



REPUBLIC OF CROATIA

**MINISTRY OF ENVIRONMENTAL
PROTECTION AND GREEN TRANSITION**

Report on projections of greenhouse gas emissions by sources and removals by sinks

Republic of Croatia

REPORT OF PROJECTIONS OF GREENHOUSE GAS EMISSIONS BY SOURCES AND REMOVALS BY SINKS

REPUBLIC OF CROATIA

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1. Introduction

'Report on projections of greenhouse gas emissions by sources and removals by sinks' (hereinafter: the Report) is an integral part of the national system for monitoring the implementation of policies and measures for greenhouse gas emissions reduction and projections of greenhouse gas emissions related to the fulfilment of commitments under the United Nations Framework Convention on Climate Change (hereinafter: the Convention) and the Paris Agreement. The Republic of Croatia is required to report to the European Commission on monitoring the implementation of these policies and measures and emission projections, based on the regulations that apply to the Member States of the European Union. The legal basis for preparation of the Report in the national legislation is in Act on Climate Change and Ozone Layer Protection (OG 127/2019).

Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, 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 – consolidated text (hereinafter: Regulation (EU) 2018/1999) and Commission Implementing Regulation (EU) 2024/1281 of 7 May 2024 amending Implementing Regulation (EU) 2020/1208 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) 2018/1999 of the European Parliament and of the Council (hereinafter: Implementing Regulation (EU) 2024/1281) are applicable regulations of the European Union which prescribe the obligations and the way of reporting for Member States.

Article 18 and Annex VII of the Implementing Regulation (EU) 2024/1281 prescribe the content of the report. The report includes projections of greenhouse gas emissions by sources and their removal by sinks for 2025, composed of the following components:

- projection of greenhouse gas emission, organised by sector and by gas,
- projections of emissions of ETS and sectors outside the EU ETS, in accordance with Regulation (EU) 2023/857 (ESR sector),
- projections of emissions from sources and removals by sinks in accordance with Regulation (EU) 2023/839 (LULUCF),
- policies and measures included in the projections,
- descriptions of methodologies, models, underlying assumptions and key input and output parameters for projections,
- sensitivity analysis of projections on input data.

The report for 2025 includes projections of emissions by sources and their removal by sinks for 2025, 2030, 2035, 2040, 2045 and 2050.

The Report presents the total projections of greenhouse gas emissions by sources and their removal by sinks and separately by the following sectors:

- Energy,
- Transport,
- Industrial processes and product use,
- Waste,
- Agriculture,

- Land use, land use change and forestry (LULUCF).

To prepare the Report on projections of greenhouse gas emissions for 2025 the following data sources were used for the parameters used:

CRF Category	Data type	Data source
General parameters	GDP – yearly growth rate Population Coal price Fuel oil price Natural gas price	Integrated Energy-Climate Plan of the Republic of Croatia for the period from 2021 to 2030 Energy Development Strategy of the Republic of Croatia until 2030 with a view to 2050 (OG 25/2020) Low-Carbon Development Strategy of the Republic of Croatia until 2030 with a view to 2050 (OG 63/2021)
Energy	Fuel consumption Electricity generation Electricity imports Final energy demand	National energy balance Integrated Energy-Climate Plan of the Republic of Croatia for the period from 2021 to 2030 Energy Development Strategy of the Republic of Croatia until 2030 with a view to 2050 (OG 25/2020)
Transport	Number of passenger kilometres Number of tonne-kilometres Energy demand in transport sector	ODYSSEE database Integrated Energy-Climate Plan of the Republic of Croatia for the period from 2021 to 2030 Energy Development Strategy of the Republic of Croatia until 2030 with a view to 2050 (OG 25/2020)
Industrial processes and product use	Production index	Sectorial studies (cement, use of N ₂ O in the food industry and for medical purposes) National Bureau of Statistics Integrated Energy-Climate Plan of the Republic of Croatia for the period from 2021 to 2030 Low-Carbon Development Strategy of the Republic of Croatia until 2030 with a view to 2050 (OG 63/2021)
	Use of solvents	Inventory Report of air pollutants on the Croatian territory under the Convention on Long-range Transboundary Air Pollution (CLRTAP) Low-Carbon Development Strategy of the Republic of Croatia until 2030 with a view to 2050 (OG 63/2021)
Agriculture	Number and type of livestock	National Bureau of Statistics Croatian Agricultural Agency Faculty of Agriculture FAOSTAT database
	Plant production	National Bureau of Statistics Statistical reports on plant production

CRF Category	Data type	Data source
		FAOSTAT database
LULUCF	Land area of each sub-category	NID 2024
	The assumed emission factors by sinks	CRT 2024 – submission of 17th December 2024, UNFCCC
Waste	The amount of generated solid waste (municipal, industrial, sludge from wastewater treatment) The amount of landfilled solid waste (municipal, industrial, sludge from wastewater treatment) The organic fraction of solid waste Share of methane recovered/flared The amount of composted organic waste	Waste Management Act (OG 84/2021) Waste Management Plan of the Republic of Croatia for the period 2023 – 2028 (OG 84/2023) Low-Carbon Development Strategy of the Republic of Croatia until 2030 with a view to 2050 (OG 63/2021) Ministry of Environmental Protection and Green Transition: - Waste Management Information System - Environmental Pollution Register

2. Projection of greenhouse gas emissions

This chapter presents greenhouse gas emissions for the initial year of projections (2022) and greenhouse gas emissions projections for the period from 2025 to 2050. The emissions are presented as total emissions of all greenhouse gases converted to carbon dioxide emission equivalent and as emissions of each greenhouse gas.

Since greenhouse gases have different irradiation properties and consequently different contribution to the greenhouse effect, emissions of each gas are multiplied by their Global Warming Potential (GWP). In this case, the emission of greenhouse gases is presented as an equivalent emission of carbon dioxide (CO₂eq). In the case of removing emissions of greenhouse gases, it refers to outflows (sinks) of greenhouse gas emissions and the amount is shown as a negative value. The global warming potentials of individual gases used in the Report are the values determined in the 5th Assessment Report of the Intergovernmental Panel on Climate Change and are listed in the Annex to Commission Delegated Regulation (EU) 2020/1044 of May 8, 2020 supplementing Regulation (EU) 2018/1999 of the European Parliament and of the Council with regard to values for global warming potentials and the inventory guidelines and with regard to the Union inventory system and repealing Commission Delegated Regulation (EU) No 666/2014. The global warming potentials used in the Report are listed below.

Gas	GWP
Carbon dioxide (CO ₂)	1
Methane (CH ₄)	28
Nitrous oxide (N ₂ O)	265
HFC-23	12400
HFC-32	677
HFC-125	3170
HFC-134a	1300
HFC-143a	4800
HFC-227ea	3350
HFC-236fa	8060
HFC-365mfc	804
SF ₆	23500

Projections of greenhouse gas emissions are shown separately for the following sectors:

- Energy,
- Transport,
- Industrial processes and product use,
- Agriculture,
- Waste,
- LULUCF.

The calculation includes projections of emissions resulting from human activities that include the following direct greenhouse gases:

- carbon dioxide (CO₂),
- methane (CH₄),
- nitrous oxide (N₂O),
- hydrofluorocarbons (HFCs),
- sulphur hexafluoride (SF₆).

Projections are presented for two scenarios: 'with existing measures' scenario and 'with additional measures' scenario. Scenario 'with existing measures' includes the application of current policies and measures whose implementation is already in process, i.e. the application of policies and measures that have been adopted. Scenario 'with additional measures' is based on the application of planned policies and measures.

Emission projections are based on the Inventory of Greenhouse Gas Emissions (NID 2024), which includes the inventory of emissions and removals of greenhouse gases for the period 1990 – 2022 (submission of 17th December 2024, UNFCCC).

Projections presented below are in accordance with the Integrated National Energy and Climate Plan for the Republic of Croatia for the period 2021-2030.

2.1. Projections of greenhouse gas emissions by sectors

Projected trends in greenhouse gas emissions by sectors are presented in Figures 2-1 to 2-2. Emissions are presented for 'with existing measures' scenario and 'with additional measures' scenario for the period from 2025 to 2050.

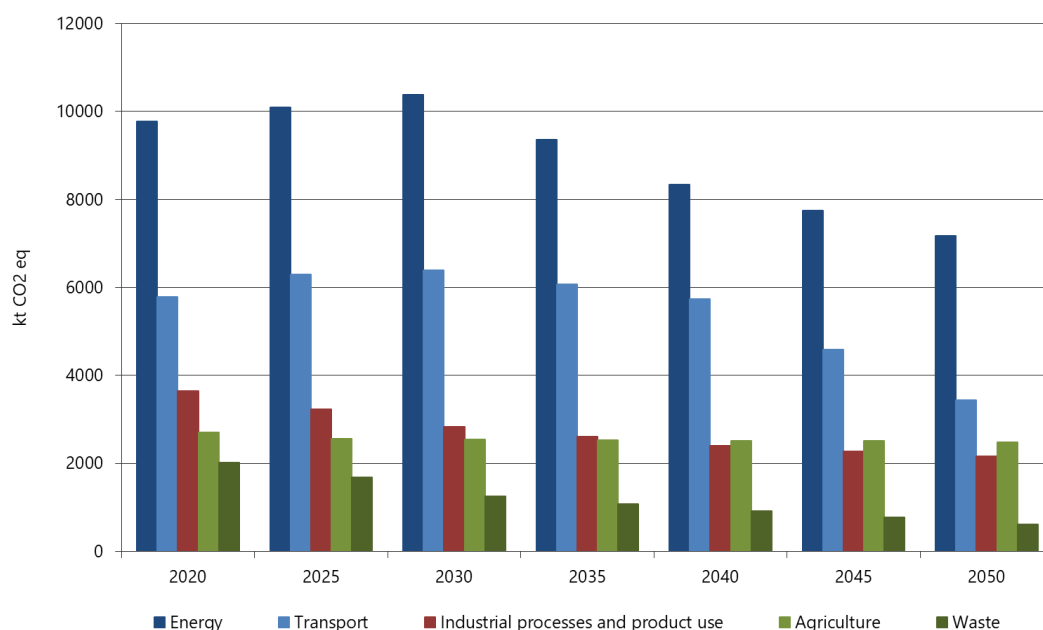


Figure 2-1: Projections of greenhouse gas emissions by sectors, 'with existing measures' scenario

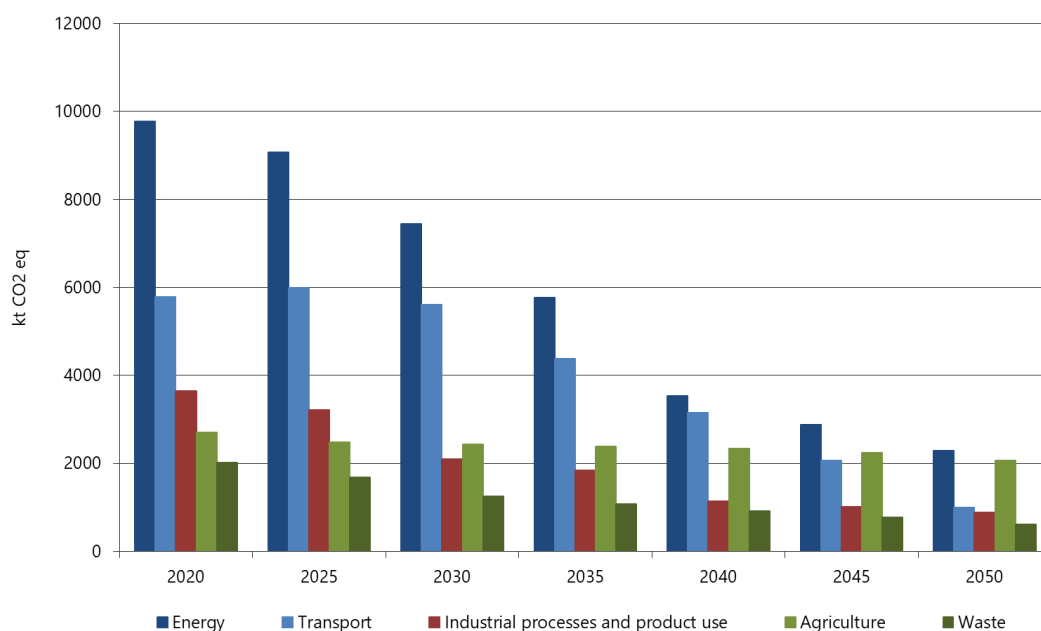


Figure 2-2: Projections of greenhouse gas emissions by sectors, 'with additional measures' scenario

The **Energy sector** covers all activities that involve fuel combustion from stationary sources and fugitive emission from fuels. The emission from the Energy sector in 2022 amounted to 10,140.77 kt CO₂eq and it is the main source of anthropogenic emission of greenhouse gases, it accounts for approximately 41.3% of the total greenhouse gases emission in 2022 (without LULUCF).

The scenario 'with existing measures' represents the group effect of measures that are in use and for which there are implementation instruments, as well as measures resulting from the adoption of the EU acquis. The scenario 'with additional measures' is based on the implementation of existing, but also additional measures.

In the 'with existing measures' scenario, projections show a decrease in emissions in the period from 2035 onwards because in that period it is expected that the growth of demand will be compensated primarily by the implementation of measures for the use of renewable energy sources, energy efficiency measures and due to the impact of the EU ETS. In scenario 'with additional measures', all measures planned in the Energy sector were taken into account and projections show a steady trend of emission reduction.

Changes compared to the previous submission

In the Energy sector, in the previous submission, CCS technology was included in the cement industry in 2040, and in this submission, based on direct communication with operators and their short-term and long-term plans, CCS was included in 2030.

The **Transport sector** includes emissions from fuel combustion in road transportation, civil aviation, railways and navigation. The emission from the Transport sector in 2022 amounted to 6,730.95 kt CO₂eq, which makes about 27.4% of total Croatia's greenhouse gases emission (without LULUCF).

The scenario 'with existing measures' includes measures to reduce greenhouse gas emissions resulting from existing regulations and the adoption of the EU acquis. The scenario 'with additional measures' is based on the implementation of existing, but also additional measures.

In the 'with existing measures' scenario in the period up to 2030, projections show an increase in emissions. Factors that encourage the growth of emissions are expected increase in economic activities and living standard and consequently increase in the number of fossil fuel vehicles. In the period from 2035 onwards, emission reductions are expected, which are primarily affected by measures to increase energy efficiency and the use of electricity and renewable sources in transport. In scenario 'with additional measures', projections show a continuous trend of reducing emissions by 2050, primarily due to expected measures to increase rail transport and the development of electric vehicles, which will be the key condition for the strong reduction of emissions in the transport sector in long term.

Changes compared to the previous submission

In the Transport sector, there was a change in emission projections compared to the previous submission. Namely, in the 'with existing measures' scenario, fossil fuel consumption is higher, especially in road transport. For other modes of transport, fossil fuel consumption is lower. In addition, a lower level of biofuels is intended for use.

The 'with additional measures' scenario includes higher amounts of biofuels and lower fossil fuel consumption for road transport compared to the previous submission.

The **Industrial processes and product use sector** includes the process emissions from industrial processes and product use, while fuel combustion emissions from this sector are included in the Energy sector. The emission from the Industrial processes and product use sector in 2022 amounted to 3,277.06 kt CO₂eq, which is 13.3% of total Croatia's greenhouse gases emission in 2022 (without LULUCF).

The 'with existing measures' scenario includes the application of measures defined by strategic and planning sector documents included in producers' business policies, which are conditioned by market requirements, legislation and requirements for the implementation of the best available techniques in production processes. Measures to reduce ozone-depleting substances and fluorinated greenhouse gases are regulated by the legislation. The 'with additional measures' scenario includes the application of cost-effective measures to reduce greenhouse gas emissions in cement production and to reduce emissions of ozone-depleting substances and fluorinated greenhouse gases.

The projections of emissions indicate stagnation and a slight reduction in emissions in the 'with existing measures' scenario due to measures for controlled substances and fluorinated greenhouse gases reduction. The projections of emissions indicate a decrease in 'with additional measures' scenario due to the implementation of cost-effective measures to reduce emissions (reducing the share of clinker in cement production and CCS).

Changes compared to the previous submission

In the previous submission, CCS technology was included in the cement industry in 2040, and in this submission, based on direct communication with operators and their short-term and long-term plans, CCS was included in 2030.

The **Agriculture sector** covers 10.1% of total greenhouse gas emissions (without LULUCF) in 2022 (emission is 2,467.91 kt CO₂eq). Projections indicate emission reductions in both the 'with existing measures' scenario due to implemented measures, while the reduction in the 'with additional measures' scenario is stronger due to the strengthening of additional measures, especially in emission sources of livestock and mineral fertilizers.

Changes compared to the previous submission

In the Agriculture sector, there was a change in the CH₄ and N₂O emission projections compared to the previous submission due to recalculations of the historical series. A new country-specific approach was developed for the emission estimate from cattle, with the assistance of experts from the Faculty of Agriculture, University of Zagreb. Country specific values were developed for key years and then interpolated for the time periods between key years. A country-specific Tier 2/3 approach was used for dairy cows, according to a dynamic simulation model that describes the mechanism of the fermentation process in the gastro-intestinal tract.

The **Waste sector** participates in total of Croatia's greenhouse gases emission (without LULUCF) with 7.9% in 2022 (emission is 1,935.29 kt CO₂eq).

Projections of emissions of greenhouse gases from the Waste sector are based on the implementation of measures prescribed by sectoral legislation, harmonized with EU legislation. The 'with existing measures' scenario includes the existing legal framework of the Republic of Croatia and the adopted EU legal framework from the waste sector for the period until 2050. The projections of emissions indicate a decrease in 'with existing measures' scenario due to the implementation of cost-effective measures to reduce emissions. The 'with additional measures' scenario is the same as the 'with existing measures' scenario since no additional measures to reduce emissions of greenhouse gases have been identified. The potentials of CO₂ emission reduction, which can be achieved by implementing the measures included in the 'with existing measures' scenario and the 'with additional measures' scenario are estimated in the Energy sector.

Changes compared to the previous submission

In the Waste sector, subsector 5.A., there was a change in the greenhouse gas projections compared to the previous submission. Namely, an error was observed in the model that occurred during the creation of projections for the previous submission. The error has now been corrected which has resulted in changes in these projections.

In preparing the projections, a model in tabular calculation interface was used. The model is structured in accordance with the table structure of the inventory of United Nations Framework Convention on Climate Change.

In the year 2022, removals by the sink in the **LULUCF sector** were -4,867.16 kt CO₂eq. Projections of removals in 2050 amount to -4,586.21 kt CO₂eq. These projections are made by sectorial sub-categories 'Forest land', 'Cropland', 'Grasslands', 'Wetlands', 'Settlements', 'Other land' and 'Harvested wood products' for the scenario 'with existing measures' (Figure 2-3).

The 'with additional measures' scenario is the same as the 'with existing measures' scenario. Namely, all activities related to forests and the forestry sector are carried out according to the current forest management plans and the main direction is determined by the main forest management plan - Forest Management Plan of the Republic of Croatia (FMPRC). This is a strategic document and it is exclusively possible to derive, assess, and plan activities to achieve the national LULUCF goal and the planned measures from the valid FMPRC. The 'with existing measures' scenario reflects the existing FMPRC, which means existing economic practices, existing logging plans, and forest management constraints regarding regulations as they were in 2022. It also takes into account the impacts of natural disasters that have occurred in the past ten years.

For defining the 'with additional measures' scenario and achieving the goal by 2030, the next FMPRC, which is in preparation for the period 2026 - 2035, is relevant. It will include projections for the next 40 years, up to 2065, which is crucial for projecting future emissions and CO₂ removal by sinks. All other forestry management works that are also essential for mitigating climate change are planned for a period of 10 years, up to 2035.

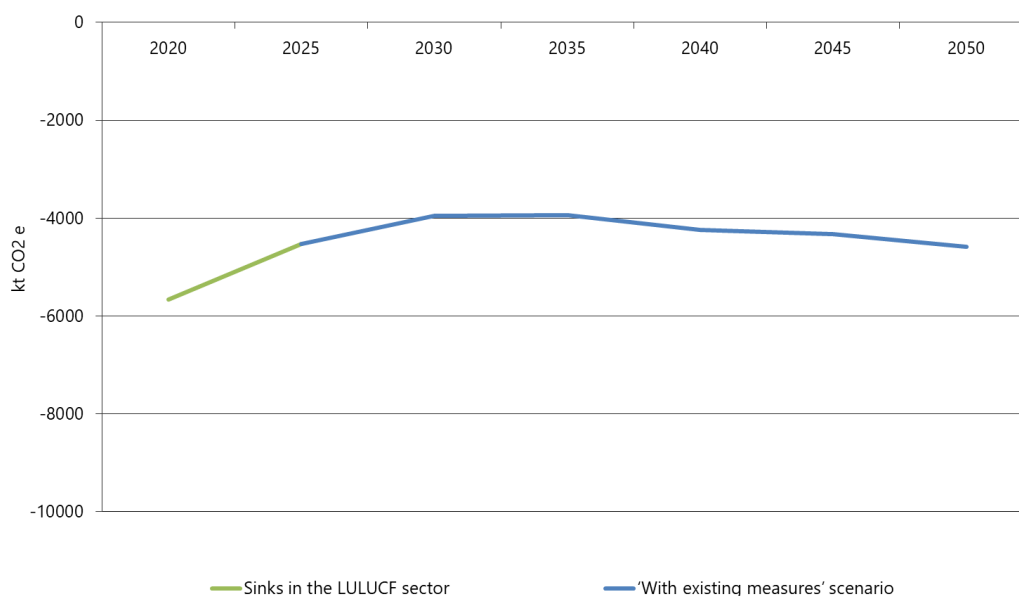


Figure 2-3: Greenhouse gas removals in the LULUCF sector, 'with existing measures' scenario

2.2. Projections of greenhouse gas emissions by gases

Trends in emissions, by greenhouse gases (CO₂, CH₄, N₂O, HFCs and SF₆), for 'with existing measures' and 'with additional measures' scenarios, in the period from 2020 until 2050 are shown in Table 2-1 and Figure 2-4.

Table 2-1: Projections of greenhouse gas emissions by gases, kt CO₂eq

CO ₂	2020	2022	2025	2030	2035	2040	2045	2050
'With existing measures' scenario	16,881.60	17,608.21	17,352.55	17,810.08	16,503.06	15,196.87	13,552.01	11,907.04
'With additional measures' scenario	16,881.60	17,608.21	16,115.36	13,584.59	10,738.81	6,905.33	5,271.89	3,705.21
CH ₄	2020	2022	2025	2030	2035	2040	2045	2050
'With existing measures' scenario	3,998.33	3,796.93	3,601.05	3,198.22	3,010.01	2,828.68	2,632.91	2,422.34
'With additional measures' scenario	3,998.33	3,796.93	3,459.86	2,915.79	2,638.92	2,366.10	2,069.28	1,672.24
N ₂ O	2020	2022	2025	2030	2035	2040	2045	2050
'With existing measures' scenario	1,452.98	1,324.79	1,379.12	1,369.57	1,335.21	1,301.00	1,263.93	1,230.71
'With additional measures' scenario	1,452.98	1,324.79	1,367.32	1,337.80	1,291.79	1,249.20	1,214.09	1,181.30
HFC	2020	2022	2025	2030	2035	2040	2045	2050
'With existing measures' scenario	1,572.23	1,812.05	1,512.69	1,013.76	790.46	567.15	442.22	317.30
'With additional measures' scenario	1,572.23	1,812.05	1,503.21	988.46	763.83	539.20	416.66	294.13
SF ₆	2020	2022	2025	2030	2035	2040	2045	2050
'With existing measures' scenario	9.35	10.00	8.10	4.95	3.70	2.45	1.83	1.21
'With additional measures' scenario	9.35	10.00	8.06	4.83	3.58	2.33	1.73	1.12
TOTAL	2020	2022	2025	2030	2035	2040	2045	2050
'With existing measures' scenario	23,914.49	24,551.98	23,853.51	23,396.57	21,642.43	19,896.14	17,892.90	15,878.59
'With additional measures' scenario	23,914.49	24,551.98	22,453.80	18,831.47	15,436.92	11,062.16	8,973.65	6,854.00

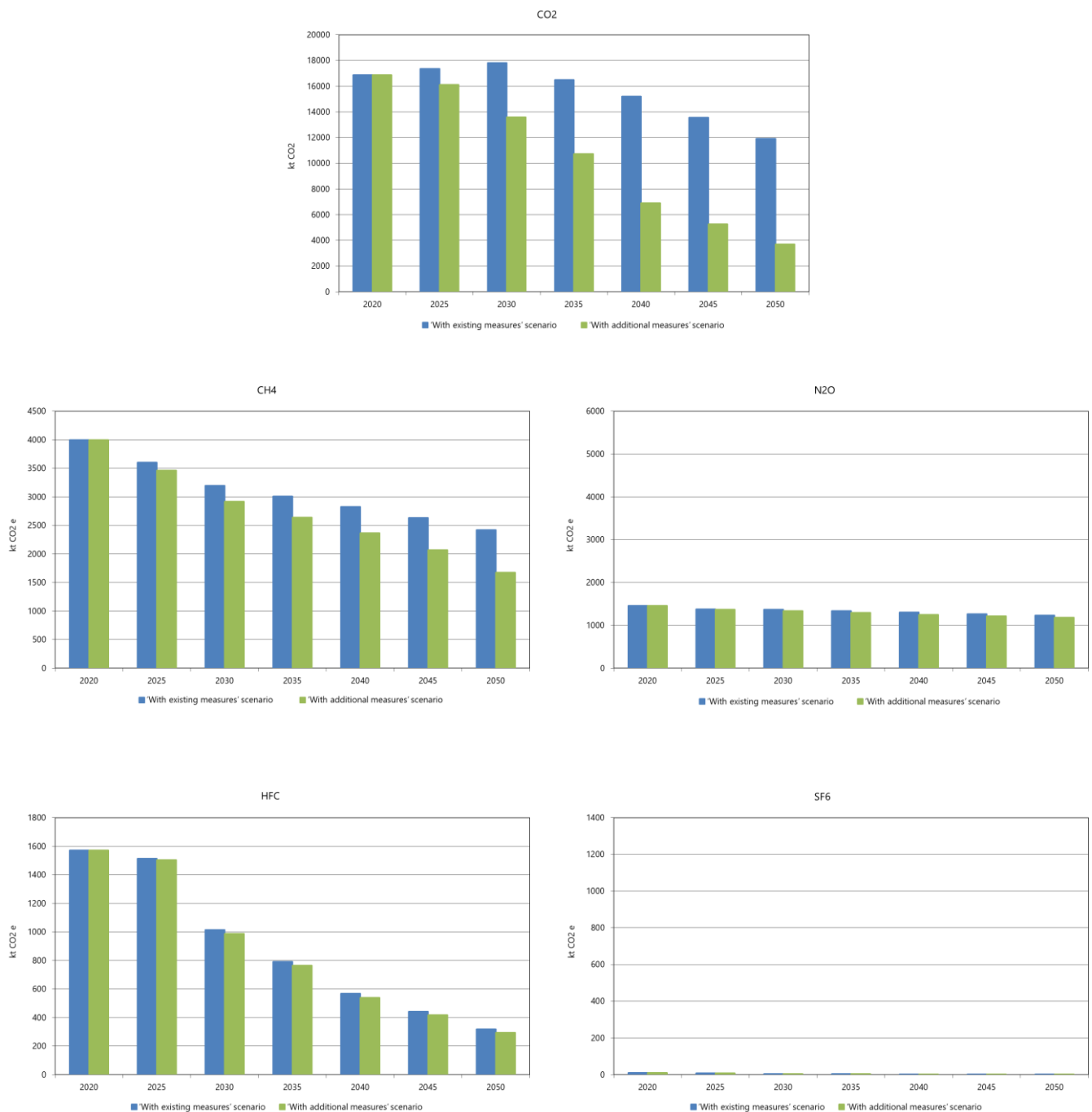


Figure 2-4: Projections of greenhouse gas emissions by gases

The Energy sector has the largest contribution to **CO₂ emissions**. Projections show emissions of 11,907.44 kt CO₂ (for the 'with existing measures' scenario) and 3,705.21 kt CO₂ (for the 'with additional measures' scenario) in 2050. Projections show a reduction in emissions by 22.1% in 2030 compared to 1990, by 33.6% in 2040 compared to 1990 and by 47.9% in 2050 compared to 1990 in the 'with existing measures' scenario. In the scenario 'with additional measures', projections show a reduction in emissions by 40.6 % in 2030, by 69.8% in 2040 and by 83.8% in 2050, compared to 1990.

The main sources of **CH₄ emissions** are the Agriculture and Waste sectors. Projections show a reduction of CH₄ emissions by 36.1% in 2030 compared to 1990, by 43.5% in 2040 compared to 1990 and by 51.6%

in 2050 compared to 1990 in the 'with existing measures' scenario. In the scenario 'with additional measures', projections show a reduction in emissions by 41.8% in 2030, by 52.8% in 2040 and by 66.6% in 2050, compared to 1990.

The most important source of **N₂O emissions** is the Agriculture sector. Projections show emissions of 1,230.71 kt CO₂eq for the 'with existing measures' scenario and 1,181.30 kt CO₂eq for the 'with additional measures' scenario in 2050.

Sources of **HFCs and SF₆ emissions** are in the Industrial processes and product use sector. Although their emissions in absolute terms are not large, due to the large global warming potential (GWP), their contribution is significant. Projections in 2050 have a maximum value of 317.30 kt CO₂eq for the 'with existing measures' scenario and 294.13 kt CO₂eq for the 'with additional measures' scenario.

2.3. Total projections

Historical emissions and projections of greenhouse gas emissions (without LULUCF) are shown in Table 2-2 and Figure 2-5. Emissions are shown for the 'with existing measures' and 'with additional measures' scenarios, for the period 2020 to 2050.

Table 2-2: Historical emissions and projections of greenhouse gas emissions by sectors, kt CO₂eq

'With existing measures' scenario	2020	2022	2025	2030	2035	2040	2045	2050
Energy	9,769.80	10,140.77	10,088.20	10,375.42	9,354.44	8,333.46	7,753.11	7,172.75
Transport	5,791.86	6,730.95	6,291.49	6,394.66	6,066.22	5,738.58	4,588.19	3,440.83
Industrial processes and product use	3,642.38	3,277.06	3,226.03	2,830.46	2,613.51	2,397.39	2,277.65	2,157.81
Waste	2,009.74	1,935.29	1,681.75	1,252.70	1,081.64	914.22	767.41	620.46
Agriculture	2,700.72	2,467.91	2,566.04	2,543.34	2,526.62	2,512.50	2,506.54	2,486.74
TOTAL	23,914.49	24,551.98	23,853.51	23,396.57	21,642.43	19,896.14	17,892.90	15,878.59

'With additional measures' scenario	2020	2022	2025	2030	2035	2040	2045	2050
Energy	9,769.80	10,140.77	9,070.25	7,445.35	5,762.02	3,528.00	2,873.21	2,285.27
Transport	5,791.86	6,730.95	5,997.95	5,610.36	4,377.33	3,147.36	2,071.62	998.58
Industrial processes and product use	3,642.38	3,277.06	3,216.50	2,092.60	1,835.16	1,140.72	1,012.77	884.73
Waste	2,009.74	1,935.29	1,681.75	1,252.70	1,081.64	914.22	767.41	620.46
Agriculture	2,700.72	2,467.91	2,487.36	2,430.46	2,380.77	2,331.86	2,248.65	2,064.96
TOTAL	23,914.49	24,551.98	22,453.80	18,831.47	15,436.92	11,062.16	8,973.65	6,854.00

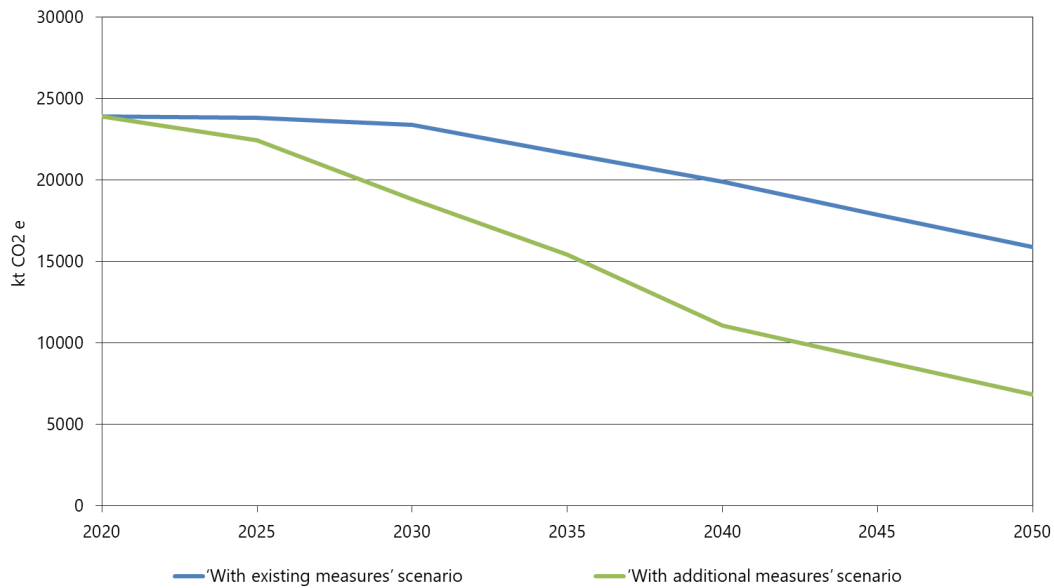


Figure 2-5: Historical emission and projections of greenhouse gas emissions (without LULUCF) for the period until 2050

Projections show that compared to 1990, emissions in the 'with existing measures' scenario in 2030 will decrease by 25.8%, while in the 'with additional measures' scenario, emissions will decrease by 40.3%. Compared to 1990, emissions in the 'with existing measures' scenario in 2050 will decrease by 49.7%, while in the 'with additional measures' scenario, emissions will decrease by 78.3%.

Projections show that in the 'with existing measures' scenario, emissions in 2030 will reduce by 4.7% compared to 2022, while in the 'with additional measures' scenario, emissions will reduce by 23.3%. In the 'with existing measures' scenario emissions in 2050 will reduce by 35.5% compared to 2022, while in the 'with additional measures' scenario, emissions will reduce by 72.1%.

In the scenario 'with existing measures', projections show stagnation until 2030. After 2030, emissions show a decline in this scenario. In the scenario 'with additional measures', the projections show a constant trend of reducing emissions.

In the scenario 'with additional measures' compared to the scenario 'with existing measures' in 2030, greenhouse gas emissions will reduce by 19.5% and in 2050, greenhouse gas emissions will reduce by 56.8%.

Historical emissions and projections of greenhouse gas emissions (including LULUCF) are shown in Figure 2-6. Emissions are shown for the scenario 'with existing measures' and 'with additional measures', for the period from 2020 to 2050.

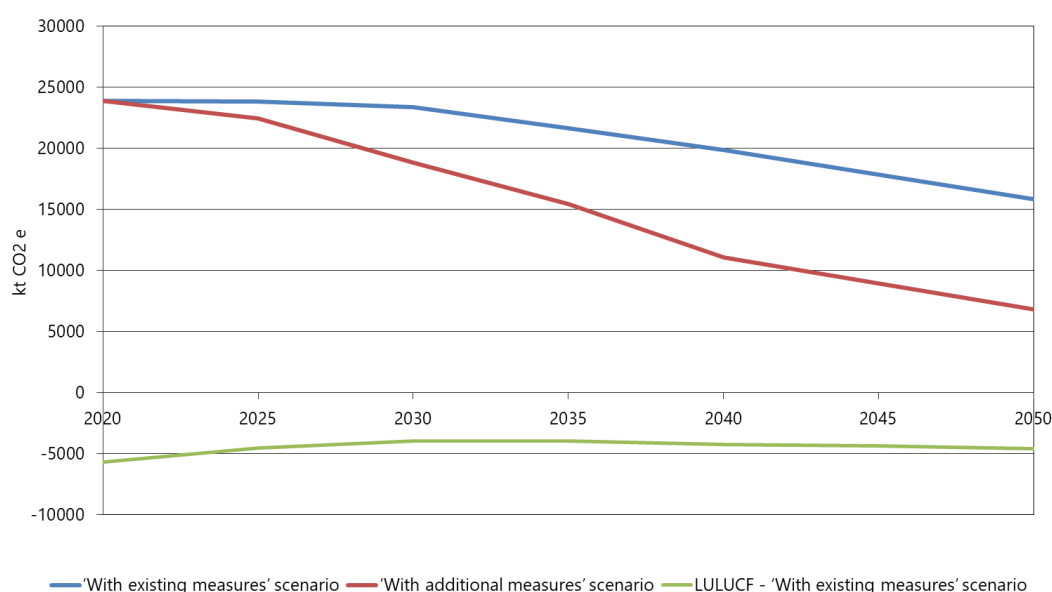


Figure 2-6: Historical emission and projections of greenhouse gas emissions for the period until 2050

2.4. Emission of sectors covered by the EU ETS and non-ETS sectors in accordance with Regulation (EU) 2023/857

Projections of greenhouse gas emissions of sectors covered by the EU ETS and non-ETS sectors under Regulation (EU) 2023/857 (ESR sectors) are shown in Table 2-3 for both scenarios.

Table 2-3: Projections of greenhouse gas emissions in ETS and ESR sectors, kt CO₂eq

	2025	2030	2035	2040	2045	2050
'With existing measures' scenario	23,853.51	23,396.57	21,642.43	19,896.14	17,892.90	15,878.59
ETS	6,465.91	6,803.06	6,124.23	5,445.36	5,168.56	4,891.69
ESR	17,363.11	16,571.14	15,495.79	14,428.33	12,701.84	10,964.37
'With additional measures' scenario	22,453.80	18,831.47	15,436.92	11,062.16	8,973.65	6,854.00
ETS	5,946.61	4,598.13	3,676.95	2,042.15	1,837.43	1,666.08
ESR	16,483.17	14,212.21	11,741.70	9,004.61	7,124.50	5,179.89

Emissions within the ETS in 2022 encompassed 26.3% of total emissions, amounting to 6,455.40 kt CO₂eq. Projections indicate that in 2030 the ETS will cover 29.1% of total emissions in 'with existing measures' scenario and 24.4% in 'with additional measures' scenario. According to the 'with existing measures' scenario, 27.4% of emissions will be included in ETS in 2040 and under the 'with additional measures' scenario 18.5% of total emissions. In 2050, the ETS will cover 30.8% of total emissions under the 'with existing measures' scenario, and 24.3% of total emissions under the 'with additional measures' scenario.

In the 'with existing measures' scenario, emission projections within the ETS show a decrease in the period up to 2050, by 24.2% in 2050 compared to 2022. In the 'with additional measures' scenario, emission projections within the ETS show a stronger declining trend. Compared to 2022, projections show a 74.2% reduction in emissions in 2050.

Emissions within the ESR sector in 2022 amounted to 18,070.82 kt CO₂eq, which represents 73.6% of total emissions.

In the 'with existing measures' scenario, emissions within the ESR sector are expected to decrease in the period from 2022 to 2050 (by 39.3% in 2050 compared to 2022).

In the 'with additional measures' scenario, an additional reduction in emissions within the ESR sector is expected, which would reduce the emissions by 71.3% in 2050 compared to 2022.

Emissions projections within the ETS and ESR sectors, for both scenarios, are shown in Figures 2-6 and 2-7.

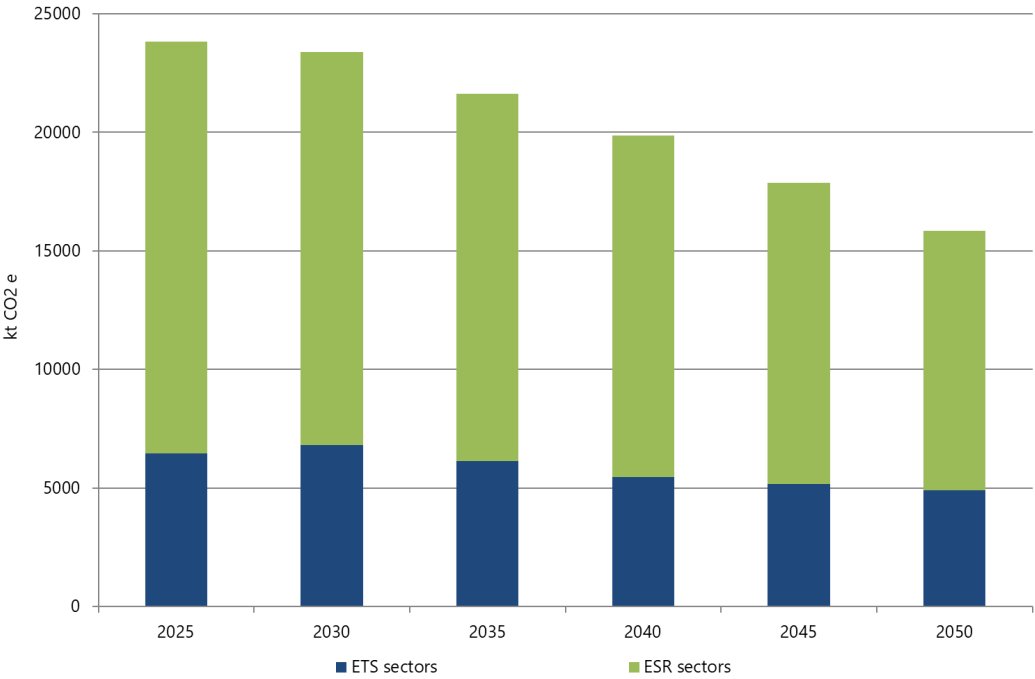


Figure 2-7: Projections of emissions within ETS and ESR sectors, 'with existing measures' scenario

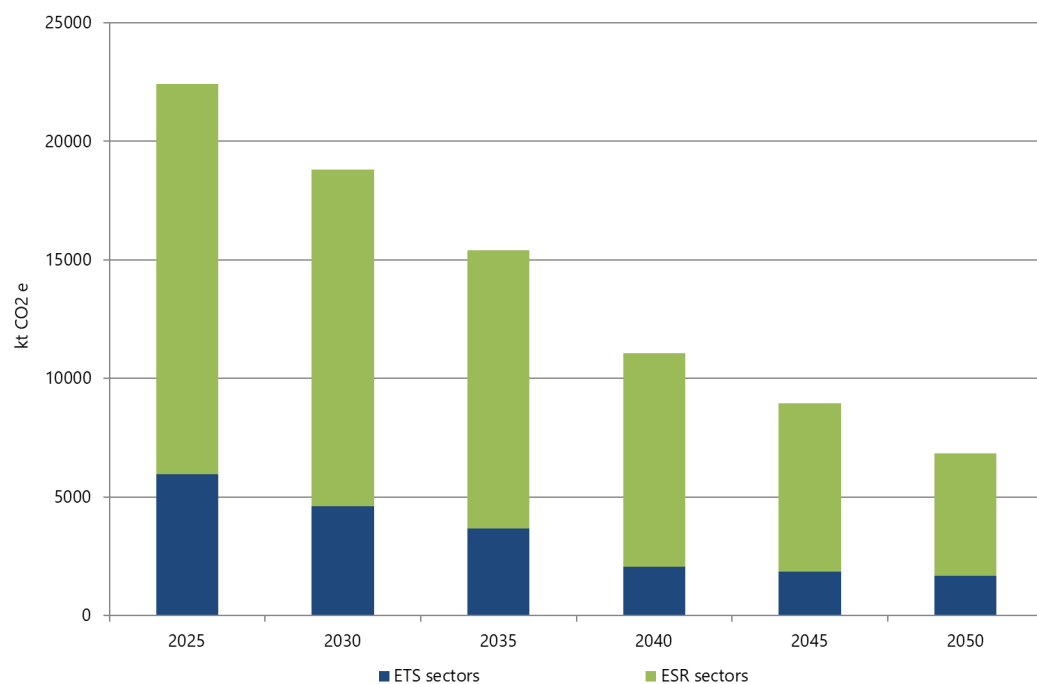


Figure 2-8: Projections of emissions within ETS and ESR sectors, 'with additional measures' scenario

3. Policies and measures included in the projections

Policies and measures to reduce emissions from sources and increase removals of greenhouse gases that are included in the projections are shown separately by sectors. Within each sector, there are measures listed for the 'with existing measures' and 'with additional measures' scenarios without presenting the potential to reduce greenhouse gas emissions. The potential for these policies and measures, as quantified effects of their implementation, are presented in the 'Report on implementation of policies and measures that reduce greenhouse gas emissions by sources or enhance removals by sinks' that was prepared as a separate document.

Projections cover the period until 2050, with five-year steps.

The GHG projections presented in this report are based on the assumptions, objectives, measures and guidelines provided by the Integrated Energy-Climate Plan of the Republic of Croatia for the period from 2021 to 2030 and the Low-Carbon Development Strategy of the Republic of Croatia until 2030 with a view to 2050 (OG 63/2021).

3.1. Energy

The Energy sector covers all activities that include the consumption of fossil fuels from stationary sources and fugitive emissions from fuels. The emission of the energy sector in 2022 amounted to 10,140.77 kt CO₂eq and is the main source of anthropogenic greenhouse gas emissions with a contribution of 41.3% in the total greenhouse gas emissions in 2022.

The 'with existing measures' scenario represents a group effect of measures that are under implementation or adopted with the enforcement of existing instruments and measures arising from the transfer of the EU acquis. The detail list and description of the measures included are listed in the separated Report on implementation of policies and measures that reduce greenhouse gas emissions by sources or enhance removals by sinks.

The 'with additional measures' scenario is based on the application of existing but also additional measures, as stated in the Report on implementation of policies and measures that reduce greenhouse gas emissions by sources or enhance removals by sinks.

3.2. Transport

The Transport sector includes emissions from fuel consumption in road, air, rail and maritime and river transport, and in 2022 the emissions amounted to 6,730.95 kt CO₂eq, which is 27.4% of the total greenhouse gas emissions of Croatia.

The 'with existing measures' scenario represents a group effect of measures that are under implementation and adopted with the enforcement of existing instruments and measures arising from the transfer of the EU acquis. The detail list and description of measures included are listed in the separated Report on implementation of policies and measures that reduce greenhouse gas emissions by sources or enhance removals by sinks.

The 'with additional measures' scenario is based on the application of existing but also additional measures, as stated in the Report on implementation of policies and measures that reduce greenhouse gas emissions by sources or enhance removals by sinks.

3.3. Industrial processes and product use

The share of greenhouse gas emissions from the Industrial processes and product use sector is 13.3% of the total emissions of the Republic of Croatia in 2022 (excluding LULUCF). Emissions from fuel combustion in industrial plants are balanced in the energy sector, while emissions from physical and chemical processes of conversion of raw materials into industrial products, emissions from the use of greenhouse gases in products and emissions from the use of carbon from fossil fuels for non-energy purposes are balanced in the Industrial processes and product use sector.

The 'with existing measures' scenario includes the application of measures defined by strategic and planning sectoral documents included in the manufacturer's business policy, which is conditioned by market requirements, laws and regulations and requirements for the application of best available techniques in production processes. Measures to reduce controlled substances and fluorinated greenhouse gases are provided by law.

The 'with additional measures' scenario includes the application of cost-effective measures to reduce greenhouse gas emissions in cement production and to reduce emissions of controlled substances and fluorinated greenhouse gases.

The 'with additional measures' scenario is based on the implementation of the planned measures set out in the Report on implementation of policies and measures that reduce greenhouse gas emissions by sources or enhance removals by sinks.

Process measures for reducing greenhouse gases emissions from Industrial processes and product use sector include:

- reducing the share of clinker in cement production
- application of CCS technology for cement production
- limiting fluorinated greenhouse gas emissions.

3.4. Agriculture

The Agriculture sector in 2022 participates in the total greenhouse gas emissions with 10.1%. The most important sectoral emissions are emissions of CH₄ with approximately 57% of total emissions and N₂O with approximately 40% of total emissions. Emissions are caused by different agricultural activities. The CH₄ emission source is animal farming (enteric fermentation), which accounts for about 72% of the sectoral CH₄ emissions.

In the period until 2050, it is expected that there will be a maintenance of the current level or a slight reduction of the livestock fund (with the exception of a slight increase in non-dairy cattle and pigs), and a maintenance or a slight increase in plant production.

In the formation of the scenarios 'with existing measures' and 'with additional measures', the emission projection model used was set using the following assumptions:

- Projections of the trend of input data on activity for livestock and crop production were taken from the global FAO report¹ "The future of food and agriculture - alternative routes until 2050", using the BAU (business as usual) scenario of the report. Because there were some differences in activity data in the base year, the BAU scenario data of the FAO report were adjusted, but an

¹ FAO. 2018. The future of food and agriculture – Alternative pathways to 2050. Rome. 224 pp. Licence: CC BY-NC-SA 3.0 IGO.

identical trend was maintained. For non-significant crops, the historical data from 2022 was retained.

- Use of mineral fertilizers obtained by extrapolation of the existing trend for the period from 2000 to 2022.

The 'with additional measures' scenario is based on the application of existing but also additional measures, as stated in the Report on implementation of policies and measures that reduce greenhouse gas emissions by sources or enhance removals by sinks. Scenarios imply the application of the following measures:

- Improving storage capacity and practices when handling manure
- Anaerobic manure decomposition and biogas production
- Improving and changing the soil tillage system (reduced tillage)
- Extension of crop rotation with higher share of legumes
- Intensification of crop rotation by using intercrops
- Improvement of organic fertilizer application methods
- Agroforestry
- Hydro-melioration interventions and system of protection against natural disasters
- Introduction of new cultivars, varieties and crops.

3.5. Waste

The Waste sector contributes to total greenhouse gas emission with 7.9% in 2022, of which 98.2% comes from the key emission sources: solid waste disposal and wastewater treatment and discharge. Of these, 71.9% of emissions related to the disposal of solid waste.

The projections were made based on expected development and future state of parameters for the projections – the amount of generated and landfilled solid waste (municipal solid waste, industrial waste and sludge from wastewater treatment), the organic fraction of solid waste, the fraction of recovered/flared methane and the amount of composted organic waste. Emission projections start from the situation and projections of macroeconomic parameters in 2022 – the projected dynamics of the annual growth rate of gross domestic product and the decline of the population.

The scenarios include the existing legal framework of the Republic of Croatia and the adopted EU legal framework from the Waste sector for the period until 2050. Projections of emissions of greenhouse gases (GHG) are based on the implementation of measures prescribed by sectoral legislation, harmonized with EU legislation. The joint effect of the measures included in the scenarios has been considered, since measures complement each other. The objectives of the Waste Management Plan of the Republic of Croatia for the period 2023 - 2028 (OG 84/2023) (hereinafter: WMP) are included in measures, in accordance with the obligations arising from the Waste Management Act (OG 84/2021, 142/2023) and EU legislation.

The 'with existing measures' scenario includes projections of greenhouse gas emissions from solid waste disposal, biological treatment of solid waste – composting, incineration of waste and wastewater treatment and discharge. The 'with additional measures' scenario is the same as the 'with existing measures' scenario since no additional measures to reduce emissions of greenhouse gases have been identified. A comparative analysis of a group of countries with similar national characteristics found that national legislation, which is in line with EU legislation, prescribes measures that all Member States should implement by a defined deadline and consider them within the 'with existing measures' scenario.

The 'with existing measures' scenario includes the following measures:

- Prevention and reduction of waste generation
- Increasing the amount of separately collected and recycled waste
- Reducing the amount of disposed biodegradable waste
- Ensuring a system for the treatment and use of landfill gas
- Reduction of food waste following the guidelines for the development of a bioeconomy
- Circular economy measures to increase resource efficiency and business application models based on repair, recycling and recovery.

Reducing the amount of disposed biodegradable waste results in an increase in the amount of biodegradable waste that is sent to biological treatment processes, such as composting and anaerobic digestion in biogas plants. It causes an increase in CH₄ emissions during the reporting period from composting activities calculated in the Waste sector. The overall effect of reducing the amount of disposed biodegradable waste is positive, i.e., there is a reduction in CH₄ emissions due to the reduction of the amount of disposed biodegradable waste at landfills, which is prescribed by sectoral legislation.

The potentials of CO₂ emission reduction, which can be achieved by implementing the measures included in the scenario are estimated in the Energy sector.

3.6. LULUCF

In the LULUCF sector, projections are made for sectorial sub-categories 'Forest land', 'Cropland', 'Grasslands', 'Wetlands', 'Settlements', 'Other land' and 'Harvested wood products' for the 'with existing measures' scenario.

The 'with existing measures' scenario reflects the existing Forest Management Plan of the Republic of Croatia (FMPRC), which means existing economic practices, existing logging plans, and forest management constraints regarding regulations as they were in 2020. It also takes into account the impacts of natural disasters that have occurred in the past ten years.

The 'with additional measures' scenario is the same as the 'with existing measures' scenario.

The 'with existing measures' scenario includes the following measures:

- LUF-1 Establishment, maintenance and upgrading of the National Information System for land
- LUF-2 Carbon sequestration on areas of existing forests
- LUF-3: Implementation of afforestation works
- LUF-4: Manufacture and use of wood and wood products
- LUF-5: Land under managed crops
- LUF-6: Managed grassland
- LUF-7: Implementation of technical projects and scientific research in the LULUCF sector.

4. Descriptions of methodologies, models, underlying assumptions and key input and output parameters for projections

Projections were made in accordance with the Guidelines for preparation of national reports by Parties included in Annex I to the Convention.

The potential for mitigation of national greenhouse gas emissions is analysed and assessed at the sectoral level. This assessment takes into account the previous trends and the current state as well as the future projections of parameters that determine the potential for mitigating emissions. The model and methodology used in preparing the projections are described by sector, in this chapter. The results of all sectoral models are integrated into the LEAP (Long-Range Energy Alternatives Planning System) software package.

A list of assumptions and input data is provided in tabular form (Tables 4-6 to 4-15). The list contains general parameters and parameters related to the sectors and sub-sectors (Energy, Transport, Buildings, Industrial processes and product use, Agriculture, Waste and LULUCF), in accordance with Implementing Regulation (EU) 2024/1281.

The 'with existing measures' and 'with additional measures' scenarios included policies and measures for the reduction of emissions from sources and increase of greenhouse gases removals. In order to determine the contribution of each individual policy and measure for emissions reduction, the reduction potential was determined. In cases where the emission reduction potential of individual policies and measures cannot be expressed separately, reports are aggregated with other potential policies and measures.

4.1. Descriptions of models and methodologies for projections

Energy and transport

In preparing the projections, a software packages MAED (Model for Analysis of Energy Demand) and MESSAGE (Model for Energy Supply Strategy Alternatives and their General Environmental Impact) were used, in which was created a model of the energy sector in Croatia. For the needs of detailed modelling of the power system development and optimization, the PLEXOS model was used, and its results were the inputs for the integrated energy model. Output data are structured in accordance with the structure of the inventory of the United Nations Framework Convention on Climate Change. It is the engineering simulation model in which are the scenarios simulated and certain processes and decisions optimized regarding the assumptions and limitations. The model is detailed to the level of individual production units, present and future.

Projections were made until 2050, with a single step every year. The model is of 'bottom-up' type because it starts from the sectoral data and individual emission sources in the power sector. Emissions of CO₂, CH₄ and N₂O are calculated.

Assumptions and input parameters used in the preparation of projections are shown in Tables 4-1, 4-6, 4-7 and 4-9.

Table 4-1: Assumptions for projections – energy and transport

Energy and Transport	
Projections of greenhouse gas emissions for this report are taken from the Integrated National Energy and Climate Plan for the Republic of Croatia for the period 2021-2030 and the Low-Carbon Development Strategy of the Republic of Croatia until 2030 with a view to 2050 (OG 63/2021). Below is a more detailed description of the methodology used.	
1. Final energy demand	Final energy demand is projected in different sectors – industry, transport, services, households and agriculture, fisheries and forestry. The bases for projections of activities are national macroeconomic parameters. For the projections of energy intensities, development of technology and changing of lifestyles was taken into account. The analyses were performed by sub-sectors: – industry - by industry and type of fuel used, – transport – by type of transport (road, air, marine and rail) and types of means of transport (cars, buses, motorcycles, light and heavy vans) or purpose (passenger and freight) and by type of technology and fuel used, – services – by branches (tourism, trade, education, health), climatic zone (coastal or continental Croatia), purpose (heating, water heating, cooking, cooling, electrical appliances and lighting), type of fuel used, heating demand is modelled on the level of useful and final energy, – households – by climatic zone (coastal or continental Croatia), purpose (heating, water heating, cooking, cooling, electrical appliances and lighting) and by type of fuel, heating demand is modelled on the level of useful and final energy, – agriculture, fisheries and forestry - by type of fuel.
1.1. 'With existing measures' scenario	
	In the period until 2050, the development was simulated in accordance with the existing policy and measures and market development: – market-driven improvements in energy efficiency and fuel switches in the industrial sector, – renovation of buildings (renovation, replacement and new construction) at a rate of 1.1 % of the area of residential buildings per year up to the nearly Zero Energy Building standard (including the use of renewable energy sources), – penetration of electric and hybrid vehicles, – share of rail transport in the structure of cargo activity is showing a very slow increase; diesel-powered trucks will continue to dominate.
1.2. 'With additional measures' scenario	
	Continued support to energy efficiency after 2022, with the following key assumptions: – renovation of 3.5 % of buildings per year to the nearly Zero Energy Building standard (including the use of renewable energy sources), – stronger penetration of electric and hybrid vehicles – incentive measures to co-finance the purchase of vehicles powered by alternative fuels until the minimum number of vehicles on the market is reached

Energy and Transport	
	– an increase in the share of freight transport activities achieved by rail transport (electric locomotives) to around 30% in 2050 – in urban passenger traffic, almost 85% of all passenger activity is expected to be electrified by 2050 – improvements in energy efficiency in industry along with fuel substitution towards greater use of renewable energy sources and electricity.
2. Energy transformations and resources	The power system was analysed by the simulation of market development with the software for the hourly optimization of operation and development of the power system. The model includes part of the centralized heat system in the area of large cities, which is supplied from cogeneration. The simulation of the operation of the refineries was done to satisfy the domestic demand as possible with the existing capacities, which mean without building new refineries and reducing production in 'with existing measures' and 'with additional measures' scenarios.

Industrial processes and product use

In preparing the projections, the engineering simulation model derived in tabular calculation interface was used. The model is structured in accordance with the table structure of the inventory of the United Nations Framework Convention on Climate Change.

The model is detailed to the level of individual production units, the present and future ones.

Projections are made until 2050, in steps of five years. The model is of 'bottom-up' type, because it starts from the sectoral data and individual emission sources. Emissions of CO₂, CH₄, N₂O, HFC and SF₆ are calculated.

Assumptions and input parameters used in the preparation of projections are presented in Tables 4-2 and 4-8.

Table 4-2: Assumptions for projections – industrial processes and product use

Industrial processes and product use
Projections were made based on the expected development of certain industries, which includes the production goals by 2050. Emission projections start from projections of macroeconomic parameters in 2022 - the projected dynamics of the annual growth rate of gross domestic product and gross value added and the decline of population, as well the results of sectoral analysis and studies (production of cement, lime and mineral wool, trends in non-energy consumption of natural gas and N₂O use in food industry and medical purposes). Projections of macroeconomic parameters are in line with projections made for the purpose of the Integrated National Energy and Climate Plan for the Republic of Croatia for the period 2021-2030. <u>Assumptions for 'with existing measures' scenario:</u> – there will be no installation of additional capacities, – production will reach the maximum value by 2050, – reduction of emissions of controlled substances and fluorinated greenhouse gases. Regulation (EU) 2024/573 on fluorinated greenhouse gases, stipulates gradual reduction of emissions of fluorinated gases. From 2015 onwards, the total sum of HFC quotas allocated to producers and importers cannot exceed the maximum amount calculated for a calendar year. Projections of F gases for Croatia follow the trends of CO₂eq emissions at the EU level, for the 'with existing measures' scenario. The same trend of reduction until 2030 was applied until 2050.

Industrial processes and product use

Process emissions from economic activities, as defined by IPCC methodology, included in the sector Industrial processes and product use were estimated based on detailed sectoral projections of various industries and the use of N₂O in industry and medical purposes and the projected macroeconomic indicators of gross value added by other industrial branches, annual increase rate in gross domestic product and decline of the population. The scenario includes the implementation of measures defined in the strategic and sectoral planning documents included in the business policy of manufacturers, conditioned by market demands, laws and regulations and the requirements of the application of best available techniques in the production process.

Measures to reduce controlled substances and fluorinated greenhouse gases are provided by law.

Assumptions for 'with additional measures' scenario:

- application of cost-effective measures to reduce process GHG emissions in cement production.
- by increasing the share of mineral additives in cement, the share of clinker decreases, and thus the need for its production. It is assumed that the share of clinker in cement in 2022 is the same as in the 'with existing measures' scenario. In 2030, it is 65% and in 2050 50%. Thus, based on the planned production of cement, included in the business plans of the manufacturers, projections of the assumed production of clinker were made.
- application of CCS for cement production from 2030.
- reduction of emissions of controlled substances and fluorinated greenhouse gases.
- projections of F gases for the Republic of Croatia follow the trends of CO₂eq emissions at the EU level for the scenario 'with additional measures'. The same trend of reduction until 2030 was applied until 2050.

According to good practice, the projections were made for activity data and emission factors:

- activity data – applying Grade of 1, 2 and 3 methods (projections of macroeconomic parameters, effects of policies and measures, sectoral analysis and studies),
- emission factors – applying Grade of 1 and 2 methods (projections based on average values for the previous five-year period, effects of policies and measures, sectoral analysis and studies).

Agriculture

In preparing the projections, a model derived in a tabular calculation interface was used. The engineering simulation model is structured in accordance with the table structure of the inventory of the United Nations Framework Convention on Climate Change.

The model is detailed to the level of individual sources, the present and future ones.

Projections are being made until 2050, in steps of five years. The model is of 'bottom-up' type because it starts from the sectoral data and individual emission sources and calculated emissions of CO₂, CH₄ and N₂O.

Assumptions and input parameters used in the preparation of projections are presented in Tables 4-3 and 4-10.

Table 4-3: Assumptions for projections - agriculture

Agriculture

The projections were carried out based on the expected future state of key parameters.

Assumptions for the scenario 'with existing measures' and 'with additional measures':

- to determine the key parameters for making projections (number of significant livestock species and production of significant crops) trends in livestock and crop production taken from the global FAO report "The future of food and agriculture – Alternative pathways to 2050" were used, where BAU (business as usual) scenario of the mentioned report was applied. Because there were some differences in activity data in the base year, the BAU scenario data of the FAO report were adjusted, but an identical trend was maintained. For non-significant crops, the historical data from 2022 was retained.

- for mineral fertilizers, an extrapolation based on historical input data was used.

Assumptions for the scenario 'with additional measures':

- application of emission reduction potential due to: change of the ratio of certain types of feed in the diet, use of additives and fats in food, improvement of quality of voluminous feeds and improvement of grazing system, shortening of storage/disposal time of manure on the farm, covering of manure disposal site
- increase in the share of cattle, pigs and poultry on anaerobic digestion of manure and production of biogas (digesters)
- reduction of consumption of mineral fertilizers due to less need for nitrogen application because of new cultivars, varieties and crops, improvement of application methods and increase of the share of slow-release fertilizers, hydro melioration interventions and disaster protection systems.

Waste

In preparing the projections, the engineering simulation model derived in tabular calculation interface was used. The model is structured in accordance with the table structure of the inventory of the United Nations Framework Convention on Climate Change.

The model is detailed to the level of individual sources, the present and future ones.

Projections are made until 2050, in steps of five years. The model is of 'bottom-up' type because it starts from the sectoral data and individual emission sources and calculated emissions of CO₂, CH₄ and N₂O.

Assumptions and input parameters used in the preparation of projections are presented in Tables 4-4 and 4-11.

Table 4-4: Assumptions for projections – waste

Waste
Projections were made based on expected development and future state of parameters for the projections - the amount of generated and landfilled solid waste (municipal solid waste, industrial waste and sludge from wastewater treatment), the organic fraction of solid waste, the fraction of recovered/flared methane and the amount of composted organic waste. Emission projections start from the situation and projections of macroeconomic parameters in 2022 - the projected dynamics of the annual growth rate of gross domestic product and the decline of the population. The scenarios include the existing legal framework of the Republic of Croatia and the adopted EU legal framework from the Waste sector for the period until 2050. Projections of emissions of greenhouse gases (GHG) are based on the implementation of measures prescribed by sectoral legislation, harmonized with EU legislation. The joint effect of the measures included in the scenarios has been considered, since measures complement each other. The objectives of the Waste Management Plan of the Republic of Croatia for the period 2023 - 2028 (Official Gazette 84/23) (hereinafter: WMP) are included in measures, in accordance with the obligations arising from the Waste Management Act (Official Gazette 84/21, 142/23) and EU legislation. <u>Assumptions for the 'with existing measures' scenario:</u> – Solid waste disposal - reduction of the amount of generated and landfilled solid waste due to the application of measures defined by sectoral legislation harmonized with EU legislation. The WMP targets and the deadlines for increasing the mass of separately collected and recycled waste and reducing the amount of landfilled waste are covered by two WMP scenarios (Scenario 1 and Scenario 2). WMP Scenario 1 covers targets defined in accordance with legally binding EU targets for waste recycling and reduction of waste disposal. Croatia was given the possibility of a delay of five years to meet the targets because it is among the Member States that are in 2013 prepared for re-use and recycled less than 20% of its municipal waste and landfilled more than 60% of its municipal waste. A delay of five years included in WMP Scenario 2 will be requested as a safeguard measure to avoid a breach of Directive 2008/98/EC if it becomes apparent that achieving the following targets is not possible: – at least 55% for recycling, sorting, re-use and repair of waste by 2025,

Waste

- limitation of the amount of landfilled municipal waste to a maximum of 10% of the total amount of generated municipal waste by 2035.
- Composting - continuous increase in the amount of waste that is being processed by composting due to the application of measures defined by sectoral legislation harmonized with EU legislation. The increase in the amount of waste to be composted depends on the reduction of the amount of landfilled biodegradable waste and the proportion of biodegradable waste that will be treated by composting and anaerobic digestion.
- Waste incineration - no more incineration of clinical waste is carried out without energy recovery.
- Wastewater treatment and discharge - continuous increase in the quantity of wastewater treated in industry sectors and decrease in the quantity of wastewater treated in residential/commercial sectors and decrease the population with an individual system of drainage (septic tank).

Assumptions for the 'with additional measures' scenario:

The 'with additional measures' scenario is the same as the 'with existing measures' scenario since no additional measures to reduce emissions of greenhouse gases have been identified.

According to good practice, the projections were made for activity data and parameters included in the models for GHG emission calculation:

- applying Grade of 1 and 2 methods (projections of macroeconomic parameters, effects of policies and measures, sectoral analysis and studies, expert judgement).

LULUCF

Assumptions used in the preparation of projections are presented below. Input parameters used in the preparation of projections are shown in table 4-12.

Forest land: The WEM scenario assumes additional increase in forest area for deciduous and coniferous strata, assuming at least 20,000 ha by 2050 by natural forest expansion in sparsely populated areas, partly by afforestation where possible or by conversion of part of the stands from the strata of macchia and scrub. Forest harvest increase by 18.5% from year 2020 to 2050. The scenario envisages a gradual decrease in increment in the first decade, partly due to a gradual increase in forests being restored and consequently increase of the first age class, and partly due to natural losses due to dying of some trees. At a later stage, the increment should rise again along with the increase in young forests (second and third age classes). The protection of biodiversity and habitats is carried out according to the FMPPRC, in accordance with the nature protection regulations that were in place until 2020.

Crops and grasslands: It is assumed that the area under crops and grasslands will decrease in similar trends as in the period 2011 - 2020, crops by 0.1% per year until 2050, grasslands by 0.24% per year.

It is assumed that the area of land with conservation tillage on land under annual crops will increase to 18.7% in 2050. The increase in zero-tillage area is increasing to 2.9% in 2050. The area under organic production will grow to 20% in 2050. It is assumed that the area of land under perennial crops will increase, with organic production up to 30% in 2050.

Wetlands: The area of the wetland does not change. According to the CAP, and in accordance with the GAEC 2 (Good Agriculture and Environmental Conditions) standards, wetlands and peatlands are protected according to the Ramsar List, also carbon rich soil are protected.

Harvested wood products (HWP): Due to a slightly higher share of mature stands in the total harvest, it is envisaged to improve the assortment structure in terms of a slightly higher share of technical wood. This scenario takes into account the neutral influences of the identified influencing factors on the use of wood products. The assumption is that human resources will be available in the labour market. Emigration and immigration of people are in balance. Another assumption is that the demand for the

observed groups of wood products is constant, i.e. there is no increase or decrease, on the local or external market. Technological investments are present on a smaller scale. Sporadically, new plants and or plants for wood processing are introduced. Machines and equipment whose service life has reached the end of their service life in the manufacturer's production facilities are replaced. Existing machinery and equipment are regularly maintained.

Settlements: Areas under settlement are growing with the trend as it was in the period 2011 - 2020. The increase is about from year 2021 to 2050 by 39 kha.

4.2. Parameters on projections

Table 4-5: Parameters on projections – general economic parameters

Parameter		2022	2025	2030	2035	2040	2045	2050
GDP	EUR million	60,864.58	65,897.67	71,851.8	76,909.67	83,148.06	89,967.5	96,918.32
Population	million	3.86	3.80	3.68	3.58	3.49	3.39	3.30
Oil prices	EUR/toe	643	643	643	643	680	738	824
Gas prices	EUR/toe	1,391	554	473	473	473	473	494
Coal prices	EUR/toe	220	128	130	131	139	146	153

Table 4-6: Parameters on projections – Energy sector: electricity generation, gross inland consumption

Parameter		2022	2025	2030	2035	2040	2045	2050
Electricity generation by fuel								
Solid	GWhe	1,558.90	1,486.04	1,364.62	0	0	0	0
Gas (including derived gases)	GWhe	3,509.60	3,944.71	4,669.89	4,134.12	3,598.36	3,029.62	2,460.88
Oil (incl. refinery gas)	GWhe	87.10	63.80	24.96	22.74	20.52	42.07	63.63
Renewables	GWhe	9,064.90	10,861.87	13,856.82	16,548.51	19,240.20	24,625.91	30,011.61
Total	GWhe	14,220.50	16,356.42	19,916.28	20,705.37	22,859.08	27,697.60	32,536.12
Final inland consumption								
Solids	ktoe	80.78	89.26	103.40	101.12	98.84	97.14	95.43
Oil	ktoe	2,981.69	2,888.91	2,734.29	2,737.52	2,740.74	2,744.21	2,747.67
Natural gas	ktoe	1,048.17	1,062.98	1,087.67	1,048.17	1,008.67	962.20	915.73
Electricity	ktoe	1,396.79	1,481.58	1,622.90	1,742.82	1,862.75	2,049.15	2,235.56
Renewable energy	ktoe	1,149.66	1,188.84	1,254.15	1,226.18	1,198.22	1,158.20	1,118.18
Other	ktoe	248.21	302.32	315.48	320.98	326.5	360.08	393.66
Total	ktoe	6,905.30	7,013.91	7,117.88	7,176.80	7,235.71	7,370.97	7,506.23

Table 4-7: Parameters on projections – Energy sector: final energy consumption

Parameter		2022	2025	2030	2035	2040	2045	2050
Final energy consumption								
Industry	ktoe	1,175.07	1,189.18	1,212.70	1,222.35	1,232.01	1,249.78	1,267.55
Households	ktoe	2,286.17	2,312.25	2,355.73	2,316.23	2,276.73	2,231.19	2,185.65
Services	ktoe	808.95	859.20	942.95	974.48	1,006.01	1,026.79	1,047.57
Transport	ktoe	2,420.82	2,391.81	2,343.63	2,380.73	2,417.82	2,546.36	2,674.90
Other	ktoe	260.51	261.39	262.86	264.38	265.90	268.46	271.02

Table 4-8: Parameters on projections – Industrial processes and product use

Parameter		2022	2025	2030	2035	2040	2045	2050
Clinker production - 'with existing measures' scenario	t	2,252,873	2,744,564	2,869,191	2,869,191	2,869,191	2,869,191	2,869,191
Clinker production - 'with additional measures' scenario	t	2,252,873	2,744,564	2,519,708	2,374,340	2,228,973	2,083,605	1,938,237
Lime production, both scenarios	t	138,826	147,830	200,000	207,500	215,000	217,500	220,000
Mineral wool production, both scenarios	t	170,870	242,124	245,000	245,000	245,000	245,000	245,000
Non-energy consumption of natural gas, both scenarios	t	264.2	331.4	324.7	318.2	311.9	305.6	299.5

Table 4-9: Parameters on projections – Transport sector

Parametar		2022	2025	2030	2035	2040	2045	2050
Number of passenger kilometres, all modes	10 ⁹ pkm	45,012	45,272	45,901	46,385	46,646	46,809	47,446
Freight transport tonnes-kilometres	10 ⁹ tkm	16,431	16,696	16,995	17,114	17,185	17,235	17,333
Energy consumption in transport	ktoe	2,421	2,392	2,344	2,381	2,418	2,546	2,675

Table 4-10: Parameters on projections – Agriculture

Parametar		2022	2025	2030	2035	2040	2045	2050
Dairy cattle	1,000 heads	79.0	98.5	85.5	83.2	79.2	77.3	76.1
Non-dairy cattle	1,000 heads	342.8	347.6	360.3	362.4	370.5	376.0	379.1
Pigs	1,000 heads	944.5	1,036.3	1,071.1	1,065.9	1,062.2	1,061.6	1,060.2
Sheep	1,000 heads	642.8	648.1	604.9	591.8	580.1	570.9	561.0
Poultry	1,000 heads	642.8	648.1	604.9	591.8	580.1	570.9	561.0
Nitrogen input from application of synthetic fertilizers	kt nitrogen	88.4	98.7	96.4	94.1	91.8	89.5	87.1
Nitrogen input from application of manure	kt nitrogen	33.2	23.4	22.4	22.1	21.8	21.5	21.3
Nitrogen in crop residues returned to soils	kt nitrogen	36.0	36.6	36.6	36.6	36.6	36.6	36.6
Area of cultivated organic soils	hectares	2,675.1	2,675.1	2,669.8	2,664.5	2,659.3	2,654.0	2,648.8

Table 4-11: Parameters on projections – Waste

Parametar		2022	2025	2030	2035	2040	2045	2050
Amount of generated solid waste	t	4,999,824	5,316,745	6,085,197	7,026,504	7,907,391	8,905,148	10,035,451
Amount of landfilled solid waste	t	1,829,753	1,610,460	1,256,877	757,319	620,082	434,634	190,626
Share of methane recovered/flared	%	13.1	11.4	9.6	5.4	5.9	5.2	2.0

Table 4-12: Parameters on projections – LULUCF

Parameter – Activity data (AD)		2022	2025	2030	2035	2040	2045	2050
4.A.1. Forest land remaining forest land (conifer and broadleaves stratum, out of yield not included)	(kha)	1,846.5	1,8520.5	1,855.4	1,858.7	1,862.0	1,865.4	1,868.7
4.A.2. Land converted to forest land	(kha)	63.6	59.1	41.1	33.2	0.0	0.0	0.0
4.B.1. Cropland remaining cropland	(kha)	1,482.0	1,473.8	1,465.6	1,457.5	1,449.3	1,441.2	1,433.0
4.B.2. Land converted to cropland	(kha)	40.1	37.0	31.8	26.6	21.3	16.1	10.9
4.C.1. Grassland remaining grassland	(kha)	1,073.0	1,056.0	1,044.3	1,032.6	1,020.9	1,009.2	997.5
4.C.2. Land converted to grassland	(kha)	80.2	82.63	82.63	82.63	82.63	82.63	82.6
4.D.1. Wetlands remaining wetlands	(kha)	74.3	74.48	74.69	74.89	75.09	75.29	75.5
4.D.2. Land converted to wetlands	(kha)	1.1	1.0	1.0	1.0	1.0	1.0	1.0
4.E.1. Settlements remaining settlements	(kha)	218.0	216.3	223.1	229.9	236.7	243.5	250.3
4.E.2. Land converted to settlements	(kha)	78.1	75.6	72.01	68.4	64.9	61.32	57.8
4.F.1. Other land remaining other land	(kha)	201.4	225.5	261.8	288.0	339.5	357.8	376.0

5. Sensitivity analysis of projections

Regulation (EU) 2018/1999 recommends that the assumptions and baselines used for joint EU projections should be used as far as possible and justified for national scenarios.

In June 2024, the European Commission drafted the document Recommended parameters for reporting on GHG projections². Recommended parameters include projections of demographic development, GDP rate, gross value added of individual industries, fuel price projections and emission units.

Recommended real GDP growth and population parameters were included in estimation of GHG emissions projections. Regarding that, the sensitivity analysis was made based on +/-20% real GDP growth oscillation.

The key differences between the baseline data of the national scenarios presented in this report (the 'with existing measures' scenario and the 'with additional measures' scenario) and the baseline data calculated in this sensitivity analysis is real GDP growth and the results of the are presented below, i.e. differences in greenhouse gas emissions depending on the difference of that parameter.

Information of scenarios is given in Table 5-1.

Table 5-1: Information of scenarios

Scenario	WEM/WAM	Parameters used
Scenario 1	WEM	Real GDP growth +20%
Scenario 2	WEM	Real GDP growth -20%
Scenario 3	WAM	Real GDP growth +20%
Scenario 4	WAM	Real GDP growth -20%

In the analysed scenarios, real GDP growth is assumed to oscillate for + 20% and – 20% on given recommended value for each year in the period from 2022 - 2050.

Using the positive oscillation values of real GDP growth, greenhouse gas emissions (total excluding LULUCF) in 2030 are higher by about 0.53% compared to the 'with existing measures' scenario and by 0.50%, compared to the 'with additional measures' scenario. Greenhouse gas emissions in 2050 are higher by 1.99% compared to the 'with existing measures' scenario and by 1.78%, compared to the 'with additional measures' scenario. However, with the negative oscillation of real GDP growth, greenhouse gas emissions in 2030 are lower by about 0.38% compared to the 'with existing measures' scenario and by 0.31%, compared to the 'with additional measures' scenario. In 2050 that reduction grows to 1.42% compared to the 'with existing measures' scenario and by 0.69%, compared to the 'with additional measures' scenario.

² Recommended parameters for reporting on GHG projections in 2025, EC

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