LITHUANIA’S EIGHTH NATIONAL COMMUNICATION AND FIFTH BIENNIAL REPORT

under the United Nations Framework Convention on Climate Change

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CONTENT

Foreword

The Ministry of Environment of the Republic of Lithuania is delighted to present Lithuania's 8th National Communication under the United Nations Framework Convention on Climate Change (hereinafter – UNFCCC), as well as under the Kyoto Protocol. It describes the information required by the guidelines, including the supplementary information under Article 7.2 of the Kyoto Protocol. The report gives an overview of all required elements and focuses in more detail on the developments since the 7th National Communication. The National Communication includes also most information that needs to be reported in the 5th Biennial Report. Specific information that is required under the Guidelines for Biennial Reports is included in the Annex VII.

Climate change is one of the major threats and challenges of our time. The climate change issues are particularly worrying: Lithuania is already facing increased intensity and frequency of extreme weather events (heat waves, storms, and floods), leading to reduced crop yields, loss of biodiversity, impact on economy and human health. We understand that without urgent ambitious mitigation actions globally, in the future – it will be more difficult and costly. That's the reason why Lithuania is investing in efforts to understand climate change impacts and has already taken significant steps to identify and address climate change mitigation and adaptation. The actions taken are presented in this National Communication.

Lithuania undertook the target to reduce its greenhouse gas (hereinafter – GHG) emissions by 8% below the 1990 level during Kyoto Protocol's first commitment period 2008-2012. This target has been overachieved reducing more than 55% of its GHG emissions over the first commitment period. In 2012 Lithuania together with other EU Member States and Iceland undertook a 20% GHG emissions reduction below 1990 level commitment for the second Kyoto Protocol period from 2013 to 2020. The EU has substantially overachieved its 2020 reduction target in the second Kyoto Protocol period, which means that also its Member States and the United Kingdom have fulfilled their emission reduction obligations. In 2020 Lithuania has reduced GHG emissions by 58% compared to the 1990 level.

Lithuania signed and ratified the Paris Agreement in 2016. Under the Paris Agreement Lithuania jointly with the EU and its Member States took a binding target of at least a 40% domestic reduction in economy wide GHG emissions by 2030 compared to 1990, by implementing the EU legal acts for the EU climate and energy policy targets till 2030, mainly through the EU emission trading system (EU ETS) and Efforts Sharing Regulation, as well as Clean Energy Package legislation amounting to 43% and 30% respectively by 2030 compared to 2005. Based on the European Green Deal strategy and the Commission's Communication of September 2020 on Stepping up Europe's 2030 climate ambition ('2030 Climate Target Plan') the EU has increased the European Union's binding target for 2030 towards at least 55% net emission reduction (compared with 1990 levels). The European Climate Law, adopted in 2021 sets the legally binding EU's climate neutrality target at the latest by 2050, and a binding Union domestic reduction target of at least 55% net emission reduction by 2030 compared to 1990. In order to follow the pathway proposed in the European Climate Law, and deliver this increased level of ambition for 2030, the European Commission has proposed a number of legislative proposals under the "Fit for 55" package laying down obligation to achieve the EU targets of reducing GHG emissions by 61% in the sectors covered by in the Emission trading system (ETS) and at least 40% in non-ETS sectors by 2030 compared to 2005.

In order to ensure the implementation in the international agreements and the EU legal acts defined targets for Lithuania, in 2021 the Parliament of the Republic of Lithuania approved the National Climate Change Management Agenda (hereinafter – Agenda). The Agenda sets a long-term objective of reaching net-zero emissions by 2050, in line with the EU's own targets. It sets interim targets of -85% by 2040 and -70% by 2030 (compared to 1990's levels, -30% by 2030 compared to 2005). The Agenda defines sector specific targets for 2030, with the ETS sectors to reduce emissions by 50% and the non-ETS sectors by 25% (compared to 2005 levels). The Agenda further differentiates sector specific targets for the non-ETS sectors and provides details of short-, medium-, and long-term targets within each sector, for example setting renewable energy and energy efficiency targets for 2030, 2040 and 2050 in each sector.

Lithuania's National Energy and Climate Action Plan (NECP), adopted in 2019 under EU's Climate and Energy Framework, constitutes the primary document detailing Lithuania's intended climate policies for the period from 2021-2030. It integrates a number of previous policy documents and was developed in parallel to the National Progress Plan, which sets overarching economic, social, environmental and security priorities, also for the period from 2021-2030. The NECP defines measures for the reduction of GHG emissions and adaptation to climate change in all the sectors of Lithuanian economy, including energy, transport, industry, agriculture, land-use, land-use change and forestry (LULUCF) and waste. Currently the NECP is being updated in line with the climate and energy targets of the EU "Fit for 55" legislative package and REPowerEU plan.

The implementation of the NECP is coordinated by the Ministry of Environment and the Ministry of Energy. Other ministries and relevant institutions participate in the implementation of the measures within their competence and allocating funds for their implementation of the measures. While drawing up sectorial development programmes, action plans or other planning documents for their respective management areas, the ministries shall mainstream the targets and objectives for climate change mitigation and adaptation set out in the Agenda, in order to provide for specific measures to implement those targets and objectives and to ensure close interinstitutional cooperation.

The 8th National Communication was prepared in accordance with "Revision of the UNFCCC reporting guidelines on national communications for Parties included in Annex I to the Convention" (Decision 6/CP.25) and taking into account remarks by the UNFCCC expert review team, provided in the Report of the technical review of the seventh national communication of Lithuania (FCCC/IDR.7/LTU). The 8th National Communication focuses primarily on activities during the four-year period 2017-2020 and updated policies by 2030, including data for National GHG Inventory Report 2022 and, if available, information up to 2022 is provided.

EXECUTIVE SUMMARY

1. EXECUTIVE SUMMARY

1.1 National circumstances relevant to greenhouse gas emissions and removals

Lithuania is an independent democratic parliamentary republic. The State power is executed by the Seimas (the Parliament), the President and the Government, the Judiciary inclusive.

The territory of the Republic of Lithuania covers 65 302 km^2. Lithuania borders with Latvia, Belarus, Poland, Russia and the Baltic Sea. The coastal length of Lithuania makes 90.7 km.

At the beginning of 2022, the estimated resident population of Lithuania amounted to 2 806.0 thousand, i.e. by 4.7 thousand (0.2%) less than at the beginning of 2021. In 2005-2022, the resident population declined by 549.2 thousand, or 16.4%. The decline in the resident population is caused by the natural decrease and negative net international migration (positive net international migration was observed in 2021). At the beginning of 2022, the average population density in Lithuania was 43.0 persons per square kilometre (at the beginning of 2005 – 51.4 persons).

Lithuania is the country of lowlands with the highest hills not reaching 300 meters height. Agricultural land covers about 54.4% of the total land area of the country. The Lithuanian woodland occupies about 33.7% of the country's territory and protected areas – 18.1%.

The climate in Lithuania varies from marine to continental. The mean temperature of Lithuania in the new normal period is 7.4°C. Compared with the 1961-1990 period the average temperature has already risen by about 1.2 degrees, which shows climate warming. The year 2020 with the average annual air temperature of 9.2°C was the warmest and 2019 with the average annual air temperature of 8.8°C was the second warmest year since 1961.

Over the last decades the country's economy and macro-economic indicators tended to increase steadily. The growth has been caused by the anchored market economy in the country. Lithuania's accession to the European Union in 2004 also had influence on the above. The main economic activity in Lithuania is service sector, followed by industry.

From 1990 to 2020 total primary energy consumption in Lithuania decreased by about 53%. Oil and oil products were the most important fuel in Lithuania over the previous decade. Since 2000 their share in the primary energy balance has been fluctuating about 31.5% with the smallest portion of 23.7% in 2003 and the largest share of 39.2% in 2018. The major factors influencing changes in the role of oil products were decreasing consumption of heavy oil products for production of electricity and district heat and growing consumption of motor fuels in the transport sector. At present natural gas is the most important fuel in the Lithuanian primary energy balance. The share of natural gas was fluctuating about 28.1% over the period 2000-2020.

The vast majority of Lithuania's energy consumption comes from imports. This is mainly due to the dependence of natural gas, crude oil and NGL from Russia and other non-EU countries. For natural gas, however, the LNG Terminal in Klaipėda, which was put in operation in December 2014, has allowed for significant diversification of gas import. From 2022 Lithuania has stopped Russian oil, natural gas and electricity imports. Lithuania's gas needs are endured via the Klaipėda LNG terminal with cargoes from the

US, its electricity needs are met through local power generation and imports from EU countries through existing interconnections with Sweden, Poland and Latvia, while JSC Orlen Lietuva, the only oil importer in Lithuania, refused to import Russian crude oil.

Contribution of renewable energy sources into the country's primary energy balance during the period 1990-2021 is increasing. During the period 1990-2021 primary energy supply from renewable sources increased by 5.8 times with an average annual growth of 5.7%. Lithuania has undertaken, according to Directive of the European Parliament and of the Council No 2009/28/EC on the promotion of the use of energy from renewable sources, to increase the renewable sources share in the final national energy consumption up to 23% by 2020. Lithuania has already over-reached the 23% target: in 2020, the share of renewable energy sources in the gross final energy consumption of the country accounted for 26.8%. Currently the main domestic energy resource is solid biomass, the second largest renewable energy source is wind energy.

The mission of the Lithuanian transport system is to ensure the harmonious public mobility and transport of goods, and to increase the country's competitive capacity in international markets. In 2019 transport and logistics sector accounted about 14% of total Lithuanian GDP. It is third largest economic sector in which works 142 000 workers.

Road transport is the main branch of transport sector. In 2018, national passenger transport by road do-mi-nated: it accounted for 98.2% of total national passenger transport. Passenger transport by rail accounted for 1.1%, by other modes of trans-port – for less than 1%. During the period of 1990-1995 fuel consumption significantly decreased by 46.3%. From 1995 the fuel consumption in road transport started to increase and rapid growth began in 2000. Motor gasoline was one of the main fuel types until 2000; from that year diesel usage started to increase more rapidly and in 2020 diesel amounted to 78.5%, motor gasoline – 11.8%, biofuel – 4.8%, liquid petroleum gas – 4.5% and CNG – 0.4%.

Lithuanian industry sector accounts for a significant share of gross value added in the country's economy. Dominating industry in Lithuania is manufacturing. Manufacturing constituted 85% of the total industrial production (excluding construction) in 2021. Four most important subsectors within manufacturing cumulatively produced 60% of production: manufacture of food products and beverages, manufacture of refined petroleum products, manufacture of wood products and furniture, manufacture of chemicals and chemical products.

In 2020 more than 67% of Lithuania's population lived in towns and cities. Between 1950 and 2020, the number of urban population increased more than 60%. Accordingly, more land is used for housing, infrastructure and services. The average useful floor area per capita amounted to 38.2 m² in 2021. The Renovation of the multi-apartment buildings programme is one of the country's priority projects aimed at increasing energy efficiency of the most heat-intensive multi-apartment buildings.

Agriculture sector has a great influence on the development of Lithuanian rural area as 32.6% of residents live in countryside. More than a half of Lithuania's land is suitable for agriculture. In 2021 the proportion of crop production and animal production in the total agricultural production made up 63.5% and 32.6% respectively.

The total forest land area covered 33.7% of the country's territory in 2020. Since 2003, the forest land area has increased by 156.9 thousand ha corresponding to 2.4% of the total forest cover. Coniferous stands prevail in Lithuania, covering 55.7% of the forest area.

The total amount of waste generated annually in Lithuania is about 5 million tonnes. Major part of waste is generated in industrial sector of which about 100 kt – hazardous waste. Annual municipal waste generation is a bit more than 1 million tonne. In 2020, municipal waste generation in Lithuania remained just slightly below the EU average (483 kg/year/inhabitant compared to around 517 kg on average). In 2020, Lithuania recycled 24%, composted 21%, incinerated 26% with energy recovery and disposed of 17% of municipal waste in landfills.

1.2 Greenhouse gas inventory information

Lithuania as a Party to the UNFCCC and the Kyoto Protocol is committed to provide annually information on national anthropogenic GHG emissions by sources and removals by sinks for all GHG not controlled by the Montreal Protocol. As a member of the European Union, Lithuania has also reporting obligations under the EU legislation (Regulation No 525/2013 of the European Parliament and of the Council, as repealed by Regulation (EU) 2018/1999).

National Inventory Report (NIR) covering the inventory of GHG emissions of Lithuania is being submitted to the UNFCCC secretariat annually, in compliance with the decision 24/CP.19 "Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to Convention" (FCCC/CP/2013/10/Add.3). GHG inventory is compiled in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006).

The data used in Lithuania's 8th National Communication is in accordance with its NIR that was submitted in 2022 to the Secretariat of the UNFCCC (25^{th} May submission). This submission covers the inventory of GHG emissions of Lithuania for the period 1990-2020.

The total Lithuania's GHG emission (excl. LULUCF) amounted to 20 182.6 kt CO_2 eq. in 2020. The emissions have decreased by 57.8% comparing with the base year. The base year is 1990 for the greenhouse gases CO_2, CH_4, N_2O and 1995 for the F-gases HFC, PFC, SF_6.

GHG emission trends, including and excluding LULUCF, are presented in a figure below.

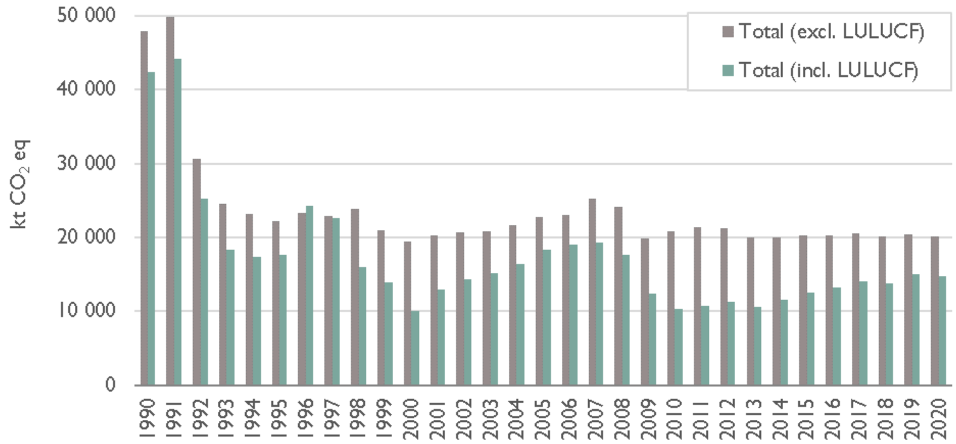

Figure 1-1. Emission trends for aggregated GHG emissions in 1990-2020

The most significant source of GHG emissions in Lithuania is energy sector with 58.5% share of the total emissions in 2020. Main contributors in energy sector are transport and energy industries. In 2020 these sectors composed 30.5% and 13.1% of the total national GHG emissions respectively.

Agriculture is the second most significant source and accounted for 22.1% of the total emissions. Emissions from industrial processes contributed 15.3% to the total GHG emissions, waste sector – 4.1%.

The most important greenhouse gas is CO_2 as it contributed 67.7% to the total national GHG emissions expressed in CO_2 eq. in 2020, followed by N_2O (15.6%) and CH_4 (14.2%). HFCs, SF_6 and NF_3 amounted together to 2.6% of the total GHG emissions (excl. LULUCF) in Lithuania.

Greenhouse gas inventory system

The main institutions involved in GHG inventory system in Lithuania are the Ministry of Environment, the Lithuanian Environmental Protection Agency, State Forest Service and sectoral experts from GHG Inventory expert working group.

Ministry of Environment of the Republic of Lithuania is a National Focal Point to the UNFCCC and is designated as single national entity responsible for the national GHG inventory. It has overall responsibility for the national system of GHG inventory and is in charge of the legal, institutional and procedural arrangements for the national system and the strategic development of the national inventory.

Lithuanian Environmental Protection Agency (EPA) under the Ministry of Environment is GHG inventory QA/QC manager and responsible for compilation of the Lithuania's National inventory report (NIR), accomplishment of cross-cutting issues such as key categories analysis, overall uncertainty assessment, analysis of GHG emission trends. EPA establishes and operates GHG inventory archive, where all GHG inventory supporting reference materials are stored. Since 2014 submission personnel of EPA is also responsible for calculation and preparation of NIR parts of the industrial processes and product use (IPPU) sector and agriculture sector (agricultural soils part) emissions.

The State Forest Service (SFS) under the Ministry of Environment compiles the National Forest Inventory (NFI) and the forest information system, carries out monitoring of the status of the Lithuanian forests, collects and manages statistical data etc. In the GHG inventory preparation process it is responsible for calculations of emissions and removals of LULUCF sector and Kyoto Protocol activities under Article 3, paragraphs 3 and 4.

Permanent GHG Inventory expert working group was established in 2011 by the Governmental Resolution No 683 (as repealed by Climate Change Management Law in 2021). The working group consists of representatives from scientific institutions, which are responsible for respective sectoral GHG emissions estimates: Centre for Physical Sciences and Technology (transport), Lithuanian Energy Institute (energy), Institute of Animal Science of the Lithuanian University of Health Sciences (livestock), Lithuanian Research Centre for Agriculture and Forestry (LULUCF), the Centre for Environmental Policy (waste).

The annual GHG inventory preparation follows the work schedule for reporting. Lithuania has to submit GHG inventory to the European Commission by 15th January and update estimates by 15th March annually. GHG inventory to the UNFCCC secretariat shall be submitted by 15th April annually.

The methodologies, activity data collection and choice of emission factors are consistent with the 2006 IPCC Guidelines. The quality requirements set for the annual inventories – transparency, consistency, comparability, completeness and accuracy are fulfilled by implementing consistently the QA/QC plan and procedures.

National Registry

The Lithuanian National GHG Registry is maintained in a consolidated manner within the Union Registry with other EU Member States. Following the Commission Delegated Regulation (EU) 2019/1122 of 12 March 2019 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards the functioning of the Union Registry the Union Registry is administrated by central administrator (the European Commission) in cooperation with the Member States' national administrators. The central administrator ensures that the Union Registry conforms to the functional and technical specifications for data exchange standards. The testing of the Registry related to the technical standards for data exchange between Registry systems is carried out under the supervision of the European Commission. Also, the central administrator operates and maintains the EU Transaction Log (EUTL) in accordance with the provisions of this Regulation.

The Environmental Projects Management Agency under the Ministry of Environment of the Republic of Lithuania (EPMA) has been assigned the functions of the national GHG registry administrator.

The latest updates related to the Lithuanian National GHG Registry are presented annually in the National Inventory Report (NIR), submitted to the UNFCCC Secretariat.

1.3 Policies and measures

Lithuania's climate policy is defined in government programmes, legal acts and in National Climate Change Management Agenda. Effective climate change policies require global collaboration and actions. Therefore, the Lithuanian climate policy is based on international agreements: the UNFCCC, the Kyoto Protocol, Paris Agreement and the common policies of the EU.

In 2012 at the Doha Climate Change Conference Lithuania – a Party of the Convention and Kyoto Protocol – together with the other EU Member States, undertook a 20% GHG emissions reduction below 1990 level commitment for the second Kyoto Protocol period from 2013 to 2020. It is therefore a joint pledge with no separate targets for Member States under the Convention. The Doha Amendment of the Kyoto Protocol was ratified by the Parliament (Seimas) on 20 October 2015. The EU has substantially overachieved its reduction target under the Convention, which means that also its Member States and the United Kingdom have fulfilled their emission reduction obligations. As stated in the 2022 EU GHG inventory submission to the UNFCCC, the total GHG emissions, excluding LULUCF and including international aviation, decreased by 34% in the EU-27 + UK compared to the base year 1990 or 1.94 billion tons of CO_2 eq.

At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first ever universal, legally binding global climate deal. Lithuania signed the Paris Agreement on 22 April 2016 and ratified on 30 December 2016. Under the Paris Agreement Lithuania jointly with the EU and its Member States took a binding target of at least a 40% domestic reduction in economy wide GHG emissions by 2030 compared to 1990. Based on the European Green Deal strategy the EU has increased the European Union's binding target for 2030. The European Climate Law, adopted in 2021 sets the legally binding EU's climate neutrality target at the latest by 2050, and a binding Union domestic reduction target of at least 55% net emission reduction by 2030 compared to 1990. In order to follow this pathway, the European Commission has proposed a number of legislative proposals under the "Fit for 55" package laying down obligation to achieve the EU targets of reducing GHG emissions by 61% in the sectors covered by in the Emission trading system (ETS) and at least 40% in non-ETS sectors by 2030 compared to 2005.

In order to ensure the implementation in the international agreements and the EU legal acts defined targets for Lithuania, on 30 June 2021 by the Decree No XIV-490 of the Parliament of the Republic of Lithuania approved the National Climate Change Management Agenda (Agenda) which lays down the targets and objectives for climate change mitigation and adaptation by 2050. The Strategy implements the EU legal acts of the Climate change and energy package till 2030 and replaces the National Strategy for Climate Change Management Policy until 2020 adopted in 2012.

The goal of the Agenda is to develop and implement climate change management policy in Lithuania. The Agenda sets the short-term (until 2030), mid-term (until 2040) and long-term (until 2050) goals and objectives in the field of climate change mitigation and adaptation.

The national climate change mitigation targets by 2030 are as follows:

- to reduce GHG emissions by 30% compared to 2005 (including LULUCF) by shifting economic sectors towards innovative, low-emission and environmentally friendly technologies and the use of RES;
- for ETS sectors to reduce GHG emissions at least 50% compared to 2005;

- for non-ETS sectors (transport, industry, agriculture, waste, small-scale energy sector), to reduce GHG emissions at least 25% compared to 2005 (including LULUCF) and not exceed the annual GHG emission allocations set for the period 2021-2030 by EU Effort Sharing Regulation.

The national climate change mitigation target by 2040 is to reduce GHG emissions by 85% compared to 1990. The Agenda sets a long-term objective of reaching net-zero emissions by 2050.

To support the implementation of climate change mitigation targets and requirements of Regulation (EU) 2018/1999 on the Governance of the Energy Union and climate action Lithuania’s National Energy and Climate Action Plan (NECP) for the period 2021-2030 was adopted in 2019. The NECP has been prepared based on and integrating the provisions, objectives, and tasks of the Lithuanian national legislation, international obligations, strategies, and other planning documents, as well as measures being implemented and planned to be implemented. The NECP sets a number of horizontal policies targeting economy-wide emissions reductions. Rather than setting economic incentives or introducing new regulations, these are primarily complementary policies, for example integrating GHG emissions reduction evaluations into the legislative process, mainstreaming climate change within educational programmes, extending the scope for green procurement, increasing public awareness, and funding research on climate mitigation. The targets, policies and measures set in the NECP are currently under revision in order to meet the increased ambition of the European climate legislation (EU “Fit for 55” package and REPowerEU plan) and GHG reduction targets set in Lithuania’s National Climate Change Management Agenda.

In Lithuania, climate policy is integrated with the decision-making processes in energy, transport, agriculture, waste, forestry and land-use sectors and territorial planning. The Ministry of Environment is the main responsible and coordinating institution for the development of climate change policy and its implementation in Lithuania. Issues related to development and implementation of the climate change policy are carried out by other sectoral ministries and institutions supervised by the relevant ministries.

Detailed information about Lithuania’s national system for reporting on policies and measures and sectorial (energy, transport, industry, agriculture, waste, LULUCF) as well as cross-sectorial (national economic and financial instruments for climate change management, EU ETS system in Lithuania etc.) policies and measures are presented in Chapter 4.

1.4 Projections and total effect of policies and measures

Chapter 5 provides information of future trends in GHG emissions and removals in Lithuania, given current national circumstances and implemented (WEM scenario) and adopted (WAM scenario) policies and measures described in Chapter 4.

Projections of GHG emissions have been calculated by carrying out systematic modelling of economic sectors of Lithuania. The model is based on an integrated approach and relies on statistical data, reflecting the existing situation of base year 2019 (2020 was not chosen as the base year due to it was extraordinary year caused by COVID pandemic and it could impact the interpretation of characteristic tendencies), and particular assumptions which affect the long-term development of the economic sectors, with the account of the EU climate change and energy objectives by 2030 and targets by 2040. The same GHG projections were used for the Lithuanian National Energy and Climate Action Plan and in the Report "Policies and Measures and Projections of Greenhouse Gas Emissions in Lithuania" submitted to European Commission in 2021.

Projections as well as policies and measures are divided into the following reporting categories: energy, transport, industrial processes and products use, agriculture, LULUCF and waste. Chapter 5 provides information on GHG projections for 2025, 2030, 2035 and 2040 by each sector and by gas.

GHG emissions projection suggests that decreasing natural gas consumption in electricity and heat production, ongoing GHG reduction measures in transport sector, as well as decreasing consumption of F-gases and consumption of inorganic N fertilizer for agriculture soils will result in the decrease of GHG emissions. The implementation of additional measures will result in total 2 285 kt CO_2 eq. (excluding LULUCF) decrease in 2040.

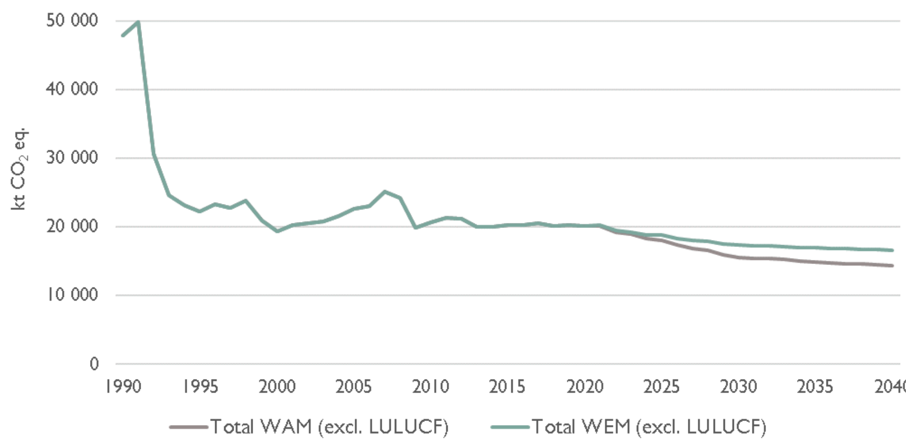

Figure 1-2. Historical and projected GHG emissions

Since 7th National Communication, Lithuania has improved the effect evaluation process of policies and measures. As mentioned before, in 2019 the National Energy and Climate Action Plan was adopted. Much effort was put into planning and assessing the GHG reduction effect of decarbonization policies. Since 2019, some planned policies have started to be implemented, and some were refused to implement due to appeared financial or social burdens. In this submission, 113 measures are presented, of which 64 are already implemented or adopted, and 49 are planned. Forty policies and measures were not quantitatively evaluated, because some of these measures are educational, have a social aspect or have no direct effect on GHG reduction and act in synergy with other measures.

For the total effect of policies and measures (PaMs), the approach used was – individually assessing the effect of each significant policy and measuring and aggregating the individual effects to arrive at a total. Therefore, the total effect of PaMs is presented only for 2030. The total effect of PaMs for 2020 was not estimated as the advanced process of evaluation and planning of PaMs strictly focusing on decarbonization was initiated only before 2018; however, currently, Lithuania is working on ex-post analysis of the PaMs effect.

The effect of adopted and implemented measures is estimated to reach about 4 652 kt CO_2 eq. in 2030. The highest reduction of GHG emissions is planned in energy, transport and industrial processes sector (implementation of F-gases policies).

The effect of the planned measures in 2030 might reach 3 575 kt CO_2 eq. The estimated difference between WEM and WAM's projected emission in 2030 is 3 600 kt CO_2 eq.

It is assessed that implemented and planned measures will have the most effect on reducing CO_2 emissions (energy, transport and LULUCF sectors); also, implementing F-gas regulation, the quantity of these gases is planned to decrease efficiently. The measures implemented and planned in the agriculture and waste sectors will affect methane emission reduction most. Additionally, the successful implementation of synthetic fertilizer use regulation could benefit the reduction of N_2O emissions. Adopted and implemented PaMs might affect reducing CO_2 emissions by 3 676 kt CO_2 eq., CH_4 by 75.9 kt CO_2 eq. and F-gases by 900.4 kt CO_2 eq. in 2030. The planned measures are estimated to reduce CO_2 emissions by 3 166 kt CO_2 eq., methane by 34.6 kt CO_2 eq., N_2O by 349 kt CO_2 eq. and F-gases by 24.7 kt CO_2 eq.

1.5 Vulnerability assessment, climate change impacts and adaptation measures

According to the results of the climate projections carried out the ongoing study within the ClimAdapt-LT project, further temperature increases are clearly visible for future time periods because of ongoing climate change.

The increase in overall air temperature (from the current 7.3°C by between 1.2°C and 2.8°C) will lead to an increase in the number of heat waves and tropical nights and the length of the growing season, while the number of cold days will decrease. We can expect an increase in the risk of fire, a similar level of frost risk during the active growing season and a decrease in the risk of migraine due to unfavourable biometeorological indicators. A further increase in precipitation is expected by 2100 (from the current 684 mm by 42 mm or 6% to 98 mm or 14%), especially in the winter season. Despite the increase in precipitation, an increase in drought risk should also be expected, as more precipitation will fall during isolated intense episodes. The Baltic Sea level is projected to rise throughout the century (ranging from 22 cm to 35 cm), with higher rises predicted during the storm season.

The abovementioned study, in the further phases, will carry out a sensitivity and vulnerability assessment of all Lithuanian municipalities, based on the data collected, the experience and methodologies of the IPCC, the World Meteorological Organisation, the European Environment Agency and other organisations working on climate change sensitivity and vulnerability. Based on this assessment, a Climate Change Adaptation Plan will be prepared for the most vulnerable Lithuanian municipality.

In 2021, Lithuania adopted National Climate Change Management Agenda, which sets out short-term (up to 2030), medium-term (up to 2040) and long-term (up to 2050) mitigation and adaptation goals and targets for the different sectors. Also, there are 55 planned policy measures to adapt to climate change in the National Energy and Climate Action Plan for 2021-2030 (NECP).

1.6 Financial, technological and capacity-building support

Lithuania provides flexible funding to multilateral organizations, including through softly earmarked voluntary contributions to trust funds (e.g., for Ukraine). The lion's share of Lithuania's Official Development Assistance goes to meeting its mandatory commitments to the European Union, World Bank Group and United Nations agencies. However, in the aftermath of Russia's war of aggression on Ukraine, Lithuania is increasing its non-core contributions to multilateral organizations, most of which are softly earmarked for a specific country, region, theme or purpose.

At the bilateral level, mostly from the Climate Change Programme Lithuania supports climate-related activities in developing countries. Lithuania's climate finance has seen a steady increase over the past years with a focus on those themes in which our country has particular expertise, such as renewable energy. In the 2014-2021 period, 7.4 mill EUR in grants were provided to climate mitigation projects in developing countries. For the implementation of development cooperation projects in 2022-2025, the Ministry of Environment from the Climate Change Programme will allocate 8 million EUR (2 mill. EUR annually). At least another 2.4 million EUR are planned to be raised from private funds in 2022-2025 for development cooperation projects. Lithuania will focus in particular on Ukraine and the EU's Eastern Partnership (EaP) Region. In the EaP countries, co-operation is based on sharing Lithuania's own transitional experience on democratic governance and implementation of reforms which also focuses on other thematic areas, such as climate mitigation, and renewable energy sources promotion where Lithuania believes it has a comparative advantage.

Lithuania has made financial contributions to the UNFCCC secretariat, World Bank funds, and Eastern Partnership Technical Assistance Trust fund.

Success stories for effective technology transfer and development cooperation projects are described in Chapter 7 of Lithuania's 8th National Communication.

1.7 Research and systematic observation

This chapter presents the main information about Lithuanian activities in climate research and observations, including international and domestic activities in addition to government's role in this field.

First of all, the Lithuanian science, technology and innovation (STI) policy is set by the Seimas (Parliament) and the Government of the Republic of Lithuania. The Research Council of Lithuania serves as an advisory body to the Seimas and the Government. The Lithuanian STI policy governance structure is based on a dual ministry model, with the Ministry of the Economy and Innovations responsible for innovation and industrial research policy, and the Ministry of Education, Science and Sport responsible for higher education and public sector research policy. It should be noted that the Ministry of Finance is responsible for the allocations of funds for national research programmes.

Lithuania made an impressive breakthrough by being one of the most rapidly growing countries in the EU in the field of research and innovations. Increasing funding for research gives more opportunities to understand the process and take the necessary steps to solve the problems. It also shows the importance and high

Lithuanian ambitions in the field of science. In 2020 research and development expenditure amounted to 572 million EUR, which is almost 20% more than in the previous year.

Lithuania has participated in the Smart Specialization Strategy during the life-span of the 2014-2020 programming period. Smart Specialization is a strategic programme of state support for research development and innovations in which Lithuania, like other European Union countries, has set its priorities, considering existing or potential competitive advantage. One of the priority areas of the Smart Specialization Programme is "Energy and sustainable environment", which has close links to influencing climate change. The main priorities of the "Energy and sustainable environment" priority area are the following: smart systems for energy efficiency, diagnostic, monitoring, metering and management of generators, grids and customers; energy and fuel production using biomass/waste and waste treatment, storage and disposal; technology for the development and use of smart low-energy buildings – digital construction; solar energy installations and technologies for using them for the power generation, heating and cooling.

National Research Programs (hereinafter – NRPs) are competitive scientific programs, which enable solving problems of state and society and increase the international competitiveness of Lithuanian science. The purpose of the NRPs is to bring together Lithuania's scientific potential and financial resources, to initiate new research and to coordinate already existing research in order to solve a given problem. One of the five National Research Programmes approved by the Research Council of Lithuania in 2013 provides competitive funding for research in a climate change research field. The NRP "Sustainability of agro-, forest and aquatic ecosystems", approved by the Government of the Republic of Lithuania started in 2015 and ended in 2021. The overall budget was EUR 6.6 million EUR. The purpose of the programme is to understand and be able to forecast the general effects of climate change and the intensive use of ecosystem resources and to obtain new fundamental and empiric knowledge to enable the avoidance of threats related to these effects.

A large number of research institutes and universities carry out research on climate change impacts, adaptation and mitigation in Lithuania: marine and inland water management and protection, climate change in peatlands, energy sector development research, modelling of long-term GHG emission reduction strategies, use of renewable energy sources, assessment of geothermal energy resources, sustainable forestry and global changes, the resistance of plants to drought and cold, sustainable animal production systems etc. Lithuanian scientific institutions are also actively involved in research activities in support of the national greenhouse gas inventory and projections development.

Lithuanian GCOS related activity is coordinated by the Lithuanian Hydrometeorological Service under the Ministry of Environment. It performs climate observations, analyzes climate changes, provides information and actively participates in the activities of Eastern and Central European working groups.

1.8 Education, training and public awareness

Lithuanian population and government pay more and more attention to the issue of climate change, and the topic comes popular in public debates or in the press. Every year institutions, businesses, NGOs and communities get involved in raising awareness of the most pressing climate change issues.

Education

The Ministry of Education, Science and Sport is responsible for the coordination of education. The relevant legislative provisions are the Law on Science and Higher Education, Law of Technology and Innovation along with the relevant ordinances.

The education and higher education studies which are offered by Lithuanian scientific institutions have successfully integrated various aspects of climate change issues. School children and students have a lot of possibilities to broaden their knowledge in sustainable development, analysis of ecosystems sensitivity, management of resources, environmental impact assessment, adapting to climate change, modelling and forecasting climate change. Also, climate change education is possible through public awareness campaigns and projects implemented by different organisations.

Public outreach

Communication about climate change is performed by different ministries and organisations, each within the sphere of their own responsibilities and tasks. Starting in 2019, the Ministry of the Environment is launching an annual Climate Week, with a wide range of events in municipalities, and educational institutions are especially active.

Non-governmental organizations (NGOs) are also important in the development of climate change policy. NGOs also organise events related to climate change, participate in the development of national and international legislation, preparing publications about climate change.

The public is grasping the importance of individually contributing to the protection of the environment, including combating climate change. European Mobility Week, European Week for Waste Reduction, ‘Velomarathon’, ‘Earth Hour’, ‘Ėjimas’, National Reforestation Day and other campaigns can be good examples of civic initiatives in Lithuania.

NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

2. NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVALS

2.1 Government structure

The governance of the Republic of Lithuania is performed by the Seimas (Parliament), the President of the Republic and the Government as well as the Judiciary according to the Constitution of the Republic of Lithuania (enacted by citizens of the Republic of Lithuania since 25 October 1992).

The Constitution of the Republic of Lithuania lays down that the Seimas of the Republic of Lithuania consist of 141 representatives of the Nation, who are elected for a four-year term. The Seimas debates, adopts and passes laws, gives or does not give its assent to the candidate proposed by the President of the Republic for the post of the Prime Minister (head of the Government), supervises the activities of the Government, approves the State Budget and supervises its execution, establishes state taxes, calls elections to municipal councils, and ratifies international treaties of the Republic of Lithuania. The Seimas forms committees for consideration of draft laws and standing and other ad hoc commissions for resolving issues of narrower scope.

The Government consists of the Prime Minister and ministers. The Government represents the executive power in Lithuania. It resolves public issues by taking the majority-vote decisions in its sittings. The Government has the right to a legislative initiative at the Parliament (Seimas). The Government adopts resolutions on Seimas draft laws and other proposals submitted to the Seimas. The Government, among the other responsibilities, executes laws and resolutions of the Seimas concerning the implementation of laws as well as decrees of the President; coordinates ministries and other governmental agencies; drafts a public budget and submits it to the Seimas; executes the public budget.

There were 14 ministries in the Republic of Lithuania in 2022. The ministries are set up to formulate public policy, as well as to organize, coordinate and monitor its implementation in areas assigned for the minister's competence.

The Ministry of Environment is the main institution forming the country's state policy of environmental protection, forestry, utilization of natural resources, geology and hydrometeorology, territorial planning, construction, provision of residents with housing, utilities and housing, as well as coordinating its implementation, has made a significant contribution to climate change regulation. Having assessed the data of environmental observations, taken into consideration the conclusions of scientific institutions and public opinion and following the existing strategic documents and preparing the legal bases, the goals of the Ministry of Environment and its subordinate institutions are as follows:

- To implement the principle of sustainable development;
- To set preconditions for rational utilization, protection and restoration of natural resources;
- To ensure provision of information about the state of environment and its forecasts to the public;
- To create conditions for the development of construction business and the provision of residents with housing;

- To ensure a proper environmental quality, taking into account the norms and standards of the European Union.

After the Seimas ratified the UNFCCC (1995) and the Kyoto Protocol (2002), most of the obligations of international agreements implementation and the related policy-making responsibilities laid down on the Ministry of Environment and a number of other ministries and institutions supervised by relevant ministries are involved in the implementation of this policy. The Ministry of the Environment is the national focal point of the UNFCCC. More information about the institutional framework of Lithuania's climate policy is presented in Section 4.1.

2.2 Population profile

Generally, changes in the population are considered to be one of the factors that influence energy consumption and the dynamics of GHG emissions accordingly.

The population of Lithuania has a declining trend. From 2005 to 2022, the resident population declined by 549.2 thousand, or 16.4%. At the beginning of 2022, the estimated resident population of Lithuania amounted to 2 806.0 thousand, i.e. 4.7 thousand (0.2%) less than at the beginning of 2021. The decline in the resident population in 2021 was caused mainly by the natural decrease (positive net international migration was observed in 2021).

In 2005-2022, due to negative net international migration, the population declined by 345.5 thousand (61.2% of the total decline), due to the natural decrease – of 218.8 thousand (38.8% of the total decline). The highest negative net international migration was recorded in 2010. The increase in the number of emigrants was influenced by an obligation for usual residents of the country to pay compulsory health insurance contributions, laid down in the Law on Health Insurance of the Republic of Lithuania; it also gave an impetus for those already living abroad to declare their departure.

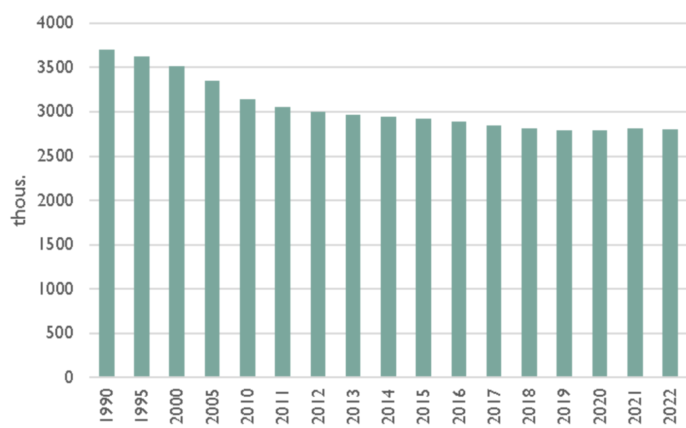

Figure 2-1. Number of population in Lithuania in 1990-2022, thous.

At the beginning of 2022, 1 913.4 thousand (68.2%) residents of Lithuania lived in cities and towns, 892.6 thousand (31.8%) – in rural areas. From 2005-2022, the urban resident population decreased by 14.3%, and the rural resident population – by 20.4%.

At the beginning of 2022, the population density in Lithuania was 43.0 persons per square kilometre (at the beginning of 2005 – 51.4 persons).

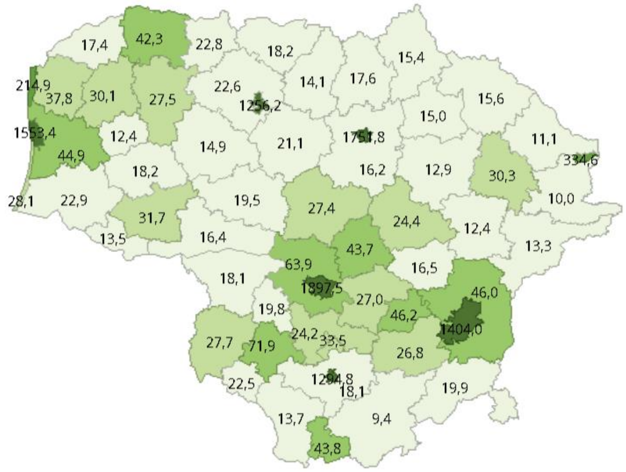

Figure 2-2. Map of population density in Lithuania in 2022, inh./km²

The number of women in Lithuania was 192.8 thousand higher than that of men (1 482.1 thousand and 1 313.6 thousand, respectively) at the beginning of 2022. As a result, women accounted for 53.4% of the total resident population; there were 1 148 women per 1 000 men (this indicator has not changed compared to 2005 – at the beginning of 2005, 53.4% and 1 148, respectively).

In 2021, life expectancy at birth for men was 69.6 years, and for women – 78.9 years (in 2015, 69.1 and 79.6 years, respectively). In 2021, the difference between life expectancy at birth for men and women was 9.3 years.

2.3 Geographic profile

Lithuania is a Central European country on the eastern coast of the Baltic Sea. The size of the territory is 65 302 km².

The current coordinates of the borders of Lithuania's territory are between 53°54' and 56°27' Northern latitude and between 20°56' and 26°51' Eastern longitude. From East to West, the territory of Lithuania goes up to 373 km, from North to South – 276 km. Our country has borders with five neighbouring countries. In the North, Lithuania has a 588 km long border with Latvia, in the East and South – a 660 km long border with Belarus. The neighbouring countries in the south-west are Poland (the length of border is 103 km) and the Russian Federation (273 km). More than three quarters of the Lithuanian borders stretch along rivers and lakes. Lithuanian economic zone in the Baltic Sea (6 400 km³) meets the Swedish waters. The length of the Lithuanian coast is 90.6 km.

Lithuania is the region of plains. The highest hill is 293.8 m above sea level. The country's territory consists of clayey plains (55.2% of the country territory), sandy plains (17.8%), hilly moraine uplands (21.2%), coastal plains (2.2%) and river valleys (3.6% of the territory).

More than half of the Lithuanian land is suitable for agriculture, i.e. the land area used for agricultural production. Changes in land use since 1990 are shown in Table 2-1. The areas of forest land, grassland and settlements have increased, while the areas of cropland, wetlands and other land have decreased.

Table 2-1. Land uses (based on the 2006 IPCC Guidelines land uses classification) in 1990 and 2020, ha

Land use	1990	2020	Change
Forest land	20 541.54	22 222.72	8.18%
Cropland	24 147.49	20 106.27	-16.74%
Grassland	12 870.41	15 422.13	19.83%
Wetlands	3 813.60	3 613.94	-5.24%
Settlements	3 474.17	3 841.56	10.57%
Other land	439.26	79.87	-81.82%
Total	65 300	65 300	-

According to the State Forest Service records, in 2020, the forested areas accounted for 33.7% of the total area. Currently, there are 255.4 thousand private forest owners in Lithuania, owning 923.8 thousand ha of forest. Private forests make up 42% of all forests.

After the restoration of independence, the area of protected areas of Lithuania has been rapidly increasing; from 1990 to 2022, it increased from 327.1 to 1 183.7 thousand ha and reached 18.1% of the country's territory. At present, the system of protected areas in Lithuania consists of 3 strict state nature reserves, 2 strict cultural reserves, and one small strict reserve, five national parks, 30 regional parks, 402 state reserves and 112 municipal reserves.

Rivers in Lithuania occupy yan area of 332 km^2, 0.5% area of the country. Lithuania has 22.2 thousand rivers and streams (waterways), with the total length of 76.8 thousand km. The longest river is Nemunas (its length in the country is 475 km), Neris (235 km), Šešupė (209 km).

Lithuania has 2 585 lakes and 1 039 reservoirs (ponds) with an area exceeding 0.5 ha. The total area of lakes amounts to 886.9 km^2. The deepest Lithuanian lake is Tauragnas, with a maximum depth of 62.5 m.

Small (up to 50 ha) swamps are predominant. Among the vestigial are mostly wetland mires (71%) and wetland bogs important from the geo-ecological approach (22%).

The country has sought and examined 17 types of mineral resources. In 2020 the following valuable mineral resources were registered in Lithuania: oil, therapeutic peat, peat, limestone, dolomite, opoka, sapropel, anhydrite, plaster, chalk marl, travertine, clay, sand and gravel.

2.4 Climate profile

The Lithuanian climate is formed and affected by global factors and local geographical circumstances. Key features of the climate depend on the geographical location of the territory. Lithuania is located in the northern part of the temperate climate zone. The second global factor is the prevailing westerly airflow. Lithuanian territory, as the whole European region, lies in the area of influence of the Atlantic Ocean and westerly airflow, with air temperature, precipitation and runoff patterns, sea level and other parameters being largely determined by the North Atlantic Oscillation.

Climate is also influenced by the local landscape. Uplands, lowlands, plateaus and hills in Lithuania are positioned in parallel or sub-parallel to north-south meridians. Important local geographical factor is a fact that South-Eastern part of the Baltic Sea does not freeze and the sea warms Lithuanian coastal region.

In accordance with Boris P. Alisov climate classification, most of Lithuania's territory is assigned to the southwestern sub-region of the continental forest region of the middle latitudes of the Atlantic Ocean. Only the Baltic Sea coastal region is closer to the climate of Western Europe and the climate can be attributed to individual Southern Baltic climate regions.

<u>Temperature</u>

In 2021 new climate norms describing average climate conditions have started to be used in Lithuania. Statistics have been calculated based on weather observations from the 1991-2020. The mean temperature of Lithuania in the new normal period is 7.4°C which is 0.5 degrees warmer than in the previous one (1981-2010). Compared with the 1961-1990 period the average temperature has already risen by about 1.2 degrees, which shows climate warming. The smallest change has been observed in October and the greatest has been in January and February. In Lithuania mean annual air temperature in 2018-2022 compared to 1991-2020 period was 0.9°C higher. The year 2020 with the average annual air temperature of 9.2°C was the warmest and 2019 with the average annual air temperature of 8.8°C was the second warmest year since 1961. In Figure 2-3 average annual air temperature is presented.

Figure 2-3. The average annual air temperature in 1981-2020 years, °C

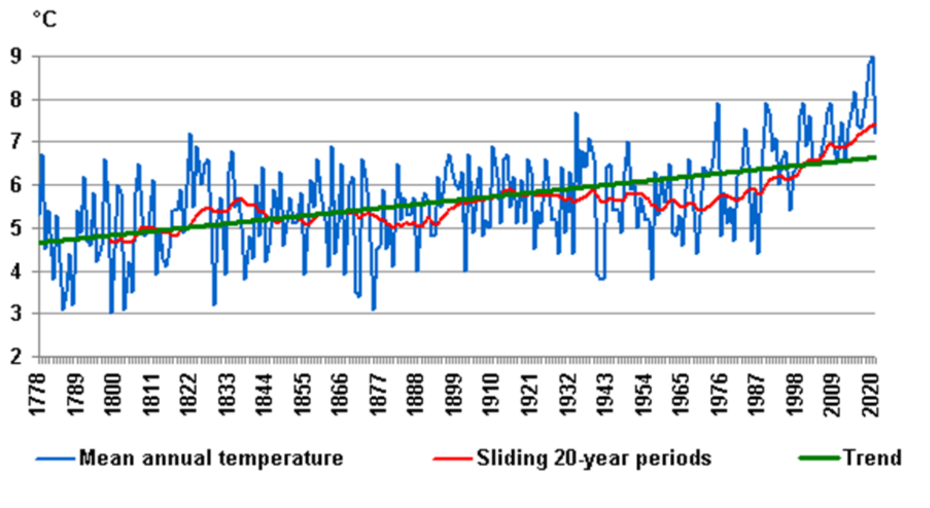

Figure 2-4. The average annual air temperature in Vilnius 1778-2022, °C

The average annual air temperature in Vilnius in 1778-2022 is presented in Figure 2-4. Air temperature rising trend is greatest from the second part of 20th century.

The hottest month in Lithuania is July; the coldest is January. In the period from 1991 to 2020, the average temperature in July was about 18.3°C and in January – about -3.2°C. In the period from 2018 to 2022 the average temperature in July was about 18.6°C, in January – about -3.2°C (Figure 2-5).

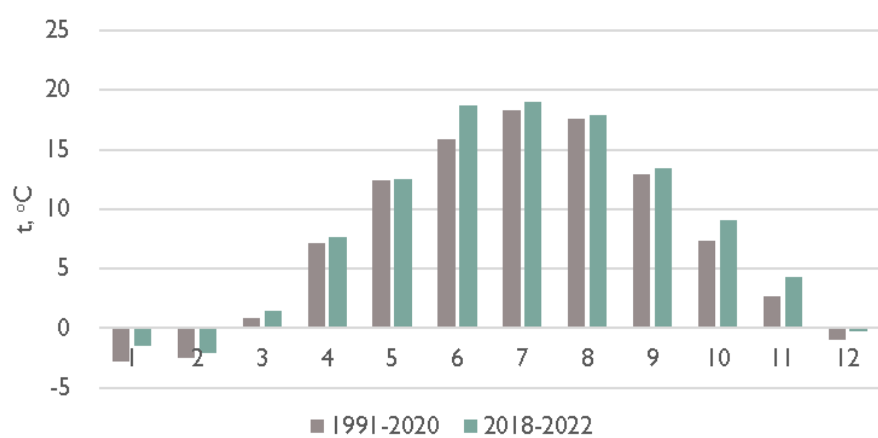

Figure 2-5. Average monthly temperature in Lithuania in 1991-2020 and 2018-2022, °C

At the end of the 20th century the number of extremely hot days with the daily maximum air temperature equal to or above 30°C has increased. In 1991-2020 on average about 4-5 days per year maximum temperature was equal of higher than 30°C. Compared to 1961-1990 the number of hot days has increased more than 3 times. The number of extremely hot days in 2018-2022 compared to 1991-2020 has increased and was about 7 days per year. The highest probability is in southern and south-western Lithuania.

Meanwhile, frosty days when the daily minimum air temperature drops to -20°C and below have decreased significantly. In the period of 1991-2020 on average 3 cold days occurred during winter (from 1 day in the seaside to 5 days in the Eastern Lithuania). Compared to the 1961-1990 period, the number of cold days decreased approximately 2 times. The number of cold days in 2018-2022 compared to 1991-2020 period has decreased and was on average less than 2 days per year. It was found out that the change in the probability of extremely hot and cold days originated mainly due to higher rates of recurrence of anticyclone processes during the summer and less frequent in winter.

Precipitation

The 1991-2020 climatic normal precipitated rainfall is 695 mm. More precipitation drops in west side (Figure 2-6). Compared with the 1961-1990 period climate normal amount of annual precipitation increased approximately by 3 percent. The most humid was warm period of the year.

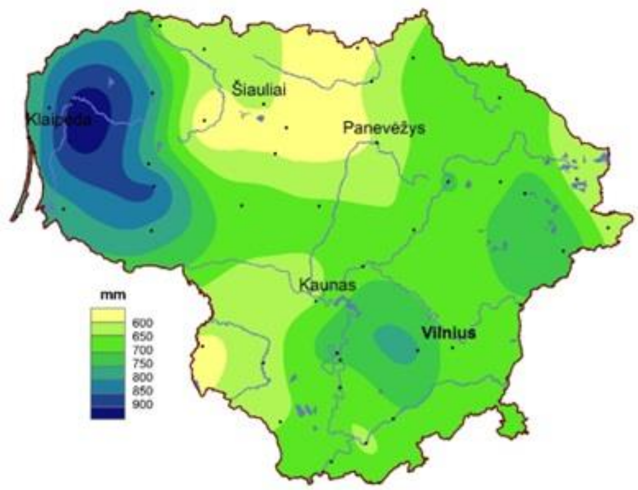

Figure 2-6. The average annual precipitation in 1991-2020, mm

The year 2017 was particularly rainy – 904 mm which is 130% of climatic normal. In 2017 autumn rainfall significantly exceeded the average multi-annual rainfall: fell 343 mm – 182% of climatic normal. Meanwhile 2018 was particularly dry – 565 mm which is 81% of climatic normal. The amount of precipitation in 2019, 2020, 2021 was a little bit less than climatic normal.

Lithuania is an excess irrigation area with increasing recurrence of warm season drought (years 1992, 1994, 2002, 2006, 2018, 2019). Due to the climate change, precipitation patterns in Lithuanian territory are changing differently – in some places it is increasing, elsewhere decreasing (however, these changes are not very large). But there is the tendency that precipitation is increasing in Lithuania during the cold season and decline in the warm season. The share of liquid precipitation in the cold period is increasing. In Figure 2-7 is presented the average annual rainfall in Vilnius, 1887-2016.

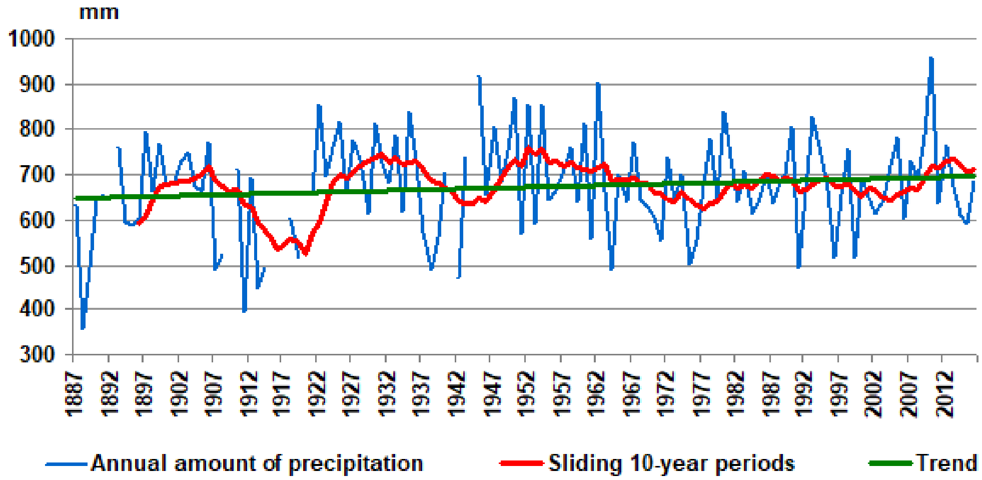

Figure 2-7. The average annual rainfall in Vilnius in 1887-2016, mm

<u>Solar radiation</u>

The average annual duration of sunshine in Lithuania is 1917 hours (based on data of 1991-2020 climatic normal). The longest sunshine duration occur in the Curonian Spit and at the seaside part of Lithuania, ranging between 1 997 and 2 076 hours (Figure 2-8). Towards to the east, the duration of the sunshine time decreases. The shortest duration of sunshine is in the southeastern part of Lithuania – 1 769 hours. The annual duration of sunshine differs by about 300 hours between the western and eastern regions. The longest duration of sunshine in Lithuania is in May and July (283 hours) and the shortest in December (29 hours).

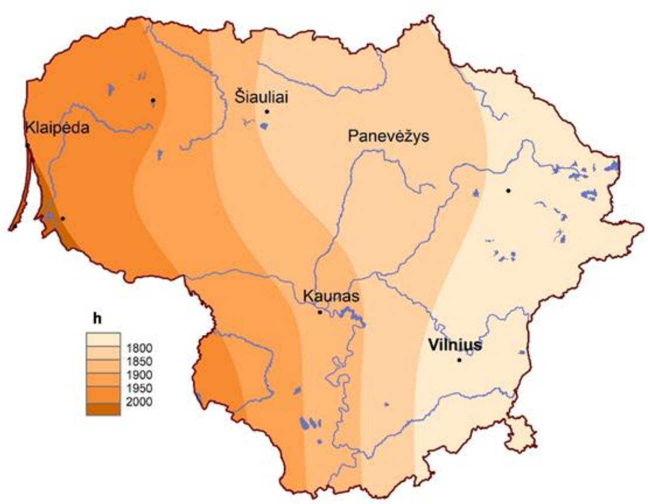

Figure 2-8. Duration of sunny hours in 1991-2020 years

Over the last five years, the duration of sunshine in Lithuania has been increasing. The number of sunny hours over the period 2018-2021 has increased by 3.7% compared to the 1991-2020 climate normal. During this period the average duration of sunshine was about 1 988 hours – 71 hours longer than climate normal, which is 1 917 hours. The increased number of hours of sunshine also can be seen by comparing the climate normal for 1981-2010 and 1991-2020: in the former case, the climate normal is 1 871 hours, and in the latter case 1 917 hours (increased by 2.5%).

In Lithuania the average general solar radiation to the horizontal surface during the year is about 3 750 MJ/m^2 (half less than the equatorial areas). However, the quantity per year is distributed very unevenly: in June solar radiation amounts to 17% and in December it makes just 1% of the annual volume. Annual global solar radiation is the highest in Curonian Spit and south-western Lithuania, while the lowest is in south-eastern, middle Lithuania and Venta middle-course plains. Solar radiation in the coastal area is higher in spring and autumn. In winter spatial differences in global solar radiation in Lithuania are not high. The total solar radiation measured at the Kaunas and Šilutė actinometric observation stations in the 2018-2021 period was 4048 and 4104 MJ/m^2, which is 12% and 6% higher than the 1991-2020 long-term average values 3627 and 3865 MJ/m^2.

<u>Wind</u>

The 1991-2020 climatic normal of mean wind speed in Lithuania is 3.1 m/s (Figure 2-9) (in 1961-1990 climatic normal was 3.7 m/s). The strongest winds blow from November to January (at the seaside 5 m/s, elsewhere approximately 3-4 m/s), the weakest – from May to September (at the seaside 3-4 m/s, elsewhere 2-3 m/s). In autumn and winter the most often south, south-west and west winds are blowing, while in summer – west and north-west winds dominate. Most, by 0.5-1.1 m/s, winds weaken in Klaipėda in the late summer and autumn (Figure 2-9).

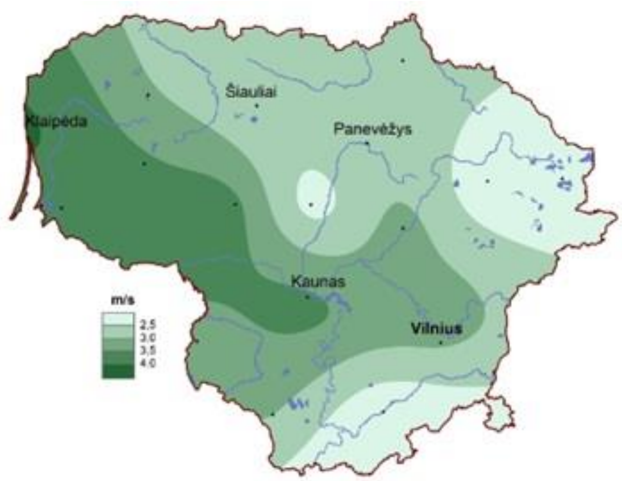

Figure 2-9. The average annual wind speed in1991-2020, m/s

When wind speed increases to 15 m/s it is perceived as a dangerous meteorological phenomenon. In Lithuania 15 m/s and stronger wind blows on average for 24 days (from 52 days at the seaside to less than 10 days at the eastern part of Lithuania) per year.

The maximum wind gusts speed at the Baltic Sea can reach 35-40 m/s and in other places of Lithuania a little bit less. Analyzing the maximum wind speeds during the period of 1991-2022 no significant changes have been identified in their long-term trends. However, it should be noted that frequency of winds with hurricane strength may increase as a result of climate warming.

2.5 Economic profile

Lithuania has experienced substantial political and economic changes since regaining its political independence in 1990. Vast economic reforms include price liberalisation and privatisation of small and medium enterprises during the period from 1991 to 2000. National currency was implemented in 1992-1993 which allowed controlling inflation via national monetary policy. During the first decade of market reforms the institutional aspects of the transition was of the biggest national and international concern and culminated with a granting of a functional market economy status upon EU accession in 2004. On 1st January 2015, Lithuania became the 19th country to adopt the euro.

The country's economy and macro-economic were the main indicators which described the development of the country over the last decade. During the period from 2000 the most rapid economy development was witnessed in 2003 (GDP growth, compared with the previous year, amounted to 10.5%), after recovery from the Russian crisis (in 1999 GDP decreased by 1.1%). In the later years, GDP growth was slightly slower, but exceeded 7% annually. In 2007 the growth of GDP rocketed and reached 11.1% comparing with 2006. Lithuania was among the most rapidly developing countries in the EU during this period. The global economic recession in 2008 affected Lithuania as well followed by GDP growth just by 2.6% and its decrease to negative factor in 2009 (-14.8%). The annual estimates of macroeconomic indicators for 2011 show an economic revival – GDP grew by 6%. In the 2012-2016 period GDP growth was moderate, reaching 3% value on average. Strong household consumption, supported by robust real wage growth, investment and increasing exports are the main GDP growth drive. Lithuania has reached decoupling emissions from economic growth. In the period 1990-2020 GDP increased by 76% and GHG emissions were reduced by 58%.

In 2018 Lithuania's economy grew rapidly – the less favourable impact of the international environment was outweighed by strong domestic demand, especially household consumption, which was determined by the cessation of the decline in employment and more moderate inflation. Although in 2019 was marked by adversity in the international environment, but this did not slow down the development of the Lithuanian economy. In the first half of the year of 2020, the economic recession caused by the pandemic in Lithuania was among the smallest in the EU countries. The spread of COVID-19, which was significantly higher than in Lithuania, and the subsequent restrictions in Lithuania's main trade partners led to a decrease in the export of goods and services, but due to an even stronger decrease in the import of goods and services, net exports contributed positively to the development of GDP in the last quarters.

In the Figure 2-10 below GDP and GHG emission index alteration is shown since 1990 to 2020.

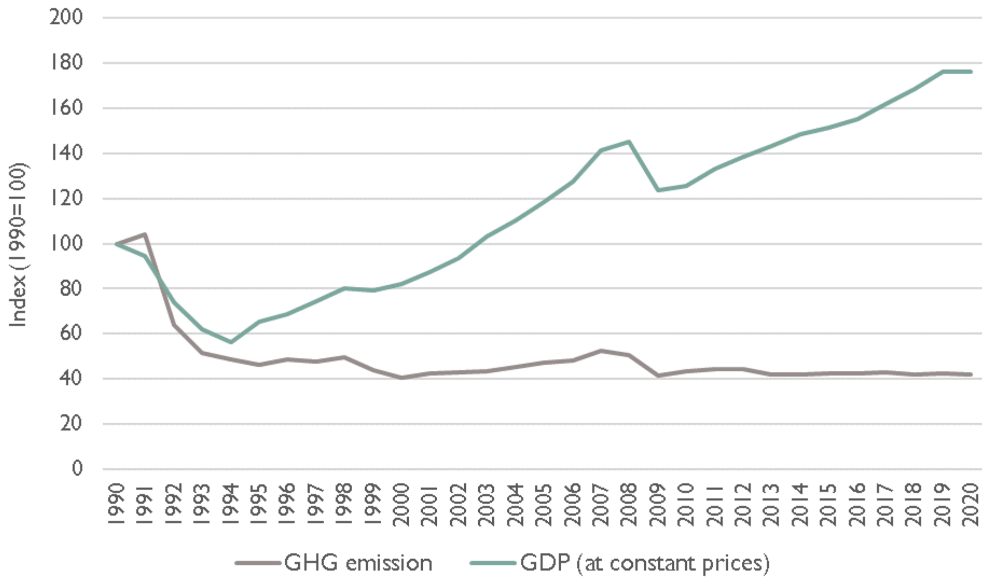

Figure 2-10. GDP and GHG emission index of Lithuania in 1990-2020

Lithuania's economy exited the COVID-19-crisis successfully and was growing fast until early 2022, buoyed by rising exports and rapid integration into global value chains. However, with Russia's aggression of Ukraine continuing and its consequences spreading, the outlook has darkened. Growth has slowed, and inflation has risen to some of the highest levels in the euro area, driven by high energy and food prices. The country cut all energy ties with Russia, relying on imports from other countries instead. The government supports the many Ukrainian refugees and helps households and firms weather the energy crisis. Structural unemployment and skills mismatch remain high, while poverty declines only slowly. Further reform could help maintain economic resilience and cope with rising uncertainty. Reducing the scope of state-owned firms and improving their governance would help raise productivity. Linking education to labour market needs more closely would help improve employment and skills. Greater uptake of digital technologies by firms, along with a modernised public sector and strong skills will also help lift trend growth. Reaching the climate objective of net zero emissions by 2050 will require bold policy action, both on the tax and the spending side.

Inflation rate in Lithuania has been constantly changing. Since 2000, it has been rapidly decreasing, in 2003 it was even a deflation, but in 2004 inflation began to rise again and reached the highest value in 2008 before the crisis. Over a ten-year period (2021, against 2012), prices for consumer goods and services increased by 16.8%. The highest (4.7%) average annual inflation was recorded in 2021, while deflation (-0.9%) – only in 2015. Within the said period, the highest average annual price growth was recorded for services of hotels and restaurants (56.4%), alcoholic beverages and tobacco products (40.2%), education (38.2%), while drop – communication goods and services (13.3%). In the figure below the annual average inflation in per cent is presented.

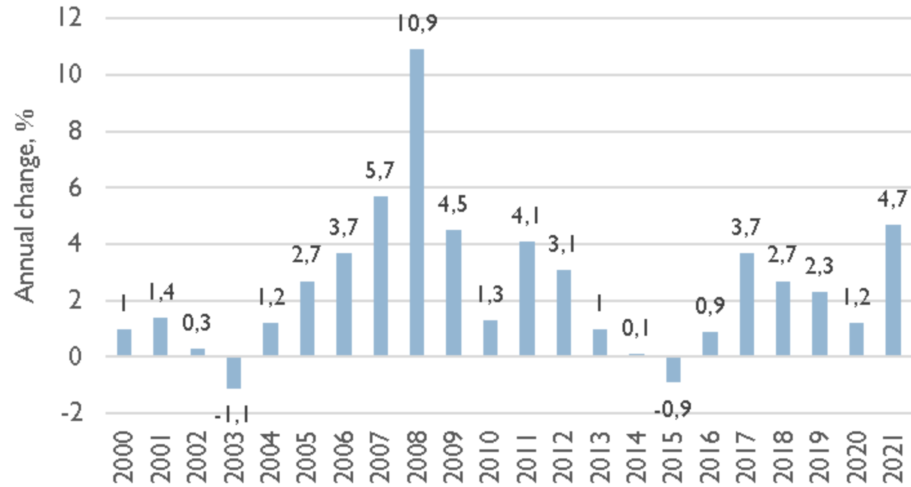

Figure 2-11. Annual change in inflation, %

Gross value added (GVA) by the type of economic activity is presented in the Figure 2-12. In 2021 the main economic activity in Lithuania was service sector (wholesale and retail trade, transport, accommodation and food service activities), followed by industry. Industry contains mining and quarrying, manufacturing, electricity, gas and water supply.

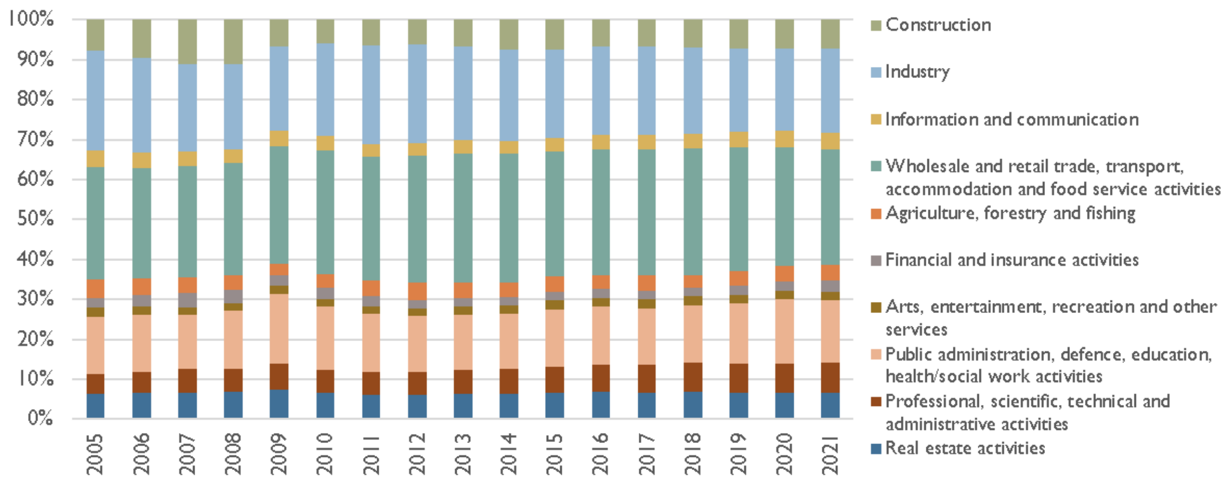

Figure 2-12. Structure of gross value added by economic activity (at current prices), %

Based on final data obtained from customs declarations, Intrastat reporting and VAT returns data, in 2021, exports of goods amounted to 34.58 billion EUR, imports – 37.77 billion EUR (see Table 2-13). Exports of goods of Lithuanian origin amounted to 21.47 billion EUR. The foreign trade deficit amounted to 3.20 billion EUR. In 2021, compared to the same period of 2020, exports increased by 20.5%, imports – 29.6%. The increase in exports was influenced by an increase in exports of petroleum products (74.1%) (amount in tonnes increased by 5.8%), furniture (22.4%), plastics and articles thereof (26.6%). The increase in imports was determined by an increase in imports of crude petroleum (68.6%) (amount in tonnes increased by 3.1%), ground vehicles (28.7%), plastics and articles thereof (40.1%).

Figure 2-13. Lithuania's imports and exports in 2000-2021, EUR million

In 2021, Lithuania mainly exported products of the chemical and allied industries (15.1%), machinery and mechanical appliances, electrical equipment (13.6%) and mineral products (10.3%); the largest imports were in machinery and mechanical appliances (17.9%), mineral products (17.4%), and chemical and allied products (12.2%). As for the goods of Lithuanian origin, the largest share in exports fell within products of the chemical and allied industries (13.9%), miscellaneous manufactured articles (12.5%), petroleum products (12.4%), prepared foodstuffs, beverages and spirits, tobacco and manufactured tobacco substitutes (8.7%).

The biggest proportion of goods was exported to the EU Member states – 57.6% of total exports from Lithuania (share of goods of Lithuanian origin – 66.2%). The biggest proportion of imports was also from the EU member states – 67.7% of total imports to Lithuania.

In 2021, there were 298.8 thous. enterprises in operation in the country – slightly more than one enterprise per 10 residents. Over a year, the number of enterprises increased by 6%, in the decade – almost twice. Most enterprises are engaged in trade activity. The number of small partnerships is growing rapidly, 200.2 thousand persons are self-employed. The majority of enterprises operating in Lithuania are very small enterprises with up to 9 employees, and they employ 41% of all persons engaged in business. The vast number of enterprises are involved in trade.

2.6 Energy

From 1990 to 2020 total primary energy consumption in Lithuania decreased by about 53%. Oil and oil products were the most important fuel in Lithuania over the previous decade. Since 2000 their share in the primary energy balance has been fluctuating about 31.5% with the smallest portion of 23.7% in 2003 and the largest share of 39.2% in 2018. The major factors influencing changes in the role of oil products were decreasing consumption of heavy oil products for production of electricity and district heat and growing consumption of motor fuels in the transport sector. In 2010 due to the closure of Ignalina Nuclear Power Plant

(NPP) the share of oil products increased to 36.2%. In the latest years the large share of oil products is caused by growing demand of motor fuel in transport sector. Dynamics of primary energy consumption in Lithuania during 1990-2020 is presented in Figure 2-14.

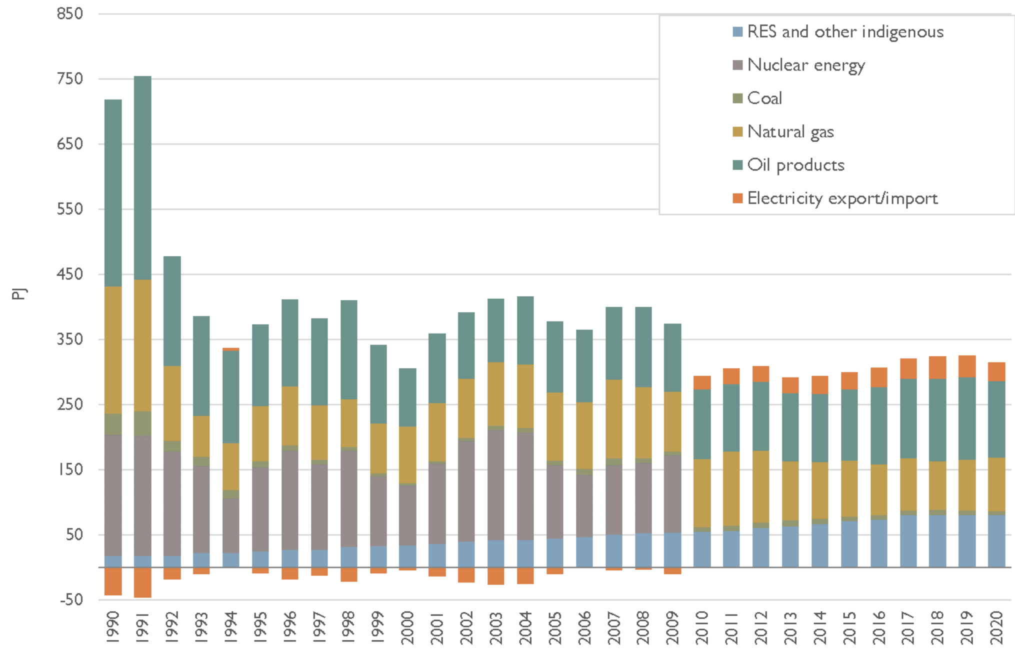

Figure 2-14. Primary energy consumption in Lithuania

At present natural gas is the most important fuel in the Lithuanian primary energy balance. The share of natural gas was fluctuating about 28.1% over the period 2000-2020. Total consumption of natural gas decreased owing to reduction of its use for non-energy needs (mineral fertilizers production) in 2008 and 2009. The consumption of natural gas started to decrease since 2011 and in 2020 its share was 26.2% in the balance of primary energy consumption.

During the period 1990-2009 the share of nuclear energy was very high and amounted about 33.3%. Nuclear fuel helped to increase the security of the primary energy supply, especially in the power sector. It is important to note that a large portion of electricity generated by this power plant was exported. Lithuania during the last decade was a net exporter of electricity and for instance in 2004 more than 37% of electricity generated by Ignalina NPP was exported to neighboring countries. During the process of accession into the EU, one of the country's obligations was a decision on the early closure of Ignalina NPP. In 2014, the share of electricity generated by all Lithuanian power plants was about 37% in the balance of gross electricity consumption and 63% of electricity necessary to meet internal requirements was covered by electricity import.

Over the period 2000-2020 the share of coal in the primary energy balance was fluctuating about 2.2% with the lowest value of 0.9% in 2001 and the highest value of 3.26% in 2013. Comparison of the primary energy consumption structure in 1990 and in 2020 is presented in Figure 2-15.

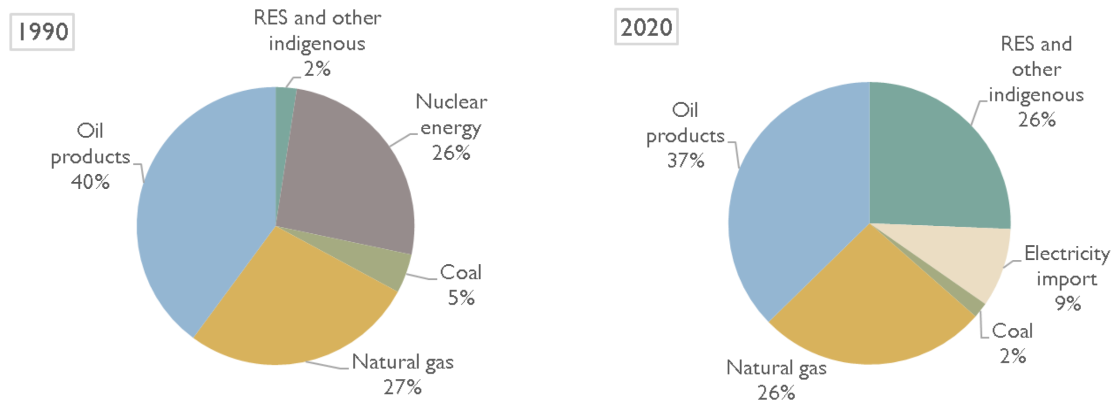

Figure 2-15. Structure of primary energy consumption in Lithuania

The vast majority of Lithuania's energy consumption comes from imports. This is mainly due to the dependence of natural gas, crude oil and NGL from Russia and other non-EU countries. For natural gas, however, the LNG Terminal in Klaipėda, which was put in operation in December 2014, has allowed for significant diversification of gas import. The Klaipėda LNG terminal significantly enhanced security of natural gas supply for all consumers in the Baltic States by providing an alternative gas supply source. The terminal regasification capacities are sufficient to cover around 90% of all current demand of the Baltic States. From 2022 Lithuania has stopped Russian oil, natural gas and electricity imports. Lithuania's gas needs are endured via the Klaipėda LNG terminal with cargoes from the US, its electricity needs are met through local power generation and imports from EU countries through existing interconnections with Sweden, Poland and Latvia, while JSC Orlen Lietuva, the only oil importer in Lithuania, refused to import Russian crude oil.

Contribution of renewable energy sources into the country's primary energy balance during the period 1990-2020 is increasing. During the period 1990-2021 primary energy supply from renewable sources increased by 5.8 times with an average annual growth of 5.7%.

Lithuania has undertaken, according to Directive of the European Parliament and of the Council No 2009/28/EC on the promotion of the use of energy from renewable sources, to increase the renewable sources share in the final national energy consumption up to 23% by 2020. Lithuania has already over-reached the 23% target: in 2020, the share of renewable energy sources in the gross final energy consumption of the country accounted for 26.8%.

Lithuania develops renewable energy resources on the basis of the National Energy Independence Strategy and the National Energy and Climate Action Plan (NECP), where long-term goals in the field of energy are set. The goals to be achieved for the share of renewable energy resources until 2050 have been set in total final energy consumption, heating and cooling, transport and electricity sectors. Pursuant to the Law on Renewable Energy Resources of the Republic of Lithuania, Lithuania has set the goal that by 2030 renewable energy consumption would reach at least 50%.

The consumption of renewable energy sources by energy forms are presented in Figure 2-16. Currently the main domestic energy resource is solid biomass. Solid biomass accounted for 75.6% in the balance of renewable energy sources in 2020. The second largest renewable energy source is wind energy. In 2020, a share of wind energy was 8%. Liquid biomass (bioethanol and biodiesel) accounted 6.1% of total renewable energy. Ambient heat provides 3% in the balance of renewable energy sources. The shares of biogas, hydro energy, renewable waste, solar energy, solar energy and geothermal energy were 2.3%, 1.6%, 2.9%, 0.7%, 0% in 2020, respectively.

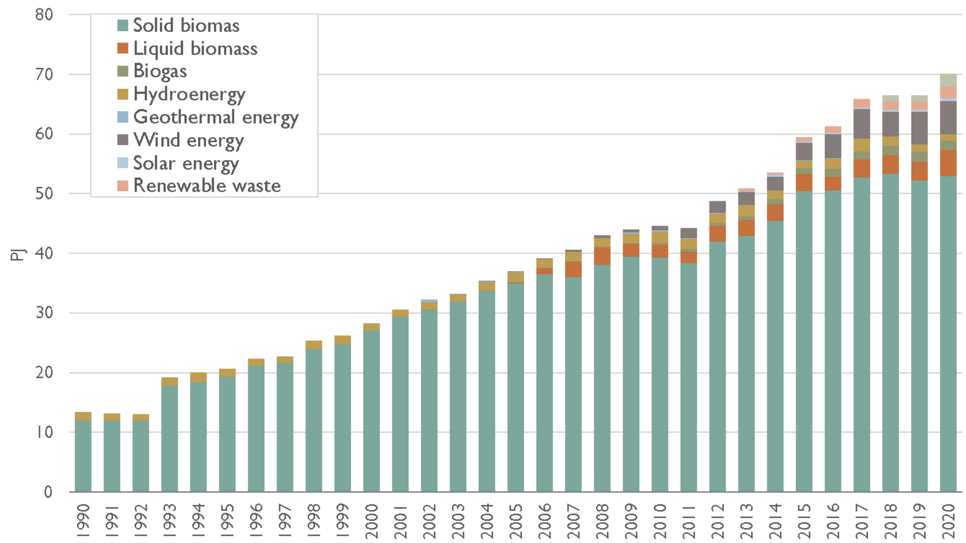

Figure 2-16. Consumption of renewable energy sources in Lithuania

Ignalina NPP played a key role in the Lithuanian energy sector producing up to 70-80% of the electricity. Even after the closure of unit 1 at the end of 2004 this power plant was dominating in the electricity market – its share in the balance of gross electricity generation in 2009 has been almost 70.7%. Therefore, the most important internal changes in the Lithuanian energy sector in 2010 are related with the final closure of Ignalina NPP (Figure 2-17). After the closure of Ignalina NPP Lithuanian Thermal Power Plant (Lithuanian TPP) is the major electricity generation source. Lithuanian TPP can cover up to 50-60% of the gross internal consumption. But the cost of electricity production at this power plant is high due to the high price of natural gas. Thus, currently more than half of the required electricity is imported from neighboring countries.

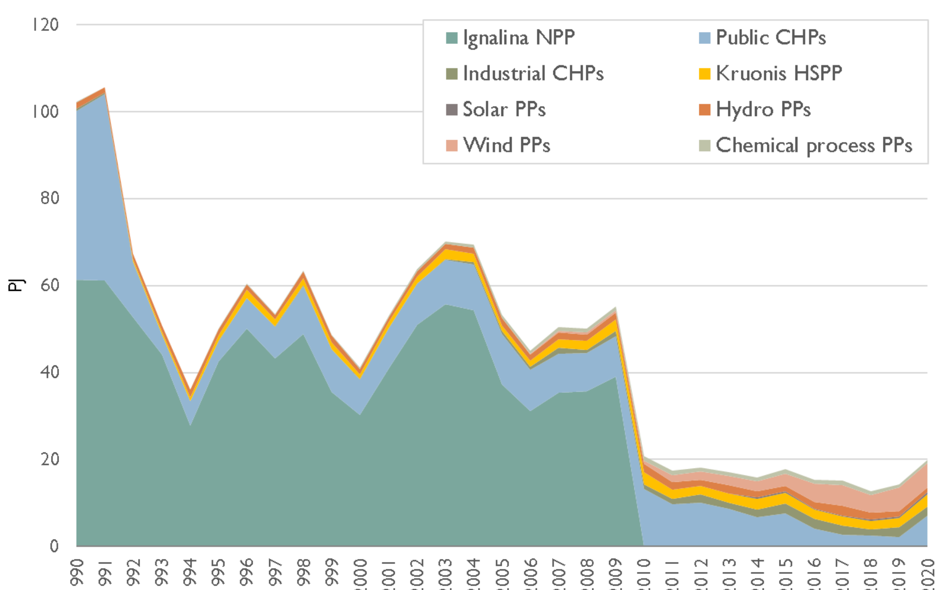

Figure 2-17. Structure of electricity generation in Lithuania

Baltic Energy Market Interconnection Plan (BEMIP) was signed in 2009 seeking to diverse and ensure the electricity supply to the Baltic States. Connecting Lithuania, Latvia and Estonia to neighboring EU countries and the internal market is the main priority of the BEMIP Action Plan. This priority requires the full implementation of the internal market rules in order to enable the three Baltic States to participate into the EU electricity market. Interconnection between Lithuania and Poland (project LitPol Link) is fully in line with the EU energy policies and National energy strategies in the region. The 500 MW power link connecting Lithuania and Poland was put into operation in December 2015. After the synchronization, the existing 500 MW LitPol Link will become available for trade with the 700 MW Harmony Link, and the LitPol Link from 2025 will be used only for system needs.

The European Commission through the European Energy Programme for Recovery provides funding for the construction electricity interconnection between the Lithuania and Sweden (NordBalt). NordBalt is a planned submarine power cable between Klaipėda in Lithuania and Nybro in Sweden. The aim of the project is to promote trading between Baltic and Nordic electricity markets, also to increase the security of power supply in both markets. Electricity transmission started in 2016.

Taking into consideration general EU energy policy, the country's energy policy is focused on gradual increase of consumption of renewable energy resources and increase of energy efficiency.

Green electricity generation has been almost stable and fully dominated by hydropower in Lithuania during the period 1990-2000 (Figure 2-18). Since 2000 green electricity generation portfolio became more diversified and renewable electricity generation volume was increasing on average by 5% per year. In 2020, electricity generation from renewable energy sources was dominated by wind power, generating about 60.3%, hydro power producing 11.7%, and biomass, biogas and municipal waste and solar energy amounted about 23.1% of green electricity. Solar electricity contribution to the structure of green electricity production was about 5% in 2020.

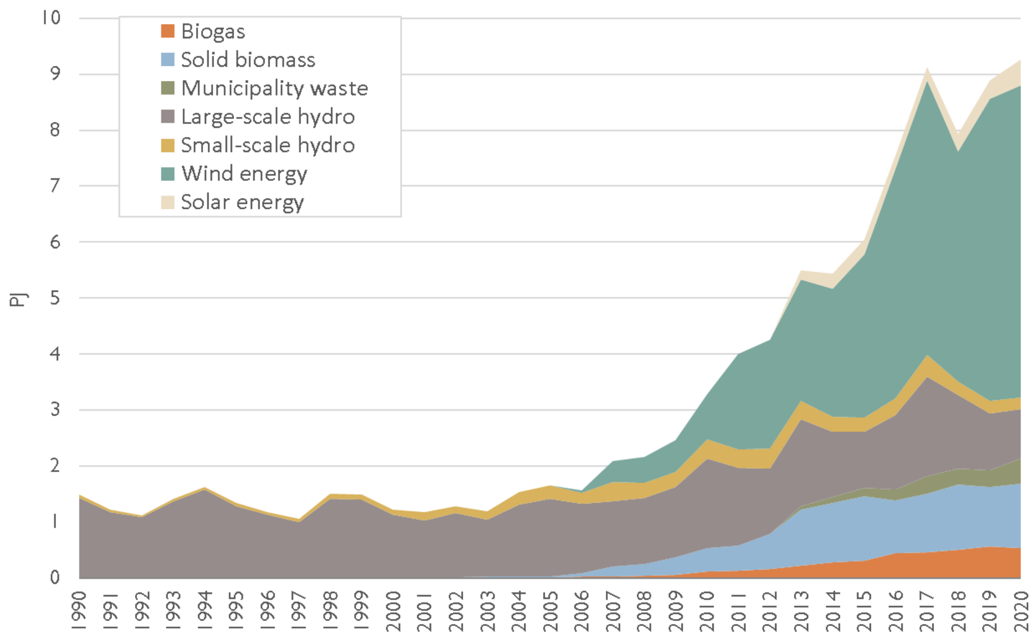

Figure 2-18. Green electricity production in Lithuania

Many factors had influence on changes of energy consumption: deep economic slump in 1991-1994, fast economic growth over the period 2000-2008, dramatic reduction of economic activities in all branches of the national economy and the closure of Ignalina NPP in 2009, a significant increase of energy prices, an increase of energy efficiency and other reasons.

Total final energy consumption (excluding non-energy use) in 1990 amounted to 405.26 PJ. In 1991-1994 final energy consumption decreased approximately by 2 times (Figure 2-19). During the period 2000-2008 the final energy consumption was gradually increasing by 3.5% per annum.

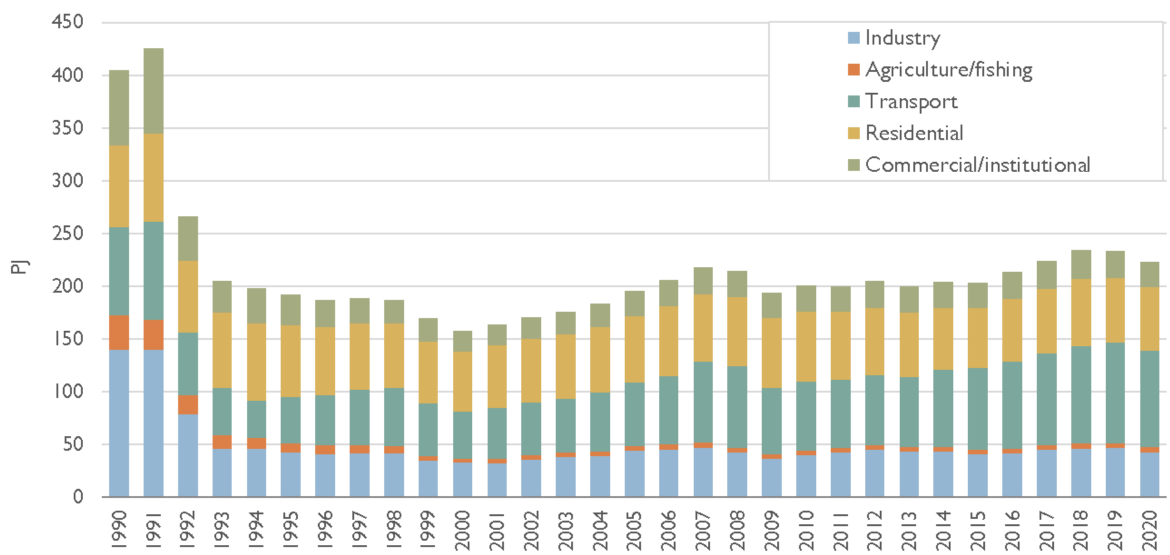

Figure 2-19. Final energy consumption in Lithuania

In 2009, total final energy consumption was by 9.5% less than in the previous year, and the most severe impact of the economic recession was in construction and transport sectors. As a result of recovering Lithuanian economy, final energy consumption started to increase from 2010. During 2011-2015 the final energy consumption remained rather stable. From 2016 final energy consumption was increasing, but in 2019 and 2020 decreased (by 0.2% and 4.4% respectively). This decrease in energy demand was influenced by COVID-19 lockdown. Due to COVID-19 energy demand significantly decreased in commercial/institutional sector, industry and transport.

Currently the transport sector is the largest energy consuming sector. In 2020, transport sector accounted 41% in the total final energy consumption. Residential sector accounted 26.9% of total final energy consumption, industry – 19.2%, commercial/institutional – 10.8% and agriculture/fishing – 2.1%.

During the transition to market economy period significant improvements in the energy efficiency has been achieved due to replacement of the old energy intensive technologies by the new innovative technologies in the industry and implementation of various energy efficiency improvement measures in other sectors of the economy.

2.7 Transportation

Lithuanian transport sector is one of the most promising sectors of the national economy. The mission of the national transport system is to ensure the harmonious public mobility and transport of goods, and to increase the country's competitive capacity in international markets.

Road transport is the best and most flexible mode of transport to deliver goods to any destination. Goods transport by road accounts for about 50% of total goods transport. Passenger transport by road accounts for about 97% of total passenger transport.

In 1993, in Lithuania were only 88 carriers licensed to carry passengers and goods, which had only 960 licensed buses and trucks. In 2018, Lithuanian carriers had 5742 licenses to carry passengers and goods, and a fleet of more than 49 thousand vehicles, of which more than 46 thousand were trucks.

According to their capacity, social and economic significance, all the roads in Lithuania are divided into: national, local and urban. The total length of the road network is equal to 84 000 km. National roads are divided in to main, national and regional roads. National roads on the basis of exclusive property rights belong to the State. Total length of national significance road network – 21 249 kilometres. There are 6 main Lithuanian roads that have been included into the E-network roads of Europe.

The current total length of the railway lines is 1 868.8 km, of which: 1 745.8 km are of 1 520 mm wide track gauge, and 123 km are of 1 435 mm wide track gauge. Railways of 1 520 mm track gauge extend to the other Baltic States and Commonwealth of Independent States (CIS) countries, track gauge of 1 435 mm railways connect Lithuania with Poland, and Poland with other Western and Central European countries.

Modernization and development of the Lithuanian railway sector infrastructure is a basic condition of its successful integration into the European railway system. Priority is given to the railway infrastructure on the international transport corridors. The main attention is given to ensure the technical interoperability of

Lithuanian railways with the European railways, to meet the contemporary requirements of safety and environment protection, to increase the load of railways and the running speed of trains, to promote combined carriage activities.

The marine transport sector of Lithuania is made of the marine merchant fleet, Klaipėda State Seaport, Šventoji State Seaport and the Būtingė Oil Terminal as well as companies and agencies which provide shipping agent services, freight forwarding, ship supply, towage and other services. Klaipėda State Seaport is the northernmost ice-free port on the Eastern coast of the Baltic Sea. It is the most important and biggest Lithuanian transport hub, connecting sea, land and railway routes from East to West. The annual port cargo handling capacity is over 65 million tons. 40.13 million tons of cargo were handled in Klaipėda State Seaport. The port operates 24 hours a day, 7 days a week, all year round.

Four state-managed international airports operate in Lithuania. Vilnius, Palanga and Kaunas airports are civil airports. They render services to regular and charter flights for passengers and goods. Šiauliai airport is a military airport, but the flights of civil aircraft are also permitted. Šiauliai airport renders services to charter flights for passengers and goods. In 2020, Lithuanian airports welcomed 1.8 million passengers and handled 30 thousand flights. In 2021 the number of passengers grew up to 2.4 million and 34.4 thousand flights.

Lithuania is one of the leading countries in field of transport and logistics throughout Europe. That is because of strategically good geographical position. The country has created the right conditions to become one of the most important centres connecting south, east and west of Europe. According to Eurostat in 2019 transport and logistics sector accounted about 14% of total Lithuanian GDP. It is third largest economic sector in which works 142 000 workers.

The total number of freight tonne-kilometres (excluding sea transport) in Lithuania during 2000-2020 increased by 55%. In domestic freight transport rail transport is predominant, for international freight transport – the road transport represents a highest share (Table 2-2). Inland waterway and air freight transport takes only negligible share of total freight transport in Lithuania.

Table 2-2. Freight carried by all modes of transport in 1995-2020, thousands of tonne-kilometres

Goods carried by different modes of transport	1995	2000	2005	2010	2015	2020
Rail	7 220 176	8 918 451	12 457 336	13 430 846	14 036 238	15 864 679
Road	5 160 289	7 768 551	15 907 835	19 397 860	26 485 187	55 291 543
Inland waterway	18 336	1 484	1 324	4 187	1 226	1 164
Air	4 316	4 098	9 991	2 605	459	8 101
Oil pipeline	2 006 249	3 456 666	4 405 680	578 634	495 521	209 342
Total	14 409 366	20 149 249	32 782 166	33 414 133	41 018 631	71 374 829

data source: Statistics Lithuania

In 2020 annual cargo turnover of Klaipeda port reached 47.7 million tonnes of goods and it created about 6% of Lithuanian GDP. Over 2000-2020 period annual cargo turnover increased by 59.4%.

In 2020, the number of passengers carried by all modes of transport amounted to 235.9 million, which is 39.2% less than in 2010 and by 44.9% less than in 2000. An average annual decrease of passengers carried by transport from the period of 1995 till 2020 is 2.6%.

Decreasing passengers number carried by public transport are observed due to the declining population and the increasing number of personal vehicles. Generally, the total number of road vehicles is increasing except trolleybuses. According to the more than twenty years data passenger cars takes the largest part of road vehicles. In 2021 passenger cars accounted 84% of all road vehicles. Other vehicles are freight vehicles, special vehicles, semi-trailers, motorcycles, buses and trolleybuses amounted 16%. Detailed Lithuania Statistics information about trends of number of road vehicles is provided in the table below.

Table 2-3. Number of registered road vehicles at the end of the year in 2000-2021

	2000	**2005**	**2010**	**2015**	**2020**	**2021**
Passenger cars	1 172 394	1 455 276	1 691 855	1 244 063	1 565 465	1 611 143
of which personal	1 097 797	1 342 972	1 554 270	1 112 167	1 358 872	1 414 952
Personal cars per 1000 population	315	408	479	385	486	504
Buses	15 069	14 839	13 261	6 856	7 655	7 590
Trolleybuses	474	472	467	430	415	395
Lorries	88 346	106 247	113 113	78 115	101 287	107 861
Road tractors	10 267	16 239	20 808	24 781	41 984	45 290
Trailers	6 479	12 852	20 400	14 962	17 426	18 388
Semi-trailers	9 875	16 590	23 819	25 565	41 366	45 630
Special purpose road vehicles	11 798	11 526	14 598	10 521	11 062	11 743
Motorcycles	19 842	24 027	38 995	26 651	45 883	52 614
Mopeds	NA	NA	17 276	11 102	15 028	16 880

data source: Statistics Lithuania

In 2018, national passenger transport by road dominated: it accounted for 98.2% of total national passenger transport. Passenger transport by rail accounted for 1.1%, by other modes of transport – for less than 1%. International passenger transport by road made up 39.1%, by rail – 26.3%, by air – 25.3%, by sea – 9.3% of total international passenger transport.

During the period of 1990-1995 fuel consumption significantly decreased by 46.3%. From 1995 the fuel consumption in road transport started to increase and rapid growth began in 2000. Motor gasoline was one of the main fuel types until 2000; from that year diesel usage started to increase more rapidly and in 2020 diesel amounted to 78.5%, motor gasoline – 11.8%, biofuel – 4.8%, liquid petroleum gas – 4.5% and CNG – 0.4% (Figure 2-20).

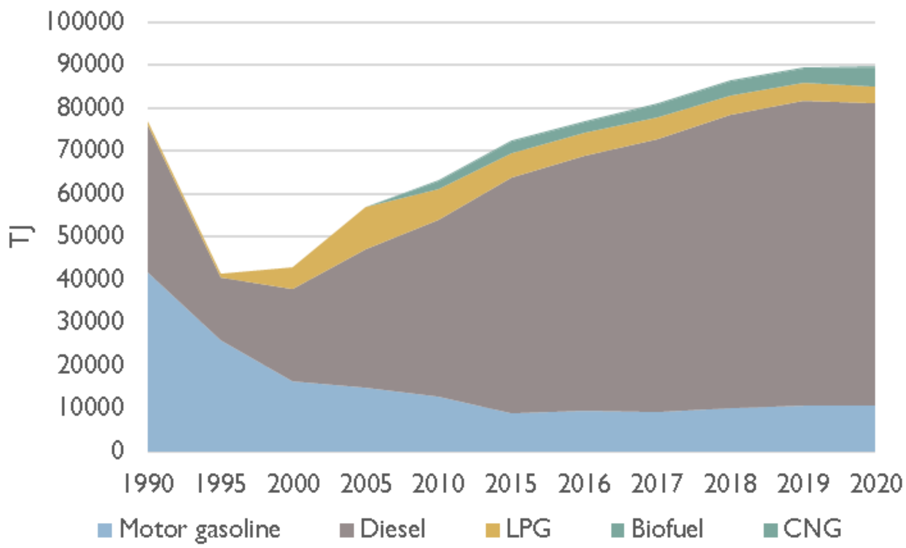

Figure 2-20. Use of fuels in Lithuania in 1990-2020

Transport sector is among the main polluters, therefore a lot of attention is paid for implementation of respective measures to reduce pollution from mobile pollution sources. These measures are described in Chapter 4.3.2.

2.8 Industry

Lithuanian industry sector accounts for a significant share of gross value added in the country's economy. Division of the country's economy as per the classifier of economic activity indicates that on the first level industry consists of four activities: manufacturing; extracting industry (mining and quarrying); supply of electricity, gas and steam; supply of water, sewerage, waste management and remediation activities. After the economic recession in early 1990s, Lithuania's industrial production and economy started to grow, as reflected by the growth of the GDP. Lithuania was struck by the global economic crisis causing significant reduction in industrial production in 2009. Economic recovery started from 2010, so the industrial production increased.

Dominating industry in Lithuania is manufacturing. Manufacturing constituted 85% of the total industrial production (excluding construction) in 2021 (Figure 2-21).

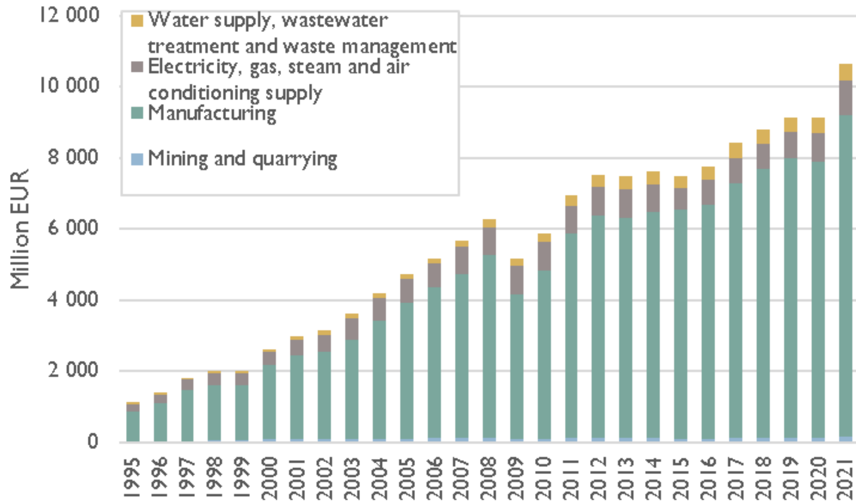

Figure 2-21. GVA per industrial economic activities in Lithuania in 1995-2021, EUR million

In 2020 four most important subsectors within manufacturing cumulatively produced 60% of production:

- Manufacture of food products and beverages (20%);
- Manufacture of wood products and furniture (16%);
- Manufacture of refined petroleum products (13%);
- Manufacture of chemicals and chemical products (11%).

Share of the main sectors in manufacturing products in Lithuania is presented in Figure 2-22 below.

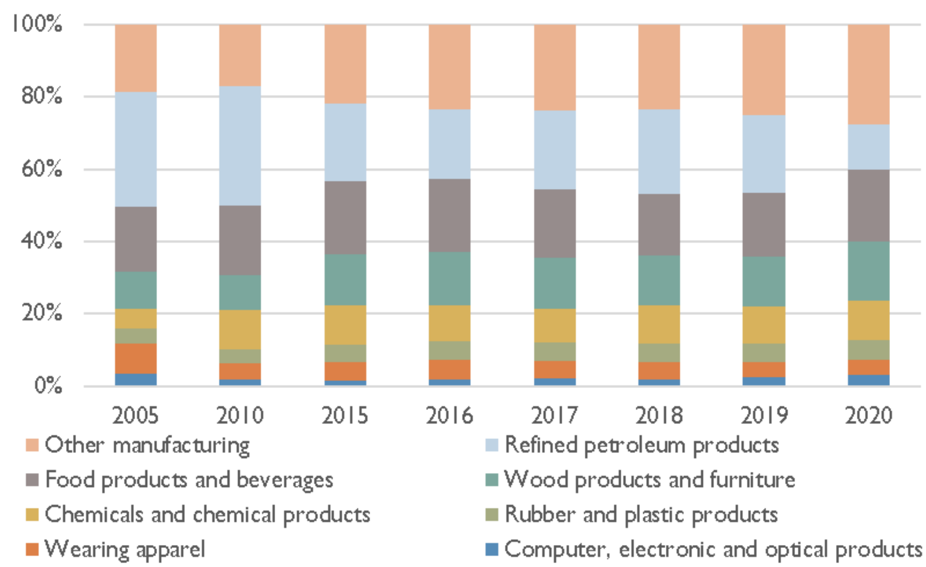

Figure 2-22. Share of production in manufacturing industry in 2005-2020, %

2.9 Building stock and urban structure

At the beginning of 2020 more than 67% residents of Lithuania lived in cities and towns, 911.6 thousand which is 32.6% – in rural areas. Vilnius is the most populated city in Lithuania with more than 550 thousand people, the second place goes to Kaunas and the third – Klaipėda. Despite of that during the period of 2009-2019 m. the urban resident population decreased by 11.4% and rural resident population by 13.7%.

In 2020 the stock of dwellings amounted 105 856,2 thousand m^2 at the end of the year. The average useful floor area per capita in urban areas reached 63.9 m^2 and in rural areas 41.9 m^2 (see Table 2-4). Private property accounted for 98.8%, state and municipal property – for 1.2% of the total stock of dwellings.

Table 2-4. Housing in 1995-2021, million m^2

	1995	2000	2005	2010	2015	2020	2021
Urban areas	45.5	50.6	51.3	55.4	58.3	63.9	64.6
Rural areas	28.7	28.9	29.5	33.8	37.0	41.9	42.6
Total	**74.2**	**79.5**	**80.9**	**89.2**	**95.4**	**105.9**	**107.2**
Average useful floor area per capita, m^2	20.0	22.8	24.6	29.2	33.0	37.9	38.2

The building stock consumes about 40.8 TWh of primary energy and emits ~5.3 Mt CO_2 eq. emissions per year. Residential buildings account 63% of the primary energy consumption of the total building stock, including 34% consumed by private houses, and 29% by multi-apartment buildings. About 78% of the total primary energy consumption of the building stock is used by buildings in energy performance class lower than C. Only 17% of buildings in Lithuania have an energy performance certificate.

In aiming for better maintenance of the existing housing (public) stock and insurance of its longer exploitation period, existing legislation has to provide favourable conditions for modernization and maintenance of the existing buildings stock and to encourage the private sector and also various financial institutions to participate in these activities. That's why Lithuania has set the Long-term renovation strategy of Lithuania aims to transform the existing building stock so that it is energy efficient (complying with the conditions for conversion to near-zero energy buildings), decarbonised, and in line with the principles of universal design by 2050. To implement this goal, the following indicators are set to be achieved by 2050 (compared to 2020):

- to reduce the annual primary energy consumption of the building stock to 16.2 TWh (~60%);
- to reduce the annual consumption of primary energy from fossil fuels in the building stock to 0 TWh (100%);
- to reduce the annual CO_2 emissions of the building stock to 0 Mt CO_2 (100%).

The Renovation of the multi-apartment buildings programme is one of the most important projects aimed at increasing energy efficiency of the most heat-intensive multi-apartment buildings. This program is funded by the state aid, municipalities, the EU structural funds, population and other resources. Together with other projects related to renovation of multi-apartment buildings until now, in Lithuania there are 4 480 renovated buildings and 2 538 under reconstruction. In Birštonas municipality 59% of all multi-apartment buildings are renovated. The second municipality that reached 46% of all renovated multi-apartment buildings is Panevėžys city and in the third place with 37% is Ignalina district municipality.

In Lithuania all new buildings starting from 2021 shall fulfil nearly zero energy buildings (A++ class buildings) requirements. All new public buildings shall fulfil nearly zero energy buildings requirements starting already from 2018. The energy performance requirements for the energy performance class are not obligatory for existing buildings, but it is planned to add the option of energy efficiency class A in the investment plans of the modernization projects of multi-apartment buildings.

The Ministry of Environment is responsible for preparation of Comprehensive Plan of Territory of the Republic of Lithuania for 2030 and guidelines for 2050. The main Plan's goals to promote sustainable low carbon, climate resilient Lithuania's economy development will ensure an efficient use, maintenance, renovation and modernization of existing housing and public buildings, as well as efficient energy performance. The conditions of the existing housing stock and public buildings will improve, with its value being preserved and increased where possible, the dwellings will be adjusted to the new needs of households. Using legal, public awareness raising and educational measures, awareness of the housing owner and the capacity to duly manage and maintain their real estate will be developed.

2.10 Agriculture

Agriculture is a source of economic wealth which supply food and energy resources. This sector has a great influence on the development of Lithuanian rural area as 32% of residents live in countryside.

Significant reforms were introduced in early 1990s, particularly after the restoration of independence. The reform included the re-establishment of private ownership and management in the agriculture sector. Legislation defined dismemberment of the collective farms, but they did not definitively ensure their replacement by at least equally productive private farms or corporations. Agricultural production decreased by more than 50% from 1989 to 1994. The farms were broken into small holdings, averaging 8.8 ha in size, often not large enough to be economically viable.

In recent years Lithuanian economy has experienced a lot of structural changes – contribution of industrial and services sectors have increased rapidly, however, agriculture remains one of the most important sectors in export, and also it provides income to the tenth of Lithuanian population.

More than a half of Lithuania's land is suitable for agriculture. According to the data of Statistics Lithuania as of 1st January 2022 the total land area was 6 528.6 thousand ha; total area of land intended for agricultural purposes made 2 937.8 thousand ha, of which arable land – 2 279.1 thousand ha; orchards and berry gardens – 29.9 thousand ha; meadows and natural pastures – 622.6 thousand ha.

In 2021, agricultural production at current prices totalled EUR 3.1 billion. Compared to 2010, the volume of total agricultural production increased by 66.1% (of which crop production – by 105.7%, animal production by 18.9%).

Table 2-5. Main agricultural production in Lithuania

	2000	2005	2010	2015	2020	2021
Grain, thous. t	2 730.7	2 870.0	2 866.8	6 521.4	6 935.4	5 621.3
Rape, thous. t	81.0	201.2	416.7	512.2	967.0	904.4

Sugar beet, thous. t	881.6	798.5	706.7	619.5	948.5	856.5
Potatoes thous. t	1 791.6	894.7	476.9	399.2	302.6	204.6
Vegetables, thous. t	329.4	369.2	188.6	215.9	225.7	246.2
Fruit and berries, thous. t	111.1	110.7	44.0	87.1	73.2	57.0
Meat (carcass weight), thous. t	186.4	238.6	221.2	270.1	275.9	259.5
Milk, thous. t	1 724.7	1 861.6	1 736.5	1 738.5	1 491.7	1 476.9
Eggs, million pcs.	692.0	864.1	829.6	786.2	881.2	876.1
Wool (physical weight), t	30	44	109	256	289	265

data source: Statistics Lithuania

In 2021 the proportion of crop production in the total agricultural production made up 67.4%, of which cereals – 33.9%, rapeseed – 14.1%, fodder crops – 7.2%. The proportion of animal production made up 32.6%, of which milk yield – 16.1%, animal and poultry breeding – 12.5%.

The biggest proportion of gross agricultural production (71.1%) was produced on farmers' and family farms: 82% of total crop and 53.9% of total animal production. Farmers mainly cultivated cereal crops (33.4% of the total agricultural production produced on farmers' farms); milk yield on farmers' farms accounted for 16.5% of their agricultural production. Agricultural companies mainly bread animals – 36.2% of their agricultural production (of which pigs – 14.8%, poultry – 18.1%) and cultivated cereals – 20.3%.

On 1st of January 2022 there were 629 thous. of cattle, 574 thous. of pigs (Table 2-6). The number of all livestock categories has fallen steadily since the 2000, except for sheep and poultry. The number of cattle has decreased by 30.0%, pig number has fallen by 38.8% since 2000.

Table 2-6. Number of livestock and poultry in Lithuania as of 1st of January, thous. heads

	2000	**2005**	**2010**	**2015**	**2020**	**2021**	**2022**
Cattle	897.8	792.0	759.4	736.6	634.6	629.5	628.7
of which dairy cows	494.3	433.9	374.6	314.0	240.9	232.9	225.2
Pigs	936.1	1073.3	928.2	714.2	550.8	580.4	573.8
Sheep	13.8	22.2	52.5	123.9	152.1	140.6	136.9
Goats	24.7	26.9	14.7	13.0	15.2	14.8	14.7
Horses	74.9	63.6	49.0	18.2	12.8	12.8	12.5
Poultry	6 372.6	8 419.4	9 308.7	10 218.4	8 649.0	8 363.6	9 026.3

data source: Statistics Lithuania

2.11 Forest

The total forest land area by the 1st of January 2021 was 2 202.2 thousand ha, covering 33.7% of the country's territory (Figure 2-23). Since 2003 the forest land area has increased by 156.9 thousand ha corresponding to 2.4% of the total forest cover. During the same period, forest stands expanded by 111.6 thousand ha to 2 062.6 thousand ha. Since 2003 the average forest area per capita increased from 0.59 ha to 0.79 ha.

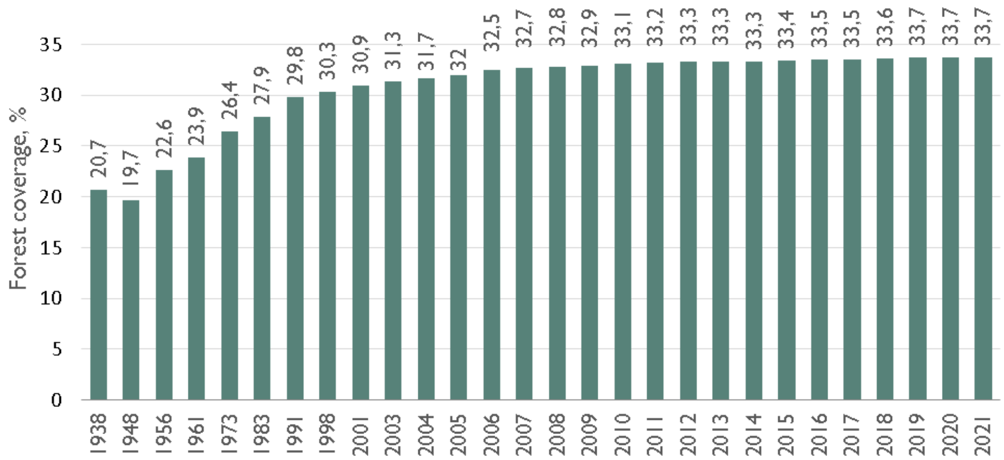

Figure 2-23. Forest cover changes in Lithuania, %

Occupying 1 148.8 thousand ha, coniferous stands prevail in Lithuania, covering 55.7% of the forest area. They are followed by softwood deciduous forests (844.5 thousand ha, 40.9%). Hardwood deciduous forests occupy 69.3 thousand ha (3.4%). The total area of softwood deciduous forest land increased by 146.1 thousand ha over the last thirteen years. The area of hardwood deciduous has decreased by 21.3 thousand ha (mainly due to dieback of ash stands) and coniferous forest by 11.2 thousand ha. Scots pine occupies the biggest share in Lithuanian forests – 709.2 thousand ha. Compared to 2003, the area of pine expanded by 2.3 thousand ha. Norway spruce stands covers 437.3 thousand ha, with a decrease of 8 thousand ha. Birch stands cover the largest area among deciduous trees. Since 2003, it increased by 58.5 thousand ha and reached 450.7 thousand ha by the 1st January 2021 (Figure 2-24).

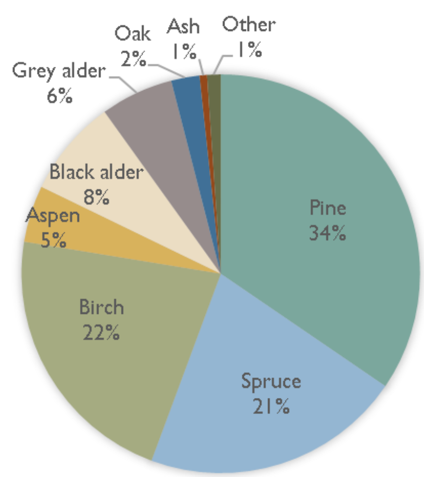

Figure 2-24. Forest stands area by dominant tree species as of 1st January 2021, %

In 2021 around a half of all forest land in Lithuania was of State importance – 1 114 thousand ha. The registered area of private forests is 863 thousand ha. The estimated area of private forests is 929 thousand ha. According to NFI data, since 2003 total growing stock volume increased from 453.4 million m³ up to 566.7 million m³. Pine stands accumulated growing stock of 232.0 million m³. In a period of eighteen years, they accumulated 52.0 million m³. The growing stock in spruce stands increased from 75.8 to 102.2 million m³. All Lithuanian forests are distributed into four functional groups. In the beginning of 2021, the distribution of forests by functional groups was as follows: group I (strict nature reserves) – 27.3 thousand ha (1.2%); group II (ecosystem protection and recreational) – 251.6 thousand ha (12.4%); group III (protective) – 273.9 thousand ha (12.4%); and group IV (commercial) – 1 649.5 thousand ha (74.9%). Over 1990-1995 felling rates in all Lithuanian forests (irrespective of their ownership) were unstable, but still slightly increasing and reached the peak in 1995 with the total of 9.43 million m^3 of living trees felled. After 1995 felling were decreasing to 7.71 million m^3 of living trees felled in 1997 and then started to increase again. The highest point over the whole accounting period was reached in 2003 (10.34 million m^3 of living trees felled) and then started slightly to decrease until 2012 (8.05 million m^3 of living trees felled). Over the past years, marginal increase in forest felling is observed (8.67 million m^3). Changes in total forest felling (living trees) for the period of 1990-2021 are presented in the Figure 2-25.

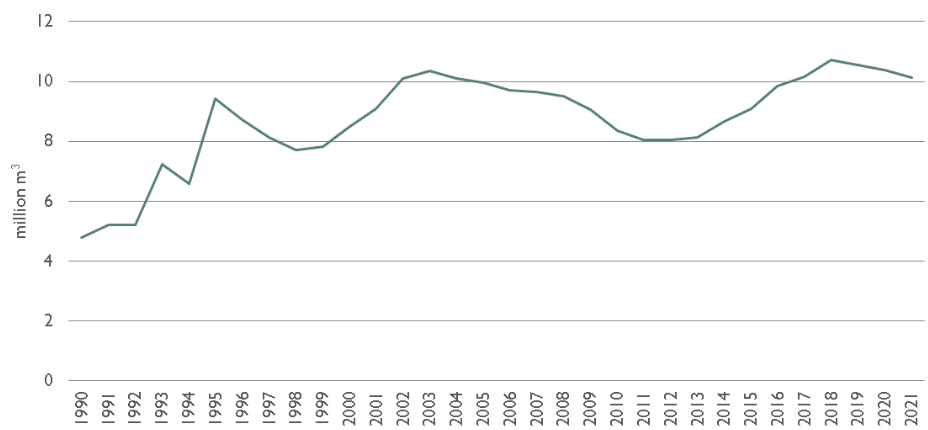

Figure 2-25. Total forest fellings (living trees) in all forests regardless of their ownership, 1990-2021

2.12 Waste

Waste and wastewater management is one of Lithuania's priorities for national environmental governance. The objectives set in this sector are to create environmentally and economically feasible management systems for hazardous and non-hazardous waste, decrease waste flows and adverse impact of waste on the environment and human health, and ensure rational waste recovery for recycling and energy generation.

Lithuania's total waste generated annually is about 5 million tonnes. A significant part of the waste is generated in the industrial sector, of which about 100 kt is hazardous waste. On the other hand, annual municipal waste generation is more than 1 million tonnes.

In the early 1990s, there were about 1000 landfills and dumps in Lithuania. In the late 1990s, waste management strategies were developed, foreseeing the development of waste management infrastructure, including constructing new regional landfills complying with EU requirements, closure of existing landfills and dumps and provision of the necessary equipment required for waste management facilities' safe and efficient operation.

During the reorganization of waste management infrastructure, all landfills and dumps not in line with the environmental protection and public health safety requirements were closed. As a result, waste disposal in the old landfills stopped in 2009. Since then, all waste has been disposed of in 11 regional non-hazardous landfills.

To encourage waste recovery and recycling and to minimize disposal in landfills, regional waste management systems were equipped with appropriate waste management facilities, including bulky waste collection sites, green waste composting sites, etc. Currently, there are 54 biodegradable waste collection areas in Lithuania. In addition, landfill gas recovery started at two landfills in 2008. Now, landfill gas is recovered in three operating and six closed landfills.

Until 2013, when there were no waste incineration plants in Lithuania, waste unsuitable for processing or reuse but with energy value was disposed of in landfills. However, in 2013, when the first waste incineration power plant established by JSC “Fortum Heat – Lietuva” (now JSC Gren Lietuva) started operating in Klaipėda, the amount of municipal waste disposed of in the landfill decreased by 10.6% compared to 2012. Since 2020 two more cogeneration municipal waste incinerating plants in Kaunas – a waste incineration capacity of 200 kt and Vilnius – with a capacity of 160 kt started their work. According to the 2020 data of the Environmental Protection Agency, 348.7 kt of waste was burned with energy extraction, i.e., 25.85% of all municipal waste. In 2019, 14.75%, in 2018 – 12.5% of all collected municipal waste was used for energy extraction.

According to data provided by municipalities, waste collection services on average were provided to 99.8% of population. In 2020, municipal waste generation in Lithuania remained just slightly below the EU average (483 kg/year/inhabitant compared to around 517 kg on average). In 2020, Lithuania recycled 24%, composted 21%, incinerated 26% with energy recovery and disposed of 17% of municipal waste in landfills. During the last five years, Lithuania increased waste recycling almost by 10%, composting by more than 112%, and waste incineration went up by more than 132%. As a result, the volume of waste in landfills declined by more than 66%.

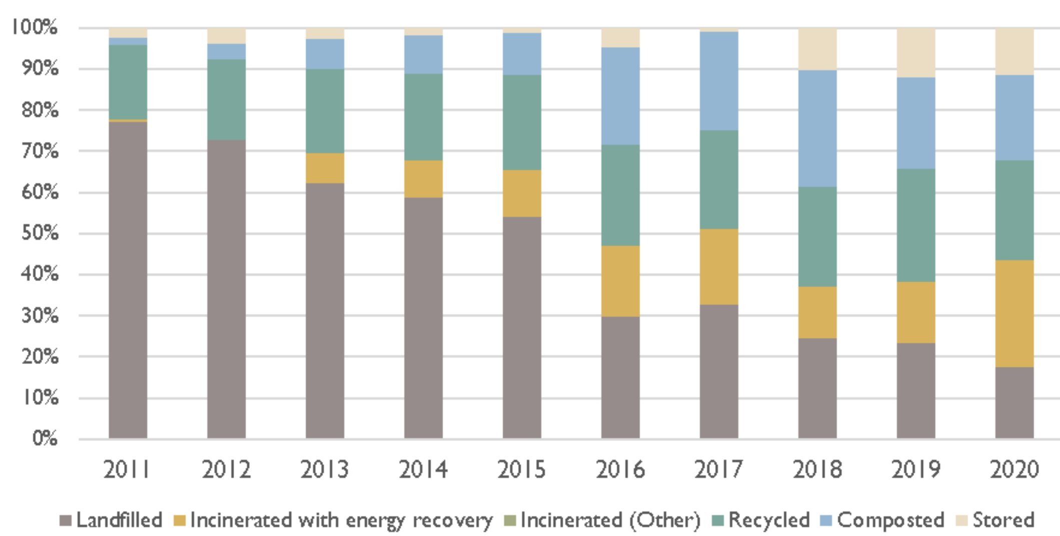

Figure 2-26. Municipal waste treatment in Lithuania in 2011-2020, %

EU structural and investment funds are an important source of funding for improved waste management systems in Lithuania. For example, in 2007-2013, EUR 190 million were invested into waste management projects, including the construction of 9 regional mechanical and biological waste treatment plants, remediation of 341 old landfills/dumpsites, construction of numerous bulky waste collection and green waste composting sites and extension of separate waste collection system (210 000 containers for recyclable and biodegradable waste). In the 2014-2020 period, EUR 87.2 million investment from EU Cohesion Fund was consumed to support further development of the separate collection of waste, modernization of capacities to prepare waste for recycling, reuse, or another recovery (sorting lines, other equipment), and modernization of the waste management information system and monitoring.

Wastewater collection and treatment, as well as the effective utilization of sewage sludge, are tasks of great importance for growing populations, rapidly developing industries and pollution reduction efforts aimed at curbing the harmful by-products generated by such processes.

In most cases in Lithuania, industrial wastewater is discharged to centralized municipal sewage collection networks and treated with domestic wastewater in centralized municipal treatment plants. According to the information provided by the Lithuanian Water Suppliers Association[1] a fraction of industrial wastewater exceeds 50% in six of 38 agglomerations with a population of more than 10 thousand. On average, industrial wastewater comprises about 20% of Lithuania's total load of municipal wastewater treatment systems.

Wastewater in Lithuania is treated in aerobic treatment systems with minimum CH_4 generation. However, 23% of the population still has no connection to public sewerage systems, and emissions from sewage collected from septic tanks are significant.

According to statistical data, the amount of accumulated sewage sludge in the country reached 53.90 kt of dry substance in 2020. Of that, approximately 50% was composted and anaerobically treated, 28% was used in agriculture, and 27% was incinerated.

Development of the Lithuanian sewage sludge management infrastructure took place during the period of 2007-2013 with the aim of treatment of around 80% of the locally produced sewage sludge using modern technologies, where the sludge would be managed in digestion, dewatering and composting facilities. By 2016, using EU structural funds 50 new sewage sludge treatment plants were constructed (including reconstructed old plants that did not ensure adequate wastewater treatment).

During 2012-2014 wastewater treated up to the required standards amounted to 95%, insufficiently treated – 5%, released without cleaning – only 0.02%. Decisive influence on such high sewage quality results had building of new and reconstruction of old wastewater treatment plants. After 2015 the share of wastewater treated to the prescribed standards decreased to 72-75%, the share of insufficiently treated wastewater increased to 25-28%. The reason for that is outdated Vilnius wastewater treatment plant, as due to city expansion it no longer has adequate capacity to clean up the increased volume of wastewater. The reconstruction works of the wastewater treatment plant officially started in August 2020. The total investment

[1] Lithuanian Water Suppliers Association. Certificate on municipal wastewater treatment plant capacity assessment, 2011.03.04.

in the renovation of the plant amounts to almost 44 million EUR, of which more than half of the funds will be provided by JSC “Vilniaus Vandenys” company and the rest by the Ministry of Environment from the EU structural funds. After the reconstruction the quality of wastewater treated will meet the required standards.

2.13 Flexibility in accordance with Article 4, paragraphs 6 and 10, of the Convention

Lithuania does not request any flexibility or consideration in accordance with Article 4, paragraphs 6 and 10, of the Convention.

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GREENHOUSE GAS INVENTORY INFORMATION

3. GREENHOUSE GAS INVENTORY INFORMATION

This Chapter contains information on Lithuania's GHG emissions trends (descriptive summary), national arrangements for GHG inventory preparation and information on National GHG registry. The GHG inventory summary tables are provided in Annex II. The data used in Lithuania's 8th National Communication is in accordance with its National Inventory Report (NIR) that was submitted in 2022 to the Secretariat of the UNFCCC in compliance with the decision 24/CP.19 "Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to Convention" (FCCC/CP/2013/10/Add.3). This submission covers the inventory of GHG emissions of Lithuania for the period 1990-2020. It has been also submitted to the European Commission in compliance with European Parliament and the Council Regulation (EU) No 525/2013 (as repealed by Regulation (EU) 2018/1999).

3.1 Descriptive summary

3.1.1 General greenhouse gas emissions trends

In 2020, Lithuania's total GHG emissions amounted to 20 182.6 kt CO_2 eq. excluding LULUCF. GHG emission level drastically fell down in 1992 and remained steady at approx. 20 Mt CO_2 eq. during the last 13 years (Figure 3-1).

A significant decrease in 1992 was caused by the collapse of the Soviet economy, which led to the transition from a centrally-planned economy to a market-based economy by restructuring manufacturing industries, energy industries and agriculture. Upon its independence from the Soviet Union in 1990, after 50 years of annexation, Lithuania inherited an economy with high energy intensity. A blockade of resources imposed by USSR during 1991-1993 led to a sharp fall in economic activity, as reflected by the decrease in GDP in the beginning of the nineties. The financial situation improved in the middle of the last decade and GDP has been increasing until 2008, when the global economic recession affected Lithuania as well followed by GDP decrease to negative factor in 2009. The annual estimates of macroeconomic indicators since 2011 showed an economic revival. In the period 1990-2020 GDP increased by 76% and GHG emissions were reduced by 58%.

At the beginning of the 1990s, mostly fossil fuel was combusted in manufacturing industries, energy industries and agriculture. A comparison of annual general fuel balances in the period of 1990-2020 shows a significant decrease in the use of fuel oil (e.g. from about an annual quantity of 57 900 TJ in 1990-1991, to 19 307 TJ in 1992 and 13 126 TJ in 1995, to less than 600 TJ since 2008), also a decrease of use of coal, petrol, natural gas, but an increase of use of biomass. The decrease of use of fuel oil, first of all, was influenced by environmental requirements: since 1 January 2004 consumption of sulphurous fuel oil was forbidden and it was followed with stricter requirements since 2008. As the elimination of sulphur from fuel oil was not economically efficient for companies, these requirements led to the shift of fuel oil to other fuel types (e.g. natural gas), resulting in a considerable decrease in annual GHG emissions.

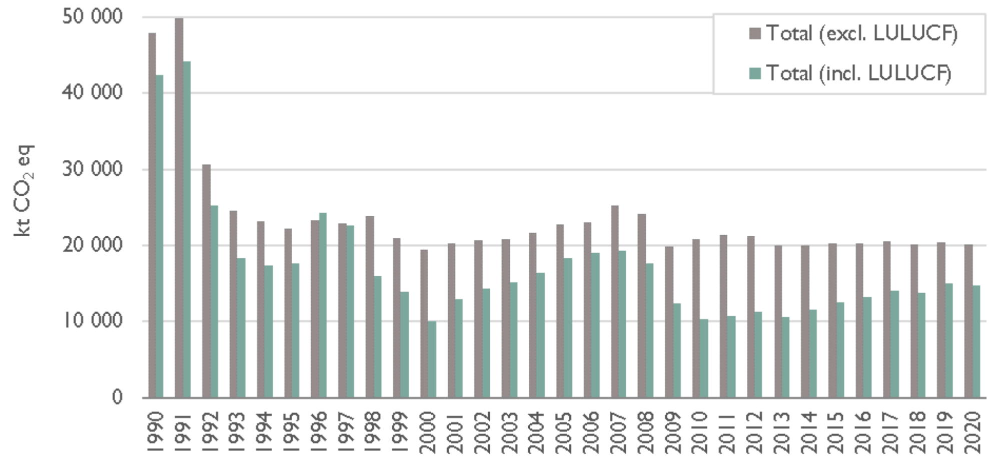

Figure 3-1. GHG emissions 1990-2020, kt CO_2 eq.

Last considerable decrease in 2009 was related with the economic crisis in Europe, while after 2009 GHG emissions stabilized at approx. 20 Mt CO_2 eq.

Comparing with 2019 the total GHG emissions have decreased by 0.9% (excl. LULUCF) in 2020.

The composition of GHG emissions by sector in 2020 is presented in Figure 3-2.

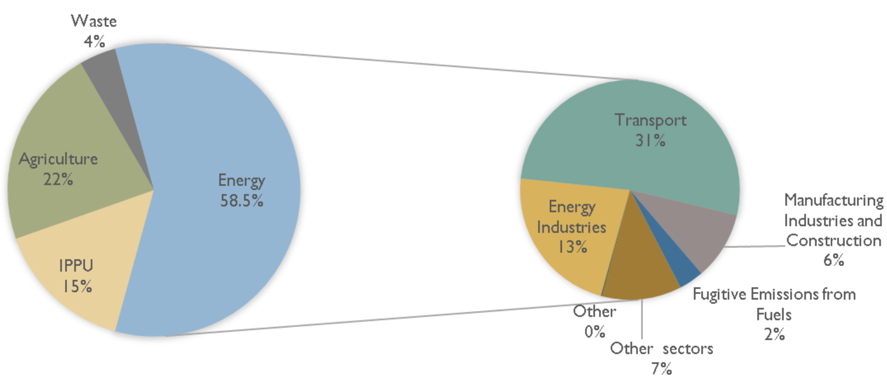

Figure 3-2. The composition of Lithuanian GHG emissions (%) by sector (excl. LULUCF) in 2020

The energy sector is the most significant source of GHG emissions in Lithuania with a 58.5% share of the total emissions (excl. LULUCF) in 2020. Emissions from energy include CO_2, CH_4 and N_2O gases.

CO_2 emissions from the energy sector constituted 82.1% of the total national CO_2 emissions (excl. LULUCF) in 2020. The main categories are transport and energy industries which contribute 44.4% and 18.9% to the total national CO_2 emission (excl. LULUCF) respectively. Compared with 2019 CO_2 emissions from the energy sector have decreased by 0.3% in 2020. The emissions of CH_4 have decreased by 8.8% and N_2O emissions decreased by 0.4%.

The second most important source of GHG emissions is agriculture sector accounting for 22.1% of the total national GHG emissions (excl. LULUCF). This sector is the most significant source of CH_4 and N_2O emissions accounting for 58.6% and 87.4% of the total CH_4 and N_2O emissions, respectively. The main source of CH_4 emissions is enteric fermentation contributing 86.2% to the total agricultural CH_4 emissions. Agricultural soils are the most significant source of N_2O emissions accounting for 93.5% of the total agricultural N_2O emissions. Compared to 2019 GHG emissions in agriculture sector have increased by 4.6% in 2020.

Emissions from industrial processes and product use (IPPU) sector amounted to 15.3% of the total GHG emissions (excl. LULUCF) in 2020. The main categories are ammonia production, nitric acid production and cement production. Ammonia production is the largest source of CO_2 emissions in the industrial processes and product use sector contributing 13.1% to the total national CO_2 emissions (excl. LULUCF) in 2020. Nitric acid production is the single source of N_2O emissions in the IPPU sector and accounted for 4.9% of the total national N_2O emissions (excl. LULUCF) in 2020. GHG emissions in 2020 from the industrial processes and product use sector have decreased by 8.3% compared to 2019.

The waste sector accounted for 4.1% of the total GHG emissions in 2020 (excl. LULUCF). Solid waste disposal on land is the second important source of CH_4 emissions. It contributes 19.7% to the total CH_4 emissions (excl. LULUCF). There was a 2.0% reduction in CH_4 emission from the waste sector in 2020 compared to 2019.

3.1.2 Greenhouse gas emissions trends by gas

GHG emissions trends by gas in CO_2 eq. are presented in the Figure 3-3 below and reflect the main tendencies of GHG level in general.

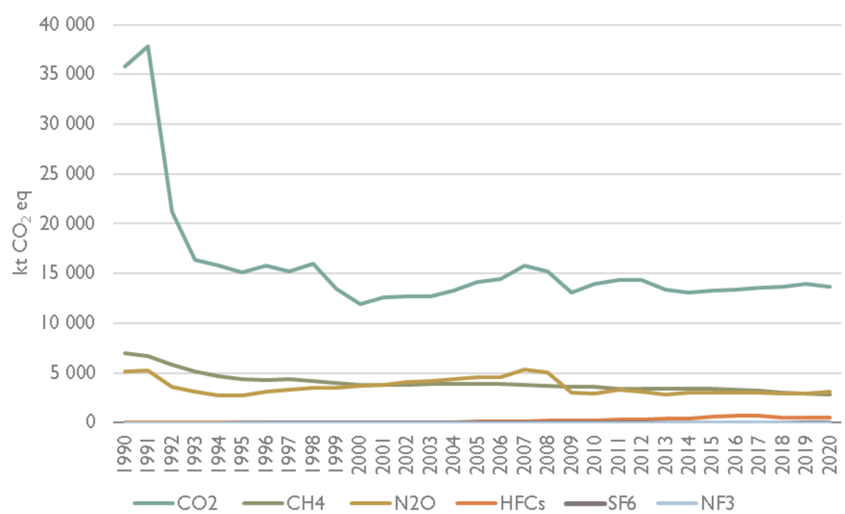

Figure 3-3. Trends of GHG emissions by gas in 1990-2020, kt CO_2 eq. (excl. LULUCF)

The most important GHG in Lithuania is carbon dioxide, it contributes 67.7% to the total national GHG emissions. In 2020, the actual CO_2 emission (excl. LULUCF) was 61.8% lower than the emission in 1990. Comparing with 2019 CO_2 emissions decreased by 4.4% including LULUCF and 1.9% excluding LULUCF.

The largest source of CO_2 emissions is energy sector which contributes around 82.1% of all CO_2 emissions. Comparing with 2019 CO_2 emission from energy sector in 2020 have slightly decreased by 0.3% wherein CO_2 emission from the energy industries increased by 16.5% and emissions from transport decreased by 2.4%.

Distribution of CO_2 emissions in 2020 by the main sectors and subsectors is shown in Figure 3-4.

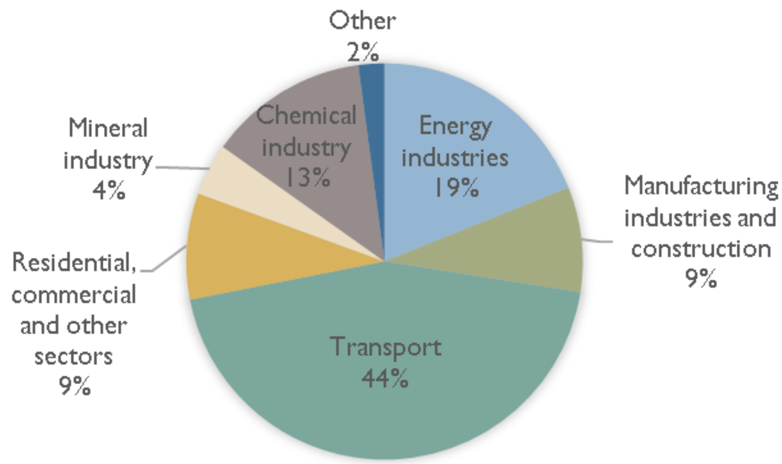

Figure 3-4. Distribution of CO_2 emissions by sector in 2020

Methane is the second most important GHG accounting for 14.2% in the total national GHG emissions (excl. LULUCF). The largest sources of methane emissions are: agriculture sector, contributing with 58.6% in 2020, waste sector – 26.1% and fugitive emissions from oil and natural gas operations – 8.8% (Figure 3-5). The emissions from agriculture derive from enteric fermentation and manure management contributing with 50.5% and 8.1% respectively of the total national CH_4 emission (excl. LULUCF).

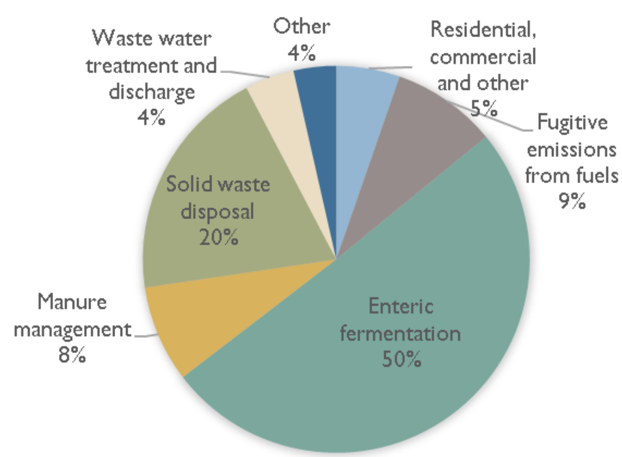

Figure 3-5. Distribution of CH_4 emissions by sector in 2020

Nitrous oxide is accounting for 15.6% in the total national GHG emissions (excl. LULUCF). Agriculture is the main source of N_2O emissions which contributed 87.4% to the total N_2O emissions in 2020. N_2O emissions from agriculture sector have increased by 9.3% comparing with 2019.

The other significant source of N_2O emissions is nitric acid production. It contributes 4.9% to the total N_2O emissions. Figure 3-6 shows the distribution of N_2O emissions in 2020 by the main sectors and subsectors.

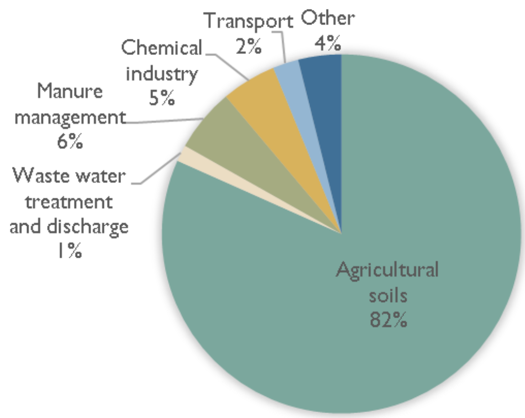

Figure 3-6 Distribution of N_2O emissions by sector in 2020

The F-gases contribute 2.6% to the total national GHG emissions in 2020. The emissions of F-gases have increased significantly during 1993-2020. A key driver behind the trend has been the substitution of ozone depleting substances (ODS) by F-gases in many applications. With the adoption of Regulation (EU) No 517/2014 (F-gases regulation) the European Union has set out restrictions to reduce HFC emissions, and as a result of implementation of this Regulation, HFCs emissions from these subcategories started to decrease in 2017. Figure 3-7 shows the trend of F-gases emissions during the period 1993-2020.

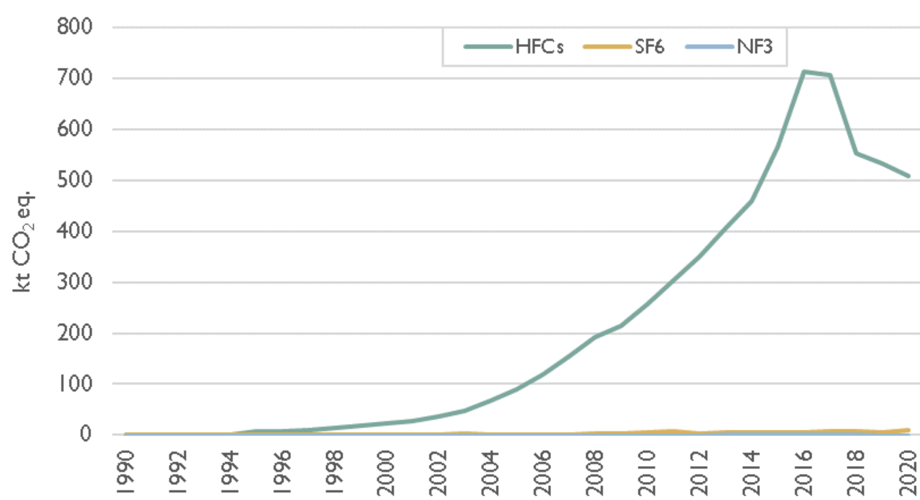

Figure 3-7. Emission trends for F-gases for the period 1993-2020 (kt CO_2 eq.)

3.1.3 Greenhouse gas emissions trends by sector

The trends of GHG emissions by sector expressed in CO_2 eq. are presented in Table 3-1.

The most significant source of GHG emissions in Lithuania is energy sector with 58.5% share of the total emissions in 2020. Agriculture is the second most significant source and accounted for 22.1% of the total emissions. Emissions from industrial processes contributed 15.3% of the total GHG emissions, waste sector – 4.1%.

Table 3-1. Greenhouse gas emissions/removals by sector during the period 1990-2020, kt CO_2 eq.

GHG source and sink category/ Year	Energy	IPPU	Agriculture	LULUCF	Waste	Total (incl. LULUCF)	Total (excl. LULUCF)
1990	33,122.5	4,460.2	8,756.0	-5,531.3	1,522.1	42,329.6	47,860.9
1991	35,176.7	4,492.7	8,626.7	-5,631.5	1,547.8	44,212.4	49,843.9
1992	19,916.2	2,653.4	6,572.0	-5,358.4	1,523.0	25,306.2	30,664.5
1993	16,039.8	1,728.3	5,269.3	-6,311.5	1,549.2	18,275.2	24,586.7
1994	15,113.0	1,926.0	4,652.7	-5,824.7	1,528.3	17,395.2	23,219.9
1995	14,161.3	2,212.3	4,327.1	-4,532.6	1,532.7	17,700.9	22,233.5
1996	14,642.2	2,604.0	4,498.5	992.1	1,531.8	24,268.6	23,276.5
1997	14,189.5	2,568.3	4,533.4	-230.2	1,549.8	22,610.7	22,840.9
1998	14,887.4	2,974.9	4,408.4	-7,827.4	1,533.8	15,977.1	23,804.5
1999	12,445.7	2,911.9	4,107.6	-7,141.5	1,522.1	13,845.8	20,987.3
2000	10,916.2	3,068.3	3,936.1	-9,432.1	1,520.4	10,008.9	19,441.0
2001	11,596.5	3,315.1	3,781.4	-7,268.9	1,550.2	12,974.3	20,243.2
2002	11,660.8	3,488.1	3,925.4	-6,323.4	1,548.0	14,298.8	20,622.3
2003	11,675.0	3,571.0	4,002.1	-5,617.3	1,541.4	15,172.2	20,789.5
2004	12,287.7	3,760.7	4,049.5	-5,164.6	1,510.8	16,444.1	21,608.7
2005	13,135.6	4,037.0	4,070.5	-4,378.1	1,471.4	18,336.3	22,714.4
2006	13,186.8	4,319.1	4,061.7	-3,971.6	1,436.2	19,032.3	23,003.8
2007	13,418.0	6,141.2	4,214.3	-5,891.5	1,408.8	19,290.9	25,182.4
2008	13,293.9	5,475.9	4,110.4	-6,537.4	1,323.6	17,666.4	24,203.8
2009	12,113.6	2,299.2	4,206.0	-7,519.3	1,292.8	12,392.2	19,911.5
2010	13,094.7	2,235.4	4,156.7	-10,423.1	1,263.3	10,327.0	20,750.2
2011	12,245.0	3,714.4	4,196.7	-10,592.6	1,187.1	10,750.6	21,343.2
2012	12,278.4	3,565.0	4,271.6	-10,000.9	1,151.7	11,265.8	21,266.7

2013	11,659.6	3,000.2	4,246.1	-9,403.4	1,121.1	10,623.5	20,026.9
2014	11,278.2	3,186.3	4,467.3	-8,479.1	1,063.9	11,516.6	19,995.7
2015	11,248.4	3,507.7	4,537.7	-7,844.5	1,010.1	12,459.4	20,303.9
2016	11,578.9	3,324.3	4,431.9	-7,131.8	991.5	13,194.8	20,326.6
2017	11,508.4	3,637.4	4,390.1	-6,498.7	993.0	14,030.2	20,528.9
2018	11,872.6	3,165.8	4,248.0	-6,353.5	872.6	13,805.5	20,159.0
2019	11,890.3	3,375.1	4,256.5	-5,302.1	838.6	15,058.5	20,360.6
2020	11,816.7	3,093.5	4,450.7	-5,407.4	821.6	14,775.2	20,182.6
2020/ 1990, %	**-64.3**	**-30.6**	**-49.2**	**-2.2**	**-46.0**	**-65.1**	**-57.8**

Energy

Energy sector is the most significant source of GHG emissions in Lithuania with 58.5% share of the total emissions (excl. LULUCF) in 2020. Emissions from energy include CO_2, CH_4 and N_2O.

Emissions of total GHG from energy sector have decreased almost 3 times from 33 122.5 kt CO_2 eq. in 1990 to 11 816.8 kt CO_2 eq. in 2020 (Figure 3-8). Significant decrease of emissions was mainly due to economic slump in the period 1991-1995. During the fast economic growth over the period 2000-2008 GHG emission in energy sector was increasing about 2.5% per annum. The global economic recession had impact on GHG reduction in energy sector by 8.9% in 2009. The closure of Ignalina NPP and GDP increase had impact on GHG increase by 8.1% in 2010.

During the period 1990-2020 the share of transport sector significantly increased. In 1990 transport sector accounted for 17.6% of total GHG emission in energy sector whereas in 2020 – 52.0%. This growth is influenced by the rapid increase of the density of transport routes and the number of road vehicles.

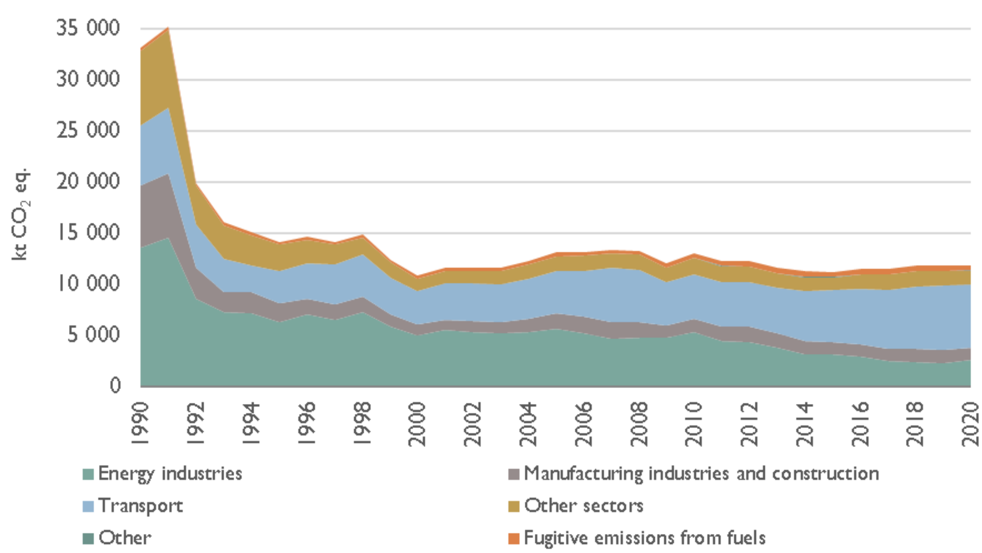

Figure 3-8. Trend of GHG emissions in energy sector during the period 1990-2020

The increase of GHG emissions from fugitive sources is mainly caused by the increase of CH_4 emissions from natural gas distribution, reflecting the increase of the length of natural gas pipelines. Since 2000 GHG emissions from this subsector was increasing by average 3.7% per annum.

Industrial Processes and Product Use

Emissions from industrial processes and product use (referred to as non-energy related ones) amount to 15.3% of the total emissions (excl. LULUCF) in 2020. Emissions from industrial processes and product use include CO_2, N_2O and F-gases emissions. Emissions of total GHG from the industrial processes and product use sector have decreased from 4 460.2 kt CO_2 eq. in 1990 to 3 093.5 kt CO_2 eq. in 2020 (Figure 3-9).

CO_2 emissions from ammonia production contributed 13.1% to the total national CO_2 emissions (excl. LULUCF) in 2020. The lowest emission of CO_2 was in 1993 due to decrease of the ammonia production and the peak of CO_2 emissions were in 2007 when the ammonia production increased. Comparing with 2019 CO_2 emissions increased by 7%.

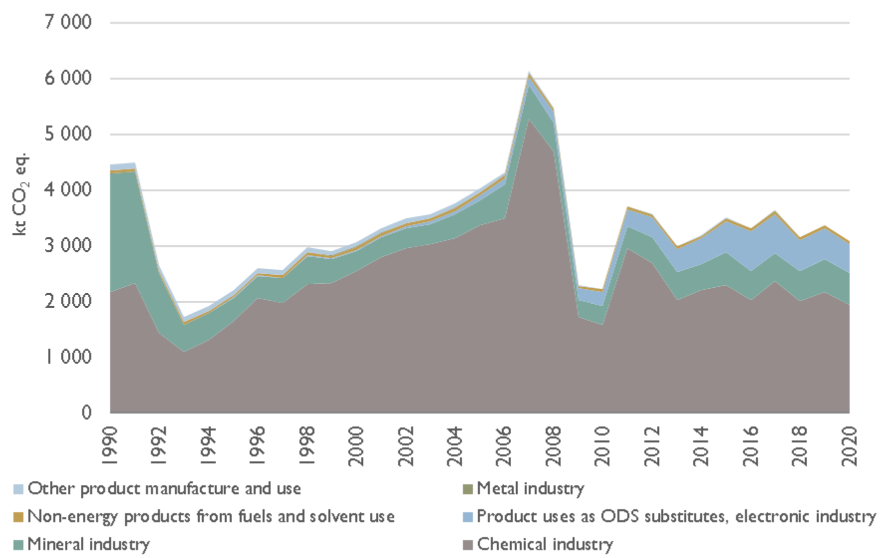

Figure 3-9. Trend of GHG emissions in industrial processes and product use sector during the period 1990-2020

Nitric acid production is the single source of N_2O emissions in industrial processes sector and accounts for 4.9% in the total national N_2O emissions (excl. LULUCF) in 2020. N_2O emissions had been increasing since 1995 and reached its peak in 2007. After the installation of the secondary catalyst in nitric acid production enterprise in 2008 the emissions of N_2O dropped drastically. Comparing with 2019 N_2O emissions from nitric acid production has decreased by 13.6%.

Agriculture

Agriculture sector is the second most important source of GHG emissions in Lithuania contributing 22.1% to the total GHG emission (excl. LULUCF). The emissions from agriculture sector include CH_4, N_2O and CO_2 emissions. Emissions of total GHG from agriculture sector have decreased almost 2 times from 8 756.0 kt CO_2 eq. in 1990 to 4 450.7 kt CO_2 eq. in 2020 (Figure 3-10).

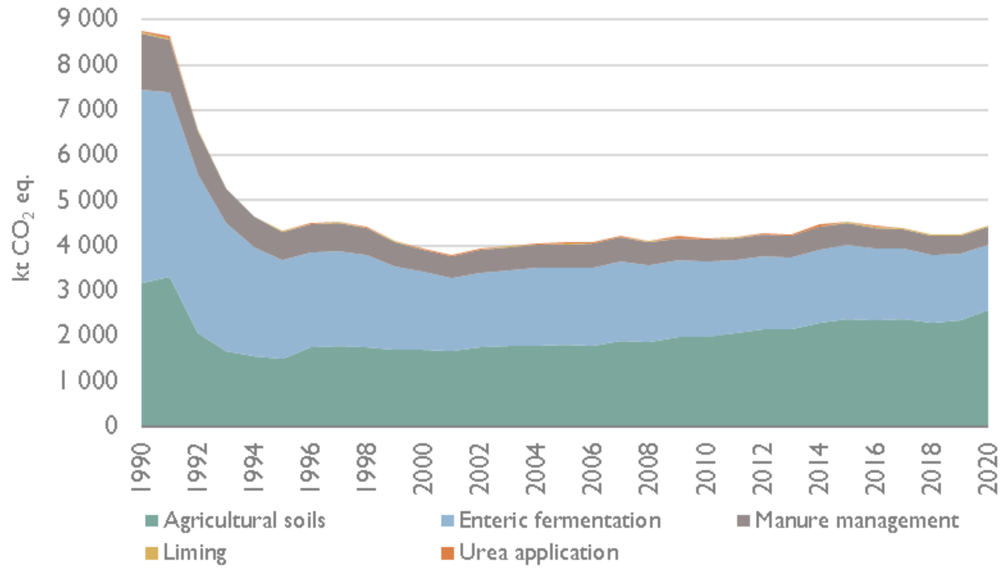

Figure 3-10. Trend of GHG emissions in agriculture sector during the period 1990-2020

Emissions from agriculture sector decreased substantially in the beginning of 1990s. The agriculture sector contributed 24% of the national GDP in 1992 and employed 19% of the labour force. Lithuania's agriculture, efficient according to the past soviet standards, produced a huge surplus that could not be consumed domestically. Lithuania was producing crops, developing livestock farming and food processing industry. Crops accounted for 1/3 and livestock for 2/3 of the total value of agricultural output. Lithuanian agricultural production was high enough to allow the export of about 50% of the total output.

Significant reforms were introduced in the early 1990s, particularly after the restoration of independence. The reform included the re-establishment of private ownership and management in the agriculture sector. Legislation defined dismemberment of the collective farms, but they did not definitively ensure their replacement by at least equally productive private farms or corporations. Agricultural production decreased by more than 50% from 1989 to 1994. The farms were broken into small holdings, averaging 8.8 ha in size, often not large enough to be economically viable. After Lithuania has joined EU in 2004, macroeconomic indicators of agriculture sector along with food processing industry has been constantly improving.

Agriculture sector is the most significant source of the CH_4 and N_2O emissions accounting for 56.4% and 85.1% in the total CH_4 and N_2O emissions, respectively. The emissions of CH_4 and N_2O from agriculture sector decreased by 61.2% and 32.4% compared to the base year, respectively. The reduction of CH_4 emissions is mostly caused by the decrease in total number of livestock population.

The major part of the agricultural CH_4 emission originates from digestive processes. Enteric fermentation contributes 50.5%, manure management – 8.1% to the total national CH_4 emissions.

Agricultural soils are the most significant source of N_2O emissions accounting for 87.4% in the total national N_2O emissions. Application of inorganic N fertilizer and cultivation of histosols leads to substantial emissions of N_2O from agricultural soils. After the restoration of Lithuanian independence consumption of fertilizers drastically declined up to 40 kt per year in 1995. Since 1995 consumption of fertilizers was constantly rising as the economy was progressing together with the growth of agriculture, demand of crops and vegetables. In 2020 the use of synthetic N fertilizers consumption has increased to more than double compared to 2000,

LULUCF

In general, historical GHG emissions from sources and removals in sinks in the Land Use, Land-Use Change and Forestry (LULUCF) sector in Lithuania are mostly related to three main categories – forest land, cropland and grassland, with addition to wetlands if there are significant amounts of peat extracted in peat extraction areas or conversions to flooded land. Historical land use patterns, usually determined by economic and political situation play a key role in land use changes and emissions or removals afterwards. Perfunctory forest land accounting during inter-war and later occupation period as well as introduction of various support schemes for agricultural land, afforestation/reforestation (especially after Lithuania joined the EU and Common Agricultural Policy have launched) has led to rather considerable land use changes and different land management, which in the end has caused fluctuations in total emissions and removals trend.

LULUCF sector for 1990-2020 as a whole acted as a CO_2 sink except in 1996 when emission constituted to 992 kt CO_2 eq. (Figure 3-11). That is explained by sudden spruce dieback that caused huge losses in trees volume, in Lithuania's spruce stands, which has direct impact on biomass calculations and on CO_2 balance from this sector. LULUCF removals have been steadily decreasing since 2011 because of decreasing annual volume increments caused by changing forest stand age structure. For comparison, in 2011 forest land generated -10 173 kt CO_2 eq. and in 2020 – -6 485 CO_2 eq. Also, in 2019, there was an increase of emissions from other land category (352 kt CO_2 eq.) when significantly large areas of forest land were deforested for the national defence purposes.

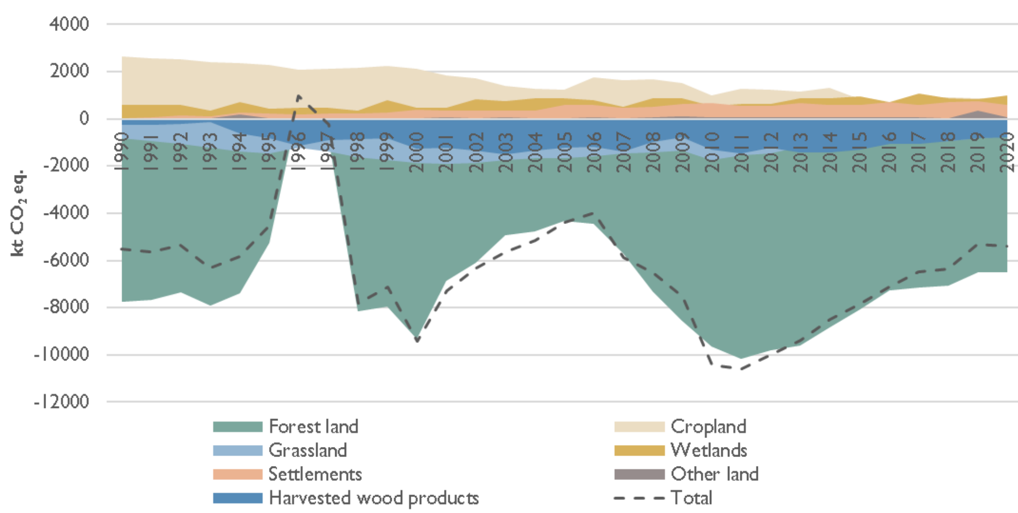

Figure 3-11. Total GHG emissions/removals from LULUCF sector for the period 1990-2020

Waste

The waste sector accounted for 4% of the total greenhouse gas emissions in 2020 (excl. LULUCF). The emissions from the waste sector included CO_2, CH_4 and N_2O emissions. Emissions of the total GHG from the waste sector have decreased from 1 522.1 kt CO_2 eq. in 1990 to 822.7 kt CO_2 eq. in 2020 (Figure 3-12).

Solid waste disposal on land (including disposal of sewage sludge) is the largest GHG emission source from the waste sector. It contributed around 69% of the total GHG emission from the waste sector in 2020. GHG emissions occurring due to solid waste and sewage sludge disposal on land were increasing slightly from 1990 to 2003 and then started to decrease due to reduction of disposed waste, extraction of landfill gas and anaerobic digestion of sewage sludge.

A certain increase in emissions was observed from 2001 to 2003 and was caused mainly by disposal of large amounts of organic sugar production waste. In later years the producers managed to hand this waste over to farmers for use in agriculture and GHG emissions declined.

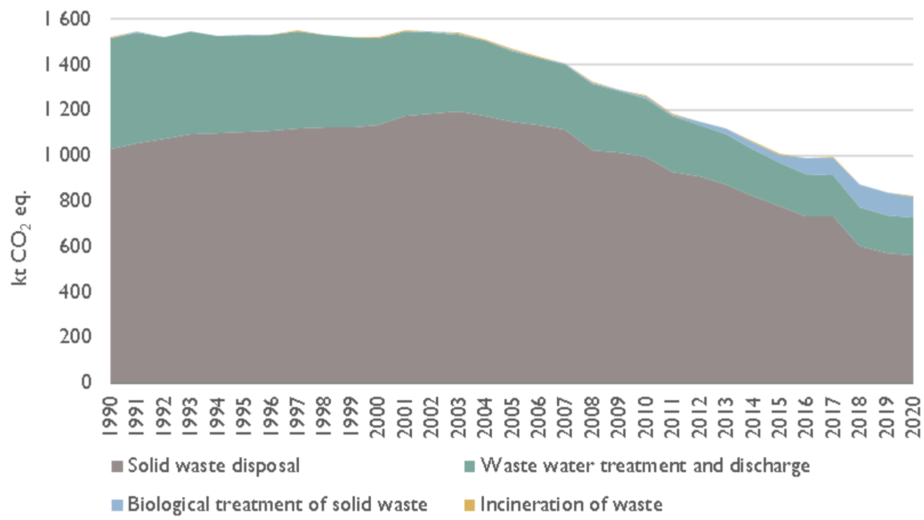

Figure 3-12. Trend of GHG emissions in waste sector during the period 1990-2020

Wastewater treatment and discharge contributed around 20% of GHG emissions from waste sector in 2020. Wastewater in Lithuania is treated in aerobic treatment systems with minimum CH_4 generation. However, about 23% of population still does not have connection to public sewerage systems and emissions from sewage collected from septic tanks are significant.

3.2 National inventory arrangements

3.2.1 Institutional arrangements for greenhouse gas inventory preparation

Detailed institutional set up for GHG inventory preparation is presented in Lithuania's National Inventory Report 2022, Chapter 1.2.1. Basic elements are presented further in this chapter. There was no change to the national inventory arrangements since the previous National Communication.

The main entities participating in GHG inventory preparation and submission process are:

- Ministry of Environment;
- Environmental Protection Agency;

- GHG inventory expert working group;
- State Forest Service;
- National Climate Change Committee;
- Data providers;
- External consultants.

The institutional set-up for GHG inventory report preparation and submission is given in Figure 3-13.

Ministry of Environment of the Republic of Lithuania (MoE) is a National Focal Point to the UNFCCC. The Ministry of Environment is designated as *single national entity* responsible for the national GHG inventory. It has overall responsibility for the National System of GHG inventory and is in charge of the legal, institutional and procedural arrangements for the national system and the strategic development of the national inventory. Within the ministry, the Climate Policy Group administers this responsibility by supervising the national system. The Group will continue to supervise and coordinate the preparation of the National Inventory Report, including the final review of draft inventory reports.

The contact person in the MoE with overall responsibility for the national GHG inventory is:

Ms. Jolanta Merkelienė
Advisor, Climate Policy Group
Tel.: +370 695 75667
E-mail: jolanta.merkeliene@am.lt

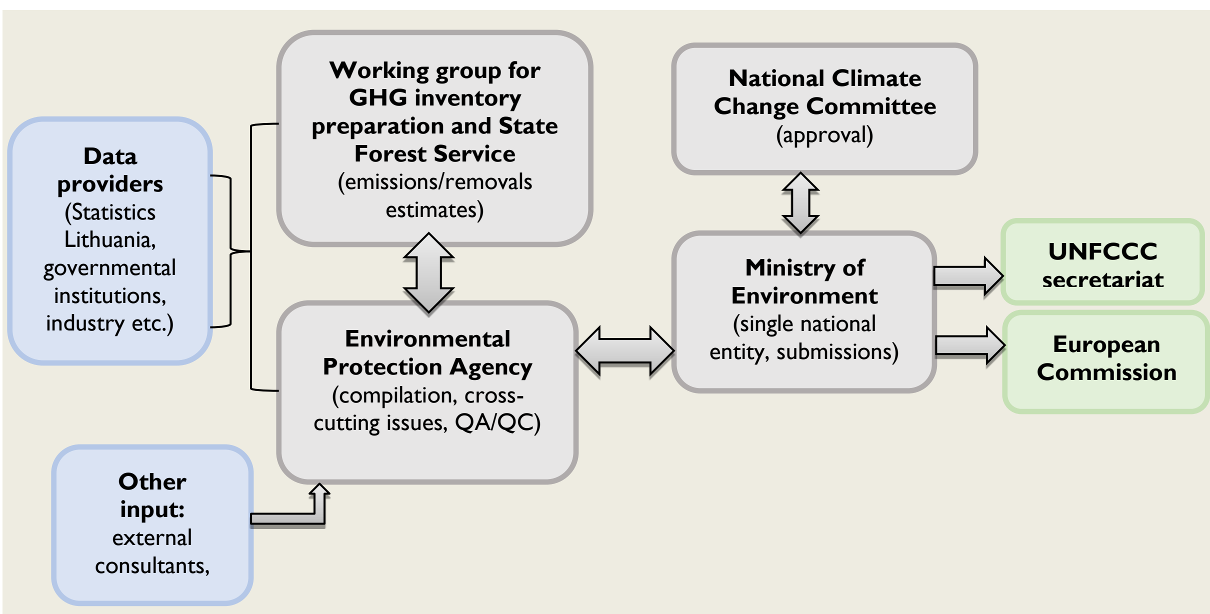

Figure 3-13. Institutional set-up for GHG inventory preparation

The **Lithuanian Environmental Protection Agency (EPA)** under the Ministry of Environment is assigned as an institution responsible for the GHG inventory compilation and QA/QC manager. In 2012 Climate change division was established within the EPA (since 2022, the GHG assessment division under the Analytical

Centre of the state of the environment). The EPA's responsibilities include: the development and implementation of a QA/QC plan and specific QA/QC procedures, collection of activity data and emission factors used to calculate emissions, collaboration with sectoral experts on the selection of best available methods complying with IPCC methodology, an accomplishment of cross-cutting issues (key categories analysis, overall uncertainty assessment, analysis of GHG trends), the establishment of GHG inventory database and archive, where GHG inventory submissions and all supporting reference material is stored and maintained etc.

Since 2014 submission personnel of the EPA is also responsible for calculation of emissions and preparation of NIR parts of the industrial processes and products use (IPPU) sector and agriculture (agricultural soils part) sector.

The EPA is responsible for compiling the final report based on the sectoral information provided by the experts/consultants – members of the permanent **GHG inventory expert working group** for GHG inventory preparation, which was established in 2012 by the Governmental Resolution No 683 (as repealed by Climate Change Management Law, 2021). It consists of experts from the Lithuanian Energy Institute, the Centre for Physical Sciences and Technology, Institute of Animal Science of the Lithuanian University of Health Sciences, the Centre for Environmental Policy, State Forest Service and Lithuanian Research Centre for Agriculture and Forestry. The composition of the expert working group for the preparation of GHG inventory is shown in Figure 3-14.

Members of the working group are responsible for determining activity data and emission factors, calculating emissions/removals on the basis of 2006 IPCC Guidelines, filling CRF tables for corresponding sectors, drafting relevant NIR sectorial chapters, applying sector specific QA/QC procedures.

External experts, independent specialists providing data for the GHG inventory, may also be involved during the inventory preparation process.

Fig. 3-14 The composition of expert working group for preparation of GHG inventory in Lithuania

The **State Forest Service** under the Ministry of Environment in the GHG inventory preparation process is responsible for calculations of emissions and removals of the LULUCF sector and Kyoto Protocol activities under Article 3 para. 3 and 4. State Forest Service's representative is also a member of the working group for GHG inventory preparation. State Forest Service inter alia compiles the National Forest Inventory (NFI) and the forest information system, carries out monitoring of the status of the Lithuanian forests, collects and manages statistical data etc.

Before final submission to UNFCCC secretariat and European Commission, reports are forwarded to the **National Climate Change Committee** for comments and final approval. National Climate Change Committee was established in 2001 in the first instance and periodically renewed (the latest in January 2021). It consists of experts from academia, government and non-governmental organizations (NGOs) and has an advisory role. The main objective of the Committee is to advise on the development and implementation of the national climate change management policy.

3.2.2 Greenhouse gas inventory preparation process, methodologies and data sources used

The work process of preparation and submission of the National GHG inventory in Lithuania is organized by performing planned activities. Figure 3-15 below shows a general overview of the GHG inventory preparation and submission process cycle.

Lithuania has to submit GHG inventory to the European Commission by 15th January and update estimates by 15th March annually. GHG inventory to the UNFCCC secretariat shall be submitted by 15th April annually.

This timeline shows only general activities overview and might be modified according to the reviews scheduled, planned projects, etc.

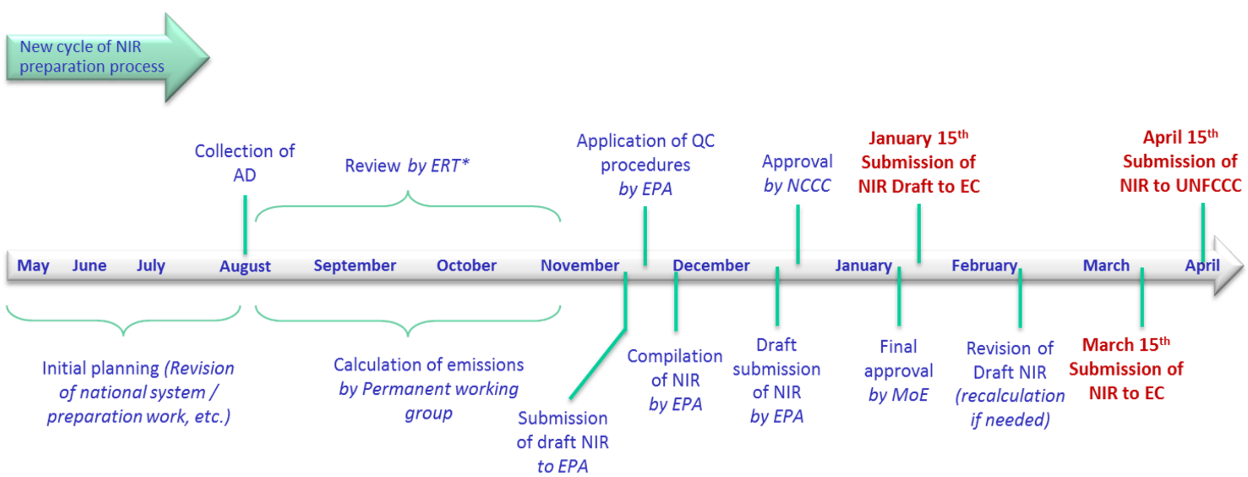

Figure 3-15. General timeline of GHG inventory preparation and submission process

One of the inventory preparation processes is data collection. This process starts with sending official requests to data providers (e.g. industrial companies) and collecting data from official statistical data sources.

This process also involves application of QC procedures (conducted by EPA by providing documentation QC protocols) in order to collect all references and evaluation of uncertainty of activity data.

Activity data necessary for the calculation of GHG emissions is collected from published materials and official national and international databases. Not published data is gathered from relevant authorities (institutes, industry companies etc.) on the request of the EPA.

The main data providers for GHG inventory estimation are:

- Statistics Lithuania (energy balance, statistics on agriculture, commodities, natural resources and environmental protection);
- The State Forest Service under the Ministry of Environment (NFI data, State Forest Cadastre data);
- The Environmental Protection Agency (ETS data, F-gases data, wastewater and waste data).

Table 3-2. Main data sources used in the GHG inventory

Sector	Main data sources
1.A Energy: Fuel Combustion	Energy Statistics database (Statistics Lithuania) EU ETS emission data
1.B Energy: Fugitive Emissions	Energy Statistics database (Statistics Lithuania) Lithuanian Geological Service Individual companies
2. Industrial Processes and Product Use	Individual production plants EU ETS emission data Industrial statistics database (Statistics Lithuania) F-gases database (EPA) Published literature
3. Agriculture	The Register of Agricultural Information and Rural Business Centre of Ministry of Agriculture Agricultural Statistics database (Statistics Lithuania) Regional Waste Management Centres Published literature International Fertilizer Association (IFA)
4. LULUCF/ KP-LULUCF	NFI (National Forest Inventory) Standwise Forest Inventory State Forest Cadastre Lithuanian Statistical Yearbook of Forestry National Paying Agency database on A/R areas Published literature
5. Waste	Waste database (EPA) Water and wastewater database (EPA) Regional Waste Management Centres

Lithuania's GHG emission inventory includes all major emission sources identified by the 2006 IPPC Guidelines with some exceptions, which have a minor effect on the total GHG emissions (insignificant categories in terms of the overall level and trend in national emissions). All Lithuania's territory is covered by GHG inventory.

The GHG inventory is prepared in accordance with IPCC methodology:

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (*IPPC, 2006*);
- 2013 Supplement to the 2*006 IPCC* Guidelines for National Greenhouse Gas Inventories: Wetlands (*IPCC, 2014*);
- 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (*IPCC, 2014*);
- 2019 IPCC Refinement (IPCC, 2019).

GHG inventory is prepared also taking into account requirements, provided in Regulation (EU) No 525/2013 of the European Parliament and of the Council on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (as repealed by Regulation (EU) 2018/1999).

Simple equations that combine activity data with emission factors are used. Different sources in the transport, agriculture, waste and LULUCF sectors necessitate using more complicated equations and models. Therefore, advanced and country-specific approaches (Tier 2 and Tier 3 methods) are used wherever possible, as these are designed to produce more accurate emission estimates than the basic (Tier 1) methods.

The choice of methodological tier for the individual categories depends among other things on the source's significance. The key categories analysis for the GHG inventory is performed according to the 2006 IPCC Guidelines (Approach 1 and Approach 2 level and trend assessment of the key categories) by EPA annually. The analysis covers all of the sources and sinks of the inventory. The Approach 2 methodology makes use of category-specific uncertainty analysis. The categories identified by Approach 2 that are different from categories identified by Approach 1 are treated as key categories.

The level of disaggregation used for the key category analysis is performed taking into account country-specific issues, specifically, in energy and agriculture sectors key categories are broken down into sub-source categories to reflect the level at which the EFs were applied and in order to focus efforts towards methodological improvements on these most significant sub-source categories.

Approach 1 key category (level assessment) with the highest contribution to national total emission in 2020 was 1.A.3.b Road transportation (CO_2). Its contribution to national total was 17% in 2020 and 11% in the base year. The second most important source in 2020 was 4.A.1 Forest land remaining forest land – carbon stock change in biomass (CO_2), accounting for 15% of the total emissions; it was also the most important source in the base year (contribution to national total 10%). The second highest source of greenhouse gas emissions in the base year was 1.AA.1.a Public electricity and heat production – liquid fuel (CO_2) accounting for 9% of the total emissions.

Results of the Approach 1 and Approach 2 Level and Trend key categories analysis are provided in Annex III.

Inventory estimates are periodically recalculated for several reasons, including revisions in key external data sources and revisions of data due to improvements in the estimation methodology or the inclusion of additional sources, input from the QA/QC activities and recommendations from the international and EU review process. Recalculations are conducted in accordance with the IPCC methodology and are reported in NIR under respective sectors. In addition, to ensure the accuracy of the estimates and to maintain consistency of the series through time, recalculations of past emissions estimates are undertaken for all previous years to view the actual difference of recalculation performed.

3.2.3 Quality assurance and quality control

Quality assurance and quality control (QA/QC) is an integral part of the inventory process. The quality requirements set for the annual inventories – transparency, consistency, comparability, completeness, accuracy – are fulfilled by implementing the QA/QC procedures. The outcomes of the QA/QC may result in a reassessment of inventory or category uncertainty estimates and subsequent improvements in the estimates of emissions and removals.

Lithuanian Environmental Protection Agency (EPA) coordinates the quality assurance and quality control (QA/QC) process of the greenhouse gas inventory.

As a GHG inventory compiler and QA/QC manager EPA performs general QC procedures which involve checking of all the input data, assumptions and data criteria, references provided, emission calculations, units and conversion, consistency between source categories, aggregation and transcription. Besides the general check, EPA fills in the checklist for primary data check and QC protocols which record all the corrective actions taken. General control procedures also involve QC of documentation and archiving system. The data providers and sectoral experts are also responsible for the quality of their inventory calculations and for implementing and documenting the QA/QC procedures. The QC procedures used in Lithuania's greenhouse gas inventory comply with the 2006 IPCC Guidelines.

Category-specific QC checks, including technical reviews of the source categories, activity data, emission factors and methods, are applied on a case-by-case basis by focusing on key categories and on categories where significant methodological and data revisions have taken place.

A QA/QC plan is a fundamental element of a QA/QC system. The Ministry of Environment and the Environment Protection Agency are responsible for developing and updating of the QA/QC plan. The last update of QA/QC plan was performed in 2020. The quality objectives of the QA/QC plan and its application are an essential requirement in the GHG inventory and submission processes in order to ensure and improve the inventory principles: transparency, consistency, comparability, completeness, accuracy, timeliness and confidence in the national emissions and removals estimates to meet Lithuania's reporting commitments under the UNFCCC and the Kyoto protocol.

Quality Assurance (QA) procedures aim to review the complete GHG inventory by the third party which is not directly involved in inventory preparation, to assess its quality i.e. assure that the best available data and methods are used. QA review can be applied to the whole inventory or a particular sector. QA procedures for Lithuania's GHG inventory are applied by performing scheduled international review (UNFCCC review, EU review) or performing national QA procedures.

More detailed information about the Lithuanian GHG inventory QA/QC system is provided in Chapter 1.2.3 of Lithuania's National Inventory Report 2022.

3.3 National GHG registry

The Lithuanian national GHG Registry is maintained in a consolidated manner within the Union Registry with other EU Member States. Following the Commission Delegated Regulation (EU) 2019/1122[2] the Union Registry is administrated by central administrator (the European Commission) in cooperation with the Member States' national administrators. The central administrator ensures that the Union Registry conforms to the functional and technical specifications for data exchange standards. The testing of the Registry related to the technical standards for data exchange between Registry systems is carried out under the supervision of the European Commission. Also, the central administrator operates and maintains the EU Transaction Log (EUTL) in accordance with the provisions of this Regulation.

The Rules of the Use of the Union Registry were changed and approved by the Order of the Minister of Environment No D1-205 on 7 April 2021. These Rules determine the main functions of the Lithuanian National GHG Registry administrator, management of accounts in the Union Registry, rights and responsibilities of the EU ETS operators, provisions for use and rendering of accounts' data. The Environmental Projects Management Agency under the Ministry of Environment of the Republic of Lithuania (hereinafter – EPMA) has been assigned the functions of the national GHG registry administrator.The latest updates related to the Lithuanian National GHG Registry are presented annually in the National Inventory Report (NIR), submitted to the UNFCCC Secretariat.

As required by the Annex II.E paragraph 32(a) to decision 15/CMP.1, Lithuania provides the name and contact information of the current registry administrator designated to maintain the national registry (see Table 3-3 below)

Table 3-3. The contact information of Lithuania's registry administrator

Lithuania's GHG registry contact information	
The entity responsible for administering the GHG Registry on behalf of a Member State	The Environmental Projects Management Agency under the Ministry of Environment of the Republic of Lithuania
Registry administrators	Jonas Balkevičius, Neringa Liudavičienė, Danutė Matelytė, Monika Ozarinskienė
Address	Labdarių str. 3, LT-01120 Vilnius, Lithuania
E-mail	sdregistras@apva.lt
Telephone number	+370 646 08 462, +370 607 61 049
Website	https://www.apva.lt/en/

2 Commission Delegated Regulation (EU) 2019/1122 of 12 March 2019 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards the functioning of the Union Registry

The access to the Union Registry is secured by e-mail, password and a QR-Code which has to be scanned with a compatible mobile device. A switch to the new authentication method 'EU Login Mobile App with QR code' became necessary to all users from 2022.

The internet address of the Union Registry has not been changed since the last National Communication. Participants of the EU ETS have access via a secure website:

https://ets-registry.webgate.ec.europa.eu/euregistry/LT/index.xhtml

All non-confidential information as described in the Decision 13/CMP.1, Annex II.E, Paragraphs 44-48, is also publicly available via the website of EPMA: https://www.apva.lt/en/national-investments/eu-greenhouse-gas-registry/

More information on the accounts and transactions can be found on the search pages of European Union Transaction Log: https://ec.europa.eu/clima/ets/welcome.do?languageCode=en

Confidential information is considered as referred to in Article 80 'Confidentiality' of the Commission Regulation (EU) 2019/1122.

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Decision 15/CMP.1 “Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol” https://unfccc.int/decisions?search=&f%5B0%5D=session%3A3696&page=1

Decision 24/CP.19 “Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention” http://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf

Environmental Projects Management Agency webpage https://www.apva.lt/en/national-investments/eu-greenhouse-gas-registry/

GHG registry website https://ets-registry.webgate.ec.europa.eu/euregistry/LT/public/reports/publicReports.xhtml

2006 IPCC Guidelines for National Greenhouse Gas Inventories https://www.ipcc-nggip.iges.or.jp/public/2006gl/

Lithuania’s National GHG Inventory Report 2022 https://am.lrv.lt/uploads/am/documents/files/Klimato_kaita/NIR_2022%2003%2015%20FINAL.pdf

Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013R0525

POLICIES AND MEASURES

4. POLICIES AND MEASURES

Lithuania's climate policy is defined in government programmes, legal acts and in National Climate Change Management Agenda. Effective climate change policies require global collaboration and actions. Therefore, the Lithuanian climate policy is based on international agreements: the UNFCCC, the Kyoto Protocol, Paris Agreement and the common policies of the EU.

This Chapter contains information on the climate change policy-making process (including the role of local governments in the context of climate change policy), national GHG targets, and strategies for sustainable development, as well as a description of the system for monitoring and evaluation of policies and measures over time. Also, this Chapter covers cross-sectorial policies and measures. Strategies and plans for individual sectors are further presented in the chapters below.

4.1 Policy making process

4.1.1 General climate policy framework

The Lithuanian climate change policy is developed in line with the targets and objectives laid down in the international agreements under the United Nations Framework Convention on Climate Change (UNFCCC), the EU strategic documents and legislation. The main goals of climate policy are to ensure Lithuania's contribution to climate change mitigation, ensure a balance of environmental, social and economic interests and promote Lithuania's ability to adapt to climate change and its impacts.

In accordance with the **Kyoto Protocol**, Lithuania has undertaken to reduce its GHG emissions by 8% below the 1990 level during the first commitment period 2008-2012 and successfully implemented achieving 56% GHG reduction, while GDP increased by 25%.

Furthermore, in 2012 at the Doha Climate Change Conference Lithuania – a Party of the Convention and Kyoto Protocol – together with the other EU Member States, undertook a 20% GHG emissions reduction below 1990 level commitment for the second Kyoto Protocol period from 2013 to 2020. It is therefore a joint pledge with no separate targets for Member States under the Convention. **The Doha Amendment of the Kyoto** Protocol was ratified by the Parliament (Seimas) on 20 October 2015.

The target implemented internally through EU legislation in the 2020 EU Climate and Energy Package. In this package, the EU introduced a clear approach to achieving the 20% reduction in total GHG emissions from 1990 levels, by dividing the effort between the sectors covered by the EU Emissions Trading System (EU ETS) and the sectors under the Effort Sharing Decision (ESD). Binding national targets were set for Member States under the Effort Sharing Decision.

The EU has substantially overachieved its reduction target under the Convention, which means that also its Member States and the United Kingdom have fulfilled their emission reduction obligations. As stated in the 2022 EU GHG inventory submission to the UNFCCC, the total GHG emissions, excluding LULUCF and including international aviation, decreased by 34% in the EU-27 + UK compared to the base year 1990 or 1.94 billion tons of CO_2 eq.

At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first ever universal, legally binding global climate deal. **Paris Agreement** sets out a global action plan to put the world on track to avoid climate change by limiting global warming to well below 2°C above pre-industrial levels and purse efforts to limit the temperature increase to 1.5°C above pre-industrial levels.

Lithuania signed the Paris Agreement on 22 April 2016 and ratified on 30 December 2016. Under the Paris Agreement Lithuania jointly with the EU and its Member States took a binding target of at least a 40% domestic reduction in economy wide GHG emissions by 2030 compared to 1990, which was endorsed in the conclusions of the European Council of 23 and 24 October 2014 on the EU 2030 climate and energy policy framework. On 6 March 2015, the Council adopted this contribution of the Union and its Member States as their intended nationally determined contribution, which was submitted to the Secretariat of the UNFCCC. The target is delivered implementing the EU legal acts on 2030 climate and energy targets by all economy sectors, with the reductions in the Emission trading system (ETS) and non-ETS sectors amounting to 43% and 30% respectively by 2030 compared to 2005.

Based on the European Green Deal strategy and the Commission's Communication of September 2020 on Stepping up Europe's 2030 climate ambition ('2030 Climate Target Plan') the EU has increased the European Union's binding target for 2030 towards at least 55% net emission reduction (compared with 1990 levels). The European Climate Law, adopted in 2021 sets the legally binding EU's climate neutrality target at the latest by 2050, and a binding Union domestic reduction target of at least 55% net emission reduction by 2030 compared to 1990. In order to follow the pathway proposed in the European Climate Law, and deliver this increased level of ambition for 2030, the European Commission has proposed a number of legislative proposals under the "Fit for 55" package laying down obligation to achieve the EU targets of reducing GHG emissions by 61% in the sectors covered by in the Emission trading system (ETS) and at least 40% in non-ETS sectors by 2030 compared to 2005.

In order to ensure the implementation in the international agreements and the EU legal acts defined targets for Lithuania, on 30 June 2021 by the Decree No XIV-490 of the Parliament of the Republic of Lithuania approved the **National Climate Change Management Agenda** (hereinafter – Agenda) which lays down the targets and objectives for climate change mitigation and adaptation by 2050. The Strategy implements the EU legal acts of the Climate change and energy package till 2030 and replaces the National Strategy for Climate Change Management Policy until 2020 adopted in 2012.

The goal of the Agenda is to develop and implement climate change management policy in Lithuania. The Agenda sets the short-term (until 2030), mid-term (until 2040) and long-term (until 2050) goals and objectives in the field of climate change mitigation and adaptation.

The national climate change mitigation targets by 2030 are as follows:

- to reduce GHG emissions by 30% compared to 2005 (including LULUCF) by shifting economic sectors towards innovative, low-emission and environmentally friendly technologies and the use of RES;

- for ETS sectors to reduce GHG emissions at least 50% compared to 2005;
- for non-ETS sectors (transport, industry, agriculture, waste, small-scale energy sector), to reduce GHG emissions at least 25% compared to 2005 (including LULUCF) and not exceed the annual emission allocations set for the period 2021-2030 by EU Effort Sharing Regulation.

The national climate change mitigation target by 2040 is to reduce GHG emissions by 85% compared to 1990. The Agenda sets a long-term objective of reaching net-zero emissions by 2050. The targets set in the Agenda are summarised in Table 4-1.

Table 4-1. National climate change mitigation targets set in the Agenda

GHG emission reduction targets	2030	2040	2050
Compared to 1990 level*	≥-70 %	-85 %	-100 %
Compared to 2005 level*	≥-30 %	–	–
For ETS sectors, compared to 2005 level	≥-50 %	–	–
For non-ETS sectors, compared to 2005 level*	≥-25 %	–	–

*Including LULUCF

To support the implementation of climate change mitigation targets and requirements of Regulation (EU) 2018/1999 on the Governance of the Energy Union and climate action **Lithuania's National Energy and Climate Action Plan** (NECP) for the period 2021-2030 was adopted in December 2019. The NECP has been prepared based on and integrating the provisions, objectives, and tasks of the Lithuanian national legislation, international obligations, strategies, and other planning documents, as well as measures being implemented and planned to be implemented. Thus, as of 2020 the Interinstitutional Action Plan of the Strategy for the National Climate Change Management Policy (2012) is incorporated in the NECP for the period of 2021-2030 in line with the requirements of the Governance of the Energy Union Regulation. The NECP sets a number of horizontal policies targeting economy-wide emissions reductions. Rather than setting economic incentives or introducing new regulations, these are primarily complementary policies, for example integrating GHG emissions reduction evaluations into the legislative process, mainstreaming climate change within educational programmes, extending the scope for green procurement, increasing public awareness, and funding research on climate mitigation. The targets, policies and measures set in the NECP are currently under revision in order to meet the increased ambition of the European climate legislation (EU "Fit for 55" package and REPowerEU plan) and GHG reduction targets set in Lithuania's National Climate Change Management Agenda.

4.1.2 Monitoring and evaluation of policy making process

The major legislation on environment issues is endorsed by the Parliament (Seimas) of the Republic of Lithuania or adopted by the Government. The relevant measures can be taken at the national and local level. The Ministry of Environment is the main managing authority of the Government of the Republic of Lithuania which develops the country's state policy of environmental protection, forestry, utilization of natural resources, geology and hydrometeorology, territorial planning, construction, provision of residents with housing, utilities, and housing, as well as coordinates its implementation. The Ministry of Environment of the Republic of

Lithuania is the main responsible and coordinating institution for the development of climate change policy and its implementation in Lithuania.

Lithuania's strategic planning system is defined in the **2021-2030 National progress program** (2020), which sets strategic goals and objectives and progress indicators in main national policy areas, including clean and safe environment, covering climate change mitigation and adaptation. Also, this Program determines strategic goals and targets for the planning 2021-2027 EU fund investments and for the formation of the state budget, the assurance of coherence between state budget and EU funds.

The Strategic Governance Law was adopted on 25 June 2020 to establish and develop a results-oriented strategic governance framework, integrating strategic planning, regional development, and spatial planning processes to ensure the long-term and sustainable progress of the State and the efficient planning and use of public finances. The purpose of this Law is to establish the principles of the strategic management system, to define the levels and types of planning documents, their interrelationships and impact on the planning of progress funds, and funds for continuing operations, to define the actors in the strategic management system, their rights, and obligations, and to establish the provisions for the governance of the strategic management system. The law identifies the environment, forests, and climate change as areas of state activity for which national development programmes are prepared.

Description of the underlying provisions to make the information on the legislative arrangements and enforcement and administrative procedures established pursuant to the implementation of the Kyoto Protocol publicly accessible

The right of access to information in official documents is a basic civil right protected by the Lithuanian constitution. Article 7 of the Law on Legislative Framework, adopted in 2012 establishes requirements for public consultation in the process of national legislation preparation, including legislation related to the implementation of the provisions of the Kyoto protocol, Paris Agreement and other international climate agreements to which Lithuania is a Party. Article 17 of this Law establishes the requirement to publish all draft legal acts in the Legislative Information System (TAIS), and approved legal acts in the Electronic Legislation Register (E-Tar), which are publicly available.

Information and participation of the public in the process of drafting legislation in the field of environmental protection is regulated by the Minister of Environment Order No D1-381 "Public information and participation in the development of plans and programs on climate change, air, water protection and waste management" adopted on July 26th, 2005 (with latest amendments in 2017).

Information on the implementation of the provisions of the Kyoto protocol and other international climate agreements (legislation adopted, the projects and studies carried out, GHG inventory data, the events organized etc.) are also published on the official website of the Ministry of the Environment under the heading 'Climate change'.

Arrangements established for the process of self-assessment of compliance with emission reduction commitments

Procedure of compliance with emission reduction targets applied until 2020

In the period of 2013-2020 the main national strategic policy for climate change management was the Strategy for National Climate Change Management Policy for 2013-2050. The Ministry of Environment coordinated the implementation of the Strategy and other sectorial ministries were responsible within their remit. The Inter-institutional Action Plan for the implementation of the goals and objectives for the period of 2013-2020 of the Strategy for National Climate Change Management Policy was approved by the Government. This Action Plan consisted of general provisions, targets, objectives, measures, financial resources, implementing institutions, assessment criteria and values. Following the Strategic planning methodology approved by the Government, the plan was prepared for 3 years and was updated annually by adding one more year. Besides that, ministries and other governmental institutions were obliged to mainstream the targets and objectives into sectoral policies and planned as set forth by the Strategy the implementation measures, to ensure close inter-institutional cooperation while developing the strategies, their implementation plans and programmes of individual sectors of the economy.

State and municipal institutions which were engaged in the implementation of the Strategy and the Inter-institutional Action Plan were reported to the Government via Monitoring Information System. Also, provided the Ministry of Environment with the information about the progress in implementing the Strategy and its implementation plan by submitting annual activity reports. The progress of the Strategy implementation was evaluated by the set of criteria established in the Inter-institutional Action Plan. In order to comply with annual GHG emission reduction targets in non-EU ETS sectors, quantitative yearly GHG emission reduction targets in million t CO_2 eq. were determined for transport, agriculture, waste management, non-ETS industries and other sectors were set as assessment criteria in the Action Plan.

Also, the targets and objectives of the Strategy were implemented by planning documents for the country's specific economic sectors, such as the National Progress Programme, sectoral development programmes or short-term planning documents. The implementation of the Action Plan was funded from the funds of the State budget of the Republic of Lithuania, municipal budgets, EU structural and investment funds and other sources.

The process of assessment of compliance with emission reduction commitments was established also on EU level. If any Member State has exceeded its ESD annual emission allocations (taking into account the flexibilities), the following measures against non-compliance according to EU decision No 406/2009 7 article (Corrective action, Art. 7) shall be taken:

a) a deduction from the Member State's emission allocation of the following year equal to the amount in tonnes of carbon dioxide equivalent of those excess emissions, multiplied by an abatement factor of 1.08;

b) the development of a corrective action plan in accordance with paragraph 2 of this Article; and

c) the temporary suspension of the eligibility to transfer part of the Member State's emission allocation and JI/CDM rights to another Member State until the Member State is in compliance.

In addition, a Member State shall, within 3 months, submit to the Commission an assessment and a corrective action plan that includes:

a) action that the Member State will implement in order to meet its specific obligations, giving priority to domestic policies and measures and the implementation of Community action;

b) a timetable for implementing such action, which enables the assessment of annual progress in the implementation.

Procedure of compliance with emission reduction targets applied from 2021

In 2021 the Strategy adopted in 2012 was repealed by the National Climate Change Management Agenda, which sets out revised targets and objectives for Lithuania's climate change management policy up to 2030, up to 2040 and in the long term up to 2050 in the areas of climate change mitigation and adaptation to the effects of climate change. Information on targets, determined in the Agenda is provided in Chapter 4.1.1 above.

The targets and objectives set out in Agenda for the period 2021-2030 shall be pursued through the implementation of the National Progress Plan and the National Energy and Climate Action Plan (NECP), which was adopted in 2019. In 2021, the Ministry of Energy and the Ministry of Environment started preparing for the update of NECP, detailed information is given in Chapter 4.1.3 below.

The NECP sets a number of policies and measures targeting economy-wide emissions reductions, as well as financial resources, implementing institutions etc. Besides that, ministries and other governmental institutions are obliged to mainstream the targets and objectives into sectoral development policies and planned implementation measures as set forth by Agenda. In addition to general GHG emission reduction targets for ETS and non-ETS sectors, in Agenda sub-sectorial targets for the following non-ETS sectors were determined: in transport, agriculture, waste, industry and small-scale energy sectors expressed as a percentage GHG reduction required by 2030 compared to 2005.

The process of assessment of compliance with emission reduction commitments by 2030 is established also on EU level under Efforts Sharing Regulation (EU) 2018/842 (amendment of this Regulation was adopted in the end of 2022). According to Regulation's Art. 9 the compliance check is set in 2027 and 2032. If the reviewed GHG emissions of a Member State exceed its annual emission allocation for any specific year of the 2021-2030 period (taking into account the flexibilities) the following measures shall apply:

a. an addition to the Member State's GHG emission figure of the following year equal to the amount in tonnes of CO_2 equivalent of the excess GHG emissions, multiplied by a factor of 1.08; and
b. the Member State shall be temporarily prohibited from transferring any part of its annual emission allocation to another Member State until it is in compliance.

If the GHG emissions of a Member State in either the period from 2021 to 2025 or the period from 2026 to 2030 referred to in Article 4 of Regulation (EU) 2018/841 (LULUCF regulation) exceeded its removals, the Central Administrator shall deduct from that Member State's annual emission allocations an amount equal to those excess GHG emissions in tonnes of CO_2 equivalent for the relevant years.

4.1.3 Institutional arrangements for the monitoring of GHG mitigation policy

In Lithuania, climate policy is integrated with the decision-making processes in energy, transport, agriculture, waste, forestry and land-use sectors and territorial planning. The Ministry of Environment is the main responsible and coordinating institution for the development of climate change policy and its implementation in Lithuania. Issues related to development and implementation of the climate change policy are carried out by Ministry of Finance, Ministry of Energy, Ministry of Economics and Innovations, Ministry of Transport and Communications, Ministry of Agriculture, Ministry of Health, Ministry of Interior, Ministry of Foreign Affairs, Ministry of Education, Science and Sport and institutions supervised by the relevant ministries. Institutions supervised by the Ministry of Environment, which are related with the climate change issues: Environmental Protection Agency, State Forest Service, Lithuanian Hydrometeorological Service, the Environmental Projects Management Agency.

National Committee on Climate Change was set up to coordinate the formulation and implementation of a national policy on climate change management. It was composed of representatives of the State, scientific and educational institutions, and associations, and its decisions were of an advisory and recommendatory nature. The structure of the Committee is currently being modified and will be composed of scientific representatives working on climate change adaptation and mitigation.

The main institutions (see Figure 4-1) involved in the preparation of the Policies & Measures (hereinafter – PaMs) and GHG emission projections and responsible for the process of submission are:

- Ministry of Environment;
- Environmental Protection Agency;
- Lithuanian Energy Agency;
- State Forest Service;
- Data providers.

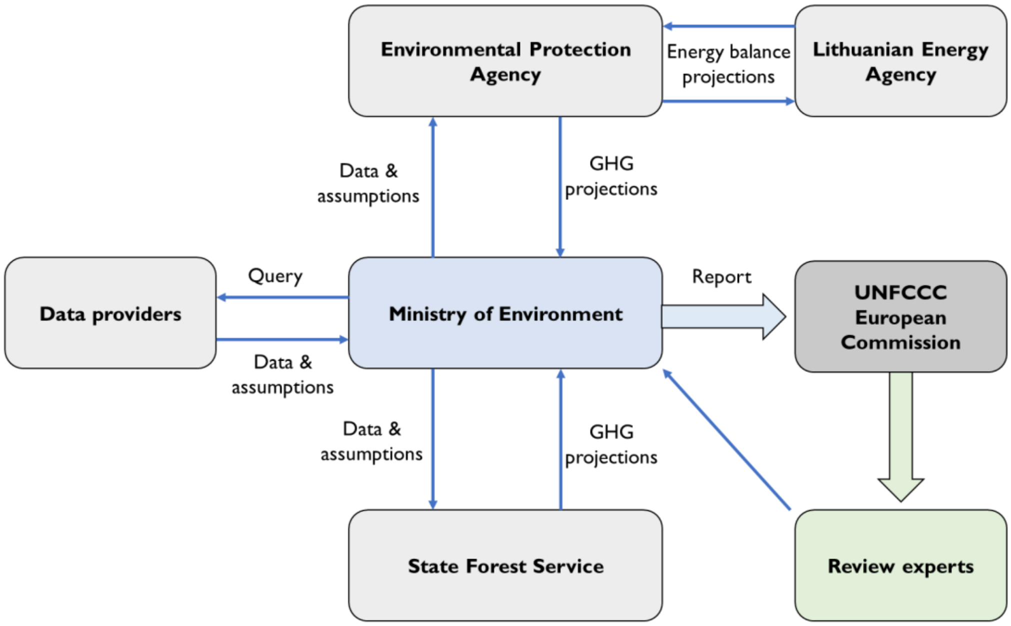

Figure 4-1. The scheme of the main responsible institutions involved in the preparation of GHG emission projections in Lithuania

Ministry of Environment

The Ministry of Environment of the Republic of Lithuania (MoE) is the main responsible and coordinating institution for the development of climate change policy and its implementation in Lithuania. It has overall responsibility for the national system of GHG inventory preparation as well as of PaMs and projections reporting, and oversees the legal, institutional and procedural arrangements for the national system and the further strategic development.

The Climate Change Division in the Ministry of Environment was established in 2008. In 2012 strengthening institutional capacities the Division was divided into two divisions: The Climate Change Policy Division and the Climate Finance and Project Management Division. In 2019 those two divisions were reunited in Climate Policy Group with strengthened institutional capacities.

Among other tasks the Climate Policy Group responsibilities are the following:

- Preparation of legal acts required for the functioning of national system;
- Development of Lithuania's position for the international climate negotiations and drafting EU legislation,
- Coordination of the preparation of National GHG Inventory Report;
- Overall coordination of PaMs and GHG projections preparation process;
- Collection of information from data providers on the currently adopted or planned PaMs in different sectors and preparation of the final report;
- Sending out the questionnaires to data providers to collect projected relevant activity data;

- An official consideration, QA and approval of the GHG emission projections report;
- Timely submission of the PaMs and GHG emission projections reports to the European Commission;
- Coordination of the process in Lithuania during the QA procedure of the European Environmental Agency;
- Keeping of archive and publication of the official submissions to the European Commission;
- Informing of other the responsible institutions on preparation process of PaMs and GHG emission projections and relevant requirements for the national system.

Environmental Protection Agency

Lithuanian Environmental Protection Agency (EPA) under the Ministry of Environment starting from 2011 was nominated as an entity responsible for GHG inventory and GHG projections preparation by the Order of the Minister of Environment No D1-1017 (repealed by the Order of the Minister of Environment No D1-64, 2021). Since 2013 EPA is responsible for calculation of GHG emissions projections based on activity data received from data providers and the preparation of part on GHG emission projections of the report for energy, industrial processes and product use, agriculture and waste sectors. EPA has the following functions and responsibilities:

- Analysis of key categories and identification of specific information, activity data and emission factors used to calculate GHG emission projections;
- Analysis of activity data received from data providers, preparation of assumptions and calculation of GHG projections;
- Performing the sensitivity analysis of GHG projections;
- Filling the Reporting on projections template and providing to the Ministry of Environment;
- Archiving the supplied and used activity data for GHG projections calculations, calculation files of GHG projections and used materials;
- Evaluating requirements for recent activity data, based on internal and external reviews;
- Implementation of initial QC procedures for GHG projections estimates.

Lithuanian Energy Agency

The Agency implements State policy measures in the energy sector in accordance with the procedures established by laws and other national and EU legislation, carries out analysis and monitoring of the implementation of these measures, performs the functions of the central organization that accumulates and manages oil products and oil reserves. LEA is currently developing a model of Lithuania's energy system to forecast energy consumption, calculate the impacts of individual policy measures, track the achievement and implementation of national energy targets.

The State Forest Service

The State Forest Service (SFS) compiles the National Forest Inventory (NFI) and the forest information system, carries out monitoring of the status of the Lithuanian forests, collects and manages forestry statistical data etc. The SFS functions are under the Ministry of Environment. Starting from 2010 in the GHG inventory preparation process SFS is responsible for calculations of emissions and removals in LULUCF sector and the Kyoto Protocol activities under Art. 3. Since 2013 under the Order of the Minister of Environment No D1-1017 (repealed by the Order of the Minister of Environment No D1-64, 2021). SFS has started to estimate the GHG emission projections for LULUCF sector. These estimates are provided directly to EPA for the compilation of GHG emission projections report.

Data providers

Aiming to set up the system to ensure better data collection for the preparation of the National GHG inventory as well as report on PaMs and GHG emission projections as it was stated above the amendment of the Government Resolution No 388 of 7 April 2004 was adopted in 2013. The Ministry of Environment requests the data from data providers on adopted and planned PaMs by sending out the questionnaires and official letters to the responsible ministries and other institutions obliged to provide information according to the Government Resolution, key industry companies as well as to science research institutions.

The main data providers are (see also Figure 4-2 below):

The Ministry of Energy identifies the main measures related with mitigation of GHG emissions in the Energy sector.

The Ministry of Transport and Communications and its subordinated institutions provide projected information on transport sector's development. The projected activity data was based on expert judgement by the competent experts, a spreadsheet model for cars, created by 'Aether' and the National transport and communication development programme for 2014-2022.

The Ministry of Agriculture provides information on projected livestock population based on the projected agriculture sector economic development. The projection of development of agriculture sector is made by the Ministry of Agriculture.

The *largest Lithuania's industry companies* provide information on their planned production capacities.

The *Waste and Water divisions in the Ministry of Environment* provide information on waste sector, wastewater and sludge treatment development and strategic plans. The additional projected data on waste management was collected from the EPA under the Ministry of Environment and Regional Waste Management Centres.

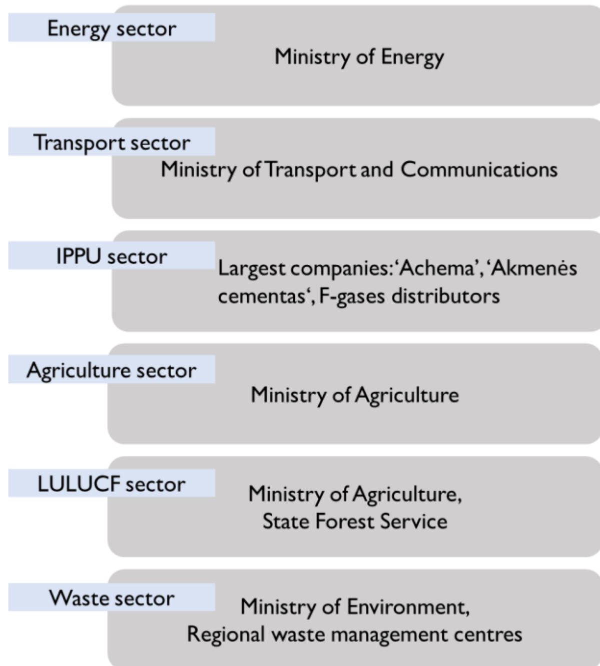

Figure 4-2. Scheme illustrating data flow and activity data providers for the preparation of GHG emission projections

The major PaMs evaluation exercise was performed during the preparation of the National Energy and Climate Action Plan (hereinafter – NECP). During that process, the Ministry of Environment launched a study to indicate the main concerning sectors regarding GHG emissions and possible contribution to reach the domestic target, and the consultants identified the possible measures. However, the sectorial ministries reviewed the proposed measures based on the sectorial objectives, development trends, economic and social aspects. EPA experts or other consultants re-evaluated the final list of PaMs.

The Eighteenth Programme of the Government of the Republic of Lithuania envisaged agreeing with society and business on how the Agenda will be implemented in different sectors of the economy. In order to do so, the National Energy and Climate Action Plan (NECP) is being updated. To achieve high quality result, the Ministry of the Environment, together with the Ministry of Energy, has set up sectoral working groups, where representatives of business, science and NGOs gave suggestions on GHG reduction measures. The update of the NECP is an important part of the implementation of the international climate change objectives set out in the Paris Agreement and the EU climate change and energy policy mitigation (GHG reduction) targets and objectives until 2030.

This process involved the social partners, who were brought together in 5 decarbonisation working groups covering 5 economic sectors in Lithuania: agriculture and forestry, energy, industry, transport and waste/circular economy. Members were briefed on existing and planned NECP measures, the OECD expert analysis, participated in discussions and proposed additional measures to achieve the 2030 mitigation targets.

The NECP is being updated in the following order:

– Review and discussion of existing decarbonisation measures;

- Collection and discussions of new alternative/additional decarbonisation measures;
- Evaluation of all decarbonisation measures (technical potential, (public) investment needs, GHG reduction effectiveness, impact on jobs, air pollution, social indicators);
- Modelling of the GHG impacts of the updated list of decarbonisation measures (alignment with OECD proposals);
- Adoption of the updated decarbonisation measures for NECP;
- Public and regional consultations;
- Revision of the updated NECP based on comments;
- Approval of the updated NECP by the Government of the Republic of Lithuania and submissions to the European Commission;
- Final version of NECP in 2024.

4.2 Cross-sectorial policies and measures

On 16 September 2009 the Government of the Republic of Lithuania by its Resolution No 1247 approved the updated **National Strategy for Sustainable Development**. In order to reach the targets and objectives, set forth in the strategy, implementation plan was prepared. Environment protection and climate change topics are under consideration in this Strategy.

On 15 May 2012 the Parliament of the Republic of Lithuania with its Resolution No XI-2015 adopted **Lithuania's Progress Strategy "Lithuania 2030".** This Strategy underlines the need for incentives for business to invest in green technologies, products and services. The main challenges and tasks in the period 2014-2020 were related to the increase of energy efficiency and use of renewable energy sources (hereinafter – RES) in final energy consumption by creating and introducing low carbon technologies in industry, agriculture and transport sectors. It is indicated that stronger cross-sectorial cooperation between research and industry is needed as well as international cooperation on joint climate change adaptation and risk prevention and management.

The National Progress Programme for 2014-2020 was approved by the Government Resolution No 1482 of 28 November 2012 for the implementation of the abovementioned Strategy. In 2020 the new **2021-2030 National progress program** was approved. As from 2021 targets of climate and energy are implemented through the **National Progress Plan 2021-2030** (NPP), which was adopted by the Government of Lithuania on 9 September 2020. The NPP has been drawn up with a view to identifying the main changes pursued by the State for the next decade and ensuring progress in the social, economic, environmental and security fields. The NPP will be implemented via sectorial development programs.

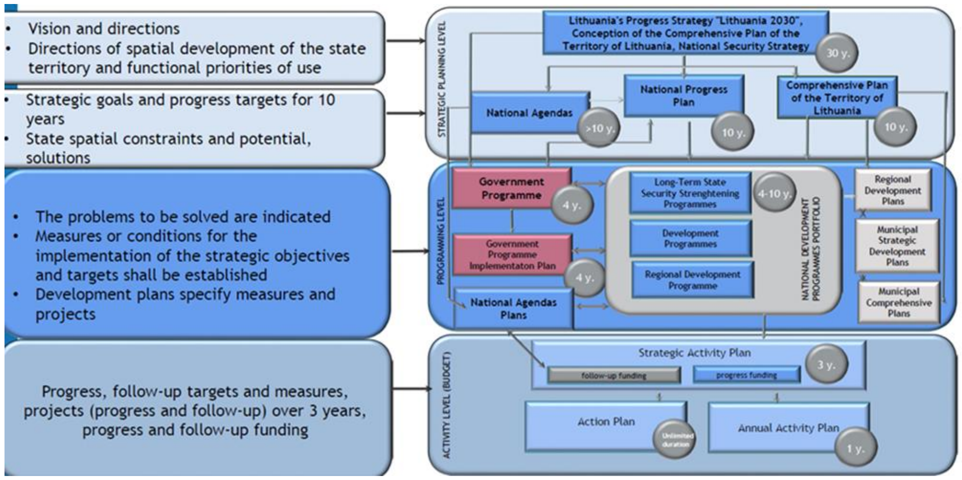

Figure 4-3. Planning documents system in Lithuania since 2020 (scheme composed by the Lithuanian Government administration)

In 2018, Lithuanian Parliament adopted the **National Energy Independence Strategy**[3], which includes the state's key energy policy tasks, directions, and implementation tasks up to 2030 and a vision up to 2050. The main strategic directions of the Lithuanian energy policy development are energy security, competitiveness, green energy development and innovations. The Strategy reflects the vision of the Lithuanian energy sector – to provide reliable, renewable and environmentally friendly energy to the residents of the country for the most favourable price as well as sets targets and objectives for renewables and improvement of energy efficiency by 2030 and 2050.

Other cross-sectorial policies related to green energy transition promoting use of renewables, energy efficiency as well as climate and energy innovation policy are provided in Chapter 4.3.1.

To support the implementation of mentioned strategies and to conduct Regulation (EU) 2018/1999 on the Governance of the Energy Union and climate action Lithuania's NECP for the period 2021-2030 was adopted in December 2019. More information on NECP is provided in Chapter 4.1.1.

New **Comprehensive Plan of the Territory of the Republic of Lithuania** adopted on 29 September 2021 by the Government provides for the long-term development prospects of the territory of the country (until 2050). It will become one of the country's key development instruments, with solutions up to 2030 and a proposed vision up to 2050. The projected spatial development orientations focus heavily on climate change mitigation and adaptation.

4.2.1 National economic and financial instruments for climate change management

The implementation of Lithuania's climate goals and the above-mentioned policies and measures also requires financing.

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[3] Source: http://enmin.lrv.lt/uploads/enmin/documents/files/National_energy_independence_strategy_2018.pdf

Climate Change Programme

The Ministry of Environment of Republic of Lithuania administrates a Climate Change Programme (hereinafter – Programme). As it is stated in the Law on Climate Change Management a Climate Change Programme was developed in order to collect additional funding for climate change management measures. All the Funds are used only for climate change mitigation and adaptation measures nationally and internationally.

The Funds for the Programme are accumulated in a separate account of the State Treasury and is regarded as part of national state budget. The Law states that the sources of financing of the Programme these:

- The funds obtained from the transfer of assigned amount units;
- The funds obtained from the auctioned allowances under the EU ETS;
- The funds obtained from the economic penalties in accordance with the procedure laid down in Chapter VI of this Law;
- The funds donated by natural and legal persons for implementation of the measures aimed at mitigation of climate change;
- Other funds received in legal ways.

The funds of the Programme are used for:

1. Energy consumption and production efficiency enhancement processes: modernization of dwelling houses and public buildings, implementation of other projects permitting most efficient reduction of GHG emissions in the energy, industry, construction, transportation, agriculture, waste management and other fields;
2. Promotion of the use of renewable energy resources, introduction of environment-friendly technologies, including efficient energy production by cogeneration;
3. Implementation of measures of the National Progress Plan, National Climate Change Management Agenda, National Energy and Climate Action Plan to increase the greenhouse gas removals capacity of land use, land use change and forestry sector;
4. Provision of information to and education of the public, scientific research and dissemination thereof, consulting and training of operators and other persons on topical issues of management and implementation of the climate change policy, enhancement of energy consumption efficiency, use of renewable energy resources and introduction of environment-friendly technologies;
5. Implementation, in the territory of the Republic of Lithuania and third countries of measures of adaptation to climate change and mitigation of climate change effects as stipulated under legal acts of the European Union, the UNFCCC, the Kyoto Protocol, Paris Agreement and other international agreements;
6. Implementation of other financial instruments for the effective management of climate change policy, which would allow operators operating the sector or sub-sector facilities that are at real risk of carbon leakage due to the high indirect costs that are actually incurred with the amount of greenhouse gas

emissions, through the use of state aid by transferring related costs to electricity prices, and for other economic entities whose activities are not included in the list of activities specified in Annex 1 of this law, to reduce the financial and economic burden of obligations to reduce greenhouse gas emissions, to implement – no more than 25 percent of the income received after auctioning emission permits;

7. To administer Programme funds and the Union GHG registry, to prepare national greenhouse gas accounting and projecting systems, and to evaluate the impact of policies and measures on climate change mitigation.

The general provisions of the management of funds of the Programme are:

- since 2022 the four-year Programme investment plans, annual reports on the use of Programme funds are prepared and the Programme funds are administered by the Ministry of Environment;
- since 2022 four-year investment plans of the Programme and their amendments, discussed with Seimas Committee on Environment Protection, are approved by the Government;
- the Ministry of the Environment submits annual reports on the use of Programme funds for the previous calendar year to the Government and the Seimas Environmental Protection Committee;
- together with the four-year Programme investment plans and the annual reports on the use of Programme funds for the previous calendar year, information on the planned reductions in the amount of greenhouse gases for each financing direction is provided.

The rules for the use of Climate Change Programme funds are approved for individual measures by order of the Minister of the Environment. The funds of the Programme are managed by the Ministry of Environment, and the selection and monitoring of the Programme projects is carried out by the designated institution – the Environmental Projects Management Agency under the Ministry of Environment.

Table 4-2. Approved financial measures under the Climate Change Programme in 2013-2021

Year	Financial measure	Number of projects*	Disbursed proceeds, EUR million
2013	Modernization of public buildings in order to reduce energy consumption	66	19.63
	Modernization of private houses in order to reduce energy consumption	180	0.05
	Installation of biomass boilers up to 10 MW	1	0.52
	Preparation of biomass material from wood waste	4	0.46
	Installation of RES technologies in private houses	225	0.03
	Installation of biomass boilers in public buildings	26	2.83
2014	Modernization of public buildings in order to reduce energy consumption	8	2.6
	Modernization of private houses in order to reduce energy consumption	158	0.49
	Installation of RES technologies in private houses	238	0.41
	Installation of RES technologies in public buildings	9	1.23
	Replacement of inefficient biomass boilers with efficient biomass boilers	2	0.77

2015	Installation of RES technologies in public buildings	19	0.4
	Installation of RES technologies in private houses	368	0.49
	Modernization of private houses in order to reduce energy consumption	148	0.23
2016	Installation of RES technologies in private houses	445	0.1
	Modernization of private houses in order to reduce energy consumption	181	-
2013-2016	Modernization of multi-apartment buildings in order to reduce energy consumption	1000	71
2017	Installation of RES technologies in private houses	500	1.7
	Modernization of private houses in order to reduce energy consumption	92	1
	Development cooperation projects	2	0.2
2018	Installation of RES technologies in public buildings	66	3.6
	Installation of RES technologies in private houses	1038	3.3
	Development cooperation projects	1	0.1
2019	Modernization of multi-apartment buildings in order to reduce energy consumption	-	25
	Modernization of private houses in order to reduce energy consumption	221	3
	Modernization of internal heating and hot water systems of multi-apartment buildings	-	5
	Renovation (modernization) of public buildings belonging to municipalities, implementing the program for increasing the energy efficiency of public buildings	22	11
	Installation of RES technologies (for electricity generation) in public buildings	191	10
	Installation of RES technologies in private houses	414	6.99
	Modernization of equipment and RES installation in the district heating sector	18	7
	Promotion of less polluting cars of mobility for individuals, who crash old car (1000 EUR)	2762	5
	Development cooperation projects	9	0.8
2020	Modernization of private houses in order to reduce energy consumption	1064	9
	Modernization of multi-apartment buildings in order to reduce energy consumption	-	10
	Modernization of internal heating and hot water systems of multi-apartment buildings	-	5.3
	Renovation (modernization) of public buildings belonging to municipalities, implementing the program for increasing the energy efficiency of public buildings	10	5
	Implementation of energy efficiency measures by private legal entities according to the energy audit report	3	13
	Installation of RES technologies (for electricity generation) in public buildings	226	22
	Installation of RES technologies (for electricity generation) for legal entities	89	3.3
	Financial instruments to producing consumers by increasing the social availability of renewable energy resources	941	2.9

	Promoting the use RES by centralized networks, replacing the use of fossil fuels	6	0.6
	Investment support for the production of biomethane gas and/or the installation of biogas treatment facilities	4	8
	Promotion of public transport and bikes, scooters for individual persons in exchange of old cars (1000 EUR)	12 351	11
	Promoting the purchase of electric cars for individuals	652	1.7
	Renewal of public transport vehicles	139	20
	Creation of non-polluting infrastructure + non-polluting vehicles	9	11
	Promoting the replacement of polluting technologies with less polluting ones in companies participating in the EU ETS	1	2.5
	Promoting the purchase of electric cars for legal entities	78	1.04
	Development cooperation projects	6	1.09
2021	Modernization of private houses in order to reduce energy consumption	1307	11.1
	Modernization of multi-apartment buildings in order to reduce energy consumption	-	9.5
	Modernization of internal heating and hot water systems of multi-apartment buildings	3	0.8
	Modernization of legal entities buildings	2	2.5
	Renovation (modernization) of public buildings belonging to municipalities, implementing the program for increasing the energy efficiency of public buildings	22	5
	Installation of RES technologies (for heating) in public buildings	25	2
	Installation of RES technologies (for electricity generation) for in public buildings	239	22
	Installation of RES technologies (for heating) for legal entities	23	1
	Installation of RES technologies (for electricity generation) for legal entities	502	11.75
	Installation of RES technologies in private houses	4349	12.5
	Installation of RES technologies for the poor people in private houses	169	1.7
	Connecting residential houses to the centrally supplied heating system by replacing heating devices using fossil fuel	7	0.04
	Promotion of less polluting cars of mobility for individuals, who crash old car (1000 EUR)	2848	2.8
	Promoting the purchase of electric cars for individuals	1996	7.3
	Promotion of public transport and bikes, scooters for individual persons who crash old car (1000 EUR)	15 103	10.1
	Promoting the purchase of less polluting cars for the poor people, who crash old car (2000 EUR)	7	0.014
	Promoting the purchase of electric cars for legal entities	398	3.3
	Renewal of public transport vehicles	143	23
	Creation of non-polluting infrastructure+non-polluting vehicles	5	7.8
	Promoting the replacement of polluting technologies with less polluting ones in companies participating in the EU ETS	5	10.3
	Investment support for the production of biomethane gas and/or the installation of biogas treatment facilities	17	15
	Promoting the replacement of polluting technologies with less polluting ones in companies not participating in the EU ETS	1	0.09

	Development cooperation projects	6	1.94
	Innovative GHG reducing projects	1	0.17
2022-2025	Development cooperation projects	-	8
	Modernization of multi-apartment buildings in order to reduce energy consumption	-	48
	Modernization of private houses in order to reduce energy consumption	-	1.4
	Promotion of purchase and/or use of less polluting transport	-	5
	Additional funding of the 2014-2020 EU measure “Renovation of Public Central Government Buildings” under the program for increasing the energy consumption of public buildings		10
	Renovation of buildings	-	16
	Promotion of RES technologies	-	81
	Investment to support for the production of biomethane	-	33
	Promotion of purchase and/or use of less polluting transport	-	12
	Promotion of the reduction of GHG emissions by legal entities	-	15
	Climate Neutral Government	-	5
	A financial incentive for non-governmental organizations	-	0.5
	For the implementation of the measures of the updated National Action Plan in the field of energy and climate	-	111.7

The diagram below shows the revenues of the Climate Change Programme, the revenue depends on ETS emissions allowances prices. As well as the annual budget of the Programme shown in the diagram. Since 2022, the Programme’s revenues and budget are planned for 4 years.

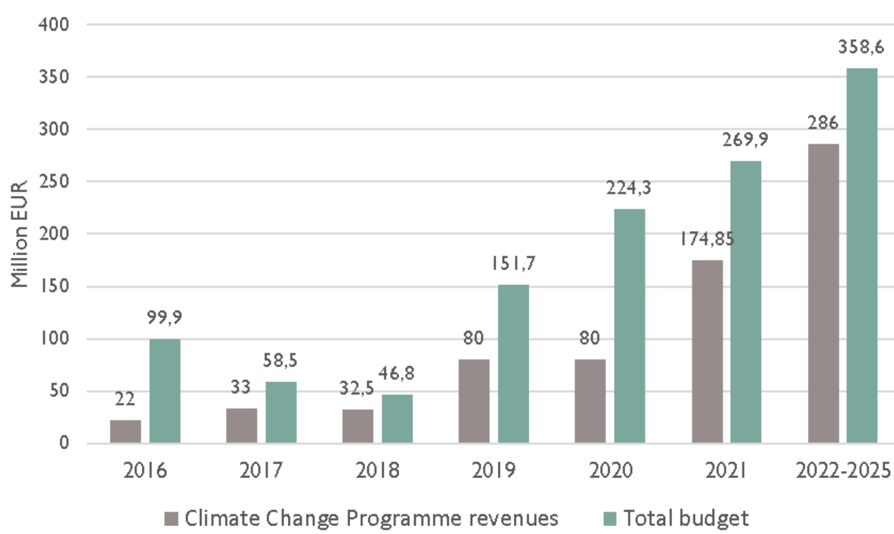

Figure 4-4. Climate Change Programme’s revenues and total budget in 2016-2025, EUR million

Figure 4-5. Quartal modernization of multi-apartment buildings

<u>Other financial programs for implementation of climate mitigation measures</u>

The Modernisation Fund is a programme under the EU ETS to support 10 Member States (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia) to meet 2030 energy targets by helping to modernise energy systems and improve energy efficiency. The Modernisation Fund provides investments in generation and use of energy from renewable sources, energy efficiency, energy storage, modernisation of energy networks, including district heating, pipelines and grids, just transition in carbon-dependent regions: redeployment, re-skilling and upskilling of workers, education, job-seeking initiatives and start-ups. The total revenues of the Modernisation Fund may amount to EUR 48 billion from 2021 to 2030 (at 75 EUR/tCO_2 eq.), depending on the carbon price. Out of this amount, around EUR 28 billion comes from allowances that beneficiary Member States have transferred to the Modernisation Fund from their resources under Article 102(b) and 10c, and around EUR 20 billion comes from the auctioning of 2% of the total EU ETS allowances from 2021 to 2030.

The Innovation Fund is one of the world's largest funding programmes under the EU ETS for the demonstration of the most innovative low-carbon technologies. The Innovation Fund was established by Article 10a(8) of Directive 2003/87/EC to support across all Member States innovation in low-carbon technologies and processes. The EU Innovation Fund support is available to projects located in all EU Member States, Norway and Iceland.

Rural development

The Common agricultural policy supports the vibrancy and economic viability of rural areas through funding and actions that support rural development.

Rural development is the 'second pillar' of the Common agricultural policy (CAP), reinforcing the 'first pillar' of income supports and market measures by strengthening the social, environmental and economic sustainability of rural areas.

The CAP contributes to the sustainable development of rural areas through three long-term objectives:

- fostering the competitiveness of agriculture and forestry;
- ensuring the sustainable management of natural resources and climate action;
- achieving a balanced territorial development of rural economies and communities including the creation and maintenance of employment.

The CAP's contribution to the EU's rural development objectives is supported by the European agricultural fund for rural development (EAFRD). The EAFRD budget for 2021-2027 amounts to EUR 95.5 billion, which includes an injection of EUR 8.1 billion from the Next generation EU recovery instrument to help address the challenges posed by the COVID-19 pandemic.

At least 30% of funding for each Rural Development Programme must be dedicated to measures relevant for the environment and climate change, much of which is channelled through grants and annual payments to farmers who switch towards more environmentally friendly practices.

Lithuania's Rural Development Programme 2014-2020 replaced National Strategic Plan for 2007-2013 Rural Development. Lithuania's Rural Development Programme for 2014-2020 period was approved by European Commission on 13 February 2015. Programme for the new period further enhances the existing policy framework for sustainable management of natural resources, contributing to both climate change mitigation and enhancing the resilience of farming to the threats posed by climate change and variability. The 2014-2020 Lithuanian Rural Development Programme identifies a priority list of 24 needs. As many as 7 needs are directly related to climate change mitigation.

Rural Development Programme promotes the growth of the agricultural sector based on technologies that are territorially and environmentally balanced, climate-friendly, climate change- resilient, competitive and innovative. It also promotes sustainable farming (25 000 ha), development of organic farming (110 000 ha), crop rotation, rational use of the mineral fertilizers, and replacement thereof with organic fertilizers. The total budget of the programme was EUR 1.978 billion. 36% of all funds were allocated for climate change mitigation (this amount included the previous programming period). Farmers receive "green payments" of EUR 50/ha under the CAP (EUR 155 million/year) if they comply with three practices that go beyond statutory management requirements and "good agricultural and environmental condition of land" standards: crop diversification (to make the soil more resilient), conservation of permanent grassland (to support carbon sequestration and protect biodiversity) and delineation of ecological focus areas (to create habitats for biodiversity). Many agricultural support measures were implemented under the 2014-2020 RDP, which Lithuanian authorities deem to have had a positive environmental impact. Lithuania devoted 40% of its RDP budget to the environment and climate, exceeding the 30% share imposed by the CAP. The main measures aimed at improving biodiversity, water and soil (EUR 100 million/year), sequestering carbon (EUR 9 million/year) and reducing GHG and ammonia emissions (EUR 3 million/year). In particular, the RDP promotes organic farming (EUR 30 million/year), "agri-environment-climate measures" (EUR 100/ha; EUR 14 million/year), forest ecosystem services, including carbon sequestration (EUR 8 million/year), development of the Natura 2000 network and improvement of water quality (EUR 3 million/year). In addition, more than half of the environment and climate budget of the RDP concerns "areas facing natural constraints", mainly wetlands (EUR 55 million/year). RDP payments encourage farmers to implement environmentally friendly practices beyond those imposed by the CAP.

Lithuanian **Agriculture and Rural Development 2023-2027 strategic plan** (hereinafter – the Strategic Plan) aims at the sustainable development of the Lithuanian agricultural and food economy, increasing the added value and competitiveness of the sector, supporting the income of promising farms (especially small and medium-sized ones), the change of generations, creating a vibrant village that is attractive for farming and business and contributing to the environment and implementation of climate goals. During the 2023-2027 period almost 4 billion EUR is planned for Lithuanian agriculture and rural development from EU funds, and about 276.5 million EUR national budget funds. The strategic plan includes:

- Direct support, systems (eco-schemes) beneficial to the climate, environment and animal welfare, sectoral programs for which 3.02 billion is allocated of EU funds and about 2.8 million EUR national funding;
- For investment, cooperation, environmental protection, climate goal-seeking and other rural development measures 977.5 million EUR of EU funds and 273.7 million. EUR national funding.

In June 2020, the government adopted **its DNA of the Future Economy Plan** that aimed to move the country to a sustainable, innovative and high value-added economy. It includes short and long-term investment projects in five priority areas: human capital; digital economy and business; innovation and research; economic infrastructure; and climate change and energy. A total of EUR 6.3 billion in investment was planned between July 2020 and December 2021, of which 25% will be dedicated to environmental and climate change issues, resource and energy efficiency. In early 2021, this plan was abolished but will be partially implemented through other policies. These include the National Progress Plan for 2021-2030, the Plan on the implementation of the Government programme, the National Energy and Climate Action Plan (NECP), the 2021-27 EU Investment Programme and the 2021-26 New Generation Lithuania recovery plan.

Parliament adopted a law on the **Innovation Promotion Fund** in June 2020. The Fund will provide loans, guarantees and risk capital for start-ups and research and development (R&D) projects. The maximum subsidy per applicant is EUR 200 000, but the amount of the subsidy for a project may not exceed 70% of total eligible costs. The funding guidelines may set a lower amount.

EU funds and the Waste Management Programme finance new waste collection measures, recycling infrastructure and its development to help municipalities to collect and recycle more waste. The programme is funded from revenues of the tax on environmentally harmful products and packaging (paid by producers and importers) and of the landfill tax. The funds finance the setting-up, operation and development of waste management schemes, including investment projects. The programme also supports training, education and provision of information to the public and municipal staff related to waste management. It can also provide grants to municipalities and subsidies to economic entities to operate and develop waste management schemes.

Lithuania was allocated EUR 10 billion from the **European Structural and Investment Funds** (ESIF) for 2014-2020. By mid-2020, 94% of the total amount planned was allocated to specific projects. In all, 55% was spent, above the EU average of 47%. About 30% of the ESIF target environmental protection, resource efficiency and climate-related objectives, including in agriculture and fishing.

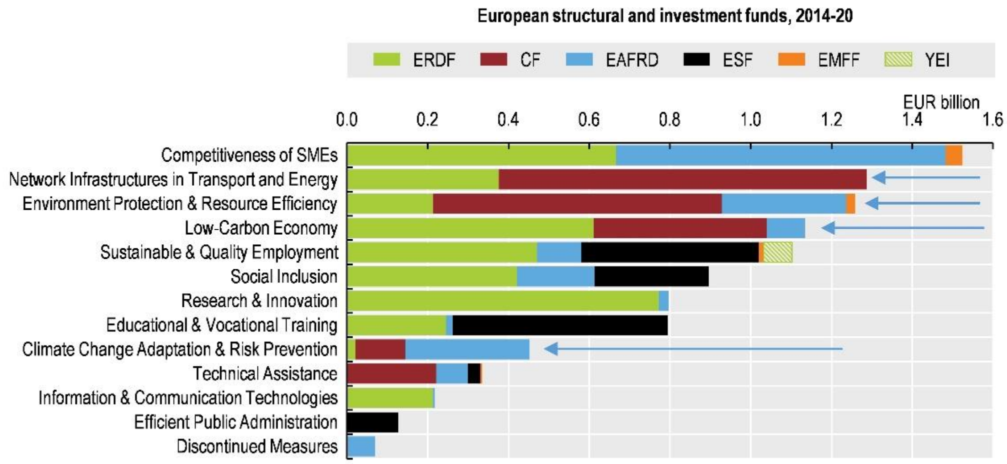

Figure 4-6. European structural and investment funds 2014-2020

Note: CF - Cohesion Fund; EAFRD - European Agricultural Fund for Rural Development; EMFF - European Maritime and Fisheries Fund; ERDF - European Regional Development Fund; ESF - European Social Fund; SMEs - Small and medium-sized enterprises; and YEI - Youth Employment Initiative, including national co-financing (EUR 1.6 billion out of EUR 10 billion).
Source: EC (2020), *European Structural and Investment Funds* (database).

Over the past decade, the government allocated annually about EUR 150 million to cities and EUR 350 million for road development and maintenance. Lithuania relies on support from the EU Structural Funds and Cohesion Fund for investment in transport infrastructure. Investment is focused on international projects such as Rail Baltica and Via Baltica, with the aim to improve links between the Baltic states and central, western and northern Europe. The 2021-2026 New Generation Lithuania recovery plan includes support for shifting to a low-carbon transport system. The main priorities of the plan are a gradual shift away from polluting urban and regional public transport and development of alternative fuelling and charging infrastructure. The plan's implementation by 2026 will require an estimated EUR 320 million in investment.

Investment in the railway sector, coming both from the state budget and the operational income of Lithuanian Railways, is expected to increase significantly in 2021-2023. The main priorities for investment are modernisation of railway infrastructure to reduce travel times, improved safety, and increased capacity for freight operations. To date, however, the state budget funding allocated to road infrastructure projects has been dominant. Lithuania still has a very high percentage of gravel roads: 27% of state roads and 62% of local roads. Thus, much of this investment is directed at upgrading gravel roads, especially in the countryside where poor road infrastructure has a negative impact on road safety and limits possibilities for residents to choose other (non-cars) environmentally friendly vehicles.

EU Structural Funds are also used to support development and implementation of sustainable mobility plans (SUMPs). Between 2014 and 2020, EUR 1.1 million was allocated for the preparation of sustainable mobility plans and EUR 18.8 million was allocated for implementation of sustainable mobility measures identified in the plans.

On 18 February of 2015 the Ministry of Finance and the Ministry of Energy together with the Public Investment Development Agency established the **Energy Efficiency Fund**. The Fund provide investments in energy efficiency projects using the following financing tools: loans for the modernization of central government buildings and guarantees for loans from commercial banks for the modernization of street lighting projects. The Fund manages EUR 79.65 million. Up to EUR 65.16 million provided for the modernization of central government buildings and up to EUR 14.48 million for street lighting modernization projects. The Public Investment and Development Agency was appointed as the Fund manager. The first loans and guarantees from the Fund provided in summer of 2015. End of this project activities implementation: September 1, 2023.

The **EU Cohesion policy** provides for important investment possibilities to implement energy policy objectives in Lithuania which will be complemented by national public and private co-financing, aiming at optimal leverage. It also ensures integrated territorial solutions to challenges by supporting capacity building and territorial cooperation, including the Baltic Sea Region macro-regional strategy in which Lithuania takes part.

Internal Energy Market: Over 2014-2020, EU Cohesion Policy was invested some EUR 154 million in smart transmission systems, as well as some EUR 21 million in smart electricity distribution grids in Lithuania. These investments contributed to around 10 000 additional users connected to smart grids.

Energy efficiency: Over 2014-2020, EU Cohesion Policy was invested some EUR 540 million in energy efficiency improvements in public and residential buildings and in enterprises, as well as in high-efficiency cogeneration and district heating in Lithuania. A further estimated EUR 626 million are invested in supporting the move towards an energy-efficient, decarbonised transport sector. These investments are contributed to around 3 000 households with improved energy consumption classification and a decrease of around 60 GWh per year of decreased primary energy consumption of public buildings, as well as to around 74 km of reconstructed or upgraded railway lines, and 20 km of new or improved inland waterways.

Decarbonisation: Overall, the EU Cohesion Policy investments in Lithuania over 2014-2020 was expected to contribute to an estimated annual decrease of GHG of around 680 kt of CO_2 eq. Over 2014-2020, EU Cohesion Policy was invested some EUR 330 million in renewable energy in Lithuania. These investments are contributed to around 760 MW of additional capacity of renewable energy production.

Research, Innovation and Competitiveness: Over 2014-2020, EU Cohesion Policy was invested significantly in R&I and in SME competitiveness in Lithuania. These investments are based on the National strategy for smart specialisation. For Lithuania, the Strategy includes a focus on energy and a sustainable environment priorities, namely (1) smart systems for energy efficiency, diagnostic, monitoring, metering and management of generators, grids and customers, (2) energy and fuel production using biomass/waste and waste treatment, storage and disposal, (3) technology for the development and use of smart low-energy buildings – digital construction and (4) solar energy equipment and technologies for its use for the production of electricity, heat and cooling. At least EUR 103 million was foreseen for investments in R&I and adoption of low-carbon technologies in Lithuania.

In August 2022 the European Commission approved **Lithuania's Programme for the European Union (EU) Funds' Investments 2021-2027**, according to which it is planned to invest EUR 7 billion 449 thousand.

Europeans, investments are aimed at ensuring Lithuania's future well-being: investments in energy security, innovation and green economy, high quality education, social and medical services for both city and regional residents, jobs for new generations.

The **EU cohesion policy** will ensure the long-term economic and social well-being of the Lithuanian population, and to strengthen the resilience of our country's economy. The EU cohesion policy allows promoting economic, social and territorial cohesion, green and digital transitions and thus contributes to Lithuania's competitive, innovative and sustainable growth, centered on the quality of life of its citizens.

The Programme for the EU Funds' Investments 2021-2027 includes the investments of **the European Regional Development Fund, the Cohesion Fund, the "European Social Fund +"** planned to be targeted in the following areas:

Smarter Lithuania – competitiveness of the economy and transition to the economy with the higher added value;

Greener Lithuania – transition to clean energy, green investments, circular economy, adaptation to climate change, risk prevention and management of extreme climate events;

Better connected Lithuania – digital connectivity, cross-border and national, regional and local mobility, sustainable, advanced, safe and diverse trans-European transport network;

More socially responsible Lithuania – investments in people and systems in the fields of employment, education, health, social inclusion and cultural policies;

Lithuania closer to its citizens – sustainable and integrated development of cities and villages and local initiatives in order to respond to demographic challenges and reduce social and economic disparities;

Social innovation – activities aimed at the implementation of new ideas related to products or services, the benefits of which are provided to the society, are funded;

Digital infrastructure – development of very high capacity broadband networks in "white spots" identified according to the analysis of investment needs;

Sustainable mobility – financing of relevant measures provided for in the sustainable mobility city plans of 18 cities and resorts in Lithuania.

For the even development of the country, investments will be made in 10 regional centres of Lithuania, realizing their economic potential. In this way, the benefits of investments would be felt not only by the residents of a specific city, but also the entire region.

Almost 47% of the Programme funds will be allocated to investments in innovations and green transition – sectors that will create the greatest added value for the Lithuanian economy in the long term.

30% of the Programme funds will be targeted to the strengthening of human capital, solving the challenges of social inclusion and improving achievements in the fields of education, health, culture and ensuring high employment rates in the labour market.

EUR 1.62 billion will be allocated to regions that will plan investments themselves and enable communities to agree among themselves on necessary projects that are important to the strategy and vision of that region.

In 2022 the Programme for the European Union Funds' Investments 2021-2027 the calls for proposals in the amount of EUR 1.1 billion are announced in energy, transport, education, health, culture, and social areas.

A total of EUR 8 billion of the EU Funds' investments are planned in Lithuania after the European Commission approved Lithuania's Territorial Just Transition Plan (TJTP) from **Just Transition Fund** on 14 December 2022. Under the TJTP activities are orientated towards two directions: industry decarbonisation and the creation of sustainable jobs. All investments are dedicated to three regions that are mostly affected by the transition towards climate neutrality: Kaunas, Šiauliai and Telšiai regions and municipalities operating in Jonava, Akmenė and Mažeikiai. Totally 273 million EUR will be invested in order to diminish the consequences of the transition. In particular, EU funding will support the introduction of 'green' hydrogen and other innovative solutions into production processes, as well as the establishing green jobs in the regions.

The Economic Recovery and Resilience Facility proposed by the European Commission is the main component of the joint "Next Generation EU" instrument of 750 billion EUR for economic recovery and preparation for future challenges, therefore the national integrated draft plan is called **"New Generation Lithuania"** in response to a common European context. 2.225 billion EUR is planned for Lithuania for grants and up to 3 billion EUR for loans. "New Generation Lithuania" milestones:

- **In the field of renewable electricity production**, in order to prepare for the construction of wind farms in the Baltic Sea, investments in preparatory seabed and technical research will be made, it is planned to support business and population investments in solar and wind power plants.
- **In the field of sustainable transport**, it is envisaged to expand the infrastructure network for electric vehicle charging and alternative refuelling stations. At the same time, financial incentives will be provided for public sector bodies and business to replace polluting vehicles, also public transport will be refurbished.
- **In the field of energy efficiency**, a reform of the renovation of buildings will be implemented. The goal is 1 000 multi-apartment buildings to be renovated per year.
- **In the field of digital innovation**, it is planned to develop innovations in data and digitalisation technologies in business through artificial intelligence, blockchains and automation. A separate priority is given to the flagship initiative – digitisation of the Lithuanian language resources, which would allow local and foreign market products or services "to speak" in Lithuanian (e.g. smart home management systems, Amazon Alexa, Apple Siri).
- **In the field of education**, it is planned to implement complex measures in general education with a view to improving students' achievements and reducing the gap. The aim will be to optimise the school network by investing in the Millennium schools, also the investments will be designated to increase the attractiveness of vocational training.
- **In the field of science and innovation**, it is planned to encourage the transformation of research and education institutions in such a way that the international competitiveness of studies in Lithuania, scope

of scientific research and its quality would grow significantly. It is planned to improve the system of funding of studies and student enrolment by ensuring better compliance with labour market needs, to increase the efficiency of study quality assessment and to ensure systematic monitoring of R&D activities.

- **In the field of health**, investments are planned to modernise infectious diseases cluster centres in 5 major cities, which will ensure accessible, high-quality infectious disease diagnostic and treatment services for the population, as well as safe working conditions for personnel. The reception units for 10 health institutions at regional level will also be modernised. This will ensure preparedness of the major hospitals of the country to effectively provide emergency medical services to a large number of patients at a time in the event of an emergency (chemical pollution, radioactive contamination, nuclear accident terrorism, epidemic of communicable diseases).
- **In the field of labour market and social inclusion**, it is planned to create opportunities for jobseekers to learn and acquire high value-added qualifications and competences, as well as to subsidise job creation which contribute to the objectives of digital and green transformation. It is envisaged to subsidise job creation for persons affected by the operational changes of the company due to the COVID-19 pandemic.
- **In the field of efficiency of the public sector**, it is planned to invest in the improvement of STI and Customs activities through the introduction of advanced IT technologies, as well as to encourage reduction of cash payments, to conduct financial education of the public in order to create opportunities for the reduction of VAT non-collection and shadow economy. The efficiency of the activities of civil servants will be increased – centralised management of human resources and managerial careers, investments in strategic competences.

In 2019 **National Energy and Climate Action Plan (NECP) of Lithuania** by implementing the EU climate and energy policy targets till 2030 were conducted the total investments to be financed 14 billion EUR investments, of which EUR 9.6 billion EUR could be public funds. Most of the funds, about 10.8 billion EUR, will be dedicated to the implementation of the goals of national energy independence and Lithuania's obligations to the EU regarding the mitigation of climate change – to promote technological and operational changes in different sectors. Also, 3.3 billion EUR planned for adaptation to climate change.

4.2.2 The GHG emissions trading system in Lithuania

The EU ETS is a key climate policy instrument that has been implemented in the EU and three participating non-EU countries jointly to achieve its objectives of reducing GHG emissions in a cost-effective manner since 2005. Since 2013 the EU ETS covers certain activities that emit CO_2, N_2O and PFCs.

EU ETS is established by the EU Directive 2003/87/EC under which each operator carrying activities under the Directives scope participates each year in a so-called “compliance cycle”. This yearly cycle includes monitoring GHG emissions, verifying them and reporting to the competent authority. After the reporting is complete each operator is obligated to surrender EU ETS allowances equal in amount to the emitted GHG in tonnes during the reporting year.

Part of EU ETS allowances are given for free to the operators which are deemed to be exposed to carbon leakage to third countries. However, this allocation is reduced each year to encourage operators to plan for the shortage of allowances and reduce their GHG emissions by modernising their installations. Since 2013 the main principle of allocation is auctions and operators receive just a limited amount of free allowances and the rest needed amount is obligated to purchase from other operators or auctions of allowances.

Since 2005, Lithuania takes part in EU Emissions Trading System. Aviation has been included in the EU ETS since 2012 and monitored since 2010. Installations under the scope of the EU ETS are required to have a GHG emissions permit, issued by the Environmental Protection Agency in accordance with Order of the Minister of Environment No. D1-231 was approved on 29 April 2004. These permits must be updated if changes to the functioning of the installation occur.

In 2021, 86 installations and 2 aircraft operators from Lithuania carried out activities that fall under the scope of the EU ETS (Figure 4-2). Most of these installations are small district heating units.

According to Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions (MRR) all 86 installations are divided into 3 categories:

- 74 installations fall under category A (installations that emit less than 50 kt CO_2 eq. per year or low emitters (less than 25 kt CO_2 eq. per year));
- 9 installations fall under category B (installations that emit more than 50 kt CO_2 eq., but less than 500 kt CO_2 eq. per year);
- 3 installations fall in category C (installations emitted > 500 kt CO_2 eq.).

In total Lithuanian EU ETS operators emit about 30% (comparing National GHG inventory report for year 2022 (20 182.55 kt CO_2 eq.) with EU ETS GHG registry data for 2020 (6 137.66 kt CO_2 eq.)) of total national greenhouse gas emissions. The majority of GHG is emitted from 3 installations that carry out production of ammonia and nitric acid, petroleum refining and cement production. All operators of stationary installations and aircraft operators in the EU ETS are required to monitor and report their annual emissions in accordance with the MRR. Reported emissions are also affected by obligations under the Accreditation and Verification Regulation (AVR) and must be verified by independent 3rd party verifiers that are accredited by the National accreditation bodies. Any verifier accredited by the EU Member State National accreditation body (NAB) may carry out verification in any EU Member State. In case of Lithuania, all verifications are carried out by verifiers that are accredited by other EU member states NABs. There are no verifiers accredited by the Lithuanian NAB.

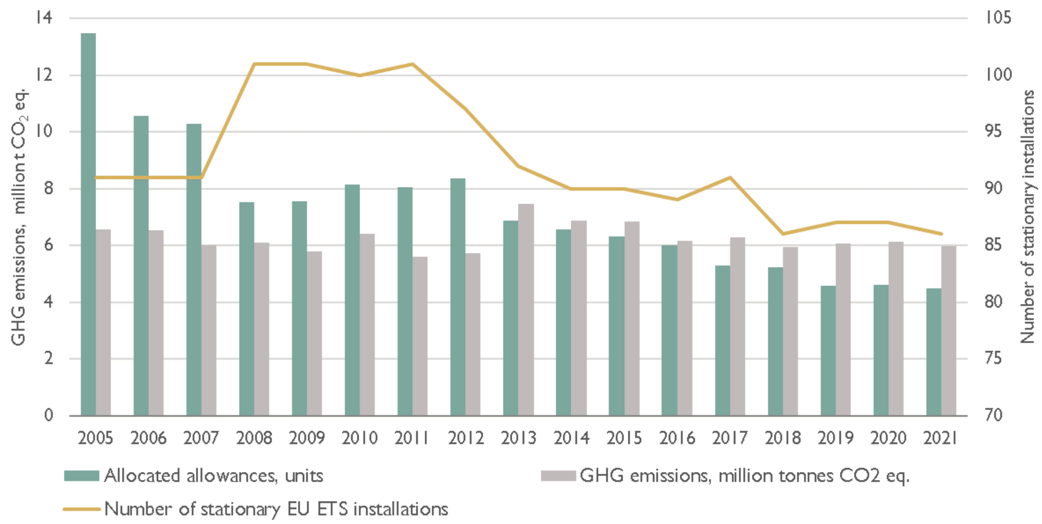

Figure 4-7. Trends of EU ETS in Lithuania[4]

During the first (2005-2007) and second (2008-2012) EU ETS trading periods, emission allowances were allocated on a national level according to EU-wide rules. Since the beginning of the third (2013-2020) trading period, the allocation was changed and this means that approximately half of the allowances are expected to be auctioned, with this proportion continually rising throughout the trading period. Furthermore, it was decided to decrease the EU ETS total emissions cap by 1.74% yearly so that the target of 21% of GHG reduction by 2020 in EU ETS would be achieved (compared to the 2005 GHG emission level).

Revision of the EU ETS – phase 4 (2021-2030)

In March 2018 the European Parliament and Council amended Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments after 2020. The annual reduction in the number of allowances of the EU quota was reduced from 1.74% linear reduction factor to 2.2% in order to provide the emissions reductions and thus deliver the underlying environmental objective (-43% GHG reduction by 2030 in EU ETS sectors compared to 2005). It is determined that further strengthen the EU ETS by temporarily doubling the rate at which allowances are placed in the Market Stability Reserve (MSR) from 2019. This change would allow the MSR to reduce the existing market oversupply of allowances faster.

Since European leaders have agreed to continue free allocation after 2021, sectorial benchmarks were updated to reflect technological progress. Changes regarding activity levels were introduced to better reflect a fair free allocation methodology. Criteria for composition of the carbon leakage list were also reviewed.

Several low carbon funding mechanisms were introduced, in particular an Innovation Fund (to support demonstration of innovative renewable energy and low-carbon innovation in the industry, as well as carbon

[4] The figure shows an increase of EU ETS GHG emissions in 2013. This is due to increase in the scope of activities that fall under the EU ETS directive (since 2013 non-combustive CO_2 emissions from ammonia production and N_2O emissions from nitric acid production started to be included in EU ETS)

capture, use and storage) and a Modernisation Fund (modernising the energy systems of EU Member States with lower GDP).

Revision of EU ETS in the context of “Fit for 55” package

On July 14, 2021, the European Commission adopted a package of legislative proposals “Fit for 55” as part of the European Green Deal. The package aims to modernize existing legislation in line with the EU's 2030 climate target and introduce new policy measures to help bring about the transformative changes needed in the economy, society and industry to achieve climate neutrality by 2050 and to support it, reduce net emissions by at least 55% (compared to 1990) by 2030.

In the context of “Fit for 55” legislative package, the Commission has proposed a comprehensive set of changes to the existing EU’s ETS that should result in an overall emission reduction in sectors concerned of 61% by 2030 compared with 2005. This will increase the yearly GHG reduction rate from the current 2.2% to 4.2%.

The increased ambition is to be achieved by strengthening the current provisions and extending the scope of the scheme. The proposal notably aims to:

- include emissions from maritime transport in the EU ETS (currently maritime sector is only obligated to monitor it’s emissions under EU ETS, but does not need to surrender ETS allowances);
- gradually phase out free allocation of emission allowances to aviation and to the sectors that are to be covered by the Carbon border adjustment mechanism (iron and steel, cement, fertiliser, aluminium and electricity generation);
- implement the global carbon offsetting and reduction scheme for international aviation (CORSIA) through the EU ETS;
- increase funding available from the Modernisation fund and the Innovation fund;
- revise the market stability reserve in order to continue ensuring a stable and well-functioning EU ETS.

In addition, the Commission proposes to create a new self-standing emissions trading system for buildings and road transport to support EU Member states in meeting their national targets under the Effort sharing regulation in a cost-efficient way. With the proposal, emissions reductions of 43% should be achieved for these sectors by 2030, compared to 2005.

4.3 Sectoral policies and measures and their effects

In this Chapter the main policies and measures related to climate change mitigation in different Lithuania’s economy sectors as well as having the most influence on GHG emissions reduction at national level are overviewed. In December of 2019 the Lithuania’s National Energy and Climate Action Plan (NECP) for the period 2021-2030 was prepared, which includes new as well as already implemented policies and measures which were adopted to achieve 2020 economy-wide emission reduction target and continue to be implemented. In this submission, we present renewed information on the policies and measures and their effects. The methods of the estimation of effects differ in separate sectors. The expert groups of different areas trough discussions determined the ex-ante effect of planned measures. These experts presented to the

Ministry of Environment their estimated sectoral parameters and predictions, and the Environment Protection Agency estimated the GHG mitigation effects according to the IPCC 2006 Guidelines methodology. As for the evaluation of fiscal measures, the external experts were involved; they mostly analysed the other countries experiences and adjusted it to Lithuania. Additionally, planned measures were discussed with various stakeholder groups. All the additional measures were incorporated in the GHG projection scenario "with additional measures" (WAM).

The information on the existing and planned mitigation actions and their effects, where available, is included in CTF Table 3. It should be noted that the status of some PaMs is reported as planned, although the implementation starting year is 2021. This is because the GHG projections developed at the beginning of 2021, and some of these PaMs still needed to be adopted.

4.3.1 Energy

The general objective of Lithuania's energy policy is to ensure energy security at competitive prices with the lowest possible environmental impacts. Energy sector is a key sector for the overall functioning of the economy as it provides an important input and service to the other sectors of the economy. Lithuania is also obligated to progressively increase the use of RES in the production of electricity and heating and to reduce energy consumption. The focus is on implementation of the strategic projects aimed to achieve energy independence including ensuring sufficient local power generation capacities to cover domestic demand (3.426 TWh in 2020 and estimated at around 10 TWh in 2030).

The Law on Energy (2002, with later amendments) is the main law, setting the functions and obligations in the energy sector. Different energy sub-sectors are regulated by the following sectoral laws: the Law on Electricity (2000, with later amendments), the Law on Heat Sector (2003, with later amendments), the Law on Natural Gas (2000, with later amendments), the Law on Nuclear Energy (1996, with later amendments), the Law on Construction (1996, with later amendments), the Law on Energy from Renewable Sources (2011, with later amendments) and the Law on Energy Efficiency Improvement (2016, with later amendments).

Renewable Energy Sources (RES)

The development of RES will follow the EU and national strategic documents and legislation. The main RES development PaMs are enshrined in the NEIS and the Law on Renewable Energy of the Republic of Lithuania, and separately for each sector.

In the 2012 adopted **National Energy Independence Strategy** (NEIS) the main strategic goals are to increase the share of electricity production from RES in the final electricity consumption up to 45% in 2030 and 80% in 2050:

- A lot of attention will be paid to the production of decentralized electricity from RES. The number of electricity consumers who can generate electricity for their own needs will be gradually increased.
- By 2030, no less than 45% of electrical power consumed in Lithuania will be produced from RES and will constitute no less than 7 TWh. With technology development trends in mind, it is estimated that the majority of electricity – no less than 53% – could come from wind power, 22% – from solar energy,

16% from biofuel energy produced in highly efficient co-generation power plants, and 8% – from hydropower. Biogas could generate about 1% of electrical power.

- By 2050, electricity generated from RES will constitute no less than 100% of power consumed in Lithuania, and the amount of energy produced from RES will be no less than 18 TWh.
- To maximize the share of RES for district heating consumers, households with independent heating and non-household consumers with independent heating:
- The share of DHS RES (including waste) will be 90% by 2030. The development of high-efficiency biofuel CHP plants will continue, non-hazardous industrial wastes that have energy value will be effectively used for energy production.
- After creating a favourable regulatory environment, households with independent heating will gradually switch to clean, zero GHG technologies and the share of RES in households will reach 80% by 2030. GHG producing technologies will be replaced by clean, clean-air technologies that do not impair the quality of air.

The Law on Energy from Renewable Sources was adopted on 12 May 2011 by the Parliament and amended in 2022. The Law was adopted to ensure the balanced development of the RES. This Law establishes the tasks for separate energy sectors in order to reach the common goal of 50% of RES in the final consumption of energy by 2030.

The key support instrument for RES production is support scheme consisting of several support measures like:

- reservation of the capacity and transfer of energy grids or systems for connection of renewable energy installations;
- discount of the costs of connection of renewable energy installations to energy grids or systems;
- priority of transmission of energy from renewable sources;
- support for production and processing of agricultural commodities, namely, raw materials for the production of biofuels, biofuels for transport, bio lubricants and bio-oils;
- support of investments in renewable energy technologies;
- purchase of energy from renewable sources.

After adoption of this Law, a mixed support measures model was chosen, where producers of small power plants have the fixed rate of the price and larger producers had to participate in an auction where they compete for quotas and for lowest desired fixed tariff price. In December 2014, the Parliament approved the amendments on Law allowing net-metering system application for small solar power plants (residential <10kW, budget and public institutions <50 kW) to promote solar energy use in households.

After the amendment of Law in 2018, a new support model to promote RES in electricity production was established – as a technology neutral (produced from sun, wind, biogas, or biomass) auctions. Auction participants compete for the possibility to get a premium to the market price. The support is funded from the budget for Services of General Interest.

After of amendment of Law in 2022, from May 2023, electricity or heat producing installations, having 20 MW or higher capacity of biomass boilers, must consume only sustainable biomass having sustainability certificates.

The Lithuanian Law on Heat Economy was adopted in 2003 by the Parliament and later amended. The objective of this legal act is to reduce the unfavourable effect of heat energy on the environment by promoting combined heat and power generation, the heat generation from biofuels and RES.

Implementing described legal documents and measures following them, Lithuania reached 23% target before 2020 and exceeded it already in 2014, when the share of RES in total final energy consumption was 23.66%. Lithuania transferred part of the surplus to Luxembourg and became the first EU Member State to sign a cooperation agreement on the transfer of statistical quotas for RES.

In 2020, the share of RES in total final energy consumption was 27.36%. These results were mainly determined by the share of RES in the heat sector, which accounted for 50.23%. The share of RES in electricity production was 20.17%, and in the transport sector – 5.5%.

Lithuania's intended 2030 RES target of 50% in final energy consumption is planned to be achieved through neutral auctioning of incentive quota allocations and the widespread deployment of low-power renewable energy facilities owned by private energy users and communities. In order to successfully integrate larger amounts of renewable energy and a large number of electricity-generating customers, it is envisaged to invest in smart energy systems, including transmission, distribution and storage infrastructure, and in increasing the necessary balancing capacity.

In April 2022 Seimas adopted the **Renewable Energy Breakthrough Package** to accelerate solar and wind energy projects. The development of first offshore wind park will help Lithuania to become self-sufficient in electricity in the next decade.

<u>Existing policy measures for renewable energy sources (RES) in the electricity sector up to 2030:</u>

RES1. Support scheme for electricity produced from RES. Although RES technologies are constantly improving and equipment costs are declining, power generated from RES in the new installations is not yet able to compete in the market, so energy generation from RES is being incentivised and this will continue up to a limit that is economically and technically acceptable for the country, with a view to active participation of producers of RES-E at market conditions, or until the production of RES-E reaches the market price. Currently Lithuania has approved a support scheme covering the following support measures:

- A price premium for RES-E.
- Priority transmission of RES-E.
- Exemption of electricity producers operating a power plant with a capacity below 500 kW from responsibility for balancing the produced electricity and/or reserving the power plant's generating capacity during the incentive period. The specified incentives are only applicable when a producer participates in a technology-neutral auction and, if successful, offers the lowest price premium.

RES2. Financial support for prosumers. Promoting active participation of electricity consumers in the market, a scheme for generating electricity was created in 2015. The target for 2030 is to have 30% of the producing consumers compared to the total number of electricity consumers. In order to ensure that the electricity generating scheme is available to all electricity consumers, the acquisition of the power plant is funded from EU Structural Funds and the National Climate Change Programme. As of 2019, prosumers received EUR 323 per kW in support. In total, it is planned to invest more than EUR 16 million from EU funds by 2023.

RES3. To implement projects for co-generation plants using local and renewable sources of energy, with priority given to Vilnius. In December 2016, the Vilnius cogeneration plant received a loan of EUR 190 million from the European Investment Bank (EIB), backed by the European Fund for Strategic Investments (EFSI), a key element of the Investment Plan for Europe. The Vilnius cogeneration unit will produce about 0.3 TWh of electricity. The total electrical capacity of the power plant will be about 92 MW. The already operating boiler only uses municipal waste leftover from sorting and not suitable for recycling. The other two biofuel boilers being built, with a capacity of about 3 times that of the waste boiler, will use biofuels.

Table 4-3. The existing and planned (highlighted in grey) PaMs in energy sector for promotion of RES in production of electricity

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq) 2025	2030
				Promotion of RES in electricity production	
RES1. Support scheme for electricity generated from RES (auctions)	RES-E annual increase 2.5 TWh by 2025	2019	385	NE	240
RES2. Financial support for producing consumers (prosumers)	RES-E annual increase of 0.075 TWh by 2024	2018	25	NE	7.5
RES3. Promotion of highly efficient cogeneration	RES-E annual increase of 0.4 TWh by 2023	2014	140	NE	128.12
RES4. Financial support for investments into small-capacity power plants	The annual increase in RES production 0.03 TWh	2022	7	NE	12
RES5. RES development in the Baltic Sea	Additional RES capacity from 350 MW to 1400 MW	2019	427	NE	295.5
RES6/P6/P7 Renewable energy resources for industry LT+ support for additional RES capacities/ Reduce the use of coal, coke and lignite	Additional RES capacity 42 MW/ To cut the subsidy from 2024	2021	55	6.05	15.86
RES7. Use of RES in public and residential buildings	Additional RES capacity 50 MW	2020	-	NE	18.05
RES8. Financing solutions of installation and storage of power generation from RES, including producing	The annual increase in RES production 0.81 TWh	2021	-	NE	81

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq)	
				2025	2030
consumers, RES communities					
RES9. RES integration into networks	Integration of additional RES-E capacity of 1944.5 MW in already existing power transmission and distribution networks	2021	-	NA	NA

<u>Brief description of existing and planned policies and measures in energy sector for promotion of RES in production of electricity</u>

RES1. Support scheme for electricity generated from RES (auctions). Renewable energy is not yet able to compete in the market, consequently, the production of energy from RES is encouraged and will continue to be within the limits of the country's economically and technically acceptable RES development, focusing on active participation of RES producers in market conditions or until RES production reaches market price. The support scheme currently approved in Lithuania includes the following support measures:

- Electricity generated from RES price premium;
- Priority transmission of electricity generated from RES;
- Exemption from liability for the balancing of generated electric energy and (or) power generation capacity reservation during the promotion period for electricity producers, operating power plants less than 500 kW.

The specified promotional measures are only applicable when participating in a technology neutral auction and after winning it with the lowest price offer. The producer who has won the auction receives support measures for a period of 12 years.

The first auction to meet the 2030 target began on 2 September 2019, distributing 0.3 TWh of electricity. The auction ended in March 2020, however, the result of this auction is expected to be visible in 2023.

The auctions will be organized according to the approved schedule until the interim target of 5 TWh annual electricity production from RES-E in the year 2025 will be achieved (2.2 TWh of RES electricity is already produced in 2018). If this goal is achieved before 2025, with the construction of power plants without support, auctioning will be stopped and the need for further support will be assessed. A technological, economic and social evaluation of RES technology development and support scheme will be carried out at least every 5 years to determine the effectiveness of the support scheme in Lithuania and its continued need.

RES2. Financial support for producing consumers (prosumers). In 2015, a scheme for electricity prosumers was created, to encourage electricity consumers active participation in the market. By 2030, we aim to have 30% of prosumers, compared to the total number of electricity consumers.

To ensure that the electricity generating scheme is available to all electricity prosumers, the EU Structural Funds and the National Climate Change Program are funding the purchase of the power plants. As of 2019, support of 323 EUR per kW to producing users provided. Total by 2023 it is planned to invest more than 16 million EUR from EU funds, with four invitations scheduled during this period.

RES3. Promotion of highly efficient cogeneration. In 2016, Vilnius Cogeneration Power Plant received 190 million EUR loan from the European Investment Bank (EIB), backed by the European Fund for Strategic Investments (EFSI) – a vital element of the Investment Plan for Europe. Vilnius cogeneration power plant will produce about 0.3 TWh of electricity. The total electrical capacity of the power plant will be about 92 MW. The already operating boiler only uses municipal waste leftover from sorting and recycling. The other two biofuel boilers being built, three times larger than the waste boiler, will use biomass.

RES4. Financial support for investments into small-capacity power plants. Support is being prepared for investments in low-power stand-alone power plants, with priority given to power plants under construction by renewable energy partnerships. The support will be awarded based on a competitive tendering procedure from revenue arising after the statistical transfer of energy between Lithuania and Luxembourg and/or the other Member States.

RES5. RES development in the Baltic Sea. In 2018, the research started to evaluate necessary development and operation of RES-based power plants in the Baltic Sea and to determine the installed capacity of these power plants. After estimating the duration of the tendering procedures and the construction of the power plants, planned that electricity production would start after 2028.

RES6. RES for industry LT+ support for additional RES capacities. Installing renewable energy generation capacity, developing and deploying new renewable energy technologies in industrial companies to meet their energy needs, and to enable the supply of surplus energy to other industrial enterprises or the transmission to centralized energy networks. The amount of funding for a project depends on the size of the company and how eligible costs are determined:

- 80% of the eligible expenses for a very small, small enterprise;
- 60% of eligible expenses for large enterprises (intensity is subject to the provisions of the EU Block Exemption Regulation).

Given the ambitious RES targets, this measure is continued after 2020. It is planned that 70% of the funds will be allocated to the development of RES in the electricity sector, the remaining 30% – in the heat sector.

RES7. Use of RES in public and residential buildings. Promoting RES (solar, wind, geothermal energy, biofuels or other) use in public and residential (various social groups) buildings with Climate Change Program funding.

RES8. Financing solutions for installation and storage of power generation from RES, including producing consumers, RES communities. EU support is planned to support the deployment of low-power electricity generation from RES owned by generating consumers, energy communities, businesses or individual energy consumers. The need for EU support funds and possible measures in this area, the need for funds and the results of their achievement are currently being assessed.

RES9. RES integration into networks. The total increase in RES power is projected to be 1 944.5 MW in 2021-2030. Such an increase will require measures to integrate new generators safely and reliably into electricity transmission and distribution networks.

Additional support measures contributing to the development of RES-E:

- RES-E exemption from excise duty. This provision applies to both electricity produced in Lithuania and imported electricity.
- Guarantees of origin RES-E. Guarantees of origin are issued to RES-E manufacturers. Guarantees of origin shall be issued and the RES-E producers who have won the auction and receive electricity price premium.
- RES purchase and sale contracts. RES producers are entitled to sell electricity to final customers under renewable electricity purchase and sale contracts without an independent electricity supplier's license. Such producers will still have to meet the requirements of an independent electricity supplier.

<u>Existing policy measures for RES in the heat and cooling sector up to 2030:</u>

- establishment of a regulatory environment conducive to attracting investment and providing a non-discriminatory environment for all players in the district heating market;
- increasing transparency in the biofuels market;
- promotion of district heating in buildings, giving priority to urbanised areas in order to reduce air pollution;
- reducing the share of heat prices controlled and set unilaterally by the national regulator (transferring part of the responsibility from national regulator to municipal councils);
- increasing the number of new heat customers connected to district heating (DH).

Table 4-4. The existing and planned (highlighted in grey) PaMs in energy sector for promotion of RES in production of heat and cooling

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, in kt CO_2 eq) 2025	2030
Promotion RES in heat and cooling					
RES17. To upgrade and/or replace worn biofuel boilers with other technologies using RES	Upgrade and/or replace worn-out biofuel boilers with other RES technologies.	2018	38.4	NO	NO
RES18. To promote the use of biofuels for heat generation in district heating systems	Improving incentive regulation to enable heating companies to build up the resources needed for modernisation. Additional RES production capacity: 70 MW	2019	0.2	NE	30.66

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, in kt CO_2 eq)	
				2025	2030
RES19. Promote the use of RES in DH for heat generation by assessing the potential for using solar technologies, heat pumps and heat storage facilities in DH systems	Nominal heat output of the new installations: 20 MW	2019	37.5	NE	91.2
RES20. To carry out the assessment of the current situation and further developments in the supply of heat in the decentralised sector	A study has been completed and necessary legislation has been adopted to create a favourable regulatory environment for gradual transition of individually heated households (dwellings) to clean and low GHG mission technologies or their entry into the DH system	2019	-	NA	NA
RES21. To review existing requirements for reserve heat generation capacity and for fuel reserves	Heat suppliers using natural gas who pay the security component should not additionally accumulate fuel reserves	2019	-	NA	NA
RES22. Promotion of small-scale biofuel cogeneration	5MW electrical and 20MW thermal capacity. 0.03 TWh of electricity per year	2019	21.7	NE	12
RES23 To upgrade and/or modernise the heat transmission network and its installations/elements		2015	29.1	NA	NA
RES24. Prospective analysis of the development of the cooling sector in Lithuania	To assess the current situation in the cooling sector, carry out a prospective analysis and establish guidelines setting out the most rational solutions for cooling supply; draw up a map of the national territory showing the existing locations for district heating and cooling supply, including infrastructure for district heating and cooling supply in the network	2019	0.1	NA	NA
RES25 To perform a general inventory of the heating installations in households/homes.	Data have been collected data on the methods of heating households/homes, 100%	2019	-	NA	NA
RES26. New biofuel combustion plants in district heating	Biofuel boilers: additional capacity of 70 MW up to 2030	2021	10.5	NE	30.7
RES27. Promote the use of RES in district heating (using	Nominal thermal capacity of the new installations: 200 MW up to 2030	2021	60	NE	87.6

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, in kt CO_2 eq)	
				2025	2030
solar technologies, heat pumps and/or heat storage)					
RES28. Promotion of the use of heat from waste generated by industry, the waste sector or due to cooling energy in district heating	Waste heat in district heating will amount to 0.45 TWh (15% of potential) per year up to 2030.	2021	20	NE	45
RES29. Modernisation of the heat metering system	All heat meters must be replaced by remote scanning by 2027.	2021	-	NA	NA

Brief description of existing and planned policies and measures in energy sector for promotion RES in production of heat and cooling

RES17. To upgrade and/or replace worn biofuel boilers with other technologies using RES. Improving incentive regulation to enable heating companies to build up the resources needed for modernisation. Nominal heat output of the replaced installations: 600 MW.

RES18. To promote the use of biofuels for the production of heat in district heating systems. Improvement of incentive regulation enabling heat supply companies to raise funds for modernization. Additional production capacity of RES – 70 MW.

RES19. Promote the use of RES in DH for heat generation by evaluating assessing the potential for the using of solar technologies, heat pumps and heat storage facilities in CDHP systems. Heat pumps are already being used in other countries and have proved their worth in energy efficiency. Because the period is 2021-2030, no specific technology is bound. The deployment of the most cost-effective solution will be supported. The nominal heat power of newly installed equipment is planned to reach 20 MW

RES20. To assess the current situation and prospects for the decentralised sector's heat supply. Preparation of study and adoption of appropriate legislation to create a favourable regulatory environment for the gradual transition of individually heated households/housing to clean or low greenhouse gas technologies or to the CHP system.

RES21. Review existing requirements for reserve heat generation capacity and reserve fuel reserves. Natural gas heat suppliers paying the security component would not accumulate additional reserve fuel reserves.

RES22. Promotion of low-power biofuel cogeneration. The planned installed capacity: 5MW electric and 20 MW thermal capacity. Totally produced 0.03TWh of electricity per year.

RES23. To upgrade and/or modernise the heat transmission network and its installations/elements. Worn out heat transmission networks are upgraded and modernised.

RES24. Analyse the potential of the cooling sector in Lithuania. Evaluate the current situation in the cooling sector, perform a prospective analysis and set guidelines for the most rational solutions for cooling;

create a map of the national territory, which reflected in the existing district heating and cooling local supply needs, including district heating and cooling network infrastructure.

RES25. To perform a general inventory of the heating installations in households/homes. The purpose of the measure is to collect all available data on the methods of heating households/homes.

RES26. New biofuel combustion plants in district heating. In 2020, the share of RES in in the heating and cooling sector was already more than 50%. In some municipalities, coal and gas oils are still used, and this measure aims at converting their heating plants into RES.

RES27. Promote the use of RES in district heating (using solar technologies, heat pumps and/or heat storage). Heat pumps are already used in other countries and have proved their worth in terms of energy efficiency. As the period is 2021-2030, there is no technology-specific focus. Implementation of the most cost-effective solution will be supported.

RES28. Promote the use of waste heat in district heating. In Lithuania, the heat generated by chemical processes in production companies has potential about 3 TWh per year, and it could be partly used in the district heating sector. Full utilization is not possible because some industrial sites are too remote from heat consumers. The priority in the heat sector is to capture, store and efficiently use environmental and residual energy emitted into the air by power plants, industrial sites and buildings. Waste heat from the thermal power plants can be used to heat buildings.

RES29. Modernization of heat accounting system. By 2027, according to the EU Internal Market Directive (2009/72/EC) and its amendment (2016/0380 (COD)) and in the case of a positive cost-benefit analysis, all heat meters must be replaced by remote reading.

Energy efficiency

Lithuania aims to continuously and consistently increase its energy efficiency, introduce innovative and less energy consuming technologies, increase consumer education and change its behaviour. The greatest potential for energy efficiency improvements in terms of the cost-effectiveness of efficiency measures lies in the industrial, building and transport sectors.

In pursuit of the energy efficiency improvement objectives, set in the **NEIS**, aim will be:

- by 2030, ensure that primary and final energy intensity is 1.5 times lower in 2030 than in 2017;
- by 2050, ensure that primary and final energy intensity is about 2.4 times lower than in 2017.

Priorities:

- To promote integrated renovation of multi-apartment and public buildings (prioritizing renovation in quarters) and to save about 5-6 TWh of energy in the renovated multi-apartment and public buildings by 2030 (by adding up savings in each year).
- Rapidly develop low-energy and energy efficiency industries install and acquire new and environmentally friendly technologies and equipment.

Table 4-5. The existing and planned (highlighted in grey) PaMs in energy efficiency

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq)	
				2025	2030
EE1. Higher excise and taxes for fuel consumption	Reduced use of energy by 6 TWh.	2020	-	NE	180
EE2. Renovation (modernisation) of multi-apartment buildings	Reduced use of energy 1.9 TWh and later 3.6 TWh.	2015	735.0	NE	168
EE3. Renovation of public buildings	The 2020 target set in this Programme is to renovate an area of 700 000 m2 of the public buildings by saving 60 GWh of the annual primary energy.	2014	90.9	NE	16.8
EE4. Consumer education and consulting (by energy suppliers)	Reduced use of energy 3 TWh	2017	-	NE	55.00
EE5. Public Service Obligations (PSO) privilege for industrial companies implementing energy efficiency measures	Energy efficiency measures will be implemented each year and 100 GWh of energy will be saved. Reduced use of energy 5.5 TWh by 2030.	2021	-	NE	100
EE6. Agreements with energy companies on energy saving	Reduced use of energy 5,5 TWh	2014	-	NE	100
EE7. Changing boilers into more efficient technologies	Reduced use of energy 11 TWh	2019	50.4	NE	200
EE8. Modernisation of heating and water systems in apartment buildings	Reduced use of energy 0.55 TWh	2019	-	NE	16.8
EE9. Energy efficiency improvements in non-industrial enterprises	To provide a subsidy for the energy savings achieved and to save about 100 GWh of energy per year and almost 5.5 TWh by 2030.	2021	24.9	NE	124.8
EE10. Financial support for renovation of single-family houses	Reduced use of energy 0.74 TWh	2021	100.0	NE	23.5
EE11. Modernisation of street lighting systems	Reduced use of energy 0.071 TWh and later 0.039 TWh	2021	27.7	NE	23.4

On the 3rd of November of 2016 the **Law on Energy Efficiency** with amendments of related energy laws was adopted. This law establishes the energy efficiency of state: management, regulation and supervision of the legal framework. The purpose of this Law – to ensure that all Lithuanian economic sectors' of energy consumption savings would be in line with Lithuania's EU legislation enshrined in energy efficiency obligations, and efficient production, distribution and use of energy. Based on this Law, the mandatory energy savings for Lithuania have been set until 1st January 2031.

Multi-apartment Building Renovation (Modernization) Programme approved by the Government Resolution No 1213 of 23 September 2004, with later amendments in 2015. In 2009 essential adjustments of the Programme were adopted which have changed the financing rules. However, in 2012 Programme of Modernization of Multi-apartment Buildings was changed again, this time enhancing implementation of actual modernisation projects. More detailed information is available in the National Reform Programme 2014.

Programme of Public building renovation approved in November 2014 by the Government Resolution No 1328. It is planned to renovate public buildings by reaching C class of building energy performance. In this Programme it is defined that the total area of public houses which are owned by the state and municipalities is 14.8 million m^2 (approximately 35% of non-residential buildings), for the heating all these buildings approximately 2 300 GWh of heat energy is used.

The **Long-term renovation strategy of Lithuania** was adopted on 31 Much 2021 by the Government Decision No 18 to support the renovation of the national building stock by ensuring:

1. Energy efficiency in the building stock;

2. Decarbonised building stock by 2050;

3. Favourable conditions for the cost-effective conversion of existing buildings into nearly zero-energy buildings.

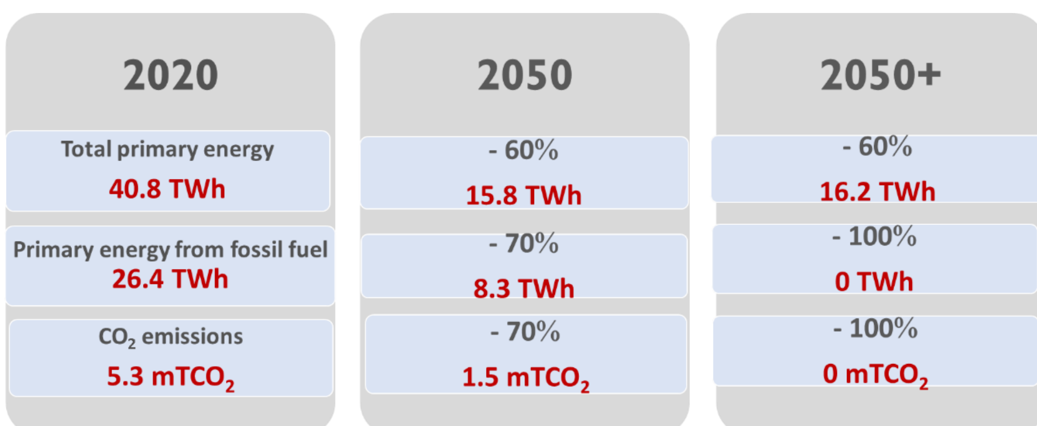

Figure 4-8. Transformation indicators of the building stock

Table 4-6. Indicators targeted by the renovation strategy

Indicator	Unit of measure	2020	2030	2040	2050
R1. Primary energy consumption per year	GWh	40 827	34 759	25 888	16 162
R2. Primary energy consumption per year (compared to 2020)	%	100%	85%	63%	40%
R3. Primary energy (non-RES) consumption per year	GWh	26 407	19 865	10 369	27
R4. Primary energy (non-RES) consumption per year (compared to 2020)	%	100%	75%	39%	0%
R5. CO_2 emissions	kt CO_2	5 287	4 003	2 108	22
R6. CO_2 emissions (compared to 2020)	%	100%	76%	40%	0%
R7. Area of inefficient buildings (class D and lower)	thous. m^2	108 924	85 887	54 043	19 981
R8. Consumption by inefficient buildings (class D and lower)	GWh	31 601	24 208	14 306	3 717
R9. Consumption by inefficient buildings (class D and lower) (compared to 2020)	%	100%	77%	45%	12%
R10. Number of renovated buildings	units	58 774*	99 281**	255 421**	436 008**
R11. Share of renovated buildings	%	8%*	17%**	43%**	74%**
R12. Area of renovated buildings	thous. m^2	29 471*	27 819**	67 233**	109 534**
R13. Area of renovated buildings	%	15%*	17%**	41%**	66%**

**New and renovated buildings in energy performance class B and higher by 2020.*

***Buildings to be renovated from 2021 with intermediate indicators for 2030, 2040, and 2050*

The **Programme on Heat industry development in 2015-2021** adopted in 2015. The Programme determines trends of heat industry development and modernisation, technical solutions and energy mix for the production of the heat, demand and potential for higher efficiency cogeneration, investments and time frames. In Lithuanian cities, approximately 72% of residential space is heated via centralized heating systems. It was forecasted that consumption of centralized heat would have been reduced by 5% by 2021 compared with 2014 due to energy efficiency improvement in public and multi-apartment buildings.

It is also important to note the improved Lithuanian energy productivity indicator (gross energy efficiency indicator), which shows the country's energy efficiency and allows the decoupling of the country's energy consumption. In 2017 the value of Lithuanian indicator reached 4.8 EUR/kgoe (the EU average is 8.3 EUR/kgoe).

Existing policy measures in the energy efficiency sector up to 2030:

EE1. Impact of higher excise duties and taxes on fuel consumption. Lithuania has a value added tax rate of 21% on fuel, which is 6 percentage points higher than the EU minimum of 15%. Petrol is subject to a higher excise duty of 21% (+ EUR 0.08/l), and liquefied petroleum gas – 243% (+EUR 0.18/l). The combined effect of higher taxes and excise duties is a price increase of 14.7% for petrol, 5.2% for diesel and 64.7% for liquefied petroleum gas compared to the levels prescribed by the EU.

EE2. Renovation/modernisation of multi-apartment buildings (to renovate a multi-apartment building to class C and save 40% of energy). By the end of 2030, around 5 000 multi-apartment buildings should be renovated, which means that nearly 500 multi-apartment buildings will be renovated each year.

EE3. Renovation of public buildings. To renovate a public building to class C and to renovate about 960 000 m^2 of public building area by 2030.

EE4. Agreements with energy suppliers on consumer education and consulting. Energy suppliers will ensure the implementation of the scope and measures of consumer education and consulting provided for in agreements concluded between them or through other persons (including the introduction of smart metering).

EE5. SPI relief for industrial enterprises. A support mechanism to finance the implementation of energy efficiency improvement measures in all major industrial enterprises in Lithuania. Annual energy efficiency measures leading to energy savings of around 100 GWh are planned.

EE6. Energy saving agreements with energy companies. Energy companies will save energy according to the levels of energy specified in the energy savings agreements (either on their own or through others) by applying cost effective energy efficiency improvement measures at the final energy customers' facilities (installations, equipment, transport).

EE7. Changing boilers into more efficient technologies. A financial measure to encourage residents to convert inefficient heat generation facilities to more efficient technologies using renewable energy. Households are expected to install 50 000 more efficient biofuel boilers by 2030. It is expected to save at least 200 GWh per year or 11 TWh by 2030. It is planned to renew 5 000 household boilers each year. The compensation of up to 50% of the cost associated with replacing the old boiler will be provided for households not connected to the district heating system.

EE8. Modernisation of heating and water systems in apartment buildings. A financial measure that will encourage building owners to upgrade old elevator-type substations to a newer contour-type substation. It is planned to reimburse up to 30% of the investment costs and upgrade about 250 substations each year. This would save about 10 GWh of energy per year, or 0.55 TWh by 2030.

EE9. Energy efficiency improvements in non-industrial enterprises. To increase business enterprises' energy efficiency, Lithuania has planned a financial instrument that will encourage enterprises to implement the energy efficiency improvement measures specified in the energy audit.

EE10. Financial support for renovation of single-family houses. The financial incentive for individual homeowners to renovate individual homes. There are plans to renovate 1 000 individual homes each year and save 13.5 GWh of energy. Up to 30% of the investment costs will be reimbursed. Total energy savings up to 2030 equals 0.742 TWh.

EE11. Modernisation of street lighting systems. Financial support for the modernization of street lighting systems. The target is to replace and upgrade about 25% of all luminaires in Lithuania or about 65 000 luminaires by 2030. Renewal of one luminaire is expected to save about 250 kWh of electricity per year and achieve a total savings of about 0.11 TWh by 2030.

4.3.2 Transport

The National Programme on the Development of Transport and Communications (hereby – the Programme) for 2014-2022 was adopted on 15 December 2014 by the Resolution No 1443 of Government. The Programme is a medium-term strategic planning document setting out the strategic goal, the objectives and tasks aimed at reaching the goal, their evaluation criteria and the institutions implementing the Programme. The Programme contains an analysis of the development prospects of the transport and communications sector, namely, transport (road, railway, maritime, inland waterways and air), logistics and post.

The strategic goal of the Programme was to create a sustainable, environmentally friendly and competitive national transport and communications system with a high added-value creation potential. Upon attainment of the strategic goal, the transport and communications system would ensure a high-quality, efficient, uninterrupted and sustainable mobility of members of the public and goods' transportation as well as high-quality logistics and postal services. There were 5 objectives of the Programme:

- Increase mobility of goods and passengers, improve the corridors of the core network of the EU Trans-European Transport Networks as well as their connections with national and local transport networks, and increase the efficiency of multimodal transport.
- By means of the active transport policy measures, increase competitiveness of the transport sector and improve the transport and logistic service quality.
- Promote sustainability of the local (urban and suburban) transport system.
- Increase energy efficiency in transport and reduce the adverse impact of transport on the environment.
- Improve traffic safety and security.

In 2020 the **Lithuania's transport and communications development strategy until 2050** was approved. Vision of the transport sector until 2050 is based on two essential pillars: environmental and public friendliness, economy and competitiveness. The main goal is to create sustainable transportation system that ensures the possibility to move efficiently, safely and comfortably both inside and outside the country, in compliance with all environmental standards and requirements. The efficiency of the transport system is the basis for competitiveness, which contributes to sustainable development and sustainable growth.

The ambitious targets for the use of alternative fuels are harmonized and set out in **the Alternative Fuels Law** adopted on 23 March 2021.

<u>Existing GHG mitigation measures in transport sector:</u>

T1. Renewal of urban and suburban public transport fleets by promoting vehicles running on alternative fuels. Renewal of the public vehicle fleet with vehicles powered by alternative fuels and electricity is carried out. Also, the installation of infrastructure for alternative fuels such as biomethane and electrical infrastructure such as stationary units is carried out in bus fleet areas.

T2. Electrification of railways. Renewal of railway infrastructure: 814 km of railway will be electrified and account for 70% of freight carriage by rail.

T3. Implementation of sustainable urban mobility plans (SUMP). Implementation of measures in SUMPs that will promote walking, cycling, public transport and the use of alternative fuels. The implementation of all SUMPs is estimated to require EUR 2.2 billion, some of which will be funded from EU structural funds in 2021-2027.

T4/RES12-15. Promotion of the RES use in the transport sector. This measure intends to:

- Promote the use of advanced (generation II) liquid biofuels (biodiesel and bioethanol) not produced from food and feed crops, in line with sustainability criteria, by progressively increasing the obligation for fuel suppliers to blend them with mineral fuels.
- Promote the emergence of sustainable biomethane gas production and supply chain guarantees through regulatory and financial instruments by encouraging public transport fleets to use gas from renewable sources. The projected volumes of production and consumption for 2030 are 81.5 ktoe.
- Promote the biogas guarantees of origin market so that 100% of biogas producers are registered in the guarantees of origin register in 2030.

RES10. Mandatory blending of biofuels into mineral fuels. Fuel sales points must sell the following fuels meeting the Lithuanian or European standards:

- petrol containing a minimum of 10% of biofuel (blending into A98 petrol is optional);
- diesel containing at least 7% of biofuel.

RES11. Excise duty concession for biofuels. Biofuel and fuel blends complying with the requirements laid down in the Law on Excise Duty and the standards EN 14214 and CEN/TS 15293 adopted by the European Committee for Standardization are subject to an excise duty rate reduced in proportion to the percentage of impurities of biological origin in the biofuel and fuel blend.

The Seimas approved the law on Alternative Fuels (LAF) on 23rd of March 2021[5]. Under the Law, the transport sector will be encouraged to shift to electricity, biomethane and hydrogen, increasing the requirements for blending biofuels. The LAF establishes clear directions for the development of alternative fuel vehicles and the infrastructure required for them.

Considerable attention paid to promote electric mobility – financial support is planned to be provided until every tenth car in Lithuania is powered by electricity, and efforts will be made to ensure that Lithuania has 6 000 public electric vehicle charging stations by 2030. There are also plans to approve an action plan for the development of electric mobility, which will set the directions and priorities for developing the electric vehicle infrastructure.

Particular attention is devoted to the transformation of the freight transport sector. There are plans to expand the network of alternative fuelling stations and promote clean vehicles while also ensuring renewable fuels.

[5] https://www.e-tar.lt/portal/lt/legalActEditions/b5c313d0986d11eb9fecb5ecd3bd711c

The target is set to reach biomethane and green hydrogen for at least 5% of final energy consumption in the transport sector by 2030.

The LAF introduces progressively increasing obligations for fuel suppliers regarding the use of biofuels, which will be possible to implement more flexibly over the years. In order to encourage the use of biomethane and other advanced biofuels and hydrogen, their blending will be offset by twice the energy value.

As of 2026, all cars and buses purchased through public procurement will have to be clean. By 2029, all public road passenger transport, including taxis and vehicles used by individuals providing transport services, will have to be adapted to use alternative fuels. The introduction of low-emission zones in cities will encourage switching to clean vehicles, thus improving urban air quality.

Implementing these changes in the 2021-2030 period will require significant investments, so the Law also establishes the Sustainable Mobility Fund to implement the alternative fuels policy. There are also plans to secure part of the European Recovery and Resilience Facility and the European Union Structural Funds.

Table 4-7. The existing and planned (highlighted in grey) PaMs in energy sector for promotion the RES use in transport

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq)	
				2025	2030
	Promotion of RES in transport				
RES10 Obligatory addition of biofuels into conventional fuels	Share of biofuels in final energy consumption in the transport sector by 2030: 5,9%, of which biodiesel 5.67% (137.7 ktoe) and bioethanol 0.23% (5.58 ktoe)	2011	-	130.7	122.3
RES11. Exemption from excise duty on biofuels	Share of biofuels from food and feed crops, compared to final energy consumption in the transport sector 7%	2010	-	NE	NE
RES12/T4 Support for II generation biofuels through obligatory addition into fuels	An additional II generation biodiesel would enter the market. 50% of all biodiesel would be II generation.	2020	8.7	NO	NO
RES13/T4 Support for biomethane and II generation bioethanol production (equipment and factories)	An additional 6.45 ktoe II generation bioethanol would appear on the market. New production capacity ensures 81.5 ktoe biomethane per year.	2020	-	44.9	251.1
RES14/T4 Support for purchasing buses running on biomethane	680 buses would consume 81.5 ktoe biomethane gas.	2020	99.6	NA	26.39

RES15/T4 Subsidy for biofuel producers (reducing price differences)	Vehicles that will consume 81.5 ktoe of biomethane gas	2020	-	NO	NO
RES16. Obligation imposed on operators of natural gas stations, supplying gas for direct consumption in transport	Obligation covering the supply of biomethane gas, estimated at 92.7 million cubic meters of gas.	2025	-	NE	NE

Table 4-8. The existing PaMs in rail transport sector

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect effect (not cumulative, kt CO_2 eq)	
				2025	**2030**
		Rail transport measures			
T2. Electrification of railways/ Renewal of railway infrastructure, electrification and development.	814 km of the railway is being electrified. 70% cargo turnover will be transported by of electrified railways	2018	292.2	131.15	146.58
T9. Introduction of incentives to use combined freight transport (instead of intermodal transportation on roads)	5% of freight will be shifted to combined transport by 2030. They reduce GHG emissions by 19% compared to road transport.	2021	684	94.77	189.54

T5. Implementation of the objectives of the EU White Paper. As a result, there should be no polluting cars in cities by 2050. This requires the development of a long-term plan for the promotion electric vehicles and electric vehicle recharging infrastructure, defining the targets and measures to that end.

T6. Developing and promoting economic and ecological driving skills. Reduced fuel consumption due to changes in driving skills achieved through training on economic and ecological driving, education, advertising, etc. Social advertising and other measures will reach 5% of drivers, reducing fuel consumption by 3.7%.

T7. Promoting the purchase of cleaner vehicles. A financial incentive will be offered for 4.8% of deals. It is accepted that 50% of these deals will benefit from the incentive and the efficiency of newly purchased cars will improve by 42%. The amount of financial support will be EUR 1 000 from **Climate Change Program** to the owner of newly purchased M1 class vehicle (second-hand as well) that meets the low emissions requirements:

– The owner scraped its old vehicle (ownership at least 1 year);

– Purchased a new vehicle (second-hand as well) that has CO_2 emissions below 130 CO_2 g/km;

– The newly purchased vehicle must not be powered by diesel (diesel/electricity or other fuel mixes with diesel is not incentivised);

– To be eligible for compensation the vehicle must have its CO_2 emissions specified in vehicles registration certificate[6].

T9. Introduction of incentives for combined freight transport. To encourage intermodal unit carriers to opt for combined transport instead of transporting intermodal units by road. By 2030, 5% of freight will be shifted to combined transport. This will reduce GHG emissions by 19% compared to road transport only.

T13. Promoting the use of electric vehicles and developing the recharging infrastructure. Purchase allowance for pure electric vehicles (indicative amount fixed at EUR 4 000 for a new vehicle and EUR 2 000 for second-hand electric vehicles up to 5 years of age).

T21. Differentiation of the vehicle registration/re-registration charge according to the level of pollution. Pollution-dependent registration/re-registration charges for new and used cars will reduce CO_2 emissions by 3.5% per year, as this will encourage the purchase of less polluting vehicles.

T23. Establishment of the LNG distribution system. Installation of a LNG distribution system to supply refuelling points for LNG, installation of 2 LNG stations, which will be supported by covering 50% of the installation costs. The sales of one LNG station are estimated at 792 tonnes per year.

T24. Traffic congestion reduction through traffic organisation solutions. Traffic organisation changes through traffic planning measures (flow distribution, rush hour traffic restriction) and / or smart traffic management technologies (smart traffic lights, crossings, etc.) help to reduce congestion and fuel consumption. 35% of all vehicles are driven in the cities of Vilnius, Kaunas and Klaipėda. It is estimated that 50% of them experience traffic jams. In traffic congestion, vehicles consume 1.8 times more fuel.

T25. Reducing traffic congestion through spatial planning solutions. Making recommendations to municipalities covering spatial planning solutions that will contribute to efficient traffic management (optimal layout of public transport stops, development of commercial areas according to traffic intensity, etc.).

T26. Promoting flexible working hours and remote work. Education and information for employers and workers on the use of flexible working time options (remote work, flexible opening and closing hours, additional days off, etc.) helps to reduce the number of trips to and from work.

T28. Allowance for the purchase of N1 electric vehicles. Electric vehicles will account for at least 30% of annual class N1 (light commercial vehicles) purchases (new and second-hand vehicles first registered and re-registered) by 2025 and 100% by 2030. Class N1 vehicles with ICE will not be registered as of 2030.

[6] https://apvis.apva.lt/paskelbti_kvietimai/maziau-tarsiu-judumo-priemoniu-fiziniams-asmenims-skatinimas-isigytas-maziau-tarsus-automobilis

T30. Development and implementation of a cross-cutting study on public transport in Vilnius city. An integrated study on the Vilnius city's public transport network and fleet will be developed to optimise public transport lines and adapt them to zero emission public transport. It is planned to explore all transport lines in order to ensure rapid and convenient transportation in the expanding city and its access roads. Development of trolleybus lines and reduction of the use of diesel buses in the downtown is envisaged. A study on other alternative zero emission fuels for passenger transport was also carried out with a view to urban applications and the most suitable vehicles and required infrastructure have been proposed for the establishment of the necessary infrastructure. A study will be implemented in 2023-2030. Strategic optimisation will reduce CO_2 emissions from buses by 12.64%.

Table 4-9. The existing and planned (highlighted in grey) PaMs in road transport

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq)	
				2025	2030
		Road transport			
T1. Renewal of public transport fleet, both within city and intercity	Purchase 200 city and suburban buses with alternative fuel and develop infrastructure	2021	119.8	6.1	12.2
T3. Implementation of measure stipulated in the plans of sustainable mobility in the cities	Implementation of PSMC measures to reduce the use of fossil fuel cars	2018	269.03	142.25	243.86
T4./RES 12–15 Promotion to use RES in transport sector	1) Increase in the share of II generation biofuels in total consumption: 0,2% by 2022; 2) 100% biogas producers should be registered in the register of guarantees of origin by 2030.	2018	-	IE (RES 12-15)	IE (RES 12-15)
T5. The goal for the EU White Book is absence of polluting cars in the cities by 2050	The total absence of polluting cars in the cities by 2050.	2011	-	NE	NE
T6. Development and promotion of economical and environmentally friendly driving skills	5% drivers will start to drive and reduce fuel consumption by 3.7%.	2021	-	21.27	22.77
T7. Promoting acquisition of low emission vehicles	The efficiency of newly purchased cars will improve by 42%.	2020	100	26	47.7
T8. E-tolling implementation in the field of freight transportation	60 lorries and an average of 5.5 buses per year will be replaced from the lower Euro standard to the higher Euro standard	2023	33	1.8	1.94

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq)	
				2025	**2030**
T10. Restriction of access to designated urban areas for vehicles with ICE	The number of vehicles driven by the internal engine will be reduced or replaced by zero emissions. Passenger cars will decline by 5 % throughout the period 2021-2030.	2023	-	36.39	97.05
T11. Creation of a sustainable mobility fund	The Fund is the primary and obligatory tool for other measures	2022	-	NA	NA
T12. Renewal of transport fleet by using green public procurement and ensuring minimum procurement objectives in the field of transport	The number of non-polluting light commercial vehicles (M1, M2, N1) in green public procurement shall be at least 60% compared with the total number of transport fleet by 2024; by 2025-2030 - 100% N2 and N3; by 2025 - 8 %; in the period 2026-2030 - 16%; M3 category by 2025 - 80%; 2026-2030 - 100%	2022	-	5.45	15.30
T13. Promotion of the use of electric cars and development of their charging infrastructure	10% annual sales of M1 (registered and re-registered passenger cars) will be electric cars by 2025 and 50% by 2030.	2020	349.86	32.09	159.94
T20. Annual car pollution tax	5% of per year newly purchased gasoline and diesel cars will be replaced with zero emissions.	2023	-	200.91	401.83
T21. Vehicle reregistration fee by level of pollution	Reduce CO_2 emissions by 3.5% per year.	2020	-	197.43	394.86
T22. Marking of vehicles by pollution level	Carbon labelling of vehicles, allowing more efficient implementation of other emission measurement measures, would ensure rapid identification of the vehicle group	2022	-	NA	NA

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq)	
				2025	2030
T23. Development of LNG distribution system	Installation of 2 LNG stations. One-stop LNG sales are projected to reach 792 tonnes per year	2018	3.6	0.32	0.32
T24-26. Reduction of traffic jams	All measures are seen as complementary and contributing to a reduction in the number of trips, with a 1.8-fold reduction in fuel consumption	2021	8.3	38.56	77.12
T27. Elimination of pollution tax concessions for operators engaged in individual activities	GHG emissions are reduced by 2% per year as a result of the elimination of fossil fuel subsidies	2021	-	14.14	31.81
T28. A concession for the purchasers of N1 electric vehicles	By 2025 electric vehicles will account for at least 30% of annual N1 purchases; since 2030 - 100%	2020	-	3.69	35.11
T29.Promotion of zero-emission taxi and ridesharing service providers	The measure planned to reduce by 2% of taxis and other carriers' emissions	2022	-	0.83	0.83
T30 Preparation of a comprehensive study of Vilnius City public transport and implementation	Strategy-based optimization will reduce bus emissions by 12.64%.	2020	20.30	16.81	44.82
T31. Behaviour changes to reduce fuel consumption through informing the public, formation of habits and pilot projects	Fuel consumption by affected population will decrease by 3.7% as a result of the measures	2022	1.11	0.63	1.42
T32. Improvement of public transport availability and its use	Fuel consumption is reduced by 3.7% due to measures	2022	-	0.42	0.94

Planned GHG mitigation measures in transport sector:

RES16. Obligation imposed on operators of natural gas stations, supplying gas for direct consumption in transport. To ensure parallel demand for and supply of biomethane gas and given the projected increase in natural gas consumption in the transport sector, suppliers of natural gas for direct consumption in the transport sector would be obliged to supply a fixed amount of gas from renewable energy sources. The intensity of the obligation would be measured in terms of the quantity and price of biomethane on the market.

T8. Introduction of E-tolling for freight transport. As a result of the toll, 60 lorries and an average of 5.5 buses will be changed from the lower Euro standard to the higher Euro standard per year.

T10. Restriction of access to designated urban areas for vehicles with ICEs. Creation of urban low-emission zones is planned, in which the traffic of both diesel and petrol-powered vehicles will be limited. The number of ICE-powered vehicles will be reduced or they will be replaced by zero emission vehicles. The reduction in the number of passenger cars will be 5% over the whole period.

T11. Creation of a Sustainable Mobility Fund. The Fund is the primary and necessary instrument for the implementation of other instruments. The fund should consist of all funds from targeted pollution taxes and be aimed at promoting cleaner transport (incentives for the installation of recharging points for electric vehicles, purchase of zero-emission vehicles, parking of zero-emission vehicles, social distribution and habit building). The mentioned measures are included and assessed individually, with no final list or scope.

T12. Renewal of the transport fleet through green procurement and ensuring minimum procurement objectives in the field of transport. Changes in the legal framework are planned to increase the use of clean vehicles and reduce the share of conventionally fuelled vehicles by implementing the minimum procurement targets: by 31 December 2025, in green procurement the share of clean passenger vehicles (categories M1, M2 and N1) in the total vehicle fleet must be at least 60%, the share of clean heavy duty vehicles (categories N2 and N3) in the total vehicle fleet must be at least 8% and the share of clean buses (category M3) in the total fleet must be at least 80%; by 31 December 2030, in green procurement the share of clean passenger vehicles (categories M1, M2 and N1) in the total fleet must be at least 100%, the share of clean heavy duty vehicles (categories N2 and N3) in the total fleet must be at least 16% and the share of clean buses (categories M3) in the total fleet must be at least 100%

T13. Promoting the use of electric vehicles and developing the recharging infrastructure. It is intended that electric vehicles should account for 10% of annual class M1 purchase transactions (registered and re-registered cars) in 2025 and 50% in 2030. Facilitating electric vehicle acquisition, electric vehicle subsidising and increasing the availability of electric vehicle recharging infrastructure through the following instruments:

- Allowance for the purchase/installation of semi-public and private normal power recharging points for electric vehicles (up to 22 kW and up to EUR 250);
- Allowance for the purchase/installation of public high power recharging points for electric vehicles in problematic or commercially unattractive locations by national roads and in the cities (up to 50 kW – EUR 5 000 000; up to 100 kW – EUR 10 000);
- The obligation to install recharging points for electric vehicles in new or reconstructed buildings and parking lots (at least 2 access points per 10 parking spaces);
- The obligation to install electric vehicle recharging points at new or reconstructed filling stations belonging to filling station networks and located by national roads.

T20. Annual car pollution charge. Higher environmental taxes as well as the annual vehicle tax depending on the level of emissions have been found to encourage the replacement of cars by cleaner ones, which are taxed less heavily. Each year, 5% of newly purchased petrol and diesel cars will be replaced by zero-emission vehicles.

T22. Marking of vehicles by level of pollution. Carbon labelling of vehicles will lead to more efficient implementation of other measures related to the determination of emissions levels and will ensure rapid identification of the vehicle group to which the vehicle belongs. Vehicles would be marked with special stickers indicating the group to which they belong and the data would be included in the database with the vehicle registration numbers. Newly registered vehicles would be marked at the time of registration of the vehicle, while vehicles already registered would be marked at the time of the mandatory roadworthiness test of the vehicle.

T27. Elimination of pollution tax concessions for operators engaged in individual activities. To abolish the concessions for the tax on pollution from mobile sources applicable to natural persons engaged in individual activities within the meaning of the Law on Personal Income Tax and using private vehicles in their activities.

T29. Promotion of zero-emission taxi and ridesharing service providers. The obligation for taxi and ridesharing providers to direct orders to the drivers of zero-emission vehicles first, using telephone or application. Orders received by taxis and ridesharing companies (their operators / administrators) should be directed first to drivers of zero-emission vehicles providing those services by phone or application, only later to others; at airports and bus and railway stations, zero-emission taxis enjoy priority in queues. The measure will change 2% of taxis and ridesharing vehicles into zero emission vehicles.

T31. Broad social dissemination, public information, habit building and pilot projects to reduce fossil fuel consumption. Changing the behaviour of residents and their habits through education and opinion formation (training, publicity, presentations, advertising, promotion, etc. in kindergartens, schools, universities, for residents, public, municipal and private enterprises and organisations, etc.). Impact factor: 5% of the affected population reduces fuel consumption by 3.7% as a result of the measures.

T32. Improving access to and use of public transport. The following measures will be implemented:

- Revision of public transport routes and/or introduction of new ones in response to changing societal needs with a view to more actively reducing the number of vehicles in the city;
- Step-by-step introduction of free public transport (reimbursement of tickets) to regulate urban traffic (free public transport for primary school children, then for school children, then for students and seniors).

Table 4-10. The existing and planned (highlighted in grey) PaMs in waterway transport

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq) 2025	2030
		Waterway transport			
T14. Construction of new freight ships and barges	54.5 million tonne-kilometres planned to be shifted from	2024	33.00	3.79	13.27

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq) 2025	2030
	road to inland waterway transport				
T15. Construction of new passenger ships	Increased passenger traffic in water transport (0.6 million passenger-kilometres) will reduce passenger traffic accordingly	2024	3.50	0.02	0.06
T16. Replacement of the existing inland water ships	Replacement of existing power plants to less polluting or to LNG, electricity, a renewable energy source is driven ones	2024	1.70	NE	NE
T17. Development and/or modernisation of inland water infrastructure, including ports and piers	The measure would allow the development of cargo shipping on Kaunas-Klaipeda route and would also open up the possibility of developing cargo shipping on Kaunas-Grodno route, including intermediate points on these routes	2021	24.55	NA	NA
T18. Establishment and application of a system of tax incentives	Establishment and application of tax incentives for inland waterway transport	2021	-	NE	NE

T14. Construction of new cargo vessels and barges. Under the measure, vehicles for the carriage of goods would be prepared or built. This would shift part of the cargo from the polluting road transport to cleaner 65 inland waterway transports. Proposed funding is up to 30% (up to 50% for LNG vessels or self-propelled barges), while the rest of the required funding would come from own funds. 54.5 million tonne-kilometres will be transferred from road transport to inland waterway transport.

T15. Construction of new passenger ships. It is assumed that the construction of new vessels and barges and the development of passenger transport by waterway will allow modern waterborne transport to contribute to GHG savings. Increased passenger flows in waterborne transport (0.6 million passenger-km) will reduce passenger flows in road transport accordingly. New vessels should be fuelled by LNG or RES. Proposed funding is up to 30% (up to 50% for LNG vessels or self-propelled barges), while the rest of the required funding would come from own funds.

T16. Replacement of existing inland cargo vessels, passenger vessels, fishing vessels and other inland waterway vessels, and upgrading of other mechanisms related to the replacement of those vessels. Many of the power stations installed on board inland waterway vessels in Lithuania, consisting of main and auxiliary engines, are highly polluting. This measure would provide for the conversion of existing power plants into cleaner power plants or conversion of diesel or petrol power plants into power plans fuelled by LNG, electricity and renewables.

T17. Development and/or upgrading of inland waterway infrastructure, including ports and landing places. There are currently only a few places suitable for cargo handling in Lithuania from Kaunas to Klaipėda (Marvelė cargo pier, Jurbarkas former inland waterway port with the Mituva Canal, and the Klaipėda State Seaport) that need to be further expanded or reconstructed. The infrastructure suitable for the transport of goods above Kaunas to the state border with Belarus is scarce and must be developed. The measure would allow the development of cargo shipping on the Kaunas-Klaipėda route and create the possibility of developing cargo shipping on the Kaunas-Grodno route, including intermediate points on these routes. Loading sites, warehouses, special fixed and mobile equipment must be installed at these loading points. The infrastructure would be used for the transport, loading and storage of goods and for serving passenger ships and passengers.

T18. Establishment and implementation of a system of tax incentives. Establishment and adaptation of a system of tax incentives for inland waterway transport would provide practical incentives for carriers to develop their freight and passenger transport business, which would significantly improve the chances of reducing air pollution. Opportunities to build new and upgrade old ships, as well as incentives for their use, can significantly reduce land transport of freight and encourage passenger transport business, which would improve mobility opportunities in cleaner transport, and encourage the introduction of advanced, cleaner technologies in inland waterway transport. Port dues concessions would also apply to ships running on alternative fuels and ensure pollution reduction in the Klaipėda State Seaport.

International transport

There are no measures planned or implemented directly influencing international transport sector. However, there is a single measure proposed to change regional GHG in the transport sector (T9). It is expected that *Rail Baltica* railway will be used for combined transport and international GHG emissions can be reduced by replacing road carriage with combined road and railway transport. There is also a measure for domestic navigation (T17); however, the impact is small because of the short transport route it covers. There is a plan to develop cargo shipping on the Kaunas-Klaipeda route, as well as open up the development of cargo shipping on the Kaunas-Grodno (Belarus) route, including intermediate points on these routes.

4.3.3 Industry

The policies and measures in industry sector are based on a few main principles which are required to reach environmental targets. Firstly, the amount of its waste should be reduced, the production more sustainable, natural and energy resources used efficiently. Secondary, raw materials should be processed, the multi-use packaging and materials produced and utilized, waste (especially hazardous) securely managed, and equipment needed for environmental protection should be manufactured.

The **Programme for Investment Incentives and Industry development for 2014-2020** was approved on 17 of September 2014 by the Resolution No 986 of the Government. In this programme an objective to encourage enterprises to use recourses and energy more efficiently as well as use of RES is set. It is planned to implement energy efficiency measures and to reduce energy use in manufacturing industry from 222.9 (in 2012) to 182.9 (in 2020) kg of oil equivalent (for creation of 1 000 EUR value added). Additionally, Ministry of Economy and Innovation prepared a study on "The potential of energy use efficiency increase in industry enterprises and determination of measures which encourage the use of different types of energy" in 2015. The aim of this study was to identify measures and main drives which encourage increasing energy efficiency in industry and to use different types of energy as well as help to identify the main implementation mechanisms and provide recommendations how to implement the proposed measures. Implementation of the Programme is financed from the EU structural funds.

The Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) and the Directive 2008/1/EC of the European Parliament and of the Council of the 15th January 2008 concerning integrated pollution prevention and control (IPPC) are transposed into the national legislation.

Industrial enterprises, exceeding 50 MW must apply for the IPPC permit and enterprises below 50 MW must apply for the Pollution permit to ensure pollution prevention and to incentivise transfer to cleaner technologies protecting the quality of environment. Natural resources must be used rationally and sparingly, energy use must be efficient, monitoring and control must be performed for the substances and raw materials, fuel and energy consumption in the processes of production. Less hazardous materials are promoted to use in the process of industrial activities.

The term "best available techniques" includes both the technology used and the way in which the installation is designed and maintained. The presented techniques are developed in the scale that allows implementation under economically and technically viable conditions and the techniques are most effective in achieving a high general level of protection of the environment as whole.

The ISO 14000 family of standards provides practical tools for companies and organizations of all kinds looking to manage their environmental responsibilities. ISO 14001:2015 and its supporting standards such as ISO 14006:2011 focus on environmental systems to achieve this. The other ISO 14000 standards focus on specific approaches such as audits, communications, labelling and life cycle analysis, as well as environmental challenges such as climate change. GHG emissions permits issued for the installations participating in the EU ETS are consistent part of the IPCC permits or Pollution permits.

In 2021 for the first time in Lithuania **the Roadmap for the transition of Lithuanian industry to a circular economy** was prepared. It analyses the reasons, sets the goals and directions, and proposes a set of policy measures that would encourage the transition of Lithuanian industry to a circular economy. In the findings of the analytical part noted that Lithuania's achievements are stable economic growth. However, this growth rested on the fundamentals of a linear economy. Meanwhile, climate change commitments force a new assessment of the situation and prospects – according to the analysis of metabolism, only 3.3%. Lithuania's economy is circular (the global circularity rate is 8.6%). The main priority areas of change for the transformation of Lithuanian industry towards a circular economy are the following: Ministry of Economy and Innovation leadership and the initiation and creation of a circular economy stakeholder cooperation platform; creating and/or improving the regulatory environment; ensuring the financial environment; creation of knowledge, competences and a common context among all stakeholders, ensuring the attraction, application of international methodologies and the initiation and support of competence centers; innovation, technology and infrastructure development; creation of a common circular economy monitoring system.

Regulation (EU) No 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006 was adopted in 2014. The main goals of this Regulation is to ensure a more cost-efficient contribution to achieving the EU's climate objectives by discouraging the use of F-gases with a high impact on the climate in favour of energy-efficient and safe alternatives, and further improving the containment and end-of-life treatment of products and equipment that contain F-gases; help to bring about a consensus on an international agreement to phase down hydrofluorocarbons (HFCs), the most relevant group of F-gases, under the Montreal Protocol.

It is aimed at cutting total EU emissions from F-gases by two thirds by 2030 compared to 2014 levels. It prohibits the placing of F-gases on the market in certain circumstances where alternatives are available. During 2018-2020, quotas for legally placing HFCs on the EU market were reduced to 63% of 2015 levels (Table 5-17).

The Ministry of Environment has updated the existing national legislation and adopted new legislation in the area of fluorinated greenhouse gases ensuring the implementation of the requirements of the Regulation (EU) No 517/2014:

- The Order No D1-897 of the Minister of Environment ensuring the implementation of the requirements of the containment, use, recovery and destruction of the fluorinated greenhouse gases was adopted on 12 December 2016. This Order defines the functions of the national authorities ensuring the implementation of the requirements of the Regulation (EU) No 517/2014;
- The Order No D1-372 of the Minister of Environment establishes the Rules on the issuance of Certificates for the companies handling fluorinated greenhouse gases;
- The Order No D1-668 of the Minister of Environment establishing the training and attestation system for the employees engaged in the activities with the fluorinated greenhouse gases was prepared with the view to amend and updated the existing national legislation in this area in order to comply with the requirements on the Regulation (EU) No 517/2014, adopted on 20 October 2016.
- The Order No D1-12 of the Minister of Environment establishing the procedures for reporting on fluorinated greenhouse gases and ozone depleting substances, data collection and management, accounting of equipment and systems which contain these gases or materials was adopted on 10 January 2010 and was amended in 2016.
- The amendment to the Administrative Infringement Code establishing more stringent responsibilities for the breach of the requirements of handling fluorinated greenhouse gases was adopted in 2016.

In July 2017, the EU and its Member States committed to ratifying the Kigali Amendment to the Montreal Protocol, it came into force on 1 January 2019 and is a significant step forward in implementing the Paris Agreement by limiting the global production and use of hydro fluorocarbons (HFCs). Science suggests that an ambitious phase-down of HFCs alone could prevent up to 0.5°C of global warming by the end of the century.

The Order No D1-973 of the Minister of Environment on the **Green procurement implementation measures for 2012-2015** adopted on 14 December 2011 and later amendments promoting the environmental management system in the manufacturing sectors as well as the strengthening ability of enterprises to organise green procurements.

In 2021 **Green procurement implementation measures plan 2021-2025** was approved by the Order No D1-448 of the Minister of Environment for the promoting the green public procurement application.

The Order No 620 of the Minister of Environment of 5 December 2002 (with later amendments in 2014) on **Limitation of emissions of volatile organic compounds** (hereinafter – VOC) was adopted. The aim of this Order is to reduce the direct and indirect impact of VOC emissions (released by paints, solvents, adhesives and other products) on environment, usually on the ambient air, and the potential risk on human health, by providing measures and procedures to be implemented in the activities referred to by this document, in case the activity exceeds the solvent consumption level prescribed in this normative document.

The estimates of policy and measures effect on GHG emissions mitigation in industry sector for 2021-2030 period were developed and included in Lithuania's **National Energy and Climate Action Plan (NECP)**, 2019. The policies and measures adopted and planned in industry sector are summarized in Table 4-11 below, planned policies and measures are highlighted in grey. The targets, policies and measures (including their mitigation effects) set in the NECP are currently under revision in order to meet the increased ambition of the European climate legislation and GHG reduction targets set in Lithuania's National Climate Change Management Agenda.

Table 4-11. The summary table of existing and planned (highlighted in grey) PaMs in industry sector

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq)	
				2025	2030
P1. Introduction of alternative fuel in industry sector	To replace 90% of fossil fuel with an alternative by 2027 in industry companies	2019	20.0	NE	67.7
P2. Implementation of F-gas Regulation/ Implementation of Kigali Amendment.	The regulation aims to reduce by 2/3 overall EU emissions of fluorinated gases by 2030 compared to the 2014 level	2015/2019	-	616.7	900.4
P8. Reduce F-gas use in the business enterprises (companies)	Reduce GHG emissions by 30% in the sector.	2021	-	12.4	24.7
P4/EE5. Relief for services in the public interest (SPI) for industrial enterprises	Support mechanism to finance the implementation of energy efficiency measures in all major Lithuanian industrial enterprises. It is planned that energy efficiency measures will be implemented every year and	2021	-	IE (EE5.)	IE (EE5.)

	save about 100 GWhh (by 2030 -5.5 TWh)				
P5. Investment and innovation incentive	Reduced profit taxes by 5% for the commercialization of R&D inventions	2018	-	NE	NE
P6/P7/RES6. RES for industry LT+ support for additional RES capacities/Reduce the use of coal, coke and lignite	Increasing generation and consumption of RES. The share of renewable energy sources in the industry: 70%. electricity and 30% heat /To cut the subsidy from 2024	2021	55.0	IE (RES6.)	IE (RES6.)
P9. Promoting the substitution of polluting technologies with cleaner ones		2020	5	60.7	121.4
P10. Introduction and promotion of technological eco-innovation/P14. Promoting traditional industrial transformation	GHG reduction by 20% in the sector.	2021	284.6	16.48	31.46
P12. Implementation and promotion of non-technological eco-innovation/P13 Encouraging investment in product / packaging / service design solutions	One company implementing non-technological eco-innovations would reduce emissions on average by about 38 t CO_2 eq.	2021	24.0	0.15	0.15
P11. Implementation of modern technologies/P15 The digitization of industry	GHG reduction by 20% in the sector.	2021	202.7	1.3	2.6

<u>Brief description of existing and planned policies and measures in industry sector</u>

P1. Introduction of alternative fuels in industrial sector. Industrial enterprises plan to increase alternative fuel combustion capacity by replacing up to 90% of fossil fuels with an alternative. The measure is targeted at companies participating in the EU ETS.

P2. Implementation of F-gas Regulation/ Implementation of Kigali Amendment. The implementation of the provisions of the F-gas Regulation will reduce emissions from the use of F-gases by two thirds by 2030 compared to 2014 levels, due to the prohibitions in the Regulation on the use of F-gases with a GWP>2 500 from 2020, the prohibitions on the placing on the market of new equipment containing HFCs with a high GWP and the phasing out of the current method for the allocation of quotas for such gases.

The provisions of the Kigali Amendment to the Montreal Protocol intended to reduce the use of HFCs are already being implemented and will be complied with through the implementation of the F-gas Regulation and national legislation.

P4/EE5. Relief for services in the public interest (SPI) for industrial enterprises. A support mechanism to finance the implementation of energy efficiency improvement measures (recommended in the energy efficiency audit reports) in all major industries in Lithuania. Companies will receive compensation for implementation of energy efficiency measures. Energy efficiency measures to be implemented are expected to result in energy savings of around 100 GWh annually and 5.5 TWh by 2030.

P5. Investment and innovation incentive. Current corporate income tax exemptions for investment and innovation: to promote entrepreneurship, as of 1 January 2018 a one-year corporate tax holiday is granted to small start-ups by exempting them from corporate income tax in their first year of their operation; to promote innovation, incentives are targeted at companies that develop the latest technologies in their activities and then use them to generate income in their activities.

P6/P7/RES6. RES for industry LT+ support for additional RES capacities/Reduce the use of coal, coke and lignite. The aim is to increase the production and consumption of RES in industrial enterprises. The measure will have an impact on the combustion of fuels in industry and construction in the non-ETS sector. RES will be distributed in industry as follows: 70% of electricity and 30% of heat.

The measure is targeted at industries not participating in the EU ETS. As coal is the most polluting fossil fuel in terms of GHG emissions, the proposal is to abolish the subsidy as from 2024.

P8. Reduce F-gas use in the business enterprises (companies). The measure is aimed at encouraging undertakings to acquire new equipment or to replace old equipment using technological alternatives other than F-gases or using low-GWP gases. In providing financial support for the purchase and installation of cooling equipment, priority should be given to those applicants who plan to purchase equipment using lower-GWP coolants. In view of other countries' experience, this measure is expected to lead to a 30% reduction in GHG emissions.

P9. Promoting the substitution of polluting technologies with cleaner ones. The measure is targeted at the participants of the EU ETS. It is intended to partly finance projects for the replacement of polluting production technologies by less polluting ones, the implementation of BATs, etc. On average, BATs and other technology improvement solutions based on the best practices are expected to reduce GHG emissions by 22%.

P10. Introduction and promotion of technological eco-innovation/P14. Promoting traditional industrial transformation. The measure is intended for SMEs. In order to reduce the negative effects of climate change and GHG emissions, investment in tangible assets (installations, technologies) is envisaged, which reduces the negative environmental impacts of economic activities, promotes industrial symbiosis and ensures a continuous environmental impact, i.e. investments in cleaner production innovations (implementation thereof) with rational use of resources and pollution prevention techniques (e.g. process modernisation/optimisation to reduce negative environmental impacts and/or to conserve natural resources, lean production, reuse/recycling of waste, use of waste heat (recovery, regeneration), separation of flows, etc.). On average, technological eco-innovation can reduce GHG emissions by around 20%.

Encouraging the transformation of traditional industries through the deployment of technologies relevant for industrial innovation and growth as a whole – the promotion/deployment of Key Enabling Technologies (KETs) in the production processes of SMEs. The measure covers nanotechnologies, micro-electronics and nanoelectronics, including semiconductor electronics, new materials, biotechnology and photonics. These technologies include flexible production systems and digital technologies. Technological development solutions are expected to reduce GHG emissions by 20%.

P11. Implementation of modern technologies/P15 The digitization of industry. Adapting existing and developing new production and service provision capacities for the production of new and existing products and provision of services. Financing will encourage companies to invest in the acquisition and deployment of new production technology lines, modernisation of existing production technology lines, installation of companies' internal engineering networks necessary for the deployment of new production technology lines or the modernisation of existing ones, and the deployment of modern and efficient technologies in service sectors; financing is also intended to ensure the functioning of the listed production and service delivery capacities.

Performance of technological audits of industrial SMEs to assess the digitisation potential and prospects of industrial SMEs' production processes and/or technological monitoring of the implementation of the provisions on technological audits (technology advisory services); deployment of industrial SMEs' production process equipment with integrated digitisation technologies, based on the recommendations from the technological audit performed.

P12. Implementation and promotion of non-technological eco-innovation/P13 Encouraging investment in product / packaging / service design solutions. The objective of the measure is to encourage SMEs to implement non-technological eco-innovations in order to help solve environmental problems. Introduction of environmental management systems in accordance with international standards and/or performance of technological and/or environmental audits of production, eco-design and eco-labelling are planned. One company having implemented non-technological eco-innovations is expected to reduce GHG emissions by around 38 t CO_2 eq.

The measure "Encouraging companies to invest in product / packaging / service design solutions" is aimed to increase the attractiveness of the company's products or services and thus the demand and productivity of the company. Financial support is envisaged for projects to develop innovative packaging designs that reduce waste in industry.

4.3.4 Agriculture

In assessing the impact of EU support for agriculture and rural development on sustainable development, the National Progress Programme highlights the positive impact of investments to modernise farms, on the environment and labour productivity, and on the development of organic farming.

The long-term goal for the agricultural sector set out in the Sustainable Development Strategy is to create a cost-effective and competitive industry based on environmentally friendly farming. Agriculture sector should develop ecological farms, produce high quality certified agriculture and food products that conserve natural resources. The main long-term challenges for the agricultural sector are:

– intensify the production of organic crop and livestock products; achieve a certified ecological production area of at least 10% of all farmland by 2020;

– to promote the efficient development of biofuel production: biofuels should replace at least 15% of the fuel used for transport.

Lithuania's Rural Development Programme (2014-2020) ended in 2020. This Programme identified a priority list of 24 needs. 7 needs are directly related to climate change mitigation. Lithuania developed a National Strategic Plan for the Common Agricultural Policy for the period 2021-2027.

The overall assessment for the period 2014-2020 of the above-mentioned programme is not done yet. However, the following results currently were reached:

- "(4B) Improving water management, including fertilizer and pesticide management: there are in 2014-2020 RDP the measures for improvement of water quality, for sustainable use of plant protection products and fertilizers" and "(5E) Carbon sequestration and emissions reduction in agriculture and forestry". This target area is to increase the carbon sequestration and GHG emission reduction by managing specific territories. The measures such as "Extensive management of wetlands", "Protection of water bodies against pollution and soil erosion in arable land ", "Improving the status of water bodies at risk", "Soil and water protection" are covering area of **13 978 ha.** In total **35 projects** related to the discharge of excess water from fields in 2019 were implemented.
- "(5D) Reducing GHG and ammonia emissions from agriculture". This target area promotes sustainable farming practices which contribute to maintaining soil quality, by growing winter crops, promotion of perennial grasses and legumes. The measures such as "Extensive management of meadows by animal grazing", "Management of specific meadows", "Extensive management of wetlands", "Strips or plots of melliferous plants in arable land", "Protection of water bodies against pollution and soil erosion in arable land", "Management of slopes of reclamation ditches", "Improving the status of water bodies at risk", "System for cultivation of environmentally friendly fruits and vegetables", "Soil and water protection", "Stubbly fields in winter season" are covering the area of **73 379 ha**.
- To select varieties of agricultural plants resistant to climate change and to introduce new varieties. The number of researches per year on agricultural species and varieties capable to adapt well to conditions in Lithuania is **500.**
- Develop farmer' skills and improve their understanding on climate change mitigation and to increase the motivation to adapt to climate changes conditions. Number of farmers that have been consulted – **350 per year**.
- Support for production of biogas from renewable sources of energy. Number of supported biogas projects from renewable energy sources – **10 units**.

- “(4C) Preventing soil erosion and improving soil management”. The target area is to protect the soil from degradation and erosion and to improve soil quality. There is also a measure to promote of adaptation to climate change. The measures such as „Strips or plots of melliferous plants in arable land“, „Protection of water bodies against pollution and soil erosion in arable land“, „Management of slopes of reclamation ditches“, „Improving the status of water bodies at risk“, „System for cultivation of environmentally friendly fruits and vegetables“, „Soil and water protection“, „Intermediate (catch) crops on arable land“, „Stubbly fields in winter season“ are covering area of **69 708 ha.**
- “Promotion of Organic farming”. Organic farming production is covering area of **200 895 ha**.

On 21 November 2022 the European Commission approved **Lithuania’s Common Agriculture Policy strategic Plan for the 2023-2027 period**, in which a strong emphasis on fair incomes for farmers. Around EUR 3 billion is allocated for income support with a redistributive payment for small- and medium-sized farms, as well as coupled support for several sectors. Lithuania’s share of young farmers is increasing and fund investments will be used to ensure that the sector remains attractive. More than 4 600 young farmers will be supported to set up and will then receive additional aid. Sustainable farming practices will also be rewarded. For example, the area under organic farming will increase at least by half by 2028 and will cover 13% of the agricultural land in the country.

National **Water Area Development Programme 2017-2023** approved on 1 February 2017 by Resolution No 88 of the Government of the Republic of Lithuania. The main goals of the Programme are: to improve status of ground and surface water bodies, to achieve and maintain good environmental status of the Baltic Sea, to reduce the risk of the floods, to provide quality public drinking water supply and sanitation services and to reduce pollution by wastewater. The Action plan for the implementation of the Programme was approved on 5 May 2017 by the Order No D1-375/3D-312 of Minister of Environment and the Minister of Agriculture of the Republic of Lithuania.

Implementation of the Council Directive of 12 December 1991 concerning **the protection of waters against pollution caused by nitrates from agricultural sources** (91/676/EEC) with the latest amendment by the Regulation (EC) No 1137/2008 of the European Parliament and the Council of 22 October 2008 (further – Nitrates Directive) is primarily directed towards the minimization of the water pollution with nitrates. Activities are supported for the establishment of modern manure silos and other measures which enable the control against manure penetration into the surroundings. Replacement of manure handling systems from thick or dry silos to liquid silos may lead to a reduction in emission of nitrogen compounds to atmosphere by up to 20 times. The country took an obligation that the Nitrates Directive would be implemented in two phases. The implementing Nitrates Directive legal documents are:

- The Order No D1-367/3D-342 of Ministers of Environment and Agriculture on **Environmental Requirements for Manure Management** adopted on 14 July 2005 with later amendments sets requirements pursuant to Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agriculture activities, particularly the environmental requirements on the use of manure for croplands fertilization. Additionally, the farms, keeping animals are required to store manure and slurry in storage vessels which comply with environmental requirements. In order to reduce GHG emissions, also there are established requirements for slurry storage covering and slurry speeding technology by the Order No D1-367/3D-342.

- By the Order No D1-490/3D-39 of Ministers of Environment and Agriculture the **Program for Minimization of Water Pollution Caused by Agriculture activities** was adopted on 8 June 2012. The Order sets requirements pursuant to Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources.

The environmental situation in the agricultural sector is trending in a negative direction. A 58% increase of area harvested of cereal grain crops and a 9% increase in arable land from 2005 to 2020 is being monitored. Those indicators show more rapid development in crop farming than cattle/pig farming, which increases the possibility of nitrogen leaching to nearby water bodies, thus more significant concentrations in water bodies.

However, more important factor is the intensity of activities in agricultural areas. In this respect, a trend of inorganic N fertilizer consumption in Lithuania for the period of 2005-2020 shows 67% increase, while the consumption of organic nitrogen fertilizer remained stable. Inorganic N fertilizer now accounts for roughly 90% of all fertilizers' (mineral and organic combined) used.

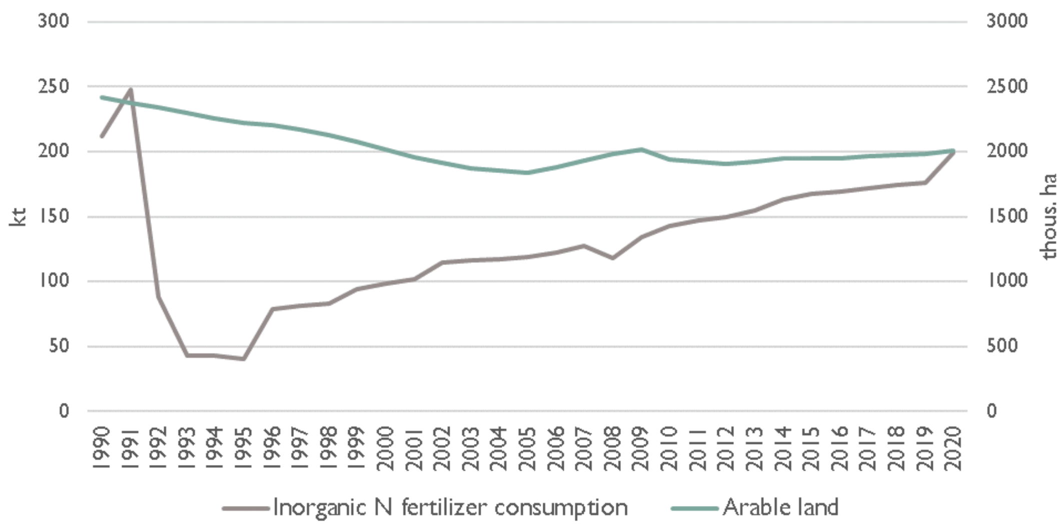

Figure 4-9. Changes in inorganic N fertilizers consumption and arable land

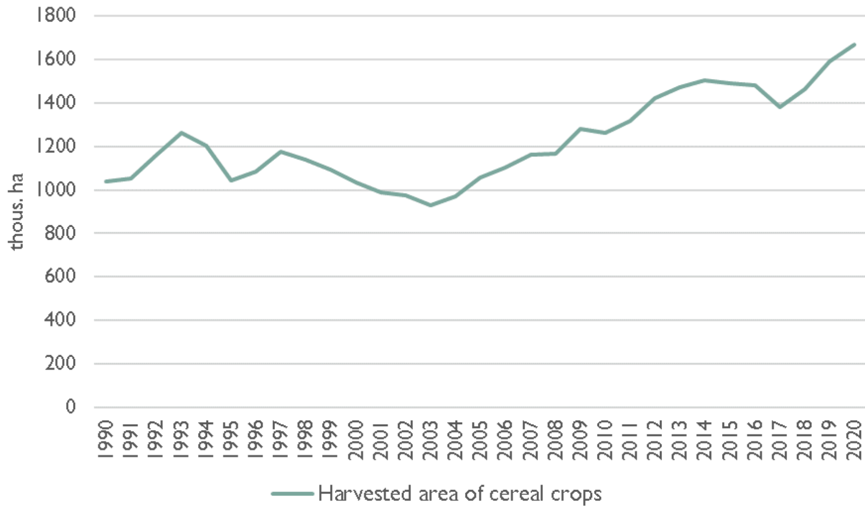

Figure 4-10. Changes in harvested area of cereal crops

For this reason, in the agriculture sector it is mainly focused on more effective and precise use of mineral nitrogen fertilizers and the education of farmers. The assessment of recent GHG inventories shows an upward trend in emissions and action will be taken to contribute to GHG reduction targets in the development of new agricultural policy solutions. The political guidelines of the EU Common Agricultural Policy also pay close attention to this. Since 2014 in Lithuania, biogas power plants producing biogas by processing manure from livestock farms have gained momentum. Another important mitigation activity is the protection of waters against nitrate pollution (such as the implementation of the EU nitrates directive and its latest amendment (1137/2008)), which contributes to reducing N_2O emissions.

The estimates of policy and measures effect on GHG emissions mitigation in agriculture sector for 2021-2030 period were developed and included in Lithuania's **National Energy and Climate Action Plan (NECP)**, 2019. The policies and measures adopted and planned in agriculture sector are summarized in Table 4-12 below, planned policies and measures are highlighted in grey. The targets, policies and measures (including their mitigation effects) set in the NECP are currently under revision in order to meet the increased ambition of the European climate legislation and GHG reduction targets set in Lithuania's National Climate Change Management Agenda.

Table 4-12. The summary table of existing and planned (highlighted in grey) PaMs in the agriculture sector

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq)	
				2025	2030
A1. Implementation of Nitrates directive	Reduced water pollution and the emissions of N_2O	2014	-	NE	NE
A1. Realisation of the recommendations of the code of good agricultural practices	Improve farmers' knowledge of the implementation of the recommendations of the	2021	-	NE	NE

	Code of Good Agricultural Practice				
A2. Granting of one-off compensatory support to farms for long-term commitments relating to climate change mitigation.	To use 30% less mineral N fertilizer in 60 thousand ha of the land.	2021	36.60	NE	NE
A3. Dissemination of knowledge and advice to farmers and fisheries on environmentally friendly and climate-friendly practices	Improving farmers' knowledge of advanced agricultural technologies and farming solutions that will reduce GHG emissions	2021	-	NE	NE
A4. Investment support for the introduction of climate-friendly farming methods in livestock farms	300 thousand m^3 of pigs and 350 thousand m^3 of cattle manure and slurry used to produce biogas; 300 thousand m^3 of slurry is used to fertilize fields by direct application to the soil; encourage the introduction of slurry acidification technologies.	2021	108.50	34.52	34.17
A5. Provision of compensations to farms for long-term obligations related to climate change mitigation	Mineral N fertilizers are no longer used in 60 thousand ha of the land	2021	159.60	NE	NE
A6. Improvement of mandatory requirements for the use of slurry and manure	The effect in 1 million ha of agriculture land.	2021	-	21.43	22.22
A7. Promotion to replace a component of the animal fodder to reduce emissions of methane and nitrogen compounds	Inform farmers about the impact of changing feed composition on GHG emissions while maintaining productivity	2021	1	NE	NE
A8. Balanced use of mineral fertilisers	Mineral N fertilizer consumption will be reduced by 15%.	2021	-	134.6	269.3
A9. Promotion of environmentally friendly and sustainable farming methods	Promote good and sustainable farming practices	2021	10	NE	NE
A10. Informing farmers about possibilities to reduce climate change (GHG emissions) at the farm level.	Consult farmers on improving energy efficiency	2021	-	NE	NE
A11. Promoting of more productive, disease and	To inform farmers about the possibilities to breed or purchase more climate-	2021	5	NE	NE

climate-resilient livestock and fish breeding	friendly and productive animal breeds (especially dairy cows)				
A12. Review of fuel consumption technological cards and excise-free fuel allocations	Reach a 20% less fuel consumption	2020	-	133.7	138.08
A13. Promoting use of non-arable technology	The 650 000 thousand ha will be used for non-arable technology,	2021	45	37.75	79.7
A14. Abolition of environmentally harmful tax concessions for transport used in agricultural activities	For all non-road mobile machinery, including agricultural machinery to fix stricter tariffs for their used fuel and emissions	2023	-	0.58	1.16
A15. Increase in the tax on air pollution from stationary sources	Increase the environmental pollution tax on livestock and poultry enterprises	2023	-	12.96	34.57
A16. Reduction of the use of fossil fuel in agriculture, forestry and fishery	Reducing fuel consumption by 5.7%	2023	0.5	2.58	5.16

Brief description of existing and planned policies and measures in agriculture sector

A1. Realisation of the recommendations of the Code of Good Agricultural Practices. The Code of Good Agricultural Practice aims to reduce negative impacts on soil, water, air and climate and will inform farmers about innovation.[7]

A2. Provision of one-off compensations to farms for long-term obligations related to climate change mitigation. Increase areas for environmentally friendly actions. Expand crop areas that do not use mineral N fertilizers. An area of 60 000 ha uses 30% less mineral N fertilizer.

A3. Sharing knowledge with farmers about environmentally friendly activities. Improve farmers' knowledge on how to use advanced agricultural technologies and farming solutions to reduce GHG emissions. Dissemination of knowledge and provision of advice on environmentally friendly and climate-friendly activities to agriculture and fish business (main activity is consultation). The task of provision the advisory and consultation services is to improve the knowledge of farmers and fish business on how to apply advanced technologies and solutions to reduce GHG emissions.

[7] Good agricultural and environmental condition of land (GAEC) is a narrow list of environmental requirements defined in EU legislation that applies to farmers seeking support under the principles of the EU's Common Agricultural Policy. The Code of Good Farming, meanwhile, is a much broader document and a voluntary set of environmentally friendly farming methods applied by farmers based on the latest scientific advice. Thus, the GAEC and Code measures are of a different nature and scope.

A4. Investment support for implementation of climate-friendly farming methods in cattle farms (investment into energy-saving and GHG emission reducing equipment and technologies). The investments are directed to more energy efficient and GHG emissions reducing technologies and equipment. The aim is to increase the efficiency of mineral fertilization of plants (according to actual plant needs and ensuring all qualitative soil parameters) and to apply slurry acidification, slurry insertion in soil. Planned results are: 300 thous. m^3 of pigs and 350 thous. m^3 of cattle manure and slurry are used to produce biogas; 300 thous. m^3 of slurry used to fertilize fields by direct application to the soil; encouraging the introduction of slurry acidification technologies.

A5. Provision of compensations to farms for long-term obligations related to climate change mitigation. The aim is to increase the areas under environmentally friendly actions, such as extending crop areas that do not use mineral N fertilizers. It is planned that after implementation of this measure the use of mineral fertilizers will be discontinued in the area of 60 thousand ha.[8]

A6. Improvement of mandatory requirements for the use of slurry and manure. It is planned to change the requirements for the application of slurry and manure when it is applied in the fields. Requiring that manure spread within 4 hours must be applied to the ground. This would make it possible to reduce the use of mineral nitrogen fertilizers and the amount of GHG produced from manure. The measure is expected to affect 1 million ha.

A7. Promotion to replace a component of the animal fodder to reduce emissions of methane and nitrogen compounds. To inform farmers about the impact of certain feed composition changes on GHG emissions while maintaining productivity: changing pig feed, reduce methane emissions from cattle by modifying the composition of feed for cattle, to inform livestock farmers of the possibilities of diversifying their feed composition by improving the quality of their feed and, at the same time, the productivity of their livestock (for example, converting common wheat, barley straw to maize, millet, etc.), by reducing the amount of carbohydrates and replacing them with unsaturated fats in the feed, incorporate nitrogen-containing slow-digesting nitrogen compounds into the feed, reduce the amount of protein in the feed for dairy cows, and avoid over-feeding.

A8. Balanced use of mineral fertilizers. Establish a system of balanced fertilization to reduce the use of mineral fertilizers and to increase use efficiency (per unit of yield or per hectare of crop): to set a requirement for the farm to provide data on the use of mineral fertilizers on the farm (by active substance); to develop a methodology for the preparation of fertilization plans to calculate the optimum fertilization by crop and to require farms to prepare mineral and organic fertilizer plans. The use of mineral N fertilizers on agricultural land is expected to decrease by 15%.

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[8] A2 and A5 measures have a similar goal: to reduce the overall use of N mineral fertilizers. However, the intensity of the measures is unequal. Under measure A2, it is planned to pay support to farms which will reduce fertilization by 30 percent, but will not completely abandon the use of mineral fertilizers. Under measure A5 the obligations of farms to completely abandon mineral fertilization is meant. Accordingly, the GHG mitigation effect of A2 measure is lower.

A9. Promotion of environmentally friendly and sustainable farming methods. The task is to promote at farm level sustainable farming by organising the practical activities, field days and showing the good and sustainable farming practices on the spot and organising the information campaigns on soil-saving technologies. To make farmers aware of the implementation of eco-schemes through direct support measures under the CAP Strategic Plan and other policy instruments This measure includes field days, information campaigns on soil-friendly technologies; fertilize according to the real need of the plants by postponing spring fertilization; to carry out local (precision) fertilization and the opportunities and benefits of reducing the use of mineral fertilizers.

A10. Informing farmers about possibilities to reduce GHG emissions at the farm level. Provide advice to farmers on energy efficiency, livestock or crop technologies to identify and advice on how to reduce GHG emissions from the production process of a specific farm.

A11. Encourage breeding of more productive, resistant to diseases and climate animals. To inform farmers about the possibilities to breed or purchase more climate-friendly and productive livestock breeds (especially dairy cows). It is also important to educate farmers about the need to consult veterinarians on a timely basis, prevent animal health issues, keep animals clean, and so on.

A12. Review of fuel norms and allotted excise-free fuel quantity. Reduced excise-free fuel consumption would save 20% of fuel consumption.

A13. Promoting use of non-arable technology. It is planned that in the end of the 2021-2030 period, 650 000 thous. ha will be used for non-arable technology, which will reduce fuel consumption by 40%.

A14. Waiver of environmentally detrimental tax privileges applied to transport used in agriculture. All non-road mobile machinery, including agricultural machinery, is subject to stricter tariffs for their fuel and pollutant emissions.

A15. Increase of air pollution taxes. Increase of environmental pollution tax on livestock and poultry enterprises.

A16. Reduction of the use of fossil fuel in agriculture, forestry and fishery. Choosing the right tractor tools according to the power of the tractor and applying the principles of eco-driving. The reduction in fuel consumption due to the introduction of the measure over the entire period will be 5.7%.

4.3.5 LULUCF

In the land use, land use change and forestry (hereinafter – LULUCF) sector one of the main factors influencing the CO_2 removals is the enlargement of forest area by afforestation or natural expansion of forests. **National Forestry Sector Development Program 2012-2020** approved by Government Resolution No 569 in 2012 set a strategic goal on forestry development, other forestry goals, and tasks to achieve the set goals, evaluation criteria. The Programme aimed to increase forest coverage of the country up to 34.2% by 2020 by afforestation of abandoned lands and lands that are not suitable to be used for agricultural activities, and to encourage financially to plant forests in private and state-owned lands, to implement forest regeneration on a genetic-ecological basis with selectively valuable and qualitative forest reproductive material. However, this goal was not achieved as forest coverage was 33.7% in 2020.

In 2011 the **Forest Law** was amended by narrowing the possibilities and fixing the procedure of forest land transformation. Forest land may be transformed into farming land or other type of land only in exceptional cases. In addition to that new compensation system was created, which ensures obligation to plant new forest on non-forest land as a compensation for the forest land plot transformed into the other land use. This regulation serves not only as additional guarantee to prevent decrease of forest land area, but also creates conditions for increase of forest coverage.

About 49 thousand ha of new forests were planted in the last 20 years period. Major part of this afforestation was done with a financial support from Rural Development Program 2007-2013 and 2014-2020. The mitigation measures in LULUCF sector to minimize GHG emissions in forestry sector during 2014-2020 were:

- **Restoration of forestry potential and introduction of prevention actions.** Fires and natural disasters pose a significant threat to forest ecosystems. Each year in Lithuania between 100 and 750 ha of forest is burned. Lithuania's Rural Development Programme 2014-2020 provides investment support for restoration of forest damaged by fires and other natural disasters including pests and diseases, as well as support for implementation of forest fire prevention measures.
- **Afforestation and restoration of damaged forest.** To reduce atmospheric pollution originated from agricultural activities and contribute to climate change mitigation as well as to reduce the area of the abandoned land, the afforestation of these lands and the restoration of damaged forests is supported. In the Inter-institutional Action Plan on the implementation of the Goals and Objectives for 2013-2020 of the Strategy for the National Climate Change Management Policy the measure was set to plant new economically valuable and productive as well as biologically resistant forests in abandoned lands in the state's possession.
- **Afforestation.** 53 million EUR were allocated for commitments under the sub-measure „Afforestation" for the programming period 2014-2020. It was planned that forest land in 2020 will reach 34.2%.

By the end of 2022 the final draft of the **National Agreement on the Future of Forests** is developed. The Agreement covers the most relevant topics: the development of stable and more climate change-resilient forests and the increase of afforestation, the protection of old forests and biodiversity, public involvement in decision-making, increasing the openness of the forest sector, their social and cultural disclosure of value, multifaceted compatibility of forest benefits, development of wood and non-wood economy, relationship between private forests and public interest, creation of attractive jobs in forest-related sectors, development of forest-related science and training systems.

The estimation of policy and measures effect on GHG emissions mitigation in LULUCF sector is related to the National Forestry Sector Development Programme for 2012-2020 where the target to increase the forest area by 2020 is set. In addition to the measures applied in forestry, additional measures, related to agricultural land use were discussed and included in the preparation of Lithuania's **National Energy and Climate Action Plan (NECP) for 2021-2030**. Most of the measures are planned to be implemented during this decade and some of them already started (see Table 4-13), planned policies and measures are highlighted in grey. During the preparation of GHG projections for LULUCF sector, policy measures and their scope were discussed internally with the responsible entities, therefore part of them are updated and are different (the extent to which the measure is applied) compared to ones originally described in the NECP. Based on the updated scope of the measures, their GHG mitigation effect (increase of GHG removals) was reviewed accordingly.

EU LULUCF Regulation 2018/841

Under LULUCF Regulation (EU) 2018/841 adopted in 2018, EU Member States have to ensure that GHG emissions from LULUCF are offset by at least an equivalent removal of CO_2 from the atmosphere in the period 2021 to 2030. LULUCF regulation sets out Member States' commitments on LULUCF that contribute to meeting the GHG emission reduction target at least 40% to compare with 1990 of the Union for the period from 2021 to 2030, as well as the rules for the accounting of emissions and removals from LULUCF and checking the compliance of Member States with these commitments. It is planned that this Regulation will incentivise more climate-friendly land use and help farmers to develop climate-smart agriculture practices and support foresters through greater visibility for the climate benefits of wood products, which can store carbon sequestered from the atmosphere and substitute for emission-intensive materials.

Following the EU Climate Law agreement in 2021, the European Commission in July 2021 presented the proposal of the LULUCF Regulation amendment to ensure an increase in carbon removals in the sector towards 2030 . Among the main changes envisaged are: by 2030, LULUCF carbon removals would have to increase to 310 million tonnes of CO_2 eq.; for the post-2025 period, the individual targets for each Member State are set. The amendment of LULUCF Regulation is currently at the final negotiation phase and will be adopted in 2023.

Table 4-13. The summary table of existing and planned (highlighted in grey) PaMs in LULUCF sector

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq)	
				2025	2030
L1. Restoration of forestry potential and introduction of prevention actions	Support restoration of forests damaged by fires and other natural disasters	2007	-	NE	NE
L2. Promotion of planting of short rotation coppices	The support for planting of short rotation coppices with an aim to produce biomass as a source of energy which partially replaces imported fossil fuels (oil, gas, coal).	2014	-	NE	NE
L3. Afforestation and restoration of damaged forests	Provide support for afforestation/reforestation activities For the period 2021-2030 it is expected to plant of 8 thous. ha of new forests or to preserve	2021	-	1,024.26	921.98

	areas of natural forest expansion annually.				
L4. Promote the use of biomass for energy production	Additional production of wood biofuels from logging residues	2012	-	NE	NE
L5. Restoration of wetlands in arable peatlands and protection of their perennial herbaceous vegetation cover	8 thous. ha of wetlands will be restored by 2030 and 20 thous. ha by 2040	2021	16.00	NE	IE (L8.)
L6. Assessment of the possibility and potential outcome of growing perennial crops (i.e. trees and shrubs) on agricultural land	To identify criteria and areas (agricultural area) where it is appropriate to expand the cultivation of perennial crops.	2021	0.05	NE	NE
L7. Promotion of perennial crops (priority: tree and shrubs)	19.6 thous. ha of arable land will be converted to perennial crop areas by 2030 and 23.6 thous. ha by 2040	2023	10.00	8.87	13.27
L8. Cultivation of herbaceous vegetation (grassland) in organic soils with restored natural water level and the promotion of sustainable use thereof	8 thous. ha will be restored by 2030 and 20 thous. ha by 2040	2022	9.90	18.61	49.63
L9. Inventory and protection of areas of natural forest expansion	Reimbursement of the costs of inventory land as forest (preparation of necessary documentation for the afforestation permit and cadastral measurements)	2022	10.00	NE	IE (L3.)
L10. Redevelopment of stands and shrubs	Redevelopment rate: 1500 ha/year	2021	20.00	NE	NE
L12. Promotion of planting of landscape elements at the edges of	10% of agricultural (arable land) to adapt to suit for biodiversity protection	2022	-	NE	NE

agricultural fields (L11, L13 deleted)					
L14.Granting of one-off compensatory support to farms for long-term commitments (ECO scheme of 'experimental' impact) relating to climate change mitigation.	An area of 650 thous. ha will be covered by "no tillage" agricultural practice by 2030 and 800 thous. ha by 2040	2023	150.00	615.14	938.60
L15. Organic soil protection	It is planned that at least 1000 ha of organic soils will not be drained.	2021	-	NE	NE
L16. Promotion of green public procurement	Introducing additional environmental criteria for public procurement to promote the use of wood and wood articles/products in the construction sector	2022	-	NE	NE
L17. Determination of the national emission factors (EFs) or stock change factors for GHG emission and removal estimation	To establish national emission factors (EF) or stock change factors in order to update GHG inventory and identify the most appropriate GHG emission reduction and enhance of carbon removals measures in the LULUCF sector	2021	-	NA	NA
L18. Promotion of cultivation of cover crops	To encourage farmers to include cover crop in agricultural practices	2021	40.00	64.71	105.89

Brief description of existing and planned policies and measures in LULUCF sector

L1. Restoration of forestry potential and introduction of prevention actions/ L2. Promotion of planting of short rotation coppices. It is expected to increase forest land area up to 35% of the total country area according to the suggestions (not precisely determined in any of the strategic planning documents). National Forestry Development Programme for 2021-2020 sets the goal to increase forest coverage by 3% until 2020. It was estimated that afforestation of the poorly fertile soils to increase forest coverage could increase LULUCF sector GHG removals by 1 680 kt CO_2 eq. in 2020. However, a successful increase in forest land area mostly depends on support from national programs for afforestation of abandoned lands and Rural Development Program, therefore the aim to increase forest coverage to 35% is unsecured. An additional measure to increase forest land coverage could be to afforest and reforest areas in abandoned land or land not suitable for agricultural purposes. The need to identify steps reducing GHG emissions and increasing absorption potential of the LULUCF sector included in the Action Plan for the implementation of the

Government Work Programme in the period of 2017-2020. Application of additional measures could increase GHG removals in the LULUCF sector approximately up to 1 050 ktCO_2 eq. in 2035.

L3. Afforestation and restoration of damaged forests. It is planned to provide support for afforestation, reforestation and forest restoration. Over the period 2021-2030, it is expected to plant 8 thousand ha of new forests annually or to preserve self-grown areas of trees.

L4. To promote the use of biomass for energy. Additional production of wood-based biofuels from wood chips.

L5. To restore wetlands in arable peatlands and protect their "green bedding" (perennial grass cover). Identify areas of former wetlands where it is appropriate to restore wetlands by naming the effectiveness of such wetlands in absorbing GHG. Promote the restoration of drained wetlands (wetlands) by ceasing arable farming, restoring adequate water levels and maintaining ecosystems through sustainable economic activities. About 2% of wetlands are planned to be restored by 2030, which is 8 023 ha of wetland areas with organic soils.

L6. To evaluate the possibilities and potential results of growing perennial plants in the agriculture land. Identify criteria and areas of farmland where it is expedient to expand perennial crop production, the range of perennial crops to be cultivated, the purpose of such crops, and assess the economic-ecosystem benefits for agricultural production.

L7. To promote the perennial crops (i.e. trees and shrubs). Promote the cultivation of perennial crops on farms through the CAP strategic plan and other incentives. 7 143 ha of arable land will be converted into grassland for the entire 2021-2030 period.

L8. To grow grasslands in organic soils and promote their sustainable use. To promote the restoration, conservation and regular maintenance of "green bedding" (perennial grass cover) of organic soils by reducing the extent of organic soil ploughing. Use the resulting products according to the principles of bio-economy and circular economy. It is planned that 8 023 ha will be restored, i.e., 7.6%

L9. To include in the accounting system abandoned land with self-grown trees as forest land (no human planted). Reimbursement of expenses for landowners of unused lands which was overgrown with trees, needed officially managed documents to assign this land area into a forest.

L10. Transformation of stands and scrubs. Through the application of the financial incentives will aim to re-establishing low absorption potential stands and scrubs to create sustainable forest ecosystems and enhance forest absorption potential. It is planned that 1 500 ha/year will be converted.

L12. Provision of one-off compensatory support to farms for short-term commitments (ECO scheme of "experimental" impact) related to climate change mitigation. By 2030 it is planned that an area of 650 000 ha land will be cultivated using non-arable technology.

L14. Promoting Green Public Procurement. Establish additional environmental criteria for public procurement to encourage the use of wood and wood products in the construction sector.

L15. Protection of organic soils. It is planned that at least 1 000 ha of organic soils will not be drained.

L16. Encourage intermediate cultivation of crops. Encourage farmers to adopt intermediate crop production practices. The RDP investment measures aim to give priority to agricultural entities that produce intermediate crops from 15% of the arable land, increasing payments according to the area of the intermediate crop.

L17. Establishment of the national emission factors (EF) or stock change factors for GHG emission and removal estimation. Establish national emission factors (EF) or stock change factors in order to update GHG inventory and identify the most appropriate GHG emission reduction and enhance of removals measures in the LULUCF sector

L18. Promotion of cultivation of cover crops Encourage farmers to include cover crops in agricultural practices.

4.3.6 Waste

The **Law on Waste Management** as a fundamental legal act of waste management, determines the priorities and basic requirements of waste prevention and management, taking into account the principles of the protection of the environment: precaution and sustainability; technical feasibility and economic viability; the protection of resources; and the overall impact on the environment, public health, and the economic and social environments.

Development and implementation of the Comprehensive Waste Management Policy is ensured by the **National Waste Management Plan for 2014-2020** and the **National Waste Prevention Programme**, which are prepared in accordance with the Law on Waste Management. The Plan and the Programme foresee priority areas, long-term goals, tasks and concrete measures for waste prevention and management, taking into account the design, manufacture and use of products as well as the reclamation and disposal of waste.

The **National Waste Management Plan for 2014-2020** purpose was to define the strategic objectives of waste management until 2020, the tasks and measures necessary for achieving the set objectives, the national waste management targets and waste management targets for municipalities, the national and EU structural assistance financing actions and the criteria for assessment of implementation of the Plan. The Plan was applied to municipal, production and other economic activity waste, the organization of management and the management of such waste within the geographical territory of Lithuania.

The main quantitative objectives were:

- not less than 50% (based on total amount of waste) of paper and cardboard, metal, plastic and glass waste must be prepared for re-use and recycling;
- not less than 65% of municipal waste (based on total amount) is recycled or recovered;
- not more than 35% of biodegradable waste (from total amount generated in year 2000) is disposed in landfills;
- not less than 70% of construction and demolition waste has to be recycled, recovered or used for backfilling purposes;

- not less than 95% of end-of-life vehicles (taking into account average weight of 1 vehicle) has to be re-used or recovered and not less than 85% of end-of-life vehicles (taking into account average weight of 1 vehicle) has to be re-used or recycled;
- In the period of 2016-2020 not less than 45% of placed on the market WEEE has to be collected, from 2020 – not less than 65% has to be collected.
- municipal waste management service has to be provided for everyone (to reach 100% by 2020);
- not less than 92% production and other economic activity waste is recycled or recovered;
- increased number of inhabitants sorting municipal waste (increased by 20% in the period 2014-2020);
- increased public awareness of the waste management sector (increased by 20% in the period 2014-2020).

In 2014-2020, EU investments were directed to waste collection and management measures in municipalities and the creation of waste incineration capacities. In the years 2021-2027, more attention will be paid to the circular economy, the development of infrastructure and increasing the awareness of public resource consumption.

Regional waste management plans must meet the requirements of the National Waste Management Plan for 2014-2020. There are 10 regional waste management systems created in Lithuania (Alytus, Kaunas, Klaipėda, Marijampolė, Panevėžys, Šiauliai, Tauragė, Telšiai, Utena and Vilnius).

Municipal waste management plans and municipal waste management rules are developed and approved at the municipal level and must comply with regional ones.

The **EU structural and investment funds** are an essential source of funding for improved waste management system in Lithuania. In 2007-2013, 190 million EUR were invested into waste management projects, including the construction of 1 regional mechanical and nine mechanical sorting and biological waste treatment facilities, remediation of 341 old landfills/dumpsites, construction of numerous bulky waste collection and green waste composting sites, an extension of separate waste collection system (210 000 containers for recyclable and biodegradable waste).

In the 2014-2020 period, it was planned to invest EUR 87.2 million into the following measures: to support further development of the separate collection of waste (including food waste, textile waste), to modernise the capacities for waste preparation for recycling, reuse or another recovery (sorting lines, other equipment), and to modernise the waste management information system and monitoring. In 2015, 9 mechanical and/or mechanical-biological waste treatment facilities started to operate, which aim to reduce the amount of biodegradable waste disposed of in landfills. It should be noted that the rate of municipal waste disposal in landfills has decreased significantly – from 54.01% in 2015 to 17.6% in 2020. By 2020, 110 large waste collection sites and 53 green waste composting sites were installed in the regions of Lithuania. Residents and organizations can also deliver green waste to facilities operated by drinking water supply and wastewater treatment companies, where green waste is treated together with sewage sludge in biogas plants. According to municipal data, in 2020, 99.5% of residents were provided with a municipal waste management service.

In 2013, first waste incineration plant in Lithuania has started operation with energy recovery. Non-energy waste incineration accounts for only 0.1% of total GHG emissions in the waste sector. Similar amounts of waste incineration are expected to remain in the future. Also, to improve the efficiency of heat and energy use, the use of indigenous and renewable resources in thermal power plants and the reduction of CO_2 emissions was more efficient in the period 2019-2020. The cogeneration plants (CHP) were built in Vilnius and Kaunas. The electric capacity of CHP is about 24 MW, heat is about 70 MW, and the incinerated amount of municipal waste 200 000 tonnes. The power plant can cover about 40% of the heat demand of Kaunas city.[9] Vilnius CHP started operating in 2021 but not at full capacity. The total electrical capacity of the power plant is planned to reach 100 MW, and the thermal capacity – about 240 MW – will cover about 40% of the amount of heat required and centrally supplied to the city of Vilnius. It is planned that Vilnius CHP will incinerate approximately 160 thousand tons of municipal waste[10]

The **National waste prevention program** covers all waste streams, but priority is given to reducing the generation of packaging, electrical and electronic equipment, biodegradable waste, hazardous and construction waste. These designated priority waste streams have the most significant negative impact on the environment and public health and/or generate substantial amounts compared to other waste streams. The implementation of the National waste prevention program was planned to reduce the growth of waste generated, the negative environmental and public health impacts of waste, the levels of harmful substances in materials and products. The principal objective of reducing the growth of emerging and unused waste, the rational use of natural resources and materials, and reducing the risk of adverse impacts of waste on public health and the environment will be met.

Ministry of Environment, with partners in June of 2022, prepared a new Program and Plan for the next (2021-2027 year) period where these two documents were merged into one, which is now called the **National Waste Prevention and Management Plan for the period 2021-2027**.

The other legal acts and programs of the Republic of Lithuania regulating waste management activities besides the Law on Waste Management are: Law on Management of Packaging and Packaging Waste, the Law on Taxes for Environment Pollution, the Rules on Waste Management. Management of wastewater and sludge is regulated by the Law on Potable Water Supply and Wastewater Handling and the Development strategy of Potable Water supply and wastewater handling.

Implementation of the Circular Economy Action Package has been a step in progressing the EU's efforts to reduce emissions from waste. The Package provides a transparent, systematic approach that focusses on several priority issues, including plastics, food waste, critical raw materials and construction and demolition and delineates actions, commitments, and timetables. In 2022, Lithuania has prepared the project of the action plan on the Lithuanian transition to circular economy until 2035.

The **Industrial Development Programme** emphasises the need to encourage companies to jointly implement the principles of industrial symbiosis in the region, which enable the saving of raw materials and waste reduction. It is estimated that, due to these measures, the proportion of recycled or otherwise utilised

9 https://kkj.lt/en/about-us/power-plant/93
10 https://ignitisgrupe.lt/en/news/vilnius-cogeneration-power-plant-has-launched-hot-testing

waste from manufacturing and other economic activities (apart from phosphogypsum waste) is likely to increase from 90% in 2012 to 92% in 2020.

Targets for 2030 are set in renewed **National Progress Programme for 2021-2030** (targets could be found in Programme's Annex 1 – target 6.8 "Reduce generation of waste and promote effective management of waste"):

- reduce amount of waste per unit of gross domestic product (GDP) – by 2025 – 110 tonnes of waste / mill. EUR; by 2030 – 90 tonnes of waste / mill. EUR.
- generation of municipal waste per capita should not overcome EU average rate;
- by 2025, prepare for re-use and recycle minimum 55%, by 2030 – 60%, by 2035 – 65% of municipal waste by weight;
- reduce amount of food waste by 50% along production and supply chains by 2030;
- till 2030 amount of landfilled waste should not exceed 5%.

Targets regarding industry reorientation towards circular economy and promotion of advanced technologies and innovations could be found in Annex 1 – target 1.4. For instance, till 2030 we seek to increase "recovered material rate" to 10.6% (in 2017 the rate was only 4.8%).

Draft **Lithuania's action plan for the transition to a circular economy till 2035** is developed. The Plan compiles already existing strategic documents planned measures aimed at ensuring Lithuania's transition to a climate-neutral economy that uses resources sparingly and reduces waste generation. The plan distinguishes 7 intervention areas that contribute the most to the targets of the circular economy: industry, construction, bioeconomy, transport, waste, consumption.

The planned measures include the development of systems, knowledge and solutions supporting the circular economy, the formation of demand for circular products, promoting industrial transformation and technological renewal, and the use of environmentally friendly and friendly raw materials. It is proposed to use resources efficient technologies and create greater added value, to ensure the principles of waste prevention and management hierarchy, to form sustainable consumption habits of the population. It focuses on the reorganization of product design, production and trade, based on the principles of renting, repairing, renewing, and redeveloping things. A lot of attention will be paid to ecological education of the population, strengthening of environmental awareness, encouraging to reduce consumption and save resources. It is planned to organize and finance informational campaigns that encourage the choice of reusable items, reuse them, reduce food waste, and strengthen food waste prevention. In addition, it is promoting the development of the sharing economy by expanding the sharing network of items suitable for reuse, by financing the activities of preparation for reuse, and the activities of small repair workshops. Funding is dedicated to finding solutions to share unused purchased materials (for example, construction materials) at their points of sale, to prepare a sharing economy analysis, to assess the possibility of expanding the use of reusable packaging.

The estimates of policy and measures effect on GHG emissions mitigation in waste sector for 2021-2030 period were developed and included in Lithuania's **National Energy and Climate Action Plan (NECP)**, 2019. The policies and measures adopted and planned in waste sector are summarized in Table 4-14 below, planned policies and measures are highlighted in grey. The targets, policies and measures (including their mitigation effects) set in the NECP are currently under revision in order to meet the increased ambition of the European climate legislation and GHG reduction targets set in Lithuania's National Climate Change Management Agenda.

Table 4-14. The summary table of existing and planned (highlighted in grey) PaMs in waste sector

Title	Objective	Starting year	Preliminary costs, EUR million	Mitigation effect (not cumulative, kt CO_2 eq)	
				2025	2030
W1. To reduce waste quantity in landfills	To reduce municipal waste recycling for at least 65% of the total waste by 2020 Municipal biodegradable waste disposed of in landfills should not exceed 35% of municipal biodegradable waste compared to 2000 To use methane (CH_4) gas from landfills for the energy generation To incinerate waste in CHP plants	2013	-	NE	NE
W2. Creation of financial incentives to encourage the repair of items	Reduce the consumption of stuff and waste in landfill by 0.5% per year	2021	1.50	3.0	3.0
W3. Prevention of food waste	Reduce food waste by 21% by 2030	2021	1.90	2.2	2.1
W4. Improvement of residents' waste sorting skills	To increase sorted and recycled waste to 15% of the total amount of waste	2021	1.50	17.6	17.5
W5. Improvement of the skills of specialists consulting on dangerous waste and training of company representatives on identification of dangerous waste	Development of a common methodology for the identification of hazardous waste. Organization of training for environmental professionals to identify and classify hazardous waste, to consult a business	2021	0.20	NA	NA

Brief description of existing and planned policies and measures in waste sector

W1. To reduce the waste quantity in landfills. To increase municipal waste recycling by at least 65% of the total waste by 2020. Municipal biodegradable waste disposed of in landfills should not exceed 35% of municipal biodegradable waste compared to 2000. To use methane (CH_4) gas from landfills for the energy generation. To incinerate waste in CHP plants.

W2. Creation of financial incentives to encourage the repair of items. Creation of financial incentives to promote repair of cycles, shoes, leather goods, clothing, furniture, etc., considering opportunities to ease the tax burden by encouraging not to dispose of old items and reuse them. The measure will reduce landfill waste by 0.5% per year.

W3. Prevention of food waste. Raising public awareness and promoting behavioural change through social campaigns, media, social networks, internet and other information channels on food waste and how it can be avoided (consumption patterns, sorting of food waste, separate collection, recovery, etc.). Creating and promoting a mobile application about expired but safe and usable food. Food waste will be reduced by 21%.

W4. Improvement of residents' waste sorting skills. Raising public awareness of waste sorting opportunities, benefits, different waste disposal sites, sorted waste through media and other information channels. Development of mobile interactive applications for citizens to promote waste sorting (including all municipalities). The amount of sorted and recycled waste will increase due to improved population's sorting skills and sorting conditions. It is expected that recycled waste will increase to 15%.

W5. To improve the capacity of environmental authorities and other institutions to identify and classify hazardous waste. Develop a standard methodology for the identification of hazardous waste and to organise the training for environmental professionals to identify and classify hazardous waste, to consult business representatives.

4.4 Methods for evaluation of PaMs effects

Lithuanian institutions in 2018-2021 focused on implementing the 2030 energy and climate targets. NECP includes new as well as already implemented measures and policies which were adopted to achieve the 2030 economy-wide emission reduction target and continue to be implemented. Thus, in this submission, we present renewed information on the PaMs and their effects. The methods of the estimation of the impact differ in separate sectors. The expert groups of different areas, through discussions, determined the ex-ante effect of planned measures. These experts presented the Ministry of Environment with their estimated sectoral parameters and predictions, and the Environment Protection Agency estimated the GHG mitigation effects according to the IPCC 2006 Guidelines. As for the evaluation of fiscal measures, the external experts were involved, mostly they analysed the other countries experiences and adjusted it to Lithuania. Additionally, planned measures were discussed with various stakeholder groups. All the additional measures were incorporated in the GHG projection scenario "with additional measures" (WAM).

Energy sector

Lithuanian energy agency evaluated the development of the energy sector and provided fuel balances for WEM and WAM scenarios and also assessed the effects of separate PaMs in energy units. The Environmental Protection Agency recalculated the planned energy savings or replacement of fuel into GHG emissions.

Transport

The following main parameters and effect evaluation strategies considered in transport sector are presented below. The PaMs code used in NECP also presented in the tables above.

- T1, T7: the effect is estimated taking into account funding for the measure, funding for one transport vehicle and average fuel savings of the single-vehicle.
- T2: an assumption is made that 90% of freight turnover in railways will be carried by electrified railways. Fuel savings in railway sector were calculated according to the planned electrification distances and dates.
- T3, T8: the effect is estimated, taking into account the reduction of the number of affected vehicles and average annual kilometrage driven combined with EF expressed in g CO_2/km.
- T4: effect of guarantees of origin is not estimated as it does not directly influence GHG emissions. There is no effect of II generation biofuels in the transport sector as GHG emissions in transport are similar for I and II generations of biofuel. Thus, the effect is only for biomethane use. In this case, the known planned additional capacities of biomethane production were calculated as diesel oil savings.
- T5: The target is for the year 2050, so the effect for 2030 is not estimated.
- T6, T21, T26, T28-T30: Fuel consumption or GHG emission savings are based on international studies.
- T9, T14, T15: an assumption is made about the number of goods or passengers transferred from road to another type of transport; GHG savings in other transport comparing to road transport are based on international studies.
- T10, T13, T19, T20, T26, T27: effect is estimated taking into account the reduction of the number of affected ICE vehicles and average annual fuel consumption per vehicle.
- T11, T16-18, T22: the effect is not estimated as it does not directly influence GHG emissions.
- T12: the effect is calculated separately for every type of purchased vehicles. A number of every kind of vehicle purchased annually, annual fuel consumptions for 100 km and annual kilometrages are taken into account. Assumptions are made that all newly purchased clean cargo vehicles will be fuelled by LNG and all clean passenger cars will be electric. Regarding buses, half of the new clean buses will be electric, and the second half will be CNG-fuelled.
- T23: Fuel sales per one LNG station and LNG consumption per kilometre are based on international study. It is estimated how much diesel oil will be replaced by LNG sold in 2 stations, and GHG savings were calculated using EFs of both fuels.
- T24, T25: the effect is estimated by taking into account the reduction of the number of affected ICE vehicles and average fuel savings per vehicle (based on study).

PaMs coded T11, T17, T18 and T22 do not directly reduce GHG emissions, but are important for implementing other PaMs in transport. For policy T5, the target is for year 2050 so the effect for 2030 is not estimated. The effect for measure T16 is very small as Lithuania has very low level of inland navigation – so the effect was not estimated.

Agriculture sector

The mitigation effect of planned measures of A8, A13, A14 and A16 were estimated according to assumptions provided by the Ministry of Agriculture and GHG estimation methods provided in the 2006 IPCC Guidelines methodology. Estimated mitigation effect of planned measure A15 was assessed based on scientific research reports. Therefore, WAM scenario was estimated as the difference between the WEM scenario and estimated planned measures GHG mitigation effects. The mitigation effect of planned measures of A13, A14 and A16 were included under the energy sector.

Industry sector

In the IPPU sector the impact of existing measures (P2) has been assessed in the light of existing legislation: F-gas Regulation and Kigali Amendment to the Montreal Protocol by limiting the use of hydrofluorocarbons (HFCs). For F-gases three scenarios have been developed: with existing measures, with planned measures and ‘business as usual’. Scenario ‘business as usual’ was based on historical F-gases trend. Scenario with measures based on restriction of F-gases use as stated in the F-gas Regulation. The mitigation effect for existing measures was estimated as the difference between the two above mentioned scenarios. For F-gases category there was only one planned measure (third scenario) which impact was assessed based on case studies investigated by United Nations Environment Programme (UNEP) Ozone Action Branch as part of UNEP’s work programme under the Climate and Clean Air Coalition (CCAC).

The mitigation effect of measure ”P1. Introduction of alternative fuel in the industry sector” was assessed based on the company’s plan to change fuel with an alternative.

The mitigation effects of measures P8-P10 were calculated based on foreign literature and experience of other countries.

Waste sector

The mitigation impact of the measures was calculated using the IPCC waste model considering the effect of each measure on the amount/composition of waste disposed of in landfills or planned recovery of the methane. In Waste sector planned measures has been estimated individually. The impact of the existing measures was assessed by the IPCC waste model, taking into consideration the impact of each measure on the amount/composition of waste disposed of in landfills and planned recovery of the methane.

LULUCF sector

The evaluation of the effect of existing and planned measures was performed using 2006 IPCC Guidelines (Vol. 4 Agriculture, Forestry and Other Land Use), in line with annual national GHG inventory. The effect of the existing and planned PaMs in the LULUCF sector is evaluated every year, taking into account assumed area changes of different land use. Therefore, it can be broadly concluded that all existing and planned measures are based on area changes. The effect of PaMs was estimated either on biomass (woody or herbaceous vegetation) or soil (mineral or organic) carbon stock changes. The effect of the implementation of PaMs was evaluated, taking into account annual land-use area changes and primary biomass or soil stock change factors:

- nationally developed growing stock volume changes for newly afforested areas (used for estimation of carbon stock changes in biomass) in L1, L2 and L3 measures;
- default values on biomass carbon stock of grassland and cropland, as provided in Table 6.4 of 2006 IPCC Guidelines;
- national carbon stock values for forest litter and mineral soils in forest land, cropland and grassland;
- default factors on carbon stock change used for cropland mineral soil organic carbon stock changes estimation due to management practices applied, as provided in Table 5.5 of 2006 IPCC Guidelines;
- default emission factor for drained organic soils in cropland and grassland, as provided in Tables 5.6 and 6.3 of 2006 IPCC Guidelines.

The so-called „soft" measures which are considered as educational or informational were not evaluated; to evaluate these types of measures the sociological research should be conducted and is quite expensive and time-consuming. However, these types of measures must be included because the education of society and dissemination of information, marketing actions, changing the behaviour of citizens should be effective in a longer time period and are key measures.

Some PaMs do not have direct impact on GHG reduction; therefore, the mitigation impacts are not estimated for the following PaMs:

1. T11. Creation of a sustainable mobility fund does not directly reduce the GHG emissions, but it will help to implement other planned measures in transport sector.
2. T17. Development and/or modernisation of inland water infrastructure, including ports and piers to be used for freight transportation, stevedoring and warehousing, service of passenger ships and passengers
3. T18. Development and implementation of a tax credit system
4. T22. Marking of vehicles by pollution level
5. P4. Investment and innovation incentive.
6. P11/EE9 Increasing energy efficiency in companies
7. A1. Realisation of the recommendations of the code of good agricultural practices, educating farmers will be adding to better implementation of measures which are related with reduction of the application in the farms of synthetic fertilizers, which are one of the most challenging issues in Lithuania in this sector.
8. A3. Sharing knowledge with farmers about environmentally friendly activities.
9. A7. Promotion to replace a component of the animal fodder to reduce emissions of methane and nitrogen compounds.

10. A10. Informing farmers about possibilities to reduce climate change (GHG emissions) at the farm level.
11. A11. Encourage breeding of more productive, resistant to diseases and climate animals.
12. W5. Improvement of the skills of specialists consulting on dangerous waste and training of company representatives on identification of dangerous waste.

4.5 Effect of policies and measures on longer term trends

Lithuania believes that policies and measures described in Chapter 4 are modifying long-term trends in anthropogenic GHG emissions and removals, consistent with the objective of the EU commitments and international agreements.

Lithuania is aware of the importance of setting long-term goals and actively trying to achieve them. A large proportion of current climate and energy policies also contribute reducing GHG emissions in the longer term. For example, buildings have long lifetimes, therefore, the energy efficiency regulations of new and existing renovated buildings have long-lasting impacts. Also, the improving possibilities for cycling and using public transportation decrease CO_2 emissions from the transport sector. Lithuania's renewable energy share, expressed in percentage of gross final energy consumption, was about 26% in 2020, above its 2020 target of 23%. This good performance was driven mostly by the heating sector, where the share of renewables reached 46%, as opposed to 39% renewables share anticipated for 2020 by Lithuania's National Renewable Energy Action Plan. This reflects a strong growth during the last five years in the deployment of biomass via new investment in district heating and cogeneration, also helping raise the renewables shares in electricity production. In 2021 Lithuania's renewable energy share in gross final energy consumption was above 28.1%.

Renewed National Energy Independence Strategy (NEIS), which was endorsed by Government in 2017 and was approved by Parliament (Seimas) on 21 June 2018, sets ambitious gross of the final RES energy consumption targets – 45% until 2030 and 80% until 2050 and energy efficiency targets: to reduce primary and final energy intensity by 1.5 times till 2030 and 2.4 times till 2050, compared to 2017 level; to save 2.6-3 TWh energy in modernized multi-apartment and public buildings by 2020 and 5-6 TWh energy by 2030; in industry sector to reduce electricity consumption by 1 TWh till 2030.

Measures that promote investments in renewable energy and energy efficiency are the mostly contributed towards transition to low carbon development in all economy sectors in the longer term.

Furthermore, waste recycling, the disposal of biodegradable waste on landfills can be expected to lead to permanent changes in current practices, and therefore to yield permanent emission reductions.

F-gases Regulation (EU) No.517/2014 implementation and its increased ambitious amendments presented by EC in 2022 create controls of fluorinated GHG and sets the opportunity to reduce emission reductions in a longer term as well.

<u>Macroeconomic, environmental, social impacts (in terms of costs and benefits as well as cost-effectiveness) of the planned policies and measures</u>

Meeting the increased ambition of the EU’s Green Deal, and Lithuania’s National Climate Change Management Agenda, both of which target net-zero emissions by 2050, will require significant policy reform. In 2022 the OECD report “Climate neutrality by 2050. Reform options for Lithuania” was conducted aiming to contribute to the National Energy and Climate Action Plan’s (NECP) update by assessing reform options for enabling decarbonisation in Lithuania. It takes advantage of the OECD’s multidisciplinary expertise on tax policy, financial markets, social affairs, science, technology and innovation, and economic modelling to highlight a number of key policy insights. Specific analyses include: 1) a stocktake of Lithuania’s current climate policy mix and its suitability to meeting its updated targets, 2) macro-economic modelling of policy pathways to meet Lithuania’s 2030 and 2050 targets depicting policy effectiveness in terms of emissions reductions and projected macro-economic impacts, 3) a review of Lithuania’s carbon pricing landscape identifying areas for reform, 4) an assessment of Lithuania’s financial needs to ensure the necessary infrastructure investments to meet climate policy targets, 5) modelling work depicting the distributional outcomes on households of proposed carbon pricing efforts and 6) an assessment of Lithuania’s innovation and technology deployment needs in order to close the remaining emissions gap. The report offers a number of policy recommendations that, if taken on board, could support Lithuania in effectively and efficiently reaching climate neutrality by 2050.

Based on data, provided in the Commission impact assessment accompanying “A policy framework for climate and energy in the period from 2020 up to 2030”, implementation of Lithuania’s GHG emissions reduction target will cost annually from 0.39% to 0.91% of GDP depending on the range of percentage of RES in final energy demand and energy efficiency improvement, at the same time it will allow to save from EUR 2.9 till 4.7 billion for the purchasing fossil fuels, in comparison with oil prices in 2014, in the period 2021-2030. According to the preliminary calculations, Lithuania will need at least 14 billion EUR for the implementation of the measures of the NECP, in order to achieve -21% reduction of GHG emissions in non-ETS sectors. The planned need for public sector funds is 9.8 billion. EUR, of which 3.3 billion EUR for adaptation.

According to the EC's assessment, at the EU level, different scenarios predict different GDP costs from 2% to 2.8% (EUR 520-575 billion) annually from 2031 until 2050. Most of these investments are planned to be mobilized from the private sector.

4.6 Policies and measures no longer in place

During the reporting period most of the policies and measures from the previous were continued without major changes. On the other hand, some documents, legal acts expired due to the target dates. As a rule, some policy documents, strategies, legal acts were replaced with the new versions, which generally apply similar measures. Overview of some major documents expired and replaced during the reporting period is given below in table.

Table 4-15. Policies and measures no longer in place

Policy document reported in 7th National Communication Report	Status
National Strategy for Climate Change Management Policy (2012)	Replaced by National Climate Change Management Agenda, adopted on 30 June 2021 by the Decree No XIV-490 of the Parliament of the Republic of Lithuania
Inter-institutional Action Plan on the implementation of the Goals and Objectives for 2013-2020 of the Strategy for the National Climate Change Management Policy	As of 2020 the Interinstitutional Action Plan of the Strategy for the National Climate Change Management Policy is incorporated in the National Energy and Climate Action Plan (NECP) for the period of 2021-2030 in line with the requirements of the Governance of the Energy Union Regulation.
Strategy on dwellings of the Republic of Lithuania adopted in 2004	Repealed on 24 March 2017
Multi-apartment Building Renovation (Modernization) Programme, adopted in 2004	Replaced by the Lithuania's long term renovation strategy, adopted in 2021
Program of Public building renovation, adopted in 2014	Replaced by the Lithuania's long term renovation strategy, adopted in 2021
The National Programme on the Development of Transport and Communications for 2014-2022	Replaced by the Lithuania's communications development Strategy until 2050, adopted in 2021
Lithuania's Rural Development Programme (2014-2020), adopted in 2014	Lithuania's Common Agricultural Policy Strategic Plan for the period 2023-2027, adopted in 2022
National Waste Management Plan for 2014-2020, adopted in 2014	National Waste Prevention and Management Plan for 2021-2027
National Forestry Sector Development Program 2012-2020, adopted in 2012	The final draft of the National Agreement on the Future of Forests, to be adopted in 2023

4.7 Information on the assessment of the economic and social consequences of response measures (adverse effects)

Under Article 3.14 of the Kyoto Protocol and UNFCCC Decision 31/CMP.1, Annex I Parties shall provide information on how they are striving to implement their commitment while minimizing adverse social, environmental and economic impacts on developing country parties.

Since 2004 Lithuania is a Member State of the EU and, as such, designs and implements most of its policies in the framework of EC directives, regulations, decisions, and recommendations. In this context, the minimization of adverse impacts on developing countries is also largely dictated by the European Union's policy on climate change and by its policies and programmes affecting developing countries. Regulation at the European level also controls or influences market conditions, fiscal incentives, tax and duty exemptions and subsidies in all economic sectors in EU Member States. Lithuania strives to design climate change policies and measures in a way as to ensure a balanced distribution of mitigation efforts by implementing climate change response measures in all sectors and for different gases.

The impact assessment of new policy initiatives has been established in the European Union, which allows their potential adverse social, environmental and economic impacts on various stakeholders, including developing country Parties, to be identified and limited at an early stage within the legislative process. Impact Assessment Guidelines specifically address impacts on third countries and also issues related to international relations. This provides a framework in which Member States like Lithuania can also ensure a high level of protection of the environment and contribute to the integration of environmental considerations into the preparation and adoption of specified plans and programmes with a view to promoting sustainable development.

The European Union actively undertakes a large number of activities bringing positive impacts on third countries and their ability to tackle climate change, specifically through capacity building and technology transfer activities. Chapter 7 provides information on Lithuania's participation and support of programmes which aim to minimize adverse effects of climate change on developing countries.

4.8 Steps taken to promote and/or implement any decisions by ICAO and IMO to limit or reduce associated emissions

Maritime transport is a large and growing source of GHG emissions. By its nature, maritime transport is international. The EU and its Member States have a strong preference for shipping emission reduction global approach led by the **International Maritime Organization (IMO)** as this will be most effective. Considerable efforts to agree such an approach have been made over recent years within both the IMO and the UNFCCC also with a view to ensure a fair contribution of the sector to the objective of the Paris agreement to limit the average increase of the temperatures to +1,5°C.

In July 2011, the IMO approved binding energy efficiency targets for new ships. An Energy Efficiency Design Index (EEDI) will be calculated for each ship during the planning phase. The regulations have been in force since the beginning of 2013. In addition, all ships, the gross tonnage of which is 400 tonnes or more, are required to compile a Ship Energy Efficiency Management Plan (SEEMP) following a guidance format prepared by IMO.

In 2016 the IMO in its MEPC 70 meeting reached an agreement on a global data collection system as the next step in their action to tackle CO_2 emissions. Draft guidelines for administration, data verification procedures, and draft guidelines are still yet to be developed, that work will continue through a correspondence group set to meet mid-2017. Also, MEPC 70 agreed to develop a Road Map for addressing CO_2 emissions from international shipping, with initial CO_2 reduction commitments to be agreed to by 2018.

As a first step, large ships over 5 000 gross tonnes loading /unloading cargo/ passengers from 1st January 2018 at EU maritime ports are to monitor and later report their related CO_2 emissions and other relevant information in accordance with their monitoring plan. Monitoring, reporting and verification of information shall be done in conformity with the EU Regulation 2015/757 (as amended by Delegated Regulation 2016/2071). National implementation measures are outlined in the Order No D1-56 of the Minister of Environment on the approval of the content and procedures of the monitoring, reporting and verification of the carbon dioxide emissions from maritime transport, adopted on 16 January 2017.

Aviation is one of the fastest-growing sources of greenhouse gas emissions. CO_2 emissions from aviation have been included in the EU emissions trading system (EU ETS) since 2012. However, since 2013 under the EU ETS all airlines operating only in European Economic Area, are required to monitor, report and verify their emissions, and to surrender allowances against those emissions. They receive tradeable allowances covering a certain level of emissions from their flights per year. The system has so far contributed to reducing the carbon footprint of the aviation sector by more than 17 million tonnes per year, with compliance covering over 99.5% of emissions.

In 2016, the **International Civil Aviation Organization (ICAO)** adopted the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) to address CO_2 emissions from international aviation, which oblige airlines to offset the growth of their CO_2 emissions post-2020.

Under CORSIA, all airline operators with annual emissions greater than 10 000 tonnes of CO_2 are required to report their emissions from international flights on an annual basis since 1st January 2019.

CORSIA is implemented in three phases: a pilot phase (2021-2023), a first phase (2024-2026), and a second phase (2027-2035). For the first two phases (2021-2026), participation is voluntary. From 2027 onwards, participation will be determined based on 2018 revenue tonne kilometers (RTK) data.

From 2021 until 2026, only flights between states that volunteer to participate in the CORSIA pilot and/or first phase will be subject to offsetting requirements.

From 2027, all international flights will be subject to offsetting requirements. However, flights to and from Least Developed Countries (LDCs), Small Island Developing States (SIDS), Landlocked Developing Countries (LLDCs) and states which represent less than 0.5% of international RTK will be exempt from offsetting requirements unless these states participate on a voluntary basis.

Offsetting requirements started from 2021. At the end of each 3-year compliance period, operators will have to demonstrate that they have met their offsetting requirements by cancelling the appropriate number of emissions units.

All EU Member States have joined from the start. Participating countries include 18 out of the top 20 states with the largest international civil aviation activity. In its second phase (2027-2035) participation is mandatory; except for those exempted (countries with small aviation activities). This means around 80% of the emissions above 2020 levels will be offset by the scheme between 2021 and 2035.

4.9 Supplementarity relating to the Kyoto protocol mechanisms

Kyoto mechanisms allowed for Lithuania to meet its national emission reduction commitments of the Kyoto Protocol. The Kyoto Protocol introduced three market-based mechanisms: clean development mechanism (CDM); joint implementation (JI) and emissions trading. Use of Kyoto mechanisms must be supplemental to domestic action to achieve KP targets. These mechanisms are referred to as flexible mechanisms.

Certified emission reduction (CERs) units from the clean development mechanism and emission reduction (ERUs) units from JI projects, could be used to achieve the targets under the EU ETS and EU Effort Sharing Decision (with limitations) in 2013-2020 period.

In 2008-2012 there were implemented 11 Joint implementation projects related to GHG emissions reduction in electricity sector (10 wind power parks, 1 landfill biogas use for heat and electricity production) and the estimated GHG emissions reduction during whole period is 864 kt CO_2.

Together with the implemented JI projects during 2008-2012 period in Lithuania 64 wind power plants (total capacity 183.8 MW) had been installed (in 2002-2012 period there were 78 operating wind power plants in Lithuania with an installed capacity of 234.8 MW). And during the period 2003-2012 totally 20 biogas plants had been installed in Lithuania with the capacity of 20.32 MW.

GHG emissions reduction due to the 2 JI projects of N_2O emissions reduction in chemical industry amounts to 7 643 017 t CO_2 eq. Thus, without the implementation of these projects in 2013 the ETS sector‘s verified emission could be 1.2 million t CO_2 eq. higher (8.7 million instead current 7.5 million t CO_2 eq.).

Lithuania’s total GHG emissions in the 2008-2012 commitment period were 109 786 321 t CO_2 eq., approximately 52% lower than the assigned amount, which was 227 306 177 tonnes CO_2 eq. The total amount of Kyoto Protocol units retired in the first commitment period is 109 786 321. Lithuania has requested 71 822 887 AAUs, 246 966 CERs and 2 327 000 ERUs to be carried over to the second commitment period of the Kyoto Protocol.

Lithuania’s 2020 Kyoto target for the second commitment period was met entirely by domestic actions.

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PROJECTIONS AND TOTAL EFFECT OF POLICIES AND MEASURES

5. PROJECTIONS AND TOTAL EFFECT OF POLICIES AND MEASURES

5.1 Greenhouse gas emissions projections

This Chapter provides information of future trends in GHG emissions and removals in Lithuania, given current national circumstances and adopted and implemented policies and measures described in Chapter 4 above.

Projections of GHG emissions have been calculated by carrying out systematic modelling of economic sectors of Lithuania. The model is based on an integrated approach and relies on statistical data, reflecting the existing situation of ***base year 2019* (2020 was not chosen as the base year due to it was extraordinary year caused by COVID pandemic and it could impact the interpretation of characteristic tendencies)**, and particular assumptions which affect the long-term development of the economic sectors, with the account of the EU climate change and energy objectives by 2030 and targets by 2040. The same GHG projections were used for the Lithuanian National energy and climate plan and in the Report "Policies and Measures and Projections of Greenhouse Gas Emissions in Lithuania" submitted to European Commission in 2021. The starting point for projections is the year 2021 (the first year projected), emissions for 2019 and 2020 are taken from the latest GHG inventory report 2022.

In this National Communication projections by 2040 are reported. GHG projections for 2030 are also reported in CTF tables 6(a) and 6(c).

Information on models and approaches used for projections such as gases and sectors covered, interaction to other models/approaches etc. is provided in Annex IV "Summary information on the models/approaches used for the GHG projection estimation". The information on parameters used for the projections for 2030 and 2040 is provided in Annex V.

The main strengths of the models/approaches used for this submission are that all gases and categories (including relevant sub-categories) are covered. The main weaknesses of the models/approaches is that it does not take into consider overlap or synergies that may exist between different PaMs. Activating only existing measures allowed the modelling of scenarios 'with existing measures' (WEM) related to climate change mitigation. Activating the planned measures also allowed modelling scenarios 'with additional measures' (WAM) (along with existing measures) related to climate change mitigation. Lithuania put all the efforts to work on these two scenarios, which are mandatory to report according to UNFCCC reporting guidelines. The 'without measure scenario' (WOM) is not provided because the need and additional value of the WOM scenario is still under debate. As the ex-post evaluation of the PaMs just started, the need of WOM scenario and possible development of methodology for WOM scenario will be considered in the future.

Projections as well as policies and measures are divided into the following reporting categories: energy, transport, industrial processes, agriculture, LULUCF and waste.

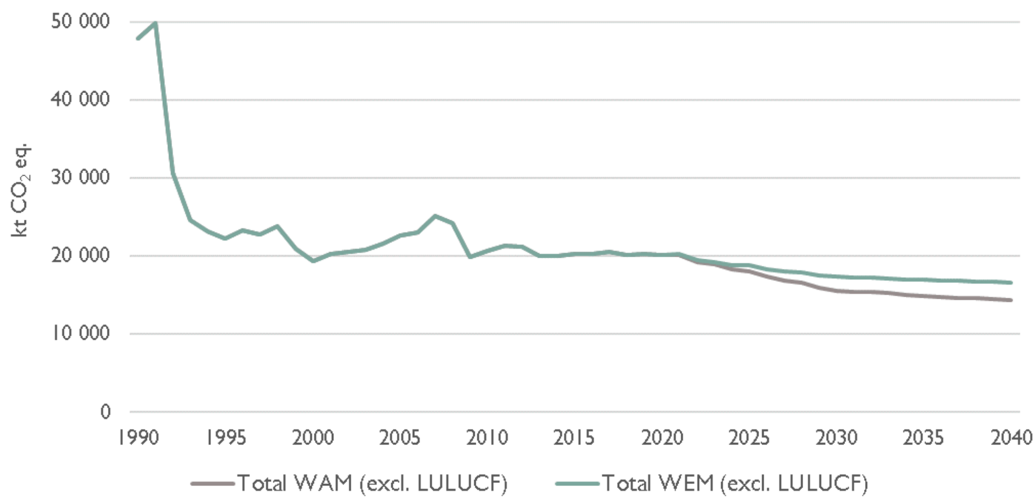

Figure 5-1. Aggregated projected GHG emissions by 2040, kt CO_2 eq.

Table 5-1. Projected GHG emissions in case of WEM scenario, kt CO_2 eq.

Sector	2019	2020	2025	2030	2035	2040
Energy	11 890	11 817	10 306	9 361	9 310	9 252
IPPU	3 375	3 094	3 680	3 414	3 326	3 241
Agriculture	4 257	4 451	4 177	4 050	3 905	3 744
LULUCF	-5 302	-5 407	-4 928	-4 945	-4 603	-4497
Waste	839	822	641	526	441	389
Total excl. LULUCF	**20 361**	**20 183**	**18 804**	**17 351**	**16 982**	**16 625**
Total incl. LULUCF	**15 058**	**14 775**	**13 876**	**12 405**	**12 379**	**12 128**

Table 5-2. Projected GHG emissions in case of WAM scenario, kt CO_2 eq.

Sector	2019	2020	2025	2030	2035	2040
Energy	11 890	11 817	9 824	8 114	7 753	7 402
IPPU	3 375	3 094	3 590	3 234	3 146	3 061
Agriculture	4 257	4 451	4 023	3 726	3 609	3 490
LULUCF	-5 302	-5407	-5 895	-6 791	-7 076	-7 262
Waste	839	822	638	523	439	387
Total excl. LULUCF	**20 361**	**20 183**	**18 075**	**15 597**	**14 947**	**14 340**
Total incl. LULUCF	**15 058**	**14 775**	**12 179**	**8 806**	**7 871**	**7 078**

GHG emissions projection suggests that decreasing natural gas consumption in electricity and heat production, ongoing GHG reduction measures in transport sector, as well as decreasing consumption of F-gases and consumption of inorganic N fertilizer for agriculture soils will result in the decrease of GHG emissions. The implementation of additional measures will result in total 2 285 kt CO_2 eq. (excluding LULUCF) decrease in 2040. In the table and figures below are provided GHG emission projections by gas both WEM and WAM scenarios.

Table 5-3. GHG emissions WEM and WAM projections by gas (excl. LULUCF)

Scenario	Gas	2019	2020	2025	2030	2035	2040
WEM	CO_2	13923	13653	12841	11781	11705	11590
WAM		13923	13653	12288	10398	10015	9610
Difference		*0%*	*0%*	*-4%*	*-12%*	*-14%*	*-17%*
WEM	CH_4	2957	2865	2626	2541	2400	2289
WAM		2957	2865	2608	2502	2361	2249
Difference		*0%*	*0%*	*-1%*	*-2%*	*-2%*	*-2%*
WEM	N_2O	2942	3148	2989	2814	2714	2603
WAM		2942	3148	2842	2507	2432	2362
Difference		*0%*	*0%*	*-5%*	*-11%*	*-10%*	*-9%*
WEM	F-gases	539	518	349	215	164	144
WAM		539	518	336	190	139	120
Difference		*0%*	*0%*	*-4%*	*-12%*	*-15%*	*-17%*

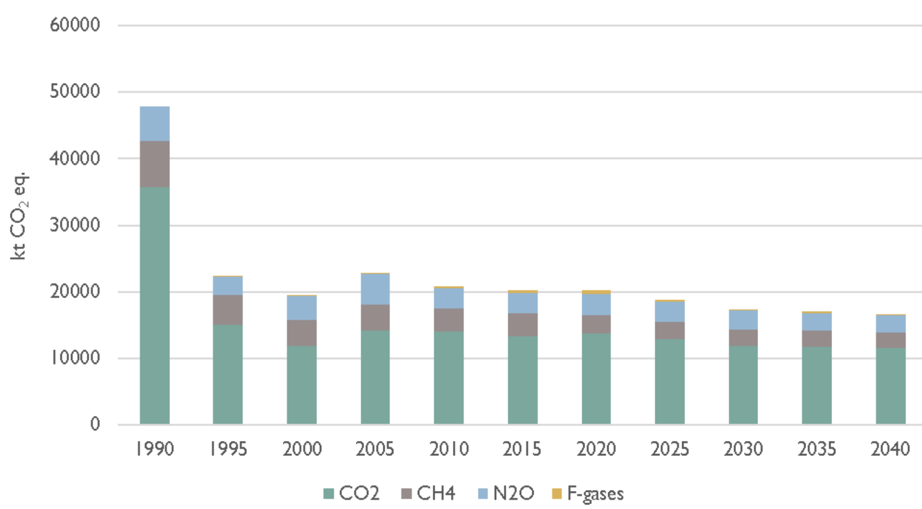

Figure 5-2. Historical GHG emissions and WEM projections by gas (excl. LULUCF)

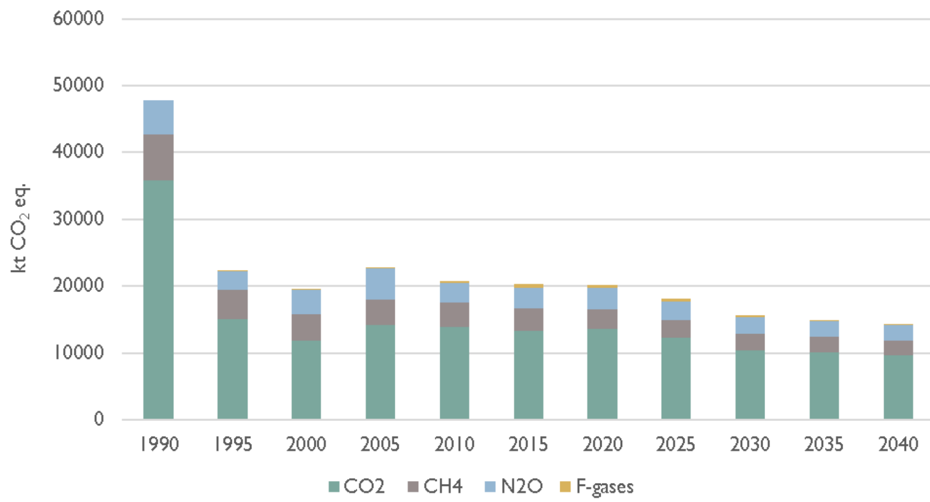

Figure 5-3. Historical GHG emissions and WAM projections by gas (excl. LULUCF)

The projections of indirect GHGs are submitted under National Emission Ceilings Directive (2016/2284/EU) to European Commission, therefore it is not provided in this report. The latest Lithuania's submission (2021) of projections for NOx, NMVOC, SOx, NH_3, $PM_{2,5}$ pollutants for 2020, 2030 and 2040 can be found at:

https://cdr.eionet.europa.eu/lt/eu/nec_revised/projected/envye5gia/LT_Projections_reporting_2021_official_submission.xls/manage_document

5.1.1 Energy

The emissions from energy sector for WEM and WAM scenarios are provided in the table and figure below.

Table 5-4. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	2019	2020	2025	2030	2035	2040
WEM scenario	5 598	5 672	4 872	4 828	4 805	4 786
WAM scenario	5 598	5 672	4 735	4 547	4 514	4 482
Difference (WEM-WAM), kt CO_2 eq.	0	0	137	281	291	304
Difference (WEM/WAM), %	0%	0%	3%	6%	6%	7%

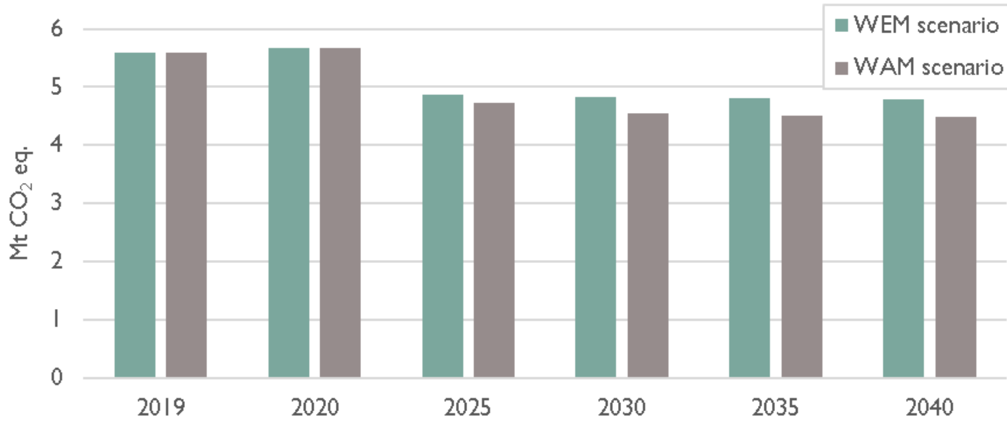

Figure 5-4. Projection of the WEM and WAM scenarios in energy sector

5.1.1.1 Scenario "with existing measures" (WEM)

The GHG emissions in energy sector were determined by firstly estimating the consumption of fuel in energy consumption sectors. The projected primary energy consumption is presented in Figure 5-5.

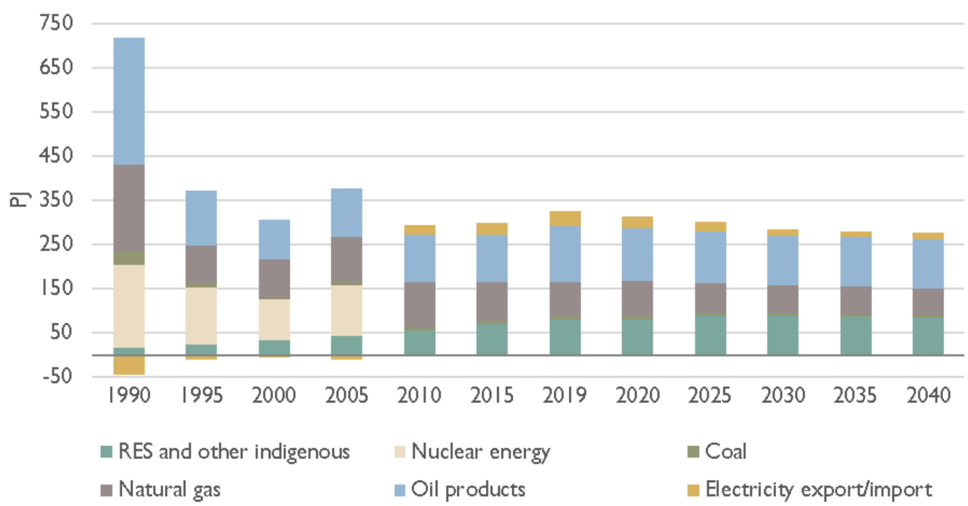

Figure 5-5. Primary energy consumption in Lithuania

It is estimated that the total primary energy consumption will decrease by 15% up to 2040 compared to 2019. Oil products shall remain the main energy source (40%), followed by RES and other indigenous energy (31%) and natural gas (22%).

The decrease in primary energy consumption is mainly associated with improvement of energy efficiency and decreasing population in Lithuania. The regular population was 2.795 million in 2020 in Lithuania, and it was assumed that the population will be 2.452 million in 2030 and 2.307 million in 2040.

The share of each energy subsector in total projected GHG emissions is presented in Table 5-5. It is estimated that petroleum refining, manufacturing industries and residential sectors will remain the main sources of GHG emissions in energy sector. Emissions in public electricity and heat production shall decrease more than 2 times and will not belong to the main sources.

Table 5-5. Projected GHG emissions from energy subsectors, kt CO_2 eq.

Sector	2019	2020	2025	2030	2035	2040
Public Electricity and Heat Production	904	1357	555	382	380	377
Petroleum Refining	1 326	1 224	1 160	1 347	1 346	1 346
Manufacture of Solid Fuels and Other Energy Industries	49	66	56	56	56	56
Manufacturing industries and construction	1 300	1 187	1 240	1 181	1 187	1 187
Commercial/Institutional	327	273	323	315	310	305
Residential	901	865	881	878	867	856
Agriculture/Forestry/Fishing	234	238	222	222	223	223
Other	29	28	20	20	20	20
Fugitive emissions from fuels	527	433	415	426	417	416

It was estimated that increased energy consumption efficiency, use of biomass, wind and solar energy will decrease the use of fossil fuel in public electricity and heat production sector by 58% in 2040 which will lead to decrease in GHG emissions in this sector. GHG emissions in other sectors shall remain rather stable.

The overall situation in the energy sector starting from 1990 and the projected emissions up to the year 2040 are presented in Figures 5-6 and 5-7.

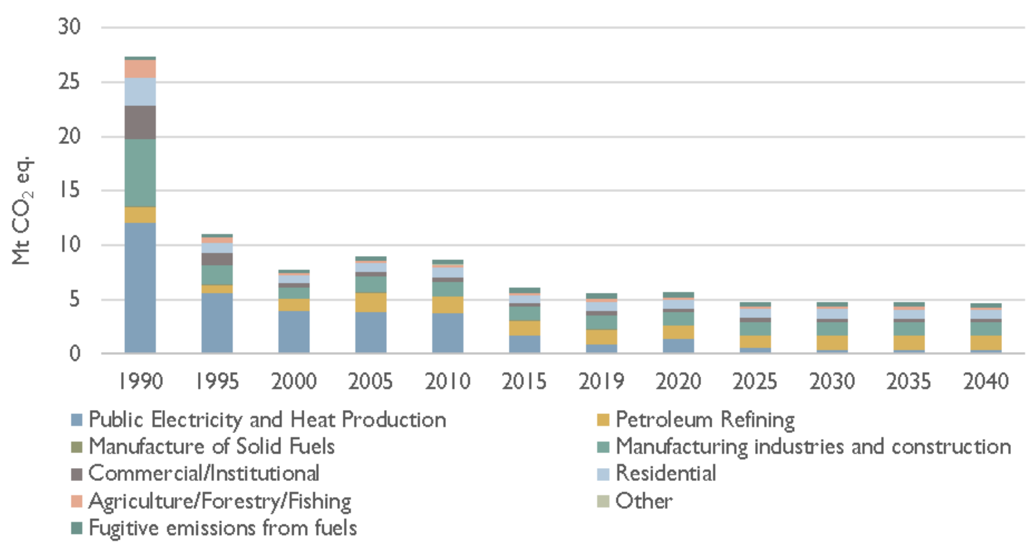

Figure 5-6. Historical and projected GHG emissions 1990-2040, kt CO_2 eq. (excl. transport sector)

It is estimated that the overall GHG emissions from energy sector (excluding the transport sector) will decrease by 82% in 2040 compared to 1990. Figure 5-7 shows the share of GHG emissions from each energy subsector in 2040.

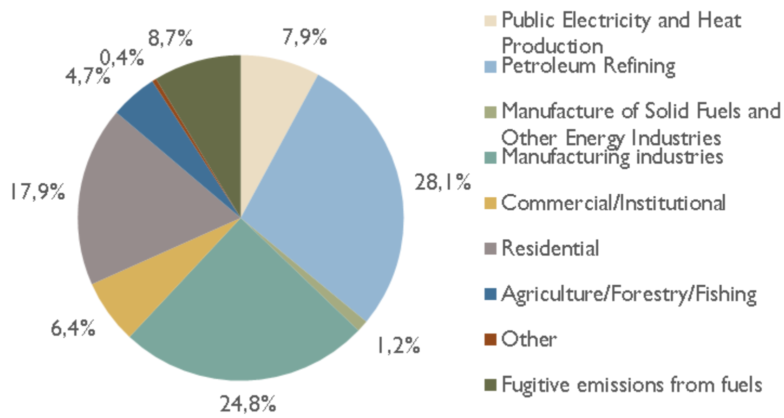

Figure 5-7. Estimated GHG emissions share by sectors in 2040

GHG emissions are estimated to reach a total of 4 786 kt CO_2 eq. in 2040. Most of the GHG will originate from Petroleum refining (28%), Manufacturing industries (25%) and Residential sector (18%). Other (military aviation) sectors are still expected to remain the smallest GHG emitters of energy subsectors.

Several factors determine GHG emission projections in the EU ETS sectors and mainly in the public electricity and heat production sector. These sectors are currently undergoing a trend of switching fossil fuel to the use of biomass. Emissions in public electricity and heat production sector shall also reduce up to 2030 due to the building renovation program. New biomass-fueled CHP boilers will start operation in Vilnius in 2023. This will reduce electricity imports for Lithuania and reduce GHG emissions in public electricity and heat production. For the current GHG projections it was assumed that the EU ETS carbon price will remain stable until 2040. Possible impact of carbon price on GHG emissions from the EU ETS sectors will be further investigated in sensitivity analysis chapter.

5.1.1.2 Scenario "with additional measures" (WAM)

The WAM scenario includes measures which pay the most attention to RES development, increasing energy efficiency and improving energy market.

The list of PaMs and total GHG reduction effect applying additional policies and measures is presented in Chapter 4.

Table 5-6. Projected GHG emissions from energy sector (kt CO_2 eq.)

	2019	2020	2025	2030	2035	2040
Public Electricity and Heat Production	904	1357	555	378	376	373
Petroleum Refining	1 326	1 224	1 160	1 347	1 346	1 346
Manufacture of Solid Fuels and Other Energy Industries	49	66	56	56	56	56
Manufacturing industries	1 300	1 187	1 226	1 147	1 137	1 122
Commercial/Institutional	327	273	323	315	310	305
Residential	901	865	758	655	651	641
Agriculture/Forestry/Fishing	234	238	222	202	202	203
Other	29	28	20	20	20	20

Fugitive emissions from fuels	527	433	415	426	417	416

Additional measures will allow reduction of GHG emissions from energy sector by 19% in 2030, compared to 2019.

Comparing to 1990, it is projected that applying additional policies and measures GHG emissions in energy sector should decrease by 83% in 2030 and remain approximately at the same level up to 2040.

5.1.1.3 Methodologies and key assumptions

Energy sector constitutes of six main subsectors (*Energy Industries, Manufacturing Industries, Transport, Other sectors, Other and Fugitive emissions from fuels*) for which GHG emissions are projected. Projections of GHG emissions from Transport sector are reported separately in Chapter 5.1.2.

The projections were carried out by firstly determining the consumption of fuel in every subsector up to the year 2040. The obtained fuel consumption was then multiplied by emission factors of every fuel to estimate projected GHG emissions. Thus, GHG projections fully correspond to the methodology used for preparation of National GHG inventory.

The fuel consumption trends up to the year 2040 were obtained carrying out systematic modelling of consumed fuel and energy types in economy sectors of Lithuania. The model relies on statistical data, reflecting existing situation of energy consumption, and special assumptions which affect projections of energy consumption change (such as measures for the increase of direct energy consumption efficiency, electricity and heat production efficiency, measures for the change of fuel consumed, promotion of the change of consumer behavior, technology trends observed in the market, etc.). The model is controlled by Lithuanian Energy Agency.

Fuel demand for house heating will decline due to the increased energy efficiency and renovation of residential and public buildings.

The military aviation activity (category 1.A.5 Other) is defined as activities using fuel purchased by or supplied to the military authorities of the country. The GHG emissions in this sector are mainly related to the consumption of jet kerosene as the main fuel. However, it is very difficult to anticipate fuel consumed by NATO airships, so the forecast shows no change in fuel consumption in the future.

Forecast of activity data of oil production, which was used in subsectors 1.B.2.a Oil and 1.B.2.c Venting and flaring, was provided by Lithuanian Geological Survey. For projections in subsector 1.B.2.b Natural gas, forecast of natural gas leakages was provided by natural gas transmission and distribution enterprises.

The scenario “with existing measures” includes the national legislation documents that include projections of energy demand, climate change mitigation measures, projects currently in development and will be set in motion during the period 2021-2040.

Main measures and assumptions used for projecting GHG emissions in energy sector:

- National Energy Independence Strategy determines the target to achieve that the part of RES in the final energy consumption balance would be no less than 45% by 2030 and 80% by 2050.
- National Energy Independence Strategy determines the target to reduce energy intensity by 1.5 times in 2030 compared to 2017 level, and by 2.4 times in 2050, compared to 2017 level.
- GHG emissions can be inversely proportional to the carbon price in the EU ETS market, therefore as the carbon price increase in sensitivity analysis it is assumed that a significant amount of GHG emissions will be reduced due to installation shifting to the use of biomass boilers instead.
- RES3. Additional biofuel CHP unit is planned to enter into operation in Vilnius in 2023. The CHP unit in Vilnius will generate electricity for the Lithuanian power grid and heat for the district heating system of Vilnius. The CHP plant will consist of two units, one fueled by non-recyclable municipal waste (which is already operating) and the other by biomass. The biomass unit will have a capacity of 70 MW of electrical power and 174 MW of thermal power. It's planned that the project promotes energy efficiency with expected energy savings of around 40%. Promotion of high efficiency cogeneration in Vilnius, and the promotion of use of biofuel for heat energy generation – these assumptions were incorporated during the calculation of final fuel used in Lithuania.
- RES1. Support scheme for electricity generated from RES (technologically neutral auctions). About 700 MW of installations consuming RES will be installed during the foreseen lifetime of the measure up to 2025, which will produce about 2.4 TWh of energy.
- RES2. Financial support for producing consumers (prosumers). The measure is approved in 2018 and foreseen to continue until 2030. Supported activity is installation of small solar power plants. It is planned that about 25 000 consumers will take advantage of this support up to 2023, who shall install about 0.168 GW of new power installations and generate about 0.075 TWh of energy.
- RES18-19. Promoting use of RES in district heating sector (by using biofuel, solar energy technologies, heat pumps and/or heat storage). According to the approved measure, 70 MW of power of biomass heat plants will be built until 2023, which will produce about 0.42 TWh of heat.
- EE2. Renovation of apartment buildings. Renewed in 2014, this measure is planned up to 2023 in case of WEM scenario. Further application of the measure is foreseen in WAM scenario. The objective of the measure is to renovate 500 apartment buildings each year. Planned heat savings due to the complex renovation will be about 70 kWh/m^2.
- EE3. Renovation of public buildings. This measure is being implemented since 2014 and will be continued up to 2030. The effect of the measure is assessed up to 2023 in WEM scenario. Further application of the measure is transferred to WAM scenario. It is foreseen that the measure will save about 20 GWh of energy each year until 2030 and 960 000 m^2 of area of public buildings will be renovated. In total, amount of energy saved will be about 1.1 TWh up to 2030.
- EE4. Consumer education and consulting (by energy suppliers). Since 2017, energy suppliers must make agreements with Ministry of Energy concerning education and consulting of end users for issues of increasing efficiency. It is planned that this measure will save about 300 GWh of energy because of behavioral changes in end users each year up to 2030.

- EE5. PSO privilege for industrial companies implementing energy efficiency measures. This measure is approved in 2019. According to it, large industry companies are promoted to install measures increasing energy efficiency, thus reducing consumption of energy. It is planned that about 100 GWh of energy will be saved each year until 2030 in manufacturing industries.
- EE6. Agreements with energy companies on energy saving. Since 2017, energy companies must make agreements on energy saving with the Ministry of Energy. According to these agreements, they must install measures to increase energy efficiency for end users. It is planned that this measure will save about 100 GWh of energy each year until 2030.

The main additional (WAM scenario) measures to increase energy efficiency, which will reduce energy consumption until 2040, are continued renovation of multi-apartment and public buildings and improving energy efficiency in enterprises.

Additional measures, which will contribute most to the promotion of consumption of RES in electricity production until 2040, are continued financial support for producing consumers, financial support for investments into small-capacity power plants and support for additional RES capacities.

Heat sector will also change in WAM scenario – RES share in public heat production will increase almost by 30%, and it should already amount slightly more than 91% in 2027. This will be determined by the continued financial support for small-capacity CHPs, promotion of use of RES in district heating and waste heat usage in public heat grids.

5.1.2 Transport

The emissions from transport sector for WEM and WAM scenarios are provided in the table and figure below.

Table 5-7. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	2019	2020	2025	2030	2035	2040
WEM scenario	6 293	6 145	5 434	4 533	4 505	4 466
WAM scenario	6 293	6 145	5 089	3 567	3 240	2 920
Difference (WEM-WAM), kt CO_2 eq.	0	0	345	966	1 265	1 545
Difference (WEM/WAM), %	0%	0%	7%	27%	39%	53%

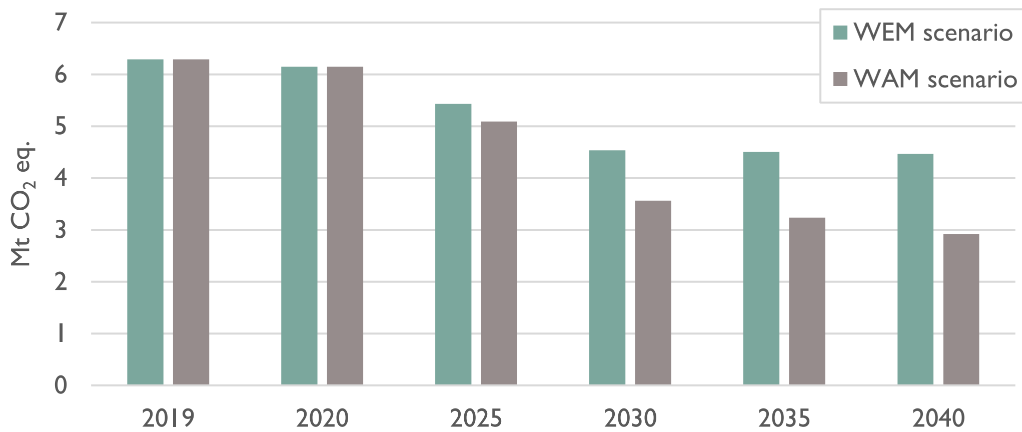

Figure 5-8. Projection of the WEM and WAM scenarios in transport sector

5.1.2.1 Scenario "with existing measures" (WEM)

Road transport sector is the main source of GHG emissions and fuel consumption in transport sector. It was assumed that GHG emissions in road transport sector are directly linked with fuel consumption which is influenced by the number of fossil fuel powered road vehicles registered in Lithuania. The total projected number of cars registered in Lithuania was provided by the Ministry of Transport and Communication of Lithuania. This number of cars is anticipated without measures adopted from late 2019, therefore impacts of these new measures were additionally included in calculations of anticipated fuel consumption or subtracted from final GHG emissions in WEM scenario.

Road transport sector is projected to remain the only gasoline and the main diesel oil consumption source in transport sector. Road transport will remain the main fuel consumer in transport sector. As a result, it will remain the main GHG emissions source in this sector (97% of total transport sector emissions) in 2040 (Figure 5-9). This is a result of increase in vehicle number in Lithuania. It is projected that diesel oil and gasoline will remain the main fuel used in transport sector. This is mainly influenced by the fuel use trend in road transport sector.

GHG emissions from transport sector are projected to decrease down to 4 466 kt CO_2 eq. in 2040 (Figure 5-9). Compared to 2019, the GHG emissions from this sector will decrease 1.4 times in 2040. The decrease of GHG occurs due to the implementation of existing GHG reduction measures, due to increasing energy efficiency in road transport and due to decreasing population.

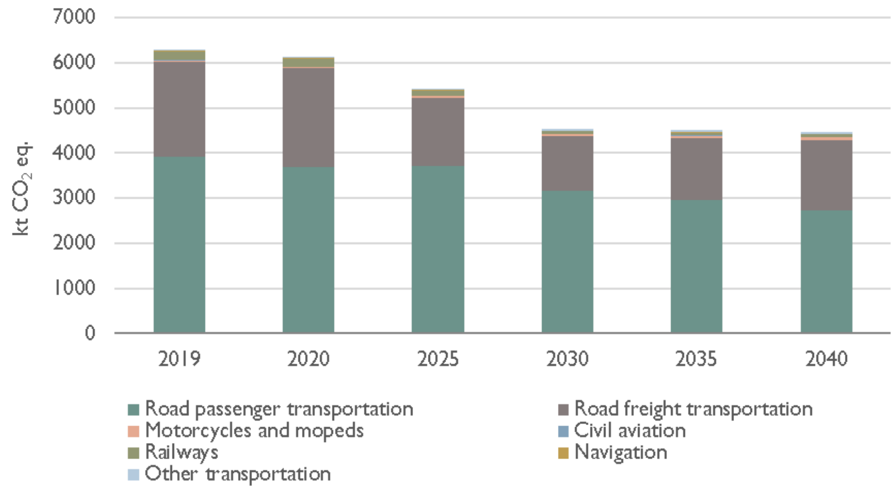

Figure 5-9. Projected total GHG emissions in transport sector (WEM scenario)

The second largest GHG emissions source in transport sector will remain railways sector. In civil aviation subsector it is estimated that the GHG emissions would increase 1.1 times, but this sector will remain a minor source of GHG emissions as there are only 9 aircraft operators[11] that have valid license issued to perform air communication in Lithuania. Most of the flights performed by the Lithuanian aircraft operators are international and are excluded from the projections for the national total.

Railways sector is projected to emit less amount of GHG in 2040 (64 kt CO_2 eq. – decreased by 66% compared to 2019). This is because the data provided by the Ministry of Transport and Communications suggests that the fuel consumption in railways would also decrease by 66% influenced by electrification of railways.

Transport sector is less affected by the EU ETS carbon price as in current situation only aviation sector and pipeline transportation companies are involved in the EU ETS market. In Lithuania there are several aircraft operators that fall under the scope of the EU ETS and according to the latest data from EUROCONTROL[12] only one aircraft operator was not considered as small emitter in 2020 (emitted 8 002 t CO_2 per year under EU ETS).

5.1.2.2 Scenario "with additional measures" (WAM)

The WAM scenario is based on the additional measures provided by the Ministry of Environment, the Ministry of Transport and Communications, the Ministry of Energy and the Ministry of Agriculture. The implementation period of measures will cover period of 2021-2030. For the period of 2031-2040 all additional measures will continue to be implemented at the same rate as it is expected in 2030. Most of these measures focuses on taxes with the aim to change road vehicles to the low-GHG emitting ones or incentives to change them to the

[11] Lithuanian transport safety administration data: https://ltsa.lrv.lt/lt/veiklos-sritys/civiline-aviacija/licencija-oro-susisiekimui-vykdyti
[12] European Organisation for the Safety of Air Navigation https://www.eurocontrol.int/

electric ones, also on fuel-efficiency (public transport, etc.). Annual car pollution tax will have the largest effect for GHG emission reduction.

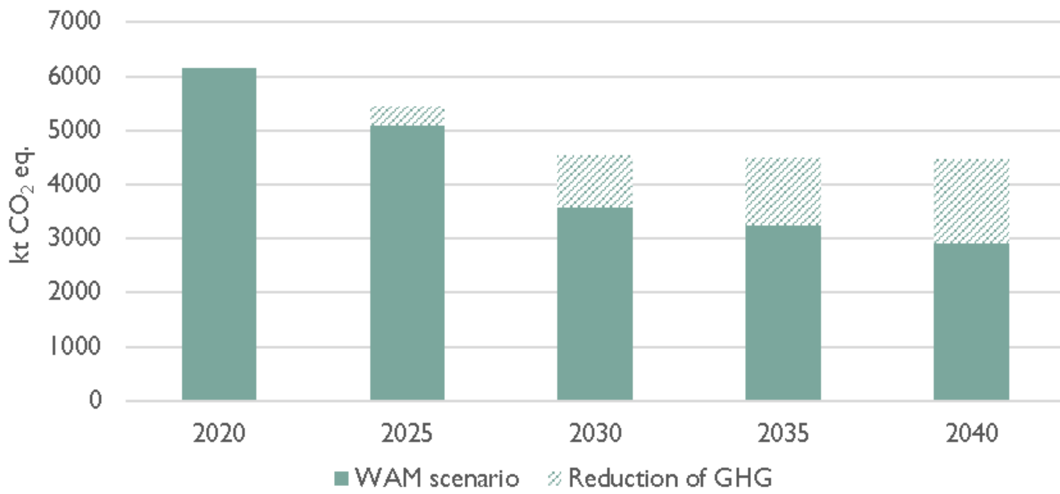

Figure 5-10. Projected GHG emissions in transport sector with additional measures

The list of PaMs and total GHG reduction effect applying additional policies and measures is presented in Chapter 4.

Additional measures will allow reduction of GHG emissions in transport sector by 43% in 2030, compared to 2019. Comparing with 1990, it is projected that applying additional policies and measures GHG emissions in transport sector should decrease by 39% in 2030, and by 50% in 2040.

5.1.2.3 Methodologies and key assumptions

The scenario “with existing measures” includes the national legislation documents that include projections of energy demand, climate change mitigation measures, projects currently in development and will be set in motion during the period 2019-2040.

The Ministry of Transport and Communications provided the required activity data for the estimation of projections in the transport sector. As the anticipated fuel consumption data was provided in 10-year intervals, the data for specific year in these intervals was linearly interpolated according to the anticipated fuel consumption change. No other measures were applied for determination of fuel consumption in the civil aviation subsector therefore the GHG emissions were calculated by applying the specific fuel emission factors used in NIR 2021.

Domestic civil aviation is essentially narrow (0.03% of GHG emissions in transport) in Lithuania. Aviation gasoline (avgas) is used for piston-type powered aircraft engines, while the jet fuel is used in turbine engines for aircraft and diesel engines. Aviation gasoline as a fuel is more common in private aircraft, while jet fuel is used in airlines and other large aircraft.

Projection of GHG emissions in railways subsector was carried out by using data received from the Ministry of Transport and Communications (MoTC). The data provided by the MoTC is shown in Table 5-8.

Table 5-8. Anticipated fuel consumption in railways subsector, TJ

Fuel type	2019	2020	2025	2030	2035	2040
Diesel oil	2 318	2 217	1 487	834	810	785
Biodiesel	76	99	48	27	26	26

No other measures were applied for determination of fuel consumption in railways subsector therefore the GHG emissions were calculated by applying the specific fuel emission factors used in NIR 2021.

The water borne navigation is composed of navigation through the inland waterways: navigable rivers, canals, lakes, man-made water bodies, and part of the Curonian Lagoon belonging to the Republic of Lithuania. In 2019 the GHG emissions from domestic navigation accounted for 16.3 kt CO_2 eq. Projection of GHG emissions in water borne navigation subsector was carried out by using data received from the Ministry of Transport and Communications, but the data was obtained only from Klaipėda's ferry between Curonian lagoon and the mainland. Other part of consumed fuel was assumed to remain unchanged in domestic navigation in WEM scenario. No other measures were applied in projection of GHG emissions from water borne navigation subsector. Road transportation is the most important GHG emissions source in the transport sector. This sector includes all types of vehicles on roads (passenger cars, light duty vehicles, heavy duty trucks, buses, motorcycles, mopeds). GHG emissions from road transport subsector accounted for 6 053.5 kt CO_2 eq. in 2019.

GHG emissions from Road transport calculation was based on the change of vehicle number (PC, LCV, motorcycles and buses) and the change of tonne-kilometers (cargo vehicles) in Lithuania according to the data of the Ministry of Transport and Communications. Exceptionally, only the trend of compressed natural gas consumption in road transport was left unchanged for the whole period up to 2040. A projected number of cars was entered into a spreadsheet private cars turnover model. An assumption was made that number of retired cars will not change year by year since base year. Using a distribution of cars by a power source and their kilometrage in base year, a forecast of the breakdown of the passenger car fleet and kilometrage by a power source and by existing and newly bought cars was calculated by the model. The obtained kilometrages were then combined with fuel consumption per kilometer and GHG emission factors to produce projected emissions. Fuel consumption per kilometer was assumed to be 20% lower for newly bought cars. For heavy-duty vehicles, base year emissions were separated into two parts (cargo vehicles and buses) considering numbers of these vehicles in the base year. GHG emission projections from cargo vehicles were created proportionally to the growth of the projected tonne-kilometers in road transport, and projections from buses were created considering projected number of buses.

Additionally, the support from EU funds to municipal administrations for purchasing low-emission urban public transport vehicles (EU-funded instrument for 2014-2030) provided funding for acquisition of environmentally safe buses. It is estimated that introduction of these buses will reduce GHG emissions from road transport sector by 1.2 kt CO_2 eq./year. Total GHG emission reduction by 2030 will amount to 12.2 kt CO_2 eq.

Gasoline traded at the points of sale must contain not less than 10% of biofuel (it is not obliged to blend biofuel into gasoline of A98 class) and diesel oil has to contain not less than 7% of biofuel from 2020. Considering that bioethanol is blended by the percentage of volume, there is an assumption that when the share of bioethanol blended is increased from 5 to 10%, the overall amount of bioethanol blended in gasoline by energy value contains no more than 7 %. Accordingly, the share of biodiesel blended in diesel oil by energy value is 6.4%.

Financial incentives are provided for persons who transferred its property rights of a car to a waste handler in Lithuania. The incentive is a flat-rate compensation which can be used to purchase an electric scooter, moped, bicycle or a used or new passenger car that meets low levels of emission criterion. This measure should reduce CO_2 eq. emissions by 47.7 kilotons by the year 2030.

An ambitious measure is providing incentives for carriers of intermodal units instead of transporting intermodal units by road to choose combined transport. It is estimated that combined transport should reduce GHG emissions by 224 kt CO_2 eq. by 2027 in road transport but increase emissions in railways. The increase in railways sector should be lower after 2027 due to the planned electrification of railways.

Formation and promotion of eco-driving skills impacts drivers in all modes of road transport: cars, freight transport, buses and motorcycles. It is assumed that the largest impact of promotion of eco-driving is during the first two years of its implementation (2021-2022) and the GHG reduction in road transport should have reached 20 kt CO_2 eq. in 2022 (10 kt CO_2 eq./year). Later, the impact is estimated to be 0.3 kt CO_2 eq./year and in 2030 the effect should reach 23 kt CO_2 eq.

The GHG emissions from natural gas transportation in pipelines sector were estimated according to the projected gross consumption of natural gas obtained from modelling of the energy sector.

The projections for the national total exclude emission projections related to fuel sold to ships and aircraft engaged in international transport in order to correspond to IPCC 2006 Guidelines. The anticipated fuel consumption for aircrafts used for civil international flights is provided in Table 5-9.

Table 5-9. Anticipated fuel consumption in international aviation, t

Fuel type	2019	2020	2025	2030	2035	2040
Aviation gasoline	0	0	0	0	0	0
Jet kerosene	119 267	52 400	102 871	127 718	133 403	139 087

GHG emission projections for international navigation were based on anticipated ship loading in Klaipėda harbour up to 2024. From 2025, the projections were carried out on the assumption that the GHG emissions from navigation sector should be reduced by 40% by 2050 as laid down in the Strategy for National Climate Change Management Policy, adopted on 6 November 2012 by the Parliament Decree No XI-2375.

Scenario "with additional measures" (WAM)

Additionally, according to scenarios in data provided by the Ministry of Transport and Communications, E-tolling for freight transport is planned to apply differentiated the "user pays" and "polluter pays" principles to freight transport. Since fuel consumption for heavy duty transport does not decrease when Euro standard increases, the effect is seen only on those companies who switch from conventional (non-Euro) vehicles into ones meeting Euro standards. It is estimated that this measure should reduce fuel consumption of heavy-duty transport by 2.25 TJ in 2037.

It is estimated that additional measures for developing domestic navigation (especially T14. “Construction of new cargo vessels and barges” and T15. “Construction of new passenger ships”) should reduce GHG emissions by 53 kt CO_2 eq. by 2030 in road transport but increase emissions in domestic navigation by 3 kt CO_2 eq. in 2030. However, due to these measures, GHG emissions from domestic navigation in WAM scenario are higher than in WEM scenario from year 2024 (the year of the beginning of the implementation of these measures).

Compared to WEM scenario, WAM has an ambitious objective to reduce actual amount of fuel consumption and to implement fuel-switch measures. A rapid decrease of diesel oil consumption is planned which is sought to be partly changed by electrification.

The measure T12. “Renewal of transport fleet by using green public procurement for transport” is dedicated to implement of objectives provided in the Directive of European Parliament and Council (EU) 2019/1161, however, the objectives provided in the measure are more ambitious than they are in the mentioned Directive.

A lot of measures together contribute to the increase of the number of electric cars and cover such aspects as yearly pollution tax for cars, higher subsidies for their acquisition, development of the infrastructure and social dissemination. An absence of any of these aspects would significantly reduce planned number of electric cars, e. g., there wouldn’t be possibilities to subsidize acquisition of electric cars in the absence of pollution taxes, and electric cars would not be attractive if there was a bad infrastructure. These additional measures contribute to the existing measures promoting electric cars: an ability to use specially marked public transport lines in Vilnius, exemptions for car parking and entrance fees in Lithuanian towns, registration charge according to the level of pollution, subsidies for acquisition of electric cars, the obligation to install recharging points for electric vehicles in new or reconstructed buildings and parking lots. Only measures T13. “Promotion of the use of electric cars and development of their charging infrastructure” and T28. “Allowance for the purchase of N1 electric vehicles” are intended to namely increase the number of electric cars – all other measures reduce GHG emissions in other ways, too.

Annual car pollution tax will have the largest effect for GHG emission reduction. If this measure is not implemented, not only the GHG reduction objective will not be reached, but also a lot of other measures will not be implemented, for which funding is required from Sustainable mobility funds. All the funds from purposive pollution taxes should fall into the mentioned fund, and they should be dedicated to promoting the use of less polluting transport.

5.1.3 Industrial processes and product use

The emissions from Industrial process and product use sector (IPPU) for WEM and WAM scenarios are presented in the table and figure below.

Table 5-10. Total projected GHG emissions for IPPU sector in case of WEM and WAM scenarios, kt CO_2 eq

	2019	2020	2025	2030	2035	2040
WEM scenario	3 375	3 094	3 680	3 414	3 326	3 241
WAM scenario	3 375	3 094	3 590	3 234	3 146	3 061
Difference (WEM-WAM), kt CO_2 eq.	0	0	90	180	180	180
Difference (WEM/WAM), %	0	0	2	5	5	6

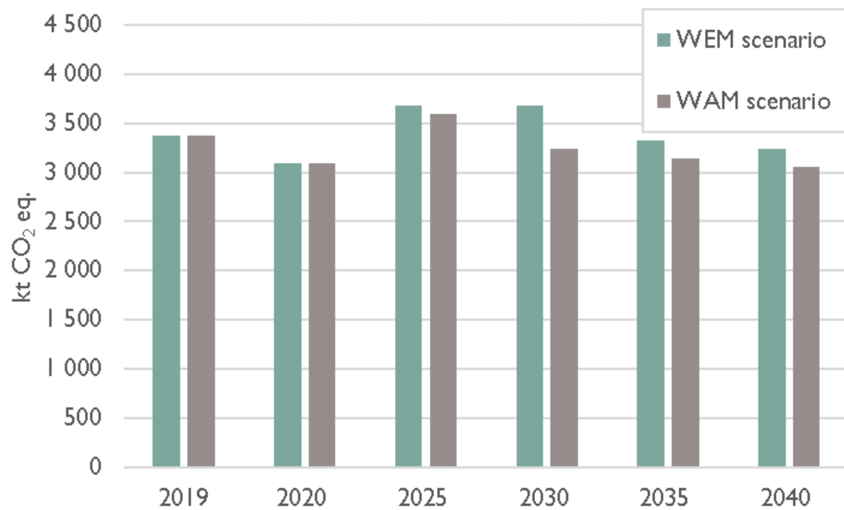

Figure 5-11. Projection of the WEM and WAM scenarios in IPPU sector

5.1.3.1 Scenario "with existing measures" (WEM)

GHG emissions projections for IPPU sector are presented in the table and the figure below. The largest source of GHG emissions is chemical industry. With regard to the share of GHG emissions it will not change a lot during projected period and Chemical industry category will remain the largest source of emissions in industrial processes and product use sector. As it was anticipated that economic recovery started from 2010 and the industrial production increased. The GHG emissions in industry sector are determined by technology processes and notable emission reduction per production output is hardly possible. Therefore, it is expected that GHG emissions from 2020 will decrease because of restrictions of Regulation (EU) No 517/2014 and decreasing effect on emissions from uses of F-gases. Compared to 2019 emissions from IPPU sector will decrease by 4% in 2040.

Historical and projected GHG emissions are presented in the table and figure below.

Table 5-11. Projected emissions in IPPU sector by category in case of WEM scenario, kt CO_2 eq.

	2019	2020	2025	2030	2035	2040
2.A Mineral Industry	602	579	832	832	832	833
2.B Chemical Industry	2 169	1 938	2 445	2 314	2 277	2 212
2.C Metal Industry	2	0	2	2	2	2

2.D Non-energy products from fuels and solvent use	59	55	48	47	46	45
2.E Electronics Industry	4	10	6	6	6	6
2.F Product uses as substitutes for ozone depleting substances	534	508	342	208	157	138
2.G Other product manufacture and use	5	4	6	6	6	6
2.H Other Production	NO	NO	NO	NO	NO	-NO
Total	**3 375**	**3 094**	**3 680**	**3 414**	**3 326**	**3 241**

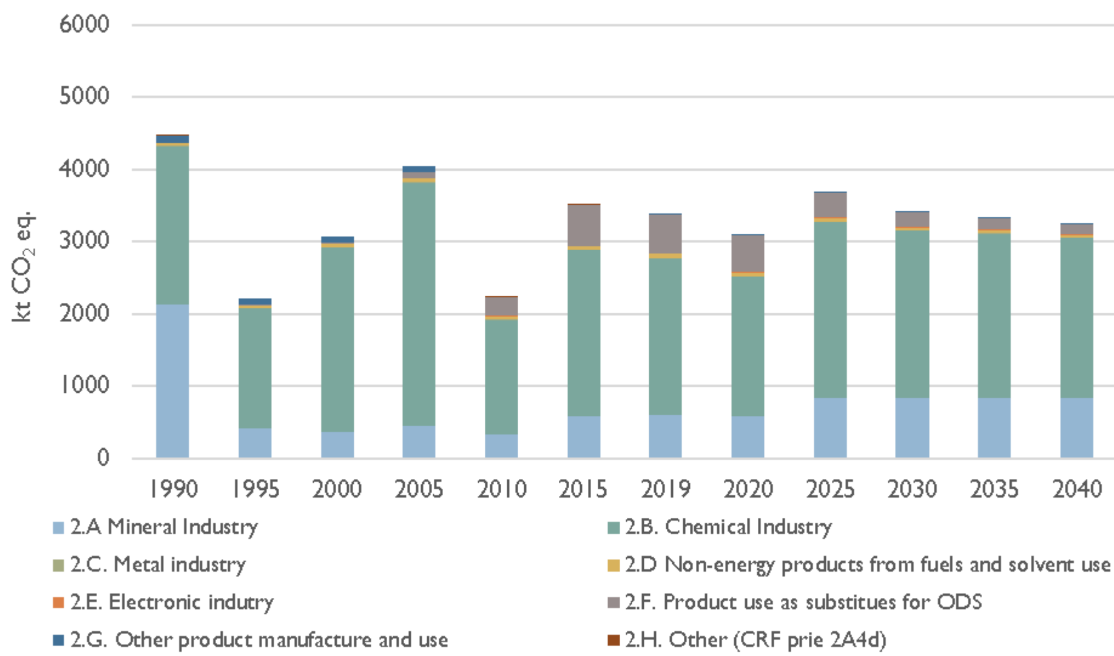

Figure 5-12. Historical and projected GHG emissions in IPPU sector

Mineral industry

A significant share of GHG emissions in mineral industry sector belongs to the CO_2 emissions from cement production. The projections of CO_2 emissions from clinker production were based on activity data provided by the company. It is assumed that clinker production will increase until 2025. From 2025 clinker production volume will remain stable until 2040. As volume of mineral industry is expected to increase for projected period, the GHG emissions will grow accordingly by approximately 38% compared to the 2019 in 2040.

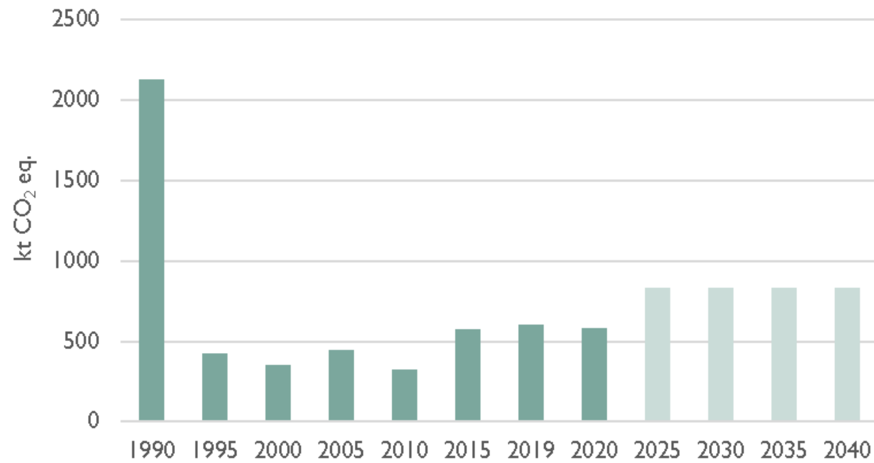

Figure 5-13. Historical and projected GHG emissions from mineral industry

Chemical industry

The main GHG emissions source in IPPU sector remains nitric acid and ammonia production. Based on projected production volume data provided by chemical industry, the GHG emissions will increase by 43 kt CO_2 eq. in 2040 compared with 2019.

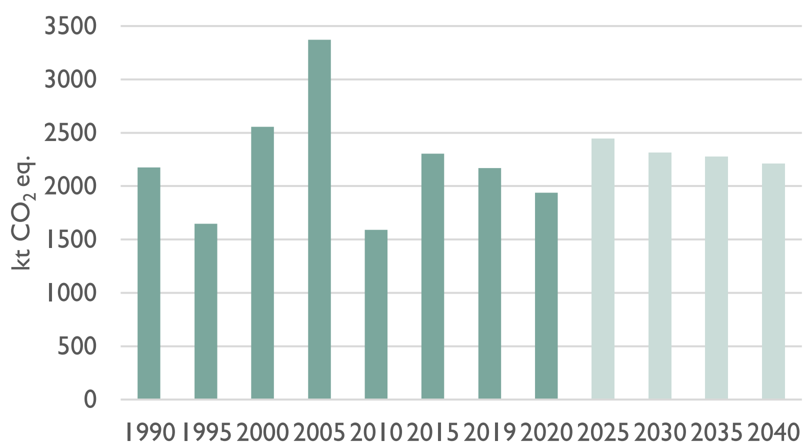

Figure 5-14. Historical and projected GHG emissions from chemical industry

Metal industry

The projections of CO_2 emissions from cast iron production were based on activity data provided by companies. According to market analysis it is assumed that cast iron production will increase and GHG emissions from metal industry will grow together with increasing cast iron production.

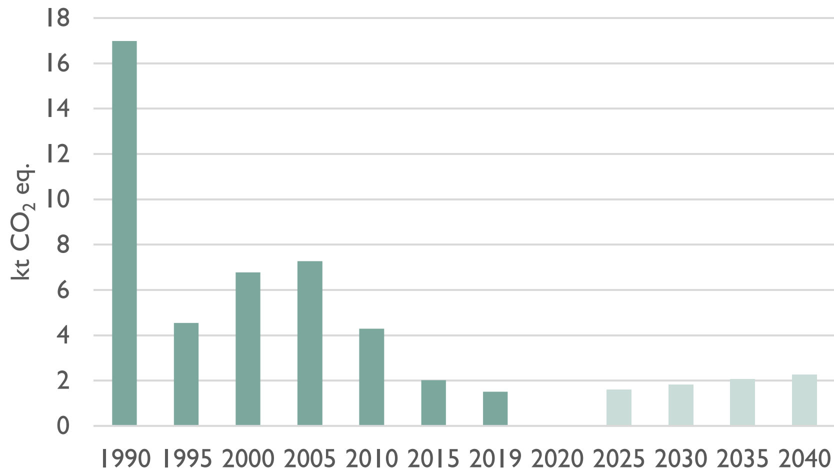

Figure 5-15. Historical and projected GHG emissions from metal industry

Non-energy products from fuels and solvent use

Emissions of non-energy products from fuels and solvent use will decrease mainly due to decreasing trend of population. Compared to 2019 CO_2 emissions from non-energy products from fuels and solvent use category will decrease by 24% in 2040.

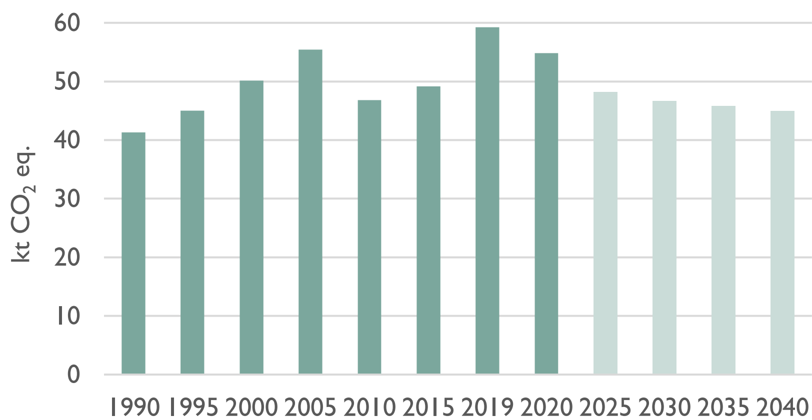

Figure 5-16. Historical and projected GHG emissions of non-energy products from fuels and solvent use

Product uses as substitutes for ozone depleting substances (ODS)

The projections of F-gases emissions for most sub-categories were based on 1990-2019 emissions trend by including relevant technological improvements and taking into account the impacts of the F-gases Regulation (EU) No 517/2014 implementation (introduced restrictions/controls of the use and introduction of quotas for placing on the market of HFCs). Projected emissions from consumption of HFCs in 2019-2040 are presented in the Table 5-12 below.

Table 5-12. Projected emissions from consumption of HFCs by 2040, kt CO_2 eq.

	2019	2020	2025	2030	2035	2040
2.F.1.a Commercial Refrigeration	190	169	100	59	35	21
2.F.1.b Domestic Refrigeration	2	2	2	1	1	-1
2.F.1.c Industrial Refrigeration	53	47	29	19	13	11
2.F.1.d Transport Refrigeration	77	102	84	71	63	59
2.F.1.e Mobile AC	139	138	84	21	10	11
2.F.1.f Stationary AC	19	17	13	9	6	5
2.F.2 Foam blowing	41	18	15	12	12	12
2.F.3 Fire extinguishers	4	2	1	1	1	1
2.F.4 Metered Dose inhalers	9	12	14	16	17	18
Total	**534**	**508**	**342**	**208**	**157**	**138**

It should be noted that restrictions due to Regulation (EU) No 517/2014 have a decreasing effect on emissions. Emissions from domestic refrigeration equipment are expected to decline due to EU wide measures and technical changes resulting in decreased leakage. One can be assumed that due to the ban on HFCs in new domestic refrigerators and freezers since 2015 only emissions from existing stocks and disposal will occur. It is expected that emissions from commercial and industrial refrigeration sectors will decline in 2020-2040. The projected decline is expected due to the entering into force of the new prohibition on the use of HFCs with GWP of more than 2 500. According to Lithuanian GHG inventory data, commercial and industrial refrigeration equipment contains HFC-32, HFC-125, HFC-143a and HFC-134a gases. The GWP of HFC-125 and HFC-143a is higher than 2 500, therefore the use of these gases in new equipment is prohibited from 2020. Furthermore, refrigerators and freezers for commercial use that contain HFCs (HFC-32, HFC-134a) with GWP of more than 150 are prohibited to place on the market from 2022. Implementation of F-gases quota system will reduce the amount of HFCs placed on the market by 79% between 2015 and 2030 (see Table 5-17). Considering that the lifetime of the equipment/cars and road vehicles is 15-24 years, most of the emissions in 2030-2040 from disposal will occur.

Taking into account these assumptions, it is predicted that in 2040 emissions from commercial and industrial refrigeration sectors will account only 13% compared to F-gases emissions in these sectors in 2019. The emissions from mobile air-conditioning will decrease also taking into account implementation of EU Mobile Air-conditioning (MAC) Directive, which prohibits the use of F-gases with GWP of more than 150 in new types of cars and vans introduced from 2011, and in all new cars and vans produced from 2019. Emissions from Transport Refrigeration account for up to 14% of the total Lithuanian F-gas emissions in base year of 2019 and are predicted to decrease slightly in the upcoming years due to impact of the HFC phase down which is a key feature of Regulation (EU) No 517/2014. The phase down will reduce the quantity of HFCs that can be sold in the EU. In addition to this, emissions from foam blowing are expected to decrease due to restrictions of F-gases regulation as well. Despite this it is assumed that emissions from metered dose inhalers will continue to increase, due to the F-gas regulation does not prohibit the use of HFCs for medical devices and despite declining population, historical data trends shows that the use of metered dose inhalers is increasing.

Electronics industry

The projected consumption of SF_6 gases was based on activity data provided by companies. It is assumed that emissions after 2025 will remain stable until 2040.

Table 5-13. Projected emissions from consumption of SF_6 gases in Electronics industry, kt CO_2 eq.

	2019	2020	2025	2030	2035	2040
2.E.1 Semiconductor manufacture	4.5	9.5	5.9	5.9	5.9	5.9
Total	**4.5**	**9.5**	**5.9**	**5.9**	**5.9**	**5.9**

Other product manufacture and use

Assumptions on the projected amounts of consumption of the SF_6 gases in electrical equipment and accelerators and N_2O from product uses are based on historical data and projected emissions are presented in the table below.

Table 5-14. Projected SF_6 emissions from Electrical equipment, Other non-specified and N_2O from product uses, kt CO_2 eq.

	2019	2020	2025	2030	2035	2040
2.G.1 Electrical equipment	0.49	0.14	0.63	0.63	0.63	0.63
2.G.2 Other non-specified	0.1	0.1	0.16	0.16	0.16	0.16
2.G.3 N_2O from product uses	4.6	3.4	4.95	4.85	4.78	4.75
Total	**5.2**	**3.6**	**5.7**	**5.6**	**5.6**	**5.5**

Consumption of the SF_6 gases in electrical equipment and accelerators is projected to be equal to 2019 level and emissions during the period 2019-2040 will remain stable, while emissions of N_2O from product uses will gradually decline due to decrease of the population during the projection period.

5.1.3.2 Scenario "with additional measures" (WAM)

The WAM scenario is based on the additional measures provided by the Ministry of the Economy and Innovation and the Ministry of Environment, the implementation period of measures will cover period of 2021-2030. For the period of 2031-2040 all additional measures will continue to be implemented at the same rate as it is expected in 2030.

The planned policies and measures in industrial sector are focusing on implementation and promotion of technological eco-innovation and modern technologies, support (partial financing) of replacement of pollutant technologies with greener technologies, promoting traditional industrial transformation and reduction of F-gases use in business companies. Financial support for companies acquiring new or replacing existing equipment with equipment using other technological alternatives (refrigerants with lower GWP) will reduce the amount of F-gases used to refill old equipment or to fill the new equipment for the first time and the refrigerants with lower GWP will be used, leading to reduction in GHG emissions.

List of policies and measures and cumulative GHG reduction effect for 2021-2030 is provided in Chapter 4.

Table 5-15. Projected GHG emissions from IPPU sector by category in case of WAM scenario (kt CO_2 eq.)

	2019	2020	2025	2030	2035	2040
2.A Mineral Industry	602	580	832	832	832	832
2.B Chemical Industry	2 169	1 938	2 385	2 192	2 156	2 090
2.C Metal Industry	2	0	1	1	1	1
2.D Non-energy products from fuels and solvent use	59	55	31	14	13	12
2.E Electronics Industry	4	10	6	6	6	6
2.F Product uses as substitutes for ozone depleting substances	534	508	330	183	132	113
2.G Other product manufacture and use	5	4	6	6	6	6
2.H Other Production	NO	NO	NO	NO	NO	NO
Total	**3 375**	**3 094**	**3 590**	**3 234**	**3 146**	**3 061**

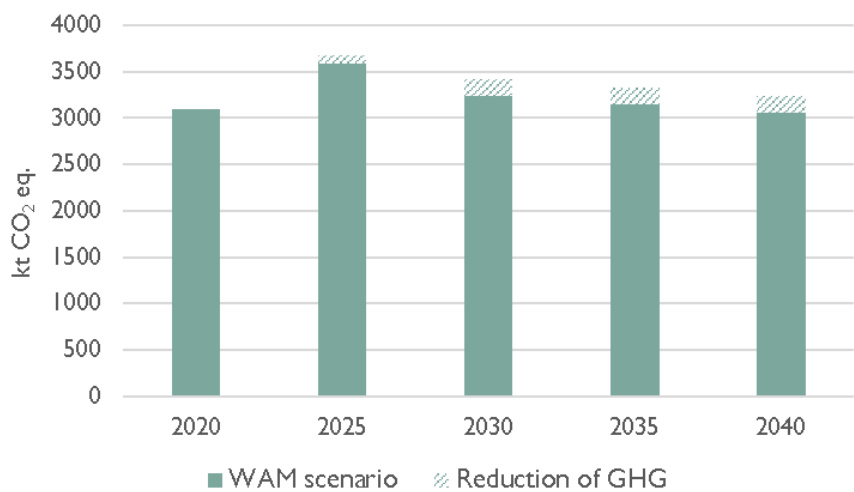

Figure 5-17. Projected emissions of IPPU sector under WAM scenario

5.1.3.3 Methodology and key assumptions

The GHG emissions projections from IPPU sector with existing policies and measures were estimated using projected production levels data (activity data) by 2040 provided by the main emitters in this sector: clinker, lime, glass, ammonia and nitric acid producing companies. Emissions from these industries covered up about 82% of total IPPU sector emissions in 2019.

The projections of GHG emissions were estimated by applying emission factors, which were calculated according to Methodological guidance for the preparation of National GHG projections guidelines prepared by Lithuanian Energy Institute in 2016. The emission factors are presented in the table below.

Table 5-16. Emission factors in industry sector

Activity	CO_2
Clinker production, t/t	0.537
Lime production, t/t	0.782
Glass production, t/t	0.091
Mineral wool production, t/t	0.153
Lubricant use, t/TJ	0.590
Paraffin wax use, t/TJ	0.590
Solvents use, t/thous. inhabitants	0.012

Projections of CO_2 emissions arising from ammonia production are calculated using projected natural gas consumption data and applying the 2006 IPCC Guidelines [13] Tier 3 method, which states that CO_2 recovered for downstream use in urea production must be subtracted from the total quantity of CO_2 generated from ammonia production. However EU ETS emissions are estimated according to data provided by the companies where CO_2 recovered for downstream use in urea production are not subtracted from the total quantity of CO_2 generated from ammonia production. This difference in methodologies leads to differences in estimated total GHG and EU ETS emissions in chemical industry.

All projected data were available for 2020, 2025, 2030, 2035 and 2040. The data in between were linearly interpolated. The base year for the GHG IPPU projections is 2019.

F-gases emission projections are performed at the same subcategory level as in Lithuanian GHG inventory using 2006 IPCC Guidelines emission factors. The WEM projection scenario for F-gases are generally based on the assumptions from Annexes III and V (Table 5-17) of F-gases Regulation[14], that creates bans, controls on the use and emissions of F-gases and EU MAC Directive[15], which prohibits the use of F-gases with GWP of more than 150 in new types of cars and vans introduced from 2011, and in all new cars and vans produced from 2017.

Table 5-17. Percentage to calculate the maximum quantity of HFCs to be placed on the market (based on Annex V of Regulation (EU) No 517/2014)

Years	Percentage to calculate the maximum quantity of HFCs to be placed on the market and corresponding quotas
2015	100%
2016-2017	93%
2018-2020	63%
2021-2023	45%
2024-2026	31%

[13] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_3_Ch3_Chemical_Industry.pdf
[14] Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006
[15] Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC

2027-2029	24%
2030	21%

Summary table of assessed emissions from IPPU sector, methods applied and emission factors are provided in the table below.

Table 5-18. Methods and emissions factors used to estimate emission from IPPU sector

CRF	Source	Emissions reported	Methods	Emission factor
2.A	Mineral Industry	CO_2	Tier 1, Tier 2	PS, D, CS
2.B	Chemical Industry	CO_2, N_2O	Tier 3	PS, D, CS
2.C	Metal Industry	CO_2	Tier 2	D
2.D	Non-energy products from fuels and solvent use	CO_2	Tier 1	D, CR
2.E	Electronics Industry	SF_6	Tier 3	PS
2.F	Product uses as substitutes for ozone depleting substances	HFCs	Tier 1a, Tier 1b, Tier 2	D, CS
2.G	Other product manufacture and use	SF_6, N_2O	Tier 1, Tier 3	D, CS, OTH
2.H	Other Production	CO_2	Tier 1	D

Mineral Industry

The mineral industry's projected emissions are based on industrial companies' projections and are taking into account planned maximum production capacities and implemented best available technologies according to companies' environmental permits. The table below shows base year and projected volume of mineral industry.

Table 5-19. Base year and projected volume of mineral industry, kt

	2019	2020	2025	2030	2035	2040
Clinker production	1 074	1 039	1 500	1 500	1 500	1 500
Lime production	2	2	2	2	2	2
Glass production	96	89	99	100	100	100
Mineral wool production	83	88	92	94	96	98

A significant share of GHG emissions in mineral industry sector belongs to the CO_2 emissions from cement production. The projections of CO_2 emissions from clinker production were based on activity data provided by the company. It is assumed that from 2020 clinker production volume will remain stable until 2040.

The projections of CO_2 emissions from lime production were based on activity data provided by the only lime production company. It is projected that lime will remain at the same level until 2040.

The projections of CO_2 emissions from glass production were based on activity data provided by two glass companies. It is projected that glass production will decrease in 2020 by 7% compared to 2019 and will start to increase from 2020 onwards and after 2030 will stabilize at approx. 100 kt.

The projections of CO_2 emissions from mineral wool production were based on activity data provided by the single company's authorities and it is projected that mineral wool production will be increasing gradually during the projected period.

Chemical Industry

The primary GHG emissions source in the IPPU sector remains nitric acid and ammonia production. Based on data from chemicals producing company, the GHG emissions trends for 2020-2040 will decrease (see table below) due to planned GHG reduction projects.

Table 5-20. Base year and planned ammonia and nitric acid production, natural gas consumption volume

	2019	2020	2025	2030	2035	2040
Ammonia production, kt	1 051	995	1 146	1 146	1 146	1 146
Natural gas consumption, thous. m^3	1 146 933	1 088 503	1 255 000	1 185 000	1 165 000	1 130 000
Nitric acid production, kt	1 158	1 166	1 319	1 319	1 319	1 319

Metal industry

The projections of CO_2 emissions from cast iron production were based on activity data provided by two companies (Table 5-21). According to market analysis it is assumed that cast iron production will increase 1.5 times in 2040 compared to 2019.

Table 5-20. Base year and planned volume of metal industry, kt

	2019	2020	2025	2030	2035	2040
Cast iron	1,7	1,7	1.8	2.1	2.4	2.6

Non-energy products from fuels and solvent use

Consumption of lubricant oil and paraffin waxes for non-energy purposes is assumed to stay constant at the level of 2020 due to forecast promise very little economic growth (Table 5-22).

Projections of solvent use are based on the population trends up to the year 2040. Emissions from solvent use sector are projected to decrease a little due to projection of population show a decreasing trend.

Table 5-22 Base year and projected parameters of non-energy products from fuels and solvent use, kt

	2019	2020	2025	2030	2035	2040
Lubricant use	24	24	24	24	24	24
Paraffin wax use	2	4	4	4	4	4
Population in Lithuania, thous.	2 794	2794	2 585	2 452	2 376	2 307

Product uses as substitutes for ozone depleting substances (ODS)

Emissions from 2.F.1 category (HFCs) were calculated applying the 2006 IPCC Guidelines Tier 1a, Tier 1b and Tier 2 methods using default and country specific emission factors. The assumptions used for HFC emission projections are as follows:

- Commercial Refrigeration (2.F.1.a): a ban on the use of HFCs with GWP of more than 2 500 in new commercial equipment since 2020 and with GWP of more than 150 since 2022. The average lifetime of equipment – 15 years.

- Domestic Refrigeration (2.F.1.b): HFCs with GWP of more than 150 in domestic refrigeration were phased out since 2015 and only emissions from stock (old equipment) and disposal will occur. The average lifetime of the refrigerator and freezers is 20 years.
- Mobile AC (2.F.1.e): a ban on the use of F-gases with GWP of more than 150 in new types of cars and vans produced from 2017. It is assumed that the average lifetime of cars and vans is 17-24 years (depending on vehicle category).
- Transport Refrigeration (2.F.1.d): it is assumed, that 5% per year refrigeration systems of newly registered road vehicles are filled using refrigerants with the lowest GWP (150 and less). The average lifetime of road vehicles is 16-19 years (depending on vehicle category).
- Stationary AC (2.F.1.f): a ban on the use of HFCs with GWP of more than 2 500 in new stationary equipment since 2020.
- Foam blowing (2.F.2) and Fire extinguishers (2.F.3): projected emissions were based on existing measures (Regulation (EU) 517/2014 Annex V) and extrapolated until 2040.
- Metered dose inhalers (2.F.4): it is assumed that HFCs emissions from metered dose inhalers will continue to increase, due to the F-gas regulation does not prohibit the use of HFCs for medical devices. Regression analysis of historical data and population dependency was performed. In this context, the forecast for 2040 was set.

Electronics industry

Emissions from 2.E.1 subcategory were calculated applying the 2006 IPCC Guidelines Tier 3 method using plant specific emission factors. Projected consumption of the SF_6 gases were based on activity data provided by semiconductor manufacturing company in Lithuania for 2019 and it is assumed that consumption of SF_6 gases will remain stable until 2040 as the company's maximum production/use capacity will remain unchanged (Table 5-23).

Table 5-23. Projected amount of SF_6 gases consumption of electronics industry, t

Planned use of gases	2019	2020	2025	2030	2035	2040
SF_6	0.391	0.837	0.520	0.520	0.520	0.520

Other product manufacture and use

Emissions from 2.G.1 and 2.G.2 subcategories are calculated applying the 2006 IPCC Guidelines Tier 3 method using country specific emission factors. Consumption of the SF_6 gases in electrical equipment and accelerators is projected based on historical data and projected amount of SF_6 gases consumption are presented in the table below.

Table 5-24. Projected amount of SF_6 gases consumption of electrical equipment and other product manufacture and use, t

Planned use of gases	2019	2020	2025	2030	2035	2040
SF_6	0.02	0.01	0.03	0.03	0.03	0.03

Other

CO_2 emissions from carbonates use in flue gas desulphurization (2.H.3) were calculated using 2006 IPCC Guidelines Tier 1 method based on mass of carbonates used. Activity data (limestone use) was supplied by powerplant. The company has reported that limestone use has not been foreseen since 2019, so emissions will not occur after 2019.

5.1.4 Agriculture

The emissions from agriculture sector for WEM and WAM scenarios are provided in the table and figure below.

Table 5-25. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	2019	2020	2025	2030	2035	2040
WEM scenario	4 275	4 451	4 177	4 050	3 905	3 744
WAM scenario	4 275	4 451	4 023	3 726	3 609	3 490
Difference (WEM-WAM), kt CO_2 eq.	0.0	0.0	154	324	297	254
Difference (WEM/WAM), %	0%	0%	4%	9%	8%	7%

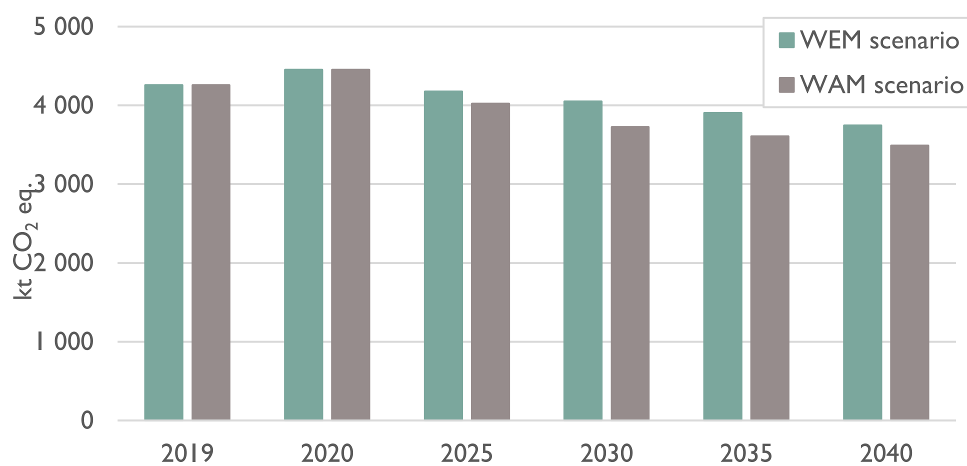

Figure 5-18. Projection of the WEM and WAM scenarios in agriculture sector

5.1.4.1 Scenario "with existing measures" (WEM)

GHG emissions projections for the agriculture sector are provided for five subsectors: enteric fermentation, manure management, agricultural soils and CO_2 emissions from liming and urea. The table below presents aggregated GHG emissions from the agriculture sector. The largest source of GHG emissions is agricultural soils, particularly direct soils emissions. The share of GHG emissions will not change a lot during projected period, agricultural soils subsector will remain the largest source of emissions in agriculture sector. Compared to 2019 emissions from agriculture sector will decrease by 5% in 2030 and by 12% in 2040.

Table 5-26. Projected GHG emissions from agriculture sector by category in case of WEM scenario, kt CO_2 eq.

Agriculture sector categories	2019	2020	2025	2030	2035	2040
Enteric fermentation	1 483	1 445	1 442	1 467	1 419	1 366
Manure management	411	411	382	392	392	389
Agriculture soils	2 334	2 571	2 322	2 160	2 066	1 962
Urea application	16	16	16	14	13	11
Liming	12	7	16	16	16	16
Total GHG emissions	4 256	4 451	4 177	4 050	3 905	3 744

The figure below represents GHG emissions trend during the historical and projected period.

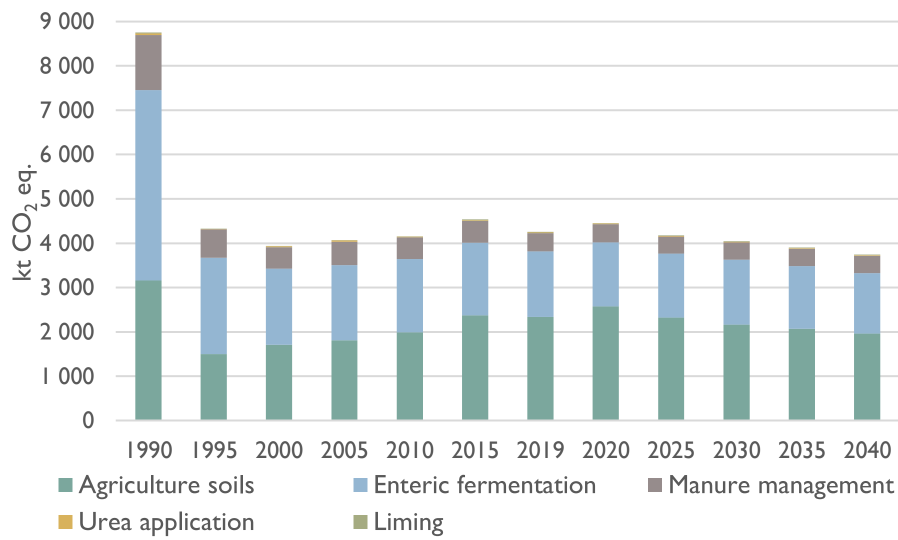

Figure 5-19. Historical and projected GHG emissions from agriculture sector by category under WEM scenario

Enteric fermentation

Projected emissions from enteric fermentation for each livestock category are provided in the table below.

Table 5-27. Projected CH_4 emission from enteric fermentation, kt CO_2 eq.

Livestock categories	2019	2020	2025	2030	2035	2040
Dairy cattle	814	776	791	798	756	709
Non-dairy cattle	595	598	576	588	581	574
Swine	18	19	18	18	20	21
Sheep	44	41	45	51	51	51
Goats	2	2	2	2	2	2
Horses	6	6	6	6	6	5
Fur-bearing animals	4	4	4	4	4	4
Total	**1 483**	**1 445**	**1 442**	**1 467**	**1 419**	**1 366**

CH_4 emissions from enteric fermentation mainly depend on livestock population. As it can be seen from the table above it is projected that emissions from enteric fermentation will be decreasing during projected period compared to 2019.

Figure below shows the share of CH_4 emissions from livestock enteric fermentation generated by different livestock categories. In 2019 the majority of these emissions comprised from dairy and non-dairy cattle enteric fermentation – 95%. During the projected period the share of emissions from livestock categories will not change a lot, therefore dairy and non-dairy cattle categories will remain the main source of CH_4 emissions from enteric fermentation. It is projected that emissions from enteric fermentation will decrease by 8% in 2040 compared with 2019.

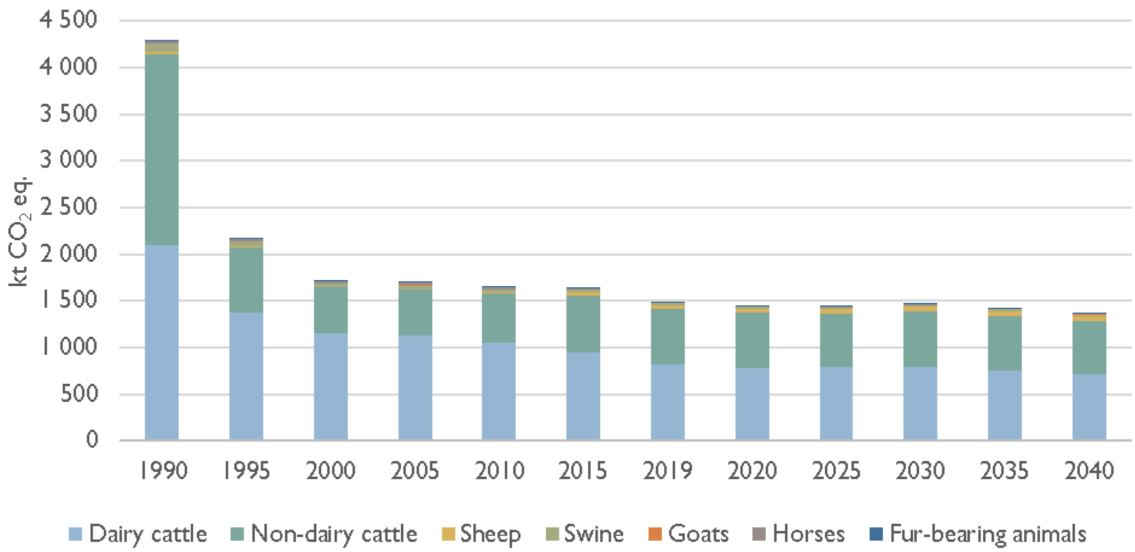

Figure 5-20. Historical and projected CH_4 emissions from enteric fermentation

Manure management

CH_4 emission from manure management

CH_4 emissions from manure management dairy cattle, non-dairy cattle, swine emission factors were calculated using projected activity data. For other livestock categories (sheep, goats, horses, poultry, fur-bearing animals) emissions factors of 2019 were used.

Table 5-28. Projected CH_4 emission from manure management, kt CO_2 eq.

Livestock categories	2019	2020	2025	2030	2035	2040
Dairy cattle	83	81	70	77	78	77
Non-dairy cattle	73	75	59	59	58	56
Swine	48	49	34	32	33	34
Sheep	2	2	2	2	2	2
Goats	0	0	0	0	0	0
Horses	1	0	1	1	1	1
Poultry	7	6	7	8	9	10
Fur-bearing animals	17	18	22	22	22	22
Total	229	232	196	202	203	202

According to 2019 data the highest CH_4 emissions from manure management occur among dairy and non-dairy cattle, swine and fur-bearing animal's categories and constitute 96% of total manure management CH_4

emissions. It is projected that overall CH_4 emissions from manure management will decrease by 12% in 2040 compared to 2019.

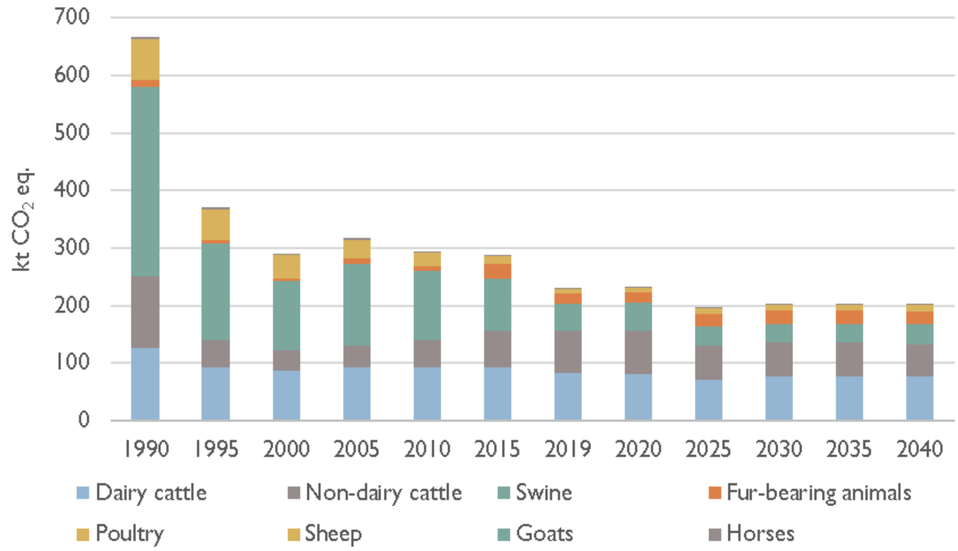

Figure 5-21. Historical and projected CH_4 emissions from manure management

Direct and indirect N_2O from manure management

N_2O emissions from manure management systems include both direct and indirect emissions (Table 5-29). Direct N_2O emission occurs through nitrification and denitrification of nitrogen contained in the manure. Indirect N_2O emissions occur from volatile nitrogen losses that occur primarily in the forms of ammonia and NO_x.

According to 2019 data the highest N_2O emissions from manure management occur among dairy cattle, non-dairy cattle constitute 83% of total N_2O emissions from manure management. For calculation of projected N_2O emissions from direct and indirect N_2O manure management default 2006 IPCC Guidelines emissions factors were applied.

Table 5-29. Projected direct and indirect N_2O emission from manure management, kt CO_2 eq.

Manure management system	2019	2020	2025	2030	2035	2040
Direct N_2O emission						
Liquid system	31	31	32	34	34	34
Solid storage system	52	51	53	52	50	48
Other systems*	14	14	13	14	14	14
Total	**97**	**96**	**98**	**100**	**98**	**96**
Indirect N_2O emission						
Liquid system	36	36	37	39	39	39
Solid storage system	34	32	33	33	32	30
Other systems	15	15	17	19	20	21
Total	**85**	**84**	**88**	**90**	**91**	**91**

*Other systems include – deep bedding, with/without litter, etc.

Direct N_2O emissions from manure management will decrease by 1% in 2040 compared to 2019; however, indirect N_2O emissions will increase by 7% during the same period.

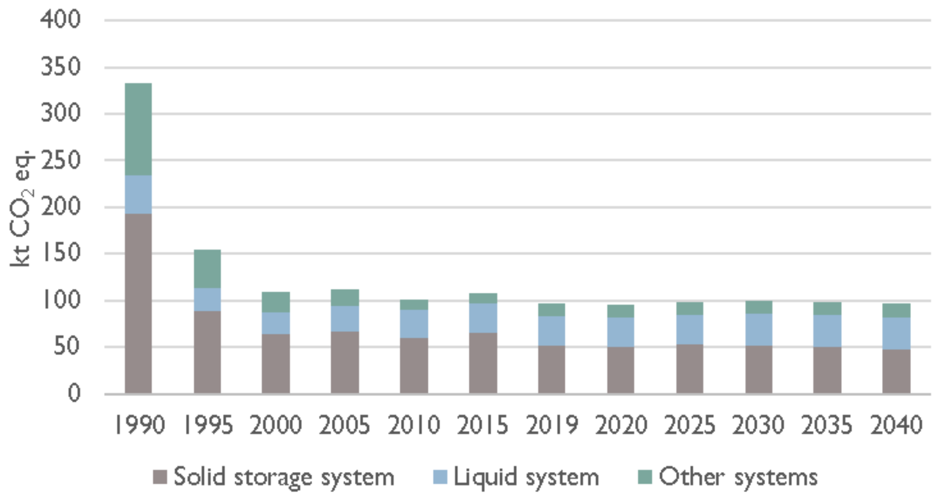

Figure 5-22. Historical and projected direct N_2O emissions from manure management

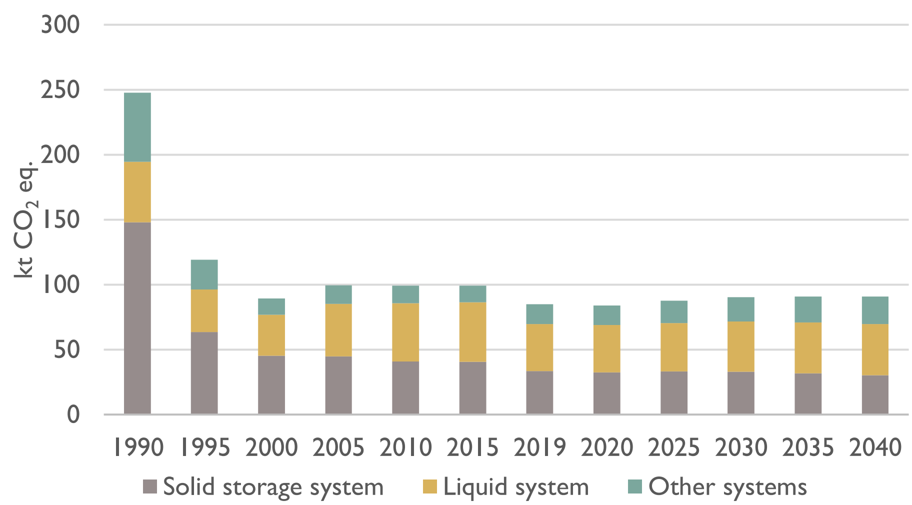

Figure 5-23. Historical and projected indirect N_2O emissions from manure management

Agricultural soils

Agricultural soils category includes direct and indirect N_2O emissions. It is assumed that in a long-term period there will be no significant changes in this category and the highest N_2O emissions from agricultural soils as it is already will occur from direct N_2O emissions. It is assumed that consumption of inorganic N fertilizers will remain the highest emission source in this category.

For calculation of projected direct N_2O emissions from agricultural soils all emission factors were taken from 2006 IPCC Guidelines.

Table 5-30. Projected total direct and indirect N_2O emissions from agricultural soils, kt CO_2 eq.

Agricultural soils subcategories	2019	2020	2025	2030	2035	2040
Direct N_2O emissions from agricultural soils						
Inorganic N fertilizers	824	932	772	686	622	558
Organic N fertilizers	153	152	144	149	150	150
Urine and dung from grazing	141	136	130	127	117	107
Crop residue	321	406	372	357	365	372
Mineralized N from loss of C stocks	NO	NO	NO	NO	NO	NO
Cultivation of organic soils	489	495	526	492	483	465
Total direct N_2O emissions	**1 928**	**2 122**	**1 945**	**1 811**	**1 736**	**1 651**
Indirect N_2O emissions from agricultural soils						
Atmospheric deposition	97	98	82	77	72	66
Leaching and runoff	309	351	294	272	258	244
Total indirect N_2O emissions	**406**	**450**	**377**	**349**	**330**	**311**

The main activity data for calculation of projected N_2O emissions from inorganic N fertilizers application is projected values of N fertilizers consumed. N_2O emissions from organic N fertilizers included animal manure applied to soils, sewage sludge and compost used as soil amendments. Animal manure applied to soils and urine and dung from grazing animals were calculated based on the calculations performed in manure management category. The amounts of sewage sludge and compost applied to soil for the projected period was provided by the Ministry of Agriculture (MoA). To calculate N_2O emissions from crop residues the main activity data was projected; values of the main crops that represent majority of crops harvested and harvested area of these crops (Table 5-37). The activity data for other crops remained constant. In 2019 organic C in mineral soils was accumulated and emissions were not occurring from this subcategory, therefore it was assumed that during the projected period organic C in mineral soils will continue to accumulate. According to the MoA area of grasslands and cropland will not change significantly, thus emissions from cultivation of histosols subcategory were estimated based on this assumption.

CO_2 emissions from urea application and liming

Default emission factor for urea application, limestone and dolomite were taken from 2006 IPCC Guidelines. Projection of urea application and applied liming materials to soils were provided by the MoA.

It is projected that emission from liming application will be increasing during the projected period. It is expected that CO_2 emissions will increase by 30% in 2040 compared to 2019.

Table 5-31. Projected CO_2 emissions from liming application, kt

Liming application	2019	2020	2025	2030	2035	2040
CO_2 emissions from urea application	16	16	16	14	13	11
CO_2 emissions from liming	12	7	16	16	16	16

It is projected that emissions from urea application will decrease during the projected period. CO_2 emissions will decrease by 29% in 2040 compared to 2019.

5.1.4.2 Scenario "with additional measures" (WAM)

The WAM scenario is based on the additional measures provided by the MoA, the implementation period of measures will cover the period of 2021-2030. For the period of 2031-2040 all additional measures will continue to be implemented at the same rate as it is expected in 2030. Most of these measures focus on more sustainable use of inorganic N fertilizers, application of environmentally friendly technologies and also on increase of air pollution taxes.

List of policies and measures and cumulative GHG reduction effect for 2021-2030 is provided in Chapters 4.3.4 and 5.2.

The emissions from agriculture sector for WEM and WAM scenarios are provided in the table and figure below.

Table 5-32. Projected GHG emissions from agriculture sector according to WAM scenario (kt CO_2 eq.)

	2019	2020	2025	2030	2035	2040
Enteric fermentation	1 483	1 445	1 431	1 440	1 391	1 338
Manure management	411	411	379	385	385	381
Agricultural soils	2 334	2 571	2 181	1 871	1 804	1 744
Urea application	16	16	16	14	13	11
Liming	12	7	16	16	16	16
Total GHG emissions	4 256	4 451	4 023	3 726	3 609	3 490

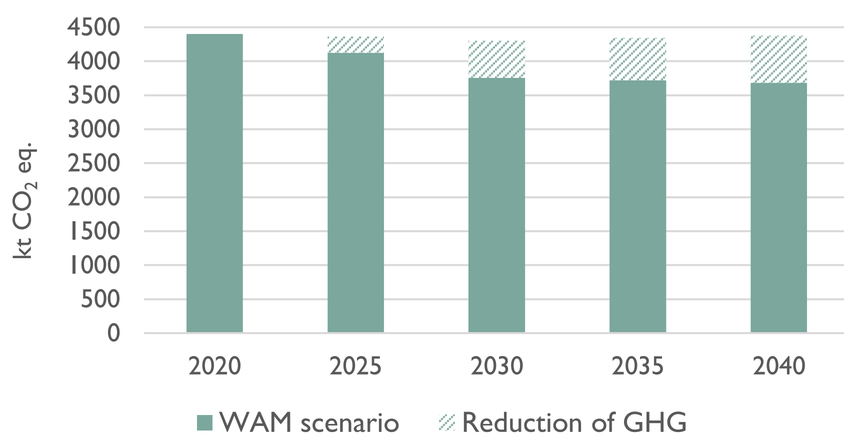

Figure 5-24. Projected emissions of agriculture sector under WAM scenario

5.1.4.3 Methodology and key assumptions

Projections of GHG emissions from agriculture sector with existing (WEM) measures is based on projected livestock population, milk production, milk fat, and the share of manure management systems for the main livestock categories (dairy cattle, non-dairy cattle and swine). GHG projections of agricultural soils category are based on projected consumption of inorganic and organic N fertilizers, main harvested crops and area harvested, application of urea and consumption of liming materials (limestone and dolomite) used for soils. Projections of the data mentioned above are provided by the Ministry of Agriculture (MoA), Lithuanian Institute of Agrarian Economics and Institute of Animal Science. Scenario with additional measures (WAM) is based on additional measures provided by the MoA.

All projected data were available for the years of 2025, 2030 and 2040. The data in between were interpolated.

Summary table of assessed emission sources from agriculture sector, methods applied and emission factors are provided in the table below.

Table 5-33. Methods and emissions factors used to estimate emission from agriculture sector

CRF	Source	GHG emissions reported	Methods	Emission factor
3.A	Enteric fermentation	CH_4	T1, T2	CS, D
3.B	Manure management	CH_4, N_2O	T1, T2	CS, D
3.D	Agricultural soils	N_2O	T1	D
3.G	Liming application	CO_2	T1	D
3.H	Urea application	CO_2	T1	D

Livestock populations

The most important projection parameter in agriculture sector is livestock populations. CH_4 emissions from enteric fermentation of dairy and non-dairy cattle categories are responsible for 95% of emission resulting from total enteric fermentation emissions. Dairy cattle, non-dairy cattle, swine and poultry categories are responsible for 90% of CH_4 emissions from manure management. Dairy cattle and non-dairy cattle are responsible for 81% of N_2O emissions from manure management. Therefore, these livestock populations are considered as the most important. The values of livestock population are presented in the table below.

Table 5-34. Projected number of livestock population in Lithuania, thous. heads

Livestock categories	2019	2020	2025	2030	2035	2040
Dairy cattle	249	237	235	229	210	190
Non-dairy cattle	409	408	402	410	405	400
Swine	561	566	550	550	600	650
Sheep	173	161	176	200	200	200
Goats	15	15	15	15	15	15
Horses	13	13	13	14	13	12
Fur-bearing animals*	967	1 067	1 300	1 293	1 286	1 278
Poultry	10 740	10 435	13 314	14 675	15 998	17 320

*Fur-bearing animals include rabbits, minks, nutrias and foxes populations

It is projected that dairy cattle population will decrease by 24% from 249 thous. heads in 2019 to 190 thous. heads in 2040. It is projected that dairy cattle productivity will increase, however number of cattle that are kept in small farms will systematically decrease, therefore the total population of dairy cattle will decrease.

Populations of non-dairy cattle will decrease by 2% from 409 thous. heads in 2019 to 400 thous. heads in 2040. It is projected that after 2025 the demand for quality beef will increase, therefore non-dairy cattle population will slightly increase.

It is assumed that around 80% of swine population are grown under industrial pork production therefore it is expected that African swine fever (ASF) will be overcome. Considering that in 2020 internal market for pork was twice larger than produced in the country it is projected that populations of swine will be increasing from 2030 during the whole period. Swine population from 2019 until 2040 will increase by 16%.

As sheep and goats farming is becoming more environmentally friendly way to maintain landscape, also farmers gain more experience in creating added value form sheep and goats' production, so it is assumed that populations of sheep and goats will increase. It is projected that sheep population will increase 16% from 173 thous. heads in 2019 to 200 thous. heads in 2040, goats' population will increase 2% from 14.7 thous. heads in 2019 to 15 thous. heads in 2040. Horse population will decrease by 7% from 13 thous. heads in 2019 to 12 thous. heads in 2040, the projection was based on historical data. It is projected that fur-bearing animals (nutria, rabbits, minks, foxes) population will increase 32% from 967 thous. heads in 2019 to 1 278 thous. heads in 2040. It is projected that overall poultry population will increase by 61% in 2040 compared to 2019.

Other livestock activity data projections

Other important livestock data are milk production and manure management systems. The MoA has provided projections of distribution of manure management systems for the most important livestock categories.

Table 5-35. Projected values of livestock production

Livestock production	2019	2020	2025	2030	2035	2040
Milk production, kg/yr	6 225	6 258	6 450	7 100	7 800	8 500
Milk fat content, %	4.18	4.17	4.24	4.27	4.29	4.30

Projections of milk production and milk fat were provided by the MoA. It is projected that milk production will increase by 37% in 2040 compared with 2019. Milk fat will increase by increase by 3% during projected period comparing with the 2019.

Table 5-36. Projected values of distribution of manure management systems, %

Manure management systems	2019	2020	2025	2030	2035	2040
Dairy cattle						
Solid storage	36.7	34.2	35.0	34.0	32.5	31.0
Liquid	33.3	36.3	37.5	41.0	45.0	49.0
Pasture	30.0	29.5	27.5	25.0	22.5	20.0
Non-dairy cattle						
Solid storage	34.8	33.9	37.3	37.7	38.4	39.0
Liquid	21.5	21.6	19.3	18.3	17.2	16.0
Deep bedding	12.2	12.8	11.6	11.7	11.8	12.0
Pasture	31.5	31.7	31.8	32.3	32.6	33.0
Swine						
Solid storage	8.9	8.6	7.1	6.4	5.7	5.0
Liquid	53.9	55.5	52.1	49.7	47.3	45.0
Deep bedding	1.8	1.7	1.4	1.0	0.5	0.0
Anaerobic digesters	35.2	34.1	39.4	42.9	46.5	50.0

For dairy cattle it is expected that solid manure management system will decrease by 6%, as liquid manure management system increase by 16% in 2040 compared to 2019. As small farms are decreasing it is expected that fewer dairy cattle will be grazed on pastures therefore the period that animals will be grazed is projected to decrease by 10% in 2040 compared to 2019.

For non-dairy cattle it is projected that solid manure management system will increase by 3% in 2040 compared to 2019. Liquid system will decrease by 6% in 2040 compared to 2019. It is expected that grazing period will increase by 2% in 2040 compared to 2019.

For swine category it is projected that solid and deep bedding manure management systems will gradually decrease respectively by 4% and 1.8% in 2040 compared to 2019. As anaerobic digesters are promoted it is expected that this manure management system will increase by 15% in 2040 compared to 2019. As the share of manure, which is handled in anaerobic digesters will increase, manure that is handled in liquid manure management system will decrease by 9% in 2040 compared to 2019.

Crops residue projections

The projections of area harvested and harvested crops are based on historical data, situation of global market and development of agro-biotechnology. The projections of main activity data are presented in the table below.

Table 5-37. Projected amount of crops harvested and area harvested

Harvested crops (thous. tons)	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Winter wheat	3 352	4 246	3 457	2 949	2 654	2 359
Spring wheat	492	573	513	530	517	504
Triticale	347	437	356	304	307	310
Barley	588	706	581	561	563	567
Oats	178	276	248	233	245	257
Rape	689	967	878	834	874	914
Peas	156	151	214	235	270	305
Beans	127	219	197	206	227	247
Buckwheat	31	37	51	55	63	71
Perennial grasses up to 5 years (excl. alfalfa, clover and their mixtures)	1 054	1 000	887	929	1 069	1 208
Area harvested (thous. ha)						
Winter wheat	739	751	649	556	500	445
Spring wheat	156	142	158	156	152	148
Triticale	105	115	101	95	96	97
Barley	175	165	174	170	171	172
Oats	86	105	106	111	116	122
Rape	242	284	279	273	286	299
Peas	75	62	99	112	128	145
Beans	55	58	69	79	87	95
Buckwheat	28	39	45	49	57	65

Perennial grasses up to 5 years (excl. alfalfa, clover and their mixtures)	188	145	137	143	165	186

In general, it is projected that crop yield will be increasing by reducing crops cultivation in less fertile areas and implementing intensive growth technologies in specialized more efficient (fertile) soil farms. Crop yield will be also increasing due to concentration of farms in the lands of middle Lithuania, the rise of farming culture, implementation of new technologies and best practice of the EU[16].

According to projections provided by the MoA harvest of crops will increase. Wheat, barley and rape will remain the main grown crops in the country. It is projected that harvest of legumes crops (peas and beans) will increase by 95% in 2040 compared to 2019. It is expected that area harvested of barley and triticale will decrease over projected period due to adverse trade conditions and structure of agriculture production. It is expected that the "EU Biodiversity Strategy for 2030"[17] and "Farm to fork"[18] strategies will encourage to convert agriculture land to grasslands, therefore it is projected that perennial grasses will increase by 15% in 2040 compared to 2019.

Inorganic and organic N fertilizer projections

Projections of inorganic and organic N fertilizers consumption were based on the projected harvest area and yield of crops.

The projections of activity data are presented in the table below.

Table 5-38. Projected amount of inorganic and organic N fertilizers consumption, kt N

Activity data	2019	2020	2025	2030	2035	2040
Inorganic N fertilizers	176	199	164	146	132	119
Urea application	10	10	9.9	8.8	8.0	7.2
Animal manure	32	32	29.9	30.9	31.0	31.0
Compost	0.143	0.178	0.127	0.144	0.166	0.187
Sewage sludge	0.547	0.557	0.761	0.762	0.766	0.770

The consumption of inorganic N fertilizers increased by 13% during the period of 2019-2020, however taking into account the "EU Biodiversity Strategy for 2030" and "Farm to fork" strategies it is assumed that consumption of inorganic N fertilizer will decrease by 40% during the period of 2020-2040. As consumption of total inorganic N fertilizer will be decreasing during the period of 2020-2040, likewise urea application will decrease.

[16] Kriščiūnaitė, I., Andrikienė, S., Galnaitytė, A., Jedik, A. 2010. *The outlook of the agriculture sector development*. Scientific study. Vilnius: Lithuania Institute of Agrarian Economics. Available from: http://www.laei.lt/?mt=leidiniai&straipsnis=292&metai=2010

[17] Communication from the Commission to the European Parliament, The Council, the European economic and social committee and the Committee of the regions – EU Biodiversity Strategy for 2030: bringing nature back into our lives, COM (2020) 380 final. Available from: https://eur-lex.europa.eu/resource.html?uri=cellar:a3c806a6-9ab3-11ea-9d2d-01aa75ed71a1.0001.02/DOC_1&format=PDF

[18] Communication from the Commission to the European Parliament, The Council, the European economic and social committee and the Committee of the regions – A Farm to Fork Strategy: for a fair, healthy and environmentally-friendly food system, COM (2020) 381 final. Available from: https://eur-lex.europa.eu/resource.html?uri=cellar:ea0f9f73-9ab2-11ea-9d2d-01aa75ed71a1.0001.02/DOC_1&format=PDF

The use of organic N fertilizers will decrease by 2% in 2040 compared to 2019. The major increase will be in the consumption of compost and sewage sludge compared to animal manure applied to soils.

Liming materials projections

Projections of liming materials were based on the changes of crops area. Projected activity data are provided in the table below.

Table 5-39. Projected amount of limestone and dolomite consumption, tones

Activity data	2019	2020	2025	2030	2035	2040
Limestone	23 579	13 833	31 005	31 018	31 178	31 338
Dolomite	4 281	1 966	5 027	5 029	5 162	5 258

In general, it is projected that agricultural soil liming will increase by 32% during the projected period. Consumption of limestone will increase by 33% in 2040. However, consumption of dolomite will decrease by 23% during the same period.

About three decades (1964-1994) soils has been consistently limed (every 5-7 years), but since 1997 soils liming has decreased sharply and as a result, currently about 66% of soil is acidic[19]. In order to improve soil quality, it is projected that in general soil liming consumption will be increasing in 2019-2040 period.

5.1.5 LULUCF

Projected GHG removals and emissions from LULUCF sector, according to scenario with existing measures (WEM) and scenario with additional measures (WAM) are presented in the table and figure below.

Table 5-40. Projected total GHG removals from LULUCF sector under WEM and WAM scenarios, kt CO_2 eq.

LULUCF categories	2019	2020	2025	2030	2035	2040
WEM scenario	-5 302	-5 407	-4 928	-4 945	-4 603	-4 497
WAM scenario	-5 302	-5 407	-5 895	-6 791	-7 076	-7 262
Difference (WEM-WAM), kt CO_2 eq.	0	0	967	1 846	2 472	2 765
Difference (WEM/WAM), %	0	0	16	27	35	38

[19] Repšienė, R., Karčauskienė, D., Ambrazaitienė D. 2014. *The use of lime materials enriched with humus in acidic soil*. Scientific article. Klaipėda. Available from: http://www.zak.lt/mokslo_darbai/2014_157_164.pdf

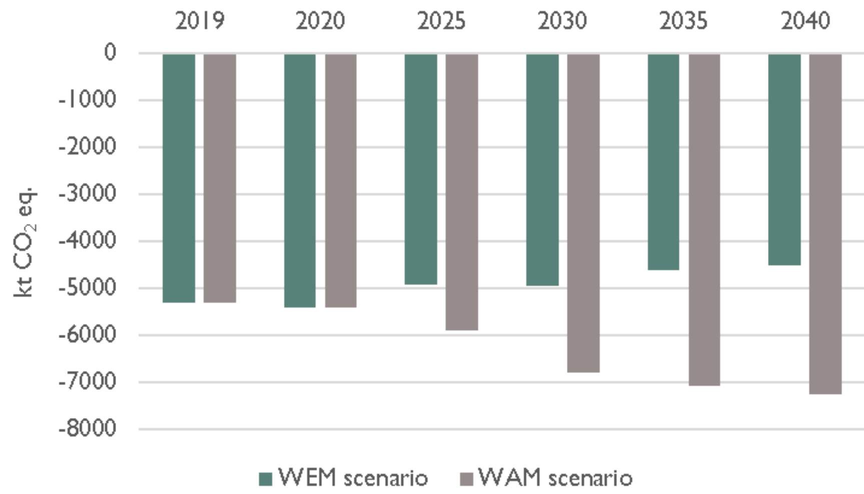

Figure 5-25. Projections under WEM and WAM scenarios in LULUCF sector

Projection of GHG emissions and removals in LULUCF sector include all relevant categories and subcategories as reported for the EU and the UNFCCC for LULUCF sector, including all relevant parameters such as land-use area, annual carbon stock change in living biomass, annual carbon stock change in dead wood and litter, carbon stock change in mineral and organic soils, implied emission factors for drainage of soils and burning of biomass, etc. Carbon stock changes and GHG emissions/removals in forest land were calculated for above and below-ground biomass, dead wood and harvested wood products applying projected growing stock volume change, felled and naturally dead trees' volume. For the estimation of GHG emissions/removals calculation spreadsheets as used in annual GHG inventory were applied with national and default factors, using 2006 IPCC Guidelines.

Total projections of GHG emissions and removals from LULUCF sector under WEM and WAM scenarios showed that both scenarios reflect a declining LULUCF carbon sink. Decline is explained by decreasing GHG removals in forest land remaining forest land biomass due to the aging forest stands.

In order to define the most accurate development for each of the sector's categories the following policies were taken into account preparing estimations of projections with existing measures:

- National Forestry Development Programme for 2012-2020;
- National Rural Development Programme for 2014-2020;
- The Strategy for the National Climate Change Management Policy;
- Inter-institutional Action Plan on the implementation of the Goals and Objectives of the Strategy for the National Climate Change Management Policy;
- National Energy and Climate Action Plan for 2021-2030 (NECP).

For the estimation of projections with additional measures (measures under discussion, not adopted) NECP was taken into account, as well as assumption of forest land increase (forest cover could reach 35% by 2040), which was mentioned as an aim in the National Forestry Development Program for 2012-2020.

Lithuania is using 2006 IPCC Guidelines for GHG emissions and removals estimation in LULUCF sector and GHG projections as well, while 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands are not yet implemented since it is not mandatory in this commitment period.

5.1.5.1 Scenario "with existing measures" (WEM)

Scenario with existing measures include measures were already adopted and implemented, meaning that significantly fewer measures were included in WEM scenario compared to WAM: afforestation/reforestation measure, planned in National Forestry Sector Development Programme for 2012-2020 and its Implementation plan until 2020, redevelopment of stands and shrubs and promotion of cover crop cultivation.

Methodological assumptions

Forest land remaining forest land. The main carbon sink in the category is biomass, carbon stock changes are estimated from the growing stock volume changes estimated during NFI measurements and projected on the same basis regarding historical growing stock volume increment and forest use. The total volume of Lithuanian forests, the increase of the volume, the volume of felled and naturally dying trees were forecasted taking into account the change in growing stock volume increment inventoried by the NFI in 2002-2018 and its use. This data was used as a reference point for the estimation of total growth and its structure (main use, intermediate use, dead tree volume and volume change) in 2019-2040. The annual growing stock volume increment is slightly decreasing due to the ageing forests: from 20.20 in 2020 to 19.62 million m^3 per year in 2040. The decreasing growing stock volume increment is mainly related to changes in the structure of the tree age classes: recently, the middle-aged stands occupying the largest areas and generating the largest volume and carbon accumulation have been ageing, which leads to increasing areas of older and more mature stands with lower growing stock volume increment and GHG uptake. The projected increase in the felled is related both to the increase in the volume felled during main felling in mature stands due to the projected increase in the area of mature trees and to the increase in the volume felled during intermediate felling, in particular thinning, in order to increase forest sustainability and reduce tree death and forest losses. The main use of forests was estimated taking into account the equivalent area of mature stands to be felled and the average volume of mature stands. An equivalent area of mature stands to be felled each year was calculated on the basis of the age class distribution of each tree species and the use of mature stands over a period of 12 to 15 years. In order to reduce natural mortality and consequently forest cultivation losses, a gradual increase in the use of intermediate forests was forecasted. Intermediate forest use is projected to account for 40-50% of main forest use. In view of the increase of final and intermediate forest felling, total felled volume was projected to increase from 10.11 million m^3 in 2017 to 11.59 million m^3 in 2040. Thus, due to the projected increase in the volume of intermediate felling, smaller natural mortality (losses) of trees was projected. Volume accumulation in stand over the projection period is defined as the difference between the total growing stock volume increase and felled volume as well as natural mortality. The volume of felled trees and natural losses account for between 72% and 75% of the total annual increment in stand volume.

Land converted to forest land (including afforestation and natural forest expansion). Projections of afforested areas and areas under natural forest expansion were estimated taking into account the former goal of forest coverage increase up to 34.2% by 2020 and actual converted areas in 2019. Afterwards, starting in 2021, annual land converted to forest land area was projected to be 3.2 thous. ha.

Cropland, Grassland, Wetlands, Settlements and Other land. Remaining areas and land converted to other land areas were assumed to remain as preliminary estimated for 2019 due to no exact measures adopted and implemented. However, for conversions between cropland and grassland the average of areas converted to and between those land uses during the recent 10 years period was applied. Therefore, stable grassland area, as adopted in Lithuania's Rural Development Programme for 2014-2020, is maintained during the whole projection period. Significantly increasing cover crop areas are projected, reaching up to 100 thous. ha in 2030 already.

Harvested wood products. Due to projected increasing harvest (as a result of aging forests), the projected felled volume was applied to estimate relative increase in wood commodities, compared to the recent data available (2019). The same distribution between wood commodities was maintained for the projections as reported for 2019, as well as share between total harvested wood volume used for energy and non-energy purposes, used for harvested wood volume carbon stock changes estimation.

All projected WEM removals and emissions are included in Table 5-41.

Table 5-41. Projected total GHG emissions from LULUCF sector, kt CO_2 eq. (WEM)

LULUCF sector categories	2019	2020	2025	2030	2035	2040
Forest land	-6 496	-6 485	-5 895	-5 783	-5 672	-5 662
Cropland	863	935	946	912	1 146	1 252
Grassland	-834	-753	-633	-614	-532	-532
Wetlands	821	994	817	817	817	817
Settlements	772	599	656	490	355	293
Other land	352	60	37	12	0	0
Harvested wood products	-808	-784	-855	-779	-718	-665
Total GHG removals	**-5 302**	**-5 407**	**-4 928**	**-4 945**	**-4 603**	**-4 497**

According to the WEM scenario, it was previously assumed that forest land area will reach 34.2% of the total country area in 2020 as it was determined in the National Forestry Development Programme for 2012-2020. It was assumed that due to the implementation of measures for afforestation/reforestation activities, listed in National Forestry Development Programme for 2012-2020 and Interinstitutional action plan on the implementation of the goals and objectives of the Strategy for the National Climate Change Management Policy, which contains LULUCF action plan measures under the LULUCF decision No 529/2013/EU, land conversion to forest land will remain as determined in base year, therefore total forest land area should increase approx. 3.2 thous. ha annually. Felling rates will significantly increase from 10.72 mill. m^3 in 2018 to 11.59 mill. m^3 in 2040. Thus, the potential of harvesting will be better exploited in Lithuania, taking into account the increasing areas of mature forest stands. Current (2019) cropland and grassland areas will remain constant, while share between conversions among these two land use categories are projected as an average converted area during 2010-2019 (preliminary data). Decreasing GHG removals in whole LULUCF sector are projected during 2019-2040 from -5 302.10 kt CO_2 eq. in 2019 to -4 497.34 kt CO_2 eq. in 2040.

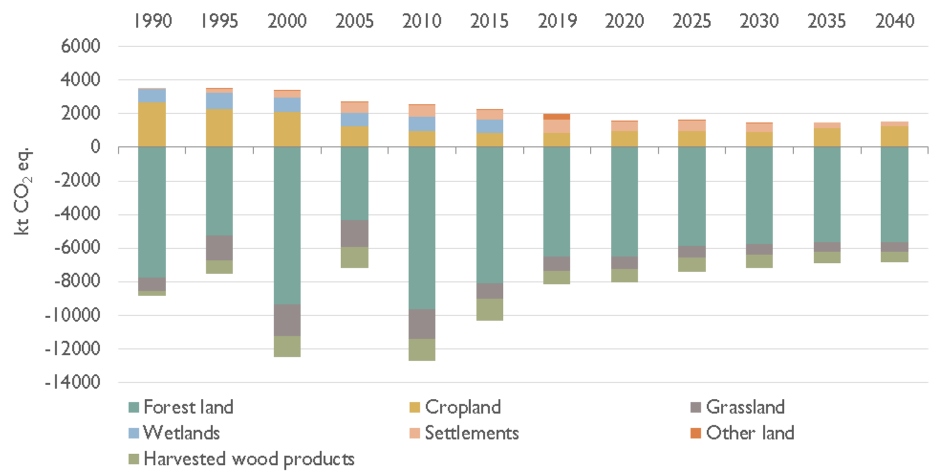

Figure 5-26. Historical and projected GHG emissions and removals from LULUCF sector (WEM scenario)

5.1.5.2 Scenario "with additional measures" (WAM)

Scenario with additional measures included abovementioned assumptions and projection descriptions for *forest land remaining forest land and land converted to forest land subcategories* and *harvested wood products* pool, therefore carbon stock changes in those subcategories are the same as reported under WEM scenario.

Cropland. Areas of no tillage cropping practice were included since 2021, constantly increasing annually and reaching 800 thous. ha in 2040, which have an impact to carbon stock changes in mineral soils in cropland remaining cropland subcategory. In addition to this, the increase of perennial cropland is projected (up to 23 thous. ha in 2040). Conversions from cropland to wetlands (rewetting and restoration of previously exploited organic soils, 20 thous. ha by 2040) were projected to decrease GHG emissions in cropland category.

Grassland. Cultivation of herbaceous vegetation (grassland) in organic soils with restored natural water level and the promotion of sustainable use thereof (conversion from cropland to grassland, 40 thous. ha by 2040) is projected according to the National Climate and Energy Action Plan for 2021-2030.

Wetlands, Settlements and Other land. GHG emissions are the same as reported under WEM scenario.

All projected WAM removals and emissions are included in Table 5-42.

Table 5-42. Projected GHG removals in LULUCF sector, kt CO_2 eq. (WAM)

	2019	2020	2025	2030	2035	2040
Forest land	-6 496	-6 485	-5 896	-5 783	-5 672	-5 662
Cropland	863	935	-9	-911	-1 130	-1 211
Grassland	-834	-753	-644	-632	-724	-829
Wetlands	821	994	815	812	812	812
Settlements	772	599	656	490	355	293
Other land	352	60	37	12	0	0

Harvested wood products	-808	-784	-855	-779	-718	-665
Total GHG removals	**-5 302**	**-5 407**	**-5 895**	**-6 791**	**-7 076**	**-7 262**

More controversial scenario is with additional measures which include adopted PaMs to mitigate climate change, which were planned to implement from the start of the new commitment period (2021) and were included in the NECP for 2021-2030. Forest land area was expected to increase up to 35% of total country area according to the suggestions (not exactly determined in any of the strategic planning documents). Increase in forest land area mostly depends on support from national programs for afforestation of abandoned lands. However, specific measures adopted to protect natural afforestation and reforestation areas (natural forest expansion) in abandoned or not suitable for agricultural purposes land could have a significant impact for increasing LULUCF GHG removals. The need for forest land area increase is foreseen in NECP. Preliminary assumption of annual 3.2 thous. ha conversions to forest land were included in projections of forest land GHG emissions/removals balance. Felling rates were expected to remain increasing as reported under WEM scenario. Carbon stock changes in other pools in forest land remaining forest are projected to develop same as for WEM scenario. Cropland area was not expected to increase in the nearest future, which will result in stable area of grasslands up to 2040. Advanced cropland management practices (no-tillage cropping system, ecological farming, and cover crops) were assumed to result in increased carbon sequestration in mineral soils of cropland remaining cropland subcategory. Total cropland emissions were projected to decrease until 2030. However, emissions were projected to increase from 2031 onwards. It was expected that grassland category will act as a net sink over 2019-2040 period adding a significant value to the total LULUCF GHG removals. LULUCF WAM scenario projections provide higher and increasing net sink of GHG removals during 2019-2040 from -5 302.10 kt CO_2 eq. in 2019 to -7 261.97 kt CO_2 eq. in 2040.

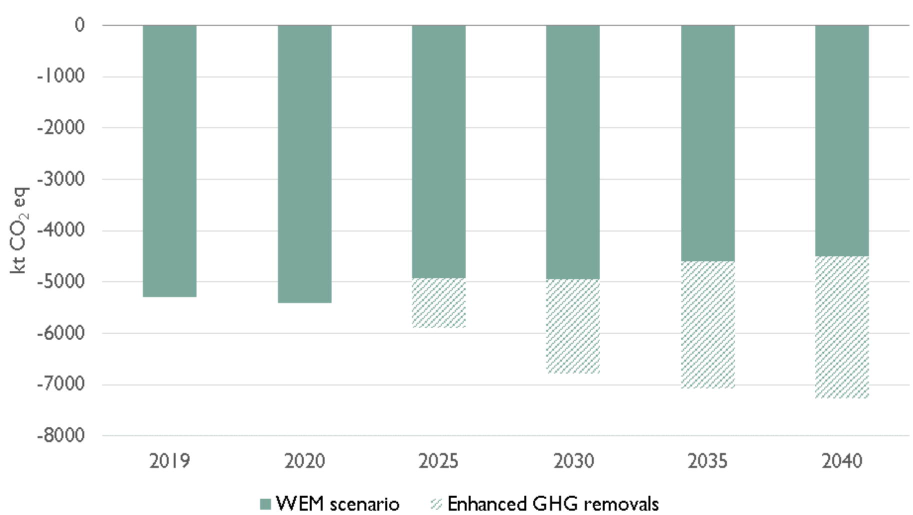

Figure 5-27. Projected GHG removals in LULUCF sector under WAM scenario

5.1.5.3 Methodology and key assumptions

Methodology for estimation of projected GHG emissions and removals is the same as used for annual GHG inventory submitted under UNFCCC. Short description of the methodology used for GHG projections estimation is provided in this Chapter, detailed description of the methodology for GHG emissions and removals estimation in LULUCF sector is provided in National GHG Inventory report 2022, Chapter 6.

The main data source for land use changes and growing stock volume changes in forest land is National forest inventory, started in 1998 on forest land and expanded to all land use since 2012. Therefore, implementing UNFCCC and its Kyoto Protocol requirements in order to comprehensively identify and quantify areas specific to LULUCF activities annually in the period of 1990-2011, two studies were launched. The study "*Forest land changes in Lithuania 1990-2011*" (*Study-1*) was addressed to recover land use changes specifically to forests and study "*Changes of areas of Croplands, Grasslands, Wetlands, Settlements and Other lands in Lithuania during 1990-2011*" (*Study-2*) was addressed to track changes of croplands, grasslands, wetlands, settlements and other lands. Thus, by implementing these studies Lithuania became able to identify land use areas and to monitor their changes for the whole time series starting with 1990. Therefore, one of the fundamental outcomes of these two studies was creation of a single and comprehensive database of land use areas in Lithuania.

Forest land

The GHG inventory for Forest land remaining forest land involves estimations of changes in carbon stock in five carbon pools (above-ground biomass, below-ground biomass, dead wood and litter, and soil organic matter) as well as estimations of non-CO_2 gases from those pools, using 2006 IPCC Guidelines. The algorithm for assessment of carbon stock changes in carbon pools is given below:

ΔC_{LUi} – carbon stock changes for a stratum of a land-use category;

ΔC_{AB} – annual change in carbon stock in above-ground biomass, t C yr^{-1};

ΔC_{BB} – annual change in carbon stock in below-ground biomass, t C yr^{-1};

ΔC_{DW} – annual change in carbon stock in deadwood, t C yr^{-1};

ΔC_{LI} – annual change in carbon stock in litter, t C yr^{-1};

ΔC_{SO} – annual change in carbon stock in soil, t C yr^{-1};

ΔC_{HWP} – annual change in carbon stock in harvested wood products, t C yr^{-1}.

ΔC_{AB}, ΔC_{BB} and ΔC_{DW} are calculated using NFI data on growing stock and dead wood volume changes, default basic wood density factors for coniferous and deciduous tree strands, country specific biomass expansion factors for coniferous and deciduous tree stands, default carbon fraction of dry matter.

ΔC_{LI} is calculated for land converted to forest land only, using area from NFI measurements and country specific carbon stock change factors. It is assumed that there are no carbon stock changes in litter in forest land remaining forest land.

ΔC_{SO} for mineral soils are calculated for land converted to forest land only, using area from NFI measurements and country specific carbon stock change factors in mineral soils. It is assumed that there are no carbon stock changes in mineral soils in forest land remaining forest land (as show the results from BioSoil project[1,11]). Carbon stock changes in organic soils are calculated as a consequence of drainage, where areas of drained organic soils are estimated using proportion of drained organic soils, established during 2nd NFI measurement cycle (2003-2007), and actual forest land remaining forest land and land converted to forest land areas with default emission factors for CO_2 and N_2O emissions.

ΔC_{HWP} is calculated using statistics of wood commodities (sawnwood, wood-based panels, paper and paper-board) as reported by FAO and calculation spreadsheets with default half-life values for each product group under IPCC 2006 Guidelines.

Additionally, to carbon stock changes reported in pools, GHG emissions from biomass burning are also calculated. Data on areas affected by forest fires under the category Forest land remaining Forest land is provided by the Directorate General of State Forests, as well as the proportion of biomass, litter and peat layer burnt in the event of a fire. Default emission factors of CO_2, CH_4 and N_2O are applied from the 2006 IPCC Guidelines.

Land converted to forest land

Data of areas of land converted to forest land are obtained from NFI measurements (natural forest expansion) and National Paying Agency (afforestation/reforestation under KP reporting). For the estimation of carbon stock changes in living biomass, growing stock volume of Lands converted to Forest land was estimated using data of *NFI* permanent sample plots on mean growing stock volume of non-forest Lands converted to Forest land according to the year of conversion. Growing stock volume estimation for new measured sample plots is executed using annual area of land converted to forest land, distributed according to the number of years after conversion, and modelled mean growing stock volume change for each of the abovementioned land converted to forest land group. 2nd order polynomial trend was used to come up with mean growing stock volume and mean growing stock volume increment of lands converted to forest land. Basic wood density, biomass expansion factors and carbon fraction from dry biomass are applied as for forest land remaining forest land. It is assumed that dead wood is not present in newly afforested areas/natural forest expansion areas, therefore only carbon stock changes in litter and soils are estimated using country specific stock change factors. GHG emissions due to the drainage of organic soils are calculated as for forest land remaining forest land.

Cropland & Grassland

The GHG inventory for cropland and grassland involves estimations of changes in carbon stock in carbon pools: biomass and soil organic matter as well as estimations of non-CO_2 gases from those pools, using 2006 IPCC Guidelines.

Biomass carbon stock changes are calculated for cropland category in the subcategory of perennial cropland – commercial gardens with the default biomass growth and final biomass at the time of harvest values. Biomass carbon stock changes in land converted to cropland and land converted to grassland category are calculated due to the different maximum biomass accumulated in different land-use categories as provided in 2006 IPCC Guidelines. In addition to this, carbon stock changes in litter and dead wood in lands converted to and from grassland were included in the reporting for projections for the first time.

ΔC_{SO} for mineral soils are calculated for land converted to cropland or grassland only, using area from NFI measurements and country specific carbon stock change factors developed in mineral soils. Carbon stock changes in organic soils are calculated as a consequence of drainage, where areas of drained organic soils are estimated using proportion of drained organic soils, established during years 2014-2018 of NFI measurements, and actual cropland and grassland areas with default emission factors for CO_2 and N_2O emissions.

Additionally, to carbon stock changes reported in pools, GHG emissions from biomass burning are calculated as well. Data on areas affected by wildfires under the categories of cropland and grassland are provided by the Fire and Rescue Department under the Ministry of Internal Affairs. Default emission factors of CO_2, CH_4 and N_2O are applied from 2006 IPCC Guidelines.

Wetlands, Settlements & Other land

Calculations are done similarly to grassland category with corresponding default carbon stock change or emission factors from 2006 IPCC Guidelines. The exception is peat extraction remaining peat extraction subcategory, where GHG emissions are calculated both from the area of peat extraction sites (provided by Lithuanian Geological Survey) and amount of peat produced for horticultural uses (data provided by the Statistics Lithuania).

Summary table of reported emissions from sources and removals from sinks as well as methods and emission factors used is provided below.

Table 5-43. Reported emissions/removals and calculation methods for LULUCF sector categories

CRF category	Emission / removal reported	Methods used	Emission factor used
4.A Forest Land; 4.B Cropland; 4.C Grassland; 4.D Wetlands; 4.E Settlements; 4.F Other land			
Carbon stock change	CO_2	T1; T2	CS; D
4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO_2; N_2O	T1; T2	D
4(III) Direct N2O Emissions from N Mineralization/Immobilization	N_2O	T1: T2	CS; D
4(V) Biomass Burning	CO_2; N_2O	T1; T2	D
4.G Harvested wood products			
Sawnwood	CO_2	T1; T2	D
Wood panels	CO_2	T1; T2	D
Paper and Paperboard	CO_2	T1; T2	D

5.1.6 Waste

The emissions from Waste sector under WEM and WAM scenarios are presented in the table and figure below.

Table 5-44. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

Scenario	2019	2020	2025	2030	2035	2040
WEM	839.18	849.12	641.37	526.13	441.37	389.00

WAM	839.18	849.12	638.28	523.16	438.89	386.86
Difference (WEM-WAM), kt CO_2 eq.	0.00	0.00	3.09	2.97	2.47	2.14
Difference (WEM/WAM), %	0%	0%	0.5%	0.6%	0.6%	0.6%

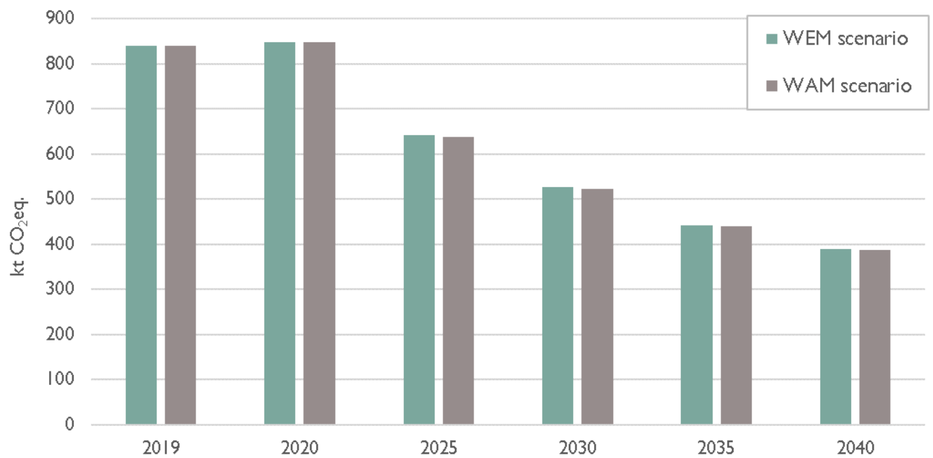

Figure 5-28. Projections in waste sector in case of WEM and WAM scenarios

5.1.6.1 Scenario "with existing measures" (WEM)

Solid waste disposal on land

Solid waste disposal on land, including stored sewage sludge, is the most significant GHG emission source from the waste sector. Projections of waste generation are based on historical as well as projected data on the population and generated the amount of MSW. The data on population trends was received from the European Commission and generated the amount of MSW was provided by the Ministry of Environment.

The revised legislative proposals on waste set clear targets for reducing waste and establishing an ambitious and credible long-term path for waste management and recycling. Lithuania sets ambitious targets for waste management and recycling by 2030. Lithuania expects to recycle and compost 65% of the total generated municipal waste, incinerate in cogeneration power plants 30% and dispose of in the landfills only 5%. Assumptions are thus in line with the assumptions made for developments of mechanical-biologically treated waste reported under sector Biological Treatment of waste. Some minor amounts of sludge are expected to be stored as well. Assumptions on the projected amounts of sludge are based on historical data. The projected data on waste generation and disposal are presented in the table below.

Table 5-45. Base year and projected amount of waste generation and disposal

Parameter	Units	2019	2020	2025	2030	2035	2040
Generation of municipal waste	kt	1 319	1 350	1 200.6	1 120.6	1 062.2	1 008.2

Municipal waste generated per capita	kg/capita	472	483	465	457	447	437
Disposal to landfills	%	23.48	17.59	14	5	5	5

A decreasing share of CH_4 recovery from landfills is due to deposited waste's decreasing gas generation potential. The assumption is based on data provided by Regional Waste Management Centers.

The projected data on CH_4 recovery is presented in the figure below.

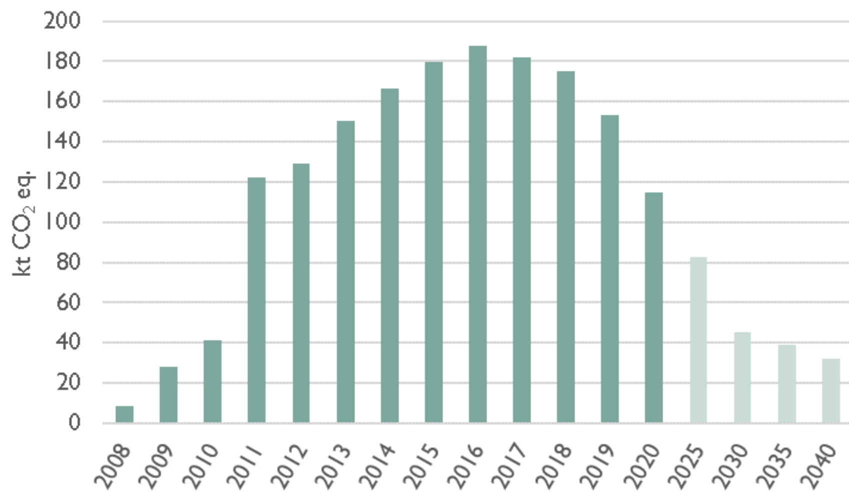

Figure 5-29. Historical and projected CH_4 recovery from landfills

The composition of landfilled waste is left as in 2019 and remains stable during the 2020-2040 period.

Biological treatment of solid waste

EU structural and investment funds are an important source of funding for municipal waste management infrastructure development. Implementing EU funded projects 9 sewage sludge, 55 green waste composting facilities, 1 mechanical sorting and 8 regional mechanical sorting and biological treatment plants were constructed by 2018.

Regional Waste Management Centres provided the projected data on the amount of composted waste and waste treated in anaerobic digestion plants. The amount of waste undergoing mechanical-biological treatment assumed to increase as separate kitchen and food waste collection is foreseen since the end of 2023. Household composting was evaluated by the number of composting bins distributed and the amount of composted waste (220 kg) per household.

Activity data for biological waste treatment is presented in the table below.

Table 5-46. Projected amount of waste undergoing biological treatment

Activity data	Unit	2025	2030	2040
Total amount of waste	tonnes	467 189	446 768	466 316

Wastewater treatment and discharge

EU structural and investment funds are an important source of funding for water sector. In 2007-2013 around 570 million EUR were invested into the wastewater collection and treatment system, focusing on the cities with more than 2 000 inhabitants. In 2014-2020, around 125 million EUR are planned to invest into wastewater collection and treatment system, focusing on the small town and villages with 200-2 000 inhabitants. These investments will help to further develop wastewater collection and treatment systems.

Biochemical oxygen demand (BOD) is one of the main parameters for assessing discharged wastewater compliance with requirements for discharges from urban wastewater treatment plants. BOD data was predicted based on historical data as well as the future development of wastewater collection and treatment system. BOD is expected to increase in line with the rising percentage of population connected to wastewater collecting system. The projected data on BOD and percentage of population connected to wastewater collecting system has been provided by the Ministry of Environment.

The main parameter to estimate N_2O emissions from human sewage is protein consumption. Protein consumption per capita was evaluated by the Health Education and Disease Prevention Centre (77.4 g/capita/day in 1998, 78.1 g/capita/day in 2002, 81.9 g/capita/day in 2007 and 63.6 g/capita/day in 2013). The protein consumption is left as 2018 and remains stable during the 2019-2040 period.

Incineration of waste

Waste incineration without energy recovery is the smallest source of GHG in Waste sector and it is not expected to expand. Assumptions on the projected amounts of incinerated hazardous and clinical waste are based on historical data.

Cogeneration power plant has started incineration of MSW in 2013 and two additional MSW incinerators are in operation since the end of 2020. It is assumed that operation of three MSW power plants will reduce the amount of MSW disposed of by landfilling and will overlay portion of fossil fuel used in public electricity and heat production sector. This assumption was incorporated in the final fuel used in Energy sector.

Table 5-47. Projected GHG emissions from waste sector (kt CO_2 eq.) under WEM scenario

	2019	2020	2025	2030	2035	2040
Solid waste disposal*	573.68	590.58	417.01	320.97	235.57	182.50
Biological treatment of waste	97.35	91.46	94.19	96.94	100.79	104.41
Waste incineration	1.73	2.18	1.51	1.51	1.51	1.51
Wastewater treatment and discharge	166.41	164.91	128.66	106.71	103.50	100.57
Total	839.18	849.12	641.37	526.13	441.37	389.00

*Including emissions from sewage sludge and CH_4 recovery

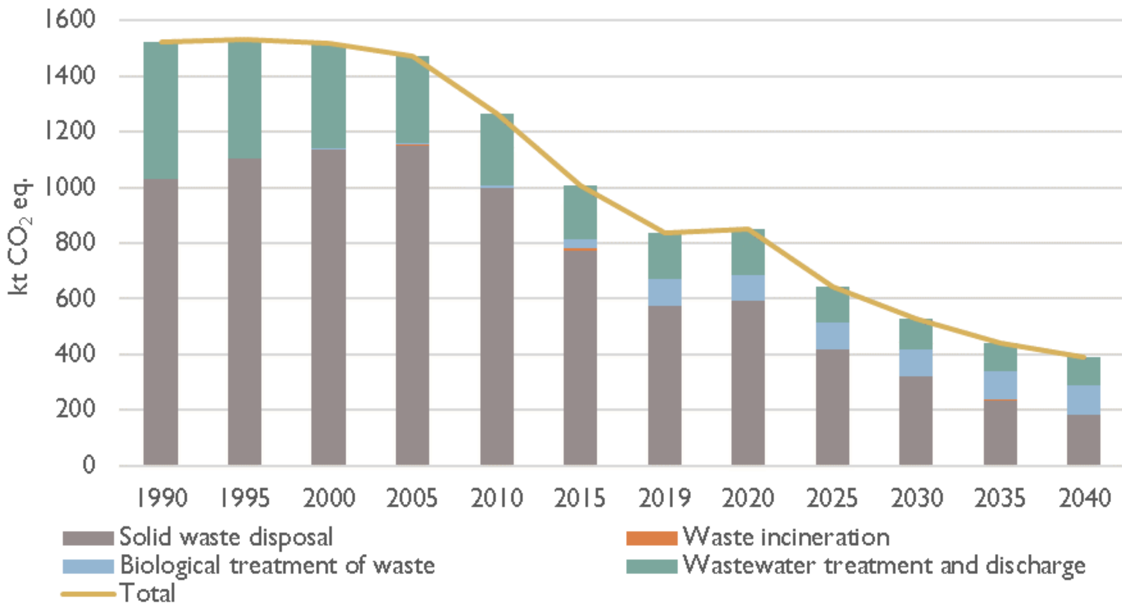

Figure 5-30. Historical and projected GHG emissions from waste sector under WEM scenario

Solid waste disposal on land

GHG projections were estimated based on the assumption that national targets such as reduction of the quantity of landfilled waste, increase of biodegradable waste composting, increase of the recovered gas use for energy will be achieved. Implementation of these targets will lead to gradual reduction of CH_4 emissions and will reach 183 kt CO_2 eq. (incl. CH_4 recovery) by 2040.

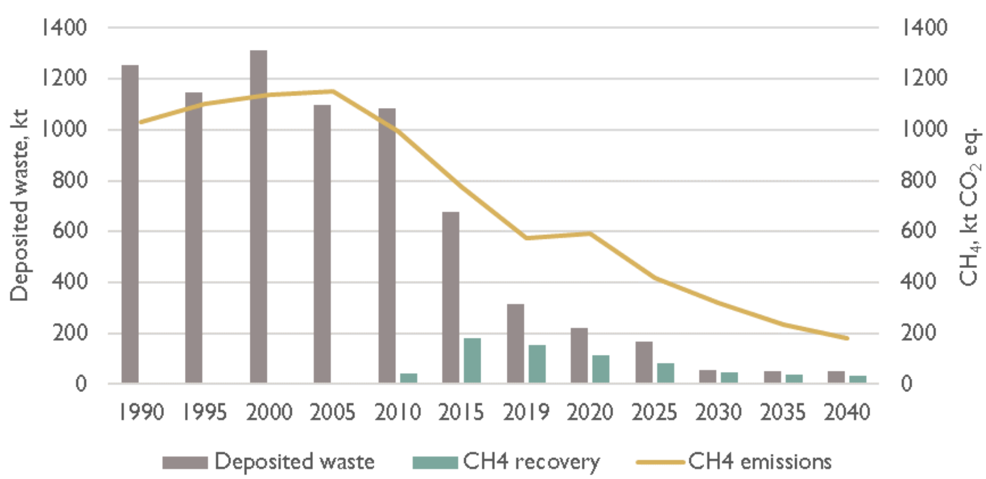

Figure 5-31. Methane emissions, CH_4 recovery and deposited waste

Biological treatment of solid waste

One of the main national targets is to reduce the amount of biodegradable waste going to landfills. To achieve these targets the mechanical-biological treatment plants have been launched in 2016. As it was expected the amount of biodegradable waste going to landfills was decreasing, resulting in lower emissions from the landfills. However, the GHG emissions from biological treatment of waste will grow due to increase of the amount of treated waste.

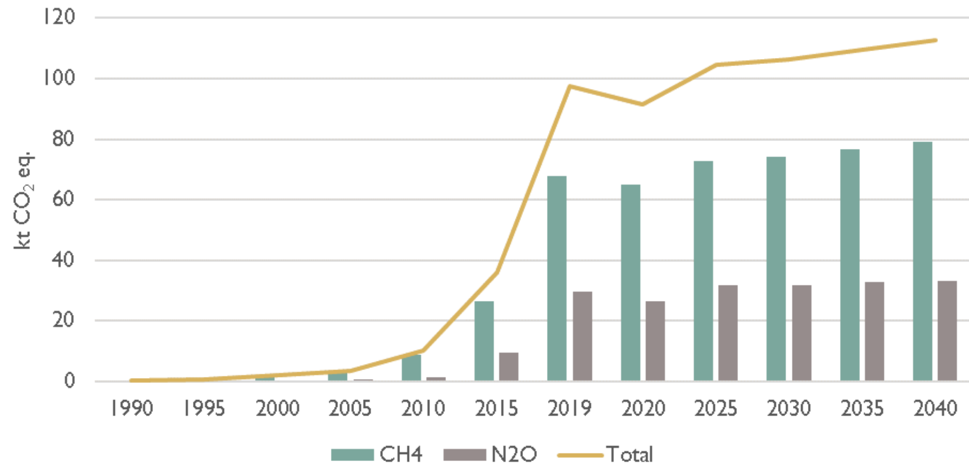

Figure 5-32. Historical and projected emissions from biological treatment of waste

Wastewater treatment and discharge

There are close to 1 800 wastewater discharge points in Lithuania. 99% of wastewater is treated in centralized aerobic wastewater treatment plants. The main source of CH_4 emissions are septic tanks. CH_4 emissions will decrease due to increase of population connected to centralized sewer networks and it is projected to be 66 kt CO_2 eq. by 2040.

No projections on protein consumption were made, therefore, N_2O emissions from human sewage were calculated based on the constant value. Emissions will drop due to decrease of the population and it is projected to be 35 kt CO_2 eq. by 2040.

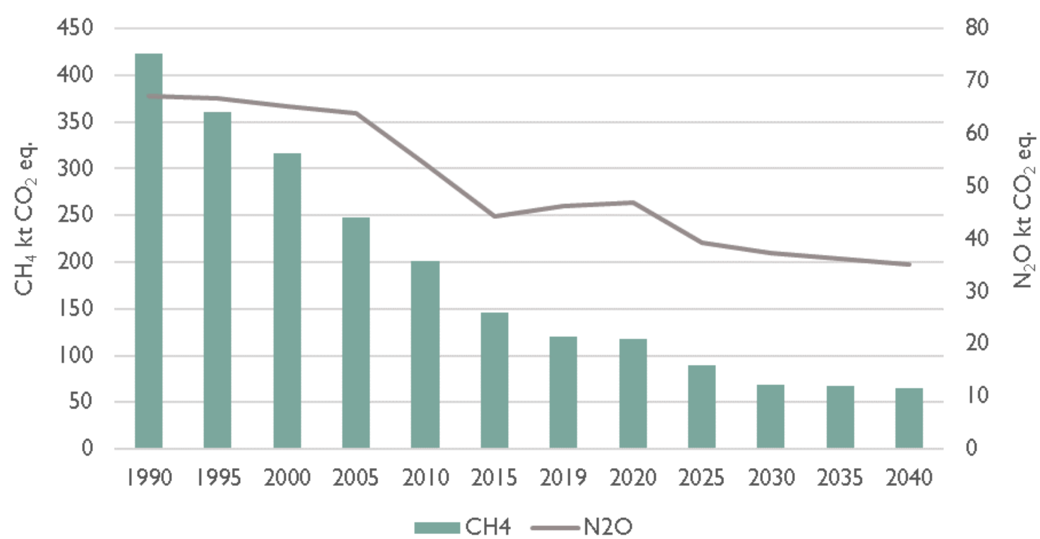

Figure 5-33. Historical and projected CH_4 and N_2O emissions in Wastewater treatment and discharge sector

Incineration of waste

Emissions from waste combustion for energy recovery are reported in Energy sector. In general, municipal, industrial and hazardous wastes are combusted for energy recovery. Only small amount of hazardous waste is incinerated without energy recovery.

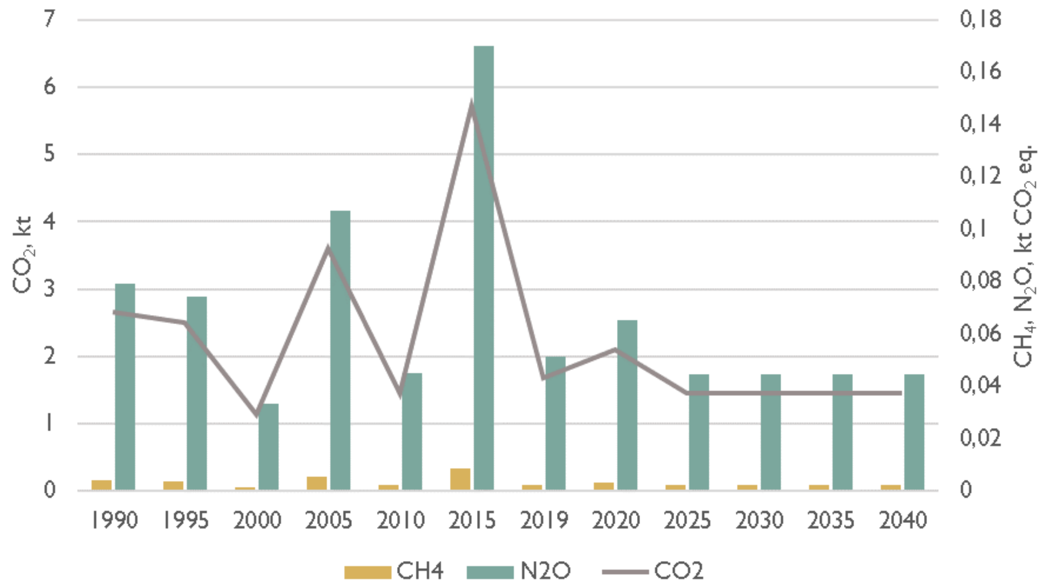

Figure 5-34. Historical and projected emissions from waste incineration

5.1.6.2 Scenario "with additional measures" (WAM)

Lithuania is taking steps towards realizing the concepts of "recycle, repair and re-use" and avoiding waste at all stages of the value chain with its EU circular economy package. The 2015 Circular Economy Package emphasizes the need to move towards a lifecycle-driven 'circular' economy, with a cascading use of resources and residual waste that is close to zero.

The WAM scenario is based on the additional measures provided by the Ministry of Environment. The implementation period of measures will cover the period of 2020-2030. For the period of 2031-2040 all additional measures will continue to be implemented at the same rate as it is expected in 2030. The planned policies and measures are focusing on education and informing the public about prevention and reduction of food waste, improving waste sorting skills, developing information websites and applications, and creating interactive maps. All planned policies and measures will reduce the amount of waste going to landfills, leading to progressive reductions in GHG emissions from landfills.

This can be facilitated by the development of, and access to, innovative financial instruments and funding for eco-innovation. Sustainable development goal (SDG) 8 invites countries to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. SDG 9 highlights the need to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG 12 encourages countries to achieve sustainable management and efficient use of natural resources by 2030.

List of policies and measures and cumulative GHG reduction effect for 2021-2030 is provided in Chapters 4.3.6 and 5.2.

Table 5-48. Projected GHG emissions from waste sector (kt CO_2 eq.)

	2019	2020	2025	2030	2035	2040
Solid waste disposal*	573.68	590.58	413.92	318.00	233.10	180.36
Biological treatment of waste	97.35	91.46	94.19	96.94	100.79	104.41
Waste incineration	1.73	2.18	1.51	1.51	1.51	1.51
Wastewater treatment and discharge	166.41	164.91	128.66	106.71	103.50	100.57
Total	**839.18**	**849.12**	**638.28**	**523.16**	**438.89**	**386.86**

*Including emissions from sewage sludge and CH_4 recovery

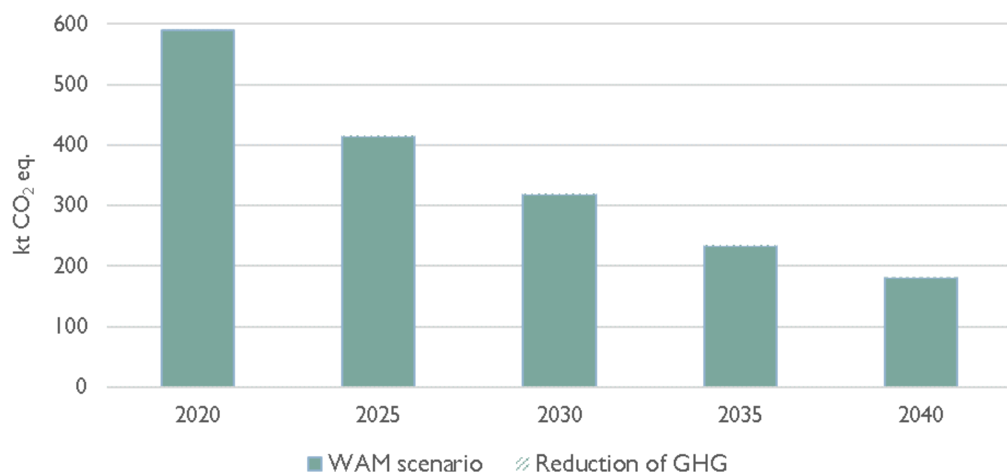

Figure 5-35. Projected emissions of CH_4 from waste disposal on land under WAM scenario

5.1.6.3 Methodologies and key assumptions

Projections of GHG emissions from Waste Sector are based on the National Waste Management Plan[20] for 2014-2020, the Landfill Directive[21], the Packaging and Packaging Waste Directive[22], the Waste Framework Directive[23], data provided by the Ministry of Environment, the Environmental Protection Agency, the Regional Waste Management Centres.

[20]https://www.e-tar.lt/portal/lt/legalAct/TAR.9945210D6571/ZtaLvZPcai
[21]https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01999L0031-20180704
[22]https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0852&from=EN
[23]https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02008L0098-20180705&from=EN

Methane emission arising from *Solid Waste Disposal* on land is calculated applying the 2006 IPCC Guidelines Tier 2 (First Order Decay) method, taking into account historical waste disposal data. This method assumes that the degradable organic component in waste decays slowly throughout a few decades. CH_4 is generated as a result of degradation of organic material under anaerobic conditions. Part of the CH_4 generated is recovered for energy or flaring, therefore CH_4 actually emitted is smaller than the amount generated. The model calculations are performed using national statistics of landfill site characteristics and amounts of waste fractions deposited each year. The parameters used for emission projections are the same as those used in the Lithuanian GHG inventory.

Solid waste disposal on land including stored sewage sludge is the largest GHG emission source from waste sector. Projections of waste generation are based on historical as well as projected data on the population and the annual GDP growth rate. Projected population data are provided by Lithuanian Statistics and GDP growth by the recommendation of the European Commision based of Reference scenario 2020 modeling excersise[24]. The amounts of waste disposed in landfills are predicted taking into account the targets set in National Waste Management Plan for 2014-2020 and the Landfill Directive. Assumptions are thus in line with the assumptions made for developments of mechanical-biologically treated waste reported under sector Biological treatment of waste. Some minor amounts of sludge are expected to be stored as well. Assumptions on the projected amounts of sludge are based on historical data.
The projected data on waste generation and disposal are presented in the table below.

Table 5-49. Base year and projected amount of waste generation and disposal

Parameter	Units	2019	2025	2030	2035	2040
Generation of municipal waste	t	1 318 626	1 200 610	1 120 640	1 062 186	1 008 198
Municipal waste generated per capita	kg/ca pita	472.3	465	457	447	437
Disposal to landfills	%	23.5	14	5	5	5

Constantly decreasing share of CH_4 recovery and flaring from landfills is assumed due to the decreasing gas generation potential of deposited waste. The assumption is based on data provided by Regional Waste Management Centers.

Biological Treatment of waste covers composting of green waste, composting and anaerobic digestion in MTB plants and household composting. Methane and nitrous oxide emissions from Biological Treatment of waste are calculated by multiplying the amount of waste by the corresponding emission factors (see the table below). CH_4 emissions from anaerobic digestion of sewage sludge are calculated using the 2006 IPCC Guidelines default EF of 5% CH_4 of biogas produced.

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https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en#modelling-framework

Table 5-50. Emission factors from biological treatment of waste (IPCC default)

Type of biological treatment	CH_4 EF (g CH_4/kg waste treated)	N_2O EF (g N_2O/kg waste treated)
Composting	10	0.6
Anaerobic digestion	2	Assumed negligible

EU structural and investment funds are an important source of funding for municipal waste management infrastructure development. Implementing EU funded projects 9 sewage sludge, 55 green waste composting facilities, 1 mechanical sorting and 8 regional mechanical sorting and biological treatment plants were constructed by 2016.

The projected data on amount of composted waste and waste treated in anaerobic digestion plants were provided by Regional Waste Management Centres. The amount of waste undergoing mechanical-biological treatment assumed to increase as separate collection of kitchen and food waste is foreseen since 2019. Household composting was evaluated by the number of composting bins distributed and the amount of composted waste (220 kg) per household. Sewage sludge amounts treated in anaerobic digestion plants are assumed to stay constant at the level of 2019.

Methane is generated from *Wastewater Treatment* in anaerobic conditions while nitrous oxide can be produced as nitrification and denitrification product in both aerobic and anaerobic conditions. Wastewater treatment and Discharge covers CH_4 emissions from wastewater transportation and treatment as well as from septic tanks used by population not connected to centralized sewer networks and N_2O emissions from human sewage. CH_4 and N_2O emissions are calculated applying 2006 IPCC Guidelines Tier 1 method, using default values.

EU structural and investment funds are an important source of funding for water sector. In 2007-2013 around 570 million EUR were invested into the wastewater collection and treatment system, focusing on the cities with more than 2 000 inhabitants. In 2014-2020, around 125 million EUR are planned to invest into wastewater collection and treatment system, focusing on the small town and villages with 200-2 000 inhabitants. These investments will help to further develop centralized wastewater collection and treatment systems.

Biochemical oxygen demand (BOD) is one of the main parameters for assessing discharged wastewater compliance with requirements for discharges from urban wastewater treatment plants. BOD data was predicted based on historical data as well as the future development of wastewater collection and treatment system. BOD is expected to increase in line with the rising percentage of population connected to wastewater collecting system. The projected data on BOD and percentage of population connected to wastewater collecting system has been provided by the Ministry of Environment.

The main parameter to estimate N_2O emissions from human sewage is protein consumption. The data on protein consumption per capita was received from the Health Education and Disease Prevention Centre (77.4 in 1998, 78.1 in 2002, 81.9 in 2007, 64.5 in 2013, and 70.1 g/capita/day in 2020). The data in years when studies on protein consumption were not performed were interpolated. For these projections, the protein consumption was left as of 2019 and remains stable from 2019 to 2040.

Carbon dioxide, methane and nitrous oxide emissions from *Waste Incineration* are calculated based on the 2006 IPCC Guidelines Tier 1 method and default emission factors are applied. Emission factors are consistent with the emission factors used in the Lithuanian GHG inventory.

Summary table of assessed emissions sources from Waste sector, methods applied and emission factors are provided in the table below.

Table 5-51. Methods and emissions factors used to estimate emission from waste sector

CRF	Source	Emissions reported	Methods	Emission factor
5.A	Solid Waste Disposal	CH_4	T2	D
5.B	Biological Treatment of Waste	CH_4, N_2O	T1	D
5.C	Incineration and Open Burning of Waste	CO_2, CH_4, N_2O	T1	D
5.D	Wastewater Treatment and Discharge	CH_4, N_2O	T1	D

Waste incineration without energy recovery is the smallest source of GHG in Waste sector and it is not expected to expand. Assumptions on the projected amounts of incinerated hazardous and clinical waste are based on historical data.

Cogeneration power plant has started incineration of MSW in 2013 and two additional MSW incinerators are under construction. It is assumed that operation of three MSW power plants will reduce the amount of MSW disposed of by landfilling and will overlay portion of fossil fuel used in public electricity and heat production sector. This assumption was incorporated in the final fuel used in Energy sector.

5.2 Assessment of total effect of policies and measures

As a European Union Member State, Lithuania is subject to EU climate policy, and thus it applies EU Common and Coordinated Policies and Measures relevant to climate change. Lithuania believes that country's policies and measures modifying long term trends in anthropogenic GHG emissions and removals consist with the objective of the UNFCCC.

Moreover, GHG emissions are inseparable from the long-term development analysis of the economic sectors that meet human needs. GHG emissions projection suggests that an increasing demand for energy will result increasing in GHG emissions. Existing measures will lessen this increase.

Since NC7, Lithuania has improved the effect evaluation process of policies and measures. As mentioned before, in 2019 the National Energy and Climate Action Plan was prepared. Much effort was put into planning and assessing the GHG reduction effect of decarbonization policies. Since 2019, some planned policies have started to be implemented, and some were refused to implement due to appeared financial or social burdens.

In this submission, 113 measures are presented, of which 64 are already implemented or adopted, and 49 are planned. Forty policies and measures were not quantitatively evaluated because some are educational, have a social aspect, or have no direct effect on GHG reduction and act in synergy with other measures. The table below shows the number of PaMs implemented and planned in different sectors.

Table 5-52. Number of adopted, implemented and planned decarbonization policies in Lithuania

Sector	Number of policies and measures
Energy	34
Transport	34
IPPU	8
Agriculture	17
LULUCF	14
Waste management	5
Total	**113**

The 'without measures' (WOM) scenario was not developed in preparation for the GHG projections. For the total effect of policies and measures, another approach was used– individually assessing the effect of each significant policy and measuring and aggregating the individual effects to arrive at a total. Therefore, the total effect of PaMs is presented only for 2030. The total effect of PaMs for 2020 was not estimated as the advanced process of evaluation and planning of PaMs strictly focusing on decarbonization was initiated only before 2018; however, currently, Lithuania is working on ex-post analysis of the PaMs effect.

The effect of adopted and implemented measures is estimated to reach about 4 652 kt CO_2 eq. in 2030. The highest reduction of GHG emissions is planned in energy, transport and industrial processes sector (implementation of F-gases policies).

Table 5-53. Estimated aggregated effect of policies and measures in different sector in 2030

PaMs in different sectors	GHG emission reduction, kt CO_2 eq. in 2030
Adopted	***418.3***
Agriculture	22.2
Energy	23.5
LULUCF	105.9
Transport	266.7
Implemented	***4234.4***
Agriculture	34.2
Energy	1583.0
LULUCF	0
IPPU	1089.6
Transport	1507.9
Waste management	19.6
Planned	***3574.6***
Agriculture	527.9
Energy	496.9
LULUCF	1923.5
IPPU	58.8
Transport	564.4
Waste management	3.0
Total sum	**8227.3**

The effect of the planned measures in 2030 might reach 3 575 kt CO_2 eq. The estimated difference between WEM and WAM's projected emission in 2030 is 3 600 kt CO_2 eq.

It is assessed that implemented and planned measures will have the most effect on reducing CO_2 emissions (energy, transport and LULUCF sectors); also, implementing F-gas regulation, the content of these gases is planned to decrease efficiently (Table 5-54). The measures implemented and planned in the agriculture and waste sectors will affect methane emission reduction most. Additionally, the successful implementation of synthetic fertilizer use regulation could benefit the reduction of N_2O emissions. Adopted and implemented PaMs might affect reducing CO_2 emissions by 3 676 kt CO_2 eq., CH_4 by 75.9 kt CO_2 eq. and F-gases by 900.4 kt CO_2 eq. in 2030. The planned measures are estimated to reduce CO_2 emissions by 3 166 kt CO_2 eq., methane by 34.6 kt CO_2 eq., N_2O by 349 kt CO_2 eq. and F-gases by 24.7 kt CO_2 eq.

Table 5-54. Estimated aggregated effect of policies and measures in different sector gas-by-gas basis in 2030, kt CO_2 eq.

Sectors affected	GHGs affected	GHG reduction in 2030, kt CO_2 eq.
Adopted		
Agriculture	CH_4	22.2
Energy	CO_2	23.5
LULUCF	CO_2	105.9
Transport	CO_2	266.7
Implemented		
Agriculture	CH_4	34.2
Energy	CO_2	1 583.0
IPPU	CO_2	189.3
	HFCs, PFCs, SF_6, NF_3	900.4
Transport	CO_2	1 507.9
Waste management	CH_4	19.6
Planned		
Agriculture	CH_4	34.6
	CO_2	144.4
	N_2O	349.0
Energy	CO_2	496.9
LULUCF	CO_2	1 923.5
IPPU	CO_2	34.1
	HFCs, PFCs, SF_6, NF_3	24.7
Transport	CO_2	564.5
Waste management	CO_2	3.0

5.3 Sensitivity analysis

5.3.1 Energy

An important parameter in preparing GHG emissions projections can be considered the EU ETS carbon price. Most of installations under the EU ETS are local districts heat providers. Over the last ten years and from the start of the 3rd EU ETS trading period many smaller installations producing heat energy started to switch from fossil fuel to biomass. This can be explained by the fact that the European Commission proposed the EU ETS market back-loading solution to decrease the surplus of EUAs in the market and therefore increase carbon price. Therefore, the switch to biomass may greatly reduce the amount of EUAs needed for installations to cover the GHG emissions or even opt-out from the EU ETS. The EU ETS carbon prices used in sensitivity analysis for the EU ETS sectors are presented in Table 5-55.

Table 5-55. Carbon price used for GHG sensitivity analysis

	Carbon price (in constant € 2020/t CO_2)			
	2025	**2030**	**2035**	**2040**
Stable price used in projections	25	25	25	25
EC recommended[25]	80	80	82	85

Results of the EU ETS GHG emissions sensitivity analysis are presented in Figure 5-32.

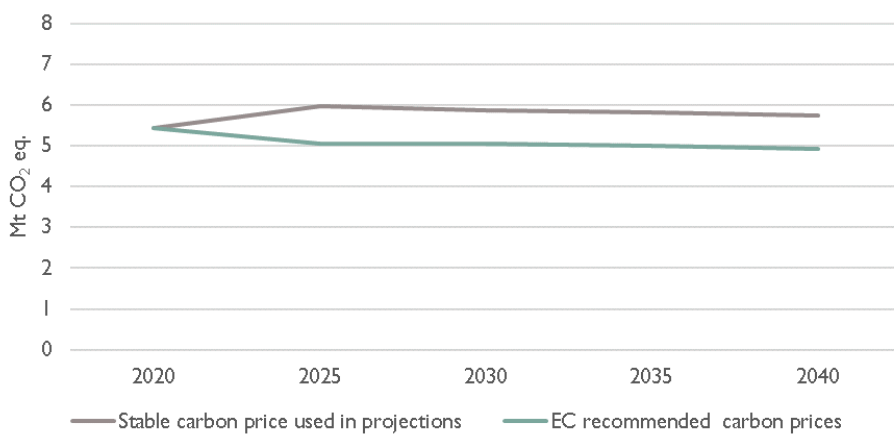

Figure 5-32. Results of carbon price impact on GHG emissions in Lithuania's EU ETS sectors

Sensitivity analysis results showed considerable margin between GHG emissions projected using stable carbon price and relatively high carbon price in 2040. Huge distinction can be explained due to increase of expenditures for GHG emissions from installations. The operators will most likely consider switching to use of biomass instead of fossil fuels. Also, it is more likely that those operators will start investing in energy efficiency due to not only increasing fossil fuel prices, but also due to increasing EUAs price.

[25] Commission guidance for reporting on GHG projections in 2023 under the MMR

Results show that because of increase of EUAs price up to 85 EUR/t CO_2 the biggest reduction of GHG will be seen in Manufacturing industries and construction sector. This is due to the fact that at a current state fossil fuel fired combustion units are still vastly used in this sector and there is a potential to replace them with biomass using units.

5.3.2 Industrial processes and product use

Sensitivity analysis for IPPU sector emissions is based on the scenarios, where amount of nitric acid production (table below) is based on the values provided by the European Commission.

Table 5-56. Values provided by European Commission

Indicator	2025	2030	2035	2040
Amount of nitric acid production, kt	1 273	1 296	1 310	1 325

Under sensitivity scenario (SEN), amount of and nitric acid production recommended by EC were implemented in calculations (table below). The methodology for calculating WEM scenario is provided in Chapter 5.4.1.

Table 5-57. GHG emission per subcategory, kt CO_2 eq.

Subcategory	2025	2030	2035	2040
Nitric acid production (WEM)	250.26	250.26	250.26	250.26
Nitric acid production (SEN)	241.49	245.85	248.51	251.35

Results of sensitivity analysis on the GHG emissions from IPPU sector (nitric acid production) are presented in the figure below.

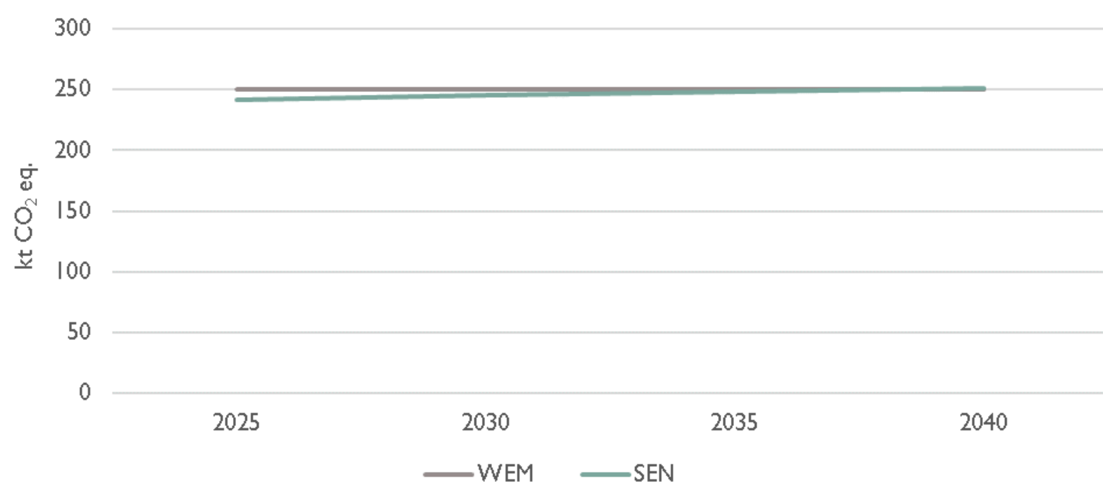

Figure 5-36. Sensitivity analysis for GHG emissions in IPPU sector

5.3.3 Agriculture

Sensitivity analysis for Agriculture sector emissions is based on livestock population, consumption of inorganic N fertilizers and other important data (table below) provided by the European Commission.

Table 5-58. Values provided by the European Commission

Indicator	2025	2030	2035	2040
Livestock data				
Dairy cattle, thous. heads	234	191	173	164
Milk production, kg/head	7 049	8 057	8 653	8 902
Non-dairy cattle, thous. heads	432	417	432	452
Swine, thous. heads	708	677	667	628
Horses, thous. heads	18	18	18	18
Sheep and goats, thous. heads	166	176	187	198
Agricultural soils data				
Inorganic N fertilizer, kt N	160	164	164	169
Crop residues, kt N	84	84	84	84
Cultivation of histosols, M ha	0.14	0.14	0.14	0.14

Under sensitivity scenario (SEN), activity data provided in the table above recommended by EC were used to estimate GHG emissions from agriculture sector (table and figure below). The methodology for calculating WEM scenario is provided in Chapter 5.5.1.

Table 5-59. GHG emission per subcategory, kt CO_2 eq.

Subcategory	2025	2030	2035	2040
Enteric fermentation (WEM)	1 441.8	1 467.3	1 418.8	1 365.6
Enteric fermentation (SEN)	1 523.3	1 372.6	1 351.1	1 369.0
Manure management (WEM)	381.6	392.3	391.9	388.8
Manure management (SEN)	4 12.5	380.0	377.7	381.6
Agriculture soils (WEM)	2 321.7	2 160.1	2 065.7	1 962.0
Agriculture soils (SEN)	2 343.7	2 146.4	2 061.1	1 977.4
Total Agriculture (WEM)	4 176.8	4 049.6	3 905.2	3 743.9
Total Agriculture (SEN)	4 311.2	3 928.9	3 818.6	3 755.5

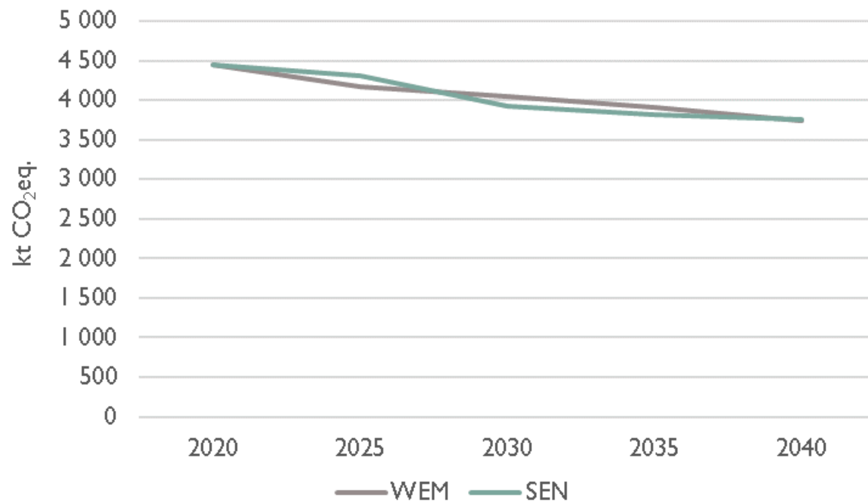

Figure 5-37. Sensitivity analysis for GHG emissions in agriculture sector

5.3.4 LULUCF

Sensitivity analysis for LULUCF sector emissions is based on the GLOBIOM scenario provided by the European Commission, where growing stock volume changes and harvested wood volume (for energy and non-energy uses) were estimated according to the values of G4M and GLOBIOM models, provided by the European Commission.

Table 5-60. Values provided by European Commission

Indicator	2020	2025	2030	2035	2040
Growing stock volume change, thous. m^3	4,968.6	4,567.7	3,206.0	3,458.2	3,705.8
Harvest for energy use, thous. m^3	3,169.5	3,546.5	4,060.4	4,029.3	3,998.8
Harvest for non-energy use, thous. m^3	5,170.4	6,233.2	7,159.1	7,097.8	7,036.1

Under sensitivity scenario (SEN), activity data provided in the table above were calculated from data recommended by EC and later used to estimate GHG removals in LULUCF sector (for forest land and harvested wood products categories); GHG removals in relevant categories and in LULUCF sector are provided in table and figure below. The methodology for calculations of WEM scenario is provided in Chapter 5.7.1.

Table 5-61. GHG removals per subcategory, kt CO_2 eq.

Subcategory	2020	2025	2030	2035	2040
Forest land (WEM)	-6 485.4	-5,895.4	-5,782.7	-5,671.5	-5,662.3
Forest land (SEN)	-6 485.4	-6,025.9	-5,969.5	-5,671.0	-5,681.1
HWP (WEM)	-784.0	-854.8	-779.3	-717.6	-664.5
HWP (SEN)	-784.0	-611.0	-806.9	-685.0	-587.8
LULUCF (WEM)	-5 407.4	-4,928.4	-4,945.2	-4,603.4	-4,497.3
LULUCF (SEN)	-5 407.4	-4,815.1	-5,159.5	-4,570.2	-4,439.3

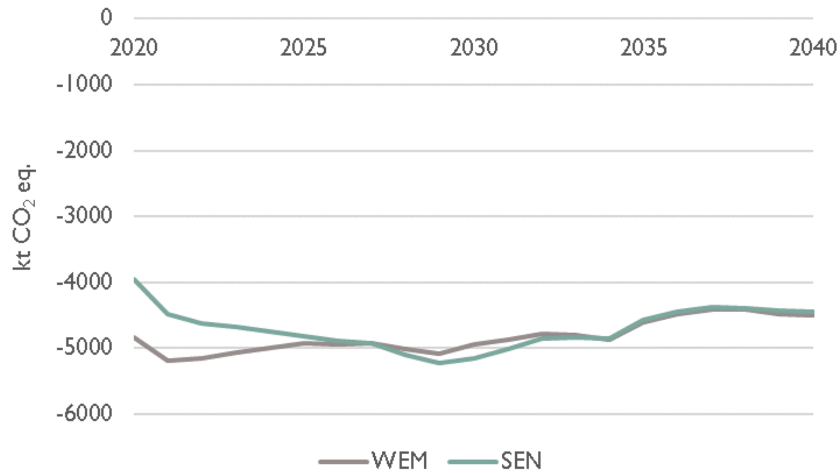

Figure 5-38. Sensitivity analysis for GHG removals in LULUCF sector

5.3.5 Waste

Sensitivity analysis for Waste sector emissions is based on the scenarios, where generated amount of MSW and population not connected to centralized wastewater collection system (table below) are based on the values provided by the European Commission.

Table 5-61. European Reference scenario modeling data provided by European Commission

Indicator	2025	2030	2035	2040
Amount of MSW, kt	1 321	1 311	1 308	1 312
Population not connected to centralized WW collection, %	28.5	27.3	25.8	24.0

Under sensitivity scenario (SEN), generated amount of MSW and population not connected to centralized wastewater collection system recommended by EC were both implemented in calculations (table below). The methodology for calculating WEM scenario is provided in Chapter 5.7.1. The subcategory Waste incineration is not affected by the change of variables.

Table 5-62. GHG emission per subcategory, kt CO_2 eq.

Subcategory	2025	2030	2035	2040
Solid waste disposal (WEM)	417.0	321.0	235.6	182.5
Solid waste disposal (SEN)	419.0	323.9	238.5	186.6
Biological treatment of solid waste (WEM)	94.2	96.9	100.8	104.4
Biological treatment of solid waste (SEN)	98.0	103.4	110.7	116.5
Wastewater treatment and discharge (WEM)	128.7	106.7	103.5	100.6
Wastewater treatment and discharge (SEN)	175.2	161.2	149.9	138.1

Results of sensitivity analysis on the total GHG emissions from waste sector are presented in the figure below.

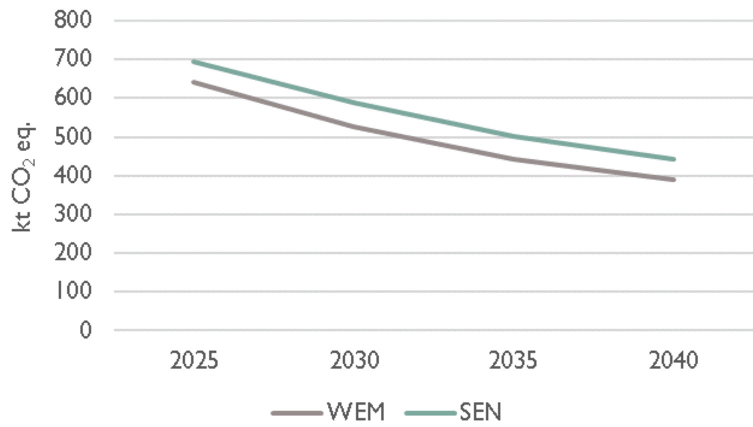

Figure 5-39. Sensitivity analysis for GHG emissions in waste sector

5.4 Changes compared to the 4th Biennial Report

As the latest GHG projections reporting was made in Lithuania's 4th Biennial Report (BR4), the comparison of methodology and assumptions used for GHG projections between BR4 and this submission (NC8/BR5) is provided (rather than comparing the changes since the 7th National Communication). The complete comparison of the parameters used for the projections for the BR4 and NC8/BR5 for 2030 and 2040 is provided in Annex IV.

The main differences in methodology and assumptions between BR4 and NC8/BR5 are as follows:

a) The base year in the NC8/BR5 is 2019, while in the BR4 was 2017.
b) In order to reflect historical or base year more accurately the projected activity data for the NC8/BR5 was updated for all sectors compared to BR4.
c) In the BR4, the data on population projections were used gained during the preparation of the Comprehensive Plan of the Territory of the Republic of Lithuania[26] and in this submission, the data was used from the Lithuanian Statistics[27].
d) The trend of compressed natural gas consumption in road transport was linearly extrapolated according to the historic data from 2009 up to 2017 in BR4. For NC8/BR5, compressed natural gas consumption in road transport was left unchanged for the whole period up to 2040.
e) For BR4 an assumption was made that the average exploitation period of a car is 20 years. For NC8/BR5, this assumption changed to the statement that the number of retired cars will not change year by year since base year. Thus, the average exploitation period of a car is approximately 8 years.

[26]http://www.bendrasisplanas.lt/2019/06/03/en/
[27] https://osp.stat.gov.lt/statistiniu-rodikliu-analize?indicator=S3R167#/

Table 5-63. Changes in projections since BR4 report (WEM scenario), kt CO_2 eq

Sector	2020	2025	2030	2035	2040
Projections in BR4 report (using WEM scenario)					
Sector	**2020**	**2025**	**2030**	**2035**	**2040**
Energy	11 840	11 506	11 206	10 994	10 851
IPPU	3 929	3 710	3 557	3 489	3 447
Agriculture	4 399	4 364	4 304	4 346	4 379
Waste	857	686	567	463	382
LULUCF	-4 663	-3 877	-3 329	-3 042	-2 772
Total excl. LULUCF	21 026	20 266	19 634	19 292	19 059
Total incl. LULUCF	16 363	16 389	16 305	16 250	16 287
Projections in NC8/BR5 report (using WEM scenario)					
Sector	**2020**	**2025**	**2030**	**2035**	**2040**
Energy	11 817	10 306	9 361	9 310	9 252
IPPU	3 094	3 680	3 414	3 326	3 241
Agriculture	4 451	4 177	4 050	3 905	3 744
Waste	822	641	526	441	389
LULUCF	-5 407	-4 928	-4 945	-4 603	-4 497
Total excl. LULUCF	20 183	18 804	17 351	16 982	16 625
Total incl. LULUCF	14 775	13 876	12 405	12 379	12 128

Table 5-64. Changes in projections since BR4 report (WAM scenario), kt CO_2 eq

Sector	2020	2025	2030	2035	2040
Projections in BR4 report (using WAM scenario)					
Sector	**2020**	**2025**	**2030**	**2035**	**2040**
Energy	11 793	10 063	8 261	7 736	7 292
IPPU	3 929	3 619	3 377	3 308	3 266
Agriculture	4,399	4 126	3 756	3 718	3 681
Waste	857	662	527	411	318
LULUCF	-4 663	-4 114	-3 936	-4 003	-4 385
Total excl. LULUCF	20 979	18 470	15 921	15 174	14 558
Total incl. LULUCF	16 316	14 356	11 985	11 170	10 173
Projections in NC8/BR5 report (using WAM scenario)					
Sector	**2020**	**2025**	**2030**	**2035**	**2040**
Energy	11 817	9 824	8 114	7 753	7 402
IPPU	3 094	3 590	3 234	3 146	3 061
Agriculture	4 451	4 023	3 726	3 609	3 490
Waste	822	638	523	439	387
LULUCF	-5 407	-5 895	-6 791	-7 076	-7 262
Total excl. LULUCF	20 183	18 075	15 597	14 947	14 340
Total incl. LULUCF	14 775	12 179	8 806	7 871	7 078

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VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

6. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

6.1 Climate projections for Lithuania

This Chapter presents the results of climate projection study carried out within the framework of the programme “Environment, Energy and Climate Change”, which is implementing activities to strengthen municipal adaptation to climate change within the ClimAdapt-LT project. The project “Preparation of climate change projections, a national study on the sensitivity and vulnerability of Lithuanian municipalities to climate change and a climate change adaptation plan for the most vulnerable municipality” is carried out.

The chapter describes various climate parameters and indicators and their variations from the present climate conditions to the end of the century (projections to 2100). Current climate variables and indicators (2006-2035) have been adjusted according to observational data provided by the Lithuanian Hydrometeorological Service and, where possible, according to the Lithuanian climatological normal. For the future periods (2021-2050, 2046-2075 and 2071-2100), changes in climate variables are projected under two greenhouse gas (GHG) emission scenarios – RCP4.5 and RCP8.5. The projections for RCP4.5 show moderate and RCP8.5 significant change of climate. Four combinations of global climate models (GCMs) and regional climate models (RCMs) are used to avoid certain model biases. These combinations form a multi-model set developed by the European Copernicus Data Repository to facilitate the use of climate models in decision-making and decision-support for adaptation to ongoing climate change.

Mean air temperature and solar radiation duration projections

The average air temperature (see *Figure 6-1*) is projected to increase from the current 7.3°C by between 1.2°C (RCP4.5) and 2.8°C (RCP8.5). The greatest warming is projected in winter (December-January, 3.9-4.4°C RCP8.5) and the least in late spring and early summer in May-July (1.9-2.1°C RCP8.5). RCP4.5 predicts a slower temperature increase in the second half of the century, while RCP8.5 predicts a steady temperature increase. The spatial distribution of projected temperatures remains unchanged: (a) moderately warmer in western Lithuania and the lowlands of central Lithuania, with cooler temperatures in the highlands of the country; (b) warmer in winter in the western region than in the eastern part of the country; (c) warmer spring temperatures in the central and southern regions; (d) cooler summers in the western and north-eastern regions.

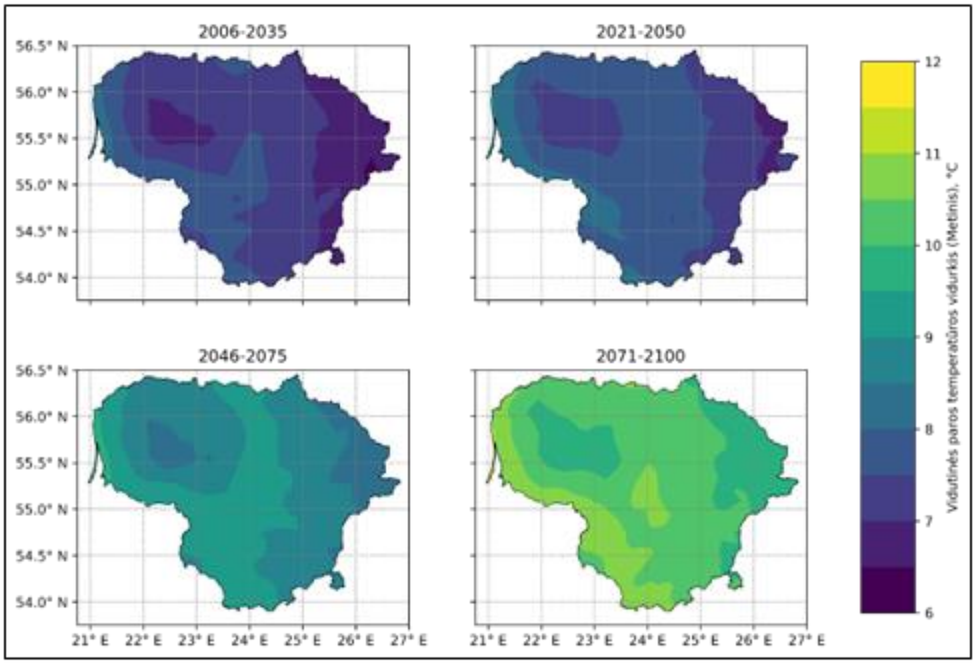

Figure 6-1. Maps of the distribution of average air temperatures over different periods

The **daily maximum temperature** in Lithuania will also increase from the current 11.3°C from 1.2°C (RCP4.5) to 2.8°C (RCP8.5). The highest annual daily temperature maximum values are forecasted for the central and southern regions.

Daily minimum temperatures in Lithuania will rise slightly from 1.4°C (RCP4.5) to 3.2°C (RCP8.5) compared to the current 3.5°C. A particularly large increase is expected in winter, from –5.5°C to –0.4°C in January. The lowest annual daily temperature maximums are predicted in the central and southern regions.

Rising temperatures will increase the risk of **heatwaves** (days when the maximum temperature exceeds 30°C for at least three consecutive days). The average number of such days could increase from the current 2 days to 7 days per year. In the south-eastern region the duration of heatwaves can reach 2 weeks.

Tropical nights (when night-time temperatures remain ≥ 20°C) are more common as the climate changes. On average, one tropical night is currently recorded every 2 years, and by the end of the century, between 1.5 (RCP4.5) and 7 (RCP8.5) tropical nights are predicted. The coastal and south-central regions are more vulnerable to an increase in the number of tropical nights (up to 10 episodes in Vilnius). **The number of cold days** with daily minimum temperatures below –15°C will decrease from the current 5.8 days by 3 days under RCP4.5 and 4.7 days under RCP8.5, to an average of one cold day per year by the end of the century. In the coastal area, cold days may disappear completely, while in Vilnius they will decrease from the current 10 days to 6-8 days in the RCP4.5 scenario and 3-6 days in the RCP8.5 scenario.

The vegetation season is projected to become longer due to climate change. On average, the length of the vegetation season in Lithuania will increase from 16 (RCP4.5) to 37 (RCP8.5) days by the end of the century, compared to 206 days today. The length of the growing season will increase more in western Lithuania, reaching 260-270 days.

The number of **heating days** below 10°C is projected to decrease as the climate changes. On average, in Lithuania, the decrease from the current 207 days will be between two weeks (RCP4.5) and one month (RCP8.5) by the end of the century. Longer warming periods in the hilly eastern and mid-western regions and shorter periods in the coastal and central/southern lowlands are projected to persist until the end of the century.

Changing climate is expected to increase the number of **cooling days** with average temperatures above 15°C. On average in Lithuania, this will increase from the current 78 days to two weeks (RCP4.5) to one month (RCP8.5) by the end of the century. Longer cooling periods of up to 120 days under RCP8.5 are projected for the coast and central/southern lowlands.

Frost episodes during the period of active vegetation period are the events when the mean air temperature is above 10°C and the minimum surface temperature falls below 0°C. On average there is 1 such episode per year. Climate projections do not provide a single answer as to whether such events will occur more or less frequently in the future. This is because the active growing season will start earlier in the future, which increases the likelihood of surface temperatures falling below 0°C on such days, despite the overall warming.

Fire risk is assessed by the number of days per year with a fire weather class of 3. The risk of fire increases with increasing temperature and decreases with increasing precipitation. Both parameters increase with climate change, so that the trend in fire risk under RCP4.5 is not clear, while under RCP8.5 the number of days at risk increases from the current 13.4 to 18.4. Higher fire risks are expected in central and northern Lithuania due to lower rainfall and in coastal area due to stronger winds.

Shortwave solar radiation is projected to slightly decrease over the century from the current 115 W/m^2 to 111 W/m^2 in RCP4.5 and 108 W/m^2 in RCP8.5. The reason for this remains unclear (most likely because of an increase in cloud cover). The largest decrease is expected in December-March (10-20% in RCP8.5) and the smallest in August-September (0-2% in RCP8.5). The highest solar radiation values are observed in the west-south-western part of the country.

Climate change will reduce the **sunshine duration** in Lithuania from the current 1854 hours, ranging from 64 hours or 3.2% (RCP4.5) to 103 hours or 5.5% (RCP8.5). The greatest reduction is expected in November–January (27-37% RCP8.5) and no change is expected in August-September. Longer sunshine durations continue to be recorded in the western part of the country.

Table 6-1. Mean air temperature and solar radiation indicators. Indication of change: red – increasing, blue – decreasing, green – neutral

Climate indicator	Current value	Future projections (2071-2100)	
		RCP4.5	RCP8.5
Annual mean air temperature, °C	7,3	8,5	10,1
Mean air temperature (January), °C	–3,1	–1,7	1,3
Mean air temperature (July), °C	18,3	18,7	20,4
Daily temperature maximum, °C	11,3	12,5	14,1
Daily temperature minimum, °C	3,5	4,9	6,7
Heatwaves, days	2,1	3,5	7,0

Tropical nights, number of episodes	0,5	1,5	6,9
Cold days	5,8	6,5	4,7
Vegetation season duration, days	206	222	243
Heating days	207	193	175
Cooling days	78	92	111
Frost, number of episodes	1,1	0,9	0,9
Fire risk, days	13,4	13,8	18,4
Solar radiation, W/m^2	115	111	108
Solar duration, hours	1854	1790	1751

Precipitation and hydrological projections

Lithuania is projected to receive an increase in **precipitation** (see Figure 6-2) from the current 684 mm (RCP4.5) by 42 mm or 6% to 98 mm or 14% (RCP8.5). Annual precipitation will reach 726 mm to 782 mm respectively. The RCP8.5 scenario projects a more even distribution of seasonal precipitation. The largest increase in precipitation (more than 20%, in Vilnius as much as 60% in December) is projected for October-May, while July-August will even see a decrease in precipitation according to RCP8.5. However, July remains the rainiest month of the year. A clear maximum is observed in the Samogitian highlands, a secondary maximum in the north-east of the country, while the central part (especially the southern and northern lowlands) is the driest. This rainfall distribution will not change much with climate change, except that the central drier zone will increase eastwards.

Number of days of **heavy precipitation** above 10 mm from the current 16 days will increase by 9% under RCP4.5 and 28.5% under RCP8.5, reaching 17.5 and 20.5 days respectively by the end of the century. The highest values of heavy rainfall days are observed in the western regions, with a secondary maximum zone in the south-east. The lowest rainfall is expected in the central part of the country.

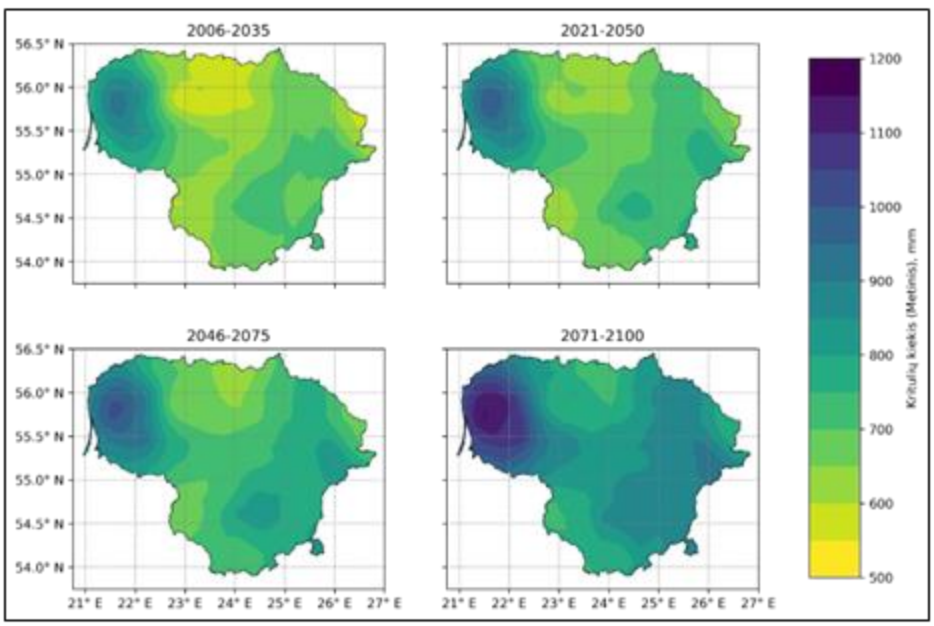

Figure 6-2. Maps of the distribution of annual precipitation over different periods

The number of **very heavy precipitation** days with precipitation totals above 20 mm will increase from the current 3.4 days by 9.5% under RCP4.5 and 38% under RCP8.5, to 3.7 and 4.7 days by the end of this century. Thus, the increase is projected to outpace the increase in the number of days of heavy precipitation.

Extreme rainfall or **daily rainfall** (mm) with 10 years recurrence period by the end of the century will increase from the current 54 mm to 58 mm (7%) under RCP4.5 and to 61 mm (12%) under RCP8.5.

The summer maximum rainfall is the sum of the 5% of the summer days (June to September) with the highest rainfall. The indicator describes the shift in the distribution of precipitation, showing the proportion of precipitation that falls during extreme events. The rainfall on the 5% of very wet days increases from the current 103 mm as the climate changes from 7 mm (RCP4.5) to 19 mm (RCP8.5). Thus, future rainfall episodes can be expected to be more concentrated, increasing the risk of both extreme precipitation and dry spells.

The **precipitation-free days** indicator is not expected to follow a clear trend. The number of days is forecast to remain at 190 days. More dry days are expected in the central region and fewer in the western and eastern highlands.

Drought risk is defined as the number of days when the temperature-precipitation index TPI30 falls below a value of 3.5. Drought risk increases with increasing temperature and decreases with increasing precipitation. Both parameters increase with climate change, so there is no clear trend in drought risk. For RCP4.5, the risk of drought increases after mid-century and returns to its current level of 4 days by the end of the century. For RCP8.5, drought risk will increase throughout the century and reach a value of 6.3 days by 2100. The central part of the country is the most vulnerable to drought risk.

The number of days with snow cover is decreasing markedly as the climate changes. By the end of the century, it is projected to decrease from the current 8 weeks per winter to 5 weeks under RCP4.5 and only one week under RCP8.5. At the end of the century, more days with snow cover remain in the continental south-east of the country, with a secondary maximum in the coastal region and in the north of the country. In south-western and central Lithuania, snow cover almost disappears.

The maximum snow cover decreases from the current 21.5 cm by the end of the century with climate change by 2.7 cm (12.6%) in the RCP4.5 scenario and 3.4 cm (15.6%) in the RCP8.5 scenario. The highest snow cover is projected for eastern Lithuania and the western Samogitian Highlands. By the end of the century, the maximum snow cover will not exceed 25 cm across Lithuania. A more rapid decrease in maximum snow cover is expected towards the end of the century.

The number of **freeze-thaw cycles** is the number of days when the minimum air temperature is below, and the maximum air temperature is above 0°C. The number of freeze-thaw cycles decreases with climate change from the current 66 to the end of the century by 12 days (18%) under the RCP4.5 scenario and by 28 days (42%) under the RCP8.5 scenario. Contrary to common perception, the highest number of such events is recorded in the highlands and southern Lithuania. This suggests that cold nights in spring (continental climate) have a greater influence on the number of freeze-thaw cycles than winter thaws (typical of marine climates).

Biometeorological parameters associated with health risks (especially headaches) are the number of days with a daily temperature variation above 5°C (TSM5) or an atmospheric pressure variation of more than 10 hPa per day. In Lithuania, the risk of migraine associated with pressure fluctuations is more frequent (35.6 days) than temperature fluctuations (14.7 days). Climate models predict a decrease in TSM5 by the end of the century, ranging from 2.3 days (16%) under RCP4.5 to 3.9 days (27%) under RCP8. The average PSM10 will remain at the same level throughout the century. People in the coastal region are about 2 times less exposed (10 days/year) to the risk of migraine caused by temperature fluctuations than those in the south-eastern highlands (up to 20 days/year). In the northern part of the country, the risk from pressure fluctuations is higher (about 40 days) than in southern Lithuania (about 30 days).

Soil water content is a hydrological indicator of the amount of water stored in the soil but should not be interpreted as soil moisture content. The assessment of soil water content analyses the change from current climate values. Soil water content in Lithuania will increase by 27 mm under RCP4.5 and 36 mm under RCP8.5. Soil water content is characterised by a pronounced seasonal cycle, with the highest values recorded in January-April (35-42 mm higher than the annual average) and the lowest in August–September (49-53 mm lower than the annual average). Climate models predict an increase in soil water content in all months. However, the increase in January-April is predicted to be higher (29-33 mm according to RCP4.5 and 44-49 mm according to RCP8.5) than in August-September (21-22 mm according to RCP4.5 and 19-25 cm according to RCP8.5). The seasonal distribution of soil water content will be more pronounced in the future and may pose a challenge to groundwater level rise.

The depth of total runoff is a hydrological indicator that describes the amount of water draining from a site. Climate models predict that total runoff in Lithuania will increase from the current 291 mm from 11 mm (4%) under RCP4.5 to 50 mm (17%) under RCP8.5. Total runoff has a clear seasonal cyclical pattern, with the highest values observed in December–March and the lowest values in June-October. Climate models do not predict a change in this seasonal cycle, although the month of peak runoff will shift from March to February (RCP4.5) and January (RCP8.5). The spatial distribution of total runoff is quite similar, with a pronounced maximum in western Lithuania and a secondary maximum in the eastern highlands.

Table 6-2. Precipitation and hydrological indicators. Indication of change: red – increasing, blue – decreasing, green – neutral

Climate indicator	Current value	Future projections (2071-2100)	
		RCP4.5	RCP8.5
Annual precipitation, mm	684	726	782
Average January precipitation, mm	50	54	64
Average July precipitation, mm	85	92	83
Number of days with heavy precipitation	16,0	17,5	20,5
Number of days with very heavy precipitation	3,4	3,7	4,7
10-year rainfall, mm	54	58	61
Maximum summer rainfall, mm	103	110	122
Days without precipitation	193	190	190
Drought, number of days	4,4	4,0	6,3

Number of days with snow cover	54	33	8
Maximum snow cover, cm	21,5	18,8	18,2
Number of freeze-thaw cycles	66	55	39
Health risk TSM5, number of days	14,7	12,4	10,8
Health risk PSM10, number of days	35,6	35,4	35,7
Increase in soil water content, mm	–	27	37
Total leakage depth, mm	291	302	341

Wind and sea level projections

Neither the average wind speed, which remains at 3 m/s, nor its seasonality is affected by climate change. The spatial distribution of the average wind speed is characterised by a pronounced maximum at the coast (around 4 m/s), with minima in the eastern part of the country and in the northern lowlands (less than 2.5 m/s).

Climate models do not predict clear trends in peak **wind gusts**. Peak wind gusts are predicted to remain at 15.7 m/s and their seasonal distribution is expected to remain unchanged. Wind gusts will be stronger in the coastal areas (18.5 m/s) and lower in the south and east of the country (up to 15 m/s).

The **storminess index** can be calculated as the number of days with wind speeds above 8 m/s or gusts above 15 m/s. Very similar changes are predicted under both definitions. For the wind speed criterion, we can expect a slight decrease from 20 to 19 stormy days per year in the RCP4.5 scenario and a slight increase from 20 to 21 days in the RCP8.5 scenario. For the wind gust criteria these changes are –1.5 days and +2.8 days respectively. The projections of changes in the seasonal distribution of storms are not unambiguous. More stormy days are expected in the western part of the country, with a pronounced maximum of more than 50 days in the coastal area.

The **number of calm days** or days with calm winds will not change much in this century. The value of the indicator varies between 10 and 10,5 days per year. There is a significant gradient in the spatial distribution of the number of days in the north-west/south-east direction, with up to 30 calm days in the south-east and only 5 calm days in the coast.

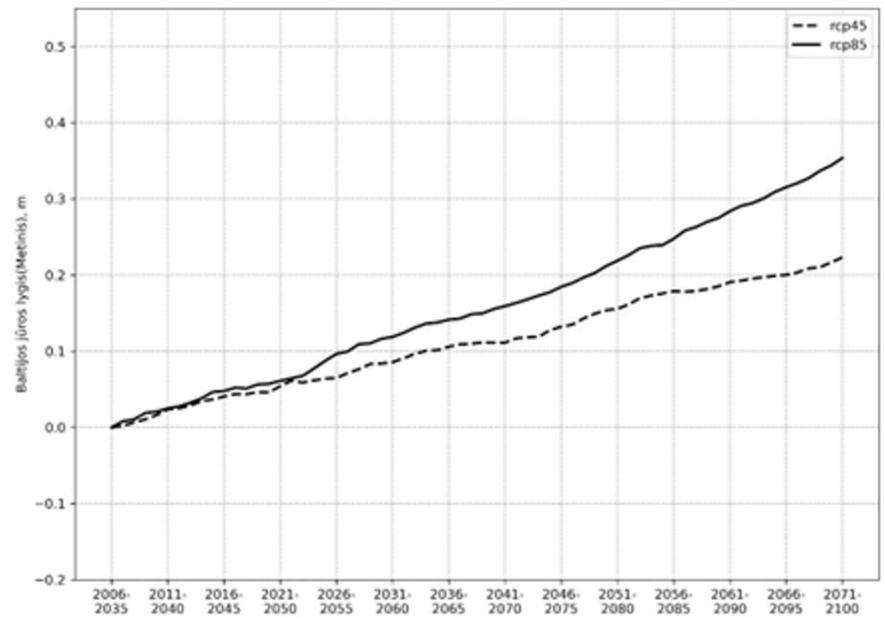

Figure 6-3. Rise of the Baltic Sea level at Klaipėda during the period considered

Climate change will lead to an average change in the **Baltic Sea level** (see *Figure 6-3*) ranging from 22 cm (RCP4.5 scenario) to 35 cm (RCP8.5 scenario). The existing seasonality of sea level, with higher sea levels observed during the storm season (October-January) and lower sea levels observed during the spring (April-May), will continue throughout the century. Slightly higher sea level rise is expected during the storm season (up to 44 cm in December).

Table 6-3. Indicators of wind speed and Baltic Sea level. Indication of change: red – increasing, blue – decreasing, green – neutral

Climate indicator	Current value	Future projections (2071-2100)	
		RCP4.5	RCP8.5
Average wind speed, m/s	3,0	2,9	3,0
Highest wind gusts, m/s	15,7	15,7	15,8
Storminess by wind speed criterion, days	19,9	19,2	21
Storminess by wind gust criterion, days	17,3	15,8	20,1
Number of calm days	10,4	10,5	10,1
Sea level rise, cm	–	22	35

6.2 Vulnerability assessment

Lithuania is investing in efforts to understand climate change impacts and is taking action to reduce vulnerability and adapt to a changing climate. The country is already facing increased incidence of extreme weather (heat waves, storms, extreme cold and floods), leading to reduced crop yields, loss of biodiversity, impact of economy and human health. Since the 7th National Communication (2017), Lithuania has continued to strengthen the evidence base that supports climate change adaptation decision-making and has enhanced efforts to increase climate resilience.

The abovementioned study on the sensitivity and vulnerability, in the further phase of Clim-Adapt-LT project, will carry out a sensitivity and vulnerability assessment of all Lithuanian municipalities, based on the data collected, the experience and methodologies of the IPCC, the World Meteorological Organisation, the European Environment Agency and other organisations working on climate change sensitivity and vulnerability. It will identify past and current climate impacts on Lithuanian municipalities with a focus on extreme events and future climate change impacts, specify sensitive and vulnerable municipal sectors, and conduct risk and vulnerability assessments at the municipal level. The review will be published on www.klimatokaita.lt, jointly with recommended adaptation measures that could be implemented in municipalities and new and (or) existing legislation to adapt more effectively to climate change. The assessment is expected to be completed in the first half of 2030.

In the last phase of the abovementioned study under the ClimAdapt-LT project, a Climate Change Adaptation Plan will be prepared for the most vulnerable Lithuanian municipality (with a population of at least 80 000) based on climate change projections and an assessment of the sensitivity and vulnerability to climate change.

In 2014, a study on the risks of climate change on human health was prepared. In 2015, Vilnius University developed a study, identifying sectoral vulnerability to climate change impacts, risk assessment and adaptation options, and the most effective adaptation measures and assessment criteria (the most vulnerable sectors identified in the study are depicted in Table 6-4).

Table 6-4. Extreme climate events and which sectors are most vulnerable to them

Extreme phenomena	Vulnerable sectors
Air temperature rises, heatwaves	Energy, transport, industry, agriculture, landscape, spatial planning, ecosystems and biodiversity, forestry, tourism, groundwater resources, waste management
High water temperatures in summer	Energy, fisheries and aquaculture
Temperature rises during the cold season	Industry, agriculture, forestry, ecosystems and biodiversity, landscape
More frequent temperature fluctuations around 0°C	Transport
Storms and hurricane force winds, thunderstorms, hail	Energy, transport, agriculture, spatial planning, ecosystems and biodiversity, fisheries and aquaculture, forestry, tourism, waste management, landscape, industry
Heavy precipitation, increase in annual precipitation	Transport, industry, spatial planning, forestry, agriculture, groundwater resources, waste management, landscape, energy, industry, fisheries and aquaculture
Floods and flash floods, receding river water, water level fluctuations	Transport, industry, spatial planning, ecosystems and biodiversity, fisheries and aquaculture, forestry, tourism, waste management, landscape, groundwater resources
Droughts, declining river flows and extreme water level fluctuations	Energy, transport, industry, agriculture, landscape, spatial planning, ecosystems and biodiversity, fisheries and aquaculture, forestry, groundwater resources, waste management

Changes in humidity	Industry
Frost and icing	Transport, forestry, energy
Blizzards, reduced visibility	Transport
Snow cover variability	Energy, industry, agriculture, fisheries and aquaculture, tourism
Sea level rise	Energy, industry, groundwater resources, waste management, spatial planning, fisheries and aquaculture, landscape
Warming of the Baltic Sea and the Curonian Lagoon and changes in salinity	Landscape, ecosystems and biodiversity, fisheries and aquaculture
Seasonal changes in climate	Tourism, industry, energy
Increasing the length of the vegetation period	Agriculture
Strengthening heat islands in cities, Ultraviolet radiation intensification	Spatial planning, ecosystems and biodiversity
Climate change in other regions of the Earth	Industry, energy

The Fire and Rescue Department under the Ministry of Interior has coordinated the performance of the National risk assessment. This assessment comprises the evaluation of all threats in Lithuania, including also the threats caused by climate change. A national risk assessment was conducted in 2013. An updated in 2015, 2018 and 2021. The Lithuanian National Risk Assessment updated in 2022 focuses on scenario development and mapping, presents the impacts of climate change, and describes prevention, preparedness, and response measures (existing measures, planning assumptions and gaps in measures).

In 2022, the Ministry of Finance, in cooperation with the Central Project Management Agency, the Deposit and Investment Insurance Fund, the Bank of Lithuania, the Ministry of the Environment, the Fire and Rescue Department under the Ministry of the Interior, and the Public Institution for Coordination of Governance, has prepared an Analysis of Fiscal Risks. It is based on good practices of the International Monetary Fund and foreign countries in a context of high uncertainty about the evolution of the COVID-19 pandemic and its impact on the Lithuanian economy, health, and social environment. It is planned to update and improve the analysis annually to provide the most up-to-date information on fiscal risks and their impact on government finances.

6.3 Adaptation measures

To minimise the risks and to benefit from the opportunities caused by the climate change, adaptation measures need to be planned and implemented.

Adaptation to climate change is integrated in the legal basis for major projects, through the processes of vulnerability and risk assessments which are:

- Vulnerability – evaluating the sensitivity and exposure of infrastructure to climate change;
- Risk – estimating the likelihood and impact of relevant climate hazards;
- Adaptation – consideration of adaptation options and integration into the project planning.

The Ministry of Environment (MoE) is the main coordinating institution responsible for the development of climate change mitigation and adaptation policy and its implementation, transposing the EU climate policy legislation and advising other institutions on integrating climate policy objectives and concerns into sectors that are not under MoE's responsibilities. Other Ministries (Energy, Finance, Transport and Communications, Health, Education, Science and Sport, Foreign Affairs, Economy and Innovation, Interior, Agriculture), municipal and other institutions within their remit are responsible for mainstreaming climate goals and objectives into sectoral strategies and programs and implementing related activities in Lithuania.

The National Climate Change Management Agenda (hereinafter – Agenda) is an integrated strategy which sets out the short-term (up to 2030), medium-term (up to 2040) and long-term (up to 2050) mitigation and adaptation goals and targets for the different sectors that currently use fossil fuels.

The goal of Lithuania's policy on adaptation to climate change, indicated in the Agenda, is to reduce the current and foreseeable vulnerability of the country's natural ecosystems and economic sectors, to strengthen adaptive capacity, to cost-effectively mitigate risks and damage and to maintain and increase resilience to climate change, with a view to securing a favourable environment for public life and sustainable economic activity so as to ensure food production is not endangered. In implementing this goal, it will be aimed by 2030:

- to apply flood protection measures to all residents in flood-prone areas;
- to ensure that the share of climate-related economic losses in the country's GDP does not exceed 0.08% per year;
- the proportion of dangerous, natural disasters and catastrophic meteorological events predicted is at least 90% of the actual events;
- the climate change adaptation goal will be pursued through adaptation measures in climate-sensitive areas such as agriculture, energy, transport, industry, forestry, ecosystems and biodiversity, landscape, public health, water resources and the coastal zone, urbanised areas, etc., in line with the main short-term directions by 2030;
- adaptation actions at local level: to promote regional cooperation, active involvement of municipal authorities and the local community in the planning and implementation of climate change adaptation measures;
- more systematic adaptation: coherence and synergies between climate change mitigation and adaptation measures;
- data-driven solutions: to increase knowledge and research on climate change impacts, vulnerability and adaptive capacity, promote experimental development and innovation;
- open data: to collect and disseminate information on ongoing climate change, the resulting damages and the magnitude of losses, to provide information to stakeholders and the public and to share best practices and examples.

The Agenda also describes adaptation targets and objectives for 2030 in individual sectors most vulnerable to climate change (public health, agriculture, forestry) and short-term cross-sectoral climate change adaptation targets and objectives.

Key long-term directions for adaptation to climate change by 2050 includes continuing monitoring the impacts of climate change and the implementation of cost-effective mitigation measures, ensuring the resilience of engineering infrastructure, increasing awareness, ensuring planning for disaster risk management, improving the meteorological and hydrological observation, forecasting and warning system.

On 30th December 2019, Lithuania adopted the National Energy and Climate Action Plan for 2021-2030 (NECP), and the Interinstitutional Action Plan (IAP) got incorporated in 2020. Adaptation measures up to 2020 were set out in the IAP, and from 2021 onwards in the NECP. There are 55 planned policy measures to adapt to climate change by 2030 for nine sector-related fields of action: Water Resources, Forestry, Ecosystems, Biodiversity and Landscape, Transport, Infrastructure, Agriculture/aquaculture, Public health, Emergency Management, Urbanised areas, Intersectoral objectives. Each measure follows the same structure: Sector – Measure – Scope and results/effect envisaged – Implementation period – Entities responsible for implementing the policy. The list of adaptation measures will be updated in 2023, according to the currently prepared EU guidelines for climate change adaptation plans.

Lithuania continuously provides updated information on adaptation activities, information about national adaptation planning and strategies in the National adaptation actions deliveries database on the European Environment Information and Observation Network (EIONET), and on the Climate-ADAPT website.

The website klimatokaita.lt administrated by MoE provides all the key information on climate change adaptation in Lithuania: why adaptation is necessary, related challenges, adaptation technologies, and ongoing projects. The information is continuously updated both in the Lithuanian and English languages.

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FINANCIAL, TECHNOLOGICAL AND CAPACITY-BUILDING SUPPORT

7. FINANCIAL, TECHNOLOGICAL AND CAPACITY-BUILDING SUPPORT

7.1 Finance

Lithuania provides flexible funding to multilateral organisations, including through softly earmarked voluntary contributions to trust funds (e.g., for Ukraine). The lion's share of Lithuania's Official Development Assistance goes to meeting its mandatory commitments to the European Union, World Bank Group and United Nations agencies. However, in the aftermath of Russia's war of aggression on Ukraine, Lithuania is increasing its non-core contributions to multilateral organisations, most of which are softly earmarked for a specific country, region, theme or purpose. In addition to its core partners noted above, other key partners include the International Committee of the Red Cross, the United Nations High Commissioner for Refugees, the United Nations Office for the Coordination of Humanitarian Affairs and the United Nations Children's Fund.

Lithuania became an official provider of development co-operation in 2004, the same year it joined the European Union. Its development co-operation programme started even earlier, in 2001, with the aim of leveraging its own transitional experience to assist neighbouring countries facing similar challenges. Over the past two decades, it continued to build on this asset, concentrating its efforts in areas where it has developed strong expertise. Environment is also a clear priority for Lithuania within its implementation of the 2030 **Agenda for Sustainable Development.** In 2021, 43.5% of Lithuania's screened bilateral allocable aid as having aid to environment as either a principal or a significant objective, complementing its environment, climate and biodiversity-related commitments at the international level.

Article 4(1) of the UNFCCC states that all parties shall fulfil their obligations considering their common but differentiated responsibilities. By doing so, the countries should evaluate their specific national and regional development priorities, objectives, and circumstances. Lithuania is among the countries listed in Annex I with the specific added condition that the country is undergoing the process of transition to market economy.

Article 4(3) of the UNFCCC (to provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in complying with their obligations under Article 12, paragraph 1), article 4(4) (to assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects) and article 4(5) (to take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties) are applicable to developed countries and countries listed in Annex II of the UNFCCC. Lithuania is not referred to as a developed country listed in Annex II of the UNFCCC. Although Lithuania is among the countries listed in Annex I with the specific added condition that the country is undergoing the process of transition to market economy and do not have obligations to support developing countries, as part of the European Union, Lithuania voluntary has been providing technical and financial support in climate change area to developing countries since 2011. In 2015 after the adoption of the Paris Agreements, the Member states of the European Union (including Lithuania) once again undertook to provide financial support and technological assistance to developing countries.

Lithuania’s aim to ensure financial and technological support for the implementation of climate change mitigation and adaptation measures in other countries, as well as cooperating with other countries in developing climate change-oriented projects is determined in various legal acts:

Law on Development Cooperation and Humanitarian Assistance (approved by the Parliament on 16th May 2013 and subsequently updated in 2016, 2020 and 2022) – provides the overarching framework, setting the institutional framework for Lithuania’s development co-operation and humanitarian aid policy and designating the Ministry of Foreign Affairs as the central coordination point. According to the Law, the Ministry of Finance is responsible for the coordination of implementation of the development co-operation policy with international financial institutions. This law determines the goals of the Lithuanian development cooperation policy, formation, implementation, coordination and financing of the Lithuanian development cooperation, and ways of providing humanitarian aid. One of the priority areas of cooperation development is climate change mitigation and adaptation measures. Most recently, amendments have provided for the establishment of a new fund with the aim of extending capacity for implementation of larger scale projects and programmes in collaboration with key partners.

Development co-operation is part of Lithuania’s commitment to the 2030 Agenda for Sustainable Development. The Law has particular emphasis on poverty reduction and promotion of democracy, human rights and gender equality. Furthermore, the **National Progress Plan for 2021-2030** (NPP) sets out domestic action in support of Agenda 2030 and other international agreements. The Law also seeks to inform Lithuanian society about development co-operation policies of Lithuania within the broader context of United Nations and EU efforts.

Law on Financial Instruments for Climate Change Management (approved by the Parliament in 2009), from January 1, 2022, the name of the Law was changed to **Law on Climate Change Management** ~~-~~states that the funds of the Climate Change Programme may be used for climate change mitigation and adaption measures in third countries in accordance with the EU legislation, the UNFCCC, the Kyoto Protocol and other international agreements.

On 13 July 2022, the **Development Cooperation and Humanitarian Aid Fund** in Lithuania started its activities, the main objective of which is to help implement a flexible, responsive, sustainable development cooperation policy focused on continuous results and to enable Lithuanian public and private sector institutions to implement large-scale, significant value-added projects in partner countries.

From 2022 Lithuania became the 31st member of the **Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC).** The overarching objective of the DAC for the period 2018-2022 is to promote development co-operation and other relevant policies to contribute to implementation of the 2030 Agenda for Sustainable Development, including sustained, inclusive and sustainable economic growth, poverty eradication, improvement of living standards in developing countries, and to a future in which no country will depend on aid.

In the **Interinstitutional action plan of implementation of objectives and tasks of the National climate change management policy strategy for 2013-2020** (approved by the Government in 2013 and annually updated), the identification of potential finance sources in public and private sectors and contribution to financing and implementation of measures of climate change mitigation and adaptation in developing countries are foreseen in 2013 and onwards (up to the year 2020) by the Ministry of Environment.

National Interinstitutional Development Cooperation Action Plan for the period 2017-2021 (approved by the Government in 2016 with the latest amendment in 2019, setting measures for 2019-2021) lays down development cooperation policy guidelines and sets out concrete measures to contribute to the achievement of the sustainable development goals set by the UN 2030 Agenda within the aid recipient countries. The Plan is based on the Lithuanian Law on Development Cooperation and Humanitarian Aid, Lithuania's foreign policy priorities, considering relevant strategic documents of the UN and EU, and international commitments. The Plan will help to ensure continuous and efficient implementation and coordination of the development cooperation activities and to enhance Lithuania's role as a reliable and responsible donor country in the international community.

Lithuania's Strategic Guidelines for Development Cooperation 2022-2025 reflect the key objectives set out in Lithuania's Law on Development Cooperation and Humanitarian Assistance "in accordance with the needs of partner countries". They also include a strong emphasis on climate change action and partnerships. The strategy underlines Lithuania's rationale for prioritization of the EU's Eastern Partnership (EaP) Region, as well as countries of migration origin and transit in the Middle East, Central Asia, and Africa. In the EaP countries, co-operation is based on sharing Lithuania's own transitional experience on democratic governance and implementation of reforms, while co-operation with other partners also focusses on other thematic areas where Lithuania believes it has a comparative advantage.

The overarching policy framework for climate change in Lithuania is the **National Climate Change Management Agenda.** The Agenda foresees the provision of financial and technological support to developing countries in climate change mitigation and adaptation.

Lithuanian institutions responsible for financial support to developing countries in the field of climate change mitigation and adaptation through are:

- Ministry of Environment through the funding from the Climate Change Programme (the main financial fund for climate related projects).
- Ministry of Foreign Affairs taking on the central role in planning, implementing, and coordinating development cooperation policy and activities across Lithuania's, some of the projects are climate related.
- Ministry of Finance that makes contribution to international funds and programs, including EPTATF.

The Climate Change Programme administered by the Ministry of Environment is the primary instrument used to support climate-related activities developing countries. From 2014 onwards the Ministry of Environment supports bilateral development cooperation projects related to climate change. The decision to focus on bilateral support was due to new legislation and policy adopted by the Government of Lithuania. The Ministry of Environment concludes that bilateral support is more efficient and beneficial for both parties, not only helps to share Lithuanian experience and gain valuable relationships through cooperation but creates enabling environment to using public finances to mobilize private sector investments into low carbon solutions under bilateral cooperation projects transferring technologies to developing countries. All public and private funding for bilateral development cooperation climate related projects was provided in the form of grants.

Multilateral activities

Most multilateral contributions given to date have taken the form of assessed contributions, there is currently no stand-alone strategy to guide multilateral implementation. Since accession to the European Union in 2004, Lithuania has contributed flexible funding and relevant expertise to European efforts in development co-operation, stepping up coordination efforts in times of crisis. Lithuanian representatives actively participate in all relevant formats of the European Union Council, European Commission, and the European Development Fund, contributing to decision making and the coordination of the European Union Team Europe joint responses. Lithuania also engages in regional, global, and country level Team Europe initiatives, on areas where it can offer relevant technical expertise. Furthermore, Lithuania is a highly active contributor to the European Investment Bank's Eastern Partnership Technical Assistance Trust Fund and Economic Resilience Initiative. Also, Lithuania has made financial contributions to the UNFCCC secretariat, World Bank funds, Eastern Partnership Technical Assistance Trust fund.

The financial resources disbursed over 2019 and 2020 as reported in this National Communication are considered new and additional to the financial disbursements.

Table 7-1. Multilateral activities in 2019-2020

Allocation channel	2019		2020		Comments
	Core/general	Climate specific	Core/general	Climate specific	
	Euros				
Multilateral climate change funds					
Framework Convention on Climate Change	NA	17 934	NA	17 934	Ministry of Environment
Kyoto Protocol	NA	3 217	NA	3 217	Ministry of Environment
Multilateral financial institutions					
World bank (International Development Association)	1 000 000	NA	1 000 000	NA	Ministry of Finance
World bank (International Bank for Reconstruction and Development)	NA	NA	1 678 220.73	NA	Ministry of Finance
Eastern Partnership Technical Assistance Trust Fund	NA	100 000	NA	200 000	Ministry of Finance. The type of support cross cutting: for environment, transport, water, agriculture, energy, waste.
Specialised United Nations bodies					
United Nations Environment Programme	45 138,58	NA	NA	NA	Ministry of Environment
Other					

Multilateral Fund for the Implementation of the Montreal Protocol	119 267.42	119 267.42	4 005.1	4 005.1	Ministry of Environment
United Nations Convention to Combat Desertification	5 249	5 249	5 249	5 249	Ministry of Environment

7.2 Technology development and transfer (bilateral cooperation)

The Climate Change Programme administered by the Ministry of Environment is the primary instrument used to support climate-related activities in developing countries. From 2014 onwards the Ministry of Environment supports bilateral development cooperation projects related to climate change. Lithuania works closely with bilateral partners to deliver effective global response to climate change. Variety of Lithuanian entities (private and public) are eligible for this bilateral support which intends to implement climate change mitigation and adaptation projects in developing countries. Each year the Ministry's *Commission on development cooperation and humanitarian aid* announces calls for project concepts/applications and selects the most distinguished projects. Requirements for projects and all procedural issues are laid down in the *Manual on the implementation of development cooperation activities by state and municipal institutions and agencies*, approved on 26 March 2014 by Resolution No 278 of the Government). Generally, applicants are required to contribute financially at least 30% of total eligible costs of the project. In this way Lithuania is seeking to mobilize private finance. The Commission approves the list of eligible countries, usually Lithuania gives priority (additional evaluation points) to the Eastern European partnership countries. Calls for submission of bilateral development cooperation projects are announced each year on www.am.lrv.lt, www.apvis.apva.lt and in the national press or on the national news portals. The decision to focus on bilateral support was due to new legislation and policy adopted by the Government of Lithuania. The Ministry of Environment concludes that bilateral support is more efficient and beneficial for both parties, not only helps to share Lithuanian experience and gain valuable relationships through cooperation, but creates enabling environment to using public finances to mobilize private sector investments into low carbon solutions under bilateral cooperation projects transferring technologies to developing countries. Activities are implemented by the Lithuanian companies in close cooperation with Ministry of Environment, Environmental Projects Management Agency under the Ministry of Environment, government institutions in developing countries. Bilateral development cooperation climate-relevant activities are the support for technology development and implementation (in 2014-2021 support was allocated to solar power construction in developing countries), the harnessing and replicating successful practices, to reduce the amount of GHG emissions in developing countries. In 2014-2021 period 5.3 mill. EUR by grants were provided to climate mitigation projects in developing countries from Climate Change Programme. Total these project value, including private funds about 7.5 million EUR.

Lithuania is attentive to developing countries' needs and priorities, GHG emissions reductions when selecting projects and its implementing partners for its work with developing countries. Assistance for climate action is designed jointly and based on a clear demonstration of demand and need by the partner country. Generally, all bilateral projects must be endorsed by the partner country (Lithuanian companies and a partner in a developing country sign an agreement on cooperation). Information about development cooperation projects, financed from Climate Change Programme provided in table below. All implemented projects were in the energy sector, they contribute to the increase of renewable energy in developing countries, also the transfer of Lithuanian experience in the field of renewable energy resource. The main objective of most of these projects was climate mitigation. Given that these projects were aimed at supplying solar energy for schools and other educational institutions, they contributing to climate adaptation as they strengthen local communities' self-sufficiency and resilience to future hazards. Public and private funding for bilateral development cooperation projects was given as grants.

In 2019 finance was given to the Lithuanian company "Okata" which implemented project electricity at the Georgia General Prosecutor's Office in Tbilisi. During the project solar power plants were installed on the roof-top of the Georgia General Prosecutor's Office (total capacity of the solar plants is 100 kW). The solar power plant started operating in 2022. The total costs of the project were 143 000 EUR, from which 100 000 EUR were subsidy from the Ministry of Environment, 43 000 EUR private funds from Lithuanian company "Okata". Switching from grid electricity to solar power plant will reduce costs for the General's Office, also it will be reduced 100 tons of GHG emissions annually.

Figure 7-1. Project in Georgia

The financial resources disbursed over 2019-2020 as reported in this National Communication are considered new and additional to the financial disbursements.

Table 7-2. The data on bilateral development cooperation projects financed from Climate Change Programme

Recipient country	The name of the project	Installed solar power, kW	Project subsidy from the Climate Change Program excl. VAT, EUR	Project value excl. VAT, EUR	The status of the project
2014 call					
Malaysia	Promoting the use of the latest renewable energy technologies and the transfer of knowledge and experience in this field to Malaysian economic entities	60 kW	144 810	222 300	implemented
2015 call					
Moldova	Bilateral cooperation in the implementation of renewable energy technologies in Moldova	55 kW	110 600	180 120	implemented
2016 call					
Georgia	Transfer of Lithuania's experience and knowledge to Georgia in the	131 kW	151 016,4	192 879,03	implemented

	implementation of solar energy technologies				
2017 call					
Georgia	Harnessing solar energy resources in Georgia through bilateral cooperation	100 kW	153 695	226 538,74	implemented
Mali	Transfer of Lithuanian experience and knowledge to Mali in the implementation of solar energy technologies	120 kW	257 267,61	307 704,41	implemented
2018 call					
Georgia	Solving the problems of energy freedom and climate change in Georgia by transferring Lithuanian experience in the field of solar energy, in cooperation with local partners and volunteers of the war refugee camp	127,8 kW	172 005,01	243 627,46	implemented
2019 call					
Georgia	Solving environmental pollution and climate change problems in Georgia by installing a 200 kW solar power plant on the roofs of the Georgian Rugby Union buildings	200 kW	210 298	330 298	implemented
Armenia	Climate change solutions in Armenia by installing solar power plants in the Getq high school and transferring Lithuanian experience to local partners, institutions and institutions	30 kW	38 700	53 700	implemented
Armenia	Climate change solutions in Armenia, by installing solar power plants at the Areviq art school and transferring Lithuanian experience to local partners, institutions and institutions	20 kW	28 700	40 700	implemented
Nigeria	Solving the problems of environmental pollution and climate change in Nigeria at the Kwara State University by installing solar power plants and transferring the experience of Lithuania	100 kW	154 725	229 396,64	implemented
Georgia	Solving climate change problems in Georgia by transferring Lithuania's experience in the field of solar energy, in cooperation with local partners and volunteers from the Khurvaleti camp for war refugees	200 kW	204 954	291 954	implemented
Georgia	The transfer of Lithuanian experience and knowledge and the implementation of measures to mitigate climate change by introducing solar energy technologies in Georgia	300 kW	245 136	383 730	implemented
Moldova	The transfer of Lithuanian experience and knowledge and the implementation of measures to mitigate climate change by introducing solar energy technologies in Moldova	31 kW	42 400	59 000	implemented
Georgia	Installation of a solar power plant in a Waldorf school in Georgia	20 kW	18 790,13	24 106,04	implemented

Georgia	Bilateral cooperation in implementing photovoltaic energy solutions in schools in Batumi	323,7 kW	443 798	601 423,07	implemented
2020 call					
Georgia	Solving the problems of environmental pollution and climate change in Georgia by transferring Lithuania's experience in the field of solar energy, in cooperation with local partners and volunteers of the Sakasheti and Skra camps of war refugees	280 kW	274 662	376 960	in progress
Georgia	Solving the problems of environmental pollution and climate change by installing a solar power plant for the supply of electricity to water bodies in the municipality of Gardabani and transferring the experience of Lithuanian solar energy to local partners	200 kW	196 818	269 880	in progress
Georgia	Bilateral cooperation in the implementation of photovoltaic energy solutions in schools in Georgia	200 kW	225 000	378 000	in progress
Georgia	Bilateral cooperation in the implementation of photovoltaic energy solutions at Georgia Tech	200 kW	214 000	359 000	in progress
Georgia	Solving the problems of environmental pollution and climate change by installing solar power plants for the General Prosecutor's Office and sharing Lithuania's experience in the field of solar energy with local partners	100 kW	111 998	154 998	in progress
Armenia	Solving environmental pollution and climate change problems by installing solar power plants for Armenian school communities and transferring Lithuanian solar energy experience to local partners and institutions	110 kW	125 867	172 589	in progress
2021 call					
Moldova	Solving climate change problems by providing energy freedom in the Eastern Partnership country in the autonomous region of Gagauzia, installing a 559 kWp solar power plant in Moldova and transferring Lithuania's experience	559 kW	475 000	742 600	in progress
Armenia	Solving climate change problems by providing energy freedom in the EaP country Armenia by installing a 260 kW solar power plant and transferring Lithuania's experience	260 kW	229 136	357 976	in progress
Georgia	Solving climate change problems by providing energy freedom in the EaP country Georgia by installing a 375 kW solar power plant and transferring Lithuania's experience	375 kW	290 159	450 359	in progress

Armenia	Solving climate change problems by providing energy freedom in the EaP country Armenia by installing a 206 kW solar power plant and transferring Lithuanian experience	206 kW	195 347	311 991	in progress
Moldova	Solving climate change problems by providing energy freedom in the country Moldova by installing a 420 kW solar power plant and transferring Lithuanian experience	420 kW	330 298	548 494	in progress
Georgia	Bilateral cooperation in the implementation of photovoltaic energy solutions at the Georgian Vaziani Brigade training and training center	500 kW	417 384	673 000	in progress

Solar power plant total capacity	Public funds	Private funds	GHG emissions reduction
			
~ 5 MW	~ 5,3 million EUR	2,1 million EUR	~ 40,8 kt/ CO_2

Provision of financial resources

Lithuania's climate-related development cooperation has steadily increased over the last years. Starting from 2018 Lithuania is voluntarily doubling its climate finance to developing countries and had intended to mobilize 1 million EUR for climate financing from public and private sources annually till 2020. For the implementation of development cooperation projects in 2022-2025, Ministry of Environment will allocate 8 million EUR (2 mill. EUR annually) from Climate Change Programme. At least another 2.4 million EUR are planned to be raised from private funds in 2022-2025 for development cooperation projects.

7.3 Capacity building

Sharing Lithuania's expertise through European Union instruments

The EU-funded EU Twinning Program supports cross-border co-operation between institutions, strengthens the administrative capacity of the beneficiary countries and helps them implement the necessary reforms. EU Twinning project is an EU instrument for representatives from the public administrations of the EU Member States and Beneficiary Countries working together in order to transfer the know-how and good practices developed within the EU to beneficiary public administrations during implementation of the Twinning Project.

Lithuania is participating in this programme since 2004.Since 2019, the dual European Union instruments Technical Assistance and Information Exchange (TAIEX) and Twinning have been expanded to support sharing of European Union country expertise with developing partner countries and potential accession countries with the aim of strengthening public administrations in line with national development priorities to help achieve the Sustainable Development Goals. Both instruments have supported the needs of countries in Africa, the Americas, Asia and the Caribbean in wide ranging policy areas such as e-governance, anti-corruption, migration, customs, sustainable finance and food safety. Through peer-to-peer exchanges, the instruments look to strengthen the capacities of beneficiary institutions while respecting their ownership over national, legal and institutional processes and reforms. While TAIEX is geared to support short-term projects, including through digital exchanges, Twinning is a medium to long-term institution building instrument jointly owned and implemented with development partners. Both TAIEX and Twinning have been evaluated as successful tools for development of individual and institutional capacities. In 2021, most European Union states were involved in these instruments. Overall, Lithuania ranked second among European Union members for participation in Twinning projects (after Italy), with high participation levels in TAIEX as well. Consultations with programme administrators highlighted Lithuania's "excellent" score in feedback from partner countries. Key sectors for Lithuania's contribution were customs, digitalisation, judiciary, migration, judiciary, security and fundamental rights.

Lithuania has participated in international cooperation measures listed in Table 7-3 below.

In 2020 Environmental Project Management Agency experts from Lithuania shared experience TAIEX-REGIO webinars about Green public procurement. Green public procurement is a powerful tool for achieving environmental policy goals related to tackling climate change, resource management, and sustainable consumption and production.

Table 7-3. International cooperation measures

Recipient country/ region	Programme or project title, implementation period	Description of programme or project
Azerbaijan	Strengthening hydrometeorological and climate services in Azerbaijan 2022-2024	Lithuania, together with Finland and France, participates in the EU Twinning Program project "*Strengthening hydrometeorological and climate services in Azerbaijan*". The project will be gradually implemented over 2 years by the experts of the Lithuanian Hydrometeorological Service and the Environmental Projects Agency. It is planned that about 20 experts (specialists) from LHMT will participate in short-term missions to Azerbaijan. The aim of this project is to contribute to the improvement of Azerbaijan's national regulation of hydrometeorology and climate services, to share good practices and experiences so that the local Office meets EU and World Meteorological Organization (WMO) standards and recommendations. The project also aims to improve the adaptability of the citizens of Azerbaijan and different social sectors to the effects of climate change and to prepare for natural disasters. The project develops the weather, climate, and early warning services of the

Recipient country/ region	Programme or project title, implementation period	Description of programme or project
		Azerbaijan Hydrometeorological Service (NHMS) in accordance with international standards and best practices.
Serbia	Serbia's waste management system improvement 2017-2019	Specialists of the Ministry of Environment and the Environmental Project Management Agency helped Serbia to develop and improve its waste management system under the EU Twinning programme project intended to support the waste management policy. The European Commission has assigned 1.5 million EUR to this project. The Lithuanian experts participated in the project together with their colleagues from Austria and Sweden. For two years they helped the Serbian Ministry of Agriculture and Environment to drawn up national and strategic waste management plans, upgrade legislation of this sector and determine economic instruments for ensuring its operation.
Macedonia	Strengthening the capacities for effective implementation of the acquis in the field of water quality From May 2017 to January 2019	Recognizing the need to improve the water quality management issues in the country, the EU, through the Instrument for Pre-Accession Assistance, was funding the Twinning Project *"Strengthening the capacities for effective implementation of the acquis in the field of water quality"*. The project duration was 21 months (May 2017 – January 2019) with a budget of 1.2 million EUR. The main beneficiary institutions were the Ministry of Environment and Physical Planning and the Hydrometeorological Service. The main EU member state partners were Environment Agency Austria (Umweltbundesamt), Ministry of Environment of the Republic of Lithuania and the National Institute for Public Health from The Netherlands. The project purpose was to strengthen the administrative capacities in the area of water management by implementing the appropriate EU acquis. In particular the project had assisted the national authorities in drafting the Vardar River Basin Management Plan and in harmonising and implementing secondary legislation in the area of water monitoring and water permitting.
Georgia	Strengthening Sustainable Management of Forests in Georgia From June 2017 to November 2018	The EU Twinning project *"Strengthening Sustainable Management of Forests in Georgia"* was implemented by Lithuanian and Hungarian consortium. This was the first Twinning project in Georgia, which was implemented by Lithuania as a leading partner. Ministry of Environment of the Republic of Lithuania, State Forest Service of Lithuania and Ministry of Agriculture of the Republic of Hungary in cooperation with National Food Chain Safety Office of Hungary enhanced the capacity of the state forest institutions in order to prevent and combat illegal activities in the sector, ensuring the sustainable management of Georgian forests and harmonizing the Georgian forest regulatory framework to the EU standards and practices. Environmental Projects Management Agency was responsible for the project administration management, while Central Project Management Agency was responsible for the financial management of the project. This Twinning project was implemented during 18 months period. The European Commission provided the budget of 840,000 EUR. As a Junior Leader, Lithuania has been participating in two other EU Twinning projects in Georgia. Lithuanian Standards Board with partner institutions from Germany were strengthening the Meteorology and Standards Infrastructure in Georgia in 2010-2012. Moreover, Lithuanian National Commission for Energy Control and Prices in cooperation with partners from Austria have been helping to develop Energy Market Regulatory System in Georgia since 2015.

Recipient country/ region	Programme or project title, implementation period	Description of programme or project
Macedonia	Strengthening capacities to effectively implement EU requirements in the area of nature protection in Macedonia. From November 2017 to August 2019	State service for protected areas under the Ministry of Environment, together with the Finnish state-owned enterprise "Metsähallitus" had implemented the project *"Strengthening capacities to effectively implement EU requirements in the area of nature protection"* in Macedonia. The project consisted of four activities: preparation of management plans for natural protected areas, strengthening of capacities for the preparation of assessment studies, strengthening of capacities for the preparation of biodiversity monitoring methodologies and development of the National Biodiversity Monitoring Programme. The Lead Project Leader was Finland, while Lithuania was the Junior Project Leader.

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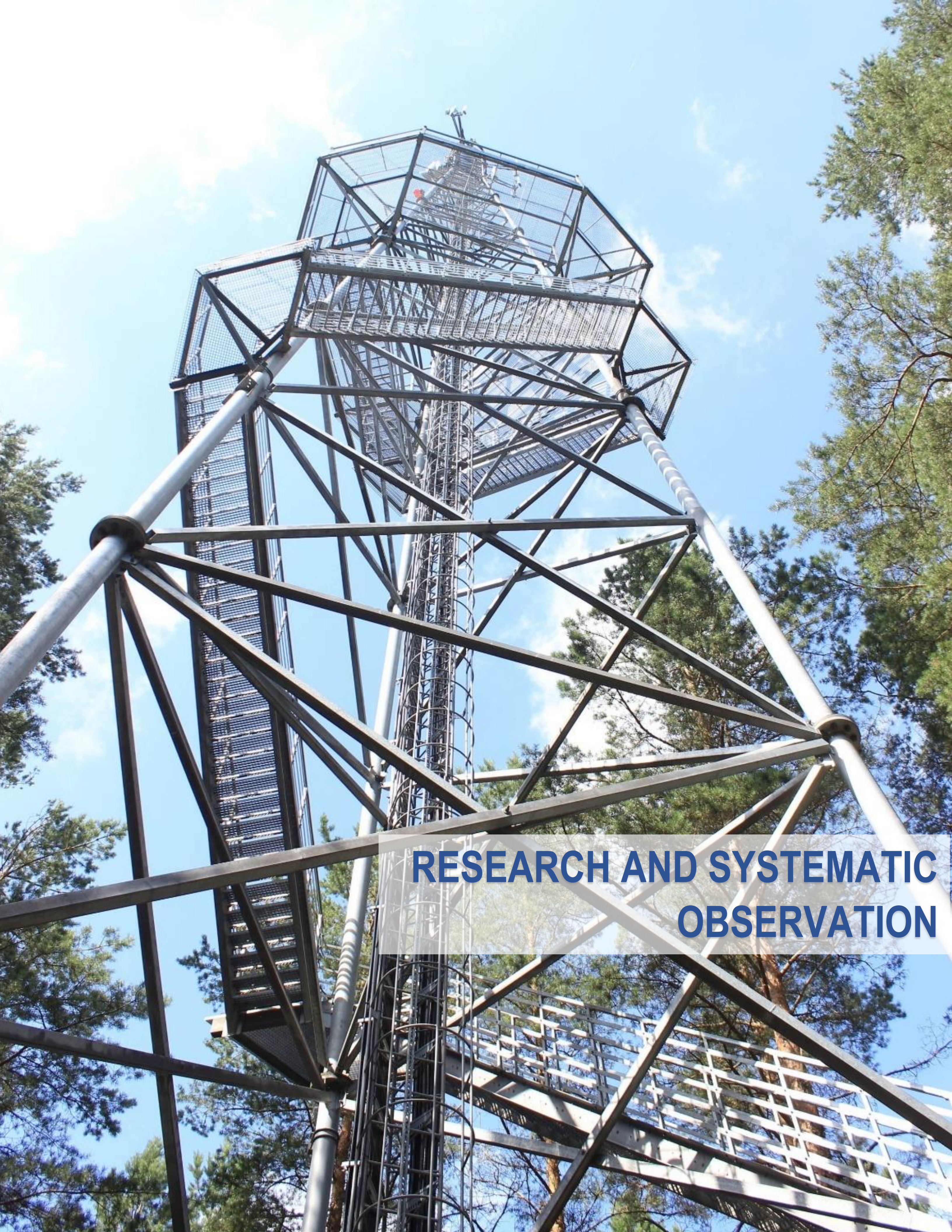
Organization for economic co-operation and development webpage https://www.oecd.org/countries/lithuania/lithuania-joins-the-oecd-development-assistance-committee-dac.htm

Website of the Ministry of Environment https://am.lrv.lt/

Website of the Lithuanian Hydrometeorological Service http://www.meteo.lt/

More information about the projects is provided in the webpage http://am.lrv.lt/lt/veiklos-sritys-1/klimato-kaita/klimato-kaitos-programa



RESEARCH AND SYSTEMATIC OBSERVATION

8. RESEARCH AND SYSTEMATIC OBSERVATION

8.1 General policy on research and systematic observation

At the highest level, Lithuanian science, technology and innovation (STI) policy is set by the Seimas (Parliament) and the Government of the Republic of Lithuania.

The main laws devoted to the regulation of STI system are the Law on Science and Higher Education and Law of Technology and Innovations Science. The Lithuanian STI policy governance structure is based on a dual ministry model, with the Ministry of Education, Science and Sport responsible for higher education and public sector research policy, and the Ministry of Economy and Innovation responsible for innovation and industrial research policy. The Ministry of Economy is the principal institution involved in shaping policy for the promotion of innovation and development of small and medium enterprise. The Ministry of Education, Science and Sport deals with research excellence in the public science sector and is responsible for the development of highly-skilled human resources for research and innovation. Furthermore, the Ministry of Finance also plays a major role in allocating funding for national research programmes.

The Research Council of Lithuania (hereinafter – the Research Council) serves as an advisory body to the Seimas and the Government. In 2016, the Higher Education Monitoring and Analysis Center (MOSTA) became the institution under Lithuanian Government and it is now responsible for monitoring and analysis of all system of higher education, research, technology and innovation.

The higher education and research institutions form the framework of the Lithuanian research system. In 2022 there were 11 public universities and 7 non-public universities, 12 public and 7 non-public colleges and 11 public and 6 non-public research institutes. Research institutes as well as universities have capabilities to develop through all the technological readiness levels, however, concentrate more on the upper end in comparison to universities.

In Lithuania, there are 5 integrated research, studies and business centres ("valleys") with high level infrastructure. They provide conditions for the development of new knowledge based on the highest-level research, strengthen and concentrate R&D intellectual potential, encourage the cooperation of researchers both in public and in private sectors at the national and international level.

A background of funding research and experimental development in Lithuania is constituted from basic and non-basic financing. While research funding has started to bond with the results of science activity, new challenges related with the evaluation of the quality and reliability of these results occur to funding institutions.

According to Eurostat, in 2019 research and development (R&D) expenditure amounted to 486 million Euro or 0.99% of GDP. In 2020 expenditures increased almost by twenty percent and accounted 1.17% of GDP that is 572 million EUR. In terms of source of funding, the biggest proportion of research and development expenditure – 37.3% – was made up of business enterprise funds; foreign funds accounted for 31.0%, government funds – for 29.1%, the funds of higher education and non-profit institutions – for 2.4% and 0.2% respectively (Figure 8-1).

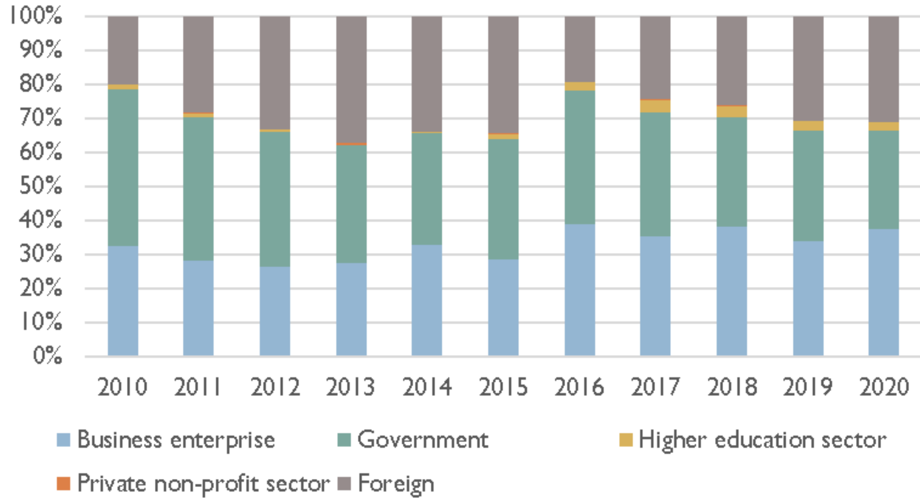


Figure 8-1. Research and development expenditure by source of funds in 2010-2020 (% of gross domestic expenditure on R&D)

According to the European innovation scoreboard 2021 (EIS 2021), Lithuania has been in the top 3 of the most rapidly growing countries among the EU member states in the field of research and innovations in the time period from 2014 to 2021.

Currently, the main responsible institutions responsible for research and innovation funding and for regulating the field and/or providing specific services are:

- Agency for Science, Innovation and Technology (MITA). Since 2010 it is the main institution responsible for the implementation of innovation policy in Lithuania. Currently, it administers a number of measures and programmes aimed at innovation and especially research collaboration.
- Lithuanian Business Support Agency administers the business support programmes, including innovation and research in the business sector.
- European Social Fund Agency administers European Union Structural funds aid and implements measures assigned to the Ministry of Education, Science and Sport in the development of human resources for science, technology and industry.
- The Research Council of Lithuania. Since 2008, this institution is the central funding agency for fundamental research and researchers' mobility, complementing institutional funding for basic research with project-type funding.
- Central Project Management Agency under the Ministry of Finance administers the high scale investments into the development of research infrastructures.
- The Lithuanian Centre for Quality Assessment in Higher Education deals with quality assurance and higher education standards.
- The agency "Invest Lithuania" is responsible for foreign direct investment attraction, and Enterprise Lithuania is responsible for entrepreneurship as well as export development.

- The Environmental Projects Management Agency under the ministry of Environment of the Republic of Lithuania managing projects that are funded by European Union and National funds in the environmental and climate change sector.
- Innovation Agency of Lithuania is the official public agency responsible for the development of Lithuanian innovation ecosystem and the promotion of innovation at all stages of business development – from developing ideas to delivering products and services to end-users.

The legal framework for prioritising and budgeting public investments in research, technological development and innovation is embedded in two strategic documents: the Lithuanian Progress Strategy “Lithuania 2030” published in 2012, and the Lithuanian Innovation Strategy for 2010-2020 published in 2010. Lithuanian Progress Strategy 2030 is a long-term strategy to strengthen fundamental public capacities, thus ensuring a harmonious development of the State and helping to respond to global economic and environmental changes and pressure coming from the global competition, as well as to create high standards of living for all. It seeks to promote fundamental changes in society and to facilitate the formation of a creative, responsible and open personality.

Aiming to implement the Lithuanian Progress Strategy “Lithuania 2030” and to conduct projects under the EU Research and Innovation Programme “Horizon 2020”, Lithuanian Innovation Development Programme for 2014-2020 was adopted in 2014. The Programme is devoted to consolidate state resources for the promotion innovation and development of competitive economy based on higher level knowledge, innovative technologies, qualified humane resources and smart specialization. The strategic goal of this Programme is to increase a competitiveness of Lithuanian economy, developing an efficient innovation system which would stimulate innovativeness of economy. It was determined by priorities and goals set in the strategy “Europe 2020”. Lithuanian Innovation Development Programme for 2014-2020 is implemented via the action plans that are prepared and approved by the Minister of Economy for the periods of 2014-2017 and 2018-2020. The institution responsible for the implementation is the Ministry of Economy.

For the period 2021-2030, the main tasks in the field of research are set out in the National progress plan 2030 (NAP) and the Research Development Program 2022-2030. The Research Development Program consists of four tasks. Three of them contribute to strategic goal 1 of the NAP “Towards sustainable economic development based on scientific knowledge, advanced technologies, innovation and increase the country's international competitiveness” and one to strategic goal 3 of the NAP “To increase the inclusion and effectiveness of education in order to meet the needs of the individual and society”.

The main working directions are:

- an attractive career for researchers (a whole cycle, from the involvement of students in R&D to the remuneration of researchers);
- improving the quality of R&D activities, competing at the international level;
- strengthening the MSI of the third mission (entrepreneurship), knowledge transfer and cooperation with business;
- science as a tool to strengthen other areas, solve societal challenges.

In 2022 renewed Smart Specialization conception for 2022-2030 was adopted with three priority areas (in place of 7 priority areas previously):

- Health technologies and biotechnologies;
- New production processes, materials and technologies;
- Information and communication technologies.

Also, three mission oriented research and innovation programmes regarding three smart specialisation priority areas were created:

- Innovations for health;
- Smart and climate-neutral Lithuania;
- Safe and inclusive e-society.

8.2 Research

8.2.1 National Research Programs

The Research Council of Lithuania is the main national institution providing R&D funding in the country. The Council oversee research and knowledge exchange functions in relation to universities and institutes. This includes providing block grant funding to the national research and education institutions (mainly universities and research institutes) for:

- research and development; developing and implementing national funding streams;
- supporting and encouraging academic participation in EU Framework Programmes;
- overseeing the sustainability of the Higher Education research base in Lithuania;
- promoting international collaborations.

The Council aims to develop and sustain an outstanding research and development system in Lithuania that gives everyone the opportunity to contribute and to benefit, enriching lives locally, nationally and internationally.

Every single year about 30 application tenders are announced in accordance with 40 national, international, European Commission and European Union investment funds intended to finance research and science-related activities, important for the career of researchers and dissemination of achievements. Funding enable to solve the most important problems related to national goals also increase the international collaboration among other counties in the World.

National Research Programs (hereinafter – NRPs) are competitive scientific programs, which enable to solve problems of state and society and increase the international competitiveness of Lithuanian science. The purpose of the NRPs is to bring together Lithuania’s scientific potential and financial resources, to initiate new research and to coordinate already existing research in order to solve a given problem. The National Research

Programs are approved by the Minister of Education, Science and Sport and the implementation of these programs is administered by the Research Council of Lithuania. In order to ensure financing of the highest competency research and to promote the competitiveness of Lithuanian science, the projects of the National Research Programs are selected through a public tender procedure.

The Research Council of Lithuania approved a new list of the National Research Programmes in 2013: Modernity in Lithuania; Welfare society; Towards future technologies; Healthy aging; Sustainability of agro-, forest and aquatic ecosystems. These programmes finance large-scale research and continue the previous NRPs.

One of the five National Research Programmes approved by the Research Council of Lithuania in 2013 provides competitive funding for research in a climate change research field. The NRP "Sustainability of agro-, forest and aquatic ecosystems", approved by the Government of the Republic of Lithuania started in 2015 and ended in 2021. Overall budget is EUR 6.6 million. This Programme replaced the previously existing programme "The Ecosystems in Lithuania: Climate Change and Human Impact". The purpose of the programme is to understand and be able to forecast the general effects of climate change and the intensive use of ecosystem resources, and to obtain new fundamental and empiric knowledge to enable the avoidance of threats related to these effects.

A characteristic feature of Lithuania is an intensive and market-driven agriculture and forestry sector that contributes to soil degradation and creates a threat to the landscape, biological diversity, and the sustainability of agro-, forest and water ecosystems. The accelerating climate change also affects all the components of ecosystems in addition to their functions and will eventually create new environmental conditions unprecedented in the history of Lithuania. The emerging ecosystem degradation processes are complex and difficult to manage and need to be examined in a comprehensive manner in order to obtain results which will constitute a basis for taking decisions and proposing the relevant measures.

The objective of the programme is to obtain, analyse and generalise, through integrated scientific research, new scientific knowledge about the impact of climate change and the use of ecosystem resources on the ecosystems of Lithuania, their adaptability to the changing climate and environmental conditions, and, having acquired new fundamental and empiric knowledge about the overall consequences of the use of ecosystem resources, to propose measures to avoid threats related to such consequences and draw up new guidelines for controlling and restoring the sustainability of ecosystems.

Two tasks are designed to meet the objective of the programme:

1. Study the effects of climate change and other environmental stress factors on agro-, forest and water ecosystems, their productivity and biological diversity;

2. Study how the intensive exploitation of resources affects agro-, forest and water ecosystems, identify the long-term consequences and the possible damage caused by such impact, and propose measures for the restoration of sustainability.

More information about NRP published on Research Council of Lithuania database "Spektras" https://spektras.lmt.lt/index0.php

8.2.2 International and domestic collaboration

Lithuania actively participating in many international programmes related to climate change. The collaboration between universities and research institutions gives an opportunity for scientists work together by sharing ideas and useful knowledges that can be helpful for scientific career and personal development. Domestic collaboration is not that popular in Lithuania, but it can be useful by solving the problems that occurs in Lithuania. The short list of the programmes that Lithuanian universities and research institutions participating can be found in Table 8-1.

Table 8-1. Short list of programmes that Lithuanian research institutions participating at

Institution	Project title	Duration of the project
Lithuanian Research Centre for Agriculture and Forestry (partners: Czech University of Life Sciences, Aarhus University, Estonian University of Life Sciences, University of Latvia, University of Ljubljana, Swedish University of Agricultural Sciences, etc.)	Towards climate-smart sustainable management of agricultural soils (EJP SOIL)	2020-2025
Lithuanian Research Centre for Agriculture and Forestry (partners: Latvia University of Life Sciences and Technologies, University of Tartu, etc.)	Demonstration of climate change mitigation potential of nutrient rich organic soils in Baltic States and Finland	2019-2023
Vytautas Magnus University (partners: The University of Birmingham, Graz University of Technology, Norges teknisk-naturvitenskapelige universitet, Katholieke Universiteit Leuven etc.)	European food chain supply to reduce GHG emissions by 2050	2021-2025
Vytautas Magnus University (partners: University of Eastern Finland, Albert-Ludwigs-Universität, Agricultural University of Athens, University of Florence, Transilvania University, etc.)	Ecosystem-based Adaptation and Changemaking to Shape, Protect and Maintain the Resilience of Tomorrow's Forests	2022-2027
Vytautas Magnus University (partner: Lithuanian Research Centre for Agriculture and Forestry)	The management of greenhouse gas emissions by changing nitrogen fluxes in an agrosystem	2020-2021
Vytautas Magnus university (partner: Lithuanian agricultural advisory service)	Creation of an accounting model for GHG emissions and CO_2 absorption at the farm level suitable for national accounting and "green" certification	2022
Vytautas Magnus university (partner: Lithuanian Research Centre for Agriculture and Forestry)	Inventory of greenhouse gas emissions in the country's crop production sector	2017-2019
Vilnius University (partners: Helmholtz Centre for Environmental Research)	Understanding and modelling compound climate and weather events	2018-2022

Lithuanian Energy Institute (partners: VTT Technical Research Centre of Finland, Riga Technical University)	Fast, flexible and secure decarbonisation of the Baltic states – possible progress in the next Ten years (FasTen)	2020-2021
Vilnius University (partners: University of Bolonia, Nature Research Center)	Impact of climate change on sustainability of aquatic vegetation in water courses with *Ranunculion* vegetation (habitat of European importance 3260)	2020-2021
Klaipėda University (partners: Universita del Salento, Universitates din Bucaresti, Universidad autonoma de Barcelona, etc.)	Ecopotential: Improving future ecosystem benefits through earth observation	2015-2019

8.2.2 The main institutions related to climate research development in Lithuania

Vytautas Magnus University (VMU) performs various research projects related to climate change effect on living organisms. After the integration of Aleksandras Stulginskis University in 2018 VMU has the academy of agriculture and the faculty of natural sciences. There are four groups of researchers who are analysing the impact of global warming on wildlife ecosystems and agricultural crops. One of the group executes research related to effect of anthropogenic environmental changes and climate to alive organisms. The aim is to investigate and evaluate response of alive organisms to single and integrated impact of anthropogenic and natural factors, changes in productivity, structure and biological diversity of populations and biological communities, and to evaluate possibilities of different economy branches to upgrade their ecological efficiency and sustainability. In order to implement this aim, researchers investigate and analyze impact of environmental factors, such as environmental acidification and eutrophication, ground level ozone, UV radiation, geo-magnetic storms, sun flashes, and consequences of climate change – increased frequency of drafts, waves of heat and frost to agro- and forest ecosystems and human health. Increased attention is paid to the research and forecast of changes in competitiveness and adaptability of agricultural plants, productivity and seasonal development of main tree species according to different scenarios of climate change. Possibilities of different morphometric, anatomical, physiological and biochemical indicators to monitor and assess environmental and climatic changes and toxicity of xenobiotics are investigated. In order to achieve practical value of obtained results, possibilities to reduce environmental impact of different economy branches is analysed. The second group of researchers working on application of innovative technologies on health risks raised by climate change and environmental pollution. The group aims to assess changes in the genetic structure of populations that occur due to changing environmental conditions. It is also desired to improve early detection technology for environmental determinants of disease using biomarkers of exposure and susceptibility. The aim is to offer a modern environmental quality monitoring tool to monitor ecosystem changes. Third researchers group analysing biodiversity and sustainability changes in forest ecosystems under climate change and human impacts. Group four studying biodiversity and sustainability changes of agroecosystems under the influence of climate and different farming conditions.

VMU Academy of Agriculture set the priority areas of science in which sustainability of agro-, forest and water ecosystems, impact of climate change is one of them. This area includes:

- Sustainability of biological natural resources;
- Mitigation and adaptation of climate change impacts on ecosystems;
- Agricultural pollution management;
- Sustainable land, forest and water management technologies, sustainable use of resources.

The Department of Hydrology and Climatology at Vilnius University actively participates in research activities in relation to climate change. The most recent ones are related to research on climate fluctuations and quantitative and qualitative changes of Lithuanian water resources. The main scientific interests are:

- Climate change research in Lithuania and the Baltic region using instrumental data;
- Climate modelling and forecasting;
- Applied assessment of climate resources and meteorological conditions;
- Assessment of climate change impact to natural, social and economic environments;
- Politics and strategy of adaptation to climate change;
- Atmospheric circulation processes research and pollution modelling;
- Synoptic meteorology;
- River and lake hydrology, hydrochemistry and hydrophysics research;
- Research methodology of hydrometeorology.

University researchers participated in these research projects:

- Climate change in peatlands: Holocene record, recent trends and related impacts on biodiversity and sequestered carbon (CLIMPEAT) project together with Nature Research Centre and University of Bern, funded by Lithuanian-Swiss Cooperation Programme. Project duration: 2013-2016.
- Regional analysis of climate and water resources. Project duration: 2004-2018. The aim of the project: identification of the tendencies of the regional climate change and the hydrological processes, assessment of the climate change impact on the Baltic Sea coasts, analysis of the measures to facilitate adequate adaptation strategies, verification of numerical weather prediction outputs under different atmospheric circulation background.

The Department also participates in two ESSEM COST action projects:

- ESSEM COST action ES1206 „Advanced Global Navigation Satellite Systems tropospheric products for monitoring severe weather events and climate (GNSS4SWEC)". Project duration: 2013-2017. The Action address new and improved capabilities from concurrent developments in both GNSS and atmospheric communities to improve short-range weather forecasts and climate projections.

- ESSEM COST Action ES1404 „A European network for a harmonized monitoring of snow for the benefit of climate change scenarios, hydrology and numerical weather prediction”. Project duration: 2014-2018. The Action co-ordinate efforts for establishing harmonized snow monitoring practices, enhancing the use of observations by promoting new observing strategies, bringing together different communities, facilitating data transfer, upgrading and enlarging knowledge through networking, exchange and training, and linking them to activities in international agencies and global networks.

The projects are funded from EU Framework Programme for Research and Innovation Horizon 2020.

Klaipėda University performs projects related to marine research, coastal protection and resource preservation, biological diversity, development of aquacultural technologies. It also plays an important role in the creation of background on environmental research of sustainable development, systematic research on the Baltic architectural, urban environment, marine and cultural landscape, modelling of tendencies and strengthening of identity. One of university researchers group woks on change in arctic benthic ecosystems: effects of glacial melt and the transport microplastics by boreal species. Another group works on ecosystem services of Lithuanian coastal zone: the global change perspective. The project aims to predict the future ecosystem services in the coastal Lithuania improving the multidisciplinary modelling and prediction tools and capacity of Lithuanian researchers to apply them. The project is focused on the mapping, validation and modelling of ecosystem services in the area of the Curonian Lagoon and Nemunas delta in a view of climate change and local socio-economic scenarios.

Vilnius Gediminas Technical University (VILNIUS TECH) initiating projects that are related with the technological development. University has two priority directions and topics of scientific research that are closely related to climate change: environmental and energy technologies that includes efficient use of resources and energy, environmental protection technologies, building energy, renewable energy and anthropogenic environmental change topics. The second research direction sustainable transport that includes topics such as environmentally friendly transport, green logistics, international transport corridors, urban mobility and etc.

VILNIUS TECH together with 49 partners from 14 countries is also involved in the EU funded project 3Ccar. The project addresses the ever growing complexity in mobility systems, especially in electrified vehicles (EV). Complexity control and reduction, translated into highly innovated semiconductors, enable improved energy efficiency, while enhanced systems integration leads to significant cost reduction, all enabling widespread EV development. 3Ccar will demonstrate semiconductor-based powertrain, battery and fuel-cell systems for higher efficiency, cost effectiveness and reliability, even in harsh environments, that are ideally suited to the plugin hybrid and electric automotive mass market. Project duration: 2015-2019.

One of the latest studies by university researchers focused on survey on buildings life cycle buildings energy performance gap influenced by occupant`s behaviour. The project duration: 2020-2022.

Kaunas University of Technology (KTU) is one the largest technological universities in the Baltics. The Institute of Environmental Engineering of KTU activities and research are based on practical engineering and management, policy decision-making related to environmental quality management. The Institute participated in the project “Novel roles of regional and local authorities in supporting energy consumers’ behaviour change towards a low carbon economy (LOCARBO)". Project duration: 2016-2020, funded from INTERREG Europe programme. An overall objective of LOCARBO is improving policy instruments targeting demand-driven initiatives to increase energy efficiency related to the built environment. This is to be achieved by finding innovative ways for regional/local authorities to support energy consumers' behaviour change. The KTU Institute of Environmental Engineering in the project will carry out research related to energy efficiency of buildings in reducing environmental impact.

The Institute participated in EU funded project "Electric Vehicles for City Renewable Energy Supply (EV ENERGY)". EV Energy analyses and develops innovative policies that promote renewable energies, electric mobility and the use of information and communication technologies for their integration. The Institute will analyse the measures and actions of the Kaunas region promoting the use of renewable energy sources and ETP in the region, good practices and the use of information and communication tools to integrate mobility and the use of renewable resources in the city. It will familiarize with the experience of other regions (project partners) and transfer their best practices to interested institutions and contribute to the implementation of the Kaunas region's sustainable urban mobility. Project duration: 2017-2021, funded from INTERREG Europe programme.

University participates in project "Social Sciences and Humanities for Transformation and Climate Resilience (SHiFT)". SHiFT proposes the creation of a transdisciplinary hub to address existing challenges in advancing timely societal transformations in the face of climate change. It includes the delivery of a plan of action-focused missions, initiatives, and digital content creation. The hub comprises a core group of SSH transdisciplinary researchers and practitioners and their extended networks with a focus on unfolding the benefits of engaging with transformation in practice ideas across different social, political, economic, environmental, and technological contexts. Recognising from the onset that these categories have blurred demarcations in practice and exploring the nexus between these and their impact on different systems and regimes. Project duration – 2022-2026; funded by European Cooperation in Science & Technology (COST).

In addition, the Institute participates in project "Preventing Groundwater Contamination Related to Global and Climate Change Through a Holistic Approach on Managed Aquifer Recharge (MAR2PROTECT)" and is a leading coordinator of the project "Advanced Smart and Zero Carbon Emission Development of Built Environment Research Using Digital Twin Technologies (SmartWins)". Both programs funded by "Horizon Europe" programme.

Lithuanian University of Health Sciences (LUHS) is the biggest institution of higher education for biomedical sciences in Lithuania. The Institute of Animal Science LUHS established for the fundamental and applied research in zootechny and biology on international and national level in the field of biomedical sciences. The main research activities of the Institute includes studies of animal genetics, biology of reproduction and genetic resources, animal nutrition and production quality, animal welfare and environmental issues related with animal production.

The University together with 22 countries implemented the program "Large-scale methane measurements on individual ruminants for genetic evaluations (METHAGENE)" (COST action FA1302). METHAGENE aims to discuss and agree on: protocols to harmonize large-scale methane measurements using different techniques; easy to record and inexpensive proxies for methane emissions to be used for genetic evaluations; and approaches for incorporating methane emissions into national breeding strategies. METHAGENE will co-ordinate and strengthen the EU scientific and technical research through improved cooperation and interactions, which is essential for breeding ruminants with lower environmental footprints resulting in less contribution to global warming. This EU funded project was implemented during 2013-2017.

The University together with Latvia, Germany, Denmark, Poland, Sweden and Estonia participates in the project “Reducing nitrogen loss from livestock production by promoting the use of slurry acidification techniques in the Baltic Sea Region (Baltic Slurry Acidification)”. Baltic Slurry Acidification aims to promote the implementation of slurry acidification techniques throughout the Baltic Sea Region. Slurry acidification techniques (SATs) will reduce the ammonia losses from livestock manure and thus reduce airborne eutrophication of the Baltic Sea. The usage of SATs will provide clear environmental benefit for the region. The use of SATs benefits also farmers by increasing the nitrogen use efficiency of their manure fertilizers and thereby decreasing their dependency on mineral nitrogen. The project started in 2016 and ended in 2019, funded by EU (Interreg Baltic Sea Region Programme).

In addition, the University participates in ”European research area network on sustainable animal production systems (ERA-NET SusAn)”. The project aims to tackle animal production challenges from projected increases in global demand for food, climate change, competition for natural resources and economic volatility. These challenges and complexities can be effectively addressed through joint European research within a framework which supports the three pillars of sustainability – economy, environment and society – and targets opportunities for innovative research spanning all areas of animal production such as health and welfare, feeding and nutrition, reproduction, breeding and genetics, housing, nutrient management and economics. The project receives funding from the EU Horizon 2020 Research and Innovation Programme, duration: 2016-2020.

The Environmental Protection Agency ensures continuous and complex monitoring, evaluation, forecast of and information providing on environmental quality and nature resources use. It also organizes and performs chemical, biological and radiological investigations of environment and pollution sources, coordinates applied and other scientific environmental research, programs and projects.

EPA has participating in the project “Updating the network of air quality and early warning stations and laboratories and improving the accounting of the amount of pollutants emitted into the ambient air“ the aim of this project is to improve the national accounting of the amount of pollutants emitted into the ambient air, to conduct research in order to assess the volume of long-range transport of air pollutants from other countries to the territory of Lithuania, the impact on the general level of pollution of the Lithuanian air basin, to determine which sources of pollution determine the conditionally natural territories characterized by a particularly small amount of local pollutants influence, condition of air and other environmental components. To update the laboratory equipment necessary for the ongoing measurements (research) in the ambient air and for their quality assurance and control, thereby creating the conditions to obtain high-quality, EU-compliant and internationally comparable environmental quality data and to provide reliable information to state management institutions, the public and international organizations. The project implemented with the funding from EU structural funds, project duration: 2017-2023.

The other important research center in Lithuania is the **Lithuanian Energy Institute** and the main objectives are to perform fundamental and applied research in the fields of thermal physics, hydrodynamics, metrology, safety and reliability of energy objects, materials engineering, hydrology, and processes management, climate change, the preparation of energy sector planning conceptual and methodological basis in the energy sector of the State's policy. The laboratory for Energy systems research is established by the Lithuanian Energy Institute. Experience of Lithuanian Energy Institute related to climate change projects is used on an international level – Institute's experts contributed to the Intergovernmental Panel on Climate Change report about climate change mitigation measures, study "Energy and climate change" in accordance with the World Energy Council plan, research supported by the International Energy and Environmental Policy Center and executed in partnership with experts from Central and Eastern European countries. The most recent projects were:

- Modelling of least-cost long-term greenhouse gas emission reduction strategies for Lithuania. Project is devoted to elaboration of methodology and corresponding mathematical models (based on IAEA tools) for evaluation of the least-cost long term greenhouse gas mitigation strategies in Lithuania, as well as for preparation of recommendations for applicability of different measures, including nuclear energy, in order to achieve foreseen emission reduction targets. Project duration: 2016-2018. Project is funded by TATENA.
- Improving energy efficiency in Lithuania. The aim of this integrated project is to support implementation of Lithuania's National Energy and Climate Action Plan (NECP). It will do so by catalysing the process implementation of energy efficiency measures, building up strategic capacities and mainstreaming greenhouse gas mitigation objectives. By overcoming gaps and shortcomings that hinder effective implementation of the NECP, LIFE IP EnerLIT will help the country's transport, building and industry sectors to achieve targets on energy efficiency and GHG emissions reductions. Duration of the project: 2021-2030.
- Process-based models for climate impact attribution across sectors (PROCLIAS). Many complex process-based models are available in Europe to project future climate impacts. Yet, the current climate impact research community is fragmented, modeling mostly individual systems. The integration of climate impacts across different natural and societal sectors is only slowly emerging. Likewise, attribution of impacts to climate and other factors is still a strongly under-researched field given that climate change is already strongly manifesting itself, an increasing number of court cases dealing with climate impacts is being negotiated and policy debates on loss and damage are intensifying. This lack of coordination amongst impact modelers and insufficient awareness about impact attribution methods hampers important scientific and political progress and more coordination and networking is urgently needed. Therefore, PROCLIAS aims to develop common protocols, harmonized datasets and a joint understanding of how to conduct cross-sectoral, multi-model climate impact studies at regional and global scales allowing for attribution of impacts of recent climatic changes and robust projections of future climate impacts. The Action will do so by focusing on key interactions of climate impacts across sectors, their accumulated effect, especially of extreme events, the attribution of impacts to climate change and the quantification of uncertainties. PROCLIAS will

make use of all COST networking tools to train young researchers to conduct and analyse multi-model simulations in a cross-sectoral way, to support a common platform for collecting impact model simulations and methods for analyzing them and to disseminate the data, code and results to scientists as well as, in a more synthesized form, to stakeholders. Duration of the project: 2020-2024.

- Profiling The Atmospheric Boundary Layer at European Scale (PROBE). The atmospheric boundary layer (ABL) is the layer closest to the Earth's surface within which most human activities take place. The vertical profile of atmospheric thermodynamic parameters in the ABL impacts weather, air quality, and climate. Surface sensor networks and satellite observations do not provide sufficient information on the high temporal variability and strong vertical gradients experienced in the ABL. Thus, despite its importance, ABL remains the single most important under-sampled part of the atmosphere. This observational gap currently hampers our ability to improve weather forecasts, air quality prediction, and climate model parameterization. However, this gap is mainly due to the lack of S&T networking and coordination. In fact, state-of-the-art ground-based remote sensing instruments able to provide ABL profiles (such as temperature, humidity, wind, aerosol, cloud) are currently deployed at numerous sites in Europe, but the harmonization of data and procedures is missing, limiting the effective use and societal benefits of the existing ABL profiling data. This Action aims to fill this gap, bridging user needs and the S&T expertise residing in industry and academia.

Lithuanian Research Centre for Agriculture and Forestry (hereinafter – LRCAF) in the perspective of it's activity focuses on sustainability of agro and forest ecosystems under changing climate conditions.

The most recent climate change related researches performed and currently executed by LRCAF are:

- "Biogeography and spread of local and invasive tree pathogens: focus on climate, tree species and intensity of forest management". Project duration: 2017-2020. It is funded by the Research Council of Lithuania.
- "Sustainable forestry and global changes". An objective of this research is a collection of knowledge that is necessary to the development of sustainable forestry in the context of natural, economic and social changes. The initial project implemented in 2012-2016 and continued during 2017-2021. It is funded from the State budget.
- "Benchmarking sustainability performance of value chains using ToSIA (the Tool for Sustainability Impact Assessment)". Project duration: 2017-2019. Funded by FP7 ERA-NET "SUMFOREST" project.
- "A holistic approach to sustainable, digital EU agriculture, forestry, livestock and rural development based on reconfigurable aerial enablers and edge artificial intelligence-on-demand systems" (CHAMELEON). Funding provided by "HORIZON EUROPE" programme, duration: 2022-2025.
- "External organic matters for climate mitigation and soil health" (EOM4SOIL). EOM4SOIL aims at proposing best management practices of external organic matter (EOM) pre-processing and application on soil to contribute to climate change mitigation and improve soil health. The net budget of soil C storage and greenhouse gas emission including the pre-process step and field application, is assessed as well as the multiple effects of EOM application on soils including contaminants are

quantified. To improve C budget and soil health, innovative pre-processing is recommended. The best management practices are defined from scenarios of use assessed with a multicriteria simulation tool, parameterized from long-term experiments. Duration of this project: 2022-2024.

- "Mechanisms underlying TRAde-offs between Carbon sequestration, greenhouse gas Emissions and nutrient losses in Soils under conservation agriculture in Europe" (TRACE-Soils). The aim of the project is to identify the mechanisms underpinning trade-offs and synergies of soil carbon sequestration, greenhouse gas emissions and nutrient losses in agricultural soils across Europe and propose climate-zone specific indicators and measures to mitigate trade-offs. Duration: 2021-2024.

The Nature Research Centre is significantly contributing to the implementation of State's ecologic monitoring, provides conclusions and proposals on the subjects of improvement of environmental quality, impacts of negative human activity and mitigation of global climate change.

Nature Research Centre participates in these projects:

- A global network of nurseries as early warning system against alien tree pests (Global Warning), COST Action FP1401. The research financed from EU Framework Programme for Research and Innovation Horizon 2020. Project duration: 2014-2018.
- Geo-environment and its resources in conditions of climate change and anthropogenic pressure. One of the main theme of the project is Composition of subsurface traditional and non-traditional, mineral and geoenergy resources, their localization and prediction of potential resources occurrence in particular geosystems; impact assessment of anthropogenic pressure and climate change on the formation of surface and subsurface hydrosphere resources and their quality.

8.3 Systematic observation

8.3.1 Global Climate Observing System

Lithuanian GCOS-related activity is coordinated by the Lithuanian Hydrometeorological Service under the Ministry of Environment (hereinafter – LHMS). It performs climate observations, analyses climate changes, provides information, and actively participates in the activities of Northern European working groups.

Lithuanian hydrometeorological observation

LHMS was established in 1921, and its goals regarding climate activities today are to ensure continuous and complex hydrological and meteorological observations in the State territory, climate monitoring, evaluation, forecast, and provide information on weather and climate change. The first meteorological observations in Lithuania were conducted in 1778. The long-term high-quality climate records are obtained from the core meteorological stations network, which consists of 10 long-term performing stations (one of them is recognized as Centennial Observing Station by WMO). Systematic observations are conducted by the current network of meteorological observations that covers all territory (see Figure 8-2). It is composed of 9 semi-automatic meteorological stations, 3 aeronautical meteorological stations, 45 automatic meteorological stations, 4 lightning detectors, and 2 Doppler weather radars which constantly provide meteorological data and are used for climate analysis. Net of hydrological measurement includes 101 water gauge stations.

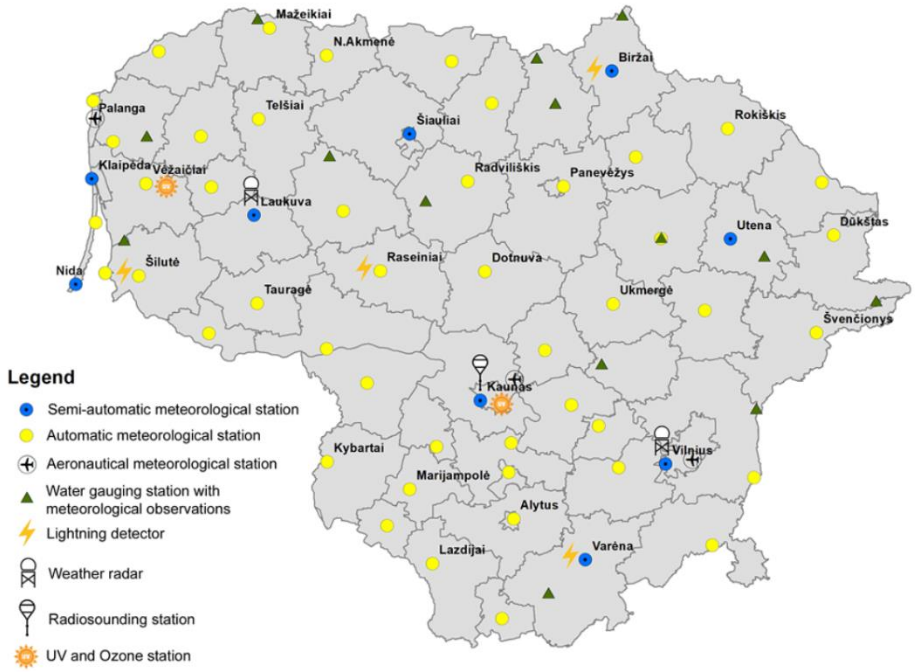


Figure 8-2. Meteorological stations network map (source: LHMS)

Vilnius meteorology station is included in the GCOS Surface Network (GSN). It contributes to the surface-based atmospheric essential climate variables (ECVs) – continuously observed Precipitation, Surface pressure, Surface radiation budget, Surface Wind Speed and Direction, Surface Temperature, and Surface Water Vapour. Significant planning is undertaken to ensure an appropriate correlation between Lithuanian and international needs and collected data. In addition, LHMS has bilateral agreements with the institutions in Latvia (Latvian Environment, Geology and Meteorology Centre) and Poland (Institute of Meteorology and Water Management), which allow an improvement of quality and expedition of information provided by both sides. In such a way a partnership is formed, and it stimulates the sustainable development of the other countries and the making of decisions related to the ecologic economy, climate change, and others.

LHMS participates in the following international projects and programmes:

- Cooperation with EUMETNET (a network of 31 European National Meteorological & Hydrological Services) – meteorological computer-aided learning programme 'Eumetcal';
- WMO World Cities Forecasts project – WMO World Weather Information Service is provided on a daily basis with 5-day forecasts for 5 Lithuanian cities as well as with climate data. The information is posted at http://worldweather.wmo.int;
- HIRLAM (High Resolution Limited Area Model) adaptation for Lithuania's conditions, origination of numerical forecasts, participation in transition to HARMONIE prognostic model;

- CEE–WMO/GWP (Associated Programme on Flood Management) programme – cooperation in implementation of the joint flood management programme for Central and Eastern Europe, participation in workshops, submission of information on the largest floods in Lithuania;
- CLIPS (Climate Information and Prediction Services) programme – cooperation in the development of climate information and climate prediction systems and investigations on the climate change, preparation and submission of reports on climate research in Lithuania;
- NAVTEX safe navigation programme – origination and transmission of marine hydrometeorological forecasts and warnings for Southeast Baltic twice per 24h;
- WOUDC (World Ozone and Ultraviolet Radiation Data Centre) – regular provision of national ozone and ultraviolet solar radiation data with reciprocal right to access the WOUDC global database;
- Cooperation with the Czech Hydrometeorological Institute on CLIDATA (Climatological Database) creation and maintenance – maintaining of the climatological database to store, systemize and analyse meteorological observation data including their presentation facilitated by a GIS application. Stations' metadata are also stored in the database;
- Global Climate Observation System (GCOS) – cooperation in climate observation, assessment of climate variability, exchange of information, participation in the East and Central Europe's working group;
- WMO World Weather Research Programme – cooperation by submitting information on relevant scientific research in Lithuania;
- WMO-supported Global Runoff Data Centre (GRDC) – cooperation in creating world river runoff database by provision of hydrological observation data and metadata on Lithuanian rivers with reciprocal access to the GRDC global database;
- Nordic weather radar network NORDRAD – cooperation in exchanging weather radar observation data.

8.3.2 Systematic observation of other climate parameters

A purpose of **State Environmental Monitoring Programme for 2018-2023** (hereinafter – Programme) is, pursuant to the current international commitments and national needs, to supply responsible state' and international institutions with reliable information about the state of natural environment and changes influenced by anthropogenic impact. Implementation of the Programme enable easier data collection and it contributes to the correct evaluation of natural environment in Lithuania, the management and forecasting on national and international levels, to supply institutions responsible for environmental quality and public health of all levels with information about the state of environment that is of utmost importance in order to make decisions. Moreover, it will allow a solution of environmental problems, including threats of climate change, consequences to public health and ecosystems, long-range transboundary air pollution, increased intensity of occurrence of sinkholes, deteriorative soil conditions due to land use in karst region in the Northern part of Lithuania.

The implemented tasks of the Programme enable to solve the following environmental problems:

- air pollution, the effects of climate change on human health and ecosystems;
- the negative impact of radionuclides on the radiological quality of the environment;
- the negative impact of anthropogenic activity on the state of groundwater, territorial sea, coastal and intermediate waters, inland rivers, lakes and ponds;
- deterioration of soil quality due to natural processes induced by natural or economic activity, increasing soil anthropogenic physical and chemical pollution;
- the loss of biodiversity and irrational use of wildlife;
- the spread of non-indigenous invasive plants and animals of species threatening biodiversity and human health;
- the threat of long-range transboundary air pollution from other countries to Lithuania and the impact of climate change on semi-natural ecosystems;
- increasing pollution of the Baltic Sea, loss of biodiversity and productivity of agro-ecosystems, pollution of wells with nitrates due to pollution of surface and groundwater with nutrients from diffuse sources;
- the degradation of the most valuable and ecologically sensitive landscape complexes (in the protected areas), including the shores of the sea, aesthetic decline in their value due to economic activity and recreational load;
- intensification of the karst processes due to climate change, deteriorating territory conditions in the karst region in the Northern part of Lithuania;
- negative impact of natural seismic events (earthquakes) and anthropogenic seismic events on the environment, landscape and economic activity in seismically active zones.

There are few types of monitoring performed in Lithuania: air, water, live nature, ecosystems, landscape and radiological:

- *Air monitoring*. Priorities of environmental protection policy in the field of air state observation are concurrent to the priorities of sustainable development in Lithuania: reduction of impact of the main economic sectors on environment and threats on human health, mitigation of global climate change and its consequences.
- *Water monitoring*. The main tasks of the Programme for 2011-2017 are defined for the state of certain water bodies, also for the monitoring of the effect of measures foreseen in the management plans of river basins and the provision of the data and information.
- *Monitoring of live nature*. The most part of measures of the Programme foreseen for the evaluation of the state of live nature is constituted from observations for the state evaluation of species (important to European Community, habitats and concentration locations of bird migration). It shall ensure a collection of information which will allow to identify the most sensitive areas of biological diversity and to stop its decline.

- *Landscape monitoring*. In the Programme the substantial monitoring system of landscape is kept as it was set in 2005-2010: structural changes of landscape are recorded and analysed, a degree of landscape polarization is set on national, regional and local levels, and specific parameters are foreseen for monitoring of coastal zone, region of sinkholes and protected areas.
- *Radiological monitoring*. Radiological monitoring is performed in Lithuania for more than 50 years by EPA. Pursuant to the Programme which was prepared in accordance to the recommendations of European Commission, International atomic energy agency (IAEA) and Helsinki commissions, a radiological monitoring of Gama dose power, air aerosols, surface water and bottom silt in the rivers, lakes, the Baltic Sea and the Curonian lagoon is performed. Also EPA functions include a control of Ignalina Nuclear Plant.
- *Monitoring of ecosystems*. Recently research on complex impact of air pollutants and climate change on forest ecosystems is prioritized not only due to increased detrimental impact on forestry, but also due to necessity to observe an impact of global pollution on natural ecosystems of various countries and regions.

Environmental goals and tasks are defined and their implementation will require state observations of natural environmental on a national level, therefore, measures, responsible institutions, funding scheme, need of funding and allocation are foreseen in the Programme until 2023.

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EDUCATION, TRAINING AND PUBLIC AWARENESS

9. EDUCATION, TRAINING AND PUBLIC AWARENESS

Lithuania invests in raising people's awareness of the challenges posed by climate change, including reducing greenhouse gas emissions and adapting to climate change. This Chapter reports information on raising public interest in climate change issues, education and climate change awareness, and education and training on climate change mitigation and adaptation.

In the National Climate Change Management Agenda, approved in 2021 (hereinafter – Agenda), the development and application of economic, financial, and educational measures to reduce energy poverty and other inequalities exacerbated by climate change and public education and engagement improvement are identified as the key horizontal policies for managing climate change. It is stressed in the Agenda that it is essential to implement information and education initiatives that promote public environmental awareness, consciousness, engagement, and responsible, environmentally friendly, and climate-friendly behaviour to achieve the goals. What is more, it is necessary to invest in human resources by training, re-skilling, and up-skilling professionals and mainstream climate change into all education curricula.

Every year, various events are organised to raise awareness about climate change. It is observed that institutions, businesses, NGOs, and communities are becoming engaged in dialogue on the challenges of climate change, organising events and initiatives. Information on climate change is also featured on TV, in radio programs, in newspapers, and in magazines.

9.1 Primary, secondary and higher education

At the highest level, Lithuanian science, technology, and innovation (STI) policy is set by the Seimas (Parliament) and the Government of the Republic of Lithuania. The main laws devoted to the regulation of STI system are the Law on Science and Higher Education (2009) and Law of Technology and Innovation (2018).

The Ministry of Education, Science and Sport implements the national system of formal and informal education, which influences social attitudes in favour of education, creates conditions for lifelong learning, implements the state policy of science and studies following the Law on Science and Studies (1991) and other legal acts and coordinates the activity of Lithuanian institutions of science and studies.

The National Agency for Education is the education assistance institution founded by Lithuania's Ministry of Education, Science and Sport. The Agency's mission includes conducting education monitoring; organizing national and international education research; organizing the development of the preschool, pre-primary, and general education content and coordinating its implementation; developing the education assistance system while implementing provisions on inclusive education; organizing and administering evaluation of learning achievements, Matura examinations and other examinations; and evaluating key competences of individuals and acquired professional competencies.

The Monitoring and Evaluation Department is part of the National Agency for Education. The Department is responsible for national and international assessments, including the PISA study. It also evaluates schools, teacher training institutions, and other institutions with education mandates.

Organisation of the school system

The Table 9-1 below shows (in summary) the learning outcomes as developing values, achievements, and capacities of students, related to climate change themes, environmental sustainability, and sustainable development in the National Curriculum (The General Education Programs). Note: In the 2008 National Curriculum for Primary and Lower secondary education and the 2011 National Curriculum for Upper secondary education, the content is provided in concentric units implemented over two school years, and in the 2022 draft of National Curriculum (The General Education Programs, 2022), the content is set out for each grade. National Curriculum 2011 is divided into 2 courses: General Course and Advanced Course. Students may choose the Course by their preferences.

Table 9-1. Learning outcomes related to climate change in the National Curriculum

Primary education	
2008	**2022**
Grades 1-2	
Developing values. **World awareness**: save electricity. Saving and preserving nature.	Achievements. **Science:** knowledge of the harmony between humans and the environment.
Grades 3-4	
Developing values. **World awareness**: saving electricity to protect the environment.	Achievements. **Science:** understanding the harmony between people and the environment. Provides examples and explains how human activities, products, and technologies affect the natural environment.
Lower secondary education	
2008	**2022**
Grades 5-6	
Developing values. **Science**: protecting and preserving nature. Understanding the interrelationship between human activity and nature.	Achievements. **Science:** understanding the harmony between people and the environment. Explains how human activity, scientific discoveries, and technology lead not only to progress but also to social and ecological problems.
Grade 6 Developing values. **Geography**: developing a sense of values: developing a responsible attitude toward the problems of nature and society	Achievements. **Geography**: Knowledge of geographical phenomena, processes, and systems. Identifies and describes major natural phenomena and processes in Lithuania and the world and is encouraged to identify their causes and effects.
Grades 7-8	
Developing values. **Science**: willing to participate in conservation activities. Understanding the interrelationship between human activity and natural processes.	Achievements. **Biology**: knowledge of the harmony between people and the environment. Achievements. **Chemistry**: understanding the harmony between people and the environment.

	Achievements. **Physics**: Understanding the harmony between people and the environment.
Developing values. **Geography**: to develop a responsible attitude towards the problems of nature and society.	Achievements. **Geography**: Awareness and Spatial and Map Orientation. Explains the cognitive and practical significance of geography in the study of natural and social objects.
9-10 (Gymnasium I-II)	
Developing values. **Science:** a sense of responsibility for the conservation of nature and the rational use of resources.	Achievements. **Biology**: Awareness of the harmony between people and the environment. Achievements. **Chemistry**: Awareness of the harmony between people and the environment. Achievements. **Physics**: Human-environment harmony. Identifies sustainable development measures to ensure human well-being now and in the future.
Developing values. **Geography**: To develop a respectful, sustainable attitude towards nature and the social environment and its diversity.	Achievements. **Geography**: Geographical Science Awareness and Spatial and Map Orientation. Explains how geography explains and solves problems of the spatial territorial context of Lithuania and the world.
Capacities. **History:** Identify the most important problems facing people in Europe and the world today.	Achievements. **History**: Orientation in historical time and space. Characterizes the historical periods under study; identifies and argues for turning points in history.
Capacities. **Citizenship:** examine how international organisations are tackling a selected European or global social, economic or environmental issue.	Achievements. **Citizenship:** Knowing and exploring self and society. Drawing on a variety of information sources, identify relevant local, national, and global issues.
Upper secondary education	
2011	**2022**
Grades 11-12 (Gymnasium III-IV)	
Developing values. **Biology**: Understand that biodiversity is determined by genes and the environment.	Achievements. **Biology**: understanding the harmony between people and the environment. Describes the importance of sustainable development.
Developing values. **Chemistry**: developing values: taking personal responsibility for preserving the environment.	Achievements. **Chemistry**: Understanding the harmony between people and the environment. Describes sustainable development as a set of measures to ensure human well-being now and in the future.
Developing values. **Physics**: taking personal responsibility for preserving the environment.	Achievements. **Physics**: human-environment harmony. Describes sustainable development measures to ensure human well-being now and in the future.
Developing values. **Geography**: respectful relationship with the natural and social environment, life and its diversity.	Achievements. **Geography**: Knowledge of geographical phenomena, processes, and systems. List and describe natural phenomena, processes, and patterns, identifying their features, causes, consequences, and areas of occurrence.
-	Achievements. **Economics and entrepreneurship:** Understanding global economic processes.

Vocational education

Sustainable development topics are integrated into the educational content and methodological material 'Sustainable development education: a practical guide for teachers' has been prepared. Teachers apply the acquired knowledge in lessons that analyse climate change, the greenhouse effect, air and water pollution, poverty and food shortage, and other problems relevant to all of humanity. It helps students better understand these problems, their impact on our everyday life, strengthens students' awareness, encourages them to change their decisions and actions to be more environmentally responsible.

Vocational education institution 'Klaipėda Ernestas Galvanauskas Vocational Education Center' implemented the international project 'European climate initiative: together for a harmonious school'. Climate change, air and water pollution, loss of biological diversity, food shortages and other problems relevant to all of us were analysed in remote mathematics, chemistry, biology, ethics, English langue lessons and integrated into history-Lithuanian langue, history-geography, Russian langue-biology lessons.

Creatively, using problem-solving-based learning, the teachers introduce students with the goals, tasks, and environmentally friendly ideas of sustainable development, and students enthusiastically discussed and proposed ways to solve problems. The initiatives proposed by the students will be implemented in the vocational education centre.

Higher education establishments

The higher education and research institutions form the framework of the Lithuanian research system. In Lithuania there is a binary system of higher education: 11 state and 7 non-state universities (orientation towards theoretic and high-level research) and 12 state and 7 non-state colleges of higher education (with orientation towards more practical issues). In addition, there are 11 state and 6 non-state research institutes. Research institutes as well as universities have capabilities to develop through all the technological readiness levels, however, concentrate more on the upper end in comparison to universities.

According to Vilnius University (VU), in 2020 Lithuanian universities signed an agreement on climate change. They committed to reducing greenhouse gas emissions, evaluating their campuses, and developing more climate change scientific research. The institutions also aim to collaborate to raise public awareness and strengthen the role of scientists in policy decision-making. Vilnius University offers Sustainable Development course and Master's program 'Sustainable Corporate Finance and Investments', offered in English. VU Faculty of Law has courses in English 'Sustainable development and Environmental Law'. The new master program 'Climate System Studies' launched in Faculty of Chemistry and Geosciences of Vilnius University prepare climate system specialists with modern knowledge of climate change, atmosphere, hydrosphere, environmental protection and ecology. The 'Meteorology and Hydrology' bachelor's study program includes a whole series of study subjects directly or indirectly related to various aspects of climate change. Climate change is also studied in the new 'Environmental Science and Protection' bachelor study program (the joint program of Faculty of Chemistry and Geosciences and the Life Sciences Center. All VU students can choose the elective course 'Climate and Ecosystem Change' aimed at improving general competences. In 2022 the new teacher's competence development program 'Climate Change' was launched in faculty of Chemistry and Geosciences of Vilnius University.

At Vytautas Magnus University, the Faculty of Forest Sciences and Ecology offers the course Ecology and Climate Change. The course is addressed to graduate students and includes topics in the syllabus on protection of hydro-ecosystems, environmental policy, and nature management, all with a climate change perspective. It has integrated sustainable development and climate change issues in Biology and Genetics, Molecular Biology and Biotechnology, Environmental Management.

In Kaunas University of Technology, climate change aspects are included in the curricula. The activities and research of the Institute of Environmental Engineering are based on practical engineering and management, and on decision-making related to the management of environmental quality.

Klaipėda University carries out research on marine ecosystems, coastal protection and resource conservation, biodiversity, and projects on aquaculture technology development and other topics. It is active in developing links between environmental quality and sustainable development, and in research on the Baltic urban environment and the marine and cultural landscape. Klaipėda University have integrated different aspects of climate change issues in bachelor, master and doctoral studies in Ecology and Environmental studies, Hydrology, Geography, Social Geography, Environmental Engineering, Marine Engineering.

Vilnius Gediminas Technical University and its partners have signed an agreement for the establishment of the Lithuanian Cleantech Cluster, which brings together knowledge and experience from different fields to collaborate in the design and development of clean technologies and sustainable business solutions.

The climate change aspects integrated into Mykolas Romeris University's study programmes in Environmental Protection and Policy, Public Administration, Sustainable Environmental Policy and Management provide students with the opportunity to analyse and systematise the main directions of climate change policy and its implementation, to understand climate change and its impacts, and to learn about the opportunities for adaptation to climate change.

At the University of Health Sciences, the biomedical sciences focus on the impact of climate change on human health and the potential for adaptation to climate change.

Various universities in Lithuania maintain alliances with other stakeholders. Vilnius University has joined study initiatives with the Arqus European University Alliance, including in climate change events. For example, Vilnius University promoted the workshop on climate change with the Alliance and other European universities. The call invited researchers to cooperate on ongoing research projects, establish priorities, share knowledge, and develop a better understanding and solutions for mitigation and adaptation to climate change.

9.2 Society involvement and awareness raising

In November 2019, the Ministry of Environment organized Climate Week for the first time. Scientists, politicians, public figures, and the public were invited to discuss strategic goals and measures of Lithuania's climate change policy, climate challenges, and opportunities in the forestry, energy, transport, industry, and agriculture sectors. The success of Climate Week has led to the decision to organize it on an annual basis (see Table 9-2), timed to coincide with International Day of Climate Action (24th October):

- On 19th-25th October 2020, Climate Week brought together dozens of events across Lithuania, covering the environment, climate change, and more sustainable living from different angles. The focus was on Lithuania's climate policy goals in the context of the European Union's growing ambitions. It also focused on funding opportunities for mitigation and adaptation projects. Together with our partners, we revealed a wide variety of other topics that feed into the common ambition to live in a clean and healthy environment.

- On 18th-24th October 2021, Climate Week started with a conference organized by the Lithuanian Hydrometeorological Service dedicated to commemorating its 100th anniversary. The Climate Week ended with a panel discussion called 'Is the climate crisis moving from the margins to the centre?', where politicians, businesses, education, and NGOs discussed how to make Lithuania climate neutral. The slogan for Climate Week was 'Code: RED' to raise awareness of the need for urgent action. Institutions and organizations from all over Lithuania were joining this initiative, and educational institutions were especially active.
- On 24th-30th October 2022, Climate Week was mostly dedicated for cities and how to improve their resilience to climate change. On 24th October, the Ministry of the Environment organised a national climate change conference 'Climate Change and Cities: will flowering meadows help drowning streets?', which featured presentations by representatives of the European Commission, the European Environment Agency, the Organisation for Economic Cooperation and Development (OECD), mayors and leaders of Lithuania's transformation into a climate-neutral and resilient economy. The conference attracted a great deal of public interest, with around 155 000 people watching the live stream. Also, there was a hackathon 'Green Life Hack: Mobility', a green procurement fair, the public was invited to participate in exhibitions, excursions, various discussions, watch movies for free, etc.

Figure 9-1. National climate change conference, 2022 (source: Ministry of Environment)

In 2020-2022, in addition to events organised by the Ministry of the Environment and other governmental institutions, the public, NGOs, municipalities, educational institutions were also invited to organise their own events during Climate Week. Public interest continues to grow each year (see Figure 9-2), the Ministry of the Environment shares the selected events on website klimatokaita.lt as well as on its social media.

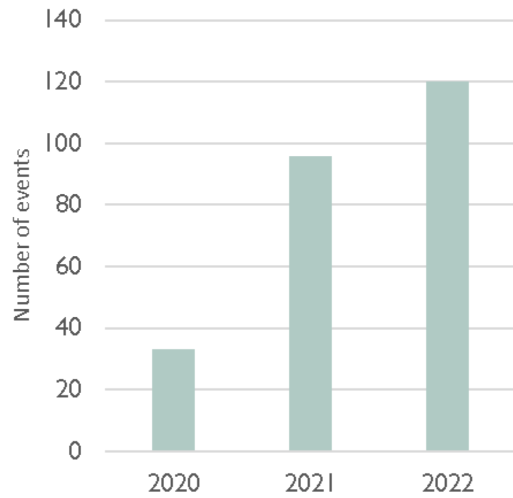

Figure 9-2. Number of suggested events for Climate Week by the public

Events on climate change are taking place all over Lithuania not only during Climate Week. Lithuanian population and government pay high attention to the issue of climate change, and the topic comes popular in public debates or in the press. Numbers of awareness-raising campaigns were launched for the environment and global warming in particular at the various political levels in the country (see Table 9-2).

Table 9-2. Events related to climate change

Institution	Event
Ministry of Environment and partners	National Climate Week events: - 22-29th November, 2019 - 19-25th October, 2020 - 18-24th October, 2021 - 24-30th October, 2022
Academy of Agriculture of Vytautas Magnus University	31st May, 2019: Annual seminar of the Lithuanian Agronomy Alumni Club 'If climate change - changing agriculture?'
Lithuanian Research Centre for Agriculture and Forestry	26th November, 2019: Inventory of greenhouse gas emissions in the crop production sector of the country, final conference
Academy of Agriculture of Vytautas Magnus University and Ministry of Agriculture	9th September, 2021: Scientific conference 'Air pollution reduction in livestock breeding'
Agency for Science, Innovation and Technology (MITA) and partners	28th September, 2020: Webinar 'Baltic Sea Region - Towards Sustainable Economic Transformation'
	10th March, 2021: Event for organizing the coordination group for the transition of Lithuanian industry to the circular economy
	18th March, 2021: 'Circular economy roadmap. Process and benefits' 25th March, 2021: Event, related to the project "Roadmap for Lithuania's industrial transition to a Circular Economy"

	22nd April, 2021: 'Good practices for the Government and industry transition to a circular economy'
	30th April, 2021: Consultation Workshop 'Analysis of Circularity of Lithuanian Industry'
	4th June, 2021: Discussion 'From Paris to Glasgow Agreements: Can Startups and Scale-ups Have and Impact on Countries' Climate Commitments?'
	8th July, 2021: Online strategic session 'Scenarios and vision of Lithuanian industry transformation from linear to circular economy'
	13th August, 2021: Discussion of the strategic directions of Lithuanian industry transformation from linear to circular economy
	19-21st November, 2021: Hackathon 'Innovation hack. Society goes green!'
	30th November, 2021: Annual Economic forum 'How to keep up in the competitiveness highway: rapid transformation and digitalization'
	17th December, 2021: Final conference of the project 'Roadmap for Lithuania's industrial transition to a circular economy': 'How can industry lead the Green and Circular Economic Transformation?'
	16th June, 2022: 'Application of circular economy principles in food technology and materials engineering
	13th July, 2022: 'Industry 2030: how to get on the departing train?'
Innovation Agency, Confederation of Lithuanian Industrialists, etc.	25th July, 2022: Sustainability Innovation Expedition at the White Bridge
SE 'Oro navigacija' (ON)	23-23th September, 2021: International conference 'Climate change and the role of air traffic management'
Vilnius university	22nd May, 2020: Conference 'Climate change in Lithuania: global and national challenges, monitoring and policy guidelines' 20th January, 2022: Interdisciplinary scientific conference 'Forests in the context of climate change' 4th November, 2022: Interdisciplinary climate change conference 'Edges of climate protection'

Additionally, Lithuania participated in EXPO 2020, the six-month-long World Expo in Dubai. On the eve of the closing ceremony, Lithuania was awarded the International Exhibition Bureau's Silver Award in the category of small pavilions built by the participating countries themselves for its excellent presentation of the theme Sustainable Synergy.

Figure 9-3. Lithuania's participation in EXPO 2020 (source: Ministry of Environment)

To mark its 100th anniversary, the Lithuanian Hydrometeorological Service together with the Ministry of Environment has produced a series of videos on climate change and its impact on different sectors, and how meteorologists and hydrologists monitor it.

In 2018-2021, specialists of the Climate Change Policy Group of the Ministry of Environment together with the representatives of the Lithuanian Hydrometeorological Service actively participated in more than 600 radio and TV programs, related to public awareness of climate change issues.

9.3 Participation in international programs and projects

Several international projects related to climate change issues are already accomplished or still on-going. Between 2020 and 2024, the Ministry of the Environment will implement the 'Environment, Energy and Climate Change' programme, which will include activities under the ClimAdapt-LT project to strengthen municipal adaptation to climate change. The project is funded by the European Economic Area and Norwegian Financial Mechanism Programme. The project plans to produce climate projections for Lithuania up to 2030, 2050, 2075, 2100, to prepare a vulnerability assessment describing the most vulnerable sectors and social groups covering all municipalities, to update the emergency management of the selected municipality and to prepare a climate change adaptation plan, taking due account of the different scenarios of climate change, as well as to raise the awareness of municipalities and the public about the importance of climate change adaptation measures.

For the period 2021-2023, Lithuania, together with the European Commission's DG Reform and the Organisation for Economic Co-operation and Development (OECD), is carrying out the project 'Reform of all economy sectors of Lithuania towards climate neutrality by 2050'. Lithuania is planning for adjustments to its National Energy and Climate Action Plan (NECP), to increase ambitions in non-ETS sectors by 2030, in line with national and EU policies. The transition to a climate neutral economy will require policy reforms, adjusted public expenditure, and private investments across key economic sectors (in particular, energy, transport, industry and agriculture). The OECD will formulate policy recommendations based on such its assessment of costs and benefits assessment, providing an overview of policy options by 2030 and 2040, with the aim of achieving climate neutrality by 2050. The OECD team is responsible for coordinating and administering the Project, as well as for consulting with DG REFORM and with the Project team from Lithuania, on the Project's outputs.

From February to December 2021, the Lithuanian Centre for Children and Youth invited schools with students aged 14-18 to participate in the international sustainable development education project 'European Climate Initiative: Together for a sustainable school'. The main objective was to develop competences that can help people assess their actions and their social, cultural, economic and ecological impact on the environment and the world.

9.4 Public information campaigns

Many of campaigns make considerable use of the social media tools, but also include chance for personal live interaction. The main campaigns and activities related to climate change issues are carried out in Lithuania:

- **European Mobility Week** – every year, the Ministry of the Environment, the coordinator of the European Mobility Week in Lithuania, invites not only municipalities, but also all companies and organisations in the country to actively join the annual campaign, which takes place 16th-22nd September. During the week, the European Commission is encouraging people to leave their cars behind and switch to cycling or public transport. Many cities across the country are running competitions and offering free public transport for one day.

Figure 9-4. Visual for European Mobility Week (source: Ministry of Environment)

- **National Reforestation Day** (lith. *Nacionalinis miškasodis*) – the largest reforestation campaign organised by the Ministry of the Environment and the State Enterprise 'Valstybinių miškų urėdija'. During the event, seedlings were planted all over Lithuania by various companies, institutions, organisations, communities and citizens who love nature and want to contribute to the increase of Lithuania's forest cover, which currently stands at 33.7%.

Figure 9-5. Visual for National Reforestation campaign (source: Ministry of Environment)

- **Mobile climate museum** – project, which travelled through 16 Lithuanian cities in 2022. The museum was housed in four colourful marine containers where visitors could see, touch, and understand climate change. The museum presented 4 main themes: the causes and consequences of climate change, the main points of the EU Green Deal in the Baltic States, the importance of nature in modern human life, and the sustainable changes we can easily make every day. This project is part of the European Climate Initiative (EUKI) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

Figure 9-6. Mobile climate museum from inside (source: www.klimatomuziejus.lt)

- **European Week for Waste Reduction** – a simultaneous campaign in all European countries to raise public awareness on sustainable resource use and waste management. During the campaign, participants have the opportunity to learn about the various options available to help avoid waste. They exchange ideas on recycling, learn how to properly manage the waste they already generate, create poems and songs on the theme, exchange unwanted items, give lectures, engage in social activities, etc. The events are coordinated by the Ministry of the Environment.

Figure 9-7. Visual for Waste Reduction Week (source: www.ewwr.eu)

- **Earth Hour** – worldwide movement to raise awareness about climate change by voluntarily switching off for one hour. On the 20th of March, as every year, the Earth Flag waved in Vilnius next to the Seimas building and Ministry of Environment. The United Nations officially declared the World Earth Day in 1971. It is celebrated on the spring equinox to mark the precise moment when day and night become equal in length on all spots of the globe. After Lithuania regained Independence, initiator of the Earth Day John McConnell addressed our nation calling to become Earth guardians and to mark the spring equinox, which falls on the 20th or 21st of March at different locations of the planet, as the World Earth Day.

Figure 9-8. Earth Hour event in Vilnius, Cathedral Square (source: Scanpix)

- **Velomarathon** – the biggest cycling event in Lithuania, that is held in Vilnius. An initiative based on four values – family, healthy lifestyle, ecology, road safety – aimed at strengthening the cycling culture in Lithuania by creating a new and unique tradition. The race divided into three groups: children, amateurs, and sports.

Figure 9-9. Velomarathon 2022 (source: Ministry of Environment)

- **'Ėjimas'** – one of the biggest events for hikers in Kaunas and Vilnius. The 5, 10, and 25 km routes are open to everyone, from families with toddlers to experienced hikers. The routes chosen are rich not only in the beautiful scenery, but also in natural, architectural, and historical sites. The walking challenge encourages attention to the benefits of walking for the body and mind, as well as for the environment.

Figure 9-10. The start of hiking event 'Ėjimas' (source: www.ejimas.lt)

- Since 14th January 2022 the Environmental Project Management Agency has become the promoter of the project 'Promoting Responsible and Environmentally Friendly Behaviour in Society'. The project produces articles for various Lithuanian newspapers and other publications, as well as Facebook, Instagram posts and a webpage encouraging Lithuanians to move more sustainably.

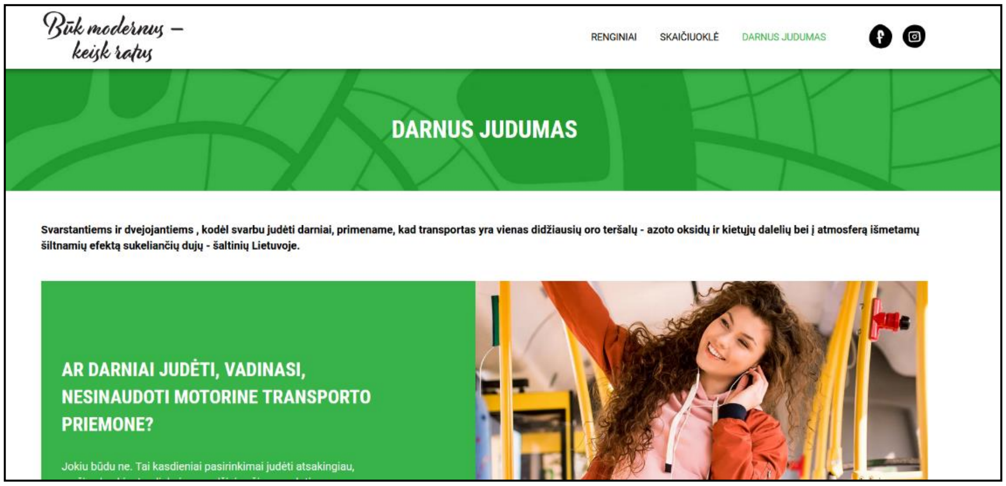

Figure 9-11. Sustainable Mobility Initiative project website (source: www.darnusjudumas.lt)

9.5 Information availability

As part of its European environmental obligations, Lithuania ensures public access to information through online portals that provide information on climate change. One such platform is the Ministry of Environment website, which has a special section on climate change information (currently only available in Lithuanian).

Reports and information related to the climate change topic are available on the internet portals of the Environmental Protection Agency (https://aaa.lrv.lt, https://aplinka.lt/klimato-kaita) the Lithuanian Hydrometeorological Service (http://www.meteo.lt/lt/klimato-kaita), Health Education and Disease Prevention Center (http://www.smlpc.lt/lt/aplinkos_sveikata/klimatas_ir_sveikata), Research Council of Lithuania (https://www.lmt.lt/lt/klimato-kaita-istekliu-naudojimo-efektyvumas-zaliavu-tiekimas/359).

All legal acts are placed in the internet portal of the Parliament of the Republic of Lithuania (www.lrs.lt). Also, Ministry of Environment publishes information in such social networks as Facebook, LinkedIn, Instagram and YouTube.

Vilnius University (VU) runs a blogging platform 'Climate Change Group', which brings together VU's researchers and students interested in climate change, the latest climatological and sociological research and policy agreements. This page acts as a platform to share the knowledge and views on one of the most important issues of our time (https://www.klimatogrupe.vu.lt/about).

From the beginning of 2018 the Ministry of Environment runs the website klimatokaita.lt (Climate Change), which provides publicly accessible information on climate change. The website offers information on the organization of climate action in Lithuania, climate maps and prognostics, and educational information. The website provides up-to-date information on ongoing processes and projects and is continuously updated. Material is available in both Lithuanian and English.

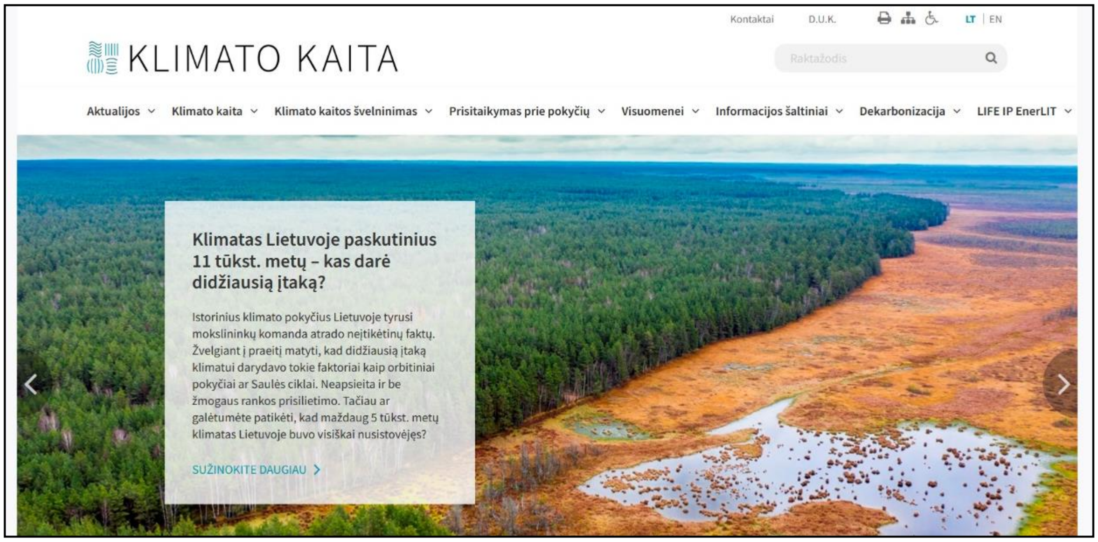

Figure 9-12. Website klimatokaita.lt

Electronic book library www.gamtoskyga.lt combines projects as electronic books, video clips, audio records, photos and other information about environment.

The European Climate Adaptation Platform Climate-ADAPT is a partnership between the European Commission and the European Environment Agency (EEA). This platform aims to support Europe in adapting to climate change helping users to access and share data and information on expected climate change in Europe, current and future vulnerabilities, adaptation strategies and actions, case studies, and potential options and tools that support adaptation planning.

Table 9-3. Websites which include information about Lithuanian climate and (or) air quality

Websites	
Ministry of Environment	https://am.lrv.lt/lt/veiklos-sritys-1/klimato-kaita
Climate change website	https://klimatokaita.lt/en
Lithuanian Hydrometeorological Service	www.meteo.lt/en
Environmental Protection Agency	https://aaa.lrv.lt/lt/veiklos-sritys/siltnamio-efekta-sukeliancios-dujos-1/bendra-informacija-apie-klimato-kaita
Health Education and Disease Prevention Centre	http://www.smlpc.lt/lt/aplinkos_sveikata/klimatas_ir_sveikata
Information about air pollution	http://193.219.53.11/ap3
Climate change group (Vilnius University)	https://www.klimatogrupe.vu.lt
Research Council of Lithuania	https://www.lmt.lt/lt/klimato-kaita-istekliu-naudojimo-efektyvumas-zaliavu-tiekimas/359

ClimAdapt	https://climate-adapt.eea.europa.eu/en/countries-regions/transnational-regions/baltic-sea-region

9.6 Involvement of the public and non-governmental organizations

Non-governmental organizations in Lithuania (see Table 9-4) actively participate in climate change actions. They organise events related to public education, collaboration, and sharing of experience related to climate change, participate in the development of national and international legislation, prepare and issue publications about changing climate, its consequences, and measures for prevention, and participate in the other projects related to climate change awareness raising.

Environmental Coalition is an umbrella organization that unites Lithuanian environmental NGOs (Environmental Information Centre, 'Baltic wolf', Lithuanian Entomological Society, 'Circular Economy', 'Atgaja', Sustainable Development Initiatives, Klaipėda Initiative for Democracy and Ecology, 'Rupi', Foundation for Peatlands Restoration and Conservation, Lithuanian Geographical Society). The Coalition aims at safeguarding healthy environmental conditions for current and future generations and creating co-existence between people and wildlife. Our mission is to exchange knowledge, experience, and resources between the organisations.

Centre for Environmental Management and Technology (ECAT) work on waste management, public environmental education, water protection, air pollution, climate change, noise, corporate social responsibility and sustainable consumption. Green Policy Institute analyses topics of circular economy, waste management, renewable energy, energy efficiency, climate change, responsible consumption, submits evidence based proposals, practical solutions and advocate for their implementation into the political decision making. Center for environmental policy's experts are members of the expert working group which prepares annual Lithuania's National Greenhouse Gas Inventory Reports. Lithuanian Green Alliance, in cooperation with representative and implementing authorities and non-governmental organisations, carries out programmes to reduce environmental pollution and climate change with a view to achieving sustainable environmental development. Social Innovations for Cleaner Environments (SICE) conducts research in order to develop evidence-based innovative social technologies for sustainability for communities and organisations. Baltic Environmental Forum's main areas of activity are biodiversity protection, agri-environment, rural development, natural tourism, sustainable development, management of hazardous chemicals, and corporate social responsibility. Lithuanian Fund's for Nature activities are closely related to the preservation of wildlife.

In order to achieve more effective cooperation in the NGO sector and to consolidate the capacities of organisations working in different fields of activity, the NGO Information and Support Centre is dedicated to coordinate the work of the NGO Coalition.

Table 9-4. List of NGOs working in the field of Climate Action

Name of NGO	Website
Environmental Coalition	https://www.akoalicija.lt/en

Public Enterprise 'Circular Economy'	http://www.circulareconomy.lt/
Centre for Environmental Management and Technology	https://ecat.lt/
Sustainable Development Initiatives	http://www.dvi.lt/index.php/pageid/490
Green Policy Institute	http://zaliojipolitika.lt/aboutus/
Environmental Information Centre	https://www.apicentras.lt/
Center for environmental policy	https://www.aapc.lt/about-the-center-for-environmental-policy-aapc/activities/
Lithuanian Green Alliance	https://www.lzaljansas.lt/lt/
Social Innovations for Cleaner Environments	http://www.sice.lt/
Baltic Environmental Forum Lithuania	https://bef.lt/?lang=en
Lithuanian Fund for Nature	http://www.glis.lt/?site=5
NGO Information and Support Centre	http://www.3sektorius.lt/

From September 2020, the Ministry of the Environment organises 'Social Partner Fridays' to discuss relevant climate change management issues and topics with stakeholders (relevant projects and funding opportunities, green procurement, the Modernisation Fund, the valuation of ecosystem services, green infrastructure, the EU ETS framework, the National Climate Change Management Agenda, adaptation, hydrological droughts, the EC's 'Fit for 55' package, etc). From October 2021, the discussions moved to the format of the decarbonisation working groups 'Mission 0'.

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European Week for Waste Reduction: https://ewwr.eu/

Earth Hour: https://www.earthhour.org/

'Ėjimas': https://www.ejimas.lt/en

Kaunas University of Technology: https://ktu.edu/

Kaipėda University: https://www.ku.lt/

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Ministry of Environment: https://am.lrv.lt/en/

Ministry of Education, Science and Sport: https://smsm.lrv.lt/en/

Mykolas Romeris University: https://www.mruni.eu/en/

Mobile climate museum: https://klimatomuziejus.lt/en/

National Agency for Education: https://www.nsa.smm.lt/english/

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National Reforestation Day: https://am.lrv.lt/lt/naujienos/nacionalinis-miskasodis-daugiau-nei-1-5-tukst-zmoniu-iveise-miska-50-zemes-sklypu

PISA study: https://www.oecd.org/pisa/

Republic of Lithuania Law on Higher Education and Research, No. XI-242 (2009). https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/136176908a8711e4be90fee65c21bf37?jfwid=125azlbh0p

Sustainable Mobility Project: https://darnusjudumas.lt/

The Arqus European University Alliance: https://arqus-alliance.eu/

University of Health Sciences: https://lsmuni.lt/en/

Vilnius University: https://www.vu.lt/en/

Vilnius Gediminas Technical University: https://vilniustech.lt/

Velomarathon: https://www.ikivelomaratonas.lt/en

Vytautas Magnus University: https://www.vdu.lt/en/

Website 'Climate Change': https://klimatokaita.lt/en/

ABBREVIATIONS

BR	Biennial Report
BY	Base year
CIS	Commonwealth of Independent States
CHP	Combined heat and power
CRF	Common reporting format
CTF	Common tabular format
EaP	Eastern Partnership
EC	European Commission
EF	Emission factor
EPA	Environmental Protection Agency
EPMA	Environmental Projects Management Agency
EPTATF	Eastern Partnership Technical Assistance Trust Fund
ESD	Effort Sharing Decision
ESR	Effort Sharing Regulation
ETS	Emissions Trading System
EU	European Union
EUA	European Union emission allowance
GCOS	Global Climate Observing Systems
GDP	Gross domestic product
GHG	Greenhouse gases
GWP	Global warming potential
IPCC	Intergovernmental Panel on Climate Change
ISPS Code	International Ship and Port Facility Security Code
JI	Joint Implementation
KC	Key category
LULUCF	Land Use, Land-Use Change and Forestry
MoA	Ministry of Agriculture
MoE	Ministry of Environment
NC	National Communication
NECP	Lithuania’s National Energy and Climate Action Plan for 2021-2030
NIR	National Inventory Report
NGOs	Non-governmental organizations
NMVOC	Non-methane volatile organic compounds
Non-ETS	Sectors not included in EU ETS
NPP	Nuclear Power Plant
QA/QC	Quality assurance/ Quality control
R&D	Research and development
RES	Renewable energy sources
SMEs	Small and medium enterprises
SFS	State Forest Service
UCTE	The Union for the Co-ordination of Transmission of Electricity
UNFCCC	United Nations Framework Convention on Climate Change
WAM	Scenario with additional measures
WEM	Scenario with existing measures

WOM	Scenario without measures

CHEMICAL FORMULAS

CH_4	Methane
CO_2	Carbon dioxide
HFCs	Hydrofluorocarbons
N_2O	Nitrous oxide
NF_3	Nitrogen trifluoride
PFCs	Perflurocarbons
SF_6	Sulphur hexafluoride
VOC	Volatile organic compounds

UNITS OF MEASUREMENT

CO_2 eq.	CO_2 equivalent
^oC	Degree Celsius
GWh	Gigawatthour
ha	Hectare
kg	Kilograms
km^2	Square kilometres
kt	Kilotonnes
ktoe	Kilotonne of oil equivalent
Mt	Million tonnes
MW	Megawatt
%	Per cent
PJ	Petajoule
thous.	Thousand
toe	Tonnes of oil equivalent
TJ	Terajoule
TWh	Terawatt hours

ANNEX I Summary of reporting of the Supplementary information under Article 7, paragraph 2, of the Kyoto Protocol in the NC8

Information reported under Article 7, paragraph 2	Chapter of the 8th National Communication
National systems in accordance with Article 5, paragraph 1	**3.2**
National Registries	**3.3**
Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17	**4.9**
Policies and measures in accordance with Article 2	**4; 7**
Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures	**3.2-3.3; 4.1**
Information under Article 10: – **Article 10a** (programmes to improve the quality of local emission factors, activity data and/or models which reflect the socio-economic conditions of each Party for the preparation and periodic updating of national inventories)	**3.2; 8.2**
– **Article 10b** (measures to mitigate climate change and measures to facilitate adequate adaptation to climate change)	**4; 6.3**
– **Article 10c** (transfer of, or access to, environmentally sound technologies, know-how, practices and processes related to climate change, in particular to developing countries)	**7**
– **Article 10d** (maintenance and the development of systematic observation systems and development of data archives to reduce uncertainties related to the climate system etc.)	**8.3**
– **Article 10e** (the development and implementation of education and training programmes)	**9**
Financial resources	**7**

ANNEX II SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS

Inventory 2020
Submission 2022 v2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2[(1)]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
	CO_2 equivalent (kt)								
Total (net emissions)[(1)]	8062,72	2864,04	3330,55	508,10	NO	9,75	NO	NO	14775,16
1. Energy	11210,69	440,56	165,49						11816,75
A. Fuel combustion (sectoral approach)	11029,08	189,08	165,48						11383,65
1. Energy industries	2584,43	24,39	38,87						2647,70
2. Manufacturing industries and construction	1168,01	5,34	13,32						1186,66
3. Transport	6064,96	7,05	73,24						6145,25
4. Other sectors	1184,02	152,30	39,82						1376,14
5. Other	27,66	0,00	0,23						27,90
B. Fugitive emissions from fuels	181,61	251,48	0,01						433,10
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	181,61	251,48	0,01						433,10
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	2417,39	NO	158,27	508,10	NO	9,75	NO	NO	3093,50
A. Mineral industry	579,47								579,47
B. Chemical industry	1783,05	NO	154,88	NO	NO	NO	NO	NO	1937,93
C. Metal industry	0,04	NO	NO	NO	NO	NO	NO	NO	0,04
D. Non-energy products from fuels and solvent use	54,83	NO	NO						54,83
E. Electronic Industry				NO	NO	9,54	NO	NO	9,54
F. Product uses as ODS substitutes				508,10	NO	NO	NO	NO	508,10
G. Other product manufacture and use	NO	NO	3,38	NO	NO	0,21	NO	NO	3,59
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	22,97	1677,04	2750,72						4450,72
A. Enteric fermentation		1445,40							1445,40
B. Manure management		231,64	179,61						411,24
C. Rice cultivation		NO							NO
D. Agricultural soils		NA	2571,11						2571,11
E. Prescribed burning of savannas		NO	NO						NO

F. Field burning of agricultural residues		NO	NO						NO
G. Liming	7,02								7,02
H. Urea application	15,94								15,94
I. Other carbon-containing fertilizers	NE								NE
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry(1)	-5590,43	0,35	182,69						-5407,39
A. Forest land	-6515,40	0,15	29,84						-6485,40
B. Cropland	886,30	0,01	48,64						934,95
C. Grassland	-753,29	0,19	0,40						-752,70
D. Wetlands	988,97	NO,NE	4,66						993,63
E. Settlements	548,01	NO	50,85						598,86
F. Other land	38,93	NO,NE	21,12						60,05
G. Harvested wood products	-783,96								-783,96
H. Other	NO	NO	NO						NO
5. Waste	2,11	746,08	73,39						821,58
A. Solid waste disposal	NO,NA	563,04							563,04
B. Biological treatment of solid waste		65,04	26,42						91,46
C. Incineration and open burning of waste	2,11	0,00	0,07						2,18
D. Waste water treatment and discharge		118,00	46,90						164,91
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items:(2)									
International bunkers	743,88	1,37	5,91						751,16
Aviation	162,55	0,03	1,35						163,93
Navigation	581,34	1,34	4,56						587,23
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	5991,23								5991,23
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	3909,27								3909,27
Indirect N_2O			NO,NE						
Indirect CO_2 (3)	NO,NE								
Total CO_2 equivalent emissions without land use, land-use change and forestry									20182,55
Total CO_2 equivalent emissions with land use, land-use change and forestry									14775,16
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

(1) For carbon dioxide (CO_2) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). (2) See footnote 7 to table Summary 1.A. (3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO_2, the national totals shall be provided with and without indirect CO_2.

TABLE 10 EMISSION TRENDS

GHG CO_2 eq emissions

Inventory 2020
Submission 2022 v2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	kt CO_2 eq										
Total (net emissions)[2]	42329,61	42329,61	44212,41	25306,16	18275,17	17395,24	17700,86	24268,56	22610,71	15977,08	13845,82
1. Energy	33122,49	33122,49	35176,74	19916,16	16039,84	15112,96	14161,33	14642,23	14189,47	14887,37	12445,71
A. Fuel combustion (sectoral approach)	32833,55	32833,55	34892,25	19637,07	15756,11	14834,71	13876,20	14349,67	13874,85	14571,25	12176,06
1. Energy industries	13552,63	13552,63	14625,40	8605,07	7284,17	7235,41	6373,98	7055,83	6498,19	7308,07	5915,99
2. Manufacturing industries and construction	6164,93	6164,93	6212,65	3051,70	2006,50	2055,30	1759,75	1540,60	1565,97	1535,00	1194,54
3. Transport	5815,97	5815,97	6396,95	4237,00	3230,41	2590,23	3180,93	3493,72	3870,57	4060,57	3593,03
4. Other sectors	7299,65	7299,65	7656,81	3742,80	3234,46	2953,05	2560,66	2258,43	1938,88	1666,08	1470,68
5. Other	0,36	0,36	0,44	0,51	0,58	0,73	0,87	1,09	1,24	1,53	1,82
B. Fugitive emissions from fuels	288,94	288,94	284,48	279,09	283,72	278,25	285,13	292,56	314,62	316,12	269,65
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	288,94	288,94	284,48	279,09	283,72	278,25	285,13	292,56	314,62	316,12	269,65
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	4460,24	4460,24	4492,69	2653,39	1728,32	1925,99	2212,34	2604,04	2568,26	2974,94	2911,88
A. Mineral industry	2129,61	2129,61	2009,92	1076,57	498,63	481,63	422,45	403,27	439,78	506,23	418,05
B. Chemical industry	2176,29	2176,29	2332,62	1433,80	1091,10	1306,93	1646,90	2057,60	1975,19	2315,17	2339,66
C. Metal industry	16,98	16,98	13,68	6,97	5,43	5,35	4,55	5,07	5,33	5,67	6,25
D. Non-energy products from fuels and solvent use	41,28	41,28	42,18	43,55	42,46	43,13	44,99	45,05	54,21	51,85	50,09
E. Electronic industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes	NO	NO	NO	NO	0,03	0,09	6,35	7,75	10,24	13,89	17,46
G. Other product manufacture and use	96,05	96,05	94,26	92,47	90,67	88,87	87,10	85,29	83,52	82,14	80,37
H. Other	0,02	0,02	0,02	0,02	0,00	NO	NO	NO	NO	NO	NO
3. Agriculture	8756,04	8756,04	8626,70	6571,98	5269,28	4652,68	4327,15	4498,49	4533,40	4408,40	4107,57
A. Enteric fermentation	4290,91	4290,91	4093,53	3501,54	2828,89	2409,65	2170,51	2106,02	2114,54	2023,45	1840,37

B. Manure management	1246,87	1246,87	1165,27	959,22	757,11	678,39	644,95	621,45	616,16	597,41	537,63
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	3161,95	3161,95	3305,53	2075,81	1673,35	1554,78	1500,92	1744,33	1775,92	1759,68	1703,98
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming	20,59	20,59	20,59	20,59	2,70	2,62	4,03	13,38	13,11	13,82	9,76
H. Urea application	35,71	35,71	41,77	14,82	7,24	7,24	6,74	13,31	13,66	14,05	15,83
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry(2)	-5531,28	-5531,28	-5631,54	-5358,38	-6311,51	-5824,69	-4532,63	992,06	-230,20	-7827,43	-7141,46
A. Forest land	-7763,91	-7763,91	-7679,05	-7361,53	-7924,05	-7402,65	-5232,25	570,53	-806,42	-8153,91	-7944,45
B. Cropland	2655,95	2655,95	2565,38	2511,64	2408,22	2368,33	2266,59	2085,82	2118,88	2176,82	2227,88
C. Grassland	-812,81	-812,81	-934,52	-1071,58	-1209,19	-1367,84	-1472,23	-1230,35	-1388,59	-1622,53	-1733,56
D. Wetlands	586,53	586,53	581,34	600,24	351,81	733,61	445,03	474,19	487,06	348,67	800,11
E. Settlements	38,96	38,96	82,69	150,10	128,07	262,74	230,07	193,64	223,47	235,53	264,19
F. Other land	NO,NE	NO,NE	NO,NE	26,59	38,31	194,69	42,68	35,39	35,39	48,46	41,29
G. Harvested wood products	-252,55	-252,55	-263,83	-230,80	-121,60	-633,13	-830,06	-1154,42	-916,97	-877,01	-815,09
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	1522,13	1522,13	1547,82	1523,01	1549,24	1528,29	1532,67	1531,75	1549,78	1533,80	1522,11
A. Solid waste disposal	1028,83	1028,83	1053,64	1076,08	1095,40	1101,03	1102,71	1111,02	1118,94	1123,13	1125,97
B. Biological treatment of solid waste	0,35	0,35	0,39	0,44	0,49	0,55	0,62	0,70	0,78	0,87	1,26
C. Incineration and open burning of waste	2,74	2,74	2,74	0,78	2,22	0,68	2,59	0,88	0,88	0,97	0,42
D. Waste water treatment and discharge	490,20	490,20	491,05	445,72	451,13	426,03	426,75	419,16	429,18	408,82	394,45
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items:											
International bunkers	707,45	707,45	987,45	1130,08	624,17	602,43	571,14	517,94	284,55	240,71	306,69
Aviation	402,27	402,27	484,15	195,82	108,25	114,81	118,16	96,38	90,33	81,01	74,89
Navigation	305,18	305,18	503,30	934,26	515,92	487,62	452,98	421,56	194,22	159,71	231,80
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	1207,57	1207,57	1207,57	1208,48	1804,56	1865,67	1957,08	2144,15	2194,52	2419,39	2507,86
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	2160,50	2160,50	2242,62	2321,92	2395,63	2466,94	2543,73	2617,71	2690,77	2760,23	2832,04
Indirect N_2O	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Indirect CO_2 (3)	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE
Total CO_2 equivalent emissions without land use, land-use change and forestry	47860,90	47860,90	49843,94	30664,54	24586,68	23219,93	22233,49	23276,50	22840,92	23804,51	20987,28

Total CO_2 equivalent emissions with land use, land-use change and forestry	42329,61	42329,61	44212,41	25306,16	18275,17	17395,24	17700,86	24268,56	22610,71	15977,08	13845,82
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
	kt CO_2 eq										
Total (net emissions)(2)	10008,86	12974,29	14298,84	15172,23	16444,07	18336,33	19032,29	19290,87	17666,40	12392,20	10327,02
1. Energy	10916,16	11596,52	11660,78	11675,05	12287,67	13135,57	13186,84	13418,04	13293,86	12113,57	13094,72
A. Fuel combustion (sectoral approach)	10612,52	11282,53	11342,90	11371,95	11943,41	12758,83	12832,65	13103,19	12925,23	11672,74	12597,27
1. Energy industries	5055,97	5532,75	5350,47	5223,86	5399,42	5655,86	5202,95	4736,99	4804,58	4782,67	5329,66
2. Manufacturing industries and construction	1091,49	1052,18	1117,01	1142,33	1221,86	1492,60	1635,08	1643,95	1482,02	1192,74	1290,68
3. Transport	3221,59	3505,14	3610,45	3698,04	3986,62	4200,84	4452,25	5212,00	5179,93	4270,86	4387,00
4. Other sectors	1239,97	1191,72	1263,88	1304,23	1326,11	1397,00	1530,21	1494,30	1446,31	1415,11	1573,90
5. Other	3,50	0,73	1,09	3,50	9,40	12,53	12,16	15,95	12,38	11,36	16,03
B. Fugitive emissions from fuels	303,64	313,99	317,88	303,10	344,26	376,74	354,19	314,86	368,63	440,83	497,45
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	303,64	313,99	317,88	303,10	344,26	376,74	354,19	314,86	368,63	440,83	497,45
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	3068,31	3315,07	3488,12	3570,96	3760,68	4036,95	4319,07	6141,21	5475,86	2299,17	2235,37
A. Mineral industry	355,86	357,64	352,29	361,00	424,00	443,56	596,43	598,16	520,61	305,44	327,54
B. Chemical industry	2554,78	2794,02	2964,15	3028,41	3136,38	3370,95	3500,32	5288,90	4693,48	1716,92	1589,02
C. Metal industry	6,78	7,11	7,17	6,78	6,89	7,26	6,95	6,54	4,69	4,19	4,29
D. Non-energy products from fuels and solvent use	50,15	51,15	53,51	52,76	53,62	55,43	55,29	61,07	54,90	44,02	46,82
E. Electronic industry	NO	NO	NO	NO	NO	NO	NO	NO	2,96	2,37	4,74
F. Product uses as ODS substitutes	22,00	28,29	35,84	47,06	67,86	89,11	118,51	154,04	192,25	214,03	256,29
G. Other product manufacture and use	78,75	76,87	75,15	74,95	71,93	70,64	41,57	32,50	6,96	12,20	6,66
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

3. Agriculture	3936,11	3781,36	3925,36	4002,10	4049,52	4070,48	4061,73	4214,31	4110,42	4205,96	4156,71
A. Enteric fermentation	1715,38	1603,96	1635,79	1686,86	1710,89	1697,01	1729,03	1748,17	1710,70	1677,40	1649,91
B. Manure management	488,92	476,65	501,66	519,10	521,90	527,57	539,73	525,39	501,43	493,45	493,07
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	1707,63	1677,99	1759,49	1768,45	1789,13	1807,44	1766,79	1902,49	1868,26	1991,99	1991,67
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming	7,67	5,59	9,05	8,15	7,90	6,92	7,26	6,72	10,64	6,86	6,29
H. Urea application	16,51	17,18	19,37	19,54	19,71	31,54	18,92	31,54	19,40	36,27	15,77
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry[(2)]	-9432,15	-7268,87	-6323,42	-5617,30	-5164,61	-4378,08	-3971,56	-5891,50	-6537,36	-7519,30	-10423,14
A. Forest land	-9325,45	-6859,03	-6093,84	-4940,84	-4763,44	-4306,87	-4463,00	-5692,21	-7291,94	-8546,42	-9645,13
B. Cropland	2115,80	1850,74	1710,44	1392,94	1294,61	1235,79	1758,92	1630,82	1697,79	1516,30	982,57
C. Grassland	-1879,08	-1907,03	-1850,16	-1744,60	-1669,28	-1646,64	-1569,43	-1481,37	-1428,23	-1345,56	-1764,44
D. Wetlands	466,29	472,73	843,30	769,67	878,70	888,68	794,75	528,03	875,72	890,87	548,67
E. Settlements	401,42	332,24	341,15	343,22	362,84	595,96	605,14	454,84	502,96	615,92	679,40
F. Other land	41,29	57,84	47,32	63,87	47,46	47,46	57,97	47,46	80,58	92,64	71,59
G. Harvested wood products	-1268,83	-1232,17	-1336,93	-1518,42	-1334,16	-1209,53	-1174,22	-1396,56	-993,29	-763,96	-1317,45
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	1520,43	1550,21	1548,00	1541,42	1510,81	1471,41	1436,20	1408,80	1323,62	1292,80	1263,35
A. Solid waste disposal	1136,00	1172,91	1184,54	1195,54	1174,27	1152,34	1134,71	1117,01	1022,37	1012,85	995,99
B. Biological treatment of solid waste	2,15	2,29	2,68	3,18	3,18	3,43	3,61	5,91	4,74	5,69	10,31
C. Incineration and open burning of waste	1,17	1,59	1,43	3,81	1,97	3,71	3,39	0,68	0,66	0,72	1,51
D. Waste water treatment and discharge	381,11	373,41	359,36	338,89	331,38	311,93	294,49	285,20	295,84	273,54	255,54
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items:											
International bunkers	366,38	412,39	436,58	445,93	468,94	601,44	601,69	584,31	520,16	521,80	596,07
Aviation	70,81	94,34	84,14	94,27	105,27	140,09	159,47	199,75	231,37	110,88	146,57
Navigation	295,57	318,05	352,44	351,66	363,67	461,35	442,23	384,56	288,79	410,93	449,50

Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	2736,85	2977,49	3216,01	3396,38	3558,69	3597,57	3783,42	3822,71	4051,35	4157,76	4146,05
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	2914,20	2988,26	3062,06	3123,10	3185,77	3252,57	3315,74	3380,93	3456,88	3525,71	3593,46
Indirect N_2O	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Indirect CO_2 (3)	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE
Total CO_2 equivalent emissions without land use, land-use change and forestry	19441,01	20243,16	20622,26	20789,53	21608,68	22714,41	23003,85	25182,36	24203,76	19911,51	20750,16
Total CO_2 equivalent emissions with land use, land-use change and forestry	10008,86	12974,29	14298,84	15172,23	16444,07	18336,33	19032,29	19290,87	17666,40	12392,20	10327,02
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Change from base to latest reported year**
	kt CO_2 eq										**%**
Total (net emissions)(2)	10750,60	11265,83	10623,48	11516,61	12459,42	13194,77	14030,22	13805,54	15058,49	14775,16	-65,09
1. Energy	12245,04	12278,44	11659,55	11278,22	11248,43	11578,93	11508,38	11872,59	11890,34	11816,75	-64,32
A. Fuel combustion (sectoral approach)	11813,65	11802,86	11153,11	10745,54	10735,70	11023,89	10983,15	11349,85	11363,19	11383,65	-65,33
1. Energy industries	4461,86	4411,34	3851,99	3177,99	3155,10	2 955,86	2 573,02	2 447,77	2 279,10	2 647,70	-80,46
2. Manufacturing industries and construction	1387,11	1487,05	1431,83	1310,43	1187,30	1 160,59	1 181,02	1 260,55	1 299,88	1 186,66	-80,75
3. Transport	4358,40	4371,62	4362,43	4838,04	5090,72	5 476,31	5 708,03	6 077,07	6 292,56	6 145,25	5,66
4. Other sectors	1593,39	1523,82	1489,45	1383,90	1266,26	1 405,95	1 495,19	1 544,00	1 462,16	1 376,14	-81,15
5. Other	12,89	9,03	17,41	35,19	36,32	25,18	25,88	20,45	29,49	27,90	7559,60
B. Fugitive emissions from fuels	431,38	475,58	506,44	532,68	512,73	555,05	525,22	522,74	527,15	433,10	49,89
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
2. Oil and natural gas and other emissions from energy production	431,38	475,58	506,44	532,68	512,73	555,05	525,22	522,74	527,15	433,10	49,89

C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
2. Industrial Processes	3714,37	3564,99	3000,17	3186,32	3507,67	3324,29	3637,38	3165,84	3375,15	3093,50	-30,64
A. Mineral industry	380,92	457,87	516,12	464,65	576,44	512,23	492,11	539,49	602,25	579,47	-72,79
B. Chemical industry	2965,99	2700,49	2021,46	2201,09	2303,66	2 037,58	2 370,67	2 003,46	2 168,60	1 937,93	-10,95
C. Metal industry	3,91	3,22	2,48	2,60	2,02	1,46	2,07	1,86	1,51	0,04	-99,76
D. Non-energy products from fuels and solvent use	46,95	44,48	42,33	46,06	49,15	49,57	53,50	56,18	59,25	54,83	32,81
E. Electronic industry	5,93	3,56	5,98	5,05	4,70	4,17	7,13	5,96	4,46	9,54	100,00
F. Product uses as ODS substitutes	303,24	350,40	406,77	460,59	566,14	714,11	706,32	553,41	533,93	508,10	100,00
G. Other product manufacture and use	7,44	4,99	5,03	6,29	5,57	5,17	5,58	5,48	5,16	3,59	-96,26
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
3. Agriculture	4196,68	4271,56	4246,07	4467,26	4537,70	4431,90	4390,12	4248,02	4256,50	4450,72	-49,17
A. Enteric fermentation	1631,62	1616,78	1585,78	1626,11	1634,31	1 584,53	1 537,27	1 513,24	1 483,12	1 445,40	-66,31
B. Manure management	487,19	483,42	484,04	488,19	493,01	462,47	444,12	427,71	411,47	411,24	-67,02
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
D. Agricultural soils	2054,93	2146,00	2143,72	2287,17	2373,14	2 352,65	2 382,47	2 279,69	2 333,73	2 571,11	-18,69
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
G. Liming	8,75	11,17	16,77	24,79	19,25	13,80	12,23	11,45	12,42	7,02	-65,89
H. Urea application	14,19	14,19	15,77	41,00	17,98	18,45	14,04	15,93	15,77	15,94	-55,35
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0,00
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
4. Land use, land-use change and forestry(2)	-10592,62	-10000,90	-9403,43	-8479,09	-7844,47	-7131,81	-6498,68	-6353,48	-5302,10	-5407,39	-2,24
A. Forest land	-10172,74	-9811,27	-9613,54	-8825,23	-8086,01	-7 271,91	-7 154,58	-7 074,94	-6 496,45	-6 485,40	-16,47
B. Cropland	1296,82	1232,76	1176,87	1299,70	824,48	646,91	934,44	924,53	863,39	934,95	-64,80
C. Grassland	-1538,11	-1445,65	-1198,94	-1090,30	-937,88	-973,16	-960,17	-928,27	-834,17	-752,70	-7,40
D. Wetlands	639,54	641,84	881,31	880,06	965,10	730,84	1 069,85	859,38	821,28	993,63	69,41
E. Settlements	560,49	534,65	691,10	594,57	603,80	701,37	578,66	728,45	772,09	598,86	1437,02
F. Other land	71,59	59,79	64,54	70,57	54,16	54,16	54,16	48,26	352,37	60,05	100,00
G. Harvested wood products	-1471,49	-1233,46	-1426,19	-1429,82	-1289,53	-1 043,37	-1 044,78	-934,54	-808,30	-783,96	210,42
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
5. Waste	1187,13	1151,74	1121,12	1063,90	1010,10	991,46	993,02	872,57	838,60	821,58	-46,02

A. Solid waste disposal	927,10	910,40	873,97	822,11	776,15	734,69	733,66	602,15	573,10	563,04	-45,27
B. Biological treatment of solid waste	8,63	13,49	23,57	32,03	36,06	71,84	76,65	99,10	97,35	91,46	25978,43
C. Incineration and open burning of waste	4,59	1,06	0,80	2,02	5,90	0,66	1,30	0,90	1,73	2,18	-20,61
D. Waste water treatment and discharge	246,81	226,80	222,79	207,74	191,98	184,27	181,41	170,43	166,41	164,91	-66,36
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
Memo items:											
International bunkers	625,33	580,20	494,32	271,85	490,32	806,89	880,19	1023,80	995,45	751,16	6,18
Aviation	168,35	191,88	212,86	236,10	247,14	289,32	320,34	381,20	373,10	163,93	-59,25
Navigation	456,97	388,32	281,46	35,75	243,18	517,57	559,85	642,61	622,35	587,23	92,42
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 emissions from biomass	4042,62	4462,75	4617,23	4892,87	5441,80	5 477,09	5 851,83	5 875,84	5 773,30	5 991,23	396,14
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
Long-term storage of C in waste disposal sites	3662,47	3721,85	3763,17	3800,99	3835,83	3 854,27	3 869,62	3 884,05	3 897,61	3 909,27	80,94
Indirect N_2O	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0,00
Indirect CO_2 (3)	NE,NO,IE	NE,NO,IE	NE,NO,IE	NE,NO,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE	0,00
Total CO_2 equivalent emissions without land use, land-use change and forestry	21343,22	21266,73	20026,92	19995,70	20303,89	20326,58	20528,91	20159,02	20360,59	20182,55	-57,83
Total CO_2 equivalent emissions with land use, land-use change and forestry	10750,60	11265,83	10623,48	11516,61	12459,42	13194,77	14030,22	13805,54	15058,49	14775,16	-65,09
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,00
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,00

TABLE 10 EMISSION TRENDS SUMMARY

Inventory 2020
Submission 2022 v2

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (kt)										
CO_2 emissions without net CO_2 from LULUCF	35767,73	35767,73	37850,00	21201,46	16353,75	15801,14	15091,55	15773,44	15196,35	16030,58	13482,97
CO_2 emissions with net CO_2 from LULUCF	30106,46	30106,46	32089,30	15705,67	9909,56	9828,29	10421,79	16629,83	14832,60	8073,64	6201,35
CH_4 emissions without CH_4 from LULUCF	6945,49	6945,49	6736,55	5875,01	5132,55	4652,21	4401,17	4321,93	4348,31	4229,22	3993,46
CH_4 emissions with CH_4 from LULUCF	6948,50	6948,50	6739,30	5881,07	5136,36	4656,02	4404,98	4325,75	4352,13	4231,93	3997,23
N_2O emissions without N_2O from LULUCF	5147,67	5147,67	5257,40	3588,07	3100,36	2766,48	2734,37	3173,33	3285,94	3530,32	3492,84
N_2O emissions with N_2O from LULUCF	5274,66	5274,66	5383,81	3719,41	3229,23	2910,84	2867,69	3305,19	3415,68	3657,11	3629,23
HFCs	NO	NO	NO	NO	0,03	0,09	6,35	7,75	10,24	13,89	17,46
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	NO	0,05	0,05	0,08	0,51	0,54
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	47860,90	47860,90	49843,94	30664,54	24586,68	23219,93	22233,49	23276,50	22840,92	23804,51	20987,28
Total (with LULUCF)	42329,61	42329,61	44212,41	25306,16	18275,17	17395,24	17700,86	24268,56	22610,71	15977,08	13845,82
Total (without LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (kt)										
1. Energy	33122,49	33122,49	35176,74	19916,16	16039,84	15112,96	14161,33	14642,23	14189,47	14887,37	12445,71
2. Industrial processes and product use	4460,24	4460,24	4492,69	2653,39	1728,32	1925,99	2212,34	2604,04	2568,26	2974,94	2911,88
3. Agriculture	8756,04	8756,04	8626,70	6571,98	5269,28	4652,68	4327,15	4498,49	4533,40	4408,40	4107,57
4. Land use, land-use change and forestry[5]	-5531,28	-5531,28	-5631,54	-5358,38	-6311,51	-5824,69	-4532,63	992,06	-230,20	-7827,43	-7141,46
5. Waste	1522,13	1522,13	1547,82	1523,01	1549,24	1528,29	1532,67	1531,75	1549,78	1533,80	1522,11
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)[5]	42329,61	42329,61	44212,41	25306,16	18275,17	17395,24	17700,86	24268,56	22610,71	15977,08	13845,82

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	CO_2 equivalent (kt)										
CO_2 emissions without net CO_2 from LULUCF	11876,40	12627,07	12699,16	12692,60	13287,31	14117,41	14434,08	15824,05	15204,23	13043,23	13946,61
CO_2 emissions with net CO_2 from LULUCF	2313,30	5231,68	6249,30	6942,73	7980,16	9611,06	10305,88	9802,00	8526,26	5368,58	3368,79
CH_4 emissions without CH_4 from LULUCF	3842,69	3759,56	3820,70	3878,86	3892,76	3885,80	3884,33	3846,41	3714,38	3630,17	3605,06
CH_4 emissions with CH_4 from LULUCF	3846,40	3762,49	3825,94	3882,97	3896,70	3886,79	3896,43	3847,28	3715,99	3634,13	3606,46
N_2O emissions without N_2O from LULUCF	3699,19	3827,58	4065,81	4168,66	4359,61	4620,41	4565,42	5356,64	5089,48	3021,09	2936,28
N_2O emissions with N_2O from LULUCF	3826,43	3951,18	4187,01	4297,12	4498,19	4747,70	4709,96	5486,33	5228,48	3172,48	3089,57
HFCs	22,00	28,29	35,84	47,06	67,86	89,11	118,51	154,04	192,25	214,03	256,29
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	0,72	0,66	0,75	2,35	1,15	1,68	1,50	1,22	3,42	2,98	5,91
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	19441,01	20243,16	20622,26	20789,53	21608,68	22714,41	23003,85	25182,36	24203,76	19911,51	20750,16
Total (with LULUCF)	10008,86	12974,29	14298,84	15172,23	16444,07	18336,33	19032,29	19290,87	17666,40	12392,20	10327,02
Total (without LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	CO_2 equivalent (kt)										
1. Energy	10916,16	11596,52	11660,78	11675,05	12287,67	13135,57	13186,84	13418,04	13293,86	12113,57	13094,72
2. Industrial processes and product use	3068,31	3315,07	3488,12	3570,96	3760,68	4036,95	4319,07	6141,21	5475,86	2299,17	2235,37
3. Agriculture	3936,11	3781,36	3925,36	4002,10	4049,52	4070,48	4061,73	4214,31	4110,42	4205,96	4156,71
4. Land use, land-use change and forestry(5)	-9432,15	-7268,87	-6323,42	-5617,30	-5164,61	-4378,08	-3971,56	-5891,50	-6537,36	-7519,30	-10423,14
5. Waste	1520,43	1550,21	1548,00	1541,42	1510,81	1471,41	1436,20	1408,80	1323,62	1292,80	1263,35
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)(5)	10008,86	12974,29	14298,84	15172,23	16444,07	18336,33	19032,29	19290,87	17666,40	12392,20	10327,02

GREENHOUSE GAS EMISSIONS	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
	CO_2 equivalent (kt)										(%)
CO_2 emissions without net CO_2 from LULUCF	14292,83	14349,49	13355,97	13108,08	13319,68	13351,18	13571,83	13691,35	13923,31	13653,15	-61,83
CO_2 emissions with net CO_2 from LULUCF	3545,87	4201,13	3800,01	4472,60	5321,57	6056,15	6908,62	7173,54	8433,97	8062,72	-73,22
CH_4 emissions without CH_4 from LULUCF	3451,10	3460,28	3393,42	3401,69	3371,06	3271,80	3208,06	3013,33	2956,64	2863,69	-58,77
CH_4 emissions with CH_4 from LULUCF	3453,48	3461,36	3394,30	3404,57	3372,34	3272,48	3208,37	3013,94	2957,74	2864,04	-58,78
N_2O emissions without N_2O from LULUCF	3288,42	3102,70	2864,50	3019,18	3041,63	2984,84	3035,06	2894,61	2941,71	3147,86	-38,85
N_2O emissions with N_2O from LULUCF	3440,37	3249,07	3016,15	3172,70	3193,98	3147,36	3199,28	3058,33	3127,84	3330,55	-36,86
HFCs	303,24	350,40	406,77	460,59	566,14	714,11	706,32	553,41	533,93	508,10	100,00
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
SF_6	7,64	3,87	6,20	5,85	5,13	4,46	7,62	6,30	5,01	9,75	100,00
NF_3	NO	NO	0,06	0,29	0,26	0,20	0,01	0,03	NO	NO	0,00
Total (without LULUCF)	21343,22	21266,73	20026,92	19995,70	20303,89	20326,58	20528,91	20159,02	20360,59	20182,55	-57,83
Total (with LULUCF)	10750,60	11265,83	10623,48	11516,61	12459,42	13194,77	14030,22	13805,54	15058,49	14775,16	-65,09
Total (without LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,00
Total (with LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
	CO_2 equivalent (kt)										(%)
1. Energy	12245,04	12278,44	11659,55	11278,22	11248,43	11578,93	11508,38	11872,59	11890,34	11816,75	-64,32
2. Industrial processes and product use	3714,37	3564,99	3000,17	3186,32	3507,67	3324,29	3637,38	3165,84	3375,15	3093,50	-30,64
3. Agriculture	4196,68	4271,56	4246,07	4467,26	4537,70	4431,90	4390,12	4248,02	4256,50	4450,72	-49,17
4. Land use, land-use change and forestry(5)	-10592,62	-10000,90	-9403,43	-8479,09	-7844,47	-7131,81	-6498,68	-6353,48	-5302,10	-5407,39	-2,24
5. Waste	1187,13	1151,74	1121,12	1063,90	1010,10	991,46	993,02	872,57	838,60	821,58	-46,02
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
Total (including LULUCF)(5)	10750,60	11265,83	10623,48	11516,61	12459,42	13194,77	14030,22	13805,54	15058,49	14775,16	-65,09

[(1)] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[(2)] Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[(3)] In accordance with the UNFCCC reporting guidelines, for Parties that decide to report indirect CO2 the national totals shall be provided with and without indirect CO_2.

[(4)] In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is kt of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.

[(5)] Includes net CO_2, CH_4 and N_2O from LULUCF.

ANNEX III List of key categories in Lithuanian greenhouse gas inventory

IPCC Category	Greenhouse gas	Identification criteria	Comments*
1.A.1. Energy industries-Other fossil fuels	CO2	L1, T1	
1.A.1. Energy industries-Solid fuels	CO2	T1	
1.A.1. Energy industries-Biomass	N2O	T2	
1.A.1. Energy industries-Biomass	CH4		L2sub, T2sub
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO2	L1, T1, T2	
1.A.1.a Public electricity and heat production - Liquid Fuels	CO2	T1, T2	
1.A.1.b Petroleum refining - Liquid Fuels	CO2	L1, T1	
1.A.1.b Petroleum refining - Gaseous Fuels	CO2	L1, T1	
1.A.2 Manufacturing industries and construction-Gaseous fuels	CO2	L1, T1	
1.A.2 Manufacturing industries and construction-Liquid fuels	CO2	L1, T1, T2	
1.A.2 Manufacturing industries and construction-Solid fuels	CO2	L1, T1	
1.A.3.b Road transportation	CO2	L1, L2, T1, T2	
1.A.3.c Railways	CO2	L1	
1.A.4 Other sectors-Biomass	CH4	L1, L2, T1, T2	
1.A.4 Other sectors-Biomass	N2O		L2sub, T2sub
1.A.4 Other sectors-Gaseous fuels	CO2	L1, T1	
1.A.4 Other sectors-Liquid fuels	CO2	L1, T1	
1.A.4 Other sectors-Liquid fuels	N2O		T1sub, T2sub
1.A.4 Other sectors-Solid fuels	CH4		T2sub
1.A.4 Other sectors-Solid fuels	CO2	L1, T1, T2	
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH4	L1, T1	
1.B.2 Oil, natural gas and other emissions from energy production	CO2	L1, L2, T1, T2	
2.A.1 Cement Production	CO2	L1, T1	
2.A.2 Lime Production	CO2	T1	
2.A.4 Other process use of carbonates	CO2	T1	
2.B.1 Ammonia Production	CO2	L1, T1	
2.B.2 Nitric Acid Production	N2O	L1, T1	
2.F.1 Refrigeration and Air Conditioning Equipment	HFCs	L1, L2, T1, T2	
3.A.1 Enteric Fermentation - Cattle	CH4	L1, L2, T1, T2	
3.B.1.1 Manure Management - Cattle	CH4	L1	
3.B.1.3 Manure Management - Swine	CH4	T1	
3.B.2 Manure Management - Cattle	N2O		L1sub, L2sub
3.B.2 Manure Management - Other	N2O	T2	
3.B.2 Manure Management - Indirect N2O Emissions	N2O	L1, L2, T2	
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	L1, L2, T1, T2	
3.D.1.2 Direct N2O Emissions From Managed Soils - Organic N Fertilizers	N2O	L1, L2, T2	
3.D.1.3 Direct N2O Emissions From Managed Soils - Urine and dung deposited by grazing animals	N2O	L1, L2, T1, T2	
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	L1, L2, T1, T2	

3.D.1.6 Direct N2O Emissions From Managed Soils -Cultivation of organic soils	N2O	L1, L2, T1, T2	
3.D.2.1 Indirect N2O Emissions From Managed Soils - Atmospheric deposition	N2O	L1, L2	
3.D.2.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	L1, L2, T1, T2	
4.A Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	L1, L2, T1, T2	
4.A.1 Forest land remaining forest land - carbon stock change in biomass	CO2	L1, L2, T1, T2	
4.A.1 Forest land remaining forest land - net carbon stock change in dead wood	CO2	L1, L2, T1	
4.A.2 Land converted to forest land - carbon stock change in biomass	CO2	L1, L2	
4.A.2 Land converted to forest land - net carbon stock change in mineral soils	CO2	L1, L2	
4.B Cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	L1, L2, T1, T2	
4.B.1 Cropland remaining cropland - net carbon stock change in mineral soils	CO2	L1, L2, T1, T2	
4.B.2 Land converted to cropland - net carbon stock change in mineral soils	CO2	L1, L2	
4.B.2 Land converted to cropland- carbon stock change in biomass	CO2	L1, L2, T1, T2	
4.B.2 Land converted to cropland- net carbon stock change in dead organic matter	CO2	L1, T1	
4.C.2 Land converted to grassland - net carbon stock change in mineral soils	CO2	L1, L2	
4.C.2 Land converted to grassland - net carbon stock change in biomass	CO2	T1, T2	
4.D.1 Wetlands remaining wetlands -net carbon stock change in organic soils	CO2	L1, L2, T1, T2	
4.D.2 Land converted to wetlands	CO2	L1, L2, T1, T2	
4.E.2 Settlements	N2O	T2	
4.E.2 Land converted to settlements	CO2	L1, T1, T2	
4.G Harvested wood products	CO2	L1, L2, T1, T2	
5.A Solid Waste Disposal	CH4	L1, L2	
5.B Biological treatment of waste	CH4	T2	
5.B Biological treatment of waste	N2O		T2sub
5.D Wastewater Treatment and Discharge	CH4	L1, L2, T1, T2	

**Lsub, Tsub denote the categories that were identified by level and trend assessment for a subset without LULUCF when compared to Approach 1*
Abbreviations:
L1, T1 – approach 1 (level and trend) assessment
L2, T2 - approach 2 (level and trend) assessment

Annex IV Summary information on the models/approaches used for the GHG projection estimation

Field	Description
Model 1	
Model name (abbreviation)	**Energy model**
Full model name	Model of fuel and energy consumption in the sectors of the Lithuanian economy
Model version and status	Not applicable
Latest date of revision	2022-11-23
URL to model description	Not applicable
Model type	Spreadsheet-based calculator
Summary	Energy model is based on statistical data and assumptions regarding certain macroeconomic factors with various existing and planned policy measures taken into account. Primarily used to evaluate and predict achievement of national targets in energy efficiency and renewable energy source use. Results of Energy model are used to assess GHG emissions.
Intended field of application	Primary and final energy consumption projections for National energy and climate plan
Description of main input data categories and data sources	Statistical data reflecting the current energy consumption situation and specific assumptions influencing the energy consumption projections. Information on existing and planned energy efficiency, renewable energy source promotion and green-house-gas emission reduction measures.
Validation and evaluation	General quality control procedures where applied estimating Energy projections: analysis of projected activity data trends, consistency check of activity data sources, completeness check and etc.
Output quantities	Primary and final energy consumption by fuel and energy type
GHG covered	Not applicable
Sectoral coverage	Energy sector
Geographical coverage	Lithuania
Temporal coverage (e.g. time steps, time span)	2040 year per year
Other models which interact with this model, and type of interaction (e.g. data input to this model, use of data output from this model)	1. Data input and output with Energy and transport emissions tool (fuel consumption) 2. Use of data output from Private cars model (vehicle-kilometers of electric cars)
Input from other models	Fuel consumption in transport, vehicle-kilometers of electric cars
References to the assessment and the technical reports that underpin the projections and the models used	Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania
Model structure (if diagram please attach to your submission in Reportnet)	Not applicable
Comments or other relevant information	Not applicable
Model 2	
Model name (abbreviation)	**Energy and transport**
Full model name	Energy and transport emissions calculator

Model version and status	Not applicable
Latest date of revision	2022-12-08
URL to model description	Not applicable
Model type	Spreadsheet-based calculator
Summary	The obtained fuel consumption or other activity data in energy sector and for passenger cars is multiplied by emission factors of every fuel in order to estimate projected GHG emissions. Thus, GHG projections fully correspond to the methodology used for preparation of National GHG inventory. For other transport modes, the projections were carried out by firstly determining the consumption of each fuel type in every subsector.
Intended field of application	Projections of emissions from energy sector
Description of main input data categories and data sources	Consumption of different fuel types and other activity data in each subsector of energy. Projected activity data are provided by Ministry of Transport and Communications, several companies (petroleum refining, other energy industries and fugitive emissions) and other models (see below).
Validation and evaluation	General quality control procedures where applied estimating Energy and transport projections: analysis of projected activity data trends, consistency check of projected emissions in the Energy and transport emissions accounting tool and projected emissions in the GovReg_Proj_T1a_T1b_T5a_T5b template, consistency check of activity data sources, completeness check and etc.
Output quantities	GHG emissions
GHG covered	Energy sector GHG emissions (CO_2, CH_4 and N_2O)
Sectoral coverage	Energy sector including transport
Geographical coverage	Lithuania
Temporal coverage (e.g. time steps, time span)	2040 year per year
Other models which interact with this model, and type of interaction (e.g. data input to this model, use of data output from this model)	1. Data input and output with Energy model (fuel consumption) 2. Use of data output from Private cars model (fuel consumption)
Input from other models	Consumption of different fuel types in each subsector of energy and for passenger cars
References to the assessment and the technical reports that underpin the projections and the models used	Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania
Model structure (if diagram please attach to your submission in Reportnet)	Diagram is attached in Reportnet
Comments or other relevant information	Not applicable
Model 3	
Model name (abbreviation)	**Private cars model**
Full model name	Private cars model
Model version and status	Not applicable
Latest date of revision	2022-12-08
URL to model description	Not applicable
Model type	Spreadsheet-based calculator
Summary	The model contains calculations to forecast the breakdown of the passenger car fleet and kilometrage by power source and by existing and newly bought cars. This is then combined

	with fuel consumption per kilometer to produce projected fuel consumption.
Intended field of application	Projections of fuel consumption of passenger cars for National energy and climate plan
Description of main input data categories and data sources	Number of ICE and electric passenger cars at the end of the year, provided by Ministry of Transport and Communications
Validation and evaluation	General quality control procedures where applied estimating Energy projections: analysis of projected activity data trends, consistency check of data sources, completeness check and etc.
Output quantities	Projected fuel consumption of passenger cars
GHG covered	Not applicable
Sectoral coverage	Road transport sector (passenger cars)
Geographical coverage	Lithuania
Temporal coverage (e.g. time steps, time span)	2050 year per year
Other models which interact with this model, and type of interaction (e.g. data input to this model, use of data output from this model)	1. Data input to Energy and transport emissions calculator (fuel consumption) 2. Data input to Energy model (vehicle-kilometers of electric cars)
Input from other models	Not applicable
References to the assessment and the technical reports that underpin the projections and the models used	Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania
Model structure (if diagram please attach to your submission in Reportnet)	Not applicable
Comments or other relevant information	Not applicable
Model 4	
Model name (abbreviation)	**Industrial emission accounting tool**
Full model name	MS Excel based industrial emission tool
Model version and status	Not applicable
Latest date of revision	2022
URL to model description	Not applicable
Model type	MS Excel based calculator
Summary	Projections of GHG emissions from IPPU sector is based on projected data provided by the main emitters in IPPU sector: clinker, lime, glass, ammonia and nitric acid, mineral wool producing companies. F-gases emission projections are performed at the same subcategory level as in Lithuanian GHG inventory using 2006 IPCC Guidelines emission factors.
Intended field of application	IPPU GHG emissions projections
Description of main input data categories and data sources	Projected production data provided by the main emitters in IPPU sector: clinker, lime, glass, ammonia and nitric acid, mineral wool producing companies wich provide information about projected amount of ammonia production, natural gas consumption, nitric acid production, clinker production, lime production, glass production, mineral wool production. In other subcategories historical data and population are used.

Validation and evaluation	General quality control procedures where applied estimating IPPU projections: analysis of projected activity data trends, consistency check of activity data sources, completeness check and etc.
Output quantities	CO2 emissions from cement, lime, glass production, ceramics, other uses of soda ash, mineral wool production, ammonia production, cast iron production, lubricant, paraffin wax, solvents use, urea-based catalyst, from asphalt roofing, road paving with asphalt. N2O emissions from nitric acid production, from propellant for pressure and aerosol products and medical applications. HFCs emissions from product uses as substitutes for ozone depleting substances (ODS), SF6 emissions from semiconductor manufacturing, electrical equipment and NF3 emissions from photovoltaics.
GHG covered	IPPU sector GHG emissions (CO2, N2O, HFCs, SF6, NF3)
Sectoral coverage	Mineral, Chemical, Metal industry, Non-energy products from fuels and solvent use, Electronics industry, Product uses as substitutes for ODS, Other product manufacture and use.
Geographical coverage	Lithuania
Temporal coverage (e.g. time steps, time span)	2040 year per year
Other models which interact with this model, and type of interaction (e.g. data input to this model, use of data output from this model)	Data input to this model from Agriculture model (CO2 emissions from urea).
Input from other models	Not applicable
References to the assessment and the technical reports that underpin the projections and the models used	Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania
Model structure (if diagram please attach to your submission in Reportnet)	Not applicable
Comments or other relevant information	Not applicable
Model 5	
Model name (abbreviation)	**Agriculture emissions calculator**
Full model name	MS Excel based agriculture calculator
Model version and status	Not applicable
Latest date of revision	2022
URL to model description	Not applicable
Model type	MS Excel based calculator
Summary	Projections of GHG emissions from agriculture sector is based on projected livestock population, milk production, milk fat, and the share of manure management systems for the main livestock categories (dairy cattle, non-dairy cattle and swine). GHG projections of agricultural soils category are based on projected consumption of inorganic and organic N fertilizers, main harvested crops and area harvested, application of urea and consumption of liming materials (limestone and dolomite) used for soils.
Intended field of application	Agriculture GHG emission projections
Description of main input data categories and data sources	Main livestock population data, Main harvest of crops and area harvested, Inorganic N fertilizer, Amount of limestone materials consumed, Application of urea All projected activity data are provided by Ministry of Agriculture

Validation and evaluation	General quality control procedures where applied estimating Agriculture projections: analysis of projected activity data trends, consistency check of activity data sources, completeness check and etc.
Output quantities	Methane (CH_4) emissions from enteric fermentation of livestock; CH_4 and nitrous oxide (N_2O) (direct and indirect) emissions from manure management; direct and indirect N_2O emissions from managed soils; carbon dioxide (CO_2) emissions from soil liming and application of urea
GHG covered	Agriculture sector GHG emissions (N_2O, CH_4, CO_2)
Sectoral coverage	Agriculture sector (Enteric fermentation, Manure management, Agriculture Soils, Liming, Urea application)
Geographical coverage	Lithuania
Temporal coverage (e.g. time steps, time span)	2040 year per year
Other models which interact with this model, and type of interaction (e.g. data input to this model, use of data output from this model)	1. Data input from LULUCF model (data of organic CL and GL area and average annual soil carbon stock change in mineral soil) 2. Data output to IPPU model (CO_2 emissions from urea)
Input from other models	Data of organic CL and GL area and average annual soil carbon stock change in mineral soil from LULUCF
References to the assessment and the technical reports that underpin the projections and the models used	Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania
Model structure (if diagram please attach to your submission in Reportnet)	Not applicable
Comments or other relevant information	Not applicable
Model 6	
Model name (abbreviation)	**IPCC Waste Model**
Full model name	IPCC Waste Model
Model version and status	Not applicable
Latest date of revision	2021
URL to model description	https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html
Model type	MS Excel based
Summary	Projections of GHG emissions from Solid waste disposal on land is based on generated amount of municipal solid waste, amount of waste disposed of in the landfills, the amount of CH_4 recovered.
Intended field of application	Projections of GHG emissions from solid waste disposal on land
Description of main input data categories and data sources	Data on municipal waste disposed of in the landfills, CH_4 recovery. Other parameters (DOC, DOCf, OX and etc.) are default, provided in the model.
Validation and evaluation	General quality control procedures where applied estimating Waste sector projections: analysis of projected activity data trends, consistency check of projected emissions in the Waste sector emissions calculator and projected emissions in the GovReg_Proj_T1a_T1b_T5a_T5b template, consistency check of activity data sources, completeness check and etc.
Output quantities	Methane (CH_4) emissions from solid waste disposal on land
GHG covered	Methane (CH_4)
Sectoral coverage	Solid waste disposal on land

Geographical coverage	Lithuania
Temporal coverage (e.g. time steps, time span)	2040 year per year
Other models which interact with this model, and type of interaction (e.g. data input to this model, use of data output from this model)	Not applicable
Input from other models	Not applicable
References to the assessment and the technical reports that underpin the projections and the models used	Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania
Model structure (if diagram please attach to your submission in Reportnet)	Not applicable
Comments or other relevant information	Not applicable
Model 7	
Model name (abbreviation)	**Waste tool**
Full model name	MS Excel based waste calculator
Model version and status	Not applicable
Latest date of revision	2021
URL to model description	Not applicable
Model type	MS Excel based calculator
Summary	Projections of GHG emissions from Biological treatment of waste is based on amount of waste composted; projections of GHG emissions from waste incineration is based on historical data; projections of GHG emissions from Wastewater treatment and discharge is based on amount of organically degradable material in wastewater, population connected to wastewater collecting system.
Intended field of application	Projections of GHG emissions from biological treatment of waste, waste incineration and wastewater treatment and discharge.
Description of main input data categories and data sources	Data on biodegradable waste composted, incinerated waste (without energy recovery), amount of organically degradable material in the wastewater (TOW), population connected to wastewater collecting system, protein consumption per capita, emission factors (IPCC default), population.
Validation and evaluation	General quality control procedures where applied estimating Waste sector projections: analysis of projected activity data trends, consistency check of projected emissions in the Waste sector emissions calculator and projected emissions in the GovReg_Proj_T1a_T1b_T5a_T5b template, consistency check of activity data sources, completeness check and etc.
Output quantities	Methane (CH_4) and nitrous oxide (N_2O) emissions from Biological treatment of waste; CO_2, CH_4 and N_2O emissions from waste incineration; CH_4, N_2O emissions from wastewater treatment and discharge
GHG covered	CO_2, CH_4, N_2O,
Sectoral coverage	Biological treatment of waste, Incineration of waste, Wastewater treatment and discharge
Geographical coverage	Lithuania
Temporal coverage (e.g. time steps, time span)	2040 year per year
Other models which interact with this model, and type of interaction (e.g. data input to this model, use of data output from this model)	Not applicable
Input from other models	Not applicable

References to the assessment and the technical reports that underpin the projections and the models used	Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania
Model structure (if diagram please attach to your submission in Reportnet)	Not applicable
Comments or other relevant information	Not applicable
Model 8	
Model name (abbreviation)	**LULUCF calculator**
Full model name	MS Excel based LULUCF calculator
Model version and status	Not applicable
Latest date of revision	2021
URL to model description	Not applicable
Model type	MS Excel based calculator
Summary	Projections of GHG emissions and removals in LULUCF sector is based on projected areas of land remaining in land category and land converted to other land category and areas of different cropland management practices; in addition to this, projected growing stock volume changes, harvested volume, natural mortality (dead wood volume) in forest land; volume of peat extracted for horticultural use in peat extraction remaining peat extraction subcategory are necessary for projection of GHG emissions and removals in LULUCF sector.
Intended field of application	GHG emissions and removals in LULUCF sector
Description of main input data categories and data sources	Growing stock volume changes, harvested wood volume, dead wood volume, land use area and land use area changes for all categories (forest land, cropland, grassland, wetlands, settlements, other land) Projected activity data is a combination of data provided by the Ministry of Agriculture (MoA) and State Forest Service (SFS)
Validation and evaluation	General quality control procedures where applied estimating LULUCF sector GHG projections: analysis of projected activity data trends, consistency check of projected emissions in the LULUCF GHG emissions and removals calculator and projected emissions in the GovReg_Proj_T1a_T1b_T5a_T5b template, consistency check of activity data sources, completeness check and etc.
Output quantities	Carbon stock changes in biomass, dead organic matter and soils (both mineral and organic) in all land use categories (forest land, cropland, grassland, wetlands, settlements and other land); CH_4 emissions due to wildfires in forest land, cropland and grassland categories; direct N_2O emissions due to drainage and N mineralization/immobilization in forest land, cropland, grassland, wetlands, settlements and other land; indirect N_2O emissions due to Nitrogen leaching and run-off (in all land use categories).
GHG covered	CO_2, CH_4, N_2O
Sectoral coverage	LULUCF sector (forest land, cropland, grassland, wetlands, settlements, other land)
Geographical coverage	Lithuania
Temporal coverage (e.g. time steps, time span)	2040 year per year

Other models which interact with this model, and type of interaction (e.g. data input to this model, use of data output from this model)	1. Data input from other calculators of growing stock volume change, harvested volume, dead wood volume; 2. Data output to Agriculture sector model (areas of cropland and grassland organic soils and mineral soil carbon stock changes in cropland remaining cropland);
Input from other models	Data of growing stock volume change, harvested wood volume, dead wood volume
References to the assessment and the technical reports that underpin the projections and the models used	Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania
Model structure (if diagram please attach to your submission in Reportnet)	Not applicable
Comments or other relevant information	Not applicable
Model 9	
Model name (abbreviation)	**Forest land calculator**
Full model name	MS Excel based Forest land increment structure calculator
Model version and status	Not applicable
Latest date of revision	2021
URL to model description	Not applicable
Model type	MS Excel based calculator
Summary	Projections of forest land increment structure consist of growing stock volume increment, harvested wood volume and dead volume, which are projected taking into account historical data obtained from National Forest Inventory (NFI) measurements of 2002 - 2017 (data of growing stock volume increment and its use, age class structure).
Intended field of application	GHG emissions and removals in LULUCF sector
Description of main input data categories and data sources	Historical data of growing stock volume increment and its use (growing stock volume increment, harvested wood volume and dead volume) as well as age class structure, obtained from National Forest Inventory (NFI) measurements of 2002 - 2017 Projected activity data is provided by State Forest Service (SFS)
Validation and evaluation	General quality control procedures where applied estimating LULUCF sector GHG projections: analysis of projected activity data trends, consistency check of projected emissions in the LULUCF GHG emissions and removals calculator and projected emissions in the GovReg_Proj_T1a_T1b_T5a_T5b template, consistency check of activity data sources, completeness check and etc.
Output quantities	Growing stock volume changes, harvested wood volume, dead wood volume in cubic meters
GHG covered	CO2
Sectoral coverage	LULUCF sector forest land category
Geographical coverage	Lithuania
Temporal coverage (e.g. time steps, time span)	2040 year, 10 year time steps
Other models which interact with this model, and type of interaction (e.g. data input to this model, use of data output from this model)	1. Data output to LULUCF model (growing stock volume changes, harvested wood volume, dead wood volume); 2. Data output to IPCC HWP Worksheet (harvested wood volume)
Input from other models	Actual NFI data
References to the assessment and the technical reports that underpin the projections and the models used	Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania

Model structure (if diagram please attach to your submission in Reportnet)	Not applicable
Comments or other relevant information	Not applicable
Model 10	
Model name (abbreviation)	**IPCC HWP Worksheet**
Full model name	IPCC HWP Worksheet
Model version and status	Not applicable
Latest date of revision	2021
URL to model description	https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html
Model type	MS Excel based calculator
Summary	Projections of GHG removals in harvested wood products relate on projected total harvested wood volume and historical volume share between sawnwood, wood-based panels, paper and paper board and proportion of harvested wood products produced from total harvested wood volume.
Intended field of application	GHG emissions and removals in LULUCF sector
Description of main input data categories and data sources	Main input data is provided from Forest land calculator (harvested wood volume) and actual activity data for harvested wood products subcategories are subdivided according to historical share of volume between sawnwood, wood-based panels, paper and paper board and proportion of harvested wood products produced from total harvested wood volume.
Validation and evaluation	General quality control procedures where applied estimating LULUCF sector GHG projections: analysis of projected activity data trends, consistency check of projected emissions in the LULUCF GHG emissions and removals calculator and projected emissions in the GovReg_Proj_T1a_T1b_T5a_T5b template, consistency check of activity data sources, completeness check and etc.
Output quantities	GHG removals (CO2) in harvested wood products categories: sawnwood, wood-based panels and paper and paper board
GHG covered	CO2
Sectoral coverage	Forest land harvested wood products category
Geographical coverage	Lithuania
Temporal coverage (e.g. time steps, time span)	2040 year per year
Other models which interact with this model, and type of interaction (e.g. data input to this model, use of data output from this model)	1. Data input from Forest land calculator (harvested wood volume)
Input from other models	Forest land calculator
References to the assessment and the technical reports that underpin the projections and the models used	Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania
Model structure (if diagram please attach to your submission in Reportnet)	Not applicable
Comments or other relevant information	Not applicable

Annex V The comparison of the parameters used for the projections for the BR4 and NC8/BR5 for 2030 and 2040

	BR4			BR5			Difference		Relative difference, %		
Parameter used ('with existing measures' scenario)	**2030**	**2040**	**Default unit**	**2030**	**2040**	**Default unit**	**2030**	**2040**	**2030**	**2040**	**Comment**
Population	2726645.043	2675506	Count	2452166	2307089	Count	-274,479	-368,417	-10%	-14%	
Gross domestic product (GDP): -Real growth rate	1.568180287	1.205332669	Annual growth rate (%)	1.430390138	1.331869562	Annual growth rate (%)	0	0	-9%	10%	
Gross domestic product (GDP): -Constant prices	48119.96	54626	constant EUR million (2013 = t-7)	51189	57962	EUR million (2016)	3,069	3,336	6%	6%	
EU ETS carbon price	25	25	EUR/EUA	25	25	EUR/EUA	0	0	-	-	
Energy parameters											
Gross inland consumption: solid fuels	6367	6250	TJ	4875	4762	TJ	-1,492	-1,488	-23%	-24%	Coal and peat
Gross inland consumption: total petroleum products	134421	120054	TJ	112153	111249	TJ	-22,267	-8,805	-17%	-7%	
Gross inland consumption: gas	68307	68232	TJ	63543	61798	TJ	-4,764	-6,434	-7%	-9%	
Gross inland consumption: -Renewables	92785	90390	TJ	85892	81177	TJ	-6,892	-9,214	-7%	-10%	
Gross inland consumption: -Nuclear	0	0	TJ	0	0	TJ	0	0	-	-	
Gross inland consumption: -Other	16771	17939	TJ	17483	18651	TJ	711	712	4%	4%	Electricity import and non-biomass fraction of waste
Gross inland consumption: -Total	318651	302865	TJ	283947	277636	TJ	-34,705	-25,229	-11%	-8%	
Gross electricity production: -Renewables	5.1	5.1	TWh	5.4	5.4	TWh	0	0	4%	4%	

Gross electricity production: -Nuclear	0.0	0.0	TWh	0	0	TWh	0	0	-	-	
Gross electricity production: -Total	7.1	7.1	TWh	7.0	7.0	TWh	0	0	-2%	-2%	
Final energy consumption: -Industry	39683	39683	TJ	38804	38912	TJ	-879	-771	-2%	-2%	
Final energy consumption: -Transport	94190	91419	TJ	NE	NE	TJ	-	-	-	-	
Final energy consumption: -Residential	58764	56925	TJ	56448	54719	TJ	-2,316	-2,206	-4%	-4%	
Final energy consumption: -Agriculture/Forestry	4387	4417	TJ	6365	6414	TJ	1,978	1,997	45%	45%	
Final energy consumption: -Services	25173	24961	TJ	24183	23980	TJ	-990	-981	-4%	-4%	
Final energy consumption: -Other	1945	1964	TJ	NE	NE	TJ	-	-	-	-	Construction and fisheries
Final energy consumption: -Total	224141	219369	TJ	219990	215443	TJ	-4,151	-3,926	-2%	-2%	
Transport parameters											
Number of passenger -kilometres (all modes)	41037	39211	million pkm	NE	NE	million pkm	-	-	-	-	
Freight transport tonnes -kilometres (all modes)	25448	26255	million tkm	23995	25868	million tkm	-1,453	-386	-6%	-1%	International carriage of trucks not included in BR4. Only road and rail transport modes are included in BR5
Final energy demand for road transport	85416799	81829754	GJ	NE	NE	GJ	-	-	-	-	
Industrial process and product use parameters											
Quantity of the manufactured product:											
The production of clinker	1500	1500	kt	1500	1500	kt	0	0	-	-	

The production of lime	80	80	kt	2	2	kt	-78	-78	-98%	-98%	The company has reported that from 2019 it did not produce lime, therefore the projections of lime production significantly decreased compared to BR4
The production of glass	93	95	kt	100	100	kt	7	5	8%	5%	
The production of mineral wool	88	91	kt	94	98	kt	6	7	7%	8%	
The production of ammonia	1146	1146	kt	1146	1146	kt	0	0	0%	-	
The production of nitric acid	1319	1319	kt	1319	1319	kt	0	0	0%	-	
Amount of SF6 consumption (Semiconductor)	0.624	0.624	t	0.520	0.520	t	-0.10	-0.10	-17%	-17%	
Amount of NF3 consumption (Photovoltaics)	0.680	0.680	t	NO	NO	t	-	-	-	-	The company has reported that production of photovoltaics was stopped and use has not been foreseen, so emissions will not occur after 2019
Amount of SF6 consumption (Electrical equipment)	0.040	0.040	t	0.030	0.030	t	-0.01	-0.01	-25%	-25%	
Amount of SF6 consumption (Other non-specified)	NO	NO	t	NO	NO	t	-	-	-	-	The company has reported that limestone had not used since 2017, so emissions will not occur after 2017
Agriculture parameters											

Livestock: -Dairy cattle	195	180	1000 heads	229	190	1000 heads	34	10	17%	6%	
Livestock: -Non-dairy cattle	410	400	1000 heads	410	400	1000 heads	0	0	-	-	
Livestock: -Pig	800	900	1000 heads	550	650	1000 heads	-250	-250	-31%	-28%	
Livestock: -Poultry	12010	12620	1000 heads	14675	17320	1000 heads	2,665	4,700	22%	37%	
Nitrogen input from application of synthetic fertilizers	172	173	kt Nitrogen	147	119	kt nitrogen	-25	-54	-14%	-31%	
Nitrogen input from application of manure	32	35	kt Nitrogen	30	31	kt nitrogen	-2	-4	-7%	-11%	
Nitrogen fixed by N-fixing crops	IE	IE	-	IE	IE	-	-	-	-	-	
Nitrogen in crop residues returned to soils	86	87	kt Nitrogen	76	80	kt nitrogen	-10	-7	-11%	-8%	
Area of cultivated organic soils	133277	133277	Ha (hectares)	131420	124024	Ha (hectares)	-1,857	-9,253	-1%	-7%	
Waste parameters											
Municipal solid waste (MSW) generation	1301	1314	kt	1121	1008	kt MSW	-180	-306.0	-14%	-30%	The difference on MSW generation is due to the projected lower population numbers.
Municipal solid waste (MSW) going to landfills	180	125	kt	56	50	kt MSW	-124	-74.6	-69%	-148%	The assumption is that Landfill directive requirements on the landfilling waste will be fulfilled.
Municipal solid waste (MSW) going to landfills	14%	10%	%	5%	5%	%	-	-	-	-	

ANNEX VI Response to the review recommendations of Lithuania's Seventh National Communication (FCCC/IDR.7/LTU)

Table and issue No	Recommendations/encouragements	Lithuania's response
Table 5, issue 1	The ERT noted that the information provided does not include a description of the underlying provisions to make the information on the legislative arrangements and enforcement and administrative procedures established pursuant to the implementation of the Kyoto Protocol publicly accessible. **The ERT recommends that Lithuania improve the transparency of its submission by including information on the existing provisions to make information on the legislative arrangements and enforcement and the administrative procedures established pursuant to the implementation of the Kyoto Protocol publicly accessible,** in line with the information provided during the review.	This information can be found in Chapter 4.1.2 of the 8th National Communication.
Table 7, issue 1	The Party did not provide, in its NC7, information on the identification of its own policies and practices that encourage activities that lead to greater levels of anthropogenic GHG emissions than would otherwise occur. **The ERT reiterates the encouragement made in the previous review report that Lithuania report on the action taken to identify and periodically update its own policies and practices that encourage activities that lead to greater levels of anthropogenic GHG emissions than would otherwise occur, if any**, and provide the rationale for such action.	In Chapter 4 of 8th National Communication Lithuania's actions taken to identify and periodically update its own policies and practices that encourage activities that lead to greater levels of anthropogenic GHG emissions than would otherwise occur are reported.
Table 7, issue 2	In the text of chapter 4.7.1 of the NC7, concerning PaMs in the energy sector, the Party reports two planned projects, namely the construction of cogeneration power plants in Vilnius and Kaunas, for which the specified period for implementation is 2017–2020. However, these projects are reported as "implemented" in the sectoral table 4-4 of the NC7. **The ERT recommends that Lithuania provide in the next NC correct and consistent information in the text and in the tables on the status of implementation of its PaMs.**	In this National Communication submission the information in the text and tables on the status of implementation of PaMs is consistent.
Table 11, issue 1	The chapter in the NC7 on projections does not include a WOM scenario (see para. 57 above), although such a scenario was included in the NC6. **The ERT encourages Lithuania to improve the completeness of its reporting by including a WOM scenario in its next NC or to provide a duly substantiated explanation as to why this information is not included in its NC.**	Lithuania put all the efforts to work on WEM and WAM scenarios, which are mandatory to report according to UNFCCC reporting guidelines. The 'without measure scenario' (WOM) is not provided because the need and additional value of the WOM scenario is still under debate. As

		the ex-post evaluation of the PaMs just started, the need of WOM scenario and possible development of methodology for WOM scenario will be considered in the future. This explanation is provided in Chapter 5.1 of the 8th National Communication.
Table 11, issue 2	It is not clear in the NC7 projections chapter (e.g. section 5.1) what year is used as the starting point for the WEM and WAM scenarios. **The ERT recommends that Lithuania clearly indicate the year used as a starting point for its projections in the projections chapter of its next NC in order to enhance transparency.**	In the 8th National Communication starting point of the projections (WEM and WAM scenarios) is year 2021 (the first year projected), the emissions of the years 2019 and 2020 are taken from the latest GHG inventory submission (NIR 2022). As explained in Chapter 5.1 the base year for projections is 2019 (year 2020 was not chosen as the base year due to it was extraordinary year caused by COVID pandemic and it could impact the interpretation of characteristic tendencies).
Table 11, issue 3	According to paragraph 32 of the UNFCCC reporting guidelines on NCs, for the WEM and WAM projections, the starting point should generally be the latest year for which inventory data are available in the NC. The ERT considers that, as the NC7 was due 1 January 2018, the latest available inventory is that submitted in 2017 and consequently the latest available inventory year is 2015. In chapter 3 of the NC7, inventory data are provided for the period 1990–2015 in line with the 2017 annual submission, but 2014 is used as a starting point for the projections. **The ERT encourages Lithuania to use the latest inventory year for which inventory data are available as the starting point for scenarios in the NC in order to enhance transparency, or to provide a duly substantiated explanation of why this is not possible in its next NC.**	In the 8th National Communication projections reported the base year is 2019. Although the year 2020 is the latest inventory year for which inventory data are available, it was not used as the base year due to it was extraordinary year caused by COVID pandemic and it could impact the interpretation of characteristic tendencies. This explanation is provided in Chapter 5.1.
Table 11, issue 4	Projections of indirect GHGs are not provided in the NC7. **The ERT encourages Lithuania to improve the completeness of its reporting by including projections of indirect gases in its next NC.**	The projections of indirect GHGs are submitted under National Emission Ceilings Directive (2016/2284/EU) to the European Commission, therefore it is not provided in this report. The reference to the latest Lithuania's submission (2021) of projections for NOx, NMVOC, SOx,

		NH_3, $PM_{2,5}$ pollutants for 2020, 2030 and 2040 is given in the Chapter 5.1.
Table 11, issue 5	The ERT noted that projections related to fuel sold to ships and aircraft engaged in international transport are reported in CTF tables 6(a) and 6(b). Such projections are not provided separately in the NC7 and it is not clear whether the projections for the national total exclude emission projections related to fuel sold to ships and aircraft engaged in international transport. **The ERT recommends that the Party report emission projections related to fuel sold to ships and aircraft engaged in international transport separately in its next NC, or, if such projections are presented in the BR, that the Party refer to its BR.**	Emission projections related to fuel sold to ships and aircraft engaged in international transport are reported separately in NC Chapter 5.1.1. The projections for the national total exclude emission projections related to fuel sold to ships and aircraft engaged in international transport in order to correspond to IPCC 2006 Guidelines.
Table 11, issue 6	The NC7 indicates that projections of GHG emissions have been calculated according to the "Methodological guidance for the preparation of national GHG emission projections", prepared in 2016 by the Lithuanian Energy Institute, and a reference to this methodological guidance is included in the NC7. However, there is insufficient information in the NC7 to enable the ERT to obtain a basic understanding of the models and/or approaches used for projecting GHG emissions and for estimating the total effects of PaMs on emissions and removals. During the review, Lithuania provided a summary of the models and approaches used for the projections. **The ERT encourages Lithuania to improve the completeness of its reporting by including in its next NC summary information on the models and/or approaches used for projecting GHG emissions and for estimating the total effect of PaMs on emissions and removals.**	Summary information on the models/ approaches used for projecting GHG emissions and its key characteristics is provided in Annex IV. Chapter 5.2 explains the approaches used to estimate the total effect of PaMs, as well as provides the results of the total effect estimates.
Table 11, issue 7	Lithuania's NC7 did not include for each model or approach used for projections information such as the gases/sectors considered, the type of model used (key characteristics, original purpose) and the model's strengths/weaknesses, as well as how it accounts for any overlap or synergies that may exist between different PaMs. In the NC7, the Party referred to the "Methodological guidance for the preparation of national GHG emission projections". To increase transparency, the **ERT encourages Lithuania to include in the next NC for each model and approach used for projections the following information: the gases/sectors considered, the type of model used** (key characteristics, original purpose) and the model's strengths/weaknesses, as well as how it accounts for any overlap or synergies that may exist between different PaMs.	Information on models and approaches used for projections such as gases and sectors covered, interaction with other models/approaches etc. is provided in Annex IV "Summary information on the models/approaches used for the GHG projection estimation". The main strengths/weaknesses of the models/approaches used are mentioned in Chapter 5.1.

Table 11, issue 8	In the NC7, Lithuania reported on the differences in the results of projections between the NC6 and NC7 (see para. 70 above). However, Lithuania did not report the main differences in the assumptions and methods employed between its NC6 and NC7. During the review, Lithuania provided information on the main differences in the projections between the NC6 and NC7 (see para. 56 above). **The ERT encourages Lithuania to enhance the transparency of its reporting by including in its next NC the main differences in the assumptions and methods used between the projections in its current and previous NCs.**	The main differences in the assumptions and methods employed between BR4 and NC8/BR5 are reported in Chapter 5.4. As the latest GHG projections reporting was made in Lithuania's 4th Biennial Report (BR4), the comparison of methodology and assumptions used for GHG projections between BR4 and this submission (NC8/BR5) is provided (rather than comparing the changes since 7th National Communication). The complete comparison of the parameters used for the projections for the BR4 and NC8/BR5 for 2030 and 2040 is provided in Annex V.
Table 11, issue 9	Lithuania did not provide information on key underlying assumptions such as population growth, tax levels and international fuel prices in its NC7 using table 2. During the review, Lithuania indicated that information on population growth, GDP growth rate and international fuel prices is available in CTF table 5. **The ERT reiterates the encouragement made in the previous review report that Lithuania enhance the completeness of its reporting by including in its next NC information about the key underlying assumptions and values of variables** (e.g. population growth, international fuel prices) used for the projections, using table 2, or, if such information is provided in the BR, a reference to that information.	Summary information on the models/ approaches used for projecting GHG emissions, key underlying assumptions and values of variables (such as population growth, international fuel prices) is provided in Annex IV.
Table 13, issue 1	In its NC7, Lithuania did not present the estimated and expected total effect of implemented and adopted PaMs. During the review, Lithuania provided information on the total effect of implemented and adopted PaMs (under the WEM scenario). The Party indicated that the mitigation impact was not estimated for all PaMs. **The ERT recommends that Lithuania improve the completeness of its reporting by including in the next NC the estimated and expected total effect of implemented and adopted PaMs.**	The estimated and expected total effect of implemented and adopted PaMs (WEM scenario) is provided in Chapter 5.2.
Table 13, issue 2	In its NC7, Lithuania did not present the total expected effect of planned PaMs. During the review, Lithuania provided information on the total effect of planned PaMs (under the WAM scenario). The Party indicated that the mitigation impact was not estimated for all PaMs.	The expected total effect of planned PaMs (WAM scenario) is provided in Chapter 5.2.

	The ERT encourages Lithuania to improve the completeness of its reporting by including in the next NC the expected total effect of planned PaMs.	
Table 13, issue 3	Lithuania did not present in its NC7 an estimate of the total effect of its PaMs in terms of GHG emissions avoided or sequestered, by gas (on a CO2 eq basis). During the review, Lithuania explained that the total effect of PaMs by gas will be evaluated for the next NC. **The ERT reiterates the recommendation made in the previous review report that Lithuania report the total effect of PaMs, in accordance with the WEM definition, compared with a situation without such PaMs, by gas (on a CO2 eq basis), in its next NC.**	The total effect of PaMs in accordance with the WEM definition, compared with a situation without such PaMs, by gas is provided in Chapter 5.2

Annex VII Fifth Biennial Report of Lithuania

CONTENTS

1. INTRODUCTION

Lithuania's Fifth Biennial Report (BR5) under the United Nations Framework Convention on Climate Change (hereinafter – UNFCCC) is presented as an Annex of Lithuania's 8th National Communication. To report the same information once only, references to the respective chapters and sections of Lithuania's 8th National Communication are provided where appropriate.

The 5th Biennial Report is elaborated following the UNFCCC biennial reporting guidelines for developed country Parties (Decision 2/CP.17 of the Conference of the Parties under UNFCCC). As defined in the Guidelines, the report structure is the following:

- information on greenhouse gas (hereinafter – GHG) emissions and trends;
- quantified economy-wide emission reduction target;
- progress in the achievement of quantified economy-wide emission reduction targets;
- GHG projections;
- provision of financial, technological, and capability-building support to developing country Parties.

This Biennial Report contains summary information on GHG inventory information for the period 1990-2020, provides summary information on Lithuania's progress made concerning Lithuania's contribution to the joint EU quantified economy-wide emission reduction target, on GHG projections until 2040. Information provided on GHGs and trends is consistent with the information in Lithuania's National GHG inventory submission to the UNFCCC secretariat in 2022 (25th May submission version).

The EU and the Member States are committed to achieving a joint quantified economy-wide emission reduction target -20% by 2020 compared to 1990 levels. The details of the EU joint target under the UNFCCC are clarified in this Report. Additional information related to the quantified economy-wide emission reduction targets presented in the document "Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention" (FCCC/SB/2011/INF.1/Rev.1).

The Biennial Report is prepared taking into account remarks by the UNFCCC expert review team, provided in the Report of the technical review of the Fourth Biennial Report of Lithuania (FCCC/TRR.4/LTU).

Tabular information to be reported electronically in the Common Tabular Format (CTF) following "UNFCCC biennial reporting guidelines for developed country Parties" (Decision 19/CP.18 of the Conference of the Parties under UNFCCC) is enclosed to the BR5 submission (submitted to the UNFCCC using the CTF software).

2. INFORMATION ON GREENHOUSE GAS EMISSIONS AND TRENDS

Summary information on national GHG emissions and trends prepared according to the UNFCCC Annex I inventory reporting guidelines (decision 24/CP.19) is presented in Lithuania's 8th National Communication (Chapter 3.1) and in CTF tables 1, 1(a) to 1(d). The data presented cover the period 1990-2020 and is fully consistent with GHG inventory data that was submitted in 2022 to the Secretariat of the UNFCCC in compliance with the UNFCCC Annex I inventory reporting guidelines.

Summary information on Lithuanian national inventory arrangements is presented in Chapter 3.2 of Lithuania's 8th National Communication. Since the submission of Lithuania's 4th Biennial Report, no changes have been made to the GHG inventory arrangements and the national system under Article 5, paragraph 1, of the Kyoto Protocol.

As required by the 'Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol', information on the national registry is also reported in Lithuania's 8th National Communication (Chapter 3.3).

3. QUANTIFIED ECONOMY WIDE EMISSION REDUCTION TARGET

The climate change policy in Lithuania is based on the EU climate change policy. Lithuania's emission reduction target for 2013-2020 is part of the joint target of the EU. The EU quantified economy-wide emission reduction target is implemented through the EU Climate and Energy Package 2020. This Chapter explains Lithuania's 2020 emission reduction target under the UNFCCC. Information regarding Lithuania's emission reduction commitment is presented also in CTF table 2.

3.1. Quantified economy-wide emission reduction target jointly with the European Union

Under the UNFCCC, Lithuania – a Party of the Convention and Kyoto Protocol – together with the other EU Member States has committed to achieving a joint quantified economy-wide greenhouse gas emission reduction target of 20 per cent below the 1990 level by 2020 in the second commitment period from 2013 till 2020 ("the Cancun pledge"). It is therefore a joint pledge with no separate targets for Member States under the Convention. The UK remains part of the joint EU 2020 target together with the 27 EU Member States.

The EU has jointly committed to its UNFCCC target and implemented it internally through EU legislation in the 2020 EU Climate and Energy Package. In this package, the EU introduced a clear approach to achieving the 20% reduction in total GHG emissions from 1990 levels, by dividing the effort between the sectors covered by the EU Emissions Trading System (EU ETS) and the sectors under the Effort Sharing Decision (ESD). Binding national targets were set for Member States under the Effort Sharing Decision. The achievement of EU internal compliance under the 2020 Climate and Energy Package including the national targets under the ESD is not subject to the UNFCCC assessment of the EU's joint commitment under the Convention.

Information on the EU quantified economy-wide emission reduction target has been presented to the UNFCCC and is contained in the "Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention" (FCCC/SB/2011/INF.1/Rev.1) and document FCCC/AWGLCA/2012/MISC.1. No individual target is set for Lithuania in the documents mentioned previously as 20% target will be reached jointly by the EU. Key assumptions and conditions related to the EU's target (e. g., sectors, base year, coverage of gases etc.) are included in the document FCCC/AWGLCA/2012/MISC.1. The summary information of the EU's target assumptions and parameters is given in Table VII-1 below.

Table VII-1. Key assumptions and parameters of the EU-28 target

Parameters	Target
Base Year	1990
Target Year	2020

Emission Reduction target	-20% in 2020 compared to 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
Global Warming Potential	4th AR
Sectors Covered	All IPCC sources and sectors, as measured by the full annual inventory and international aviation to the extent it is included in the EU ETS.
LULUCF	Accounted under KP, reported in EU inventories under the Convention. Assumed to produce net removals
Use of international credits (JI and CDM)	Subject to quantitative and qualitative limits
Other	Conditional offer to move to a 30% reduction by 2020 compared to 1990 levels as part of a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.

The EU Directive of the GHG Emissions Trading System (Directive 2003/87/EC and relevant amendments) and the Effort Sharing Decision (Decision No 406/2009/EC) are the main EU legal acts that lay down provisions for the implementation of the target. A joint quantified economy-wide emission reduction target of 20% is calculated, providing that in 2020 emissions from sectors covered by the EU ETS will be 21% lower than in 2005. As the common EU climate policy objectives shall be divided in accordance with the capacities of the Member States and their development. In 2013 the European Commission by the Commission Decisions 2013/162/EU and 2013/634/EU, adopted the national annual limits denominated in annual emission allocations (AEAs), which have been transferred into binding quantified annual reduction targets for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council (hereinafter – ESD). With this Decision the national emission targets for 2020 have been set based on Member States' GDP per capita and emission level in 2005 (Figure VII-1).

The Commission Implementing Decision 2013/634/EU adjusts these annual emission allocations taking into account the changes in coverage of the EU ETS from 2013 onwards. In addition, in 2017, the AEAs of the EU Member States were further adjusted to take into account changes introduced by the implementation of the 2006 IPCC Guidelines for national GHG inventories on the emissions levels in the inventory as these guidelines were applied in inventory reporting after the AEAs under the ESD were agreed upon (adjusted only AEAs for years 2017 to 2020).

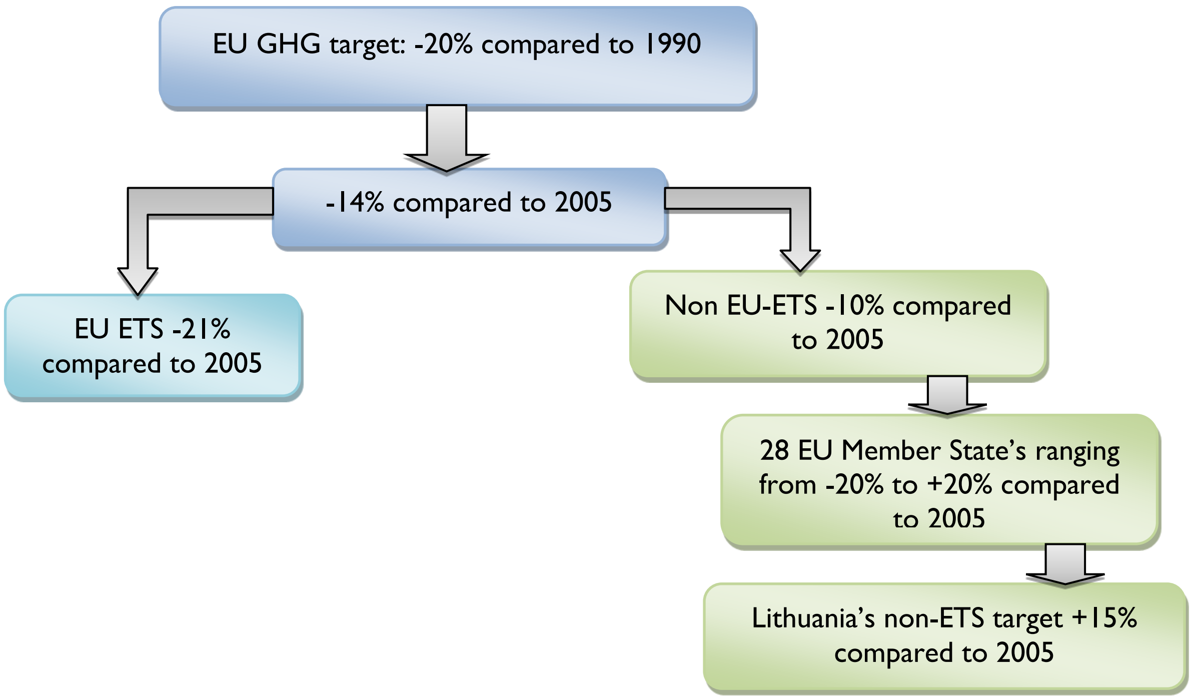

Figure VII-1. GHG emission 2020 target in ETS and ESD separation scheme under the EU legislation (Lithuania's example)

Under the revised EU ETS Directive (Directive 2009/29/EC), a single ETS cap covers the EU Member States and three participating non-EU countries (Norway, Iceland and Liechtenstein), and there are no further individual caps for Lithuania. As a result, allowances allocated in the EU ETS from 2013 to 2020 decreased by 1.74% annually, starting from the average allowances issued by Member States for the second trading period (2008-2012). For further information on recent EU ETS changes, please see Lithuania's 8th National Communication Chapter 4.2.2.

<u>The EU has substantially overachieved its 2020 reduction target under the Convention, which means that also its Member States and the United Kingdom have fulfilled their emission reduction obligations.</u> As stated in the 2022 EU GHG inventory submission to the UNFCCC, the total GHG emissions, excluding LULUCF and including international aviation, decreased by 34% in the EU-27 +UK compared to the base year 1990 or 1.94 billion tons of CO_2 eq.

In the case of Lithuania, about 90 stationary installations (larger than 20 MW combustion plants, chemical and other industry) and aircraft operators participating in the EU ETS jointly with the analogical operators from the other EU Member States had to cut GHG emissions by 21% compared to 2005. On the other hand, in the sectors which are not participating in the EU ETS (transport, agriculture, waste management, small-scale industry and district heating companies, households, services and other non-ETS sectors), the GHG emissions must not exceed annual emission allocations (kt CO_2 eq.) and to achieve, that GHG emissions in 2020 would not increase by more than 15% compared to 2005.

Generally, GHG emissions in non-ETS sector must be at most 112.643.919 kt CO_2 eq. over eight years. Lithuania's binding ESD annual emission allocations (AEAs) and their implementation for 2013-2020 are provided in Table VII-2 below.

Table VII-2. Lithuania's ESD annual emission allocations 2013-2020 and actual ESD emissions, tonnes CO_2 eq.

	2013	2014	2015	2016	2017	2018	2019	2020
ESD annual emission allocations*	12.936.664	13.297.646	13.658.629	14.019.611	14.125.626	14.497.103	14.868.581	15.240.059
Actual ESD emissions	12.449.462	12.922.268	13.250.961	13.921.700	14.132.498	14.283.074	14.298.998	14.042.972

*AEAs including adjustments in Commission Implementing Decision 2013/634/EU and Commission Decision (EU) 2017/1471

The ESD allows Member States to use flexibility provisions to meet their annual targets, with certain limitations. For example, the overachievement in a given year can be carried over to subsequent years or transferred to other Member States up to 2020[28].

Lithuania's total GHG emissions have decreased by 11.1% between 2005 and 2020, based on data from the National GHG inventory report 2022. Lithuania as a Member State with a positive limit under Annex II of ESD over the years 2013-2020 was in compliance with AEAs targets as there was no shortage of the AEAs during whole commitment period, except for year 2017 (the shortage of AEA's in that year was covered with the banked surplus of AEAs from previous years). To achieve Lithuania's ESD 2020 emission reduction target Lithuania has not used any credits from the international market-based mechanisms, Lithuania's 2020 Kyoto target for the second commitment period was met entirely by domestic actions.

3.2. Other emission reduction targets

In addition to the EU target under the Convention, the EU also committed to a legally binding quantified emission limitation reduction commitment for the second commitment period of the **Kyoto Protocol** (2013-2020). In Table VII-3, all relevant GHG reduction targets for the EU and their key facts are displayed in an overview. On the left, the table includes the international commitments under the Kyoto Protocol and the UNFCCC. On the right, the EU commitments under the **Climate and Energy Package** are included.

Table VII-3. Overview of GHG reduction targets for the EU

	International commitments			EU domestic legislation	
	Kyoto Protocol		UNFCCC	Climate and Energy Package	
				EU ETS	ESD
Target year of period	First commitment period (2008-2012)	Second commitment period (2013-2020)	2020	2013-2020	2013-2020
Emission reduction target	-8%	-20%	-20%	-21% compared to 2005 for ETS emissions	Annual targets by MS. In 2020 -10% compared to 2005 for non-ETS emissions
Further targets	-	-	Conditional target of -30% if	According to **Renewable Energy Directive** Lithuania has	

[28] More information on ESD annual emission allocations 2013-2020 and flexibilities is available in https://ec.europa.eu/clima/policies/effort/framework_en

			other Parties take on adequate commitments	undertaken to increase the RES share in the final national energy consumption up to 23% by 2020. In 2018, the share RES in the total energy balance of the country accounted for 25.03%. According to the **Energy Efficiency Action Plan for 2017-2019** to increase energy efficiency by 1.5% annually until 2020, the target is to achieve savings of 740 ktoe of the total final energy consumption until 2020.	
Base year	1990 KP Flexibility rules (Art 3(5)) regarding F-Gases and Economies in Transition	1990, but subject to flexibility rules. 1995 or 2000 may be used as the base year for NF_3	1990	1990 for overall emission reduction target; 2005 for renewable energy and energy efficiency target; as well as for targets broken down into ETS and non-ETS emissions	
LULUCF	Included ARD and other activities if elected	Includes ARD and forest management, other activities if elected (new accounting rules)	Excluded	Excluded	
Aviation	Domestic aviation included. International aviation excluded	Domestic aviation included. International aviation excluded	Aviation in the scope of the EU ETS included. In practice total aviation emissions considered	Domestic and international aviation included, as in the scope of EU ETS	Aviation generally excluded, some domestic aviation included (operators below ETS *de minimis* thresholds)
Use of international credits	Use of KP flexible mechanisms subject to KP rules	Use of KP flexible mechanisms subject to KP rules	Subject to quantitative and qualitative limits	Subject to quantitative and qualitative limits	Subject to quantitative and qualitative limits
Carry-over of units from preceding periods	Not applicable	Subject to KP rules including those agreed in the Doha Amendment	Not applicable	EU ETS allowances can be banked into subsequent ETS trading periods since the second trading period	No carry-over from previous period

Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6[29]	
Sectors included	Annex A of KP (Energy, IPPU, agriculture, waste), LULUCF according to KP accounting rules for CP1	Annex A of KP (Energy, IPPU, agriculture, waste), LULUCF according to KP accounting rules for CP2	Energy, IPPU, agriculture, waste, aviation in the scope of the EU ETS	Power & heat generation, energy-intensive industry sectors, aviation (Annex 1 of ETS directive)	Transport (except aviation), buildings, non-ETS industry, agriculture (except forestry) and waste
GWPs used	IPCC 2nd AR	IPCC 4th AR	IPCC 4th AR	IPCC 4th AR	

Lithuania signed the Paris Agreement on 22 April 2016 and ratified on 30 December 2016. Under the Paris Agreement Lithuania jointly with the EU and its Member States took a binding target of at least a 40% domestic reduction in economy wide GHG emissions by 2030 compared to 1990, which was endorsed in the conclusions of the European Council of 23 and 24 October 2014 on the EU 2030 climate and energy policy framework. On 6 March 2015, the Council adopted this contribution of the Union and its Member States as their intended nationally determined contribution, which was submitted to the Secretariat of the UNFCCC. The target is delivered implementing the EU legal acts on 2030 climate and energy targets by all economy sectors, with the reductions in the Emission trading system (ETS) and non-ETS sectors amounting to 43% and 30% respectively by 2030 compared to 2005.

Based on the European Green Deal strategy and the Commission's Communication of September 2020 on Stepping up Europe's 2030 climate ambition ('2030 Climate Target Plan') the EU has increased the European Union's binding target for 2030 towards at least 55% net emission reduction (compared with 1990 levels). The European Climate Law, adopted in 2021 sets the legally binding EU's climate neutrality target at the latest by 2050, and a binding Union domestic reduction target of at least 55% net emission reduction by 2030 compared to 1990. In order to follow the pathway proposed in the European Climate Law, and deliver this increased level of ambition for 2030, the European Commission has proposed a number of legislative proposals under the "Fit for 55" package laying down obligation to achieve the EU targets of reducing GHG emissions by 61% in the sectors covered by in the EU ETS and at least 40% in non-ETS sectors by 2030 compared to 2005.

The figure below summarizes EU and Lithuania's 2020 GHG reduction and energy sector targets and their implementation, as well as presents renewed targets by 2030.

[29] In its third trading period, the EU ETS only covers the gases CO_2, N_2O, CF_4 and C_2F_6.

Indicator		2020 targets	Implementation in 2020	2030 targets	
EU targets	GHG reduction compared to 1990	-20%	-34% (EU) (-58%) LT	>-40%	>-55%
	GHG reduction in ETS sector compared to 2005	-21%	-48.4% (EU) (-37%) LT	-43%	-61%
LT targets	GHG reduction in non-ETS sector compared to 2005	+15%	+11%	-9%	-21% ESR -25% (NCCMA*)
	RES use in final energy consumption	23%	27.36%	45%	50% (NCCMA*)
	RES use in transport	10%	5.5%	15%	15%
	Increase of Energy Efficiency	11.67 TWh	12.962 TWh (111%)	-	27.3 TWh

*Note: *NCCMA – National Climate Change Management Agenda*

Figure VII-2. EU and Lithuania’s 2020 targets implementation and targets by 2030

4. PROGRESS IN ACHIEVEMENT OF QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGETS

Information on Lithuania's mitigation actions, including on the policies and measures implemented and newly planned since the 7th National Communication and 4th Biennial Report to achieve the emission reduction commitment is provided in the Chapter 4 of Lithuania's 8th National Communication. Reporting of mitigation actions is provided by sector (energy, transport, industrial processes and product use, agriculture, LULUCF, waste) and by gas. The information on the existing and planned mitigation actions and progress in attaining the goal under the Convention, where available, is also included in CTF Tables 3 and 4.

Information on Lithuania's domestic institutional arrangements, including institutional, legal, administrative and procedural arrangements used for domestic compliance, monitoring, reporting, archiving of information and evaluation of the progress towards the economy-wide emission reduction target is provided in Chapter 4.1 of Lithuania's 8th National Communication. The changes in domestic institutional arrangements since the submission of Lithuania's 7th National Communication and 4th Biennial Report are also reported in the Chapter 4.1 of Lithuania's 8th National Communication.

Information on the assessment of the economic and social consequences of response measures (adverse effects) is presented in Chapter 4.7 of Lithuania's 8th National Communication.

For Lithuania's compliance with the emission reduction target 2020 no any credits from market-based mechanisms were used. Removals in the LULUCF sector are not included in the EU target under the Convention and are reported in CTF Table 4 and CTF Table 4(a) as "not applicable" (NA). Mitigation actions in the LULUCF sector are described in Chapter 4.3.5 of Lithuania's 8th National Communication and presented in CTF Table 3.

5. PROJECTIONS

All information on updated GHG projections for the years 2025, 2030, 2035 and 2040 consistent with the UNFCCC Annex I reporting guidelines on national communications are presented in Chapter 5 of Lithuania's 8th National Communication, as well as CTF tables 5 and 6(a) to 6(c).

As the latest GHG projections reporting was made in Lithuania's 4th Biennial Report (BR4), in Chapter 5.4 of the 8th National Communication the comparison of methodology and assumptions used for GHG projections between BR4 and this submission (NC8/BR5) is provided (rather than comparing the changes since the 7th National Communication). The complete comparison of the parameters used for the projections for the BR4 and NC8/BR5 for 2030 and 2040 is provided in Annex IV of the 8th National Communication.

6. PROVISION OF FINANCIAL, TECHNOLOGICAL AND CAPACITY-BUILDING SUPPORT TO DEVELOPING COUNTRY PARTIES

Information on the provision of financial, technological and capacity-building support to developing country Parties is provided in Chapter 7 of Lithuania's 8th National Communication and in CTF tables 7, 8, and 9.

7. OVERVIEW ON CTF TABLES PROVIDED WITH THE 5TH LITHUANIA'S BIENNIAL REPORT

Table VII-4. Overview of CTF tables

CTF Table No	Reporting elements
CTF Table 1	Emission trends
CTF Table 2	Description of quantified economy-wide emission reduction target
CTF Table 3	Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects
CTF Table 4	Reporting on progress
CTF Table 4(a)II	Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
CTF Table 4(b)	Reporting on progress
CTF Table 4	Reporting on progress
CTF Table 4(a)II	Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
CTF Table 4(b)	Reporting on progress
CTF Table 5	Summary of key variables and assumptions used in the projections analysis
CTF Table 6(a)/(c)	Information on updated greenhouse gas projections under a 'with measures' scenario and under a 'with additional measures' scenario
CTF Table 7	Provision of public financial support: summary information CTF Table 7(b) Provision of public financial support: contribution through bilateral, regional and other channels

8. RESPONSE TO THE REVIEW RECOMMENDATIONS OF LITHUANIA'S FOURTH BIENNIAL REPORT

Information on how Lithuania had addressed the recommendations and encouragements from the "Report of the technical review of the Fourth biennial report of Lithuania" (FCCC/TRR.4/LTU) is provided in the table below.

Table VII-5. Responses to recommendations of previous reviews of Lithuania's biennial reports

Table and issue No	Recommendations and encouragements	Lithuania's response
Table 3, issue 1	The Party submitted a blank table for CTF table 2(e)II, "Other market-based mechanisms". The BR4 states (p.80) that the Party does not intend to use credits from market-based mechanisms for compliance with the ESD 2020 target. During the review, the Party stated that it will make efforts to further increase the transparency of the CTF tables. **The ERT recommends that Lithuania improve the transparency of its reporting by indicating in CTF table 2(e)II that it does not intend to use units from other market-based mechanisms to achieve its emission reduction target.** This could be done, for example, by using notation keys or including a custom footnote in the table.	In this submission, in CTF table 2(e)II it is reported that Lithuania does not intend to use units from other market-based mechanisms to achieve its emission reduction target (notation key 'NA' is used).
Table 5, issue 1	The PaMs reported in the BR4 did not always clearly link to the corresponding entry in CTF table 3, particularly for the LULUCF sector. There were also several inconsistencies in the status and start date of implementation of the	In this submission consistent information on PaMs reported in the textual part of the NC and

	PaMs. Lithuania did not provide information on the status of implementation of measures with an end date in 2020, such as the progress in increasing the area of forests or progress towards the climate-related targets of the Rural Development Programme. **The ERT recommends that Lithuania improve the transparency of its reporting by providing consistent information on PaMs reported between the textual part of the BR and in CTF table 3 and by providing consistent information on the start date and status of implementation of the various PaMs.** The ERT notes that updates on the progress of implementation of key PaMs, especially those that are close to completion, would further enhance transparency.	in CTF table 3 as well as consistent information on the starting date and status of implementation of the various PaMs is provided.
Table 5, issue 2	The Party did not provide in its BR4 information on the assessment of the economic and social consequences of its response measures. During the review, the Party provided a reference to the NC7 (chap. 4.12) and to chapter 5 of the BR4, where projects are listed. **The ERT reiterates the encouragement from the previous review report for the Party to improve the completeness of its reporting in its next BR by providing, to the extent possible, information on the assessment of the economic and social consequences of response measures or by including a reference to the section of its most recent NC or to other relevant documents that provide this information.**	Information on the assessment of the economic and social consequences of response measures is provided in Chapter 4.7 of the 8th National Communication.
Table 5, issue 3	Lithuania reported the quantified mitigation impacts of some of its mitigation actions as "NE" in CTF table 3 and did not provide an explanation as to why the impacts of mitigation actions were not estimated. **The ERT recommends that, in its next submission, Lithuania provide estimates of the mitigation impacts of individual PaMs or explain why this was not possible owing to national circumstances.** For example, a custom footnote could be included in CTF table 3 to explain why some information is not included. The ERT notes that, if impacts are estimated for a group of PaMs, the Party could improve transparency by explaining which PaMs are included and why their mitigation impact could only be estimated as a group.	CTF table 3 completeness was substantially improved in this submission. Explanations why impacts of some mitigation actions were not estimated are provided in Chapter 4.4 of 8th National Communication.
Table 5, issue 4	Lithuania did not report on the arrangements established for the process of self-assessment of compliance with emission reduction commitments or the level of emission reduction that is required by science. Lithuania also did not report on its progress towards establishing national rules for taking national action against domestic non-compliance with emission reduction targets. During the review the Party explained that its self-assessment of compliance is carried out at the national level through the Inter-institutional Action Plan for the Implementation of the Goals and Objectives for 2013–2020 of the Strategy for National Climate Change Management Policy. The Party explained further that its compliance is also monitored by the EU and EU rules for action against noncompliance are applied. **The ERT reiterates the encouragement from the previous review report for the Party to improve the completeness of its reporting by providing in the next BR, to the extent possible, information on its self-assessment of compliance with emission reduction commitments and of its progress towards establishing national rules for taking action against non-compliance.**	Information on the arrangements established for the process of self-assessment of compliance with emission reduction commitments can be found in Chapter 4.1.2. of Lithuania's 8th National Communication.
Table 7, issue 1	The contribution of LULUCF and market-based mechanisms was generally not reported in CTF table 4, except for 2016 and 2017, for which "NA" was reported for the contribution of LULUCF. The use of units from market-based mechanisms under the Convention was reported as "NA" for 2017 and as "0" for 2016. Furthermore, the ERT noted that CTF tables 4(a)I_n and 4(b) were reported for 2017 and 2018 instead of for 2016 and 2017. In CTF table 4(b), units for market-based mechanisms were not given, although Kyoto Protocol units and totals were reported as "0" or "NA". Lithuania reported in its BR4 that it does not intend to use credits from market-based mechanisms to comply with the 2020 ESD target. During the review, Lithuania stated that it will work to increase the transparency of the CTF tables. **The ERT recommends that Lithuania report in CTF table 4 the intended contribution of LULUCF for all relevant years, and in CTF tables 4 and 4(b) the Party's intention not to use units from market-based mechanisms under the Convention or other market-based mechanisms or Kyoto Protocol units.** The ERT notes that the Party could do this by using	In this submission in the CTF table 4 it was reported that intended contribution of LULUCF for all relevant years is 'not applicable' ('NA'). In addition, in CTF tables 4(a)I_n and 4(b) intention not to use units from market-based mechanisms under the Convention or other market-based mechanisms or Kyoto Protocol units was reported using notation key 'NA'.

	notation keys or custom footnotes, or by reporting the quantity of units from market-based mechanisms or the quantity of Kyoto Protocol units used to meet the ESD target. The ERT also recommends that the Party provide information in CTF tables 4(a)I and 4(b) for the two last years, consistent with the time range reported in CTF table 4.	
Table 11, issue 1	Lithuania reported WAM projections in its BR4, but did not report a WOM projection. **The ERT reiterates the encouragement from the previous review report for Lithuania to improve the completeness of its reporting by including a WOM scenario in its next BR or to provide a duly substantiated explanation as to why this information was not included in the BR owing to Lithuania's national circumstances.**	Lithuania put all the efforts to work on WEM and WAM scenarios, which are mandatory to report according to UNFCCC reporting guidelines. The WOM scenario is not provided because the need and additional value of the WOM scenario is still under debate. As the ex-post evaluation of the PaMs just started, the need of WOM scenario and possible development of methodology for WOM scenario will be considered in the future. This explanation is provided in Chapter 5.1 of the 8th National Communication
Table 11, issue 2	Lithuania did not report a projection of indirect GHG emissions in its BR4. However, the BR4 included a link to the data submitted under the EU directive on national emission ceilings for certain atmospheric pollutants. **The ERT encourages Lithuania to provide projections of indirect GHG emissions in its next BR.** The ERT notes that, while reporting indirect GHG emission projections is not a mandatory reporting element, providing a projection or, at the very least, a description of the projection submitted under the EU directive on national emission ceilings for certain atmospheric pollutants would increase the transparency of Lithuania's reporting on projections.	The projections of indirect GHGs are submitted under National Emission Ceilings Directive (2016/2284/EU) to European Commission, therefore it is not provided in this report. The reference to the latest Lithuania's submission (2021) of projections for NOx, NMVOC, SOx, NH_3, $PM_{2,5}$ pollutants for 2020, 2030 and 2040 is provided in the Chapter 5.1 of 8th National Communication
Table 11, issue 3	Lithuania did not provide diagrams of its projections on a gas-by-gas basis in its BR4. **The ERT encourages Lithuania to provide diagrams illustrating its projections on a gas-by-gas basis in its next BR.**	The diagrams illustrating projections on a gas-by-gas basis (WEM and WAM scenarios) are provided in Chapter 5.1 of the National Communication.
Table 11, issue 4	In the BR4, Lithuania reported general assumptions and methodologies and referred to the "Methodological guidance for the preparation of national GHG emission projections" published by the Lithuanian Energy Institute without specifically addressing some of the requirements of the UNFCCC reporting guidelines on NCs, such as the gases and sectors considered and the type of model used (key characteristics, original purpose), including its strengths and weaknesses and how it accounts for any overlap or synergies that may exist between different PaMs. **The ERT reiterates the encouragement from the previous review report for the Party to increase transparency by not only providing general information on the models and approaches used but also including detailed information that describes each model and approach used for projections: the gases and sectors considered, the type of model used (key characteristics, original purpose) and the model's strengths and weaknesses, as well as how it accounts for any overlap or synergies that may exist between different PaMs.**	Information on models and approaches used for projections such as gases and sectors covered, its key characteristics etc. is provided in Annex IV "Summary information on the models/approaches used for the GHG projection estimation". The main strengths/weaknesses of the models/approaches used are mentioned in Chapter 5.1 of National Communication.

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