of GHG emissions in this document with the EU obligations and targets from the CEP. The current WMP is coming to the end of its period, but as the new 2025-2035 WMP is not yet approved by the government and is not available, the current WMP with its assumptions is still the basis for the 2025 projections.

Type of policy: Regulatory

Implementing entity: Ministry of Environment (Government)

Period of implementation: 2015-2024

Implemented in scenario: WEM

Mitigation impact: The assumption for GHG emission reduction is 0.56 Mt CO_2 eq. or 10% over the period of 2015-2024

Sectors: Waste, Energy

Greenhouse gas coverage: CH_4

Legislative Instruments

1.6.2 EU Circular Economy Action Plan (Circular Economy Package)

The new Circular Economy Action Plan (CEAP) was adopted by the European Commission in March 2020 as one of the building blocks of the European Green Deal. This replaced an earlier version of the plan adopted in 2015. CEAP introduces both legislative and non-legislative measures targeting areas where action at the EU level brings real added value. The new action plan announces initiatives along the entire life cycle of products. It targets how products are designed, promotes circular economy processes encourages sustainable consumption, and aims to ensure that waste is prevented and the resources used are kept in the EU economy for as long as possible. Moreover, in 2023, the Commission revised the circular economy monitoring framework and also adopted several initiatives on microplastics.

Time of policy: Regulatory

Implementing entity: Ministry of Environment (Government)

Period of implementation: 2020-2035

Implemented in scenario: WEM

Mitigation impact: Not quantified. There is an assumption that meeting CEAP targets will strongly support EU mitigation efforts.

Sectors: Waste

Greenhouse gas coverage: CH_4, CO_2

2 Projected greenhouse gas emissions by gas and source

Projections of greenhouse gas (GHG) emissions are prepared for the following sectors:

- Energy (sector 1),
- Industrial Processes and Product Use (IPPU) (sector 2),
- Agriculture (sector 3),
- Land Use, Land Use Change and Forestry (LULUCF) (sector 4),
- Waste (sector 5).

Projection values presented in this textual report and Tables 1-5 in Reportnet 3 are calculated based on GWPs from AR5.

The preparation of GHG emissions projections includes the following steps:

(i) **Selection of the latest available National Inventory Document (NID) –** The currently available NID (CHMI, 2024) contains GHG emission estimates for the above-listed sectors for the period 1990 - 2022. According to NID (CHMI, 2024), the total GHG emissions (including indirect emissions and LULUCF) were 121 Mt CO_2 eq. in 2022. Emissions decreased in 2022 by 37% compared to 1990.

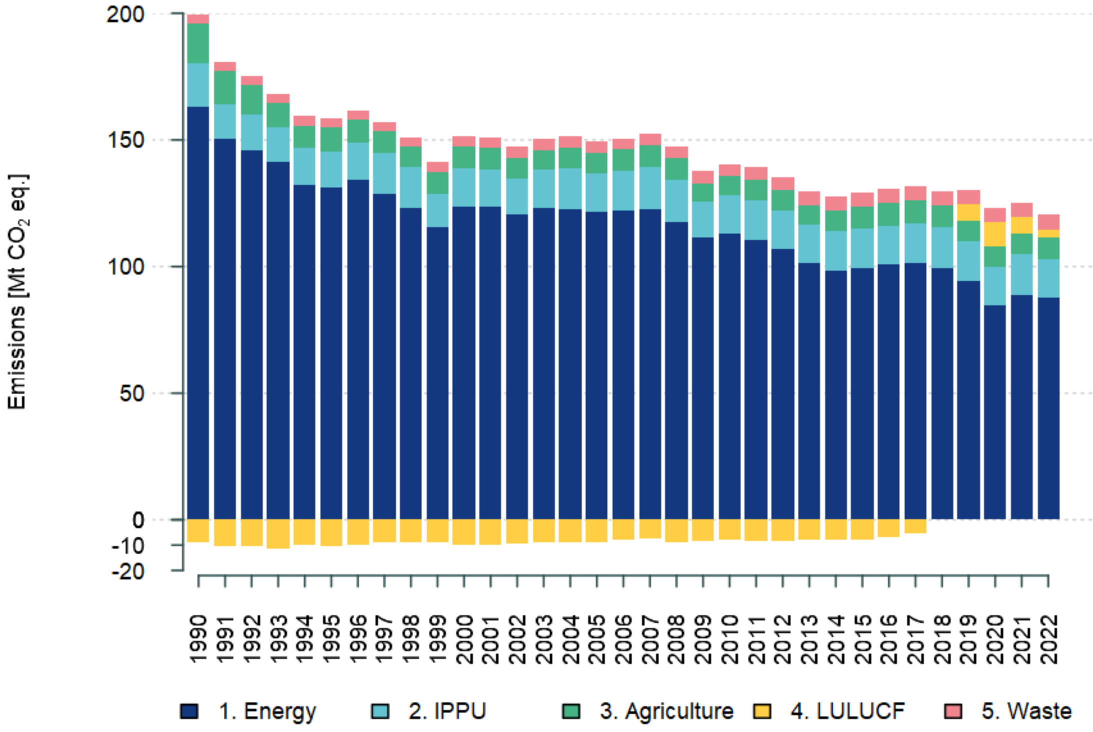


Figure 2-1: Total GHG emissions of the Czech Republic for 1990 – 2022 (CHMI, 2024)

The total trends of GHG emission estimates (including LULUCF) published in NID (CHMI, 2024) are shown in Table 2-1 and Figure 2-1. The highest share of GHG emissions in 2022 was in sector 1. Energy (73%), where 97% comes from 1.A Fuel combustion. The share of other sectors on total GHG emissions is the following: 2. IPPU. 12%, 3. Agriculture 7% and 5. Waste 4%. 4. LULUCF was the only sector acting as a GHG sink until 2017, however, since 2018 has been acting as an emitter. In 2022 it contributed to the balance as an emitter by 3% due to the bark beetle mitigation measures.

Table 2-1: Overview of GHG emission/removal trends by ETF categories (CHMI, 2024)

	Base year kt CO_2 eq.	2022 kt CO_2 eq.	2022 Total share [%]	2022 Sectoral share [%]	Trend [%]
1. Energy	**163204.12**	**87907.24**	**72.98**	**100.00**	**-46.14**
A. Fuel combustion (sectoral approach)	149368.82	85463.09	70.95	97.22	-42.78
1. Energy industries	56830.03	42 769.93	35.51	48.65	-24.74
2. Manufacturing industries and construction	47105.11	11 317.57	9.40	12.87	-75.97
3. Transport	11249.47	19 390.69	16.10	22.06	72.37
4. Other sectors	33989.81	11 715.76	9.73	13.33	-65.53
5. Other	194.42	269.14	0.22	0.31	38.43
B. Fugitive emissions from fuels	13835.30	2444.15	2.03	2.78	-82.33
1. Solid fuels	12637.63	1 927.17	1.60	2.19	-84.75
2. Oil and natural gas and other emissions from energy production	1197.66	516.98	0.43	0.59	-56.83
C. CO_2 transport and storage	NO	NO	NA	NA	
2. Industrial Processes	**17115.22**	**15045.20**	**12.49**	**100.00**	**-12.09**
A. Mineral industry	4082.45	3 288.22	2.73	21.86	-19.45
B. Chemical industry	2825.39	2 053.53	1.70	13.65	-27.32
C. Metal industry	9811.61	5 658.30	4.70	37.61	
D. Non-energy products from fuels and solvent use	125.56	119.97	0.10	0.80	-4.46
E. Electronic industry	NE,NO	53.55	0	0.36	
F. Product uses as ODS substitutes	NO	3 609.06	3.00	23.99	
G. Other product manufacture and use	270.21	261.86	0.22	1.74	-3.09
H. Other	NO	0.71	0	0.00	
3. Agriculture	**15747.95**	**8422.28**	**6.99**	**100.00**	**-46.52**
A. Enteric fermentation	6611.86	3 680.70	3.06	43.70	-44.33
B. Manure management	2571.36	762.11	0.63	9.05	-70.36
C. Rice cultivation	NA,NO	NA,NO	NA	NA	
D. Agricultural soils	5219.49	3 633.76	3.02	43.14	-30.38
E. Prescribed burning of savannas			NA	NA	
F. Field burning of agricultural residues	NA,NO	NA,NO	NA	NA	
G. Liming	1236.71	153.77	0.13	1.83	-87.57
H. Urea application	108.53	191.94	0.16	2.28	76.85
I. Other carbon-containing fertilizers	NO	NO	NA	NA	
J. Other	NA	NA	NA	NA	
4. Land use, land-use change and forestry	**-8837.11**	**3377.55**	**2.80**	**100.00**	**-138.22**
A. Forest land	-7471.53	5 528.01	4.59	163.67	-173.99
B. Cropland	115.91	45.28	0.04	1.34	-60.94
C. Grassland	-143.86	-500.87	-0.42	-14.83	248.17
D. Wetlands	24.10	56.53	0.05	1.67	134.54
E. Settlements	318.74	194.87	0.16	5.77	-38.86
F. Other land	NA,NO	NA,NO	NA	NA	
G. Harvested wood products	-1680.47	-1 946.26	-1.62	-57.62	15.82
H. Other	NO	NO	NA	NA	
5. Waste	**3014.26**	**5135.78**	**4.26**	**100.00**	**71.78**

A. Solid waste disposal	1792.69	3 293.75	2.73	64.13	85.52
B. Biological treatment of solid waste	NE,IE	735.70	0.61	14.33	
C. Incineration and open burning of waste	20.48	113.23	0.09	2.20	422.08
D. Waste water treatment and discharge	1201.08	993.09	0.82	19.34	-17.38
E. Other	NO	NO	NA	NA	
Total CO_2 equivalent emissions without land use, land-use change and forestry	**199386.71**	**117076.83**			**-41.28**
Total CO_2 equivalent emissions with land use, land-use change and forestry	**190549.60**	**120454.38**			**-36.79**
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry	**201313.55**	**117687.98**			**-41.54**
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land- use change and forestry	**192476.44**	**121065.53**			**-37.10**

(ii) **Selection of base, final, and cross-cutting years for projections** – 2022 was selected as the base year for GHG emissions projections for all sectors as it is the latest year with available information on macroeconomic development, energy balances and emission estimates.

(iii) **Selection of the methodology and model instruments for the projection preparation** – Detailed methodology and modelling instruments used for GHG emissions projections can be found in the chapter Methodological issues for each sector.

(iv) **Collection and analysis of input data for the projection** – More detailed information about the collection and analysis of input data used for GHG emissions projections can be found in the chapter Methodological issues for each sector.

(v) **Establishment of initial assumptions** – More detailed information about initial assumptions used for GHG emissions projections can be found in chapter Methodological issues for each sector.

(vi) **Definition of scenarios** – GHG emission projections contain two scenarios: 'With existing measures' (WEM) and 'With additional measures' (WAM). Policies and measures (PaM) introduced before 1st July 2024 are reflected in the WEM scenario, while PaMs introduced after 1st July 2024 are reflected in the WAM scenario. More detailed information about PaMs and their implementation can be found in Chapter 1. Policies and Measures.

(vii) **Calculation of scenarios and results presentation** – Results of GHG emission projections are presented for each sector as a total emission for the sector, emissions by gases and emissions by categories. Results can be found in the chapter Projected greenhouse gas emissions 'With measures (WEM) scenario' and 'With additional measures (WAM) scenario' for each sector.

(viii) **Sensitivity analysis on selected assumptions** – Detailed information is available in the chapter Sensitivity analysis for each sector.

2.1 Projected greenhouse gas emissions 'With measures (WEM) scenario' and 'With additional measures (WAM) scenario'

The total GHG emissions (Table 2-2 and Figure 2-2) are projected to continuously decrease for both WEM and WAM scenarios. The difference between the WEM and WAM scenarios is caused by additional measures in 1. Energy and 5. Waste sectors. Total GHG emissions for the WEM scenario are projected to amount to 37.00 Mt CO_2 eq. in 2050, representing an 81% decrease in emissions compared to 1990. For the WAM scenario, the total GHG emissions in 2050 are projected to amount to 12.48 Mt CO_2 eq., representing a 93% decrease in emissions compared to 1990.

Table 2-2: Reported and projected emissions of GHG – WEM and WAM (including LULUCF)

[Mt CO_2 eq.]	Reported emissions				Projected emissions						Difference [%]			
	1990	2005	2020	2022	2025	2030	2035	2040	2045	2050	1990 – 2022	1990 – 2030	1990 – 2040	1990 – 2050
WEM	192.48	141.71	123.74	121.01	81.33	59.80	50.26	44.04	39.86	37.00	-36.49	-68.62	-76.89	-80.58
WAM	192.48	141.71	123.74	121.01	75.35	54.06	34.90	24.19	17.93	12.48	-36.49	-71.63	-87.31	-93.45

Note: reported values including GWPs from AR5 are taken from NID 2024

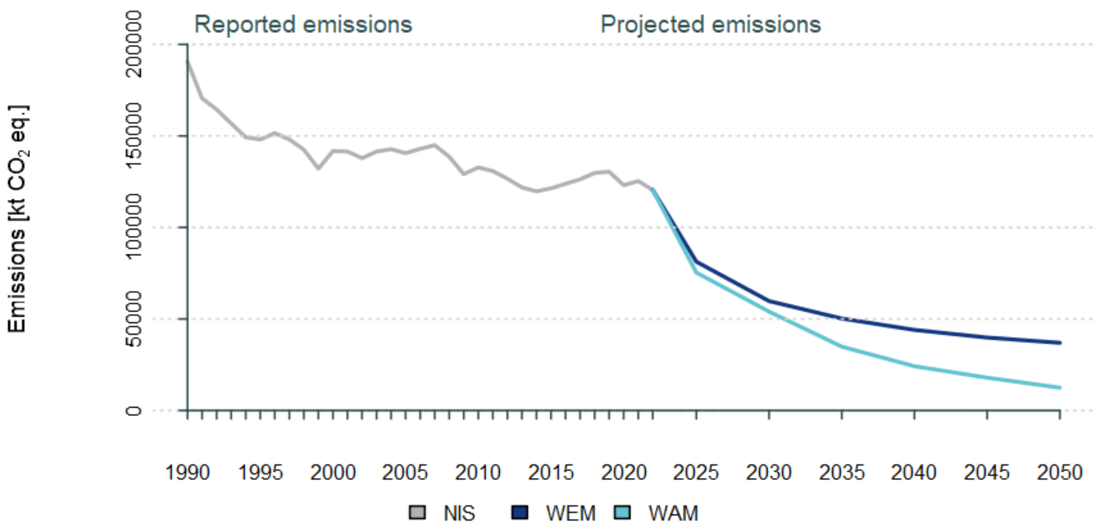


Figure 2-2: Reported and projected GHG emissions – WEM, WAM scenario (including LULUCF)

2.1.1 Projected greenhouse gas emissions 'With measures (WEM) scenario'

According to the WEM scenario, emissions of all monitored greenhouse gases are expected to decrease. Although the decrease in N_2O emissions is slightly lower compared to the last projections report – where the reduction was 59% between 1990 and 2050 – it still represents a significant decline of 55% in the current report.

Table 2-3: Breakdown of reported and projected emissions of GHG by gases - WEM scenario (including LULUCF)

[Mt CO_2 eq.]	Reported emissions				Projected emissions						Difference [%]			
	1990	**2005**	**2020**	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**1990 – 2022**	**1990 – 2030**	**1990 – 2040**	**1990 – 2050**
CO_2	157.30	118.08	102.00	98.48	62.11	43.02	35.18	30.11	26.64	24.21	-36.76	-72.65	-80.86	-84.61
CH_4	26.83	16.54	13.10	12.93	12.22	10.96	10.00	9.33	8.88	8.67	-51.81	-59.14	-65.21	-67.68
N_2O	8.25	5.62	4.82	4.88	4.37	4.24	4.08	3.87	3.81	3.74	-40.82	-48.59	-53.12	-54.69
HFCs	NO	1.35	3.75	3.61	2.56	1.52	0.97	0.69	0.50	0.35	NA	NA	NA	NA
PFCs	NO	0.01	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA
SF_6	0.09	0.11	0.07	0.07	0.06	0.05	0.04	0.04	0.03	0.03	-24.33	-43.30	-59.61	-71.18
NF_3	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA
Total	**192.48**	**141.71**	**123.74**	**121.01**	**81.33**	**59.80**	**50.26**	**44.04**	**39.86**	**37.00**	**-37.13**	**-68.93**	**-77.12**	**-80.78**

Note: reported values including GWPs from AR5 are taken from NID 2024

The most rapid decrease in 1990 – 2050 is expected in 1. Energy sector (82%), as shown in the Table 2-4. A drop of 92% in the same period is projected in the category 1.A.1 Energy industries, which has major share on total GHG emissions from 1. Energy. This drop is driven mainly by the category 1.A.1.a Public electricity and heat production. As for the 2. IPPU sector, current legislation mainly focuses on F-gas emissions reduction, particularly HFCs, which are used extensively in 2.F.1 Refrigeration and air conditioning systems. In 3. Agriculture, the decrease in synthetic fertilization application leads to the reduction of nitrous oxide emissions from Agricultural Soils, therefore emissions from this sector tend to decrease compared to the previous report in 2023. On the basis of 4. LULUCF projections, the sector, which is typically a GHG sink, was temporarily an emitter due to an exceptional outbreak of bark beetle infestation and the associated dieback of spruce. However, from 2025 onwards, it is expected to regain its role as a GHG sink. For 5. Waste sector, slight decrease of GHG emissions is expected in years 2025 - 2050.

Table 2-4: Breakdown of reported and projected emissions of GHG by sectors - WEM scenario (including LULUCF)

[Mt CO_2 eq.]	Reported emissions				Projected emissions						Difference [%]			
	1990	**2005**	**2020**	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**1990 – 2022**	**1990 – 2030**	**1990 – 2040**	**1990 – 2050**
1. Energy	163.20	121.84	84.89	88.94	60.92	45.86	39.90	36.21	32.27	29.76	-45.50	-71.90	-77.81	-81.77
2. IPPU	17.12	14.91	14.78	15.05	11.97	7.39	5.76	4.24	3.97	3.73	-12.10	-56.82	-75.26	-78.21
3. Agriculture	15.75	8.19	8.05	8.42	7.81	7.80	7.70	7.58	7.55	7.52	-48.33	-50.48	-51.88	-52.23
4. LULUCF	-8.84	-8.72	9.70	3.38	-4.70	-5.74	-6.74	-7.07	-6.74	-6.67	138.22	35.03	20.03	24.52
5. Waste	3.32	4.36	5.68	5.51	5.32	4.49	3.64	3.08	2.82	2.66	66.12	35.32	-7.06	-19.93
Total	**190.55**	**140.59**	**123.09**	**121.01**	**81.33**	**59.80**	**50.26**	**44.04**	**39.86**	**37.00**	**-36.49**	**-68.62**	**-76.89**	**-80.58**

Note: reported values including GWPs from AR5 are taken from NID 2024

2.1.2 Projected greenhouse gas emissions ‘With additional measures (WAM) scenario’

The difference between WEM and WAM is caused by additional measures included in WAM scenario for 1. Energy and 5. Waste. The trend of individual gases projections (Table 2-5) is very similar to the WEM scenario.

Table 2-5: Breakdown of reported and projected emissions of GHG by gases - WAM scenario (including LULUCF)

[Mt CO_2 eq.]	Reported emissions				Projected emissions						Difference [%]			
	1990	2005	2020	2022	2025	2030	2035	2040	2045	2050	1990 – 2022	1990 – 2030	1990 – 2040	1990 – 2050
CO_2	157.30	118.08	102.00	98.48	56.49	37.75	20.79	11.43	5.95	0.86	-36.76	-76.00	-92.74	-99.46
CH_4	26.83	16.54	13.10	12.93	11.99	10.72	9.34	8.55	8.04	7.80	-51.81	-60.04	-68.15	-70.95
N_2O	8.25	5.62	4.82	4.88	4.35	4.24	4.05	3.83	3.77	3.70	-40.82	-48.59	-53.65	-55.16
HFCs	NO	1.35	3.75	3.61	2.47	1.29	0.69	0.35	0.14	0.10	NA	NA	NA	NA
PFCs	NO	0.01	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA
SF_6	0.09	0.11	0.07	0.07	0.06	0.05	0.04	0.04	0.03	0.03	-24.33	-43.30	-59.61	-71.18
NF_3	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA
Total	**192.48**	**141.71**	**123.74**	**121.01**	**75.31**	**54.02**	**34.86**	**24.16**	**17.90**	**12.46**	**-36.49**	**-71.63**	**-87.31**	**-93.45**

Note: reported values including GWPs from AR5 are taken from NID 2024

The trend of projected GHG emissions for individual sectors in WAM scenario (Table 2-6) is also very similar to the WEM scenario. According to the WAM scenario, emissions from 1. Energy and 5. Waste should be lower compared to WEM scenario.

Table 2-6: Breakdown of reported and projected emissions of GHG by sectors - WAM scenario (including LULUCF)

[Mt CO_2 eq.]	Reported emissions				Projected emissions						Difference [%]			
	1990	2005	2020	2022	2025	2030	2035	2040	2045	2050	1990 – 2022	1990 – 2030	1990 – 2040	1990 – 2050
1. Energy	163.20	121.84	84.89	88.94	55.06	40.44	24.94	16.81	10.91	5.81	-45.50	-75.22	-89.70	-96.44
2. IPPU	17.12	14.91	14.78	15.04	11.88	7.17	5.48	3.90	3.61	3.48	-12.10	-58.13	-77.24	-79.65
3. Agriculture	15.75	8.19	8.05	8.14	7.81	7.80	7.70	7.58	7.55	7.52	-48.33	-50.48	-51.88	-52.23
4. LULUCF	-8.84	-8.72	9.70	3.38	-4.70	-5.74	-6.74	-7.07	-6.74	-6.67	138.22	35.03	20.03	24.52
5. Waste	3.32	4.36	5.68	5.51	5.30	4.40	3.52	2.97	2.60	2.34	66.12	32.42	-10.53	-29.47
Total	**190.55**	**140.59**	**123.09**	**121.01**	**75.31**	**54.02**	**34.86**	**24.16**	**17.90**	**12.46**	**-36.49**	**-71.65**	**-87.32**	**-93.46**

Note: reported values including GWPs from AR5 are taken from NID 2024

2.1.3 Split of greenhouse gas emissions between EU ETS and ESD/ESR sectors

Following tables contain historic and projected greenhouse gas emissions under EU ETS sectors and ESD/ESR sectors for WEM and WAM scenario. Negative projected values for subcategory 1.A.1.a in WAM scenario for years 2045 and 2050 are caused by introduction of CCUS from biomass (chapter 2.2.4).

Table 2-7: Split of historic and projected EU ETS and ESD/ESR emissions – WEM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						Difference [%]			
	2005	2020	2022	2025	2030	2035	2040	2045	2050	2005 – 2022	2005 – 2030	2005 – 2040	2005 – 2050
EU ETS	82.45	54.68	58.14	32.22	18.47	15.74	13.22	10.92	9.99	-29.49	-77.60	-83.96	-87.89
ESR	58.13	68.42	59.49	53.79	47.06	41.26	37.88	35.67	33.68	2.33	-19.04	-34.83	-42.07

Table 2-8: Split of historic and projected EU ETS and ESD/ESR emissions – WAM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						Difference [%]			
	2005	2020	2022	2025	2030	2035	2040	2045	2050	2005 – 2022	2005 – 2030	2005 – 2040	2005 – 2050
EU ETS	82.45	54.68	58.14	28.69	18.52	9.89	5.65	2.24	-0.44	-29.49	-77.54	-93.15	-100.53
ESR	58.13	68.42	59.49	51.35	41.27	31.74	25.60	22.42	19.59	2.33	-29.01	-56.96	-66.31

2.2 Energy

The 1. Energy sector in the Czech Republic is driven by the combustion of fossil fuels in stationary and mobile sources; however, fugitive emissions are also an important source of emissions. The two main categories are 1.A Fuel combustion and 1.B Fugitive emissions from fuels.

CO_2 emissions from the category 1.A Fuel combustion decreased by 43%, from 147 Mt in 1990 to 84 Mt in 2022. Furthermore, CO_2 emissions from the 1.B Fugitive emissions from fuels decreased by 90% from 458 kt in 1990 to 44 kt in 2022, as well as CH_4 emissions from 1.B Fugitive emissions from fuels decreased by 82% from 478 kt in 1990 to 86 kt in 2022. GHG emission trend from sector 1. Energy for 1990 - 2022 is depicted in Figure 2-3 and Table 2-9 (CHMI, 2024).

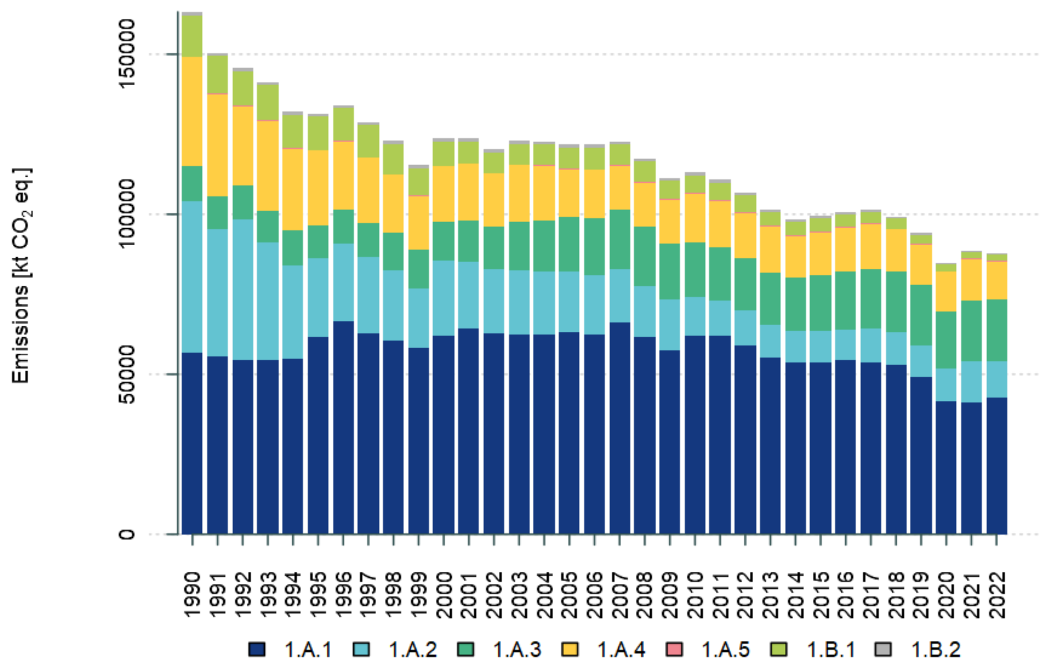


Figure 2-3: The emission trend in 1. Energy during reporting period 1990 – 2022 (CHMI, 2024)

Table 2-9: The emission trend in 1. Energy during reporting period 1990 – 2022 (CHMI, 2024)

Year	CO_2 kt	CH_4 kt	N_2O kt
1990	147 099	552.81	2.36
1991	135 613	509.56	2.20
1992	132 067	467.33	2.16
1993	127 484	476.49	2.12
1994	118 935	448.35	2.09
1995	118 523	438.73	2.12
1996	121 234	441.35	2.21
1997	116 383	426.49	2.18
1998	111 129	401.14	2.15
1999	104 682	362.07	2.17
2000	113 903	329.18	2.34
2001	114 655	303.11	2.00
2002	111 694	292.04	1.99
2003	114 333	287.99	2.06
2004	114 299	277.24	2.09
2005	113 050	294.43	2.07
2006	112 884	303.89	2.08
2007	114 195	285.32	2.15
2008	109 091	281.41	2.09
2009	103 746	254.40	1.98
2010	105 460	258.10	1.99
2011	103 005	256.67	2.01
2012	99 424	248.55	1.99
2013	94 926	215.38	1.97
2014	91 949	213.66	2.00
2015	93 079	208.55	2.03
2016	94 754	192.31	2.08
2017	95 842	180.88	2.11
2018	93 948	171.13	2.10
2019	89 329	157.32	2.07
2020	80 676	131.63	1.98
2021	84 380	134.32	2.11
2022	83 773	127.63	2.11
Trend 1990 - 2022	**-43%**	**-77%**	**-11%**

2.2.1 Methodological issues

The projections preparation in the 1. Energy sector in the current submission reflects an ongoing transition to complete projection preparation in the 1. Energy sector by the TIMES-CZ model (Rečka, et al., 2023; Rečka & Ščasný, 2018).

In the current submission, projections of greenhouse gas (GHG) emissions from the sector 1. Energy are prepared by three different methodological approaches for the following categories:

Projections of emissions from category 1.A.1, 1.A.2, 1.A.4, 1.B.1 and 1.B.2 – projections are prepared by using data from the TIMES-CZ model.

Projections of emissions from category 1.A.3 – projections are prepared by using data from COPERT.

Projections of emissions from categories 1.A.5– projections are prepared using a data-driven model structure using some of the modelled expectations by TIMES-CZ.

2.2.1.1 Methodological issues – 1.A.1, 1.A.2, 1.A.4, and 1.B

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) (IEA-ETSAP, 2022). 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 (Loulou, et al., 2020).

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 (Capros, et al., 2014); but it is regionalised into 14 regions of Czechia; its base year is updated to 2019, individual data of EU ETS facilities modify the model structure, and a detailed transport module is developed. (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 five-year-time steps. Activity data and emissions were calibrated with actual values in 2022. A year is divided into 12 time slices, 4 seasonal time slices, and 3-day levels (day, peak and night). GHG emissions (CO_2, CH_4, N_2O) and other pollutants (SO_2, NO_X, NMVOC, PM) are included in the model. GHG emissions from agriculture and Land Use, Land Use Change and Forestry Use (LULUCF) are not included in the model.

The Czech transmission system operator (ČEPS) provided the electricity prices for import and export and the import-export profiles from the model PLEXOS for scenarios WEM and WAM in the NCEP prefinal versions 2024. Those electricity prices and import-export profiles are also applied in the emission projection.

There are methodology differences in fuel and emission allocation among the sectors between the projection from the TIMES-CZ model and the emission inventory. Fuel consumption for generation heat in auto producers' CHP is allocated to the given sector instead of evenly spread across the industry's final energy consumption. New auto producers' CHP is completely assigned to 1A2s sectors, while part of their production could be set in 1A1a in the inventory.

Projected emissions in 1.B Fugitive emissions from fuels are dominantly linked to projections of domestic coal mining, which is the major source of 1.B emissions.

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 prefinal versions in 2024. The WAM scenario in the current submission follows this validation.

Activity data

The activity is common for WEM 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 Czech Republic (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 2-10: 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
Glas	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

Energy savings in buildings

WEM: The energy savings potential in buildings corresponds to the Baseline Scenario of the Building Renovation Strategy (MIT, 2020).

WAM: The energy savings potential in buildings corresponds to the Hypothetical Scenario of the Building Renovation Strategy (MIT, 2020).

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 2-11: Applied EUA, EUR_{2023}/t CO_2

	WAM		WEM
	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 2-12: 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

Hydrogen

WEM: The WEM scenario does not include hydrogen imports. There is no target for RFNBO hydrogen in the WEM scenario.

WAM: 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 Czech Republic 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 Czech Republic. 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 capacity development and PV and Wind potential

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).

Scenario-specific development of new nuclear capacities and PV and wind potential is provided below:

WEM:

- Nuclear capacity development:
- 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

WAM:

- 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

2.2.1.2 Methodological issues – 1.A.3 Transport

Road transport shows steadily growing activity and consequently energy consumption and GHG emissions. After 2007, transport, especially freight transport, was hit by the economic crisis. However, the growth of transport activity continued in 2010 – 2019. The decrease in 2020 is probably due to the COVID-19 pandemic.

In 2022, the total emissions from 1.A.3 Transport were 19 391 kt CO_2 eq. GHG emission trend from 1.A.3 Transport for 2000 to 2022 is depicted in Figure 2-4.

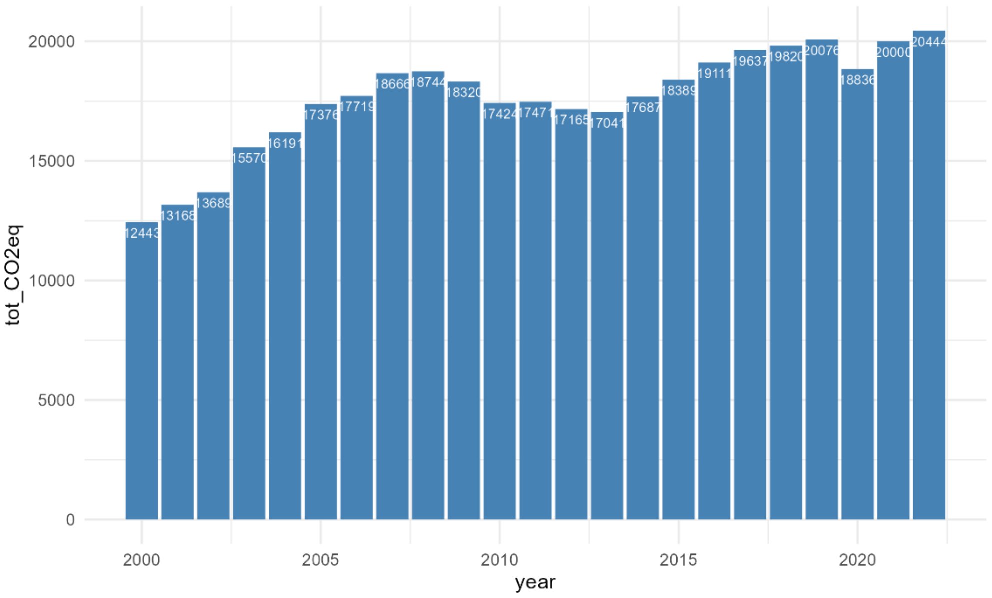


Figure 2-4: The emission trend in 1.A.3 Transport during reporting period 2000 – 2022 (CHMI, 2024)

The projected structure of energy carriers in the 1.A.3 Transport counts with growing shares of biofuels and natural gas use. A significant increase of electric and hybrid cars is supposed to start following 2030.

The update of the projections for this reporting was based mainly on the new road transport data, which were obtained from COPERT. COPERT is the EU standard vehicle emissions calculator which uses a detailed methodology for EMEP/CORINAIR transport emissions calculations (EEA , 2016). The overall transport performance forecast and the division of transport work are based on the Transport Sector Strategy (MT, 2019). Also, non-road transport forecasts were not changed. In the field of road transport projections, the procedure was as follows:

- Aggregation of downloaded data from COPERT for 2000 - 2020 into less detailed categories (aggregation type - sum). COPERT has a total of 432 categories of vehicles, the projection cannot be performed for such a number of categories. Aggregation was made by transport mode, the fuel used and the EURO emission standard. The original 432 COPERT categories have been aggregated into groups by vehicle category, used fuel and Euro Standard.

- Addition of vehicle categories with supposed use in future, which are not in COPERT now.
- Addition of non-road vehicle categories.
- Including additions above, in total, the model has 112 vehicle categories.
- Calculation of annual vehicle kilometres (2000 – 2020), from fleet and mileage data.
- Updating data on new registrations and discarded vehicles.
- Distribution of future vehicle kilometres from older vehicle categories (2021 – 2050), so their number is continuously decreasing to zero as part of ongoing fleet renewal.
- Input of official transport prognosis data (from Transport Sectoral Strategy (MT, 2019)) to emissions projections model.
- Calculation of future vehicle kilometres from new vehicles for each year (2021 - 2050), based on the difference between total prognosis data (from Transport Sectoral Strategy (MT, 2019)) and sums of performance of older vehicles.
- Input of official energy consumption prognosis data (from the Czech Ministry of Industry and Trade).
- Splitting of future vehicle kilometres from new vehicles by fuel, with the help of the mentioned energy consumption prognosis data.
- Export of implied emission factors from the COPERT program and their appropriate distribution for vehicle categorisation in the projection model.
- Calculation of projected emissions, multiplying outputs and emission factors.
- Expression of GHG emissions as CO_2 equivalent, based on the global warming potential of CH_4 and N_2O.
- Calculation of supposed emissions reductions by individual Policies and Measures (PaM), their aggregation With existing measures (WEM) and With additional measures (WAM) scenarios and calculation of GHG emissions in WEM and WAM scenarios.

With regards to emission reductions applying of individual policies and measures (for more details please see chapter 1.2.2), only quantifiable measures have been calculated. Calculable measures are described in the following Table 2-13.

Table 2-13: Overview of PaMs with estimated emission reductions

PaM title	Changes in the prediction model
Support of biofuels	CO_2 emission factors result from an increased share of biofuels.
Regulation on CO_2 from cars	Modification of new car activity data to have its weighted average equal to 95 g/km.
Regulation on CO_2 from vans	Modification of new car activity data to have its weighted average equal to 147 g/km.
ICAO agreement (International Civil Aviation Org.)	No changes from the previous projections.
Modal shift	Reduced road freight transport performance with an estimated share of trips longer than 300 km, of which 30% should be shifted to rail.
Economical and tax tools	Change in prospective energy consumption where environmentally friendly fuel predominates, which should be less taxed.
Road toll	There is a change in the demand for road freight transport, based on price-demand dependency.
Further reduction of CO_2 emissions	Modification of new cars and light duty vehicles activity data to achieve required decrease of CO_2 emissions in 2025 and 2030.

Fit for 55	Modification of new cars and light duty vehicles activity data to achieve required decrease of CO_2 emissions in 2030 and only zero emissions from new cars from 2035.

2.2.1.3 Methodological issues – 1.A.5

For category 1.A.5, a data-driven model was applied with assumptions related to the 1.A.4 categories, mostly to 1.A.4.c since, the basis of the emission is similar in 1.A.4.c and 1.A.5. Category 1.A.5 Other is also related to 1.A.3 Transport, however, sector 1.A.5 is expected to decline slower than 1.A.3 Transport since 1.A.5 includes army, air force and rescue service for which slower electrification and slower implementation of any policies or measures can be expected.

Data for electricity and heat production are provided by current version of the National Energy and Climate Plan.

2.2.2 Projected greenhouse gas emissions 'With existing measures (WEM) scenario' and 'With additional measures (WAM) scenario'

According to the projections of GHG emissions in 1. Energy sector (Table 2-14) it is expected that emissions decrease for both scenarios. The decrease of emissions is more visible for WAM scenario which includes additional measures for category 1.A.1 Energy industries, 1.A.2 Manufacturing Industries and construction, 1.A.3 Transport and 1.A.4 Other sectors. For 2050, the difference between WEM and WAM scenario is calculated as 23.95 Mt CO_2 eq.

In total numbers it is expected that GHG emissions from 1. Energy sector will decrease approximately by 82% in 2050 compared to 1990, by 76% compared to 2005 and by 67% compared to current level (2022) of emissions for WEM scenario. It is projected, that GHG emissions will decrease in WAM scenario approximately by 96% in 2050 compared to 1990, by 95% compared to 2005 and 93% compared to current level (2022).

Table 2-14: Reported and projected emissions of GHG in 1. Energy sector – WEM and WAM scenarios

[Mt CO_2 eq.]	Reported emissions			Projected emissions						Difference [%]			
	1990	2005	2022	2025	2030	2035	2040	2045	2050	1990 – 2025	1990 – 2030	1990 – 2040	1990 – 2050
WEM	163.20	121.84	88.94	60.92	45.86	39.90	36.21	32.27	29.76	-62.67	-71.90	-77.81	-81.77
WAM	163.20	121.84	88.94	55.06	40.44	24.94	16.81	10.91	5.81	-66.27	-75.22	-89.70	-96.44

2.2.3 Projected greenhouse gas emissions 'With existing measures (WEM) scenario'

The 1. Energy sector is a source of CO_2, CH_4 and N_2O emissions. It is expected that emissions are going to decrease for all gases emitted by 1. Energy sector during the projected period (Table 2-15). CO_2 emissions are projected to decrease in 2050 by 42%, CH_4 by 77% and N_2O by 11% compared to the current level (2022) of emissions.

Table 2-15: Breakdown of reported and projected emissions of GHG by gases - WEM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						Difference [%]			
	1990	2005	2022	2025	2030	2035	2040	2045	2050	1990 – 2025	1990 – 2030	1990 – 2040	1990 – 2050
CO_2	147.10	113.05	84.81	57.58	43.06	37.27	33.76	30.02	27.61	-60.86	-70.73	-77.05	-81.23
CH_4	15.48	8.24	3.57	2.97	2.51	2.38	2.21	2.03	1.94	-80.79	-83.77	-85.74	-87.48
N_2O	0.63	0.55	0.56	0.37	0.29	0.25	0.24	0.22	0.21	-41.20	-54.14	-61.60	-66.42

Total	163.20	121.84	88.94	60.92	45.86	39.90	36.21	32.27	29.76	-45.50	-71.90	-77.81	-81.77

In 2022 the dominant GHG source in the 1. Energy sector was the category of 1.A.1 Energy industries (36%), followed by 1.A.3 Transport (16%), 1.A.4 Other Sectors (10%) and 1.A.2 Manufacturing industries (9%) (Table 2-1). Emissions from category 1.B Fugitive emissions from fuels account for 3% share of total emissions from the 1. Energy sector. A significant reduction of GHG emissions can be observed in 1.A.2 Manufacturing industries (76%) and 1.A.4 Other Sectors (66%) during the past three decades (1990 – 2020), mainly due to the transition from domestic coal to other fuels, in particular natural gas.

The vast majority of categories under 1. Energy sector emissions are expected to decrease in 2050 compared to the current level. For the category 1.A.1 Energy Industries, which has a major share of total GHG emissions from 1. Energy, emissions are expected to decrease by 89% in 2050 compared to the 2022 level.

The emission trend in category 1.A.1 Energy industries is mainly driven by 1.A.1.a Public electricity and heat production and shows a rapid decrease after 2020. This change in electricity generation results from the decreasing power generation due to decreasing net export of electricity (exogeneous assumption) and price of EUA that induces phase-out of lignite power plants. Renewable energy sources and natural gas replace the decreasing power generation from lignite. Carbon capture and storage technology will be implemented in natural gas heat and power cogeneration starting in 2045. Additionally, limited application of this technology to biomass power generation is planned for 2050. Between 1990 and 2050 a drop of 92% is projected in the category 1.A.1 Energy industries. This drop is driven mainly by the category 1.A.1.a Public electricity and heat production.

The projected emissions in category 1.A.2 Manufacturing industries and construction are decreasing. Carbon capture and storage technology will be applied in iron, steel, and non-metallic minerals production from 2035. The drop in GHG emission in this sector is 89% in the period 1990 – 2050.

In 1.A.4 Other sectors, a decrease of 76% in 2050 compared to 1990 is expected to be achieved. In the 1.A.4.a commercial sector, even decrease of 65% will be reached if all existing measures are applied. The highest emission share (>49%) in 1.A.4 Other sectors is from the category 1.A.4.b Residential.

The projected decline of 1.B Fugitive emissions from fuels results mainly from decreasing mining of hard and brown coal and includes methane leakages from deep and open coal mines, crude oil mining and cracking, natural gas leakages from mining, transmission and distribution of natural gas and natural gas leakages from power plants and heating plants.

Table 2-16: Breakdown of reported and projected emissions of GHG by categories in Energy – WEM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						Difference [%]			
	1990	2005	2020	2025	2030	2035	2040	2045	2050	1990-2025	1990-2030	1990-2040	1990-2050
1. Energy	**163.20**	**121.84**	**88.94**	**60.92**	**45.86**	**39.90**	**36.21**	**32.27**	**29.76**	**-62.67**	**-71.90**	**-77.81**	**-81.77**
A. Fuel combustion (sectoral approach)	**149.37**	**114.22**	**86.50**	**58.91**	**44.23**	**38.33**	**34.83**	**31.03**	**28.57**	**-60.56**	**-70.39**	**-76.69**	**-80.87**
1. Energy industries	**56.83**	**63.14**	**42.77**	**22.11**	**10.69**	**9.10**	**6.70**	**4.67**	**4.55**	**-61.10**	**-81.18**	**-88.22**	**-92.00**
a. Public electricity and heat production	54.82	56.46	40.66	20.45	9.46	8.03	5.75	3.95	3.92	-62.70	-82.74	-89.52	-92.85
b. Petroleum refining	0.49	0.89	0.51	0.63	0.63	0.62	0.62	0.49	0.41	27.53	27.10	26.24	-15.85
c. Manufacture of solid fuels and other energy industries	1.52	5.79	1.61	1.03	0.61	0.45	0.33	0.23	0.22	-32.10	-60.17	-78.39	-85.82
2. Manufacturing industries and construction	**47.11**	**18.84**	**11.32**	**8.40**	**8.91**	**7.03**	**7.15**	**6.50**	**5.42**	**-82.17**	**-81.08**	**-84.81**	**-88.50**
3. Transport	**11.25**	**17.36**	**20.43**	**15.84**	**14.04**	**12.72**	**12.32**	**11.69**	**10.27**	**40.76**	**24.79**	**9.55**	**-8.74**
a. Domestic Aviation	NO	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	NO	NO	NO	NO
b. Road Transportation	10.42	16.95	20.14	15.56	13.78	12.48	12.10	11.48	10.07	49.35	32.27	16.13	-3.34
c. Railways	0.77	0.29	0.23	0.22	0.20	0.19	0.17	0.16	0.15	-71.62	-73.67	-77.33	-80.51
d. Domestic Navigation	0.05	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	-83.38	-85.35	-88.62	-91.15
e. Other Transportation	0.01	0.07	0.03	0.03	0.03	0.03	0.03	0.03	0.03	536.22	536.22	536.22	536.22
4. Other sectors	**33.99**	**14.61**	**11.72**	**12.34**	**10.37**	**9.29**	**8.47**	**8.00**	**8.19**	**-63.68**	**-69.49**	**-75.08**	**-75.91**
a.Commercial/institutional	9.96	3.53	2.33	3.18	3.57	2.96	2.60	2.82	3.46	-68.06	-64.12	-73.94	-65.27
b. Residential	20.18	9.75	8.19	8.19	5.83	5.47	5.07	4.43	4.04	-59.44	-71.10	-74.89	-79.97
c.Agriculture/forestry/fishing	3.85	1.32	1.19	0.98	0.96	0.85	0.81	0.75	0.69	-74.62	-74.96	-79.02	-82.19
5. Other	**0.19**	**0.27**	**0.27**	**0.22**	**0.21**	**0.19**	**0.18**	**0.17**	**0.15**	**12.35**	**10.46**	**-7.65**	**-21.76**
B. Fugitive emissions from fuels	**13.84**	**7.63**	**2.44**	**2.02**	**1.63**	**1.58**	**1.39**	**1.24**	**1.18**	**-85.43**	**-88.24**	**-89.97**	**-91.44**
1. Solid fuels	**12.64**	**6.62**	**1.93**	**1.37**	**0.91**	**0.83**	**0.71**	**0.59**	**0.53**	**-89.17**	**-92.84**	**-94.37**	**-95.82**
2. Oil and natural gas and other emissions from energy production	**1.20**	**1.00**	**0.52**	**0.65**	**0.72**	**0.75**	**0.68**	**0.65**	**0.66**	**-45.94**	**-39.79**	**-43.60**	**-45.16**
C. CO_2 transport and storage	**NO**	**NO**	**NO**	**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NO**	**NO**	**NO**	**NO**

2.2.4 Projected greenhouse gas emissions 'With additional measures (WAM) scenario'

Additional measures in the 1. Energy sector are applicable for projections of GHG emissions from the categories of 1.A.1 Energy industries, 1.A.2 Manufacturing Industries and construction, 1.A.3 Transport and 1.A.4 Other sectors. Additional measures applied for 1.A.1 Energy industries, 1.A.2 Manufacturing industries and construction, and 1.A.4 Other sectors are described in section 2.2.1.1.

Table 2-17 shows the reported and projected emissions of GHG by categories in Energy for the WAM scenario.

In the 1.A.1 Energy industries, the emissions of GHG decrease faster in WAM than in WEM due to higher EUA prices, higher potential of photovoltaic and wind power plants, higher energy savings, and phase-out of lignite in 2033. In 2050 the emissions of GHG are 7.36 Mt CO_{2e} (162%) lower in WAM than in WEM, in 1.A.1 Energy industries. Carbon capture and storage technology will be applied to natural gas heat and power cogeneration from 2035, and to biomass power generation from 2045. The increase in CH_4 emissions from 2030 onwards in sector 1.A.1.a is related to the increasing use of biomass energy. The use of biomass energy is higher than in the WEM scenario, and as a result, the CH_4 emissions in 1.A.1 Energy industries are higher in the WAM scenario than in the WEM scenario.

The projected emissions in category 1.A.2 Manufacturing industries and construction are decreasing. The GHG emissions decrease in this sector is 98% from 1990 to 2050. Carbon capture and storage technology will be applied in the production of iron and steel, and non-metallic minerals from 2035. In 2050, the emissions of GHG are 4.3 Mt CO_{2e} (79%) lower in WAM than in WEM, in 1.A.2 Manufacturing industries and construction.

In the 1.A.4 Other sectors, the GHG emissions decrease faster in WAM than in WEM after 2035, mainly due to the introduction of ETS2 for buildings and the higher potential for energy savings. In 2050, the GHG emissions are 7.17 Mt CO_{2e} (88%) lower in WAM than in WEM in the 1.A.4 Other sectors.

Table 2-17: Breakdown of reported and projected emissions of GHG by categories in Energy – WAM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						Difference [%]			
	1990	2005	2020	2025	2030	2035	2040	2045	2050	1990-2025	1990-2030	1990-2040	1990-2050
1. Energy	**163.20**	**121.84**	**88.94**	**55.06**	**40.44**	**24.94**	**16.81**	**10.91**	**5.81**	**-66.27**	**-75.22**	**-89.70**	**-96.44**
A. Fuel combustion (sectoral approach)	**149.37**	**114.22**	**86.50**	**53.19**	**38.91**	**23.80**	**15.98**	**10.24**	**5.18**	**-64.39**	**-73.95**	**-89.30**	**-96.53**
1. Energy industries	**56.83**	**63.14**	**42.77**	**18.21**	**9.62**	**2.75**	**0.87**	**-1.31**	**-2.81**	**-67.95**	**-83.08**	**-98.48**	**-104.95**
a. Public electricity and heat production	54.82	56.46	40.66	16.64	8.33	1.82	0.10	-1.81	-3.17	-69.65	-84.81	-99.81	-105.78
b. Petroleum refining	0.49	0.89	0.51	0.63	0.63	0.61	0.55	0.35	0.22	27.53	27.10	11.74	-56.28
c. Manufacture of solid fuels and other energy industries	1.52	5.79	1.61	0.95	0.66	0.31	0.21	0.15	0.14	-37.67	-56.41	-86.11	-90.74
2. Manufacturing industries and construction	**47.11**	**18.84**	**11.32**	**8.38**	**7.91**	**5.60**	**3.62**	**2.31**	**1.13**	**-82.21**	**-83.20**	**-92.31**	**-97.59**
3. Transport	**11.25**	**17.36**	**20.43**	**15.45**	**13.25**	**10.07**	**8.17**	**6.84**	**5.69**	**37.38**	**17.81**	**-27.40**	**-49.45**
a. Domestic Aviation	NO	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	NO	NO	NO	NO
b. Road Transportation	10.42	16.95	20.14	15.18	13.00	9.83	7.94	6.63	5.49	45.70	24.75	-23.75	-47.30
c. Railways	0.77	0.29	0.23	0.22	0.20	0.19	0.17	0.16	0.15	-71.62	-73.67	-77.33	-80.51
d. Domestic Navigation	0.05	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	-83.38	-85.35	-88.62	-91.15
e. Other Transportation	0.01	0.07	0.03	0.03	0.03	0.03	0.03	0.03	0.03	536.22	536.22	536.22	536.22
4. Other sectors	**33.99**	**14.61**	**11.72**	**10.92**	**7.92**	**5.18**	**3.14**	**2.24**	**1.02**	**-67.87**	**-76.71**	**-90.76**	**-97.00**
a.Commercial/institutional	9.96	3.53	2.33	3.06	2.82	1.53	0.62	0.08	0.04	-69.24	-71.67	-93.75	-99.62
b. Residential	20.18	9.75	8.19	6.88	4.21	2.80	1.74	1.48	0.77	-65.93	-79.15	-91.39	-96.20
c.Agriculture/forestry/fishing	3.85	1.32	1.19	0.98	0.89	0.85	0.78	0.68	0.22	-74.51	-76.96	-79.67	-94.34
5. Other	**0.19**	**0.27**	**0.27**	**0.22**	**0.21**	**0.19**	**0.18**	**0.17**	**0.15**	**12.35**	**10.46**	**-7.65**	**-21.76**
B. Fugitive emissions from fuels	**13.84**	**7.63**	**2.44**	**1.87**	**1.53**	**1.14**	**0.83**	**0.67**	**0.63**	**-86.51**	**-88.97**	**-93.98**	**-95.46**
1. Solid fuels	**12.64**	**6.62**	**1.93**	**1.25**	**0.99**	**0.64**	**0.49**	**0.38**	**0.39**	**-90.12**	**-92.19**	**-96.10**	**-96.93**
2. Oil and natural gas and other emissions from energy production	**1.20**	**1.00**	**0.52**	**0.62**	**0.54**	**0.50**	**0.34**	**0.29**	**0.24**	**-48.39**	**-55.02**	**-71.63**	**-79.99**
C. CO_2 transport and storage	**NO**	**NO**	**NO**	**NO**	**NO**	**NE**	**NE**	**NE**	**NE**	**NO**	**NO**	**NO**	**NO**

2.2.4.1 WAM for 1.A.3 Transport (including WEM)

Only difference between WEM and WAM scenario in Energy sector is in additional measures used for projections of GHG emissions from category 1.A.3 Transport. Following chapter will describe category 1.A.3 in more detail with focus on difference between WEM and WAM scenario.

The GHG emissions from transport are expected to decline in both scenarios WEM and WAM from 2025 (Table 2-18 and Figure 2-5). This results from fuel switches in favour of fuels with lower carbon content, from obligatory improved energy efficiency of new personal cars and especially from a higher share of electric and hybrid vehicles. Due to reduction measures the decrease of CO_2 emissions is supposed to 2050. The main efficiency has the application of CO_2 regulation of cars and vans and also the support of biofuels.

Table 2-18: Reported and projected emissions of GHG in 1.A.3 Transport – WEM and WAM scenarios

[Mt CO_2 eq.]	Reported emissions			Projected emissions						Difference [%]			
	1990	2005	2020	2025	2030	2035	2040	2045	2050	1990 – 2020	1990 – 2030	1990 – 2040	1990 – 2050
WEM	11.43	17.41	18.91	14.21	12.50	11.85	11.02	10.22	9.41	65.44	9.41	-3.58	-17.67
WAM	11.43	17.41	18.91	13.95	11.54	8.48	7.47	6.78	6.12	65.44	0.94	-34.63	-46.48

Note: reported values include biomass, compared to the values from NIR

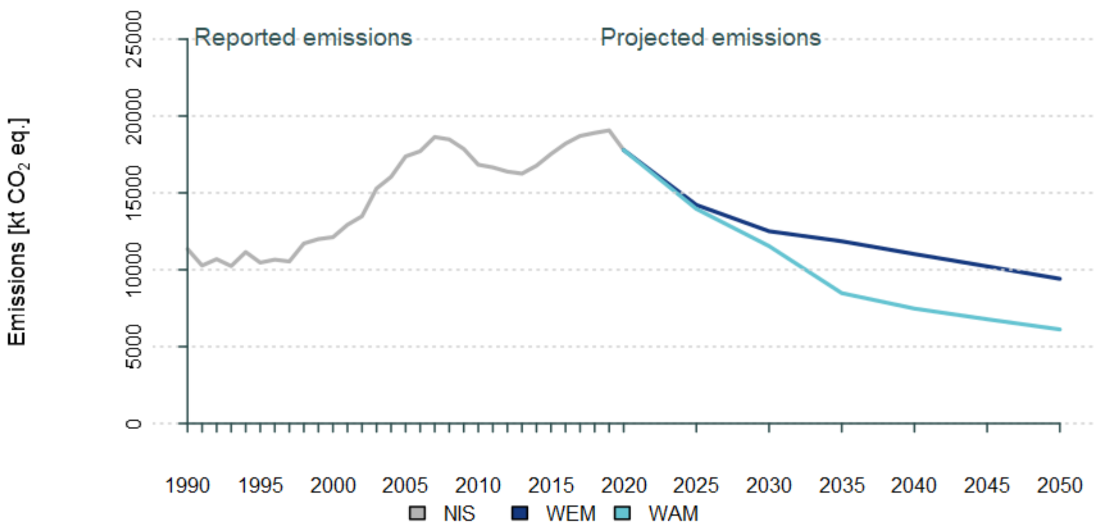


Figure 2-5: Reported and projected emissions of GHG in 1.A.3 Transport – WEM, WAM scenario

Following tables contain breakdown of reported and projected emissions by gases and by categories for WEM scenario. According to the WEM scenario, emissions from 1.A.3 Transport should decrease by 3.58% in 2040 compared to 1990.

Table 2-19: Breakdown of reported and projected emissions of GHG by gases in 1.A.3 Transport - WEM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						Difference [%]			
	1990	2005	2020	2025	2030	2035	2040	2045	2050	1990 – 2020	1990 – 2030	1990 – 2040	1990 – 2050
CO_2	11.17	17.15	18.69	14.06	12.37	11.73	10.91	10.11	9.31	67.3	10.76	-2.36	-16.63
CH_4	0.08	0.07	0.02	0.02	0.01	0.01	0.01	0.01	0.01	-70.15	-83.97	-83.75	-82.91
N_2O	0.18	0.19	0.2	0.14	0.12	0.11	0.1	0.09	0.09	9.63	-33.57	-43.96	-53.07
Total	11.43	17.41	18.91	14.21	12.5	11.85	11.02	10.22	9.41	65.44	9.41	-3.58	-17.67

Note: reported values include biomass, compared to the values from NIR

Table 2-20: Breakdown of reported and projected emissions of GHG by categories in 1.A.3 Transport - WEM scenario

[Mt CO_2 eq.]	Reported emissions	Projected emissions	Difference [%]

	1990	2005	2020	2025	2030	2035	2040	2045	2050	1990 – 2020	1990 – 2030	1990 – 2040	1990 – 2050
1.A.3.a Domestic Aviation	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0	0	16.72	-14.67	-36.1	-51.02
1.A.3.b Road Transportation	10.44	16.99	18.59	13.92	12.23	11.59	10.78	10	9.2	78.12	17.16	3.28	-11.85
1.A.3.c Railways	0.86	0.32	0.26	0.24	0.22	0.21	0.19	0.18	0.17	-69.66	-73.9	-77.55	-80.69
1.A.3.d Domestic Navigation	0.05	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-76.21	-81.53	-85.66	-88.88
1.A.3.e Other Transportation	0.07	0.07	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-53.05	-53.05	-53.05	-53.05
Total	**11.43**	**17.41**	**18.91**	**14.21**	**12.50**	**11.85**	**11.02**	**10.22**	**9.41**	**65.44**	**9.41**	**-3.58**	**-17.67**

Note: reported values include biomass, compared to the values from NIR

It is projected, that additional measures *Economic tax tools, Road toll* and mainly *Further decrease of CO_2 emissions in 2025 and 2030* will influence GHG emissions from 1.A.3 Transport as it is shown in following tables. Description of the measures is specified in Chapter 1.2.2. According to the WAM scenario, emissions from 1.A.3 Transport should decrease by 34.6% in 2040 compared to 1990.

Table 2-21: Breakdown of reported and projected emissions of GHG by gases in 1.A.3 Transport - WAM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						Difference [%]			
	1990	2005	2020	2025	2030	2035	2040	2045	2050	1990 – 2020	1990 – 2030	1990 – 2040	1990 – 2050
CO_2	11.17	17.15	18.69	13.81	11.41	8.38	7.38	6.70	6.04	67.3	2.17	-33.90	-45.90
CH_4	0.08	0.07	0.02	0.02	0.01	0.01	0.01	0.01	0.01	-70.15	-85.25	-90.86	-91.44
N_2O	0.18	0.19	0.2	0.13	0.11	0.09	0.08	0.07	0.07	9.63	-37.34	-55.33	-62.99
Total	**11.43**	**17.41**	**18.91**	**13.95**	**11.54**	**8.48**	**7.47**	**6.78**	**6.12**	**65.44**	**0.94**	**-34.63**	**-46.48**

Note: reported values include biomass, compared to the values from NIR

Table 2-22: Breakdown of reported and projected emissions of GHG by categories in transport – WAM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						Difference [%]			
	1990	2005	2020	2025	2030	2035	2040	2045	2050	1990 – 2020	1990 – 2030	1990 – 2040	1990 – 2050
1.A.3.a Domestic Aviation	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	16.72	-14.67	-36.1	-51.02
1.A.3.b Road Transportation	10.44	16.99	18.59	13.66	11.26	8.22	7.23	6.56	5.91	78.12	7.89	-30.71	-43.41
1.A.3.c Railways	0.86	0.32	0.26	0.24	0.22	0.21	0.19	0.18	0.17	-69.66	-73.9	-77.55	-80.69

1.A.3.d Domestic Navigation	0.05	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-76.21	-81.53	-85.66	-88.88
1.A.3.e Other Transportation	0.07	0.07	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-53.05	-53.05	-53.05	-53.05
Total	**11.43**	**17.41**	**18.91**	**13.95**	**11.54**	**8.48**	**7.47**	**6.78**	**6.12**	**65.44**	**0.94**	**-34.63**	**-46.48**

Note: reported values include biomass, compared to the values from NIR

2.2.5 Sensitivity analysis

2.2.5.1 Sensitivity analysis of 1.A.5

Sensitivity analysis for 1.A.5 is based on the changes in input data for +/-5% in the major indicators. Those changes are resulting in changes in the final projected emissions. The following table shows details of the resulting emissions after these changes for each category.

Table 2-23: Sensitivity analysis of 1.A.5 Other on input activity data (WEM scenario)

[Mt CO2 eq.]	2022	2025	2030	2035	2040	2045	2050	2055
WEM	0.27	0.22	0.21	0.19	0.18	0.17	0.15	0.15
WEM -5%	0.26	0.21	0.20	0.18	0.17	0.16	0.14	0.14
WEM +5%	0.28	0.23	0.23	0.20	0.19	0.18	0.16	0.16

2.2.5.2 Sensitivity analysis of 1.A.1, 1.A.2, 1.A.4 and 1.B

Two parameters within the scenario assumptions of the TIMES-CZ model are modified to perform a sensitivity analysis of greenhouse gas emission projections for categories 1.A.1, 1.A.2, 1.A.4, and 1.B. First, the low and high price of the natural gas from the Recommended parameters for reporting on GHG projections in 2025 (DG Climate Action, 2024), see Table 1-25. Second, the final energy service demands are increased or decreased by 5%. Those two adjusted parameters are combined in the following way: In the +5% option, the low price of natural gas and increased demand for final energy services in category 1.A.4 are applied. In the -5% option, the high price of natural gas and decreased demand for final energy services in category 1.A.4 are applied. The sensitivity analysis is provided for both WEM and WAM scenarios.

Table 1-25 provides the values of emissions of GHG for the sensitivity analysis of 1.A.1.a Public electricity and heat production and 1.A.4 Other sectors.

Table 2-24: Proposed range for the gas price trajectory (EUR2023)

EUR2023	Gas (min)		Gas (Max)	
	€/GJ	€/toe	€/GJ	€/toe
2025	9.4	394	9.4	394.1
2030	6.8	284	12.6	527.4
2035	6.6	275	12.6	527.4
2040	6.7	279	12.6	527.4
2045	6.4	268	12.6	527.4
2050	6.1	256	13.2	551.6
2055	5.8	244	13.5	564.2

Table 2-25: Sensitivity analysis of emission of GHG from 1.A.1, 1.A.2, 1.A.4, and 1.B

[Mt CO2 eq.]		2025	2030	2035	2040	2045	2050
WEM - 5%	1.A.1.	22.33	11.81	7.23	4.12	1.20	2.26
	1.A.2	8.47	8.51	6.60	6.89	5.75	4.94
	1.A.4.	11.99	9.35	8.48	12.24	7.76	7.87
	1.B	1.95	1.58	1.42	1.26	1.04	1.05
WEM +5%	1.A.1.	24.42	9.57	8.06	6.60	4.28	4.06
	1.A.2	8.86	11.31	10.60	10.66	10.12	8.96
	1.A.4.	12.93	11.18	10.24	14.07	8.95	9.31
	1.B	2.06	1.64	1.64	1.47	1.40	1.36
WAM - 5%	1.A.1.	18.85	9.70	2.75	0.84	-1.11	-2.50
	1.A.2	8.03	7.29	4.66	2.98	2.03	1.08
	1.A.4.	11.18	6.80	4.26	6.43	2.07	1.07
	1.B	1.81	1.43	1.06	0.77	0.61	0.57
WAM +5%	1.A.1.	20.21	9.62	2.94	1.08	-1.27	-2.75
	1.A.2	8.82	8.92	6.69	5.30	3.16	1.13
	1.A.4.	11.58	8.72	6.26	7.01	2.40	1.02
	1.B	1.91	1.52	1.25	0.94	0.73	0.69

2.2.5.3 Sensitivity analysis of 1.A.3 Transport

The sensitivity analysis for 1.A.3 Transport was done with a help of the Monte Carlo method that relies on repeated random sampling to obtain numerical results. Essential idea of the Monte Carlo method is using randomness to solve problems that might be deterministic in principle. The method is often used in physical and mathematical problems and is the most useful in the cases when it is difficult or impossible to use other approaches. From the methods of Monte Carlo, the probability density function was preferred.

A statistical analysis of the used emission factors was carried out using the example of carbon dioxide CO_2, basic statistical analysis and graphical representation, with the help of box plots. The R program was again used as a tool. Within the framework of statistics, the following statistical indicators were evaluated for each type of transport and fuel used: minimum, 1st quartile, median, arithmetic mean, 3rd quartile and maximum.

Table 2-26: Basic statistical analysis of CO_2 emission factors

Category	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Passenger_Cars Petrol	128.1404	151.5357	173.506	182.2228	209.2723	282.3935
Passenger_Cars Diesel	123.9636	177.7773	178.3135	194.3462	225.2791	245.2108
Passenger_Cars LPG	200.7887	204.4284	205.3952	205.1393	205.4638	210.4394
Passenger_Cars CNG	237.5078	237.5261	237.5444	237.5451	237.5736	237.5736
Light_Commercial_Vehicles Petrol	167.0682	208.6025	230.7941	224.2562	252.3916	270.271
Light_Commercial_Vehicles Diesel	196.2346	239.5782	269.2146	264.6384	281.0667	306.5755
Heavy_Duty_Trucks Diesel	343.9522	600.3441	754.0099	726.89	883.3578	1155.585
Buses Diesel	644.3637	782.1573	859.7694	908.1302	1087.214	1352.788
Buses CNG	1175.969	1176.38	1176.792	1176.792	1177.203	1177.614
L_Category Petrol	51.04198	53.14733	68.75892	73.55148	87.18936	110.4895

This assessment was used for the calculations of total emissions in the lower and upper band and determination of the possible statistical error (uncertainty) in the calculations. Uncertainty calculations were made for the years 2030 and 2050. It must be emphasized that the uncertainty reflects the different CO_2 production of different categories of vehicles and not the overall projected development of traffic or the development of fuel and energy consumption. Therefore, the same traffic performance was always entered into the calculations of CO_2 emissions in the lower and higher uncertainty bands. As for the emission factors, the minimum and maximum values were deliberately not selected, due to large deviations from the averages. The first and third quartile values were preferred. The first quartile separates the lowest 25% of the data from the highest 75%, while the third quartile separates the lowest 75% of the data from the highest 25%.

The total uncertainty of the calculations of CO_2 emission projections (from emission factors, not from activity data) in 2030 is estimated at 13%. The uncertainty number in 2050 is further reduced slightly to 12%. This seemingly illogical drop can be explained by the fact that this year there will already be more zero-emission vehicles (electric cars, hydrogen vehicles) and fewer emissions-producing vehicles, which means fewer sources of uncertainty.

2.2.6 Difference between previously and currently reported projections

There are some significant changes in projections of GHG emissions from the 1. Energy sector compared to the previous submission. These changes were mentioned in the section 2.2.1. Methodological Issues. The biggest change is that we extended using the TIMES-CZ model for categories 1.A.2 Manufacturing industries and construction and 1.B Fugitive emissions from fuels. Assumptions of EUA and fuel prices are taken from Recommended parameters for reporting on GHG projections in 2025 (DG Climate Action, 2024). Assumptions about energy savings, the potential of photovoltaic and wind power plants, and the development of nuclear power plants are updated in line with the prefinal version of the actualized NECP. However, no significant differences occurred while preparing projections from the 1.A.5 category.

Projections for category 1.A.3 Transport were calculated in R-project. In road transport, COPERT time series from 2000 to 2020 were used for emissions projections. COPERT data are very detailed and need to be aggregated and processed in various ways. Also, the projections are more closely related to the prediction of energy consumption in the fleet area, with the newly registered vehicles being assigned categories respecting the expected development of fuel consumption. Emission factors used for projections are available from the COPERT database, which is generally recognized as very reliable data source.

2.3 Industrial Processes and Other Product Use

For consistency with greenhouse gas (GHG) emission inventory, the sector 2. Industrial processes and other product use (IPPU) category includes only emissions from technological processes and not from the fuel combustion used to supply energy for carrying out these processes (CHMI, 2024).

In 2022, the total aggregate GHG emissions from 2. IPPU were 15 045.20 kt of CO_2 eq., a decrease of 1% compared to the previous year and a decrease of 13% compared to the base year 1990. A major share of CO_2 emissions in this sector comes from subcategories 2.C.1 Iron and steel production, 2.F.1 Refrigeration and air conditioning and 2.A Mineral industry. N_2O emissions coming from the 2.B Chemical industry are less significant (CHMI, 2024).

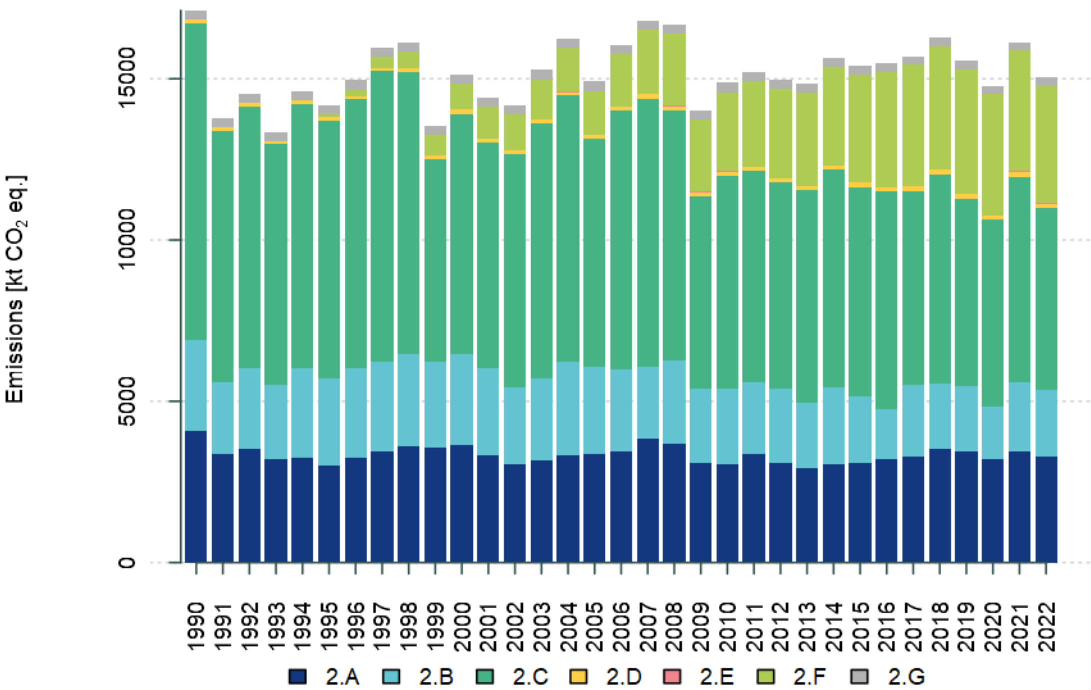


Figure 2-6: The emission trend in 2. IPPU sector during reporting period 1990 – 2022 (CHMI, 2024)

Table 2-27: The emission trend in 2. IPPU sector during reporting period 1990 – 2022 (CHMI, 2024)

[kt CO_2 eq.]	Mineral industry (2.A)	Chemical industry (2.B)	Metal industry (2.C)	Non-energy products from fuels and solvent use (2.D)	Electronic industry (2.E)	Product uses as ODS substitutes (2.F)	Other product manufacture and use (2.G)
1990	4 082.45	2 825.39	9 811.61	125.56	NO,NE	NO	270.21
1991	3 365.96	2 230.75	7 791.57	109.65	NO,NE	NO	270.04
1992	3 506.00	2 519.74	8 099.48	126.15	NO,NE	NO	271.41
1993	3 195.85	2 296.98	7 492.64	93.14	NO,NE	NO	272.60
1994	3 249.88	2 767.44	8 202.17	113.77	NO,NE	NO	273.73
1995	3 019.09	2 694.75	7 981.27	103.75	NO,NE	86.90	274.78
1996	3 247.34	2 788.89	8 328.54	90.19	NO,NE	216.17	284.70
1997	3 435.56	2 775.67	9 020.54	76.63	1.02	389.62	282.44
1998	3 599.41	2 885.17	8 721.15	119.67	1.02	530.01	281.27
1999	3 553.49	2 668.78	6 291.17	114.36	8.69	636.76	274.00
2000	3 633.37	2 828.76	7 434.79	140.30	11.16	802.15	286.27
2001	3 322.41	2 690.78	7 007.18	110.83	20.87	1 001.69	270.14
2002	3 064.16	2 353.58	7 257.11	96.09	19.31	1 102.27	300.72
2003	3 165.55	2 564.36	7 894.72	102.57	4.79	1 218.89	329.39
2004	3 330.41	2 900.54	8 241.78	117.31	3.99	1 351.78	307.47
2005	3 345.75	2 706.44	7 080.15	120.85	6.17	1 357.33	297.50
2006	3 445.51	2 535.41	8 016.79	128.02	19.99	1 610.64	290.91
2007	3 826.59	2 235.45	8 309.65	143.03	17.81	1 968.06	279.58
2008	3 674.72	2 599.17	7 750.59	109.84	26.30	2 228.87	289.21
2009	3 075.56	2 327.58	5 964.65	98.76	32.26	2 244.56	289.84
2010	3 048.42	2 330.82	6 610.22	113.00	38.28	2 458.45	282.43
2011	3 356.80	2 215.82	6 562.73	124.97	6.27	2 665.40	287.79
2012	3 092.40	2 315.27	6 398.26	108.52	3.98	2 769.14	292.17
2013	2 912.52	2 058.91	6 587.14	115.62	3.88	2 897.49	282.02
2014	3 049.90	2 366.02	6 770.43	116.34	4.04	3 076.25	279.70
2015	3 084.24	2 066.89	6 496.16	140.71	5.20	3 326.21	276.61
2016	3 220.27	1 522.48	6 760.76	141.42	6.32	3 544.33	275.86
2017	3 298.43	2 210.80	6 016.78	146.16	6.95	3 751.21	271.80
2018	3 505.16	2 044.49	6 466.55	159.16	6.47	3 816.80	268.46
2019	3 442.48	2 009.50	5 840.23	153.90	5.35	3 839.59	266.29
2020	3 218.44	1 619.90	5 796.14	128.26	4.51	3 747.82	263.78
2021	3 443.96	2 146.05	6 375.96	134.21	35.08	3 737.85	261.57
2022	3 288.22	2 053.53	5 658.30	119.97	53.55	3 609.06	261.86

2.3.1 Methodological issues

The projections of GHG emissions in 2. IPPU are based on data and methodology used for inventory emission estimates reported in the National Inventory Document (NID) (CHMI, 2024).

The projections are estimated separately for each subcategory under the 2. IPPU sector and also for each GHG. Due to the new F-gas regulation (EU) 2024/573 on fluorinated greenhouse gases that entered into force on 11 March 2024, there is a new additional measure for the 2. IPPU sector and therefore both scenarios With Existing Measures (WEM) and With Additional Measures (WAM) is calculated.

The projections are implemented directly into the calculation sheets used for inventory emission estimates to NID (CHMI, 2024). This approach allows using country-specific emission factors (EF) and the same or slightly modified methodology where appropriate. For example, in cases where Tier 3 methodology is used, data are not projected for each producer/facility but rather for a group of producers/facilities.

The first is the anticipated activity data and EFs used to project the whole 2023–2050 timeframe.

Projection of activity data:

For the main subcategories under 2.A Mineral production, 2.B Chemical production and 2.C.1 Iron and steel production, the activity data were calculated from the Recommended parameters for reporting on GHG projections in 2025 (DG Climate Action, 2024) for 2025 - 2050. The expectations of Carbon capture and stored technology in the production of iron and steel and non-metallic minerals from 2035 were taken from the prefinal version of the actualised NECP. The activity data for 2.C.2 - 2.C.7 were projected using statistical methods (see Table 2-28) by experts from the Czech Hydrometeorological Institute (CHMI); however, the emissions are under the threshold of significance (0.05%) for the whole time series (1990 – 2050). For the category 2.D Non-energy products from fuels and solvent use the activity data were projected (see Table 2-28) by experts from CHMI.

There are no official forecasts of the fluorinated GHG (F-gases) consumption for the 2.E Electronics industry, 2.F Substitutes for ozone-depleting substances and 2.G Other product manufacture and use. Thus, the activity data are based on expert judgement at CHMI, strictly following Regulation No 2024/573, Directive 2006/40/EC and the Kigali Amendment of the Montreal Protocol. The correlation of F-gases consumption with GDP or number of inhabitants is also investigated for better accuracy of activity data projections.

Source of activity data used for projections for each subcategory under 2. IPPU is summarised in Table 2-28.

Projection of EFs:

Emission projections are based on the same approaches as in NID (CHMI, 2024), which follows the IPCC 2006 Guidelines (Gl.) (IPCC, 2006). In most cases, projections of EFs are based on EFs in previous years. EFs used for projections are derived as an average of EFs for a selected period or EFs are calculated by forecasting methods (Table 2-28). Where default EFs are used for inventory emission estimates in NID, the same approach is applied for projections (mainly for Tier 1 methodology and F-gases inventory emission estimates).

Detailed information about EFs used for projections in subcategories under 2. IPPU is described in Table 2-28.

Projection of emissions:

Final projections for selected subcategory under 2. IPPU are calculated by using projected activity data and EFs. The approach is in line with IPCC 2006 Gl. (IPCC, 2006). For example, projections for category 2.F.1 Refrigeration and air conditioning equipment are calculated by model Phoenix, which is used in

NID (Ondrusova & Krtkova, 2018(1)) (CHMI, 2024). Methodology used for projections is Tier 2a, following the inventory emission estimates in NID (CHMI, 2024) (IPCC, 2006).

Table 2-28: Detailed information about methodology assumptions used for projections of (sub-)categories under 2. IPPU

Projections 2023 – 2050			
Category	**Activity data**	**Emission factors**	**Methodology**
2.A Mineral Production			
2.A.1 Cement production	MIT data	Average for 2019 – 2022	Modified Tier 3
2.A.2 Lime production	MIT data	Average for 2019 – 2022	Modified Tier 3
2.A.3 Glass production	to 2030 from MIT, to 2050 derived from MIT data	Average for 2019 – 2022	Modified Tier 3
2.A.4.a Brick and ceramics	Trend of data obtained from MIT was applied on data from NID	Average for 2019 – 2022	Modified Tier 3
2.A.4.b Soda ash production	Average production from 2019 to 2022	Plant specific	Modified Tier 3
2.A.4.d Mineral wool production, flue-gas desulphurisation and denitrification	Mineral wool - Average production from 2014 to 2022 Desulphurisation – based on trends in coal power plants Denitrification - Average consumption from 2019 to 2022	Mineral wool – Default Desulphurisation – plant specific Denitrification – plant specific	Tier 1 for mineral wool production, Modified Tier 3 for desulphurisation and denitrification
2.B Chemical Production			
2.B.1 Ammonia production	to 2030 from MIT, to 2050 derived from MIT data	Default	Tier 1
2.B.2 Nitric acid production	to 2030 from MIT, to 2050 derived from MIT data	Average for 2019 - 2022	Modified Tier 3
2.B.4.a Caprolactam	Constant production	Default	Tier 1
2.B.8.b Ethylene	to 2030 from MIT, to 2050 derived from MIT data	Default	Tier 1
2.B.8.c Vinyl chloride monomer	to 2030 from MIT, to 2050 derived from MIT data	Default	Tier 1
2.B.8.f Carbon black	Average consumption from 2016 to 2022	Default	Tier 1
2.B.8.g Styrene	Average consumption from 2016 to 2022	Plant specific, Default	Modified Tier 3, Tier 1
2.B.10 Other non-energy use in chemical industry	Average consumption from 2016 to 2022	Default, country specific	Tier 1
2.C Iron and Steel Production			
2.C.1 Iron and steel production	to 2050 from MIT	Default, country specific, plant specific	Tier 2
2.C.2 Ferroalloys production	Average consumption from 2016 to 2022	Default	Tier 1
2.C.5 Lead production	Average consumption from 2016 to 2022	Default	Tier 1
2.C.6 Zinc production	Average consumption from 2016 to 2022	Default	Tier 1
2.D Non-energy products from fuels and solvent use			
2.D.1 Lubricant use	Average consumption from 2016 to 2022	Default	Tier 1

Projections 2023 – 2050			
Category	**Activity data**	**Emission factors**	**Methodology**
2.D.2 Paraffin wax use	Average consumption from 2016 to 2022	Default	Tier 1
2.D.3 Other	Average consumption from 2016 to 2022	Default	Tier 1
2.E Electronics Industry			
2.E.1 Integrated circuit or semiconductor	SF_6 – projections of consumption are based on correlation with GDP NF_3 – projections of consumption are based on correlation with GDP	Default	Tier 2a
2.F Product uses as substitutes for ODS			
2.F.1 Refrigeration and air conditioning	Projections of consumption are based on previous trends (Regulation No 2024/573), and Kigali Amendment of the Montreal Protocol For 2.F.1.e, vehicle fleet projections are based on correlation with population, MIT data, Directive 2006/40/EC	Country specific and default	Tier 2a Model Phoenix was used for projections of subcategories under 2.F.1, except 2.F.1.e, where country specific approach was applied following NID (CHMI 2024)
2.F.2 Foam blowing agents to 2.F.5 Solvents	Projections of consumption are based on previous trends or average consumption, Regulation No 2024/573, and Kigali Amendment of the Montreal Protocol	Default	Tier 1a
2.G Other product manufacture and use			
2.G.1 Electrical equipment	Average consumption from 2019 to 2022	Default	Tier 1
2.G.2 SF_6 and PFCs from other product use	Projections of consumption based on previous trend	Default	Default
2.G.3 N_2O from product uses	Constant consumption	Default	Default

(CHMI 2024, IPCC 2006, MIT 2024)

2.3.2 Projected greenhouse gas emissions 'With existing measures (WEM) scenario' and 'With additional measures (WAM) scenario'

The WEM scenario includes policies and measures which affect the consumption of F-gases apart from the latest one, Regulation No 2024/573. All policies and measures are described in Chapter 1.3. Regulation 2024/573 is calculated in the WAM scenario.

According to the WEM scenario, total emissions from 2. IPPU will slightly decrease in the next few years and then sharply decrease. The rapid decrease of the production capacity for the main products, such as lime, cement, ammonia, iron and steel is unforeseen in the Czech Republic. The reason for the sharp decrease is the planned carbon capture and stored technology in the production of iron and steel and non-metallic minerals from 2035. The ban on F-gases helps the decrease of GHG emissions until 2050 as well. According to the current projections (Table 2-29 and Figure 2-7), it is expected that total emissions from 2. IPPU in 2050 will decrease by 77% compared to the year 1990 and by 75%

compared to 2022. Emission projections are based on the current situation in the Czech industry and legislation and the prefinal version of the actualized NECP.

Table 2-29: Reported and projected emissions of GHG in 2. IPPU – WEM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions					Difference [%]			
	1990	2005	2022	2025	2030	2035	2040	2050	1990 – 2025	1990 – 2030	1990 – 2040	1990 – 2050
WEM	17.11	14.83	15.05	11.97	7.39	5.76	4.23	3.97	-30.05	-56.81	-75.27	-76.79

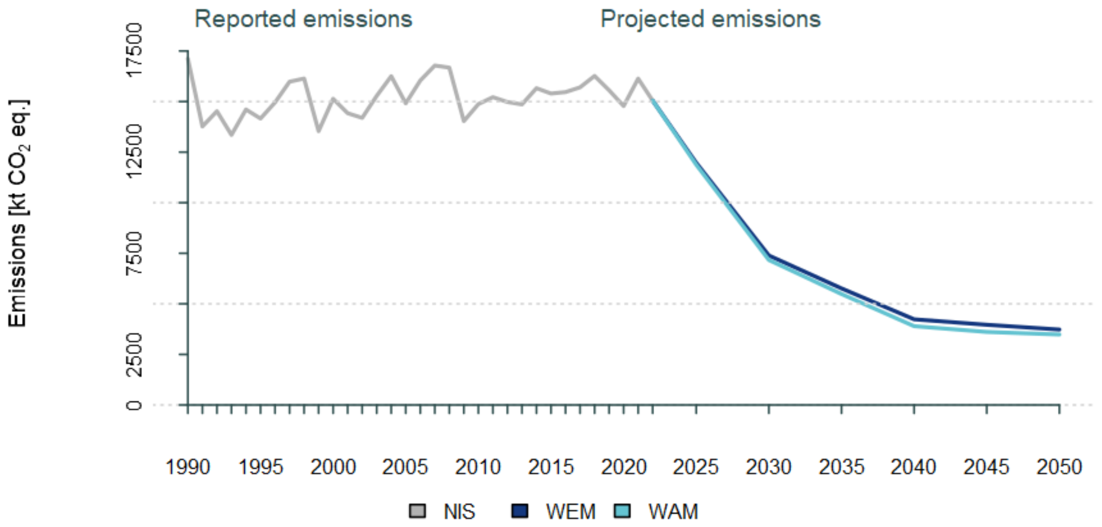


Figure 2-7: Reported and projected emissions of GHG in IPPU – WEM scenario

2.3.2.1 Projected greenhouse gas emissions 'With existing measures (WEM) scenario'

WEM scenario takes into account the following policies and measures:

- Regulation No 517/2014,
- Directive 2006/40/EC,
- Kigali Amendment of the Montreal Protocol.

As visible from Table 2-30, a major share of total emissions from 2. IPPU has by far CO_2. It is expected that emissions of CO_2 will gradually decrease mainly due to the planned carbon capture and stored technology that will be applied in the production of iron and steel and non-metallic minerals from 2035 and by the planned transition to hybrid electric arc furnaces. No significant changes are expected in CH_4 emissions, where the main source is sinter production. N_2O emissions are expected to rise with the anticipated increase of its main source, the N_2O production.

Table 2-30: Breakdown of reported and projected emissions of GHG by gases in 2. IPPU - WEM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions					Difference [%]			
	1990	2005	2022	2025	2030	2035	2040	2050	1990 – 2025	1990 – 2030	1990 – 2040	1990 –2050
CO_2	15.65	12.39	10.89	8.83	5.31	4.23	2.98	2.81	43.57	66.07	80.96	82.04
CH_4	0.05	0.06	0.06	0.07	0.07	0.07	0.07	0.07	29.97	31.60	31.53	31.54
N_2O	0.35	0.31	0.35	0.44	0.44	0.45	0.45	0.47	11.67	15.23	19.42	22.73
HFCs	NO	1.07	3.61	2.55	1.52	0.97	0.69	0.35	NA	NA	NA	NA
PFCs	NO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA
SF6	0.08	0.11	0.00	0.00	0.00	0.00	0.00	0.00	-20.33	-40.05	-53.01	-61.38
NF3	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA
Total	**17.11**	**14.83**	**15.05**	**11.97**	**7.39**	**5.76**	**4.24**	**3.73**	**-30.04**	**-56.81**	**-66.33**	**-78.19**

Legislation currently in force focussing on F-gas emissions reduction, mainly HFCs, which are used extensively in 2.F.1 Refrigeration and air conditioning systems. The applicable policies and measures (PaM) are reflected in the presented projections. Reported and projected emissions of F-gases are in Table 2-30 and overall results of F-gases projections in Figure 2-8. Decrease of HFCs, PFCs, and NF_3 emissions compared to 1990 cannot be calculated because at that time these F-gases were unused in the Czech Republic and thus emissions are reported as not occurring (NO) (Table 2-30). Therefore, the base year for F-gases is 1995 (CHMI, 2024) (IPCC, 2006). As expected, HFCs emissions became decreasing before around 2020. Compared to 2022, HFCs emissions should be 90% lower in 2050. The decrease in F-gases emissions will be slower than expected because of leaking during the equipment's lifetime, which can take more than a decade. SF_6 and NF_3 are used by semiconductor manufacturers and SF_6 is also as an insulation gas in switchgear. Emissions of SF_6 will start to decline, unlike emissions of NF_3, which is expected to be more commonly used soon. NF_3 emissions will increase unless a new PaM or a new alternative is adopted. PFCs are not used anymore in the Czech Republic but the formation of CF_4 as a byproduct during etching and cleaning in the semiconductor industry is considered and thus emissions might be still occurring.

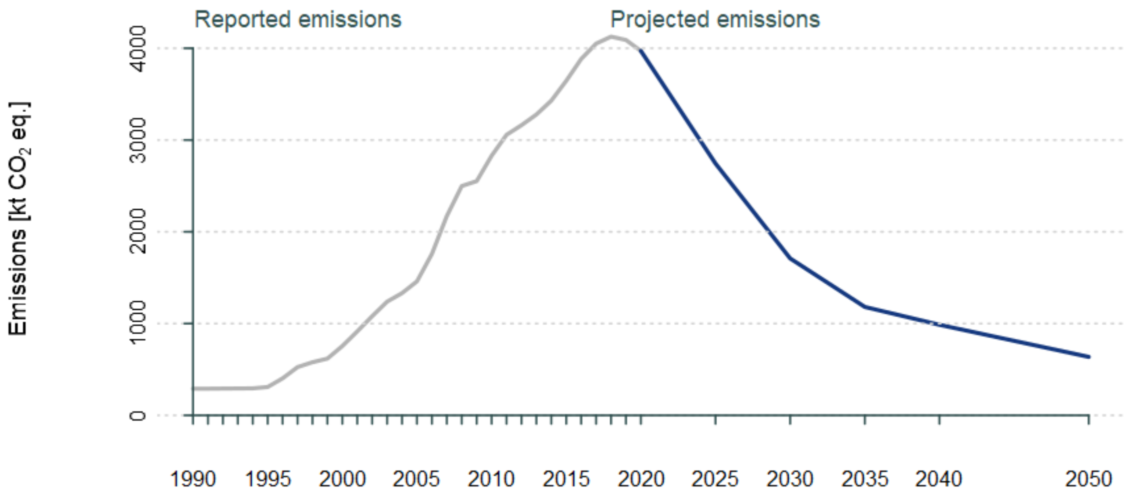


Figure 2-8: Reported and projected F-gases (HFCs, PFCs, SF_6, NF_3) emissions from categories 2.E, 2.F, 2.G – WEM scenario

As shown in Table 2-31, a decline in GHG emissions is expected compared to 1990 for all categories, except 2.D Non-energy use of fuels. Emissions from 2.A Mineral industry are projected to decrease until 2050. Although the decline in cement production is improbable the use of low-emission cement likely takes place. It is expected that emissions from 2.B Chemical industry will decrease slightly until 2050, although an exceptional sink was already detected in 2020. 2.C.1 Iron and steel production is the main emission subcategory of 2. IPPU. It is expected that the 2.C.1 production will not change much but emissions will sharply decrease in future. The carbon capture and stored technology will be applied in the production of iron and steel and non-metallic minerals from 2035. Moreover, the planned hybrid electric arc furnaces will cause t a sharp decrease in emissions.

It is expected that F-gas emissions for the category 2.E.1 Electronic industry will increase in the next few years because currently there is no legislative measure influencing F-gases use in this category. Projections for this category are based on a positive correlation of F-gases consumption in semiconductor manufacturing with GDP although emissions from semiconductor manufacturing are under the threshold of significance (0.05%). The main source of F-gas emissions is the category 2.F Product uses as substitutes for ODS, in particular subcategory 2.F.1 Refrigeration and air conditioning. Due to banning certain substances (Regulation No 2024/573) emissions will be decreasing.

Table 2-31: Breakdown of reported and projected emissions of GHG by individual categories in 2. IPPU - WEM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions					Difference [%]		
	1990	2005	2022	2025	2030	2035	2040	2050	1990 – 2030	1990 – 2040	1990 – 2050
2.A. Mineral industry	4.08	3.35	3.29	3.07	3.16	2.19	1.01	0.99	-22.66	-75.15	-75.69
2.B. Chemical industry	2.83	2.71	2.05	2.16	2.09	2.02	1.96	1.82	-26.11	-30.70	-35.42
2.C. Metal industry	9.81	7.08	5.66	3.78	0.24	0.20	0.20	0.20	-97.57	-97.98	-97.98
2.D. Non-energy products from fuels and solvent use	0.13	0.12	0.12	0.14	0.14	0.14	0.14	0.14	9.35	8.52	8.21
2.E. Electronics industry	NO	0.01	0.05	0.00	0.00	0.00	0.00	0.00	NA	NA	NA
2.F. Product uses as substitutes for ODS	NO	1.36	3.61	2.56	1.52	0.97	0.69	0.35	NA	NA	NA
2.G. Other product manufacture and use	0.27	0.30	0.26	0.25	0.25	0.24	0.23	0.22	-9.00	-13.99	-17.47
2.H. Other	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA
Total	**17.12**	**14.91**	**15.04**	**11.97**	**7.39**	**5.76**	**4.24**	**3.73**	**-56.82**	**-75.26**	**-78.21**

2.3.2.2 Projected greenhouse gas emissions ‘With additional measures (WAM) scenario’

WAM scenario considers the following policies and measures:

Regulation No 2024/573.

It is projected, that additional measures with this will influence GHG emissions from 2.F Product uses as substitutes for ODS as it is shown in the following tables. The description of the measures is specified in Chapter 1.2.2 According to the WAM scenario, emissions from 2.F Product uses as substitutes for ODS should decrease by 92% in 2050 compared to 2005.

Table 2-32: Breakdown of reported and projected emissions of GHG by individual categories in 2. IPPU - WAM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions					Difference [%]		
	1990	2005	2022	2025	2030	2035	2040	2050	1990 – 2030	1990 – 2040	1990 – 2050
2.A. Mineral industry	4.08	3.35	3.29	3.07	3.16	2.19	1.01	0.99	-22.66	-75.15	-75.69
2.B. Chemical industry	2.83	2.71	2.05	2.16	2.09	2.02	1.96	1.82	-26.11	-30.70	-35.42
2.C. Metal industry	9.81	7.08	5.66	3.78	0.24	0.20	0.20	0.20	-97.57	-97.98	-97.98
2.D. Non-energy products from fuels and solvent use	0.13	0.12	0.12	0.14	0.14	0.14	0.14	0.14	9.35	8.52	8.21
2.E. Electronics industry	NO	0.01	0.05	0.00	0.00	0.00	0.00	0.00	NA	NA	NA
2.F. Product uses as substitutes for ODS	NO	1.36	3.61	2.47	1.29	0.69	0.35	0.10	NA	NA	NA
2.G. Other product manufacture and use	0.27	0.30	0.26	0.25	0.25	0.24	0.23	0.22	-9.00	-13.99	-17.47
2.H. Other	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA
Total	**17.12**	**14.91**	**15.04**	**11.88**	**7.17**	**5.48**	**3.90**	**3.48**	**-58.13**	**-77.24**	**-79.65**

Table 2-33: Breakdown of reported and projected emissions of GHG by categories in F-gases – WAM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						Difference [%]			
	1995	2005	2022	2025	2030	2035	2040	2045	2050	2005–2022	2005–2030	2005–2040	2005 – 2050
2.F.1.Product uses as substitutes for ODS	NO	1.36	3.61	2.47	1.29	0.69	0.35	0.14	0.10	165.90	-4.66	-74.12	-92.28

2.3.3 Sensitivity analysis

Projections of GHG emissions from the 2. IPPU sector are based on calculation sheets used for inventory emission estimates in NID (CHMI, 2024). Activity data is the only variable that changes during

2023-2050 (see Chapter 2.3.1.1 for detailed information about activity data projections), while EFs are constant. Thus sensitivity analysis would provide a lack of interesting outcomes for categories under 2. IPPU sector (except category 2.F.1). If activity data will change by ±5% emissions will change by ±5% because emission factors used for inventory emission estimates are constant during the projected period.

The only category where sensitivity analysis could bring interesting output is the category 2.F.1 Refrigeration and air conditioning, which is also a key category (CHMI, 2024). The projections are prepared with the national model Phoenix, which takes into account a specific approach for calculating the amount of chemicals remaining in the equipment at decommissioning, using the Gaussian distribution model with mean at the lifetime expectancy for newly filled equipment and assuming only half lifetime expectancy for serviced equipment (Ondrusova & Krtkova, 2018(1)). Sensitivity analysis for category 2.F.1 is implemented using variable consumption of F-gases by ±5% while respecting the emission trend from NID (CHMI, 2024). The result of the sensitivity analysis is depicted in Table 2-34.

Table 2-34: Sensitivity analysis using variable consumption of F-gases in category 2.F.1 under 2. IPPU sector

Emission difference [%]	2025	2030	2035	2040	2045	2050
WEM and WEM +5%	0.13	0.15	-0.07	2.16	1.44	3.35
WEM and WEM -5%	-0.46	-0.85	-1.40	-1.07	-1.16	-1.55

2.3.4 Difference between previously and currently reported projections

The main changes are described in the section 2.3.1 Methodological issues. The recommended parameters for reporting on GHG projections in 2025 were applied and the planned carbon capture and stored technology plans from the prefinal version of the actualized NECP together with planned innovation of the metallurgical operation were considered. The difference in F-gases projections is due to the new PAMs. The decrease in F-gases emissions was projected to be slower in previous projections.

2.4 Agriculture

Agriculture is the third largest emissions producing sector in the Czech Republic. In 2022, it contributed 7% to the total GHG emissions excluding LULUCF and indirect emissions. This equalled to 8 422 kt CO2 eq.; 44% of these emissions were attributed to enteric fermentation, 43% to managed agricultural soils, and 9% to manure management. Additionally, carbon dioxide emissions from liming and urea application on managed soils contributed by 4% to the total agricultural emissions in 2022 (CHMI 2024).

The sum of emissions from agriculture in the Czech Republic culminated in 1990 (100%), with the lowest emissions estimated in 2009 and 2010, when emissions were 48% of the total emissions in 1990, reflecting a 52% decrease). The reason for the relatively large decrease after 1990 was a reduction in the livestock population. Since then, the total emissions were relatively stable from 1997 to 2022, fluctuating by 7-20%, with an average decrease of 12%, with the lowest values in 2009.

Quantitative data overview and emission trends in Agriculture categories for the period 1990-2022 are shown in Figure 2-9, Table 2-35 and Table 2-36 (CHMI, 2024).

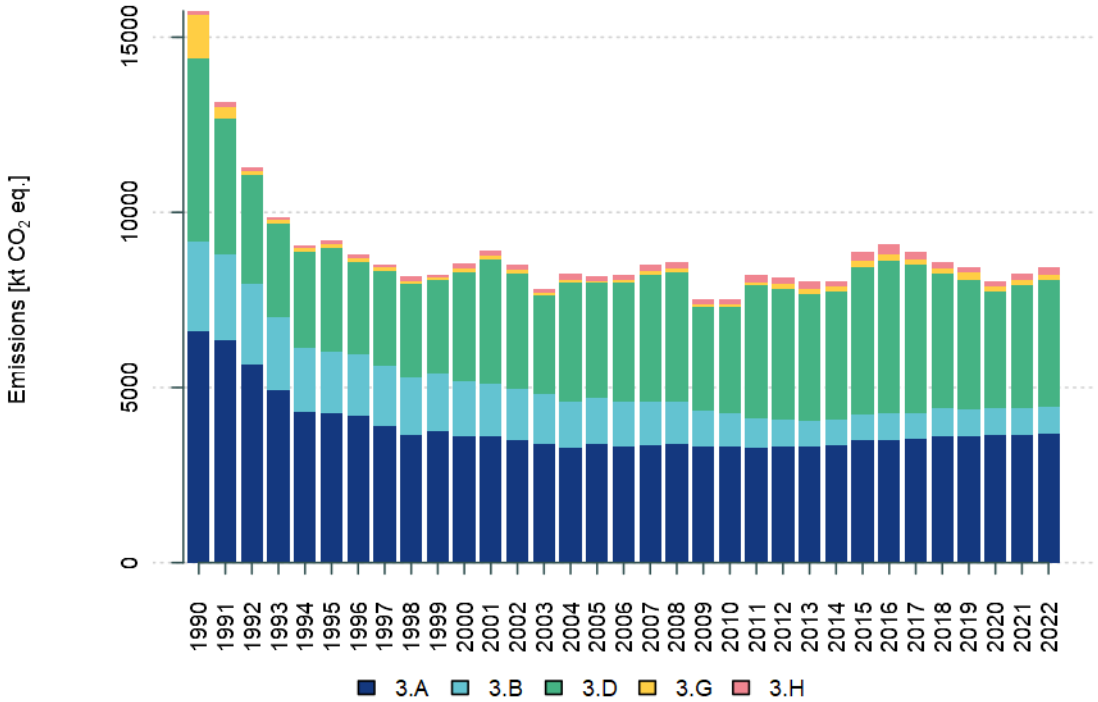


Figure 2-9: The emission trend in 3. Agriculture sector in period 1990-2024 (CHMI, 2024)

Table 2-35: The emission trend in 3. Agriculture sector in period 1990-2022 (sorted by IPCC categories) (CHMI, 2024)

[kt CO_2 eq.]	TOTAL	Enteric Fermentation (3.A)	Manure Management (3.B)	Agricultural soils (3.D)	Liming (3.G)	Urea Application (3.H)
1990	15 748	6 612	2 571	5 219	1 237	109
1991	13 147	6 338	2 450	3 897	329	132
1992	11 272	5 669	2 280	3 100	114	109
1993	9 875	4 909	2 096	2 669	108	93
1994	9 060	4 297	1 843	2 722	109	91
1995	9 215	4 276	1 760	2 954	116	109
1996	8 798	4 188	1 756	2 635	118	100
1997	8 500	3 916	1 699	2 721	97	67
1998	8 179	3 653	1 640	2 649	95	143
1999	8 232	3 753	1 659	2 640	91	88
2000	8 529	3 604	1 574	3 117	118	116
2001	8 926	3 605	1 510	3 544	110	157
2002	8 495	3 502	1 467	3 290	104	132
2003	7 822	3 399	1 421	2 799	82	120
2004	8 238	3 267	1 331	3 409	80	151
2005	8 192	3 377	1 312	3 290	67	146
2006	8 222	3 329	1 265	3 390	82	156
2007	8 505	3 365	1 239	3 620	84	197
2008	8 564	3 398	1 185	3 702	100	179
2009	7 505	3 316	1 035	2 939	67	148
2010	7 519	3 309	939	3 045	65	161
2011	8 208	3 279	846	3 792	84	207
2012	8 158	3 314	773	3 743	121	206
2013	8 024	3 314	735	3 635	142	198
2014	8 034	3 362	718	3 667	158	130
2015	8 875	3 492	735	4 210	171	268
2016	9 093	3 504	765	4 360	175	290
2017	8 889	3 527	751	4 221	166	225
2018	8 594	3 621	792	3 833	163	185
2019	8 423	3 620	773	3 687	193	149
2020	8 051	3 631	777	3 323	165	156
2021	8 240	3 629	777	3 512	146	176
2022	8 422	3 680	762	3 634	154	192

Source: CHMI 2024

The share of emission categories in the total emissions was relatively stable until the year 2000 and began to change gradually from 2001, when the anaerobic digesters were incorporated into estimating nitrous emissions. While the share of emissions from manure management decreased, the share of emissions from managed soils slowly increased. Urea Application during the reported period reached the maximum in 2015-2017 and decreased slightly from 2018.

Table 2-36: Breakdown of reported GHG emissions from Agriculture by emitted gases

GHG	Reported emissions from Agriculture [Mt CO_2 eq.]							
	1990	1995	2000	2005	2010	2015	2020	2022
CO_2	1.34	0.23	0.23	0.21	0.23	0.44	0.32	0.35
CH_4	8.19	5.39	4.59	4.18	3.82	3.85	4.02	4.06
N_2O	6.22	3.60	3.71	3.80	3.47	4.59	3.71	4.02
Total	15.75	9.22	8.53	8.19	7.52	8.88	8.05	8.42

Source: CHMI 2024

2.4.1 Methodological issues

In general, the emissions quantifications and estimates of projections are being prepared in compliance with IPCC methodology (IPCC, 2006), and in case of Enteric Fermentation and emissions from managed soils, they are prepared in compliance with IPCC refinements concerning the sector (IPCC, 2019). All the calculation procedures correspond to the GHG estimates methodology as it is being prepared for 2024 submission for Agriculture sector.

2.4.1.1 Activity data

Activity data and trends of emission factors (EF) used for these predictive accounting projections were derived from data already prepared for previous predictions by the Institute of Agricultural Economics and Information and other sectoral research institutes (Research Institute of Plant Production, Institute of Livestock Production).

The entries were subsequently confirmed by the Ministry of Agriculture. Some input data marked ** in the tables (Table 2-37 and following) were expertly adjusted based on the development of the actual values found in 2021 and 2022.

Note: If there was no possibility to predict the future development of any activity data (e.g. amount of sewage sludge applied to soils, etc.), constant values were used for reporting purposes.

The following activity (input) data were available (Table 2-37 – Table 2-43):

2.4.1.1.1 Livestock population

Table 2-37: Livestock population within the projected period

Livestock category	Projected data [thousands of animals]						
	2022*	2025	2030	2035	2040	2045	2050
Cattle	1 421	1 454	1 478	1 495	1 503	1 506	1 506
- dairy cattle	358	360**	360	360	360	360	360
- suckler cows	230	229	232	235	238	238	238
- mature heifers (>2 yrs.)	68	81	84	85	86	86	86
- mature bulls (>2 yrs.)	21	21	22	22	22	22	22
- heifers 1-2 yrs.	210	222	230	232	234	234	234
- bulls 1-2 yrs.	105	113	117	118	119	119	119
- heifers 0.5-1 yr.	114	114	114	115	115	116	116
- bulls 0.5-1 yr.	73	74	74	75	75	77	77
- calves (<0.5 yrs.)	243	240	245	253	254	254	254
Swine	1 421	1 400**	1 500**	1 500	1 500	1 500	1 500
Sheep	174	170**	165	165	165	165	165
Goats	25	35	25	25	25	25	25
Horses	38	35	35	35	35	35	35
Poultry	23 026	24 180	26 695	26 695	26 695	26 695	26 695

*Data of CZSO, **Expert estimation

The table above shows work data, which predicts the maintenance of the current trend for a shorter period and then a neutral trend without decreasing or increasing development. According to the MoA official strategy (MoA, 2016), there are ambitious plans for livestock populations for the years 2025 and 2030; currently, the MoA estimate is considered to be overestimated.

2.4.1.1.2 Milk production, milk quality

Table 2-38: Milk production and quality projection

	Daily milk production [kg/day/head]	Fat content [%]	Protein content [%]
2022*	25.59	3.89	3.42
2025	26.34	3.89	3.46
2030	27.58	3.90	3.50
2035	27.58	3.90	3.50
2040	28.99	3.90	3.55
2045	28.99	3.90	3.55
2050	30.48	3.90	3.60

Source: 2022 Yearbook of cattle breeding, 2030-2050 (Expert estimate, Institute of Animal Science, 2022)

While the Czech Republic has already been lined up among EU countries with the highest productivity (and considering the probable population growth in systems of organic farming, where high milk yield is hardly assumed), it is predicted that average daily milk production will increase by 1% per year; however, this increase will slow down to about 0.5% per year between 2030 and 2050. As for the content of milk components, the future trend in the breeding of dairy cattle populations in the Czech Republic will be essential. The fat content is expected to remain at the current values, while the protein content is predicted to increase slightly.

2.4.1.1.3 Manure Management systems

Table 2-39: Manure Management systems, projection 2020-2040

	Manure Management system - Nitrogen fraction of Manure Management per system [%]			
	Anaerobic digestion	**Liquid**	**Solid**	**Pasture**
Dairy cattle				
2022	32	11	57	0
2025-2050	32	11	57	0
Other cattle				
2022	3	7	62	28
2025-2050	3	7	62	28
Swine				
2022	48	20	32	0
2025-2050	48	20	32	0
Poultry				
2022	7	0	93	0
2025-2050	7	0	93	0

Source: CHMI, 2022; 2030-2050 Expert estimate, Institute of Crop Research, 2022

For the purposes of predictions, the proportion of individual Manure Management systems has remained the same as in 2022 (2016-2022 respectively). An increase in the number of biogas stations based on the manure use is not presumed, as there is a need to increase the return of quality organic matter into the soil, and to avoid increasing the amount of slurry, especially the manure entering the biogas stations. The statistical data currently available do not yet allow a more detailed breakdown of the AWMS to be used for reporting and predictions either.

An estimate of manure production and application in the Czech Republic is based on the proportion of various bedding technologies and coefficients from Decree No. 377/2013 Coll. (Coll., 2013), considering the input of manure and slurry into biogas stations according to the study by the Institute of Agricultural Economics and Information (Klír, 2019).

2.4.1.1.4 Nitrogen content of mineral fertilizers

Table 2-40: Nitrogen content in mineral fertilization projection

Nitrogen content	**Projected data**						
	2022*	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Projection [%]	100	- 19%	- 13%	- 12%	- 11%	- 11%	- 9%
Projection [kt N]	325	262	228	200	177	157	143
F2F target [%]			- 30%				- 50%

Source: MoA, Ing. Budňáková; Institute of Crop Research (actual values), Institute of Agricultural Economics and Information, a suggestion according to F2F 2025-2030 and on;

note.: yr. 2025-2050: the percentage reduction for the given 5 yr. period is reduced cumulatively, in relation to 2020

A significant source of nitrogenous emissions from Agricultural Soils management is the application of synthetic nitrogen fertilizers. There is a target for 25% reduction in the maximum doses applied to crops where high doses are applied (winter wheat, winter canola, corn). This target is achievable by providing qualified decision-making to encourage locally based nutrition principles and enhance purchasing of technologies enabling more diverse fertilization applications. The support of organic farming is an alternative to these measures. Partial measures also include the cultivation of low leguminous intercrops and reduced tillage (no-till farming practices).

The Strategic plan SZP 21+ (State Agricultural Policy 21+) for 2024-2028 counts with an increase in the area of precision agriculture by 200 thousand ha/yr. The increase in organic farming area is planned to be continuous, at a level of 7%/yr.; the plan for its area in 2027 is 750 thousand hectares (CAP, 2023-2027).

2.4.1.1.5 Sowing area and annual harvest of individual crops

Table 2-41: Annual harvest of the selected crops projection

Annual harvest	**Projected data [kt]**						
	2022*	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Cereals	8 218	8 839	8 507	8 646	6 930	7 896	7 939
Pulses	124	159	159	159	94	109	104
Potatoes	574	406	406	406	348	406	377
Sugar beet	4 055	4 122	4 122	4 122	3 671	4 186	4 057
Fodder (hay)[1]	5 295	6 307	6 307	6 307	7 344	7 344	7 436
Soya	66	65	65	65	65	65	65
Rape	1 166	1 350	1 350	1 350	1 350	1 350	1 350

Source: 2022* CZSO, projections 2025-2050 Institute of Agricultural Economics and Information (Foltýn, Farma 6 on the background of LPIS)

[1] data corresponding to the production of 50% grassland (the rest of 50% considered as pastures), original mass data (14 t/ha in original mass)

Table 2-42: Sowing area of the selected crops projection

Sowing area	**Projected data [th. ha]**						
	2022*	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Cereals	1 386	1 463	1 408	1 431	1 147	1 307	1 314
Pulses	46	64	64	64	38	44	42
Potatoes	22	14	14	14	14	14	14
Sugar beet	58	64	64	64	57	65	63
Fodder (hay)	507	451	451	451	525	525	531
Soya*	29	28	28	28	28	28	28
Rape	344	380	380	380	380	380	380

Source: 2022 CZSO, projections 2025-2050 Institute of Agricultural Economics and Information (Foltýn, Farma 6 on the background of LPIS)

* economic data on soya bean production is not available in model Farma 6, kept constant

2.4.1.1.6 Limestone consumption and Urea Application in Agriculture

Table 2-43: Limestone/dolomite and Urea Application in Agriculture

	Projected data [kt]						
	2022*	2025	2030	2035	2040	2045	2050
Limestone/dolomite	337	408	449	494	543	598	598
Urea/DAM	262	198	180	180	180	180	180

*Source: CRI, Ing. Klem Karel, Research Institute of Agricultural Engineering, Dědina M.

Limestone/dolomite consumption by 2025 is presented in a more realistic way and the following years represent an optimum. There is a significant representation of agricultural soils with low to very low pH in the Czech Republic and it is estimated that this unfavourable situation could be improved by application of 2 500 kt/yr. (MoA, Ing. Budňáková 2022). The prediction is based on the need to increase liming. There is a projected real increase of +10% for every 5-year prediction period, culminating in an increase of 77% for the whole predicted period. This prediction is based on the reasoning of Dr. Karel Klem (Global Change Research Institute, Czech Academy of Sciences), who was kindly requested for consultation.

For DAM (a liquid nitrogen fertilizer containing about 30% nitrogen, of which one quarter is in the form of ammonium, one quarter is in the form of nitrate and one half is in the form of amide), there was a reported decreasing trend in use during the last 5 years. However, it is still a fertilization applied within the vegetation period as a fast acting option, suitable for fertilizing intercrops, etc. During the last 20 years, nitrogen consumption from DAM mostly reached a level of around 85 kt. There is an expectation of increased consumption in the future. Nitrogen consumption from urea fertilization decreased by 40% during the last 5 years. A decreasing trend in its application is also expected, in regard with a legal duty of its immediate application into the soil, which can bring complications for farmers and increase application cost – therefore its attractiveness has been legislatively reduced. However, urea with urease inhibitors, which does not need to be applied immediately, can be used instead, but this solution is more expensive (Dedina, M., Research Institute of Agricultural Engineering, personal communication, 2022).

2.4.1.2 Methane emissions

For the purposes of the emissions estimates, computing tools based on Excel sheets with pre-defined macros (functions and command lines automating the calculations), which are standardly used for emissions estimations were utilized. All of the methodology updates planned for the 2023 submission were also involved into the 2025+ predictions.

Enteric Fermentation and Manure Management are the main sources of CH_4 emissions in the Agriculture sector. Activity data on livestock population is decisive for estimating, especially the number of cattle in case of Enteric Fermentation and animal waste management in stables, feedlots, and manure storage systems.

Emissions from Enteric Fermentation are estimated in compliance with the IPCC Refinement (IPCC 2019), Tier 2 methods for cattle and Tier 1 methods for other livestock. Methane (CH_4) emissions from Manure Management are quantified using Tier 2 methods for cattle and swine and Tier 1 for other livestock.

The default values for emission factors used for estimating methane emissions according to Tier 1 methods are taken from IPCC GL 2006 (horses, sheep, goats, swine). The predicted values for emission factors calculated according to Tier 2 (Enteric Fermentation, Manure Management, cattle) are accounted based on expected energy consumption in the individual livestock categories. The emission factors for predicting methane emissions from Manure Management of swine are derived from Decree No. 377/2013 Coll., on the manure storage and management.

The emission factor (EF) for methane emissions from Enteric Fermentation from cattle is derived from the energy intake of animals providing milk production, weight gain or maintenance, respectively. The dependence of the emission factor from Enteric Fermentation on milk production and body weight is detailed in Table 2-44, where the reported and predicted values are shown.

Table 2-44: Values of calculated emission factor (EF) for enteric fermentation for dairy cattle, relevant milk production and body weight, development within time period 1990-2050

Dairy cattle	Reported data				Projected data					
	1990	2010	2015	2022	2025	2030	2035	2040	2045	2050
EF for enteric fermentation [kg CH_4/head/yr]	98	131	137	149	151	155	155	160	160	165
Milk production [kg/day]	11	19	23	26	26	28	28	29	29	30
Body weight [kg]	520	590	650	650	650	650	650	650	650	650

Source: IFER, 2022

2.4.1.3 Nitrous oxide emissions

There are two main sources of nitrous oxide (N_2O) emissions in Agriculture sector: Manure Management and Agricultural Soils.

Direct and indirect emissions from Manure Management depend on livestock population, the amount of nitrogen in their excrement, and Animal Waste Management System (AWMS) currently applied. Tier 2 methods are used for the associated GHG estimation in the National Inventory Report (CHMI 2022) as there are country-specific data for AWMS and the nitrogen excretion value (Nex) available for the individual categories of livestock. The emission factors are taken from IPCC GL 2006.

The total N_2O emissions from Manure Management decreased rapidly by 60% during the period 1990-2015 (CHMI 2022), due to the reduction of livestock herds. Further decrease by 10% occurred in this category within the period of 2016-2018, when a new category of the AWMS (anaerobic digestion) was reflected in the inventory. Another 4% reduction during the years 2019-2020 arose from the transition to the use of the country-specific data on the amount of nitrogen excreted (CZ Decree No. 317/2013 Coll.).

Thus, in 2020, the emissions from Manure Management were only 20% of the 1990 estimate. There are no further decreases predicted for the period 2025-2050.

Direct and indirect nitrous oxide emissions from managed Agricultural Soils decreased by 35% since 1990, reaching a minimum in 2010. The estimate is based on the Tier 1 method. This category is determined by the amount of mineral fertilization applied, which accounts for up to 55% (2019) of N_2O emissions from Agricultural Soils. From the data prepared by the Ministry of Agriculture, it is evident that a decrease in consumption is expected.

The amount of nitrogen from crop residues entering the soil after harvest is another important input in the estimate. In 2019, the contribution on the total nitrogen emissions from Managed Soils category was 28%. It is predicted that there will be no significant trend in increased yield, sowing area, or increase in the amount of biomass from crop residues. The calculation of prediction contains the update of use of the country-specific coefficients for estimating the amount of dry matter content, nitrogen content and the amount of crop biomass used as a feed or bedding. This update has been prepared in cooperation with colleagues from the Institute of Crop Research for Submission 2023 (CHMI, 2023).

For the purposes of the greenhouse gas inventory (NID 2025) and these projections, an analysis of the climate of the Czech Republic was conducted, considering the distinction between areas with wet and dry climates (where the ratio between precipitation and evapotranspiration is less than 1, or greater than 1, in accordance with the IPCC 2006 good practice guidelines). The analysis revealed that, on average, over the past 20 years, this ratio has been less than one on most (54%) of the territory of the Czech Republic. Therefore, for the calculation of N_2O emissions, standard emission factor values and the proportions of volatilizable and leached nitrogen fractions were used, corresponding to a combination of both climate types.

2.4.1.4 Carbon dioxide emissions

There are two main sources of CO_2 emissions in Agriculture reported in the National Inventory Report (CHMI 2022):

1. Liming (3G)

2. Urea Application (3H)

Tier 1 methods of IPCC GL 2006 and the default emission factors (CHMI 2022) are used for estimating of the amount of CO_2 emissions from both the listed sources.

2.4.2 Projected greenhouse gas emissions 'With existing measures (WEM) scenario' and 'With additional measures (WAM) scenario'

In projections composed for the requirements of MoE and reporting purposes for EU authorities, two scenarios are distinguished: WEM scenario (With Existing Measures) and WAM scenario (With Additional Measures).

There are no additional measures planned to decrease GHG emissions in the Agriculture sector currently. Therefore, **there are no differences between WEM and WAM scenario**.

The scenario for predictions, presented already during activity data development, includes corresponding policies and measures, which may influence the development of emissions in the short and medium term. WEM scenario expects a relatively slightly increasing trend in production of GHG emissions from Agriculture. The total emissions from Agriculture for 2050 are estimated at 7 523 kt CO_2 eq., approximately 10% less than it was reported on Projections prepared in 2022 (8.136 Mt CO_2 eq.).

Quantitative data overview and emission trends for the reported and projected period are shown in Table 2-45 – Table 2-50 and Figure 2-10.

Table 2-45: GHG in Agriculture sector reported and projected – WEM scenario

	Reported data (CHMI 2022) [Mt CO_2 eq.]				Projected data [Mt CO_2 eq.]					
	1990	2010	2015	2022	2025	2030	2035	2040	2045	2050
Agriculture	15.75	7.52	8.88	8.41	7.81	7.80	7.70	7.58	7.55	7.52

Source: CHMI, IFER, 2024

Table 2-46: The difference of the reported/projected emissions of GHG to the base year 1990, Agriculture sector

	Difference [%]			
	1990-2025	1990-2030	1990-2040	1990-2050
Agriculture	- 46.6	- 49.5	- 48.1	- 47.7

Source: CHMI, IFER, 2024

The emission changes reported in Agriculture sector are consequent to the activity data development:

1. Cattle production increases, which leads to the increase of methane emissions from Enteric Fermentation by 6%, compared to the current estimate for 2022.
2. Nitrous oxide and methane emissions from Manure Management increase by 13.4%, which is associated with population growth by about 4% for cattle and 6% for swine.
3. The decrease in synthetic fertilization application leads to the reduction of nitrous oxide emissions from Agricultural Soils, up to 30%.
4. The increased intensity of Liming increases carbon dioxide emissions in this sub-category: 2025-2050 by 64%, the increase in emissions is estimated to 122 kt CO_2 for the whole projected period.

Table 2-47: Breakdown of the reported and projected emissions of GHG from Agriculture by its categories

Agriculture, source category	Reported emissions [Mt CO_2 eq.]				Projected emissions [Mt CO_2 eq.]					
	1990	**2010**	**2015**	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
3A Enteric Fermentation	6.61	3.31	3.490	3.68	3.80	3.81	3.84	3.90	3.91	3.96
3B Manure Management	2.57	0.94	0.74	0.76	0.78	0.81	0.82	0.83	0.83	0.83
3D Agricultural Soils	5.22	3.05	4.21	3.63	2.90	2.83	2.68	2.46	2.40	2.33
3G Liming	1.24	0.07	0.17	0.15	0.19	0.21	0.23	0.25	0.28	0.28
3H Urea Application	0.11	0.16	0.27	0.19	0.15	0.13	0.13	0.13	0.13	0.13
Total	**15.75**	**7.52**	**8.88**	**8.42**	**7.81**	**7.80**	**7.70**	**7.58**	**7.55**	**7.52**

Source: CHMI, IFER, 2024

Table 2-48: The difference of the reported/projected emissions of GHG to the base year 1990, Agriculture sector

Agriculture, source category	Difference [%]			
	1990-2022	**1990-2030**	**1990-2040**	**1990-2050**
3A Enteric Fermentation	- 44.33	- 42.36	- 41.00	- 40.09
3B Manure Management	- 70.43	- 68.48	- 67.70	- 67.70
3D Agricultural Soils	- 30.46	- 45.79	- 52.87	- 55.36
3G Liming	- 87.90	- 83.06	-79.84	-77.42
3H Urea Application	+ 72.73	+ 18.18	+18.18	+ 18.18
Total	**- 46.54**	**- 50.48**	**- 51.87**	**- 52.25**

Source: CHMI, IFER, 2024

Table 2-49: Breakdown of reported and projected emissions of GHG from Agriculture by emitted gases

Agriculture, GHG	Reported emissions [Mt CO_2 eq.]				Projected emissions [Mt CO_2 eq.]					
	1990	**2010**	**2015**	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
CO_2	1.34	0.23	0.44	0.35	0.33	0.34	0.36	0.38	0.41	0.41
CH_4	8.19	3.82	3.85	4.06	4.18	4.21	4.24	4.31	4.31	4.37
N_2O	6.22	3.47	4.59	4.02	3.30	3.25	3.10	2.88	2.82	2.75
Total	**15.75**	**7.52**	**8.88**	**8.42**	**7.81**	**7.80**	**7.70**	**7.58**	**7.55**	**7.52**

Source: CHMI, IFER, 2024

Table 2-50: The difference of the reported/projected emissions of GHG to the base year 1990, Agriculture sector by emitted gases

Agriculture, GHG	Difference [%]			
	1990-2022	1990-2030	1990-2040	1990-2050
CO_2	- 73.88	- 74.63	- 71.64	- 69.40
CH_4	- 50.43	- 48.60	- 47.37	- 46.64
N_2O	- 35.37	- 47.75	- 53.70	- 55.79
Total	**- 46.54**	**- 50.48**	**- 51.87**	**- 52.25**

Source: CHMI, IFER, 2024

The total GHG emissions from Agriculture (Agriculture sector + the selected LULUCF sub-categories, 4B and 4C) originate mostly from Agriculture sector emissions (livestock production). However, the CO_2 offset in the above-mentioned LULUCF sub-categories is an order lower number, so the total results reduced just slightly (Figure 2-10).

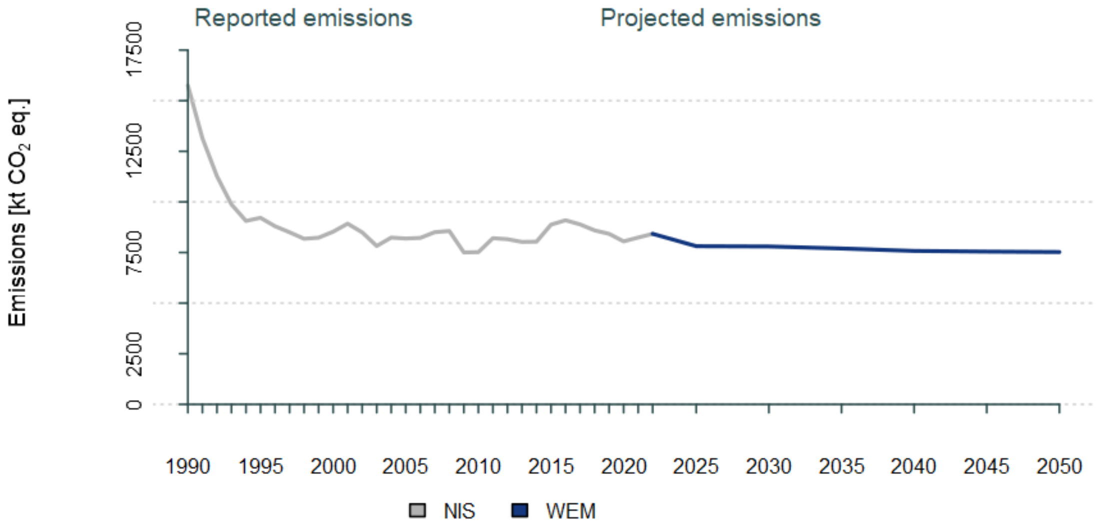


Figure 2-10: Total emissions from Agriculture, reported and projected, 1990-2050

2.4.3 Sensitivity analysis

The projections of GHG emissions from Agriculture are built on calculation procedures in tables used for GHG estimation in National Inventory Report (CHMI 2022). The activity data predicted for 2025-2050 are being used. The majority of emission factors within the projected period remain constant, so the sensitivity analysis would not come up with any reporting value. If there is a change in activity data by ± 5%, then there will be a change by ± 5% in the estimated emissions, too.

A more complicated situation arises when the country-specific data, consequent to Tier 2 method, is used to derive the emission factors, e.g. for Enteric Fermentation or methane emissions from Manure Management. In such cases, calculation of emission factors is determined by additional parameters – such as nutrition (DMI), digestibility of feed, energy for maintenance and production, a management system and temperature of environment within individual AWMS. The emissions estimates are then influenced by a knowledge of the individual process.

Table 2-51 shows the dependence of emission factors and milk production. It is obvious that the predicted milk production may increase emissions by up to 16 kg CH_4/head/yr.

Table 2-51: The comparison of projected and reported value of CH_4 emission factor (EF) for Enteric Fermentation, the sensitivity of calculation

Dairy cattle	Projected data [kg CH_4/head/yr]						
	2022	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
EF from enteric fermentation Calculated with projected milk production	149	151	155	155	160	160	165
EF from enteric fermentation Calculated with constant milk production (2022)	149	149	149	149	149	149	149

2.4.4 Difference between previously and currently reported projections

The predictions for Agriculture sector within this study have a slightly different trend compared to the previous predictions prepared in 2022 (Figure 2-11).

Predictions from 2022 clearly followed the trend of increasing livestock populations according to a revised Strategy of MoA from 2016 (MoA, 2016), and updated for 2022. However, the current activity data prediction is more detailed, and the trend of increasing livestock populations is less distinct.

The progress of the prediction is significantly influenced by the increase in the number of cattle and pigs and the gradual reduction of emissions due to the reduction of the number of synthetic fertilizers applied to agricultural land. The current projections suggest a different trend than those from 2022. While the 2022 projections showed a downward trend, the current projections indicate a milder decrease in emissions. For the year 2025, previous projections predicted emissions to be less than 2% higher than the current ones. For the year 2050, current projections are almost 7% higher than those from the previous cycle of projections.

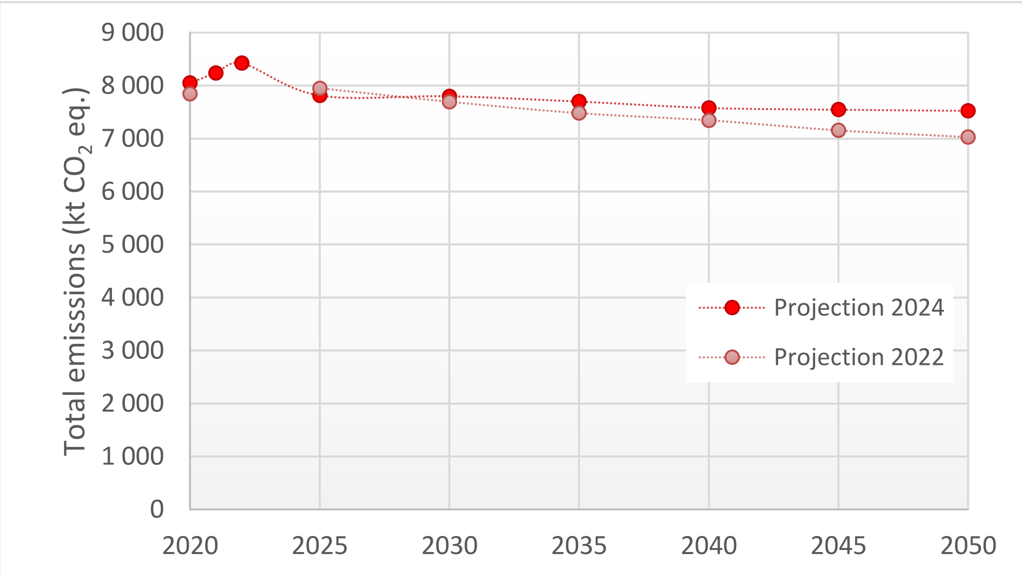


Figure 2-11: The comparison of projected value of GHG emissions in projections estimated for Agriculture sector in 2022 (reported in 2023) and 2024 (reported in 2025)

2.5 Land Use, Land-Use Change and Forestry

Sector 4. Land Use, Land-Use Change and Forestry (LULUCF) is a specific category within the greenhouse gas (GHG) emission inventory framework under the UNFCCC. It is the only sector able to directly offset CO_2 emissions due to the photosynthetic fixation of carbon in plants and increasing individual ecosystem carbon pools. Carbon accounting has always been challenging for the LULUCF sector, despite voluminous methodological advice compiled specifically for this sector by the International Panel on Climate Change (IPCC) (2003) (IPCC, 2006) (IPCC, 2014a) (IPCC, 2014b) (IPCC, 2019). Therefore, the estimates related to the LULUCF sector are commonly accompanied by the largest uncertainty, often in the range of higher tens of percent.

The estimated and reported GHG emissions and removals by the individual LULUCF categories for the period 1990 to 2022 are shown in Figure 2-12 below. The emissions are expressed in units of CO_2 eq., including CO_2, CH_4 and N_2O. The dominant greenhouse gas (GHG) in the LULUCF sector is CO_2, whereas the contribution of the other two gases is fragmental - two orders of magnitude smaller. Therefore, Figure 2-12 shows all gases together, while the individual contributions can be found in the latest National Inventory Report (NID; CHMI, 2024).

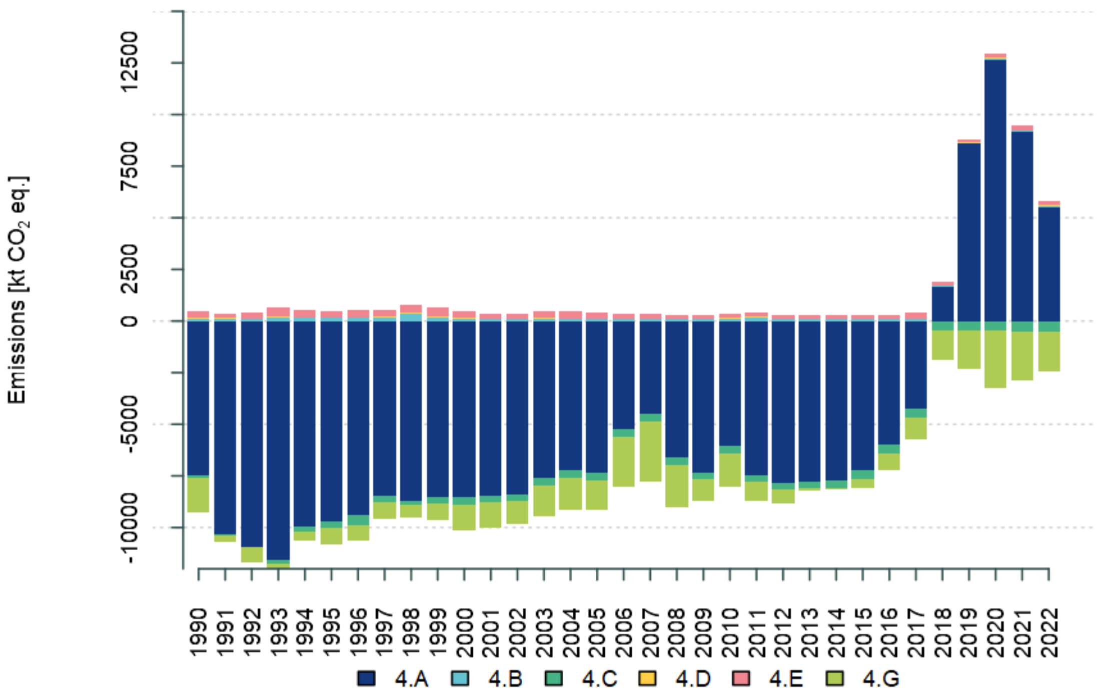


Figure 2-12: The emission trend in the LULUCF sector (Total by black line) during the reporting period 1990 – 2022, and the share of the decisive categories Forest land (4A), Harvested wood products (4G) and other land use categories (4B to 4E) (CHMI, 2024)

As apparent from Figure 2-12, the CO_2 emission depends mainly on carbon stock changes in 4.A Forest land, followed by contribution of 4.G Harvested wood products (HWP), whereas the contribution of other categories is minor.

2.5.1 Methodological issues

Fundamental methodological steps of emission estimates in the LULUCF sector must be considered while designing projections. These include a) treatment of land use areas b) emission estimates for individual land-use categories c) including 4.G HWP contribution. These steps are described below and summarized in Table 2-52.

Table 2-52: The estimated emissions and removals in the LULUCF sector during the reporting period 1990 – 2022 (CHMI, 2022) – every 5th year is shown since 1990, and annual values are shown since 2020.

	Total [kt CO2 eq.]	Forest land (4.A)	Cropland (4.B)	Grassland (4.C)	Wetlands (4.D)	Settlements (4.E)	HWP (4.G)
1990	-8835	-7472	116	-144	24	319	-1680
1995	-10382	-9714	153	-302	12	295	-827
2000	-9684	-8496	128	-371	35	289	-1271
2005	-8722	-7365	102	-360	27	307	-1434
2010	-7712	-6056	101	-360	37	186	-1620
2015	-7854	-7209	82	-427	27	150	-478
2020	9700	12670	50	-476	34	214	-2792
2021	6588	9153	48	-495	26	245	-2390
2022	3378	5528	45	-501	57	195	-1946

a) Treatment of land use areas

The emission estimates in the LULUCF sector are largely determined by the development of land areas categorized by their use. Therefore, the LULUCF emission estimates and their projections must primarily methodologically solve the issue of land areas. The data on areas used in National Inventory Reporting (CHMI, 2024) are exclusively based on the cadastral land use information of the Czech Office for Surveying, Mapping and Cadastre (COSMC; www.cuzk.cz). The land-use representation and the land-use change identification system of the 4. LULUCF emission inventory use annually updated COSMC data, elaborated at the level of about 13,000 individual cadastral units. The observed development of the major IPCC land use categories (IPCC, 2006) is reported in NID (CHMI, 2024).

The projections beyond 2022 are based on the observed trends, additional data from 2023 (the most recent known data when preparing this material) and anticipation of gradually diminishing category-specific land use changes until 2050. Specifically, for land use categories 4.A Forest land and 4.E Settlements, a half-declining trend concerning the changes since 1990 are foreseen for the period until 2050. For 4.D Wetlands and 4.C Grassland, a continuation of the trend from 1990s and 2000s is foreseen, respectively. The trend projections of land areas are constructed based on either nonlinear fit using a sigmoid function (4.A Forest land, 4.E Settlement), parabolic function (4.C Grassland), or linear fit (4.D Wetlands). For 4.B Cropland, the estimates for the projection period are given by balancing the total land area with the other projected land use categories.

The historical and projected land use areas are in Table 2-53 and Figure 2-13 below. There is an increase in land use categories 4.A Forest land, 4.C Grassland, 4.D Wetlands and 4.E Settlements. The area of 4.B Cropland is expected to further decrease. The changes in the land use category 4.B (Cropland) represent the most significant shift in land use both in relative and absolute numbers, expected in the country from 2021 until 2050 (the end year of the projection period). During that time, the area share of 4.B Cropland would decrease from 40.2% to 38.3% in the country (Figure 2-14), which means a loss of 152 kha in this period. The share of other land use categories would correspondingly increase (Table 2-53).

Table 2-53: Land use areas (kha): reported until 2020, projected until 2050 (*IE - areas of 4.F Other land are included within 4.E Settlements)

	Reported area [kha]						Projected area [kha]					
Land use category	**1990**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
4.A Forest land	2629	2637	2647	2657	2668	2677	2686	2692	2696	2699	2700	2701
4.B Cropland	3455	3319	3286	3248	3211	3178	3125	3095	3070	3050	3033	3018
4.C Grassland	833	961	974	986	1001	1023	1051	1067	1082	1095	1107	1118
4.D Wetlands	158	159	161	163	165	167	169	170	172	174	175	177
4.E Settlements	812	810	819	833	841	842	856	863	867	870	872	873
4.F Other land*	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE

Source: CHMI 2022, IFER (unpublished data)

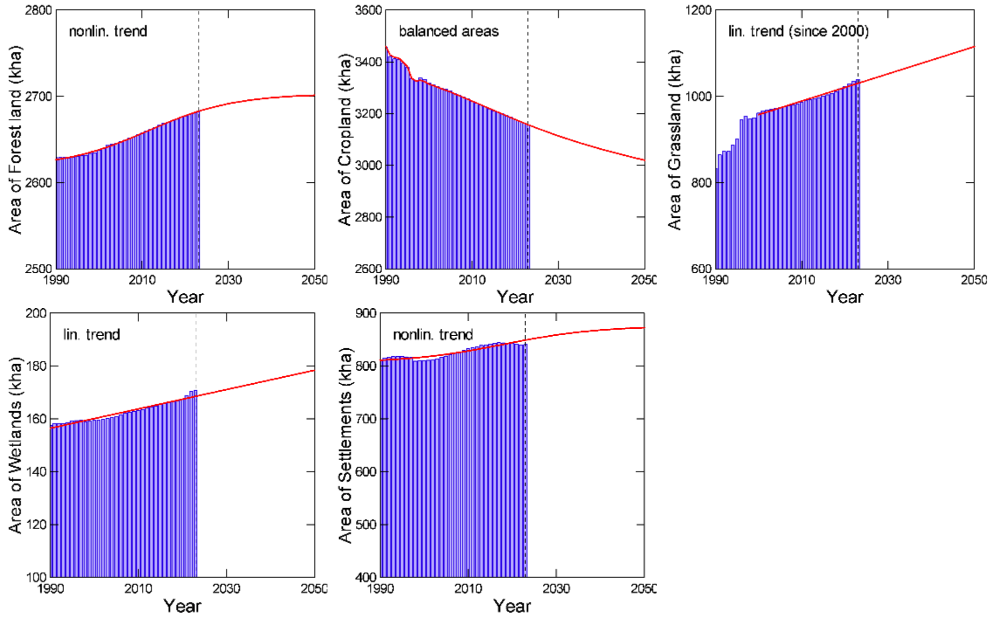


Figure 2-13: Actual areas of the major IPCC land use categories in the Czech Republic from 1990 to 2023 and the projected trends shown until 2050. Within each category, a note on the extrapolation approach is included.

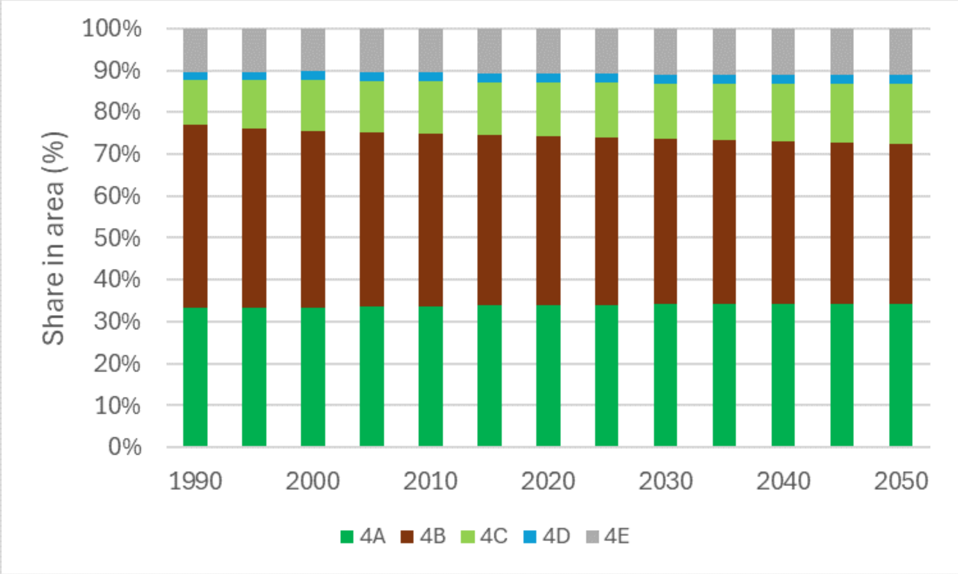


Figure 2-14: Share of areas for the IPCC land use categories (*4.E Settlements also include a fraction representing an area of 4.F Other land) in 5-year intervals from 1990 to 2050, using the actual data (until the year 2020 in the graph) and projections until 2050.

b) Emission estimates for individual land-use categories

Secondarily, following the projection setup of land use areas, the projections of emission estimates for individual categories are prepared.

Specific attention is given to 4.A Forest land, which always represents the key emission category of the LULUCF sector as well as within the entire NID (CHMI 2024). For this reason, the projections related to forestry are elaborated using the nationally calibrated Operational Scale Carbon Budget Model of the Canadian Forest Service (CBM-CFS3, v. 1.2) (Kull, et al., 2016, 2019), (Kurz, et al., 2009), Cienciala and Melichar (2024). This is coherent with the GHG emission reporting of 4. LULUCF sector under UNFCCC (CHMI 2022 and later). CBM-CFS3 is an empirical model driven by yield and standing inventory data, the same as used by operational foresters in timber supply analysis and forest management planning tools.

CBM-CFS3 has previously been used to project forest resources of the Czech Republic for setting up the national Forest Reference Level (FRL) under EU Regulation 2018/841 for the period 2021-2025, which is described in detail in the Czech National Forest Accounting Plan (NFAP)[4]. Since NIR 2022, this tool has been used for emission estimates of land use categories related to forest land in the GHG emission inventory of the country.

Specifically for the projections in this report, CBM-CFS3 was used to assess the GHG emissions for category 4.A.1 Forest land remaining Forest land. The emissions corresponding to the category 4.A.2 Land converted to Forest land were estimated from the implied emission factor (IEF) reported for the category in 2022 (NID 2024, CHMU 2024) and corresponding land areas. These were projected based on the linear trend observed from 2018 to 2023 ($R2=0.77$, $p<0.05$, $n=6$) until 2050. Using the known areas of the categories 4.A.1 and 4.A.2, the projected estimates by CBM and the attributed estimates for 4.A.2 could be used to attribute the emissions to these categories in line with the GHG reporting rules.

[4] https://www.mzp.cz/C1257458002F0DC7/cz/opatreni_v_ramci_lulucf/$FILE/OEOK-CZ_NFAP_FRL_final-20200203.pdf

The projections of GHG emissions related to other land use categories except 4.A Forest land (i.e., 4.B Cropland, 4.C Grassland, 4.D Wetlands, 4.E Settlements) are based on simple correlations of the estimated emissions for the reference year linked exclusively to the corresponding land areas for the predicted years.

The projected GHG emissions for all other land use categories (4.B to 4.E) were estimated using the corresponding projected land areas as a proxy variable, together with the implied emission factor as reported in the latest NID report (NID 2024, CHMI 2024). The estimates of the agricultural land use categories 4.B Cropland and 4.C Grassland were also aided by identified statistical relationships. Specifically for 4.B Cropland, we used linear regression to assess the relation of annual emissions to land area ($R2=0.31$, $p=0.001$, $n=33$). Correspondingly, for 4.C Grassland we identified a multi-regression relationship combining the share of extensive grassland management, and area of Grassland as independent variables ($R2=0.80$, $p<0.001$, $n=33$).

Finally, the contribution of 4.G HWP was projected using the harvest activity data as reported in NID (CHMI, 2024). For the period from 2024 to 2050, harvest volume as adopted for the CBM-assisted estimates, was used as input and proxy for the estimation of 4.G HWP contribution following the identical methodology for 4.G HWP as described in NID (CHMI, 2024), and projection by the approach detailed in the Czech NFAP . This relies on scaling the input activity data based on the relation of adopted harvest to harvest quantities in the reference period from 2000 to 2009.

A summary of the methodological approaches used for the projection of the LULUCF categories is provided in Table 2-54.

Table 2-54: Summary of the methodological approaches used for the LULUCF categories

Activity data and category	Approaches
Land use areas for individual land use categories	COSMC data for 1990 - 2020, thereon projections until 2050 using non-linear/sigmoidal trend (4.A Forest land, 4.E Settlements) linear trend since 2000 (4.C Grassland), sustained rate linear trend (4.D Wetlands), sustained rate balanced areas complementing the above land use categories (4.B Cropland)
Emission estimates for 4.A Forest land	NIR data for 1990 - 2023 (CHMI 2024 and newer), thereon projections using CBM-CFS3 model version 1.2 (Kull et al. 2016, 2019), with ex-ante adjustment for the projected changes in 4.A Forest land area until 2050.
Emission estimates for other land use categories except 4.A Forest land	NIR data for 1990 – 2022 (CHMI 2024), thereon a rescaled reference data since 2023 using projected land area as a proxy for individual land-use categories, aided in the case of 4.B Cropland and 4.C Grassland by statistically significant regression relationships (detailed in the text)
4.G HWP contribution	Production approach as in NIR 1990 - 2022 (CHMI 2024), thereon estimates until 2050 using harvest demand (logs) as applied for CBM-assisted projection until 2050, using the relation of harvest in reference period (2000-2009) and projected harvest to derive the input activity data for assessment of the HWP emission contribution

2.5.1.1 CBM-CFS3 model set-up for the Czech Republic

To use CBM-CFS3 in the Czech national circumstances, the European Archive Database as prepared by the JRC (Pilli et al., 2018) was modified to include the locally applicable biomass allometry functions for beech, pine, spruce and oak (Cienciala et al., 2006; 2008; Vonderach et al., 2018). Czech Republic comprises 5 climatic regions according to Hijmans et al. (Hijmans, et al., 2005). Since CBM-CFS3 does not consider precipitation in decay rates, only one climatic unit with a mean annual temperature of 8 °C was employed.

For this study, we used CBM-CFS3 using the Czech Republic’s forestry as the simulated domain, spatially categorized by NUTS3 regions (Figure 2-15 regional labels as follows: CZ010 Prague, CZ020

Central Bohemia, CZ031 South Bohemia, CZ032 Plzeň, CZ041 Karlovy Vary, CZ042 Ústí nad Labem, CZ051 Liberec, CZ052 Hradec Králové, CZ053 Pardubice, CZ063 Vysočina, CZ064 South Moravia, CZ071 Olomouc, CZ072 Zlín, CZ080 Moravia-Silesia). The input data requested for the model run include growth and yield functions, current annual increment, and growing stock data (m^3 under bark) aggregated by the main species groups and age classes, together with their associated specific areas. These data were provided by the Forest Management Institute (FMI), the administrator of the national database of forest management plans.

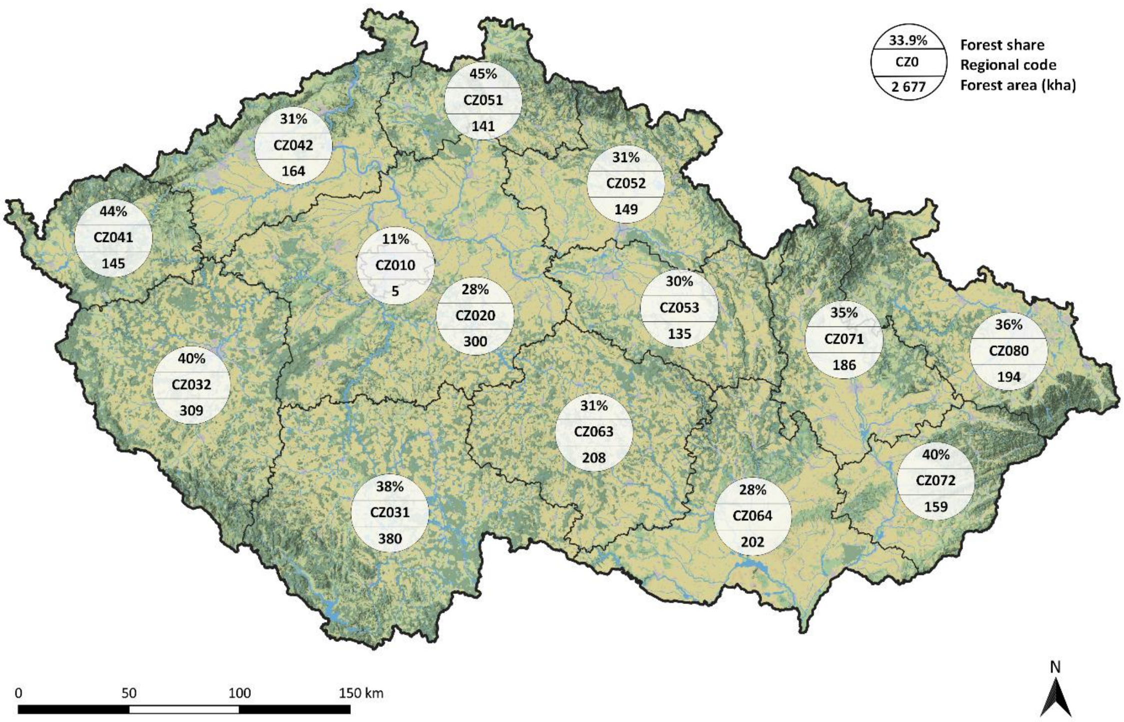


Figure 2-15: Simulated domain 4.A Forest land area shares, and a total 4.A Forest land area divided by the regions of the Czech Republic (NUTS 3), showing the specific forestation (%) and forest area (kha) as of 2020. The NUTS 3 legend shows an overall total for the Czech Republic (MoA, 2021). Background map: Natural Czechia.

Apart from the above-described spatial categorization, forest data were categorized by species groups (Table 2-55). These included seven categories of key tree species groups and/or species of ecological importance. Additionally, temporarily unstocked areas and areas with dead-standing spruce trees were treated individually.

The run performed by CBM-CFS3 covered the period from 2018 to 2050, in which the input data for 2018-2023 were the observed/reported data on forest resources, while the 2024-2050 period is a scenario projection. The carbon pools included in the projected emissions include changes in all five carbon pools, namely above- and below-ground biomass, deadwood, litter and soil. This approach is identical to the NID (CHMI, 2024).

Table 2-55: Forest types by main tree species and corresponding area share by area and/or volume in 2018. Two additional categories are clearcut areas and spruce snag representing unprocessed dead standing spruce trees (assembled from Forest Management Institute web depository – available on www.uhul.cz).

Forest type	Main species	Area share	Volume share
Spruce	Picea abies (L.) Karst.	49.6%	59.8%
Pine	Pinus sylvestris L., Pinus nigra Arnold	20.2%	19.9%
Beech	Fagus sylvatica L.	8.6%	6.7%
Oak	Quercus petrae (Matt.) Liebl. , Q. robur L.	7.4%	5.4%
Longlived broadleaves	Tilia cordata Mill., Tilia platyphyllos Scop., Fraxinus excelsior L., Acer pseudoplatanus L., Carpinus betulus L.	6.1%	4.0%
Shortlived broadleaves	Betula pendula Roth., Alnus glutinosa (L.) Gaertn., Populus spp., Alnus incana (L.) Moench	5.3%	2.6%
Fir	Abies alba Mill., Pseudotsuga menziesii (Mirb.) Franco	1.4%	1.5%
Clearing, gap	Temporarily unforested area, e.g., after clear-cut.	1.4%	-
Spruce snag	Additional forest type representing temporarily unprocessed dead spruce forest due to drought-induced bark-beetle mortality	-	-

The applicable harvest used for the scenario “With existing measures (WEM)” corresponds in principle to the Green scenario published in Cienciala and Melichar (2024). (WEM scenario details in Section Definition of ’With existing measures’ (WEM) and ‘With additional measures’ (WAM) scenario below). However, the applicable harvest volumes were based on the available stock for individual harvest categories for each forest type, with a target total harvest extraction at 17.5 Mm3/year. The harvest categories include thinning, salvage logging and planned final cut. At the same time, the amount and proportion of salvage and planned logging were regionally specific, based on the available information on forestation Figure 2-15 and forest dieback applicable to spruce stands. Harvest volumes are derived for two regimes, one is dominated by salvaging, while the other represents the ordinary planned management with limited salvage.

The harvest regime uses the observations (national data reported by the CzSO for 2018-2023. For the following projections, harvest is determined by wood available to the harvest by age classes, forest type (Table 2-55) and felling type (thinning, final cut, salvage). For this regime, harvest rate meets the sustainability requirement as prescribed in the Czech Forest Act. As for thinning, its quantity depends on the intensity of salvaging and the development of age class structure for individual forest types within each region. For the years with the extreme salvage fellings, the share of planned thinning is fragmental. On the contrary, thinning increases once the effect of spruce forest dieback diminishes as planned management (thinning and final cut) dominates the residual salvaging and the share of younger stands requiring thinning increases. Also to note, during the period of extreme dieback, the technical harvest capacities in the country were insufficient for a complete harvest of infected and/or dead standing trees, which would be mandatory under the Czech Forest Act in normal conditions. Considering this, the harvest quantities of left-over dead trees are specifically accounted for, using the information of unprocessed standing dead trees from CzSO. The harvest demand used in CBM by planned and sanitary operations is in Table 2-56. Finally, an extraction intensity applicable to harvest residues is set at 40%.

Linked to sanitary felling and planned final cut, the model run incorporates gradual changes in species composition for new planting/regeneration, based on the reported data from CzSO (2018-2023) and the specific scenario assumptions (Section 2.5.1.2 below).

Table 2-56: Harvest volumes used to drive the CBM-CFS3 model run for particular years, together with the expressed share of thinning by volume. The projected data are shown in italics.

Period	Planned (%)	Sanitary (%)	Total removals (Mm^3/yr)
2018	11	89	24.3
2019	5	95	32.8
2020	5	95	35.7
2021	13	87	30.3
2022	21	79	25.5
2023	40	60	18.9
2025	71	29	18.0
2030	70	30	17.7
2035	70	30	17.3
2040	70	30	17.4
2045	69	31	17.4
2050	69	31	17.4

The projections of GHG emissions related to other land use categories except 4.A Forest land (i.e., 4.B Cropland, 4.C Grassland, 4.D Wetlands, 4.E Settlements) are based on simple correlations of the estimated emissions for the reference year linked exclusively to the corresponding land areas for the predicted years.

Finally, the contribution of 4.G HWP was projected using the harvest activity data as reported in NIR (CHMI, 2020). For the period from 2021 to 2050, harvest volume as adopted for the CBM-assisted estimates, were used as input and proxy for estimation of 4.G HWP contribution following the identical methodology for 4.G HWP as described in NIR (CHMI, 2020), and projection in accordance with the approach detailed in the Czech NFAP[5].

2.5.1.2 Definition of 'With existing measures' (WEM) and 'With additional measures' (WAM) scenario

The WEM scenario includes the development of land areas of individual land use categories as shown in Table 2-53 and Figure 2-14. The land area is used as a proxy for the projected emissions. Hence, the development of land areas and land use changes drive the projected emissions relative to the reference year (2022) for the individual land use categories except for two:(i) 4.A Forest land, estimating GHG emissions by the model approach secondarily adjusted by land area; (ii) HPW emission contribution, which relies on harvest quantities (Table 2-56) and related activity data.

For the category 4.A Forest land, the entire WEM scenario concept was redesigned to address the recent catastrophic decline of coniferous stands due to drought-induced bark-beetle infestation. Also, the newly adopted modelling toll, the CBM-CFS3 model v1.2 (Kull et al., 2016, 2019), permitted a more detailed representation of processes associated with both management of disturbed managed forest ecosystems. The WEM scenario includes the currently implemented forest management recommendations (age-specific thinning and felling per forest types) of the Czech Forest Act and actual species composition in the reference year. At the same time, salvage felling is mandatorily prioritized

[5] https://www.mzp.cz/C1257458002F0DC7/cz/opatreni_v_ramci_lulucf/$FILE/OEOK-CZ_NFAP_FRL_final-20200203.pdf

over the planned management interventions, which is in full accordance with the valid legislation – the Czech Forest Act and its amendments.

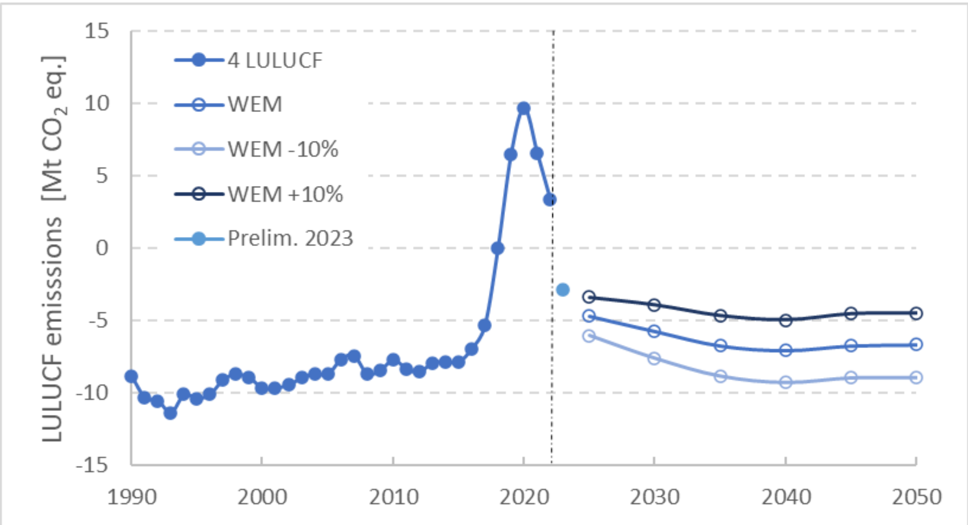
Specifically, the currently defined WEM scenario for forestry assumes Norway spruce share decline gradually until 2050. Correspondingly, the share of broadleaved tree species and fir species group would increase. This is in line with the long-term adaptation strategy of the country (Krejzar, 2008) (MoE, 2017), which includes the proposed tree species change of dominantly spruce even-aged forests to more diverse stands with higher share of broadleaved tree species such as beech and oak. The above species change scheme is prescribed for each instance of salvage felling.

The felling request is defined for the initial years of the model run (2018-2023), for which the harvest level is known based on the reported data by CzSO, while the harvest volume for the following projection years until 2050 is determined interactively using the CBM-CSF3 model operating at the level of 14 NUTS3 regions and seven forest types (Table 2-55), based on wood available for harvest by individual harvest categories and preserving sustainability criteria for harvest (Table 2-56). For the current projection, as noted earlier, the guiding total harvest volume was 17.5 Mm^3/year until 2050.

The recent extreme drought-induced bark beetle outbreak and annual share of sanitary reaching 95% (in 2020) showed that disturbances (drought and bark-beetle infestation) might temporarily represent a decisive factor in carbon balance. Specifically, under the conditions of dominating sanitary logging (a share of 60% still reported for 2023), projections of the changes in forest resources must be inherently uncertain. This justifies using one single WEM scenario, whereas any additional pragmatically implementable management intervention under any WAM scenario would likely not have any effects larger than uncertainties associated with the current disturbance to forestry. Therefore, no specific WAM scenario is elaborated in this material.

2.5.2 Projected greenhouse gas emissions 'With existing measures' (WEM) scenario

The historical data and projections using the WEM scenario are shown in Table 2-57 and Figure 2-16. It follows the observation of rapidly declining emissions from the LULUCF sector in recent years (a preliminary estimate of 2023 is also shown for a better interpretation). This trend leads to projected negative estimates under the WEM scenario until 2050. This is mostly determined by the sustained harvest level of about 17.5 Mm3/year assumed under the revised WEM scenario described earlier.



Source: IFER, 2024

Figure 2-16: Reported (1990-2022; NIR 2022) and projected (since 2025) emissions of GHG in 4. LULUCF sector for WEM scenario. It includes a sensitivity analysis on LULUCF emissions using reduced

(WEM -10%) and increased (WEM +10%) harvest applied in 4.A Forest land, as well as the associated changes in HWP, relative to that used in the WEM scenario. Additionally, the interim estimate of emissions for 2023 for the coming inventory report due in 2025 is also shown (Prelim. 2023).

The essence of the presented emission trend under the revised WEM scenarios can be interpreted as follows:

- Recently Czech forestry experienced an exceptional outbreak of bark-beetle infestation and associated dieback of spruce (also for pine on a minor scale) stands. This resulted in a rapidly increasing share of sanitary felling that peaked in 2020 and almost symmetrically declined since then (Table 2-56).
- Between 2021-2023, the harvest level rapidly declined, turning the Czech forestry and the entire LULUCF sector into a carbon sink again. This development follows the optimistic (Green) scenario or early stabilization of Czech forestry and sustained, stabilized carbon sink under adaptive forest management until 2050.
- For the projected period 2025-2050, we assume a sustained harvest volume of about 17.5 mil. m^3 wood volume per year, well below the projected increment in forestry.
- The WEM scenario represents an adaptive scenario for Czech forestry. It should result in a notable conversion of productive, but unstable spruce-dominated stands into more resilient, dominantly broadleaved and/or mixed forest stands (Figure 2-17).
- The overall importance of wood harvest on emission balance in the forestry sector is demonstrated with sensitivity analysis using changed harvest levels and the associated harvested wood products (HWP) (Figure 2-16).
- Any significant disturbance to forests such as that experienced in recent years would lead to increased harvest volumes and negatively affect the carbon balance in the sector. In our revised WEM (Green) scenario, we do not anticipate such a disturbance to occur soon. This is substantiated by the fact that the drought conditions attributed to the recent forest dieback were found unprecedented in the last 2100 years in the region (Büntgen et al. 2021), and its recurrence is highly unlikely. Also, the pool of the most sensitive spruce-dominated stands has significantly decreased in the country.

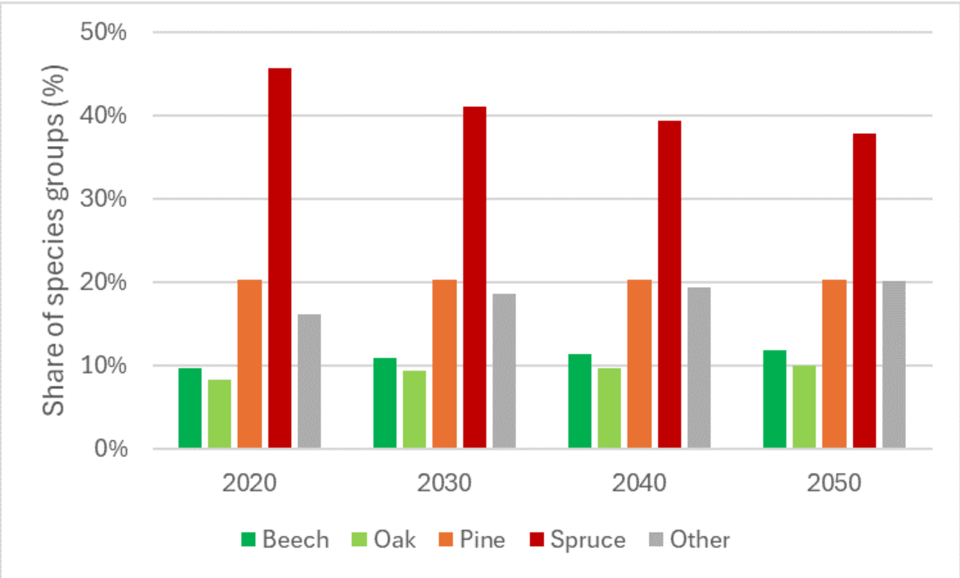


Figure 2-17: Current (2020) and projected (2030 - 2050) tree species composition within the WEM scenario, expressed by the share of the forest area occupied by the individual species groups. There is a notable decline in the spruce species group, compensated by an increased share of dominantly

broadleaved forest types (including the group Other, which is dominantly composed of broadleaves).

Table 2-57: Reported and projected emissions of GHG in 4. LULUCF sector – WEM scenario

[Mt CO_2 eq.]	Reported emissions		Projected emissions			Absolute Difference			
	1990	2022	2030	2040	2050	1990 – 2020	1990 – 2030	1990 – 2040	1990 – 2050
WEM	-8.84	3.38	-5.74	-7.07	-6.67	12.2	1.77	4.85	2.16

Source: IFER, 2024

The breakdown of historical and projected (WEM scenario) emissions by gases and individual land use categories is in Table 2-58 and Table 2-59, including the individual 4. LULUCF categories.

The emissions in the LULUCF sector are mostly determined by carbon stock changes in the category 4.A Forest land and partly by the emission contribution of 4.G HWP. The interpretation of the estimated emission levels trends in 4.A under WEM is in chapter 2.5.1.2.

Table 2-58: Breakdown of reported and projected emissions of GHG by gases in 4. LULUCF sector - WEM scenario

[kt CO_2 eq.]	Reported emissions		Projected emissions		
	1990	2022	2030	2040	2050
CO_2	-8 874	3 334	-5 775	-7 101	-6 704
CH_4	19.4	20.5	20.6	20.6	20.7
N_2O	19.8	13.5	13.0	13.0	13.0
Total	-8 835	3 378	-5 741	-7 067	-6 670

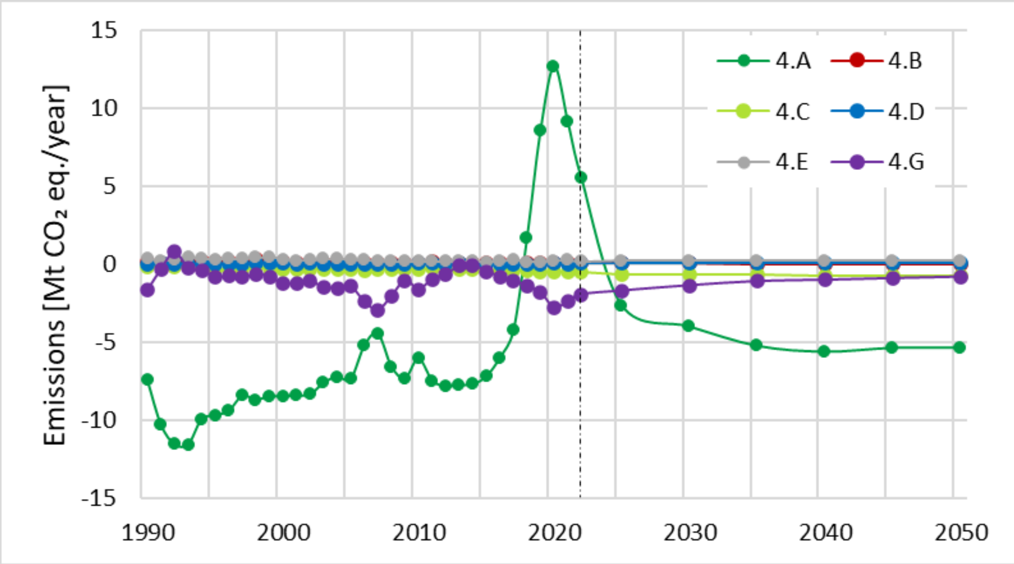
Source: IFER, 2022

Table 2-59: Breakdown of reported and projected emissions of GHG by categories in 4. LULUCF sector - WEM scenario

[Mt CO_2 eq.]	Reported emissions		Projected emissions		
	1990	2022	2030	2040	2050
4.A Forest land	-7.47	5.53	-3.99	-5.60	-5.34
4.B. Cropland	0.12	0.05	0.04	0.02	0.00
4.C Grassland	-0.14	-0.50	-0.68	-0.73	-0.77
4.D Wetlands	0.02	0.06	0.06	0.06	0.06
4.E Settlements	0.32	0.19	0.20	0.20	0.20
4.G HWP	-1.68	-1.95	-1.37	-1.02	-0.82
Total	-8.84	12.77	-5.74	-7.07	-6.67

Source: IFER, 2022

The quantitative share and trends of emissions under the WEM scenario by the individual LULUCF categories are shown in Figure 2-18. The Forest land category dominates in the historical period until 2020, and during the projected period until 2050, followed by the 4.G HWP contribution.



Source: IFER, 2024

Figure 2-18: Breakdown of reported and projected (WEM scenario) emissions of GHG by land-use categories within 4. LULUCF, namely Forest land (CRF 4.A), Cropland (CRF 4.B), Grassland (CRF 4.C), Wetlands (CRF 4.D) and Settlements (CRF 4.E), plus the quantified HWP contribution (CRF 4.G).

2.5.3 Sensitivity analysis

Sensitivity analysis investigates the effect of changes in the harvest on the total emissions of the LULUCF sector. Harvest level affects emissions of the land-use category 4.A Forest land, and, correspondingly, 4.G HWP contribution. These are the key categories of the Czech emission inventory, determined by biomass carbon stock changes in the sub-category 4.A.1 Land remaining Forest land and the stocks of 4.G HWP. Harvest intensity reflecting the forest management and natural disturbance sin the country is the decisive factor affecting changes in forest growing stock volume, ecosystem carbon stock and GHG emission balance in the LULUCF sector.

The role of harvest quantity and associated harvested wood production is demonstrated on the sensitivity analysis using smaller or larger overall harvest demand by 10% concerning the selected baseline (harvest as in the WEM scenario) using the CBM-CSF3 model. The model outcome as implemented for the WEM scenario and its two variants are in Figure 2-16. A relatively small change in harvest demand would significantly affect greenhouse gas emissions from the LULUCF sector. Harvest intensity is a more decisive GHG emission factor as compared to gradual tree species change implemented in the WEM scenario affecting carbon balance on a long-term basis.

2.5.4 Difference between previously and currently reported projections

There is no fundamental methodological difference in the concept of the LULUCF projections compared to the previously reported projections. In both cases, the nationally calibrated CBM-CSF3 model was used to project the national forest resources and the associated ecosystem carbon balance. The details of the model application are in Section 2.5.1 above.

The major change is associated with the revision of the WEM scenario assumptions, which builds on the known key activity data until 2023, specifically harvest level, its division into types of harvest (sanitary, planned, thinning, final cut) and its geographical attribution at regional (NUTS3) level. This evidence showed that Czech forestry follows a more favourable recovery trajectory (Green scenario) from the unprecedented drought-induced decline of coniferous forest stands with an exceptional bark-beetle outbreak in recent years. It improves the near-time projection for the Czech forestry that relatively effectively responded to that exceptional disturbance, and the sector relatively quickly turns to a net carbon sink. According to our information, most affected areas are newly afforested with regenerating forest stands. This development represents an optimistic recovery pathway and may result in a sustained carbon sink in the coming years and decades, despite the challenges of progressing climate change. However, this would require a sustained effort to implement adaptive forest management minimizing these risks to forests and the forestry sector in the coming decades.

The impact of the observed development on the adopted accounting of the LULUCF sector scheduled for 2021-2025 remains seriously negative for the country. It must be addressed by a specific negotiation with the EU Commission that reopens the issue of the highly questionable, unobjective reference level setting for forestry under the current EU LULUCF regulation.

2.6 Waste

The 5. Waste sector in the Czech Republic can be separated into four distinctive source categories. First, the dominant category is 5.A Solid waste disposal, which is a primary source of CH_4 emissions. Emissions of CO_2 from 5.A are of a biogenic origin and therefore, not included in the projected emissions. Category 5.B Biological treatment of waste is a source category which consists of composting and anaerobic waste digestion. As composting is an aerobic process and anaerobic digestion is a technologically controlled process, emissions from this source category tend to be negligible, even when this category seems to be growing in the Czech Republic. Emissions from the use of biogas produced in anaerobic digestion are not part of this source category, as they are part of category 1.A Energy. However, emissions leakage from the digestion process is accounted for. Emissions from category 5.C Waste incineration are accounted for in the 1.A Energy sector when it produces useable energy. Only hazardous and industrial 5.C Waste incineration is accounted for in 5.C, which is the same approach as in the National Inventory Report (NID) (CHMI, 2024). 5.C Waste incineration produces all three major greenhouse gases (GHG), but predominantly it's a fossil CO_2 source. The last category, 5.D Wastewater treatment, includes both public and private wastewater treatment plants as well as industrial counterparts and it is a source of CH_4 and N_2O emissions. In 2022, the total aggregate GHG emissions from 5.Waste were 5,440.85 kt CO_2 eq., which represents an increase of 66% compared to 1990. GHG emissions trend in the 5. Waste sector is depicted in Figure 2-19 (CHMI, 2024).

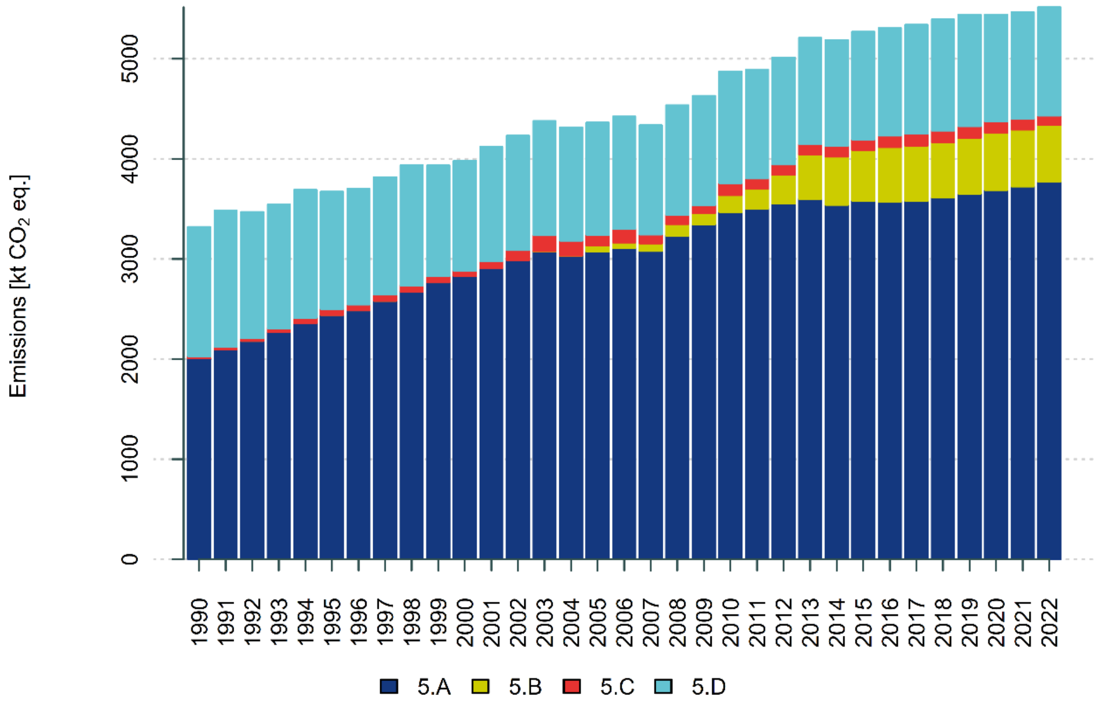


Figure 2-19:The emission trend in 5. Waste sector during the reporting period 1990 – 2022 (CHMI, 2024)

Table 2-60: The emission trend in 5. Waste sector during the reporting period 1990 – 2022 (CHMI, 2024)

[kt CO2 eq.]	Solid waste disposal (5.A)	Biological treatment of solid waste (5.B)	Incineration and open burning of waste (5.C)	Waste water treatment and discharge (5.D)
1990	2 008	NE,IE	20	1 291
1991	2 100	NE,IE	24	1 359
1992	2 180	NE,IE	28	1 260
1993	2 270	NE,IE	38	1 235
1994	2 358	NE,IE	54	1 278
1995	2 441	NE,IE	60	1 170
1996	2 487	NE,IE	60	1 152
1997	2 581	NE,IE	62	1 172
1998	2 674	NE,IE	62	1 199
1999	2 766	NE,IE	63	1 104
2000	2 830	NE,IE	51	1 098
2001	2 911	NE,IE	69	1 138
2002	2 989	NE,IE	100	1 142
2003	3 076	2	158	1 140
2004	3 033	2	149	1 131
2005	3 072	61	107	1 120
2006	3 110	56	137	1 120
2007	3080	76	89	1 089
2008	3 234	115	93	1 093
2009	3 347	111	80	1 091
2010	3 469	169	120	1 114
2011	3 504	196	105	1 087
2012	3 553	288	104	1 065
2013	3 601	444	101	1 061
2014	3 541	481	107	1 057
2015	3 582	506	106	1 074
2016	3 574	544	115	1 075
2017	3 582	551	118	1 087
2018	3 613	553	117	1 108
2019	3 653	556	118	1 112
2020	3 689	570	113	1 067
2021	3 725	568	107	1 067
2022	3 774	566	93	1 082

Overall development of the 5. Waste sector in the past decades is dominated by landfilling of waste in Solid Waste Disposal Sites (SWDS). Landfilling is still the dominant type of waste management, but its importance is decreasing due to the rise of waste recycling; collection of separated waste parts, composting and energy recovery. Soon, landfilling (mainly of municipal (MW) and organic waste) might disappear as the capacity of landfills is decreasing and other options are preferred by national legislation and obligations of the Circular Economy Package (CEP) (EC, 2018). However, the steady increase in energy recovery and even the impressive leaps in composting and material recovery during the past six years did not lead to a decrease in landfills due to a steady increase in the total amount of MW (CHMI, 2022). Even the total amount of MV is not the main issue regarding potential emission reductions in the 5. Waste sector. Until the composition of landfills waste changes, namely the food waste and other biodegradable waste is significantly reduced or eliminated from landfill, only then emission will be reduced in the 5. Waste sector.

The 5. Waste sector has high uncertainty regarding emission levels as many of the processes behind the emissions are either not sufficiently understood or are strongly dependent on local conditions that make top-down assessments such as this very difficult. Furthermore, the 5. Waste sector is the ultimate end point of all consumption and economic activity and therefore, it is also highly dependent on the whole economy setting, which makes it even harder to predict. Default uncertainty for the GHG emission levels in the 5. Waste sector is around ±40%, with some source subcategories reaching the factor of two. This uncertainty originates mainly from emission factors. Activity data is also uncertain, but due to the economic nature of waste management, it is regularly scrutinised and controlled (CHMI, 2024).

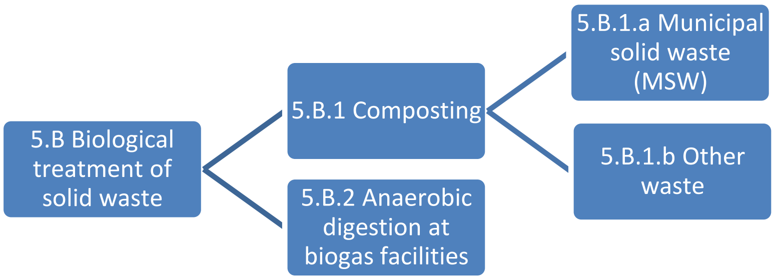
2.6.1 Methodological issues

The projections of GHG emissions in 5. Waste sector are based on the methodology used for emission estimates reported in NID (CHMI, 2024). Activity data reported in NID (CHMI, 2024) are obtained from the Czech official database of waste management VISOH ("Veřejné informace o produkci a nakládání s odpady"). The time series of spreadsheets from the NID (CHMI, 2024) were extended to cover also period 2023 -2050 for all the sectors. In the 2.12.2024 Working Group II meeting, the EU requested time series of GHG projections to be extended to the year 2055. For the 2025 March submission to the EU, 2055 values are equal to 2050 values. Czechia GHG projections will be extended to 2055 for the next 2027 submission to the EU.

Due to ongoing database developments in CENIA and VISOH, t-2 data has been unavailable on time for the March 2024 GHG inventory submission. Updated 2022 year value from CENIA in July 2024 is applied in projections instead of March 2024 NIR 2021 = 2022 value. The base year in the projections is 2022, which is the latest available data year at the time of preparing the estimates.

Emissions, activity data and parameters up to the current reporting year are from the common reporting format (CRF) and VISOH. From 2023 to 2050, extended time series were aligned with assumptions from the Waste Management Plan 2014 (WMP) (MoE, 2014) and by the obligations of the CEP (EC, 2018). The forecasted scenario in the WMP (MoE, 2014) was the guiding pathway for updating the projections. The main assumption from the WMP (MoE, 2014) is, that landfilling can be ended by 2030 or soon after. The CEP assumptions and obligations are explained in the chapter 1.6.3.

Category 5.A Solid waste disposal has default emission factors (EF) and methodology from the 2006 IPCC Guidelines. Activity data is from VISOH. Category 5.A has also With additional measures (WAM) scenario. The difference between the With existing measures (WEM) and (WAM) scenarios is an increased recovery of landfill gas, which is increasing more sharply in the WAM scenario due to increased pressure from the renewables market. The WAM scenario has higher projected trend for recovered landfill gas (LFG) than WEM from 2025. Recovered CH_4 from LFG is used for energy purposes and is subtracted from total emissions (CHMI, 2024). The projected trend of emissions from category 5.A is thus, decreasing steeply after 2025 (Table 2-65).



Wet weight data and default emission factors (EF) 4 kg CH_4/t and 0.24 kg N_2O/t from IPCC 2006 GL (IPCC, 2006) were used for both subcategories (5.B.1 and 5.B.2). Activity data values in NIR 5.B.1 spreadsheet were extended up to 2055 by linear extrapolation. This category took big annual leaps in the past, but the latest reductions in increase are reflected in the more conservative estimates. For the subcategory 5.B.2 Anaerobic digestion at biogas facilities, a country-specific (CS) emission factor (EF) of 3.1% was applied for the methane leakage for the whole historical time series (Havránek, 2021). The CS EF 3.1% will create a small discrepancy between the 2024 GHGI submission reported and the projections reported values, but the CS EF 3.1% will be implemented in the 2025 GHG inventory submission. An average increase of methane leakage from 2013 – 2022 was selected as a driver% and applied as a constant to the entire forecast for 2023 – 2050. The projected trend of emissions from category 5.B is slightly increasing between 2022 and 2050 (Table 2-65). The trend reflects the shift of biodegradable waste from landfills to composting.

Category 5.C Incineration and open burning of waste includes only waste not used for energy production. Estimation of CO_2 emissions from hazardous/industrial waste (H/IW), clinical, sludge and a small amount of municipal solid waste (MSW) incineration, is based on the Tier 1 approach (IPCC, 2006] (CHMI, 2022). Activity data was extrapolated until 2055 and the results were inserted into the spreadsheet to get emission forecast for CO_2, CH_4 and N_2O until 2055. The default emission factors used for projections (0.56 kg CH_4/Gg and 100 kg N_2O/Gg) are from the IPCC 2006 GL (IPCC, 2006). The projected H/IW is within the existing incineration capacity. The projected trend of emissions from category 5.C is decreasing slightly between 2022 and 2055 (Table 2-65).

In category 5.D Wastewater treatment and discharge, the method is based on default Tier 1 and EFs used for projection are also default from the IPCC 2006 GL (IPCC, 2006) (CHMI, 2024). Only in the category 5.D.1, MCF was changed to 0.039 due to the 2021 ESD review recommendation. Country-specific MCF is based on the observation, that the central wastewater treatment waste plants (WWTP) have 13% overflow i.e. they are not optimally managed. Timelines for CH_4 and N_2O emissions were extrapolated until 2055. Mid-population estimates from Eurostat (2024) were applied to the extended time series of the NIR spreadsheets. Modernisation and improvement of WWTP's is an ongoing task in the Czech Republic. The benefits of technological and capacity improvements resulting in better wastewater treatment and less emissions, are reflected in the slightly decreasing MCF for the WWTPs in category 5.D.1. The projected trend of emissions from 5.D is slightly decreasing between 2020 and 2055 (Table 2-61).

Table 2-61: Reported and projected MW management

	Reported								**Projected**			
[Mt]	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Material recycling	1.17	1.18	1.28	1.35	1.41	1.48	1.55	1.61	1.68	1.75	1.81	1.88
Composting	1.03	1.04	1.04	1.01	1.02	1.05	1.09	1.12	1.15	1.19	1.22	1.25
Energy recovery	0.69	0.72	0.71	0.73	0.74	0.75	0.76	0.78	0.79	0.80	0.81	0.82
Landfill	2.96	3.00	3.07	2.92	2.50	1.92	1.47	1.13	0.87	0.67	0.51	0.39
Incineration	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

(CHMI, 2024)

CENIA database development has affected available waste management historical data in Table 2-61 Reported and projected MW management. The scope of values in Table 2-61 for landfill and composting is the same as values applied in the GHG inventory submission (CHMI, 2024). Material recycling is from the Czech Statistical Office (CZSO, 2024). Energy recovery and incineration values are from the CENIA VISOH database (VISOH, 2024). The decrease in landfills is reflected in an increase in the rest of the management options, especially in composting. When new MWP24 becomes available, its reported and projected Waste management values will be official.

Table 2-62: Detailed information about methodology assumptions used in projections for 5. Waste sector (sub-)categories

Projections 2023- 2050			
Category	**Activity data**	**EFs**	**Methodology**
5.A Solid waste disposal on land	to 2021 obtained from NID (CHMI 2024) and VISOH database, exponential extrapolation was aligned with the WMP (MoE 2014) and CEP (EC 2018) assumptions. Updated 2022 year value from CENIA in July 2024 is applied in projections instead of NIR 2021 = 2022 value.	Default	Tier 1
5.B Biological treatment of solid waste	to 2021 obtained from NID (CHMI 2024) and VISOH database, linear extrapolation was aligned with the WMP (MoE14) and CEP (EC 2018) assumptions. Updated 2022 year value from CENIA in July 2024 is applied in projections instead of NIR 2021 = 2022 value.	Default, CS	Tier 1
5.C Incineration and open burning of waste	to 2021 obtained from NID (CHMI 2024) and VISOH database, linear extrapolation was aligned with the WMP (MoE14) and CEP (EC 2018) assumptions. Updated 2022 year value from CENIA in July 2024 is applied in projections instead of NIR 2021 = 2022 value.	Default	Tier 1
5.D Wastewater treatment and discharge	to 2021 obtained from NID (CHMI 2024) and VISOH database, extrapolation to 2050 was aligned with the projected trend of mid-population from Eurostat. Updated 2022 year value from CENIA in July 2024 is applied in projections instead of NIR 2021 = 2022 value.	Default	Tier 1

(CHMI, 2024) (IPCC, 2006)

2.6.2 Projected greenhouse gas emissions ‘With existing measures (WEM) scenario’ and ‘With additional measures (WAM) scenario’

As indicated in Table 2-63, emission estimates up to the latest reported year (2022) are from NID (CHMI, 2024) and VISOH database. The updated year 2022 values have become available after the March 2024 GHG inventory submission, and the updated 2022 values are applied in the projections. The timeline was prolonged up to 2050 by building upon the outlined scenario in WMP (MoE 2014) and by the obligations of the CEP (EC, 2018).

The scenario in WMP (MoE, 2014) fulfils the description of the WEM scenario, the document takes into account all measures already in effect, although further measures will be implemented in the future, based on the roadmap proposed in WMP. For both WEM and WAM scenarios, it is expected that emissions will be decreasing for 2025 - 2050, compared to 2022. The Decrease in emissions is more obvious for the WAM scenario which takes into account stricter LFG recovery coefficients after 2025. The expected total emissions from 5. Waste should decrease by -19.93% according WEM and decrease by -29.47% according to WAM between 1990 and 2050. Overall results for the 5. Waste sector are shown in Table 2-64. The reported and projected emission trend for both scenarios is depicted in Figure 2-20 below.

Table 2-63: Reported and projected emissions of GHG in 5. Waste – WEM and WAM scenarios

[Mt CO_2 eq.]	Reported emissions			Projected emissions							1990 difference [%] to				
	1990	2005	2022	2025	2030	2035	2040	2045	2050	2055	2022	2030	2040	2050	2055
WEM	3.32	4.36	5.51	5.32	4.49	3.64	3.08	2.82	2.66	2.66	66.12	35.32	-7.06	-19.93	-19.93
WAM	3.32	4.36	5.51	5.30	4.40	3.52	2.97	2.60	2.34	2.34	66.12	32.42	-10.53	-29.47	-29.47

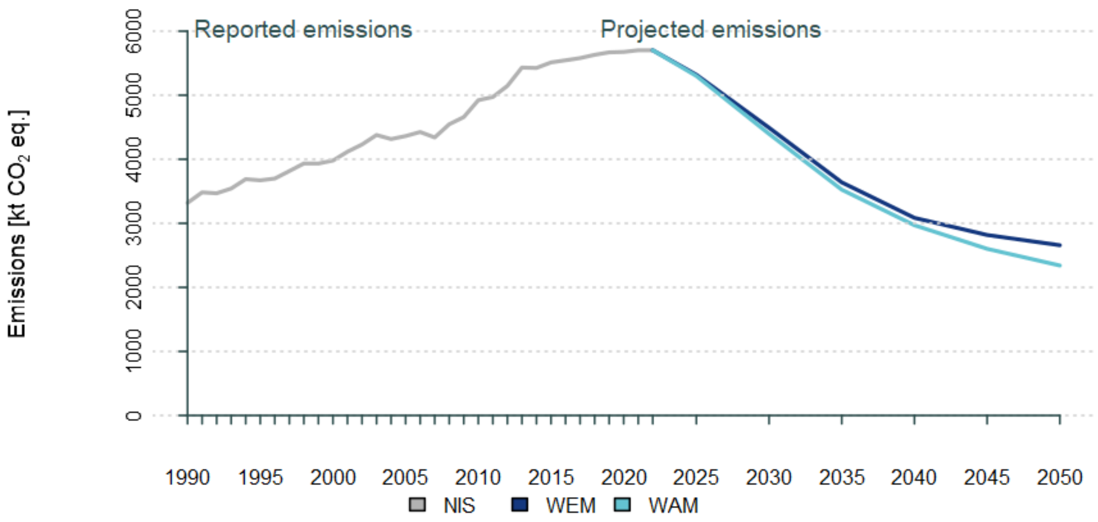


Figure 2-20: Reported and projected emissions of GHG in 5. Waste – WEM and WAM scenarios

2.6.2.1 Projected greenhouse gas emissions 'With existing measures (WEM) scenario'

The development of the WEM scenario follows assumptions: MW production is decreasing slightly, landfilling is gradually declining and composting and energy recovery is taking place instead (MoE, 2014) within the 10% landfill limit by 2035 as per CEP (EC, 2018). The shift from landfilling to composting and anaerobic digestion decreases overall emissions because composting and anaerobic digestion produce lower emissions. As landfilling decreases, a slight increase of emissions can be observed in 5.B Biological treatment of solid waste due to the CS EF 3.1% leakage from anaerobic digestion and the effects of establishing a mandatory system for separate collection of biodegradable waste and its waste management.

The shift from landfilling to 5.C Waste incineration is less visible here, as waste used for energy is reported under 1.A Energy sector, where it does not leave a significant footprint when compared to the size of 1.A Energy sector. Detailed breakdown of the emissions by gases and categories is in Table 2-64 and Table 2-65.

Table 2-64: Breakdown of reported and projected emissions of GHG by gases in 5. Waste - WEM scenario

[Mt CO2 eq.]	Reported emissions			Projected emissions							1990 difference [%] to				
	1990	2005	2022	2025	2030	2035	2040	2045	2050	2055	2022	2030	2040	2050	2055
CO_2	0.02	0.10	0.08	0.09	0.09	0.09	0.09	0.08	0.08	0.08	323.7	346.2	329.6	313.0	313.0
CH_4	3.09	4.04	5.19	4.97	4.14	3.28	2.72	2.44	2.27	2.27	67.82	33.99	-12.04	-26.46	-26.46
N_2O	0.21	0.22	0.24	0.25	0.26	0.27	0.28	0.29	0.30	0.30	16.28	25.30	34.42	44.85	44.85
Total	3.32	4.36	5.51	5.32	4.49	3.64	3.08	2.82	2.66	2.66	66.12	35.32	-7.06	-19.93	-19.93

Table 2-65: Breakdown of reported and projected emissions of GHG by categories in 5. Waste - WEM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						1990 difference [%] to				
	1990	2005	2022	2025	2030	2035	2040	2045	2050	2055	2022	2030	2040	2050	2055
5.A	2.01	3.07	3.77	3.60	2.77	1.91	1.35	1.07	0.91	0.91	87.95	37.89	-32.76	-54.83	-54.83
5.B	NO	0.06	0.57	0.58	0.61	0.64	0.67	0.70	0.73	0.73	NA	NA	NA	NA	NA
5.C	0.02	0.11	0.09	0.10	0.10	0.09	0.09	0.09	0.09	0.09	355.5	373.6	356.0	338.4	338.4
5.D	1.29	1.12	1.08	1.04	1.02	1.00	0.98	0.96	0.94	0.94	-16.23	-21.07	-24.46	-27.52	-27.52
5.E	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA
Total	3.32	4.36	5.51	5.32	4.49	3.64	3.08	2.82	2.66	2.66	66.12	35.32	-7.06	-19.93	-19.93

2.6.2.2 Projected greenhouse gas emissions 'With additional measures (WAM) scenario'

The WAM scenario is almost identical to the WEM scenario because all planned changes in waste management practice are implemented according to the WMP (MoE, 2014) and by the new obligations of the CEP (EC, 2018). The difference between the WEM and WAM scenarios is an increased recovery of landfill gas, which is rising more sharply in the WAM scenario due to amplified pressure from the renewables market. The effects can be observed in CH_4 values (Table 2-65) and the 5.A Solid waste disposal category (Table 2-66). The total amount of emissions is reduced by -29.47% compared to the -19.93% decrease in the WEM scenario from the base year 1990 until 2050. Breakdown by gases and source categories is shown in Table 2-65 and Table 2-66.

Table 2-66: Breakdown of reported and projected emissions of GHG by gases in 5. Waste - WAM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						1990 difference [%] to				
	1990	2005	2022	2025	2030	2035	2040	2045	2050	2055	2022	2030	2040	2050	2055
CO_2	0.02	0.10	0.08	0.09	0.09	0.09	0.09	0.08	0.08	0.08	323.7	346.2	329.6	313.0	313.0
CH_4	3.09	4.04	5.19	4.96	4.05	3.17	2.60	2.23	1.96	1.96	67.82	30.88	-15.77	-36.71	-36.71
N_2O	0.21	0.22	0.24	0.25	0.26	0.27	0.28	0.29	0.30	0.30	16.28	25.30	34.42	44.85	44.85
Total	3.32	4.36	5.51	5.30	4.40	3.52	2.97	2.60	2.34	2.34	66.12	32.42	-10.53	-29.47	-29.47

Table 2-67: Breakdown of reported and projected emissions of GHG by categories in 5. Waste - WAM scenario

[Mt CO_2 eq.]	Reported emissions			Projected emissions						1990 difference [%] to				
	1990	2005	2022	2025	2030	2035	2040	2045	2050	2055	2022	2030	2040	2050	2055
5.A	2.01	3.07	3.77	3.58	2.67	1.80	1.23	0.86	0.59	0.59	87.95	33.10	-38.50	-70.61	-70.61
5.B	NO	0.06	0.57	0.58	0.61	0.64	0.67	0.70	0.73	0.73	NA	NA	NA	NA	NA
5.C	0.02	0.11	0.09	0.10	0.10	0.09	0.09	0.09	0.09	0.09	355.5	373.6	356.0	338.4	338.4
5.D	1.29	1.12	1.08	1.04	1.02	1.00	0.98	0.96	0.94	0.94	-16.23	-21.07	-24.46	-27.52	-27.52
5.E	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA	NA	NA
Total	3.32	4.36	5.51	5.32	4.49	3.64	3.08	2.82	2.66	2.66	66.12	32.42	-10.53	-29.47	-29.47

2.6.3 Sensitivity analysis

A sensitive analysis is done for the key category 5.A Solid waste disposal by switching mid-level baseline population projections to low variant population projections from the Czech Statistical Office (CZSO, 2024), and then comparing the resulting kt CO_2 eq. emissions. The results from the sensitive analysis are in Table 2-68. The mid-level baseline population projections are from EUROSTAT (EUROSTAT, 2024). Table 2-68 shows that waste emissions are sensitive to population changes.

Table 2-68: ***Sensitive analysis on key category 5.A Solid waste disposal for WEM scenario***

Emissions difference	2025	2030	2035	2040	2045	2050	2055
kt CO_2 eq.	-126.77	-81.10	-61.75	-63.48	-69.75	-76.10	-76.10
%	-3.52	-2.93	-3.23	-4.70	-6.49	-8.39	-8.39

2.6.4 Difference between previously and currently reported projections

In category 5.A Solid waste disposal, a linear trend extrapolation from the previous submission was unattainable for 2025 due to the increase of landfill MW in recent years, especially in 2021, due to the bounce back from low COVID year 2020. Extrapolation was changed from a linear trend to exponential to reflect a recent landfill MW development better while keeping the CEP and MWP assumptions, mainly that biodegradable waste will be separated from the landfill waste and the landfilling will end around 2030. No new waste policies and assumptions are implemented in the 2025 submission because the new Waste Management Plan 2025 was unavailable during the preparation of projections.

In category 5.B.2, CS EF 3.1% for biogas facility leakages replaced the default 5% value. The change was applied to the whole time series lowering historical and predicted emissions. Czechia GHG inventory submission for the EU in 15.3.2025 will have the same improvement (3.1% EF) implemented.

The latest Eurostat mid-population estimations trend (EUROSTAT, 2024) is slightly different from the one applied in the previous submission. The latest population trend first increases to 2025, then decreases to 2040 and then increases again towards 2050, causing slight differences in category 5.D N_2O emissions estimates compared to previous ones.

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