Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania

Report pursuant to Articles 18 and 39 of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action and pursuant to Articles 36, 37 and 38 of Implementing regulation (EU) 2020/1208

Vilnius, 2021

Preface

The Lithuania's policies and measures (hereinafter – PaMs) and greenhouse gas (hereinafter – GHG) emissions projections submission is prepared pursuant to Articles 18 and 39 of the Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council and pursuant to Articles 36, 37and 38 of the Commission Implementing Regulation (EU) 2020/1208 of 7 August 2020 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) 2018/1999 of the European Parliament and of the Council and repealing Commission Implementing Regulation (EU) No 749/2014. The submission contains:

1. Policies & Measures and Projections of GHG Emissions in Lithuania technical report.

2. Templates for reporting under the Implementing Regulation (EU) No 2020/1208 in the Reportnet 3.0.

The submission was developed by:

Ministry of Environment of the Republic of Lithuania

Lithuanian Environmental Protection Agency

State Forest Service

CONTENTS

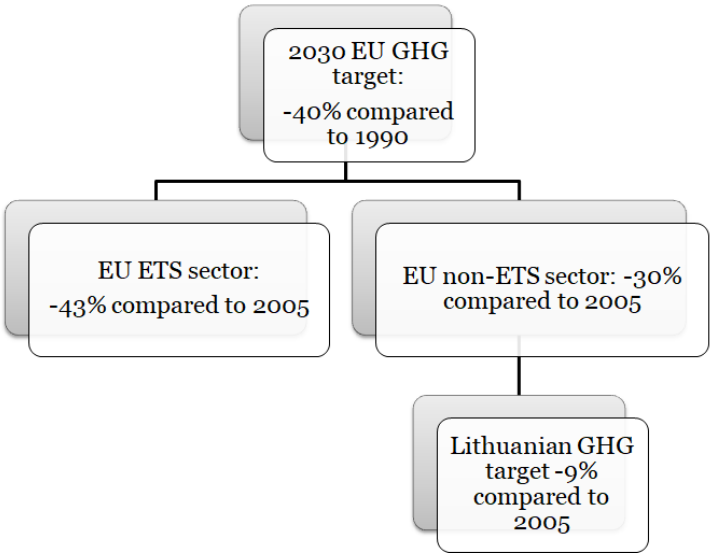
Abbreviations

ARD	Afforestation, Reforestation and Deforestation
ASF	African swine fever
CH_4	Methane
CHP	Combined Heat and Power
CO_2 eq.	Carbon dioxide equivalent
CO_2	Carbon dioxide
EC	European Commission
ENEF	Energy Efficiency Fund
EF	Emission Factor
EPA	Environmental Protection Agency
ESD	Effort Sharing Decision
ETS	Emission trading system
EU	European Union
EUA	European Union emission trading allowances
FM	Forest Management
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
KC	Key Category
kt	thousand tonnes
LULUCF	Land Use, Land-Use Change and Forestry
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MMS	Manure Management System
MSW	Municipal Solid Waste
Mtoe	Million Tonnes of Oil Equivalent
MW	Megawatts
N	Nitrogen
N_2O	Nitrous oxide
N_{ex}	Nitrogen excretion
NECP	National Energy and Climate Plan
NIR	National Inventory Report
NMVOC	Non-methane volatile organic compounds
NPP	Nuclear Power Plant
Non – ETS	non-ETS sectors
PaMs	Policies and Measures
PP	Power Plant

QA/QC	Quality Assurance and Quality Control
RDP	Rural Development Program
RES	Renewable Energy Source
SAPS	Single Area Payment Scheme
SC	Stock Company
SDG	Sustainable Development Goals
SF_6	Sulphur hexafluoride
SFI	State Forest Inventory
SFS	State Forest Service
SPD	Single Programming Document
SQQ	Siauliai Airport
SWDS	Solid Waste Disposal Sites
TJ	Terajoule
TOE	Tonne of Oil Equivalent
UNFCCC	United Nations Framework Convention on Climate Change
WAM	with Additional Measures
WEM	with Existing Measures
WOM	without Measures

Introduction

Lithuania signed and ratified the Paris Agreement in 2016. Under the Paris Agreement, Lithuania, jointly with the EU and its Member States, made a binding commitment to meet the target of at least a 40% domestic reduction in economy-wide GHG emissions by 2030 compared to 1990. Lithuania's stationary installations (around 80 installations) and 1 aircraft operator, jointly with the EU Member States operators participating in the EU ETS, will deliver a reduction of GHG emissions by 43% compared to 2005 levels. Lithuania's binding national 2030 target for GHG emissions reduction in the non-ETS sectors is 9% compared to 2005, whereas the annual binding limits will be set under Efforts Sharing Regulation. Where applicable, other national objectives and targets consistent with *the Paris Agreement* and the existing long-term strategies will be set in the updated Strategy for the National Climate Change Management Policy (national long-term low carbon development strategy) to be approved by 2020.



As a member of the European Union, Lithuania is obliged from 2021, to report to the European Commission in accordance is structured under Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action and its Implementing Regulation (EU) 2020/1208 to report on national systems for PaMs and projections, on PaMs and projections. The Regulation (EU) 2018/1999 repeals the Monitoring Mechanism Regulation (EU) No 525/2013 (MMR) and introduces some new reporting tables and requirements and updates of existing reporting tables.

In this technical report we report information on their national systems for PaMs and projections under Article 39 of the Governance of the Energy Union and Climate Action Regulation (EU) 2018/1999 and Article 36, Annex XXIII of the related Implementing Regulation (EU) 2020/1208. Additional, information on GHG policies and measures in accordance with Article 18 (1) (a), Annex VI of the Governance of the Energy Union and Climate Action Regulation (EU) 2018/1999 and Article 37, Annex XXIV of the related Implementing Regulation (EU) 2020/1208. And finally, to report GHG projections in accordance with Article 18 (1) (b) of the Governance of the Energy Union and Climate Action Regulation (EU) 2018/1999 and Article 38 of the related Implementing Regulation (EU) 2020/1208.

The report is based on available information and existing plans and strategies of the Lithuania regarding mitigation of GHG emissions and its separate economic sectors.

1. Information on National systems for Policies and Measures and Projections

Under Article 39 of the Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action the national legal acts related to reporting were updated and newly adopted. Primarily, aiming to set up the system and ensure better information and data collection for the preparation of report on PaMs and projections and determine responsibilities of the different governmental institutions the Government Resolution No 388 of 7 April 2004 was amended in December 2020. This Government Resolution determines functions of other relevant ministries and their subordinated institutions, as well as other public institutions and the state science research institutes to collect and provide information on their strategic and planning documents and other existing or planned policies related to climate change mitigation and adaptation actions also the data required for the reporting on GHG emission projections.

Secondly, to set up PaMs and projections development system, fulfil other reporting requirements and define data flow procedures the Order No D1-64 of the Minister of Environment of 2 of February 2021 "On Establishment of the National Greenhouse Gas Inventory, Projections, Adaptation to Climate Change, Implementation of Strategy Papers, Collection of Data on Financing of Climate Change Measures, Preparation of Reports and Information System." was adopted. This Order's provisions designate the main entities responsibilities and tasks for the reporting and data assessment regarding the implementation of the reporting requirements under the Regulation (EU) No 2018/1999. Aiming to ensure the timeliness of the preparation of reports, reporting deadlines are determined by this Order.

GHG projections calculations performed by EPA using methodological guidance for the preparation of national GHG emission projections.

The main institutions involved in the preparation of the Policies & Measures and GHG emission projections and responsible for the process of submission are:

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

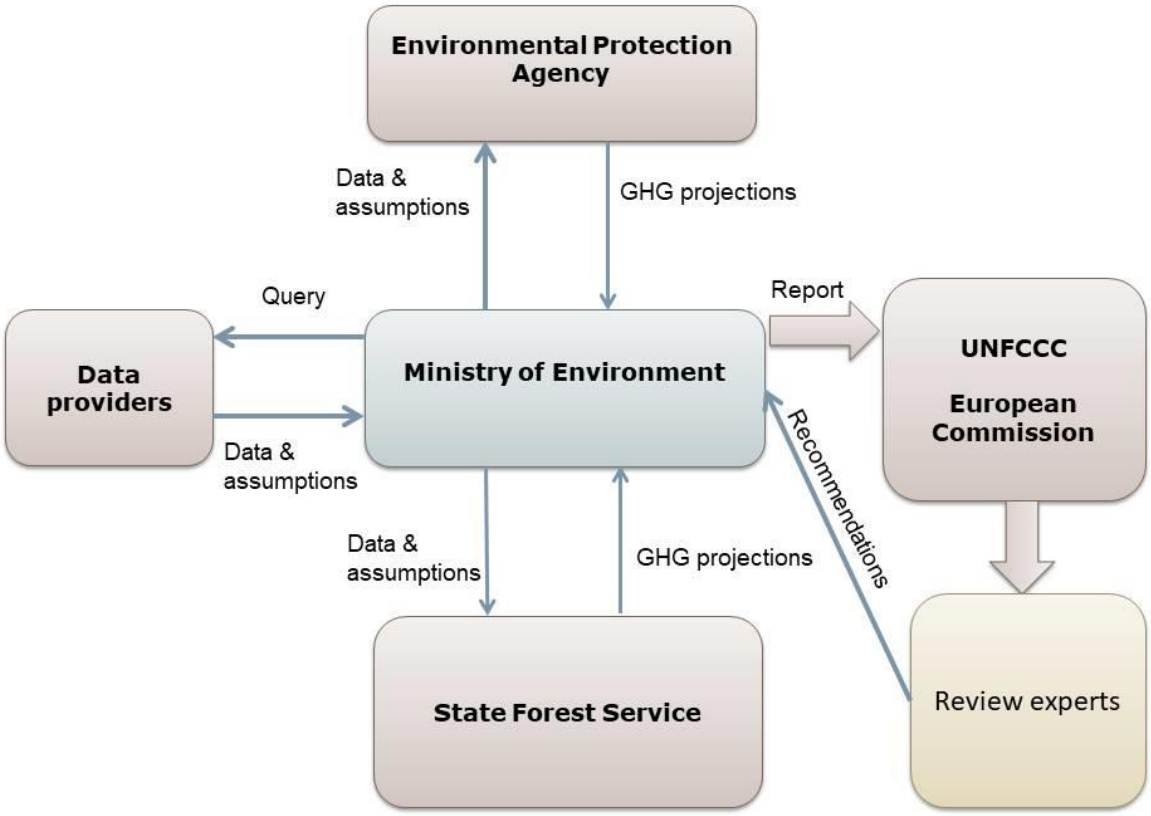


Figure 1-1. The scheme of the main responsible institutions involved in the preparation of GHG emission projections report in Lithuania.

The major PaMs evaluation exercise was performed during the preparation of the National Energy and Climate 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 (Figure 1-2). However, the sectorial ministries reviewed the proposed measures based on the sectorial objectives, development trends, economic and social aspects. EPA experts or other consultants reevaluated the final list of PaMs. This list is used now for the current submission of the report. **It is planned to be updated based on the new targets.**

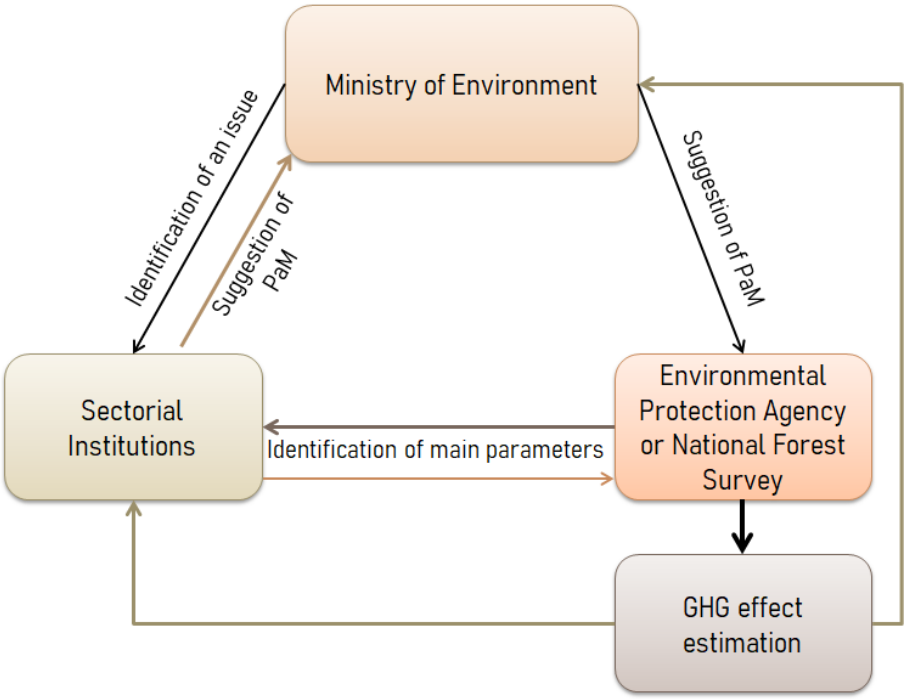


Figure 2-2. The scheme of the assessment of PaMs mitigation effect in Lithuania

Ministry of Environment

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. It has overall responsibility for the national system of GHG inventory preparation as well as of PaMs and projections reporting, and it is in charge of the legal, institutional and procedural arrangements for the national system and the further strategic development.

In 2008 the Climate Change Division was established in the Ministry of Environment. 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 Change Policy Group.

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

- Preparation of legal acts required for the functioning of national system;
- 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). 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. Starting with the 2013 submission of PaMs and projections report personnel of EPA is responsible for calculations of GHG emissions based on activity data received from data providers and the preparation of part on GHG emission projections of the report.

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.

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 report 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 (Figure 1-3). 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:

The Lithuanian Energy Agency provides the information on projected activity data in the Energy sector. Ministry of Energy identifies the main measures related with mitigation of GHG emissions.

*The Ministry of Transport and Communication*s 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.

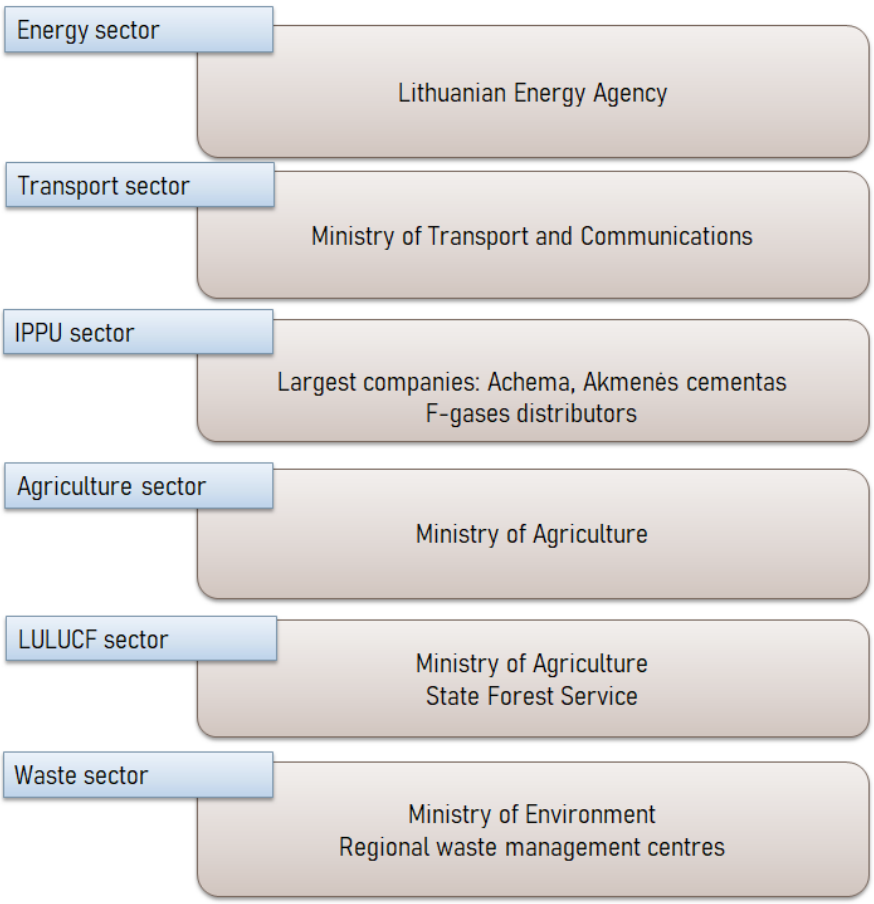


Figure 1-3. Scheme illustrating data flow and activity data providers for the preparation of GHG emission projections.

The information collection process starts with the preparation of questionnaires in different sectors (Figure 1-4). The experts from the EPA and SFS prepare the list of activity data needed to project GHG emissions in separate sectors. The Ministry of Environment coordinator rechecks the questionnaires and requests the data from data providers on projected activity data by sending out them with official letters to the responsible ministries and other institutions obliged to provide information according to Government Resolution No 388, key industry companies and other

institutions. The data collection process coordinator clarifies information if needed to data providers, systemizes the collected information, and forwards it to the EPA and SFS experts. The EPA and SFS personal check the quality of the received information, after primary quality control procedure the GHG projections is estimated. The Ministry of Environment review the final data and approves it.

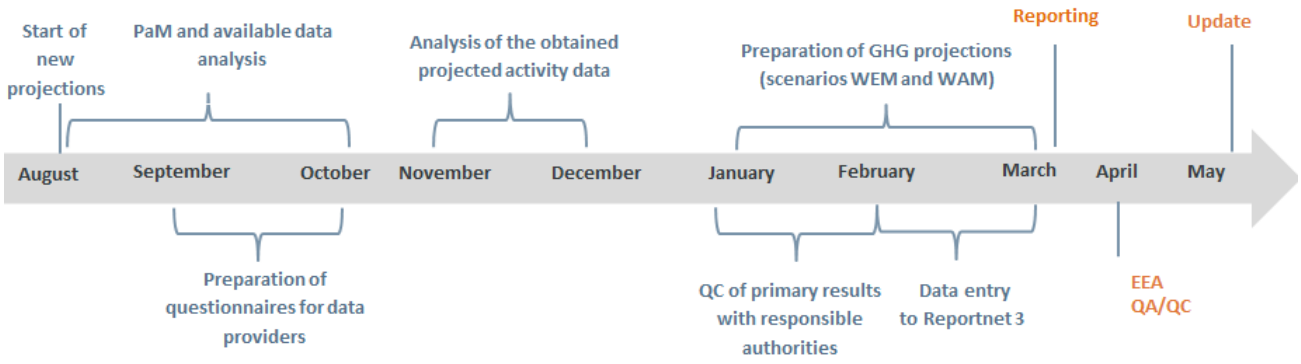


Figure 1-4. Scheme on procedural arrangements and timescales for the preparation of report on PaMs and GHG projections.

The current procedure of evaluating the PaMs and estimating the GHG projections and reporting is under review. We are planning to have a common reporting platform where the sectorial institutions would have to report the projections activity data and progress on implementation of PaMs. In the case of PaMs evaluation, we are planning to prepare the guidelines for separate sectors, which sectorial institutions could use to ease the policies planning process in GHG mitigation. The initial information of planned PaMs will be directly sent to EPA for further GHG mitigation effect evaluation.

Lithuania provides GHG projections for 2025, 2030, 2035 and 2040.

In this chapter we provide the latest information on newly adopted or under implementation PaMs related to GHG emissions mitigation in Lithuania.

2. Policy and measures

2.1 Climate change management policy in Lithuania

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.

International commitments

The Parliament (Seimas) of the Republic of Lithuania ratified the UNFCCC in 1995. The Kyoto Protocol (KP) was signed in 1998 and ratified in 2002. In accordance with the Kyoto Protocol Lithuania has undertaken to reduce its GHG emissions by 8% below 1990 level during the first commitment period 2008–2012 and successfully implemented achieving 56% GHG reduction, while GDP increased by 25%. In 2012 Lithuania together with the other EU Member States and Iceland undertook 20-30% GHG emissions reduction below 1990 level commitment for the second KP period from 2013–2020. It was ratified by the Seimas on 20 October 2015.

At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first ever universal, legally binding global climate deal. The 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 1.5ºC above pre-industrial levels. Lithuania signed the Paris Agreement on 22 April 2016 and ratified on 30 December 2016.

National commitments

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 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 was 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 above mentioned Strategy. As from 2021 targets of climate change 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 programs.

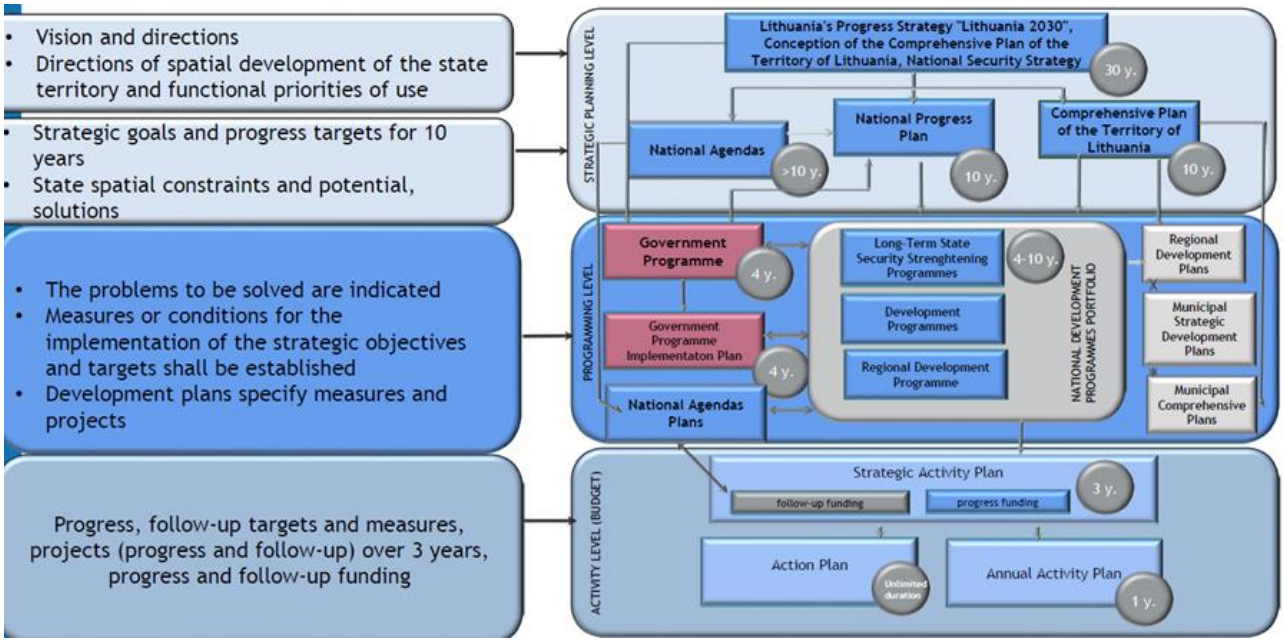


Figure 2-1. Planning documents system in Lithuania since 2020 (scheme composed by the Lithuanian Government administration).

In 2012, to ensure the implementation of the international agreements on climate change and in the EU legal acts defined targets for Lithuania, the Parliament of the Republic of Lithuania approved the *National Strategy for Climate Change Management Policy* which lays down the short-term targets and objectives for climate change mitigation and adaptation until 2020 and long-term indicative target for 2050. It is indicated that stronger cross-sectorial cooperation between public institutions, research and industry is needed as well as international cooperation on joint climate change adaptation and risk prevention and management. Lithuania has committed to contribute to the EU milestones by reducing GHG emissions by 40% to 2030; by 60% to 2040 – and by 80% to 2050 compared to 1990 level. Update of the Strategy aiming to set legally biding adaptation to climate change goals and objetives for the period 2021–2030 and aspirational target and objectives till to 2050 and beyound is planned in 2021 (it is now remained as "Climate policy Agenda").

Interinstitutional action plan on the implementation of the Goals and Objectives for 2013–2020 of the Strategy for the National Climate Change Management Policy was approved on 23 April 2013 by the Government Resolution No 366 and it is annually updated. Currently implementation of the Plan is coordinated by the Ministry of Environment. The Ministries of Finance, Energy, Transport and Communications, Economy, Education and Science, Agriculture and the Interior, as well as municipalities, the Research Council of Lithuania, state research institutions and universities, companies, entities, organizations and other persons participate in the implementation of the measures within their competence and allocating funds for their implementation of the measures. While drawing up sectorial development programs, interinstitutional 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 Strategy, in order to provide for specific measures to implement those targets and objectives and to ensure close interinstitutional cooperation.

In 2018, Lithuanian Parliament adopted the National Energy Independence Strategy[1], which includes the state's key energy policy tasks, directions, and implementation tasks up to 2030 and a vision up to 2050.

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.

Thus as of 2020 the Interinstitutional Action Plan of the Strategy for the National Climate Change Management Policy is incorporated in the NECP for the period of 2021–2030 in line with the requirements of Article 3 of the Governance of the Energy Union Regulation. The NECP present Lithuania's targets and objectives in energy sector, PaMs in all five areas of the Energy Union, including decarbonisation. The measures listed in the NECP will be mainstreamed to sectorial programs and then implemented; these programs are currently being updated. The sectoral programs or plans are following: the Multi-Apartment Building Renovation Programme, the Programme on the Increase of Energy Efficiency in Public Buildings, the Action Plan on Energy Efficiency, the Programme on Investment Promotion and Industrial Development, the National Programme for the Heating Sector Development, the National Programme on Renewable Energy Source Development, the National Programme on Transport Development, the National Waste Management Plan, the Rural Development Programme, and other strategic initiatives, such as Long-term Renovation strategy. Total investment for the NECP measures needs approximately

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

14.1 billion EUR, of which 9.8 billion EUR of public funds. Decarbonisation measures for Waste, Industry, Agriculture and Forestry, Energy-Renewables, Energy- efficiency the sectors need 10.8 billion EUR, of which 6.5 billion EUR public funds.

New Comprehensive Plan of the Territory of the Republic of Lithuania is also being prepared, which 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.

2.3 National Economic and Financial Instruments for Climate Change Management

The following economic and financing instruments are applied in order to implement targets set in the Strategy for the National Climate Change Management Policy and sectorial strategies: the EU emissions trading system (ETS) from which revenues of auctioned allowances are earmarked to the Programme for Climate Change, the EU structural and investment funds for 2014–2020, e. g. the Cohesion Fund, the European Agricultural Fund for Rural Development via the Rural Development Programme for Lithuania 2014–2020, the *JESSICA* Holding Fund and Energy Efficiency Fund, etc. Lithuania also applies a broad range of market-based instruments, among which are environmental taxes, charges and fees for air pollution. Environmentally related taxes have been reviewed and changed according to the country's need in the most efficient and effective way to achieve tasks and objectives set in the National Environmental Strategy and national legislation, to fulfil commitments set in international agreements and etc.

Environmental taxes

Environmentally related taxes and other market-based instruments are identified in the Law on Environmental Protection.

Particular economic measures are implemented through special legal acts: the Law on Environmental Pollution Tax of the Republic of Lithuania No VIII-1183, approved by the Parliament of the Republic of Lithuania in 1999, as last amended in 2020, the Law on Excise Duty of the Republic of Lithuania No IX-569, approved by the Parliament of the Republic of Lithuania in 2001, as last amended in 2019, the Law on Registration tax for motor vehicles of the Republic of Lithuania No XIII-2690, approved by the Parliament of the Republic of Lithuania in 2019, the Law on the Financing of Road Maintenance and Development Programme of the Republic of Lithuania No VIII-2032, approved by the Parliament of the Republic of Lithuania in 2000, as last amended in 2020, Methodology for the calculation of the amounts of compensation for damage caused to the environment, approved by Order No 471 of the Minister of Environment of the Republic of Lithuania 2002, as last amended in 2018 and others.

The use of economic instruments in Lithuania's environmental policy is consistent with environmental goals and broader social and economic goals.

The tax from mobile pollution sources shall be paid by those who use vehicles to carry out economic commercial activities. The purpose of this tax is to encourage the use of less polluting vehicles that meet high Euro emission standards. Tax rates on pollutants discharged into the air from mobile sources, such as road vehicles, vessels, trains, aircrafts and non–road machines used for commercial purposes, are set per tonne of fuel used, and for aircrafts per number of the take-off and landing cycle. Tax rates depend on a fuel used and pollutants discharged. The rates on pollutants discharged into the air set in the Law on Environmental Pollution Tax. Exemptions set for mobile sources used in the agriculture sector and vehicles with installed catalytic converters or vehicles used for individual activities will be phased out from 2021. According to the provisions of this Law, only vehicles and non–road machinery used for commercial purposes are subject to pollution taxation from mobile sources. The government encourages the use of low emission vehicles by differentiating the tax rates set for used motor fuels and applying exemptions to electric vehicles and vehicles driven by biofuels.

Starting from January 2021 tax exemptions for mobile sources will be applied only to passenger vehicles which are not older than 4 years and for heavy duty vehicles which are not older than 3 years. This exemption will not apply to diesel–powered vehicles. Newly established reliefs

(exemptions) could contribute to air pollution reduction and create incentives to use new and cleaner cars, abandoning the use of diesel vehicles. Such changes may help to replace of diesel–powered cars with other cleaner vehicles and escape further dieselisation of the fleet, with adverse effects on urban air quality taking in to account not only CO_2 emissions but also PM and NOx.

Lithuania also applies taxes, tolls and user charges on heavy good vehicles. These vehicles are subject to periodic tax payment on heavy good vehicles registered in Lithuania, and the road tax (vignette) is paid for driving on motorways. Taxes on heavy good vehicles only partially are seen as environmentally related taxes influencing pollution reduction and are used for road maintenance and development of road infrastructure. The Law on the Financing of Road Maintenance and Development Programme establishes the main principles of taxes, tolls, and user charges imposed on heavy goods vehicles. Annual tax on goods vehicles registered in Lithuania is paid by natural and legal persons and is differentiated by the vehicle's weight and type of suspension. Buses, goods vehicles and their units also pay the road tax (vignette) for using motorways. A system of road pricing has been in place since 2002. The road user charge (vignette) is paid by managers of vehicles (buses, trucks and their compounds). The tariff rate is based on the validity period of vignette not on driven distance and do not reflect real damage to environment and roads infrastructure.

The road user charge (vignette) it is partly based on test-cycle engine emission levels (Euro standards), although the differentiation is not very pronounced. The charge is time-based (with daily, weekly, monthly and annual tolls) and does not change with distance travelled. The vignette does not apply to passenger vehicles of category M1. The road charge revenue is used for maintenance, upgrade and extension of the road network. The latest changes of the Law on Financing of Road Maintenance and Development Programme related with vehicle and road taxation issues was adopted on 13th of June 2019 and came in to effect on 1st of November 2019.

In 2015, having in mind increased air pollution from the vehicles, including privately owned cars, and the need to reduce this pollution Lithuania carried out an analysis of the situation and improved the vehicle taxation system in 2019 by adopting the Law on motor vehicle registration tax, which is applicable to motor vehicles of class M1 or class N1. The introduction of such tax should help to achieve air quality goals in the most environmentally effective and cost-efficient way.

Starting from July 1st of 2020 Lithuania has introduced the motor vehicle registration tax that is based on vehicles CO_2 emissions and fuel used. The tax is applied to vehicles (M1 and N1 class) that are being registered in Lithuanian for the first time as well as each time when the operator changes (the only exemption is applied to historical cars). Amount of tax differs for diesel, gasoline and gas-powered vehicles, based on their CO_2 emissions.[2]

The key provisions for a tax incentive to choose a less polluting or zero emissions car (electric vehicle) are the following:

1) the tax shall be applied only to vehicles of categories M1, N1 with CO_2 emissions exceeding 130 g/km, which are registered in the Road Vehicle Register;
2) the tax payed depends on the amount of CO2 emitted: tax rate increases every 10 g/km CO_2;

[2] More information: https://www.regitra.lt/lt/paslaugos/transporto-priemones/automobiliu-registracijos-mokestis

3) the tax is differentiated according to the type of fuel used, three tax groups are distinguished according to the fuel type, the relative level of the tax rate for falling to different groups of fuel used can be represented as follows: 1: 0.5: 0.45;
4) the amount of the tax depends on the type of fuel used by the vehicle (diesel, petrol, gas) and the amount of CO_2 emissions (grams per kilometre). It ranges from € 13.5 to € 540. Both the fuel type and the CO_2 value g/km can be found in the vehicle registration certificate. If CO_2 data are not provided here, the tax is calculated according to set formulas (more information on tax rates for various CO_2 emission intervals is provided in section "Climate change mitigation and adaptation" of this Questionnaire);
5) the tax does not apply to electric vehicles;
6) if the tax is not paid, the registration of the motor vehicle in the Register of Road Vehicles will not be performed.

The new tax on CO_2 from passenger cars is a step towards renewal of the car fleet with more fuel-efficient vehicles or electric vehicles hereby reducing CO_2 emissions and air pollution. The tax should prevent from the purchase of old and polluting cars, especially diesel cars. Lithuania's car fleet is old enough – 15 years on the average and most of them are diesel fuelled. It is expected that this registration tax on motor vehicles will help to stop further dieselisation of the fleet with adverse effects on urban air quality.

Lithuania also applies a number of different taxes on energy still the most prevalent taxes are excise duties on fuel. Excise duty accounts for large part of all environmental revenues. The last amendments of the Law on Excise Duty that came into effect in 2020 increases rates on diesel fuel, and petrol. Excise duty on engine fuels increased significantly especially for diesel from 274.27 EUR/ per 1000 litres in 2010 to 372 EUR/ per 1000 litres in 2020. Excise duty on petrol also increased from 434.43 EUR/ per 1000 litres in 2010 to 466.00 EUR/ per 1000 litres in 2020. Excise duty on diesel increased significantly but it has not yet reached excise duty on petrol. Also was increased excise duty for gas oil used in agriculture from 56 EUR/1000 litter (2018) to 60 EUR/1000 litter (2020). Natural gas, used as motor fuel, is exempt from Excise duty from 2018.

Energy products used for heating or industry such as coal, coke and lignite are subject to Excise Duty from 2007. Electricity is subject to Excise Duty from 2010. From 2015 was introduced 21 EUR/ per 1000 litres excise duty for gas oil used in agriculture (before total excise duty exemption was applied), which now is increased till 60 EUR/ per 1000 litres.

In 2010, a separate excise duty rate was introduced for natural gas used as motor fuel (before the excise duty rate as for LPG was applied (as for equivalent product)). Natural gas for heating is subject to Excise duty from 2016. From 2018 natural gas used as motor fuel is exempt from Excise duty.

Excise duty exemption is applicable for a higher concentration of biofuels only corresponding to the Standards EN 14214 and CEN/TS 15293 approved by the European Committee for Standardization (excise duty rate is reduced by the percentage in proportion to the percentage of additives of biological origin in the product).

Coal is subject to an excise duty of 7.53 EUR/ per tonne of the product. However, coal used for business purposes is subject to a reduced excise duty of 3.77 EUR/ per tonne of the product. Energy products used for purposes other than motor fuel, heating fuel or motor fuel additives, and the production of all types of electricity, are exempt from excise duty. However, electricity is subject to an excise duty of EUR 1.01 per MWh of electricity. Electricity used for business

purposes is subject to an excise duty of EUR 0.52 per MWh of electricity. Excise duty exemption is applicable for natural gas, intended for use in combined production of heat and electricity.[3]

The main share of environmental revenues, with the exception of excise duty on energy products and Registration tax on motor vehicles, is accumulated in special environmental funds and used to finance environmental projects directed at pollution reduction, restoration of lost resources, others. Pollution tax is allocated: 70 % to Municipalities Environmental Protection Support Programme and 30 % – to the State budget which is used for environmental purposes only. Registration tax on motor vehicle is allocated to the State budget. Road tolls and heavy vehicle registration tax is used for road development and maintenance programme needs.

Environmental taxes play an important role and are an efficient instrument to achieve the objectives of environmental policy. According to the Eurostat data, in 2018 the total amount of collected revenues from environmental taxes amounted to EUR 899.78 million or 6.52 % of total revenues from taxes and social contribution. It is foreseen that in coming years 2021-2023 revenues coming from environmentally related taxes will increase significantly and will achieve the EU average. The figure is expected to increase in the year to come because of the changes in pollution taxation (3.5-fold increased tax rates and phased out exemptions) also introduced a new registration tax on motor vehicles.

Implementation of the EU GHG emission allowances trading scheme (EU ETS) in Lithuania

The EU Emissions Trading System (EU ETS) is a key climate policy instrument that has been implemented in the EU to achieve its objectives of reducing GHG emissions in a cost-effective manner since 2005. All the provisions of the European Parliament and Council directive 2003/87/EB are transposed in to the national legislation by the ***Law on Financial Instruments for Climate Change Management*** adopted on 7 July 2009 and its implementing legal acts (currently it is being updated). The Law stipulates the rights, duties and liability of the persons engaged in the economic activities resulting in GHG emissions as well as the sphere of competence of state institutions and bodies. The law also sets forth the main provisions on administrative structure for the administration and implementation of EU emission trading system (ETS), Joint Implementation (JI) and Clean Development Mechanism (CDM) projects.

Installations under scope of the EU ETS are required to have a GHG emissions permit, issued by the Environmental Protection Agency These permits must be updated if changes to the functioning of the installation occur.

Lithuania have taken advantage of the provision offered by Article 13 of the Monitoring and Reporting Regulation to allow use of simplified monitoring plans in low-risk cases for stationary installations.

Lithuania established an indirect carbon cost compensation scheme and may grant State aid to compensate some electro-intensive industries for indirect carbon costs, i.e., costs resulting from increased electricity prices due to power generators passing on the costs of purchasing allowances to consumers, which are valid until end of 2020.

[3] More detailed information about energy products taxing in Lithuania is in accomplished study by OECD Taxing Energy Use 2019 – Country Note Lithuania (Jonas Teuch OECD). Information on subsidies and excise duty is available in web site: http://www.oecd.org/fossil-fuels/; http://wds.iea.org/wds/pdf/WORLDBAL_Documentation.pdf.

In order to ensure the implementation in the international agreements and the EU legal acts defined targets for Lithuania, in 2012 the Parliament of the Republic of Lithuania approved the National Strategy for Climate Change Management Policy which lays down the targets and objectives for climate change mitigation and adaptation by 2050. The Lithuanian short-term GHG emissions of EU ETS sectors target do not exceed 8.530 million tonnes of CO2 eq.;

In total Lithuanian EU ETS operators emit about 35% of total national GH 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.

Starting from the third trading period, no free allocation is given to electricity producer's with the exception for some countries, including Lithuania. Under article 10c of the Directive 2003/87/EB Lithuania is able to allocate free allowance to electricity producers for the transitional period 2013-2019. Electricity producers that are willing to make use of Article 10c derogation must make investments that are fixed in the National Investment Plan. These investments must directly (i.e., within the installation) or indirectly (i.e., switching into more efficient electricity generating equipment in the installations owned by different operator) contribute to decreasing GHG emissions and this reduction must be verified and measurable. Investments should be related only with the modernization of electricity production, transmission, distribution and consumption and should be additional to investments Member States must undertake in order to comply with other objectives or legal requirements accruing from Union law.

In 2019 the EU ETS scope covered 87 installations and 1 aircraft operator.

87 installations carry out activities and emit GHG emissions listed in Annex I to Directive 2003/87/EC fall under category A, B and C installations as referred to in Article 19(2) of Regulation (EU) No 601/2012:

- Category A installations – 74 (installations that emit less than 50 kt of CO_2eq. per year;
- Category B installations – 10 (installations that emit more than 50 kt CO_2 eq., but less than 500 kt of CO_2 eq. per year);
- Category C installations – 3 **(**installations emitted > 500 kt of CO_2 eq.).

The installations included in the EU ETS sectors in Lithuania are the following:

- 75 installations which burn fuel and net rated thermal input is more than 20 MW (except installations incinerating or disposing hazardous or municipal waste);
- 1 installation of oil refinery;
- 2 installations of cement clinker and lime production in rotation furnace (when production capacity is more than 500 t per day or other type of furnaces then the capacity is more than 50 t/day);
- 2 installations producing glass production (capacity is more than 20 t/day);
- 5 installations producing ceramic products (when production capacity is more than 75 t/day);
- 1 installation producing stone wool by using glass, rocks or slag (when capacity of melting is bigger than 20 t/day);
- From 2013 in EU ETS included 1 installation producing nitrogen acid and producing ammonia.

In 2019 the EU ETS emissions in Lithuania amounted to 6 066 kt of CO_2 and constituted 29.8% of total GHG emissions in Lithuania (excluding LULUCF).

The decline in GHG emissions from the EU ETS sector is driven by few factors: reduced economic activity, decreased number of operators who participate in EU ETS (some installations are closing or reducing their capacity below EU ETS thresholds). An additional factor, fuel switching to renewable energy sources (high uptake of RES in the energy generation sector), which is promoted and subsidised through national funds. The GDP of Lithuania was growing all the time since 2009. So, we cannot say that a decline in economic activity has occurred. Furthermore, analysing the figures more deeply shows that the number of EU ETS installations has decreased by approximately 15 % from 2011, and the ETS emissions reduced by around 25 %.

All in all, although some of the installations have closed or left EU ETS (producers of ceramic products and producers of food and beverages), the effect of emission intensity improvement in the ETS sector is seen. The significant increase in the price of EU ETS allowances (EUAs) (since the end of 2018, the price increased from 5-8 EUR/EUA to 25 EUR/EUA in 2019) might had some influence on increasing the interest of major LT installations to shift their views from only buying allowances to planning investments in clean technology.

Joint implementation projects and other projects

Totally in the period of 2008–2012 there were implemented 11 Joint implementation (hereinafter – JI) 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. The main projects were 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 Mt CO_2 eq. higher (8.7 Mt instead current 7.5 M tCO_2eq.).

In 2013 the cement manufacturing company SC "Akmenės Cementas" ended modernization of technology process, when wet cement production methods were changed in to dry. This modernization allows saving the fuel consumption by half for a production unit and by quarter reducing GHG emissions i.e., to produce 1 t of clinker using the wet method 1.2 t of CO_2 is emitted and 0.85 t CO_2 is emitted by dry method This allows SC “Akmenės Cementas” to reduce GHG levels by 500 kt CO_2 eq./year.

The financial programs for implementation of climate mitigation measures

Table 2-2. The main financial programs applied to actions related with the climate change mitigation in Lithuania

No	Title	Description
1.	*Programme for Climate Change* established on 7 July 2009 by the Law on Financial Instruments for Climate Change Management with later amendments.	In 2009 the Ministry of Environment of Lithuania established Programme for Climate Change – a fund that aims to finance climate related projects in Lithuania and in developing countries. Proceeds to the Programme are gathered from the EU ETS allowances auctioning (Common EU auctioning platform). Funds are given to energy efficiency projects (for example, buildings modernisation), RES projects (for example, installation of solar energy power plants) and transport infrastructure projects (for example, purchase of eco-friendly vehicles for citizens or private companies). Proceeds from the Programme also could be dedicated to soft projects that aim to educate society about climate change, etc. Financed measures contribute to achievement of Lithuanian climate goals in achieving national RES and energy efficiency targets. Since 2011, when the

No	Title	Description
		first funds were received to the Programme, Programme generated more than 300 mln. Eur, which were mainly dedicated to energy efficiency projects (60 %), RES (25 %) and transport projects (15 %).
2.	*Lithuania's Rural Development Programme 2014 – 2020*	Lithuania's Rural Development Programme for 2014–2020 period was approved by European Commission on 13 February 2015. Programme 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 continuation of support for planting of short rotation coppices is foreseen under the sub measure "Investment to agricultural holdings" of the measure "Investments in physical assets" and biogas production from livestock holdings waste is foreseen under the sub measure "Support for production of biogas from agricultural and other waste" of the measure "Farm and business development " of the Rural Development Programme for Lithuania 2014–2020. To implement sub-measure "Support for production of biogas from agricultural and other waste" 45.2 million EUR have been allocated. In the National Rural Development Program for 2007–2013, which aimed at the improvement of life quality in rural areas by increasing employment, supporting transition from agricultural activities to non-agricultural activities, stimulating the development of main services and crafts of the rural population, financial support for rural development from the European Agricultural Foundation (EAF) was foreseen based on the following trends: increased competitiveness of agricultural and forestry sector, improvement of environment and landscape, improvement of life quality and other measures. In order to reduce water pollution, especially focussing on nitrates and other chemical elements that may have an adverse effect on public health, biodiversity, alter the traditional landscape, as well as protection of the waters of the Republic of Lithuania from eutrophication, support under the measure "Modernisation of agricultural holdings" of the Rural Development Programme for Lithuania 2007–2013 has been provided for the implementation of the Nitrates Directive in farm holdings. Also, with an aim to produce biomass as a source of energy which partially replaces imported raw materials (oil, gas, coal) and contributes to the reduction of CO_2 emissions which causes the greenhouse effect, support under this measure was granted to the planting of short rotation coppices and production of biogas from the waste of holdings. A total sum of 12.4 million EUR was allocated to the beneficiaries satisfying the requirements of the Nitrates Directive and 0.6 million EUR is paid out for short rotation coppices. There were no biogas production projects applying for support during 2007–2013. The continuation of support for planting of short rotation coppices and biogas production from livestock holdings waste is foreseen under the sub measure "Investment to agricultural holdings" of the measure "Investments in physical assets" of the Rural Development Programme for Lithuania 2014–2020. To implement this sub-measure 429 million EUR have been allocated. To fulfil EFA requirements farmers will be allowed to grow protein crops which are crucial in sustaining the nitrogen in the soil. Farmers will also be encouraged to grow protein crops by additional financial incentives available under the voluntary coupled support scheme. Under this scheme farmers will receive additional payments for the areas where selected protein crops are grown. The total coupled support for protein crops in Lithuania amounts from about 14 million EUR (about 213 EUR/ha) in 2015 to about 17 million EUR (about 254 EUR/ha) in 2019 due to external convergence of direct

No	Title	Description
		payments across the EU Member States.
3.	*The JESSICA Holding Fund*	Lithuanian Government established the JESSICA Holding Fund to offer an attractive financing scheme to support the improvement of energy efficiency in multi-apartment buildings, which were built prior 1993. At a later stage the scheme was extended to cover student dormitories and other buildings under the jurisdiction of the Ministry of Education and Science. JESSICA loan (maturity up to 20 years at fixed annual interest rate of 3%) is offered to the owners of apartments or other premises in a multi-apartment building, provided they commit themselves to implement energy efficiency measures which would result in (i) achieving at least 20% of energy savings as compared to the baseline and (ii) meeting at least the energy efficiency Class C requirements. If these targets are met, the beneficiaries qualify for a "bonus" – an interest subsidy which equals to 15% of loan principal. If these targets are met, the beneficiaries qualify for a "bonus" – an interest subsidy which equals to 15% of loan principal. At the end of 2011 the Lithuanian Parliament introduced an additional incentive to compensate additional 15% of investment cost, provided the overall calculated energy savings reach at least 30% as compared to the baseline (the Law on the State Support for the Modernization of multifamily buildings of the Republic of Lithuania amended on the 11th of October, 2011). By the amendments of the Law adopted on 17 January 2013, the municipalities are more involved in the renovation process of the multi-apartment buildings. The municipality appoints one responsible entity which may take the loan for renovation on preferential conditions. With these changes the additional incentives to compensate investment cost to citizens were introduced, the 15% of loan is compensated from State's budged and 25% from the Special Programme for Climate Change if the 40% of energy saving was reached compared with baseline. From 2005 till 2019 2 354 multi-apartments have already been renovated (under renovation 421). It is foreseen to incentivize comprehensive modernization of multi-apartment and public buildings (priority giving for the quartered renovation) and to renovate 25% of buildings stock till 2020 (2.6-3 TWh saving of energy) and 50% of buildings stock till 2030 (5-6 TWh saving of energy)
4.	*Energy Efficiency Fund*	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 provides 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. Fund manages 79.65 million EUR. Up to 65.16 million euros provided for the modernization of central government buildings and up to 14.48 million euros 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. It is planned that the Energy Efficiency Fund will operate until at least 2030.
5.	*Cohesion Policy Contribution*	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

No	Title	Description
		in which Lithuania takes part. – *Internal Energy Market:* Over 2014–2020, EU Cohesion Policy will invest some EUR 154 million in smart transmission systems, as well as some EUR 21 million in smart electricity distribution grids in Lithuania. These investments are expected to contribute to around 10 000 additional users connected to smart grids. – *Energy efficiency*: Over 2014–2020, EU Cohesion Policy will invest 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 will be invested in supporting the move towards an energy-efficient, decarbonised transport sector. These investments are expected to contribute to around 3000 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 are expected to contribute to an estimated annual decrease of GHG of around 680 000 tonnes of CO2eq. Over 2014–2020, EU Cohesion Policy will invest some EUR 330 million in renewable energy in Lithuania. These investments are expected to contribute to around 760 MW of additional capacity of renewable energy production. – *Research, Innovation and Competitiveness:* Over 2014–2020, EU Cohesion Policy will invest significantly in R&I and in SME competitiveness in Lithuania. This will be 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 this stage, at least EUR 103 million is foreseen for investments in R&I and adoption of low-carbon technologies in Lithuania, but this might increase further in line with the evolving content of the smart specialisation strategy.

2.4 National Policies and Measures in different sectors

In this sub-chapter the main PaMs 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.

As a result, in December of 2019 the Lithuania's NECP for the period 2021–2030 was prepared which includes new as well as the already implemented measures and policies which were adopted to achieve 2020 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 effects differ in separate sectors. The expert groups of different areas trough discussions determined the ex-ante effect of planned measures. These experts presented 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. As for the evaluation of fiscal measures, the external experts were involved; mostly they analyzed the other countries experiences and adjusted 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”.

2.4.1 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 (estimated at 12-14 TWh in 2020).

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 the Nuclear Power Plant (regulates the implementation of the new NPP) (2007, 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).

Renewable Energy Sources

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

In the revised NEIS the main strategic goals are to increase the share of electricity production from RES in the final electricity consumption up to 30% in 2020, 45% in 2030 and 80% in 2050:

- By 2020, the share of RES in the final electricity consumption will grow to 30% and will constitute no less than 3TWh. From the perspective of the technology development trends, it is estimated that electricity produced from wind will become the main source of RES energy and by 2020 might reach up to 44%, biomass – up to 26%, hydropower – up to 19%, energy produced in solar power plants – up to 6%, and biogas – up to 5% of all RES-generated electricity consumed.
- 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 2020, after creating a favourable investment environment, there will be at least 34 thousand electricity consumers using a prosumer scheme.
- 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:
- Up until 2020, RES consumption will continue to increase as compared to district heat consumption and in independent heating in households.
- The share of DHS RES (including waste) will be 70% by 2020 and 90% by 2030. The development of high-efficiency biofuel CHP plants will continue, non-recyclable municipal waste 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 70% by 2020 and 80% by 2030. GHG producing technologies will be replaced by clean, clean-air technologies that do not impair the quality of air.

The main objective of National Renewable Energy Resources Development Strategy, adopted on 21 June 2010 by the Government Resolution No 789 of the Republic of Lithuania, is to meet the demand of electricity in the best way in the sector of electricity, heating and transport by increase of the share of RES in the final energy balance and to reduce the import of fossil fuel and in this way to increase the energy security, energy independence and to contribute to the international efforts to reduce the emissions of GHG. This strategy foresees the minimum RES trajectory ensuring that Lithuania meets the objective of 23% of RES in the final energy consumption in 2020. The goals of this strategy are now incorporated in the revised NEIS.

The Law on Energy from Renewable Sources adopted on 12 May 2011 by the Parliament of the Republic of Lithuania, and amended in 2018. 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 23% of RES in the final consumption of energy by 2020.

The key support instruments for RES production are feed-in tariffs, also 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. Electricity produced from wind, solar, hydropower, biogas and biomass power plants with installed capacity not exceeding 30 kW was purchased at the fixed price (feed-in tariffs) which is determined by the national regulatory authority. However, in order to avoid a significant distortion of the market and reduce financial burden on consumers in 2013 the important amendments of the Law have been made, for example:

- The power of RES plant, for which the simplified requirements are applied, has been reduced from 30 kW to 10 kW.

- The frequency of feed-in tariff review for all types of renewable sources has been changed from one time per year up to four times per year.
- The rules for promotion have been changed. Feed-in tariff has been applied from the production permit date, not development permit.
- In comparison from 2012 to 2014, feed in tariffs depending on the installed capacity have decreased:
- wind power – 21-24%
- solar – 56-62%
- biomass – 38-40%.

In December 2014, the Parliament of the Republic of Lithuania 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 the main goal was set to reach no less than 38% in 2025 of the energy production from RES, compared to gross national final energy consumption, by increasing the use of the newest and most effective RES utilization technologies and enhancing energy efficiency. Additionally, 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.

The Lithuanian Law on Heat Economy was adopted in 2003 by the Parliament (Seimas) of the Republic of Lithuania and later amendments. 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.

Implementation of 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 2018, the share of RES in total final energy consumption was 25.03% or 24.21%, when taking into account the statistical transmission of energy to Luxembourg. These results were mainly determined by the share of RES in the heat sector, which accounted for 45.25%. The share of RES in electricity production was 18.41%, and in the transport sector – 4.33%.

Lithuania's intended 2030 RES target of 45% 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.

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

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 scheme93 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.
- **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, with four invitations being planned during this period.
- To **implement projects for co-generation** plants using local and renewable sources of energy, with priority given to Vilnius and Kaunas. 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 boiler will only use municipal waste left over from sorting and not suitable for recycling. The other two biofuel boilers, with a capacity of about 3 times that of the waste boiler, will use biofuels. No support was granted to the Kaunas cogeneration plant. A high-efficiency waste-fired cogeneration power plant with electrical capacity of around 26 MW will be built. Municipal waste remaining after sorting and not suitable for recycling, non-hazardous industrial waste and sludge from water treatment plants will be used. Such a capacity will allow electricity generation of around 175 GWh per year.

Table 2-3. The existing and planned measures in energy sector for promotion RES in production of electricity

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in $ktCO_2$ eq)	
				2025	2030
Promotion 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

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in $ktCO_2$ eq)	
				2025	2030
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	2021		NE	18.05
RES8. Financing solutions of installation and storage of power generation from RES, including producing consumers, RES communities	The annual increase in RES production 0.81 TWh	2021		NE	81
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

**preliminary numbers.*

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 is scheduled to end 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 2525 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 boiler will only use municipal waste leftover from sorting and recycling. The other two biofuel boilers, three times larger than the waste boiler, will use biomass.

Kaunas CHP plant was not designed to support. A high-efficiency waste-to-energy CHP plant will be installed, with an electric capacity of about 24 MW. Municipal waste remaining after sorting, non-hazardous industrial waste and sludge from water treatment plants will be used. Such capacities will allow to produce about 170 GWh of electricity per year.

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 the Republic of Lithuania and Luxembourg and/or the other Member States, planning that the first competition will be organized in 2020.

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. By 2021, it is a plan to decide on the territories of the Baltic Sea where it is appropriate to organise a tender. Until the beginning of 2022, it is a plan to hold a bid for development and commissioning. 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 planned to be 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 1944.5 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.

Existing policy measures for RES in the heat and cooling sector up to 2030:

- 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 VERT to municipal councils);
- increasing the number of new heat customers connected to district heating (DH).

Table 2-4. The existing and planned measures in energy sector for promotion RES in production of heat and cooling

Name	Objective	Implement ation year	Finance, mln. EUR*	GHG effect (not cumulative, in $ktCO_2$ eq)	
				2025	2030
Promotion RES in heat and cooling					
RES16. Installing additional RES capacities for heating Improvement	The nominal thermal capacity of the replaced equipment is 600 MW.	2018	-	NE	NE
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

Name	Objective	Implement ation year	Finance, mln. EUR*	GHG effect (not cumulative, in $ktCO_2$ eq)	
				2025	2030
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
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	0.0	NE	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	0.0	NE	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 Promoting improvement of efficiency of heat transmission network, including modernisation of relevant equipment		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	NE	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	n.d.	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 solar technologies, heat pumps and/or heat storage)	Nominal thermal capacity of the new installations: 200 MW up to 2030	2021	60	NE	87.6

Name	Objective	Implement ation year	Finance, mln. EUR*	GHG effect (not cumulative, in $ktCO_2$ eq)	
				2025	2030
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	n.d.	NO	NA

**preliminary numbers.*

RES16. Installing additional RES capacities for heating Improvement of incentive regulation enabling heat supply companies to raise funds for modernization. The nominal thermal capacity of the replaced equipment is 600 MW.

RES17. 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.

RES18. Promote the use of RES in CHP heat generation by evaluating the use of solar technologies, heat pumps and heat storage in CHP systems. The nominal heat power of newly installed equipment is planned to reach – 200 MW

RES19. 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.

RES20. 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.

RES21. 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. Promoting improvement of efficiency of heat transmission network, including modernisation of relevant equipment To renew and / or modernize the heat transmission network and its equipment / elements.

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. Promote the use of renewables and waste heat in district heating

- New biomass incinerators in district heating. In 2017, the share of RES in the district heating sector in Lithuania was already 68.7%, and in the heating and cooling sector – more than 46%. In some municipalities, coal and gas oils still used, and this measure aims at converting their heating plants into RES.

- Promote the use of RES in district heating (using solar technology, heat pumps and / or heat storage) 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.
- Promote the use of waste heat from industrial, waste or cooling energy sources in the district heating sector. Promote the use of waste heat from industrial, waste or cooling energy sources in the district heating sector. 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.

RES26. 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:

- to ensure the implementation of the EU requirements for Lithuania in the field of energy efficiency improvement by 2020, with a total savings of 11.67 TWh (primary and final energy savings), and the financing of the fulfilment of these requirements.
- 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 2.6–3 TWh of energy in the renovated multi-apartment and public buildings by 2020 and 5–6 TWh 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 2-5. The existing and planned measures in energy efficiency

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in $ktCO_2$ eq)	
				2025	2030
EE1. Higher excise and taxes for fuel consumption	Reduced use of energy by 6 TWh.	2020	0.0	NE	180
EE2. Renovation (modernisation) of multi-	Reduced use of energy 1.9 TWh and	2015	735.0	NE	168

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in $ktCO_2$ eq)	
				2025	2030
apartment buildings	later 3.6 TWh.				
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	0.0	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	0.0	NE	100
EE6. Agreements with energy companies on energy saving	Reduced use of energy 5,5 TWh	2014	0.0	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

**preliminary numbers.*

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 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 at 11.674 TWh of final energy (implementing Directive No. 2012/27/ES). This amount is equal to the sum of the amounts of energy savings achieved each year from 1 January 2014 to 1 January 2020.

Energy Efficiency Action Plan for 2017-2019 approved by Order No 1-181 of 7 July 2017 of the Minister of Energy of the Republic of Lithuania. The Action Plan describes energy efficiency improvement policies:

- taxes on fuel;
- renovation of apartment buildings;
- increasing the energy efficiency of public buildings;

- energy audits in industry;
- agreements with energy suppliers on consumer education and counseling;
- agreements with energy companies on energy saving;
- replacement of boilers in households.

Multi-apartment Building Renovation (Modernization) Programme approved by the Government of the Republic of Lithuania Resolution No 1213 of 23 September 2004, 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.

The main aim of the Programme is to reduce thermal energy use in multi-apartment buildings, built before 1993, at least by 20% by the end of 2020, i.e. estimated annual energy consumption in these buildings by the end of 2020 should be reduced at least by 1 000 GWh/year, and reduce GHG emissions by 230 kt CO_2 eq/year, compared with 2005.

Programme of Public building renovation approved in November 2014 by the Government of the Republic of Lithuania Resolution No 1328. The 2020 target set in this Programme is to renovate area of 700 000 m^2 of the public buildings by saving 60 GWh of the annual primary energy and to reduce GHG emissions by 14 kt CO_2.

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 building approximately 2 300 GWh of heat energy is used.

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 is forecasted that 5% will be reduced consumption of centralized heat 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/kgne (the EU average is 8.3 EUR/kgne).

<u>Existing policy measures in the energy efficiency sector up to 2030:</u>

- **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.
- **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.
- **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.

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

2.4.2 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 of the Republic of Lithuania (latest amendment in 2017) and replaced Long-term (until 2025) Strategy of Lithuanian Transport System Development, adopted on 5 June 2005 by the Resolution No 692 of the Government of the Republic of Lithuania. 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 areas of information society development and electronic communications, including their objectives and tasks, are analysed in 'Lithuania's Digital Agenda' – the Programme on the Information Society Development in 2014-2020 approved by Resolution No 244 of the Government of the Republic of Lithuania on 12 March 2014 'On approval of the Programme on the Information Society Development in 2014-2020 'Lithuania's Digital Agenda'. The Agenda emphasises the horizontal priorities in the area of transport and communications including the multimodality of transport, integrated urban transport, application of intelligent transport systems to all modes of transport, traffic safety and security, increase in energy efficiency in the transport sector, and development of environmentally-friendly transport.

The strategic goal of the Programme is 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 are 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 2017 the Programme was updated transposing the requirements of the Directive 2014/94/EU on the deployment of alternative fuels infrastructure.

The Programme identifies the main goals for the development of alternative fuel infrastructure:

- it is planned to install 28 public electric charging access points (high power near the road network of the "Trans-European Transport Network" (hereinafter – TEN-T) and 100 public electric vehicle charging access points (urban and suburban agglomerations with more than 25 thousand inhabitants) until 2020;
- it is planned to install 1 refueling point for liquefied natural gas (LNG) in inland waters and in port of Klaipėda;
- 1 LNG refuelling point accessible to the public for heavy-duty vehicles shall be put in place in Kaunas along the TEN-T Core Network by 2025;
- it is planned to install 1 LNG distribution system for supplying LNG fuel refuelling points until 2025;
- it is planned to install 9 publicly available refuelling points for compressed natural gas in Vilnius, Kaunas, Klaipėda, Šiauliai, Panevėžys, Telšiai, Ukmergė, Marijampolė, Elektrėnai;
- it is planned to install 10 publicly available compressed natural gas refueling points on the roads of the "TEN-T core network" near the E85 and E67 roads until 2025.

The ambitious targets for the use of alternative fuels are currently being harmonized and set out in the draft Alternative Fuels Act which is under development.

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

- **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 LNG and electrical infrastructure such as stationary units in bus fleet areas.
- **Electrification of railways.** Renewal of railway infrastructure: 814 km of railway will be electrified and account for 70% of freight carriage by rail.
- **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 2.2 billion, some of which will be funded from EU structural funds in 2021-2027.

- **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. As a result, the share of advanced liquid biofuels in total consumption will increase to 0.2% in 2022.

    - 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.

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.

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[4]. 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 fueling stations and promote clean vehicles while also ensuring renewable fuels. The target is set to reach biomethane and green hydrogen for at least 5 per cent 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.

[4] Project https://e-seimas.lrs.lt/portal/legalAct/lt/TAP/2eea182262ce11eaa02cacf2a861120c?positionInSearchResults=0&searchModelUUID=1876719a-bfd9-45af-b539-b09314895eb0

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 2-6. The existing and planned measures in energy sector for promotion the RES use in transport

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in ktCO2 eq)	
				2025	2030
Promotion 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	0.0	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	0.0	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	0.0	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	0.0	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	0.0	NE	NE

**preliminary numbers.*

- **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.

- **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%.

- **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[5].
- **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.

- **Support for the purchase of commercial vehicles fuelled by liquefied natural gas.** To grant subsidies to businesses in order to compensate the cost of purchasing vehicles for them. The plan is providing a single non-repayable flat-rate subsidy for around 1,000 vehicles per year.

- **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 of age);

- **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.

Table 2-7. The existing and planned measures in road transport

Name	Objective	Implementation year	Preliminary cost, mln. EUR*	GHG effect (not cumulative, in ktCO2 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

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

Name	Objective	Implementation year	Preliminary cost, mln. EUR*	GHG effect (not cumulative, in ktCO2 eq)	
				2025	2030
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	0	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	0	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	0	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
T10. Limitation of transport with an internal engine into defined city zones.	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	0	36.39	97.05
T11. Creation of a sustainable mobility fund	The Fund is the primary and obligatory tool for other measures	2022	0	NA	NA
T12. Renewal of transport fleet by using green public procurement for 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	0	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
T19. Support for the purchase of commercial vehicles fuelled by liquefied natural gas and other alternative fuels	Around 1000 vehicles per year planned to be subsidised.	2021	150.00	103.64	233.19

Name	Objective	Implementation year	Preliminary cost, mln. EUR*	GHG effect (not cumulative, in ktCO2 eq)	
				2025	2030
T20. Annual car pollution tax	5% of per year newly purchased gasoline and diesel cars will be replaced with zero emissions.	2023	0	200.91	401.83
T21. Vehicle reregistration fee by level of pollution	Reduce CO2 emissions by 3.5% per year.	2020	0	197.43	394.86
T22. Marking of vehicles by pollution level	Carbon labeling of vehicles, allowing more efficient implementation of other emission measurement measures, would ensure rapid identification of the vehicle group	2021	0	NA	NA

**preliminary numbers.*

Planned GHG mitigation measures in transport sectors:

- **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.

- **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.

- **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.

- **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.

- **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%

- **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 reregistered 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.

Table 2-8. The existing and planned measures in waterway transport

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in $ktCO_2$ eq)	
				2025	2030
Waterway transport					
T14. Construction of new freight ships and barges	54.5 million tonne-kilometres planned to be shifted from road to inland waterway transport	2024	33.00	3.79	13.27
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 to be used for freight transportation, stevedoring and warehousing, service of passenger ships and passengers	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. Development and implementation of a tax credit system	Establishment and application of tax incentives for inland waterway transport	2021	0.00	NE	NE

**preliminary numbers.*

- **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.

- **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.

- **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.

- **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.

- **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.

Table 2-9. The existing and planned measures in transport sector

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in ktCO2 eq)	
				2025	2030
Other 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
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	0	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	0.00	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	0.00	0.83	0.83
T30 Preparation of a comprehensive study of Vilnius City public transport (to optimise public transport lines, to adapt them to zero emission public transport) and implementation	Strategy-based optimization will reduce bus emissions by 12.64%.	2021	20.30	16.81	44.82

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in ktCO2 eq)	
				2025	2030
T31. Behaviour change to reduce fuel consumption through informing the public, formation of habits and pilot projects	Changing people's behaviour on fuel consumption will be reduced by 3.7%	2021	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	2021	0	0.42	0.94

**preliminary numbers.*

- **Support for LNG or other on alternative fuel driven truck acquisition** Provide subsidies to business companies to offset vehicle acquisition costs. It is planned to provide a one-off non-refundable flat rate subsidy; Preliminary estimate: 15,000 EUR per truck, around 1,000 vehicles per year would be subsidized.

- **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.

- **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.

- **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.

- **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.

- **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.).

- **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.

- **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.

- **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.

- **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%.

- **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.

- **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).

International transport

There is 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. The measure name is "T17. *Development and/or upgrading of inland waterway infrastructure, including ports and marinas*". 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.

2.4.3 Industrial Processes

The PaMs 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 of the Republic of Lithuania. 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 1000 EUR value added).

The Directive 2010/75/EU of the European Parliament and of the Council of 24th 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 in order 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.

On 1st of January 2015 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. The main goals of the new 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.

The Ministry of Environment has updated the existing national 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 the Republic of Lithuania 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 new 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 new 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.

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.

Existing and planned policy measures in sector of industry and industrial processes up to 2030:

- **Introduction of alternative fuels in industrial enterprises**. 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.

- **Implementation of the Regulation on fluorinated greenhouse gases.** 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>2500 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.

Table 2-10. The existing and planned measures in industrial processes sector

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in $ktCO_2$ 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	0.0	616.7	900.4
P8. Reduce F-gas use in the business enterprises (companies)	Reduce GHG emissions by 30% in the sector.	2021	0.0	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 save about 100 GWhh (by 2030 -5.5 TWh)	2021	0.0	IE (EE5)	IE (EE5)
P5. Investment and innovation incentive	Reduced profit taxes by 5% for the commercialization of R&D inventions	2018	0.0	NE	NE

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in $ktCO_2$ eq)	
				2025	2030
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 CO2 eq.	2021	24.0	0.15	0.15
P11. Implementation of modern technologies/P15the digitization of industry	GHG reduction by 20% in the sector.	2021	202.7	1.3	2.6

**preliminary numbers.*

- **Implementation of the Kigali Amendment.** 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.

- **SPI relief 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.

- **Incentives for investment and innovation.** 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.

- **The use of RES in industry (RES6/P5).** 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.

- **Reduction of the use of coal, coke and lignite.** 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.

- **Reducing the use of F-gases in businesses.** The measure is aimed at encouraging undertakings to acquire new equipment or to replace old equipment using technological alternatives other than fluorinated 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.

- **Promoting the replacement 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%.

- **Introduction and promotion of technological eco-innovation.** 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%.

- **Implementation of modern technologies.** 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.

- **Introduction and promotion of non-technological eco-innovation.** 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.

- **Promoting investment in product/packaging/service design solutions.** Encouraging companies to invest in product / service design solutions in order to increase the attractiveness of the company's products or services and thus the demand and productivity of the company. Financial support for projects to develop innovative packaging designs that reduce waste in industry.

- **Promoting the transformation of traditional industries.** 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%

- **Promoting digitisation of industry.** 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.

- **Improving energy efficiency in enterprises.** In order to improve the energy efficiency of businesses, Lithuania has planned a financial instrument that will encourage companies to implement energy efficiency improvement measures identified in the energy audit. It is planned to provide a subsidy for the energy savings achieved and to save 100 GWh annually and close to 5.5 TWh by 2030.

2.4.4 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 is preparing 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 absorption of CO_2 and emissions reduction in agriculture and forestry. This target area is to increase the carbon CO_2 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.** Number of implemented projects related to the discharge of excess water from fields in 2019 was 35 units.
- "(5D) Reducing GHand 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 farmers' 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**.

The National Forest Area Development Program 2012-2020 approved on 23 May 2012 by Resolution No 569 of the Government of the Republic of Lithuania. The goal of the Programme was to implement long-term forest economy policy that would be coherent with other sectorial policies, would be based on country specific traditions, the EU regulations, international conventions, resolutions, treaties, programmes, and to set goals and tasks for forestry sector development up to 2020. The Programme sets a strategic goal on forestry development, other forestry goals, and tasks to achieve the set goals, evaluation criteria. In the Annex the implementation evaluation criteria for the years 2011, 2015 and 2020 are set. The Programme is sought 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 people financially to plant forests in private and state-owned lands, to develop forest

regeneration on a genetic-ecological basis with selectively valuable and qualitative forest increasing matter. In 2011 the Forest Law was amended by tightening 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. In the period 2007-2013 with a financial support from Rural Development Program 2007-2013 the area of 17.2 thousand ha was afforested and additional 3.6 thousand ha were afforested in 2014.

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 waste water.

Action plan for the implementation of the Program 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 farm, 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 Oder 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 42 % increase for cereal grain crops (from 2005 to 2019) and a 17 % increase in arable land (from 2007 to 2017) 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 nitrogen fertilizer consumption in Lithuania for the period of 2005–2017 shows an approximate 44 % increase, while the consumption of organic fertilizer remained stable. Mineral fertilizer now accounts for roughly 90 % of all fertilizers' (mineral and organic combined) used.

We are also witnessing an intensification of fertilizer application in Lithuania – application of nitrogen fertilizers per ha increased by approximately 11 % from 2005 to 2017 (Figure 2-1).

As a result of those developments, increasing trends in river nitrogen concentrations are observed in agriculture dominated areas, which occupy roughly one third of Lithuania. In that region, the share of river monitoring stations with excessive nitrogen concentrations jumped from approximately 20 (in 2005) to 45 % (in 2018), with occasional spikes to 90 % (for instance, in 2017).

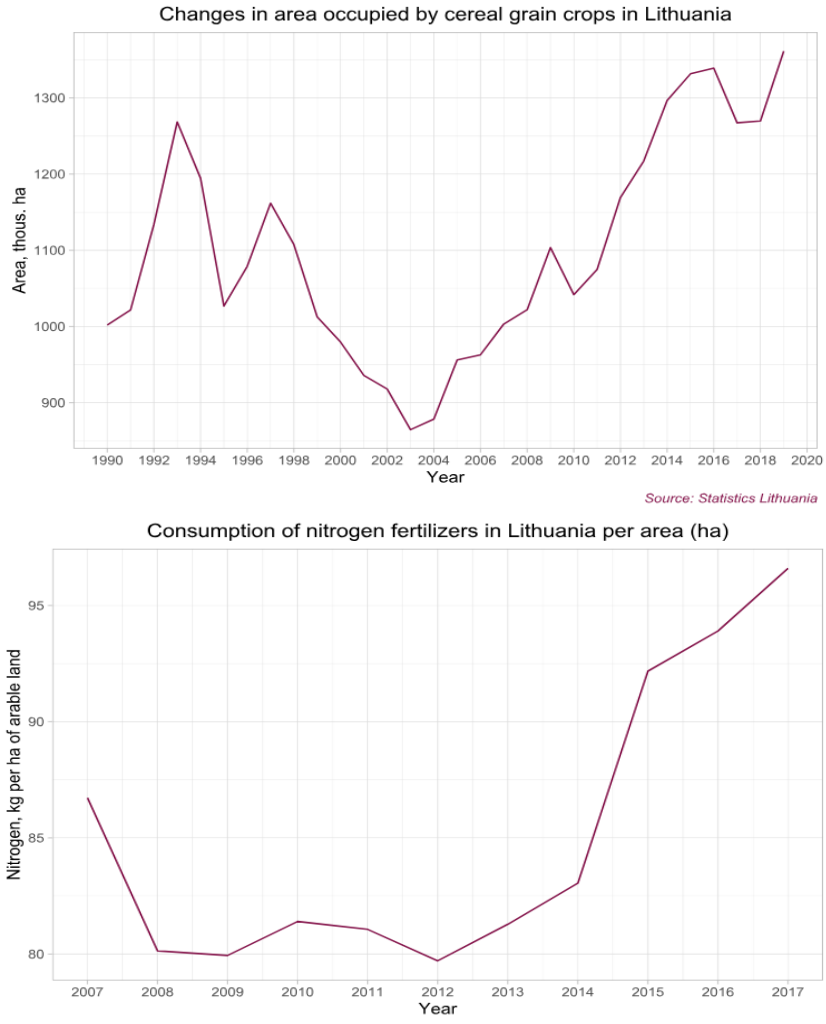


Figure 2-1. Changes in area of crops and nitrogen fertilizers consumption statistics in Lithuania

For this reason, in the agriculture sector the main focus is on the 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 CO_2 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.

Table 2-11. Existing and planned measures in the agriculture sector

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in ktCO2 eq)	
				2025	2030
A1. Implementation of Nitrates directive	Reduced water pollution and the emissions of N2O.	2014	0	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 Code of Good Agricultural Practice	2021	0	NA	NE
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	0	NA	NE
A4. Investment support for the introduction of climate-friendly farming methods in livestock farms	300 thousand m3 of pigs and 350 thousand m3 of cattle manure and slurry used to produce biogas; 300 thousand m3 of slurry is used to fertilize fields by direct application to the soil; encourage the introduction of slurry acidification technologies.	2021	108.50	35.52	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	0	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	NA	NE
A8. Balanced use of mineral fertilisers	Mineral N fertilizer consumption will be reduced by 15%.	2021	0	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	0	NA	NE

Name	Objective	Implementation year	Finance, mln. EUR*	GHG effect (not cumulative, in ktCO2 eq)	
				2025	2030
A11. Promoting of more productive, disease and climate-resilient livestock and fish breeding	To inform farmers about the possibilities to breed or purchase more climate-friendly and productive animal breeds (especially dairy cows)	2021	5	NA	NE
A12. Review of fuel consumption technological cards and excise-free fuel allocations	Reach a 20% less fuel consumption	2020	0	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	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	0	12.96	34.57
A16. Reduction of the use of fossil fuel in agriculture, forestry and fishery	Reducing fuel consumption by 5.7%	2022	0.5	2.58	5.16
		Total:	366.2	379.12	584.36

**preliminary numbers.*

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.[6]

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.

[6] Comment: 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.[7]

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); o 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%.

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.

[7] Comment: A2 and A5 measures, they have a similar goal: to reduce the overall use of N mineral fertilizers. However, the intensity of the measures is unequal. Under measure A2, we plan to pay support to farms that will reduce fertilization values by 30 percent but will not completely abandon the use of mineral fertilizers. And under measure A5, we are talking about the obligations of farms to completely abandon mineral fertilization. Accordingly, the GHG reduction value of A2 measures is lower.

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 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 thousand 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 implements 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%.

2.4.5 Land use, Land use Change and Forestry

In the land use, land use change and forestry (hereinafter – LULUCF) sector one of the main factors influencing the CO_2 absorption is the enlargement of forest area by afforestation or natural expansion of forests. *National Forestry Sector Development Program 2012-2020* approved by Resolution No 569 of the Government of the Republic of Lithuania on 23 May 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 people 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, according to the recent trend the aim might not be achieved in 2020 and it may take one or two more years to reach this goal.

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 main legal act regulating forest management is the Law on Forests No I-671 adopted by the Parliament (Seimas) of Republic of Lithuania in 1994. By the amendments of this legal act the new measures were introduced, that creates legal conditions for better preserving of forests and forest land in cases of land use change from the forestry to other use, in particular: the number of cases when it is allowed to change forest land into any other land is narrowed and prescribed precisely. The compensatory afforestation in all cases of changing forest land into any other land was established by the amendments of the Forest Law mentioned above. Aiming to promote sustainable forest and other land management and increase LULUCF sector absorption potential is set in the draft Climate Change Management Agenda, prepared by the Parliament of the Republic of Lithuania.

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 up to 34.2% by 2020 is set (Table 2-12). In addition to the measures applied in forestry, additional measures, related to agricultural land use were discussed and included in the preparation of National Energy and Climate Action Plan of the Republic of Lithuania for 2021 - 2030. Most of the measures are planned to be implemented during this decade and some of them already started (Table 2-12). During the preparation of projections measures and their scope were discussed internally in the responsible entities, therefore some of them (the extent to which the measure is applied) are different to ones described in National Energy and Climate Action Plan. Correspondingly to the changed scope of the measures, their effect to GHG emission reduction or enhance of GHG removals was also reviewed.

Regulation (EU) 2018/841 of the European Parliament and of the Council *(LULUCF Regulation*), adopted May 30th 2018, sets the rules of LULUCF sector accounting during 2021-2030 and commitments for the same period. Regulation has been prepared in order to include (to certain extent) LULUCF sector into overall European Union climate change mitigation target achievement. Commitment for LULUCF sector, set in the Regulation asks to maintain the so called “no debit” rule: “each Member State shall ensure that emissions do not exceed removals, calculated as the sum of total emissions and total removals on its territory in all of the land accounting categories referred to in Article 2” in the same Regulation. Regulation covers most of the LULUCF categories: afforested land, deforested land, managed cropland, managed grassland, managed forest land and managed wetlands (as of 2026). Regulation has provided the main rules of accounting from each accounting category, such as application average of base years’ (2005-2009) emissions and/or removals in order to account for emissions and removals from managed cropland, managed grassland and managed wetlands (as of 2026); application of reference level to account for emissions and removals from managed forest land, as well as criteria and guidance for determining forest reference level. In addition to the accounting rules set in LULUCF regulation, Regulation (EU) 2018/842 of the European Parliament and of the Council (Effort Sharing Regulation) sets rules for using the net removals from LULUCF sector as credits to cover other sectors’ GHG emission reduction target underachievement. Lithuania may use up to 6,500 kt CO_2 eq. from LULUCF sector’s accounted removals (after the “no debit” rule is met) during 2021-2030.

Table 2-12. The mitigation measures in LULUCF sector to minimize GHG emissions in forestry sector

No	Name of measure	Description	Year of implementation	Implementing entity
Increasing the national forest area *The National Forestry Sector Development Program 2012-2020* approved by Resolution No 569 of the Government of the Republic of Lithuania of 23 May 2012 is sought to increase forest coverage of the country up to 34.2% by 2020. LULUCF sector is not included into the implementation of the EU GHG emission reduction target until 2020.				

No	Name of measure	Description	Year of implementation	Implementing entity
1.	*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 hectares 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.	2014-2020	Ministry of Agriculture
2.	*Afforestation and restoration of damaged forest*	In order 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 is set to plant new economically valuable and productive as well as biological resistant forests in abandoned lands in the state's possession.	2014-2020	Ministry of Environment
3.	*Afforestation*	Afforestation actions are supported by Lithuania's Rural Development Programme 2014-2020. Afforestation is important for implementation of key environmental and social objectives of the EU policy for rural development. This measure aims for effective use of unproductive, unused and unsuitable for agricultural purpose land through support for afforestation. Increase of forest coverage strengthens ecosystems and reduces amount of carbon dioxide in atmosphere. Afforestation improves environment protection, while preventing negative environmental actions and plays significant role in climate change mitigation. In order to reach these objectives, according to this measure, support will be provided for afforestation activities in agricultural and non-agricultural land. The total budget of the measure – 47 million EUR for the programming period 2014-2020. Planned that total area of land for afforestation shall not be smaller than 5300 ha.	2014-2020	Ministry of Agriculture

Table 2-13. The summary table of PaMs adopted and planned in LULUCF sector (numeration of the measures are as of provided in National Energy and Climate Action Plan of the Republic of Lithuania for 2021 -2030)

No	Measures	Objective	Implementation period	Entities responsible for implementing the policy	GHG mitigation effect, $ktCO_2$ eq.
L1.	*Restoration of forestry potential and introduction of prevention actions*	Support restoration of forests damaged by fires and other natural disasters.	2007-2020	Ministry of Environment, Ministry of Agriculture	-
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).	2014-2020	Ministry of Agriculture, Ministry of Energy	-
L3.	*Afforestation/reforestation*	Provide support for afforestation/reforestation activities in unused land or land not suitable for agricultural use	2012-2020	Ministry of Environment Ministry of Agriculture	-2,165.9
L10.	*Redevelopment of stands and shrubs*	Redevelopment rate: 1500 ha/year	2021-2040	Ministry of Agriculture, Ministry of the Environment	-
L18.	*Promotion of cultivation of cover crops*	To encourage farmers to include cover crop in agricultural practices	2021-2040	Ministry of Agriculture	-1,747.2
				Total adopted	-3,917.1
L3.	*Afforestation and damaged forest restoration*	Provide support for afforestation/reforestation activities and restoration of degraded forest land areas.	2021-2040	Ministry of Environment	-16,805.9
L4.	*Promote the use of biomass for energy production*	Additional production of wood biofuels from logging residues	2021-2040	Ministry of Energy, Ministry of the Environment, Ministry of Agriculture	-
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	2021-2040	Ministry of Agriculture	Included under measure No. L8 (overlapping measures)
L6.	*Assessment of the possibility and potential outcome of growing perennial crops (i.e. trees*	To identify criteria and areas (agricultural area) where it is appropriate to expand the cultivation of	2021 -2040	Ministry of Agriculture	-

No	Measures	Objective	Implementation period	Entities responsible for implementing the policy	GHG mitigation effect, $ktCO_2$ eq.
	and shrubs) on agricultural land	perennial crops.			
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	2023-2040	Ministry of Agriculture	-121.9
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	2022-2040	Ministry of Agriculture, Ministry of the Environment	-1,778.7
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)	2022-2030	Ministry of Agriculture, Ministry of the Environment	Included in the measure No 3
L12.	*Promotion of planting of landscape elements at the edges of agricultural fields*	10 % of agricultural (arable land) to adapt to suit for biodiversity protection	2022-2040	Ministry of Agriculture	-
L14.	*Grants and compensations for 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	2023-2040	Ministry of Agriculture	-16,676.3
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	2021-2030	Ministry of Environment	-
L17.	*Establishment of the national emission factors (EF) 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 removals measures in the LULUCF sector	2021-2030	Ministry of Environment	-

No	Measures	Objective	Implementation period	Entities responsible for implementing the policy	GHG mitigation effect, $ktCO_2$ eq.
				Total planned	-35,382.8
				Total	-39,353.9

Additional table to Table 2-13.

Name	Objective	Implementation year	Finance, mln. EUR	GHG effect (not cumulative, in ktCO2 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		NA	NA
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	0	NA	NA
L3. Afforestation /reforestation	Provide support for afforestation/reforestation activities in unused land or land not suitable for agricultural use	2012		-1,024.26	-921.98
L4. Promote the use of biomass for energy production	Additional production of wood biofuels from logging residues	2012		NA	NA
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		Included under measure No. L8 (overlapping measures)
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	-	-
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	2022	10.00		Included in the measure No

Name	Objective	Implementation year	Finance, mln. EUR	GHG effect (not cumulative, in ktCO2 eq)	
				2025	2030
	documentation for the afforestation permit and cadastral measurements)				3
L10. Redevelopment of stands and shrubs	Redevelopment rate: 1500 ha/year	2021	20.00		NA
L12. Promotion of planting of landscape elements at the edges of agricultural fields (L11, L13 deleted)	10 % of agricultural (arable land) to adapt to suit for biodiversity protection	2021	0.00		-
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 (deleted)	It is planned that at least in 1000 ha of organic soils will not be drained.	2021	0.00	-	-
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	2021			NA
L17. Establishment of the national emission factors (EF) 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 removals measures in the LULUCF sector	2021			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

2.4.6 Waste

The ***Sustainable Development Strategy*** emphasizes that ineffective application of the 'polluter pays' principle to waste management will not lead to an effective waste management system and failure to ensure a universal, high-quality and affordable public service of municipal waste management may increase pollution by waste. The vision emphasises that a regional waste management system will be developed and primary sorting of waste will considerably reduce the flows of waste to dumpsites and increase recycling.

The National Progress Programme mentions that, with a view to rational use of natural resources, ensuring the quality of public utility services in the environmental sector would contribute to improving the quality of life. A specific objective of the programme is dedicated exclusively to the waste sector: improving water management and waste and air quality management systems. The

objective is to manage wastewater in a way that reduces environmental pollution, with attention also devoted to preventing waste generation from other economic activities, so that the volumes of waste from production and other economic activities do not grow or at least grow much slower (twice as slow) than production. The aim is to recycle or reuse as much waste as possible and to encourage the use of technologies and production methods that reduce the use of natural resources and/or prevent waste.

The Industrial Development Programme emphasises the need to encourage companies to jointly implement the principles of industrial symbiosis in the region, which enable saving of raw materials and waste reduction. It is estimated that, as a result of these measures, the proportion of recycled or otherwise utilised waste from manufacturing and other economic activities (apart from phosphogypsum waste) is likely to increase from 90 per cent in 2012 to 92 per cent in 2020.

The Law on Waste Management[8] 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[9] purpose is 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 applies to municipal, production and other economic activity waste, the organization of management and the management of such waste within the geographical territory of the Republic 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;

[8] Approved by Resolution *No VIII-787 adopted in 16.6.1998, as last amended on 1.7.2020. Source:* https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.59267/asr

[9] Approved by Resolution No 519 of the Government on 12.4.2002, as last amended on 7.4.2018 Source: https://www.e-tar.lt/portal/lt/legalAct/TAR.9945210D6571

- 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 everybody (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).

The objectives and tasks of waste prevention and their implementing measures are set out in the **National Waste Prevention Programme**[10] purpose is, upon the analysis of the current situation in the field of waste prevention, to define the waste prevention priorities, objectives and targets as well as measures for its implementation in order to ensure that, in accordance with the waste hierarchy, the highest priority in the area of waste prevention and management should be given to waste prevention, promotion of sustainable consumption and a rational use of resources and materials. The Programme sets out the waste prevention objectives, the aims and targets under the National Waste Prevention Programme 2014–2020, and the measures to achieve these aims as well as the quantitative criteria for the evaluation of the Programme, expected results and the institutions implementing the Programme.

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 have to comply with regional ones.

Ministry of Environment is currently preparing a new Program and Plan for the next (2021–2027 year) period. It is planned to merge these 2 documents into one – **National Waste Prevention and Management Plan (hereinafter – the new Plan) for the period 2021–2027.**

Currently, Ministry of Environment is carrying out an analysis of existing situation of waste prevention and management system in order to prepare the new Plan.

The analysis should consist of:

- assessment of current situation, planned and implemented measures;
- an evaluation of other EU member states experience, identification of new waste prevention measures, new waste collection schemes, the installations related with Directive 2008/98/EC requirements in order to reach the targets;
- National waste prevention and management policies, etc.

[10] *Approved by Order No D1-974 of the Minister of Environment of the Republic of Lithuania on 30.12.2016, as last amended on 29.6.2018*. Source: (https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.458655?jfwid=-wd7z7s141

After finishing the analysis, the project of the new Plan will be prepared. Adoption of the New Plan for 2021-2027 is envisaged before the end of this year.

Waste management rules[11] set more detailed requirements for waste collection, sorting, temporary storage, other waste management operations, as well as sets requirements for distributors of the products and the procedure of general waste accounting requirements.

Targets for 2030 are set **in renewed National Progress Programme for 2021-2030**[12]**. Targets could be found in 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 / mln. EUR; by 2030 – 90 tonnes of waste / mln. 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 %;
- till 2030 60 % of municipal waste has to be prepared for reuse or recycled;

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%).

Table 2-14. The existing and planned measures in waste sector

Name	Objective	Implementation year	Finance, mln. EUR	GHG effect (not cumulative, in $ktCO_2$ 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 (CH4) gas from landfills for the energy generation To incinerate waste in CHP plants	2013	0	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

[11] *Approved by Order No 217 of the Minister of Environment of the Republic of Lithuania on 14.06.1999, as last amended on 29.11.2018*. Source: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.84302/FCiMhMTBLh

[12] Source: https://www.e-tar.lt/portal/lt/legalAct/d492e050f7dd11eaa12ad7c04a383ca0

Name	Objective	Implementation year	Finance, mln. EUR	GHG effect (not cumulative, in $ktCO_2$ eq)	
				2025	2030
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		NE

Biodegradable municipal waste going to landfills

According to the Directive 1999/31/EC Article 5, the target is: not later than 15 years after the date laid down in Article 18(1), biodegradable municipal waste going to landfills must be reduced to 35 % of the total amount (by weight) of biodegradable municipal waste produced in 1995 or the latest year before 1995 for which standardized Eurostat data is available. Lithuania set the year 2000 as the starting point.

Disposed biodegradable municipal waste is directly dependent on mixed municipal waste generation and treatment. Every year a decreasing amount of mixed municipal waste is generated and disposed of in landfills without pre-treatment. Positive changes occurred since the start of operation of regional mechanical-biological treatment (MBT) facilities in 2016, when mixed municipal waste was sorted and the biodegradable part was separated and used in composting or landfill coverings. After MBT the part of the waste that is not suitable for further use or recycling is disposed of in landfills. Before that biodegradability of this waste is assessed by laboratory tests. Tests shows that most of mixed municipal waste after MBT was stabilized and does not exceed the established biodegradability parameters, therefore such waste is no longer considered biodegradable. Lithuania has already achieved the targets set in the Directive since 2013 with 36% of biodegradable waste disposed of in landfills. Moreover, from 2016 to present, the positive effect occurred with less than 5% of biodegradable waste disposed of in landfills comparing to the baseline amount of waste set in 2000.

Food waste prevention. During 2019, from all competent authorities and others institutions and associations (governmental, NGOs, charities etc.) main measures for food waste prevention, which are already in force, have been collected. Measures are related to:

- Legal regulation (amended legislation allowing safe and fit for human consumption food, fresh fruit and vegetables which do not meet market standards to be donated for charity; waste collection and treatment requirements);
- Social responsibility (information booklet for companies where they can donate excess food; Swedish table principle implementation in kindergartens, schools; promoting food collection and redistribution, etc.);
- Public awareness raising (presented and published information about “best before...” and “use by” definitions, promoting responsible consumption, waste prevention, separate collection of biodegradable waste, etc.).

As mentioned above, every year a survey regarding waste prevention and management system has been conducted. The survey showed that the positive change has been reached – the number of people who sort all waste increased (from 40 % in 2015 to 55 % in 2020).

2.5 The other legal acts

The legal framework existing in Lithuania provides conditions for relevant air pollution and air quality management. National Measures for the reduction of pollution from stationary and mobile sources and ambient air quality management are implemented according to the **Law on Environmental Protection** of the Republic of Lithuania No I-2223, approved by the Parliament of the Republic of Lithuania on 21-01-1992, as last amended on 28-01-2020, **the Law on Ambient Air Protection,** and the Law on Environmental Impact Assessment of the Proposed Economic Activity of the Republic of Lithuania No I-1495, approved by the Parliament of the Republic of Lithuania on 15-08-1996, as last amended on 26-06-2020. State control, state and economic entities monitoring performed as provided in the **Law on Environmental Protection State Contro**l of the Republic of Lithuania No IX-1005, approved by the Parliament of the Republic of Lithuania on 01-07-2002, as last amended on 26-06-2020 and the Law on Environmental Monitoring of the Republic of Lithuania No VIII-529, approved by the Parliament of the Republic of Lithuania on 20-11-1997, as last amended on 28-01-2020. The above laws provide legal prerequisites and lay down implementation mechanisms for achieving the objectives set out in the environmental policy documents, in particular the National Environmental Protection Strategy.

The following legal acts are related to GHG mitigation indirectly but also relevant:

- *The Law on Environmental Protection* regulates public relations in the field of environmental protection, establishes the principal rights and duties of legal and natural persons in preserving the biodiversity, ecological systems and landscape characteristic of the Republic of Lithuania, ensuring a healthy and clean environment, rational utilisation of natural resources in the Republic of Lithuania. The Law sets the principles of environmental protection, one of which is that the environmental protection policy and its practice must direct public and private interests towards the improvement of the quality of the environment, encourage the users of natural resources to seek the ways and means to avoid or reduce adverse effects on the environment, and to make production ecologically safe. The Law sets the principles and measures for a system for regulating economic activities, monitoring the status of the environment and limiting negative impacts on the environment, economic environmental measures and a system of state environmental inspection and legal liability. This is the main act that is followed in adopting other laws on environmental protection.
- *Law on Ambient Air Protection* (1999, with later amendments) is the main legal act harmonizing the general requirements in the area of air protection with those of the EU establishing the fundamental requirements for ambient air quality assessment and management, and setting out the principles regulating ambient air pollution from mobile sources in Lithuania.
- *Law on Environmental Monitoring* (2006, with later amendments) sets the fundamental principles of environmental monitoring in Lithuania. The Law requires continuous and systematic observation of the state of the natural environment and its elements in the territory of the Republic of Lithuania, systematization, evaluation and forecast of the spontaneous changes and the changes caused by an anthropogenic impact occurring in the natural environment, tendencies of changes in the natural environment and possible consequences. Information concerning the state of the natural environment required ensuring sustainable development, adoption of decisions regarding territorial planning and

social development, for scientific and other needs are to be accumulated, analysed and provided to state institutions and the public.

3. Methods for evaluation PaMs effects

Lithuanian institutions in 2018-2019 focused on the implementation of the 2030 Energy and climate targets. NECP document includes new as well as the already implemented measures and policies which were adopted to achieve 2020 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 trough discussions determined the ex-ante effect of planned measures. These experts presented 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. 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”.

Energy sector

Lithuanian energy agency evaluated the development of energy sector and provided fuel balances for WEM and WAM scenarios. These scenarios were calculated in this way and GHG reduction was not estimated for separate PaMs.

Transport

We present following main parameters and effect evaluation strategies considered in transport sector. The measure code is 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 CO2/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 MoA and GHG estimation methods provided in the 2006 IPCC 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.

IPPU sector

In the IPPU sector the impact of existing measures (P2) has been assessed in the light of existing legislation: Regulation of Fluorinated Greenhouse Gases (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: without measures, with existing measures and with planned measures. Scenario without measures 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 P8-10 were calculated based on foreign literature and experience of other countries.

Waste sector

The mitigation impact of the measure 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 Good Practice Guidance for National Greenhouse Gas Inventories, Vol. 4 Agriculture, Forestry and Other Land Use, in line with annual National Greenhouse Gas 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.

We did not evaluate the so-called „soft“ measures which are considered as educational or informational, to evaluate these types of measures the sociological research should be conducted and is quite expensive and time-consuming. However, we have to include these types of measures because the education of people 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 has 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 biggest problems 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 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. GHG Projections

4.1 Energy

4.1.1 Overview of the Energy sector

Many factors had influenced changes of energy consumption in Lithuania: 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, decommissioning of Ignalina Nuclear Power Plant (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 (9.68 Mtoe). In 1991-1994 final energy consumption decreased approximately by 2.1 times (Figure 4-1). The final energy consumption was increasing during the period 2000-2008 by 4.0% per annum, and in 2008 it was 212.1 PJ (5.1 Mtoe) (Statistics Lithuania, 2004-2018). During this period the final energy consumption was increasing in all sectors of the national economy.

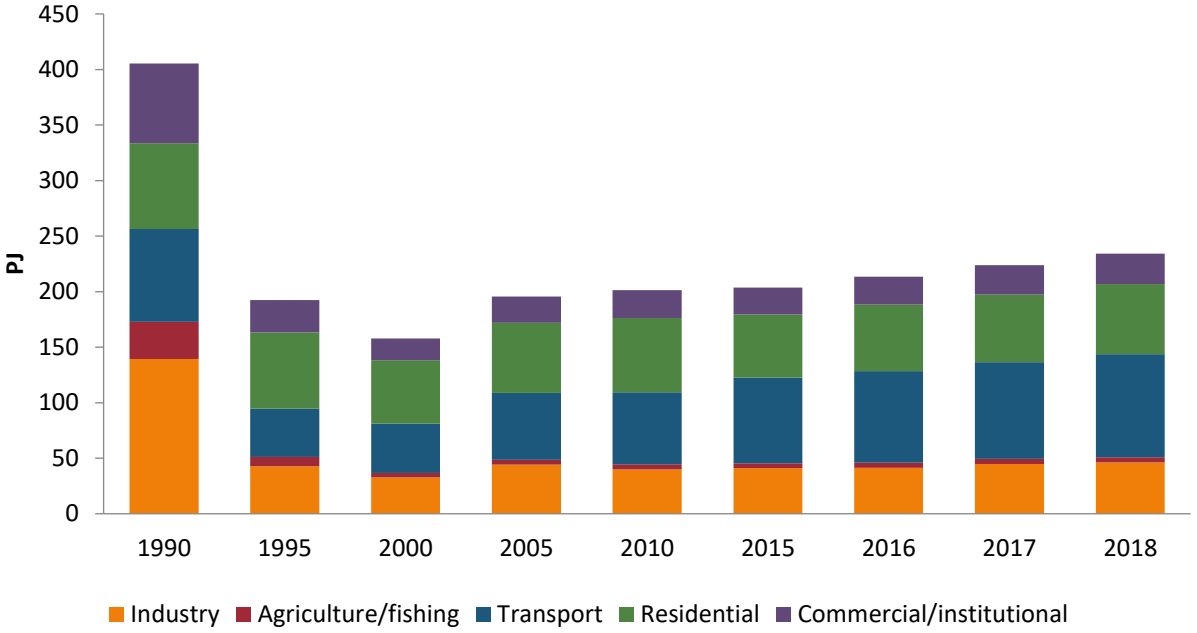


Figure 4-1. Final energy consumption in Lithuania[13]

In 2009, total final energy consumption was smaller by 9.4% than in the previous year, and the most severe impact of the economic recession was in the construction sector where energy consumption decreased by 34.9%. Energy consumption decreased in the transport sector by 18.5%. As a result of recovering Lithuanian economy, final energy consumption increased by 3.5% in 2010. During 2011-2015 the final energy consumption remained rather stable, but it was increasing by 4.8% per annum during 2015-2018. This increase was mainly influenced by energy demand increase in transport sector. In 2018, the final energy consumption amounted to 234.2 PJ (5.6 Mtoe).

[13] National Greenhouse Gas Inventory Report 2021 of the Republic of Lithuania (NIR 2021).

CO_2 emissions contribute about 95% of total energy sector GHG emissions CO_2 eq. in 2018. Total GHG from the energy sector have decreased by almost 3 times from 33 122.5 kt CO_2 eq. in 1990 to 11 877.5 kt CO_2 eq. in 2018 (Figure 4-2).

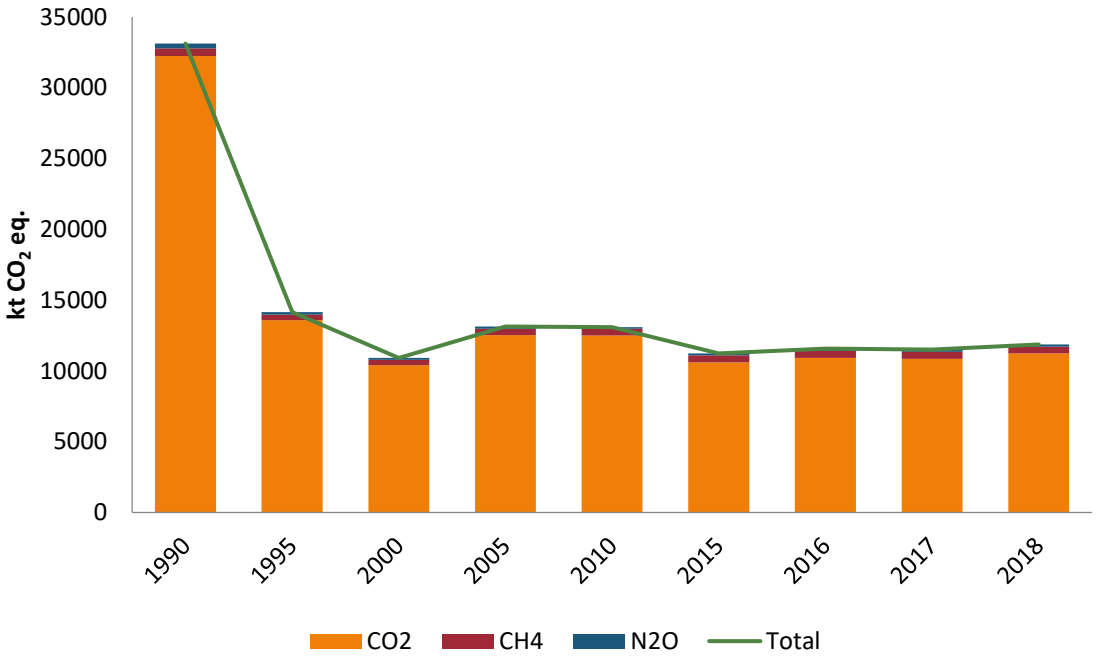


Figure 4-2. Energy sector's total GHG emissions in kt CO_2 eq.

A significant decrease in emissions was mainly due to the economic slump in 1991-1994. During the fast economic growth over the period 2000-2008, GHG emissions in the Energy sector increased by about 2.5% per annum. The global economic recession impacted GHG reduction by 8.9% in 2009. The closure of Ignalina NPP and the increase in GDP raised GHG emissions by 8.1% in 2010. In 2011, total GHG emissions in the Energy sector decreased by 6.5% due to a 22.4% decrease of GHG emissions in the public electricity and heat production sector. There was a noticeable increase in electricity import from neighboring countries, the use of renewable energy sources, and natural gas. The level of total GHG emissions in the Energy sector in 2012 remained almost the same as in 2011. In 2013, total GHG emissions decreased by 5% and in 2014 by 3.3% due to the high share of electricity import and use of renewable energy sources. In 2015, total GHG emissions remained almost the same as in 2014. In 2016, total GHG emissions in the Energy sector increased by 3% due to the increasing GHG emissions in the transport sector. In 2017, total GHG emissions in the Energy sectors remained almost at the 2016 level and in 2018 again increased by 3.2% due to the increase in the transport sector.

4.1.2 Methodologies and key assumptions

Energy sector constitute 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 the Chapter 4.2.

4.1.2.1 Scenario "with existing measures" (WEM)

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 in order 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 is based on statistical data reflecting the current energy consumption situation and specific assumptions influencing the energy consumption projections (such as direct energy efficiency improvement measures, energy efficiency improvements, fuel switching, measures to promote changes in consumer behaviour, technological trends observed in the market, etc.). The model is controlled by Lithuanian Energy Agency.

It is projected that fuel demand for house heating will decline due to the increased energy efficiency and renovation of residential and public buildings.

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” include 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.

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 30% by 2020, 45% by 2030 and 80% by 2050.
- National Energy Independence Strategy determines the target to reduce energy intensity by 1.5 time 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.
- Additional biofuel CHP unit is planned to enter into operation in Vilnius in 2022. 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 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 biofuel for heat energy generation – these assumptions were incorporated in the calculation of final fuel used in Lithuania.
- 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.
- 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.
- Promoting use of RES in district heating sector (by using biofuel, solar energy technologies, heat pumps and/or heat storage).

- Installing additional RES capacities for heating. 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.
- Renovation of apartment buildings. Renewed in 2014, this measure it 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.
- 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.
- Consumer education and consulting (by energy suppliers). Since 2017, energy suppliers have to make agreements with Ministry of Energy of the Republic of Lithuania 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.
- 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.
- Agreements with energy companies on energy saving. Since 2017, energy companies have to make agreements with on the energy saving Ministry of Energy of the Republic of Lithuania. 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.

4.1.2.2 Scenario “with additional measures” (WAM)

The main additional (WAM scenario) measures to increase energy efficiency, which will reduce energy consumption in the period 2021-2040, 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 in the period of 2021-2040, 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.

4.1.3 Projections of GHG Emissions

4.1.3.1 Scenario “with existing measures” (WEM)

This chapter will overview the projected GHG emissions results in energy sector according to scenario with existing measures.

As was mentioned before the GHG emissions in energy sector was determined by firstly estimating the consumption of fuel in energy consumption sectors. The projected primary energy consumption is presented in Figure 4-3.

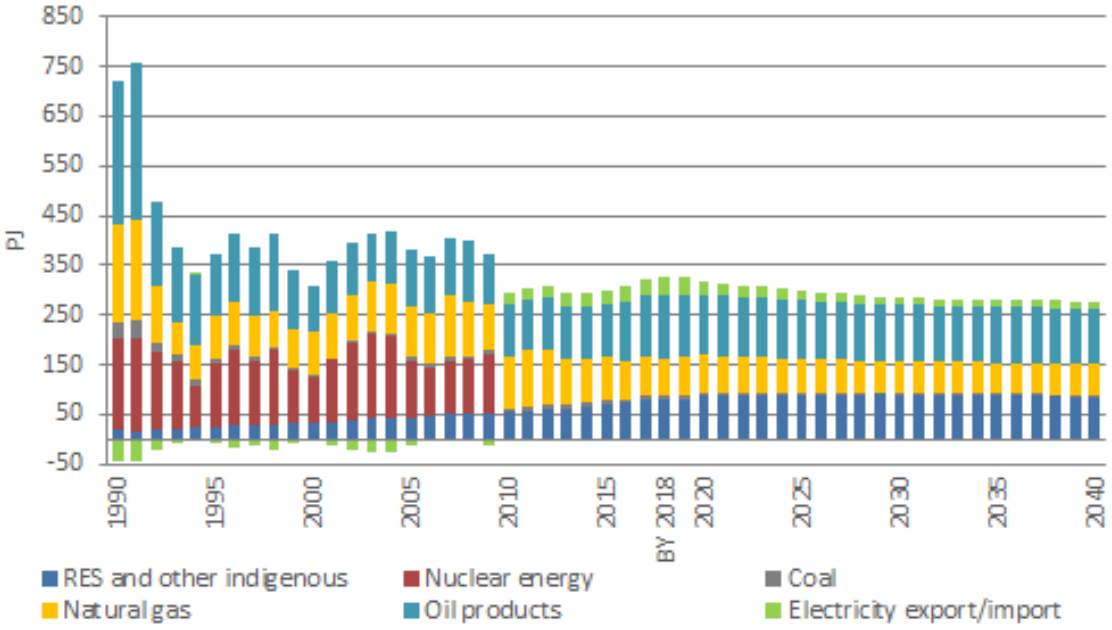


Figure 4-3. Primary energy consumption in Lithuania

It is estimated that the total primary energy consumption will decrease by 12% up to 2040 compared to 2018. Oil products shall remain the main energy source (43%), followed by RES and other indigenous energy (29%) and natural gas (22%).

The decrease in primary energy consumption is mainly associated with improving energy efficiency and decreasing Lithuania's population. It was assumed that the annual population reduction rate would be 1.2% until 2030 and 0.6% after that.

The share of each energy subsector in total, projected GHG emissions is presented in Table 4-1. It is estimated that petroleum refining, manufacturing industries and residential sectors will remain the primary sources of GHG emissions in the energy sector. Emissions in public electricity and heat production would reduce almost three times and not belong to the primary sources.

Table 4-1. Projected GHG emissions from energy subsectors, kt CO_2 eq

Sector	BY 2018	2020	2025	2030	2035	2040
Public Electricity and Heat Production	1078.7	988.6	555.3	382.5	379.9	377.1
Petroleum Refining	1314.5	1192.7	1159.9	1346.8	1345.5	1345.5
Manufacture of Solid Fuels and Other Energy Industries	54.6	55.7	55.7	55.7	55.7	55.7
Manufacturing industries	1264.4	1280.1	1240.5	1180.5	1186.9	1187.3
Commercial/Institutional	375.20	327.49	322.89	315.38	309.90	304.51
Residential	944.96	900.18	880.63	877.68	867.47	855.80
Agriculture/Forestry/Fishing	223.94	234.43	222.07	222.29	222.82	223.36
Fugitive emissions from fuels	522.74	458.23	414.56	426.41	416.56	416.39

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 78.9% 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 energy sector starting from 1990 and the projected emissions up to year 2040 are presented in Figures 4-4 and 4-5.

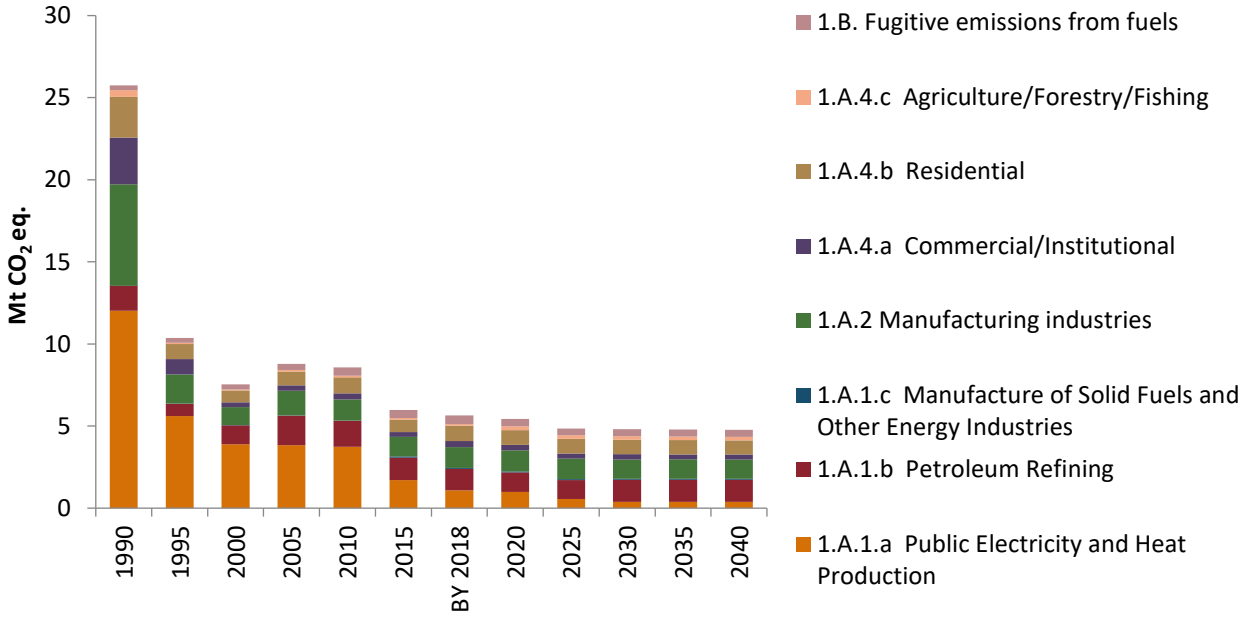


Figure 4-4. Historical and projected GHG emissions 1990-2040, kt CO_2 eq. (excluding transport sector)

It is estimated that the overall GHG emissions from energy sector (not taking into account the transport sector) will decrease by 81.5% in 2040 compared to 1990. Figure 4-5 shows the share of GHG emissions from each energy subsector in 2040.

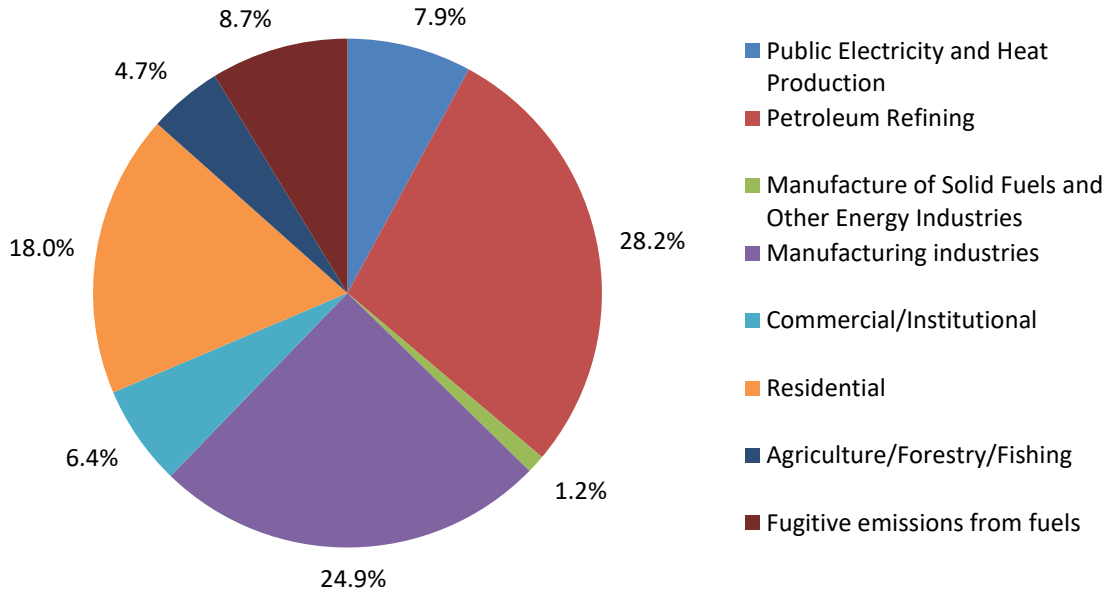


Figure 4-5. Estimated GHG emissions share by sectors in 2040

GHG emissions are estimated to reach a total of 4 765.61 kt CO_2 eq. in 2040. Most of the GHG will originate from Petroleum refining (28.2%), Manufacturing industries (24.9%) and Residential sector (18%). Manufacture of Solid Fuels and Other Energy Industries sector is still expected to remain the smallest GHG emitter of energy subsectors.

An interesting situation is expected to be 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 biomass. The same trends are seen in other energy and industry sectors. Emissions in the public electricity and heat production sector shall also reduce up to 2023 due to the building renovation program. Two new waste-fuelled CHP's started operation in Vilnius and Kaunas – in 2021 and 2020, respectively. It reduces electricity imports for Lithuania but increases GHG emissions in public electricity and heat production as about half of municipal waste is a fossil fuel. The current GHG projections assumed that the EU ETS carbon price would slightly increase to 30 EUR/tonne CO_2 in 2030 and then up to 53 EUR/tonne CO_2 in 2040. However, carbon price is assumed not to do any impact for GHG emissions, except for EU ETS companies in pipeline transportation and commercial/institutional subsectors (less than 10 kt in total in 2018 and in 2019). Possible impact of carbon price on GHG emissions from the EU ETS sectors will be further investigated in sensitivity analysis chapter.

4.1.3.2 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.

Assessing the impact of additional PaMs in energy sector, it is important to emphasize the main foreseen large jump of installed power in installations using RES – 700 MW of installed power will be built in the period of 2025–2035 for off-shore wind power plants which will generate about 20.1 TWh of electricity up to 2040 and significantly increase RES share in electricity production.

The emissions from energy sector for WEM and WAM scenarios are provided in the table and figure below.

Table 4-2. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	2020	2025	2030	2035	2040
WEM scenario	5 437.38	4 851.51	4 807.27	4 784.71	4 765.61
WAM scenario	5 417.34	4 714.61	4 526.71	4 493.77	4 461.47
Difference	20.04	136.9	280.56	290.94	304.14
	0%	3%	6%	6%	6%

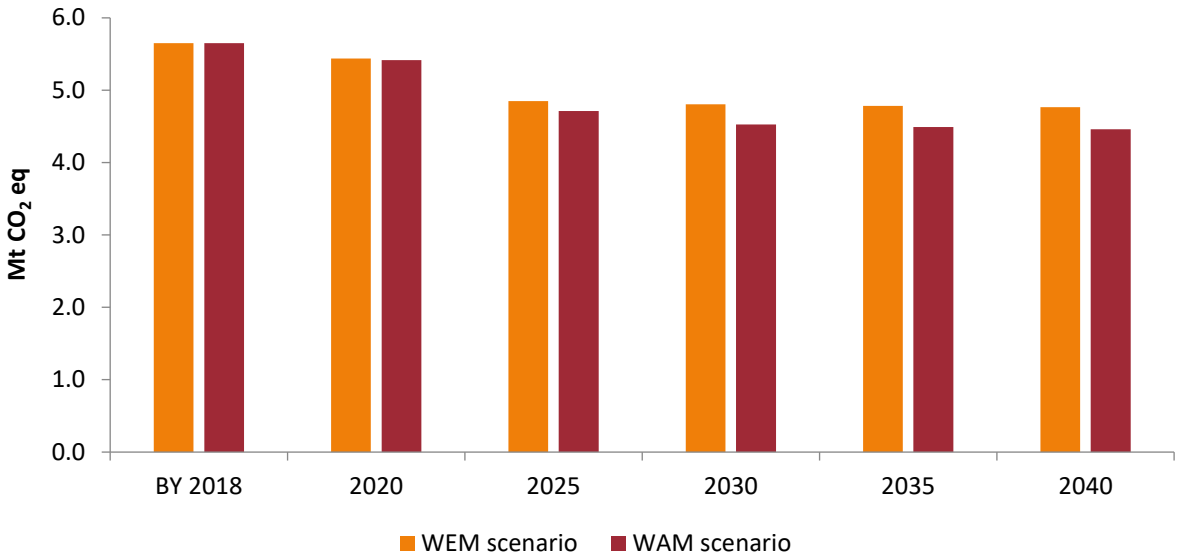


Figure 4-6. Projection of the WEM and WAM scenarios in energy sector

4.2 Transport

4.2.1 Overview of the Transport sector

Transport sector is the most important contributor to national GHG emissions in Lithuania. In 1990 transport sector accounted for 5 816.3 kt CO_2 eq. of the total national GHG emissions. In 2018 it amounted for 6 097.5 kt CO_2 eq. GHG emissions. Transport sector share in total GHG emissions increased from 1990 to 2018 by 18.1% and the overall emissions from this sector increased by 4.8%. This increase was mainly caused by the rapid increase of the density of transport routes and the number of road vehicles (Figure 4-7).

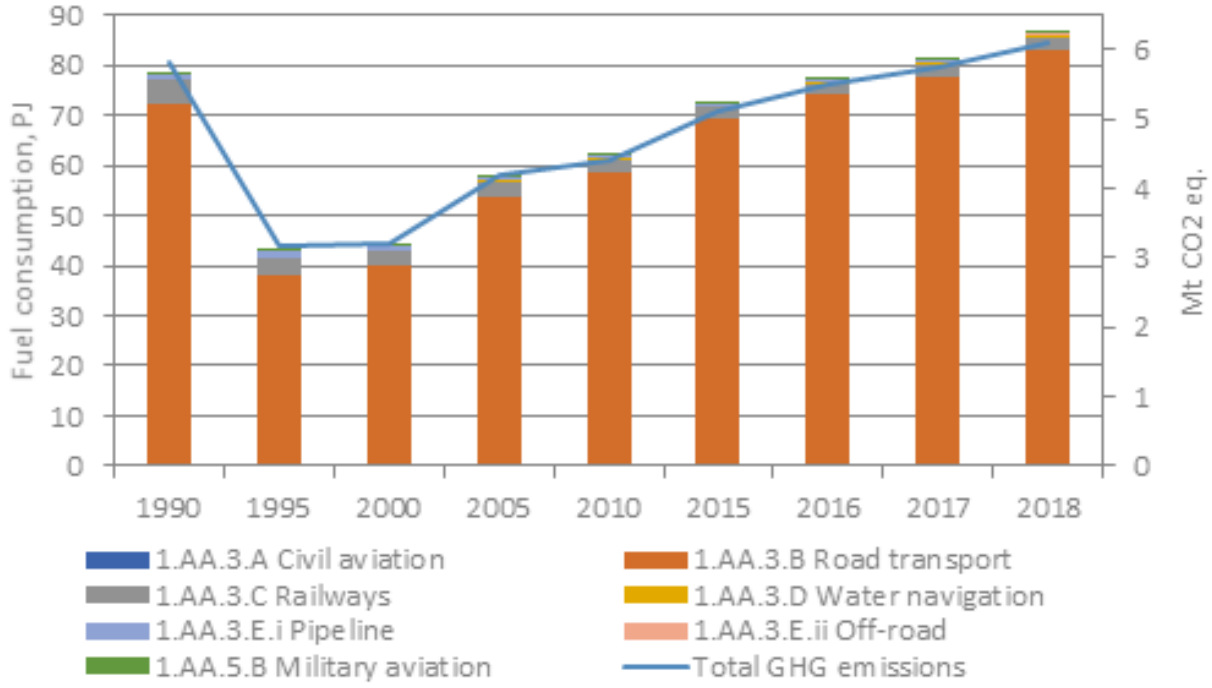


Figure 4-7. Fuel consumption and GHG emissions trends in transport sector

GHG emissions decreased significantly from 1990 to 1995 because of the decline in fuel consumption (Figure 4-7). Once the economy started to grow, emission increased but this was partly compensated by the reductions achieved through energy efficiency and measures taken to reduce emissions.

GHG emissions and fuel consumption in transport sector are distributed into 6 main subsectors:

- *Civil aviation*. This subsector includes jet and turboprop powered aircraft (turbine engine fleet) and piston engine aircraft.
- *Road transportation*. This subsector includes transportation on roads by vehicles with combustion engines: passenger cars, light duty vehicles, heavy duty vehicles and buses, mopeds and motorcycles.
- *Railways*. This subsector includes railway transport operated by diesel locomotives.
- *Water-borne navigation*. This subsector includes merchant ships, passenger ships, container ships, cargo ships, technical ships, tourism ships and other inland vessels.
- *Other transportation*. This subsector includes transport of gases via pipelines and off-road transport used in ports for loading ships, various cranes and other means of transport.
- *Other*. This subsector includes military activity.

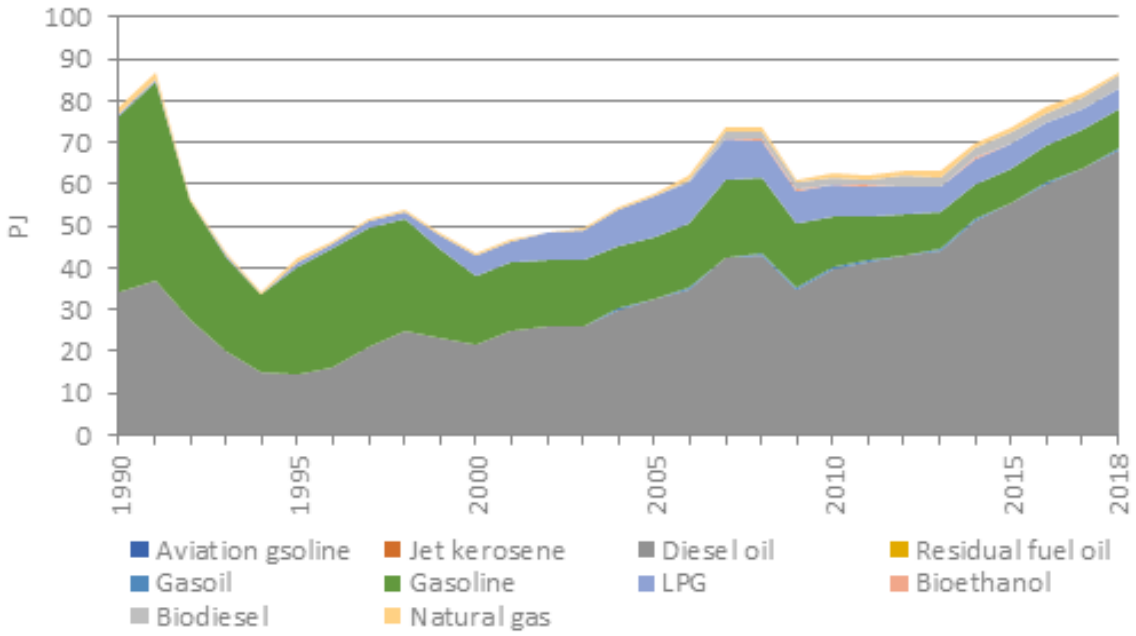


Figure 4-8. Fuel type share in total fuel consumption in transport sector

The main GHG emissions' contributor in transport sector is the road transport subsector. In 2018 this subsector accounted for 95.3% (5 811.5 kt CO_2 eq.) of total GHG emissions from transport sector. During the period 1990-2018 diesel oil and gasoline were the main two fuel types combusted in the transport sector (Figure 4-8).

4.2.2 Methodologies and key assumptions

The projections were carried out by firstly determining the consumption of each fuel type in every subsector (Civil aviation, Road transportation, Railways, Water-borne navigation, other transportation) up to the year 2040. As the GHG emissions are directly linked to the fuel consumption through specific fuel emission factors, knowing the fuel consumption during the specific time period would enable simplified calculation of the GHG emissions.

4.2.2.1 Scenario “with existing measures” (WEM)

The scenario “with existing measures” include 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 2018-2040.

The Ministry of Transport and Communications of Republic of Lithuania provided the required activity data for the estimation of projections in the transport sector. As the anticipated fuel consumption data was provided for 2020 and in 10-year intervals thereafter, the data for specific year in these intervals was linearly interpolated according to the anticipated fuel consumption change and the statistical data on fuel consumption in 2018. 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 the jet fuel is used in airlines, military aircraft and other large aircraft. The anticipated fuel consumption for aircrafts used for civil international flights is provided in Table 4-3.

Table 4-3. Anticipated fuel consumption in international aviation, t

Fuel type	BY 2018	2020	2025	2030	2035	2040
Aviation gasoline	0	0	0	0	0	0
Jet kerosene	117 749	33 976	102 871	127 718	133 403	139 087

The military aviation activity 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 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 since base year.

Projection of GHG emissions in railways subsector was carried out by using data received from the Ministry of Transport and Communication. The data provided by the Ministry is shown in Table 4-4.

Table 4-4. Anticipated fuel consumption in railways subsector, TJ

Fuel type	BY 2018	2020	2025	2030	2035	2040
Diesel oil	2 558	2140	1487	834	810	785
Biodiesel	79	70	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 2018 the GHG emissions from domestic navigation accounted for 14.9 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 Communication, 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. 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 November2012 by the Parliament Decree No XI-2375.

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 5 811.5 kt CO_2 eq. in 2018.

GHG emissions from Road transport calculation was based on the change of vehicle number (PC, LCV, motorcycles and buses) and the change of tonne-kilometres (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 from 2018 up to 2040. A projected number of cars were 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 power source and their kilometrage in base year, a forecast of the breakdown of the passenger car fleet and kilometrage and by power source and by existing and newly bought cars was calculated by the model. The obtained kilometrages were then combined with fuel consumption per kilometre and GHG emission factors to produce projected emissions. Fuel consumption per kilometre was assumed to be 20% lower for newly bought cars. For heavy duty vehicles, base year (2018) emissions were separated into two parts (cargo vehicles and buses) considering numbers of these vehicles in base year. GHG emission projections from cargo vehicles were created proportionally to the growth of the projected tonne-kilometres 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 2014-2020, continued up to 2030) provided funding for acquisition of environmentally safe busses. 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 in the points of sale will have to contain not less than 10% of biofuel (it is not obliged to blend biofuel into gasoline of A98 class) and diesel oil will have to contain not less than 7% of biofuel from 2020. Considering that biofuel is blended by percentage of volume, there is an assumption that when share of bioethanol blended is increased from 5 to 10%, overall amount of bioethanol blended in gasoline by energy value contains no more than 7%. Accordingly, 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 railway 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 will be during the first two years of its implementation (2021-2022) and the GHG reduction in road transport should reach 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 energy sector.

4.2.2.2 Scenario “with additional measures” (WAM)

Additionally, according to scenarios in data provided by the Ministry of Transport and Communication of the Republic of Lithuania, 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 “Construction of new cargo vessels and barges” and “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, and this can be seen in Annex XXV Table 1a when comparing the scenarios from year 2024 (the year of the beginning of the implementation of these measures).

Comparing 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 natural gas use and electrification. Due to the additionally increased demand of natural gas in road transport, GHG emissions from natural gas transportation in pipelines in WAM scenario are higher than in WEM scenario.

The measure “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 covers 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 poor 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 “Promoting the use of electric vehicles and developing the recharging infrastructure” and

“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 charge 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.

4.2.3 Projections of GHG Emission

4.2.3.1 Scenario “with existing measures” (WEM)

This chapter will overview the projected GHG emissions results in transport sector according to scenario with existing measures.

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 Ministry of transport and communication of Lithuania. This number of cars is anticipated without measures adopted from late 2019 to early 2021, 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 4-9). 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 4 486 kt CO_2 eq. in 2040 (Figure 4-9). Compared to 2018 the GHG emissions from this sector will decrease 1.36 times. The decrease of GHG is mostly stipulated by the implementation of existing GHG reduction measures and by decreasing population.

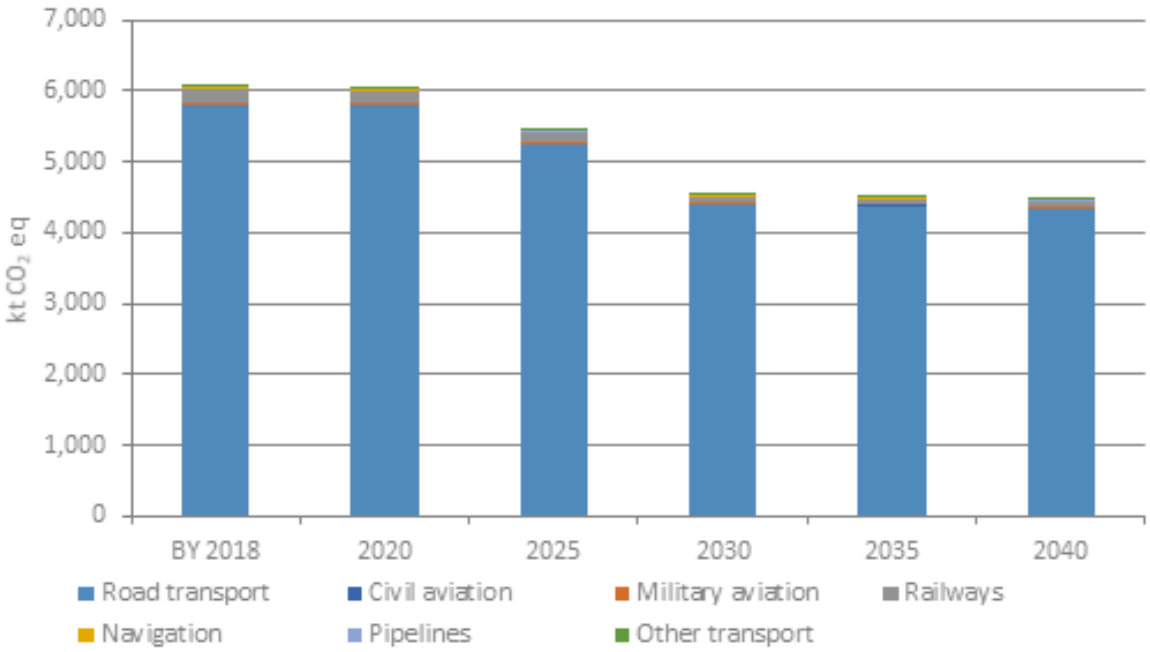


Figure 4-9. Projected total GHG emissions in transport sector

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 by 9%, but this sector will remain a minor source of GHG emissions as there are only 7 aircraft operators[14] that have valid licence issued to perform air communication in Lithuania. Most of the flights performed by the Lithuanian aircraft operators are international.

Railway sector is projected to emit less amounts of GHG in 2040 (63.9 kt CO_2 eq. – decreased by 69% compared to 2018). This is because the data provided by the Ministry of Transport and Communications suggests that the fuel consumption in railways would decrease by 69.3% influenced by electrification of railways.

Transport sector is less affected by the EU ETS carbon price as in current situation only aviation, navigation sectors 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[15] only one aircraft operator was not considered as small emitters in 2019 (emitted 20 205 t CO_2 per year).

4.2.3.2 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 ones powered by alternative

[14] Lithuanian transport safety administration data: https://ltsa.lrv.lt/lt/veiklos-sritys/civiline-aviacija/licencija-oro-susisiekimui-vykdyti

[15] European Organisation for the Safety of Air Navigation https://www.eurocontrol.int/

sources (electricity, LNG), also on fuel-efficiency (public transport, etc.). Annual car pollution charge will have the largest effect for GHG emission reduction.

The emissions from transport sector for WEM and WAM scenarios are provided in the table and figure below.

Table 4-5. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	2020	2025	2030	2035	2040
WEM scenario	6058.34	5454.08	4553.51	4525.45	4486.09
WAM scenario	6058.34	5007.24	3357.62	3030.07	2711.05
Difference	0.00	446.84	1195.89	1495.38	1775.04
	0%	8%	26%	33%	40%

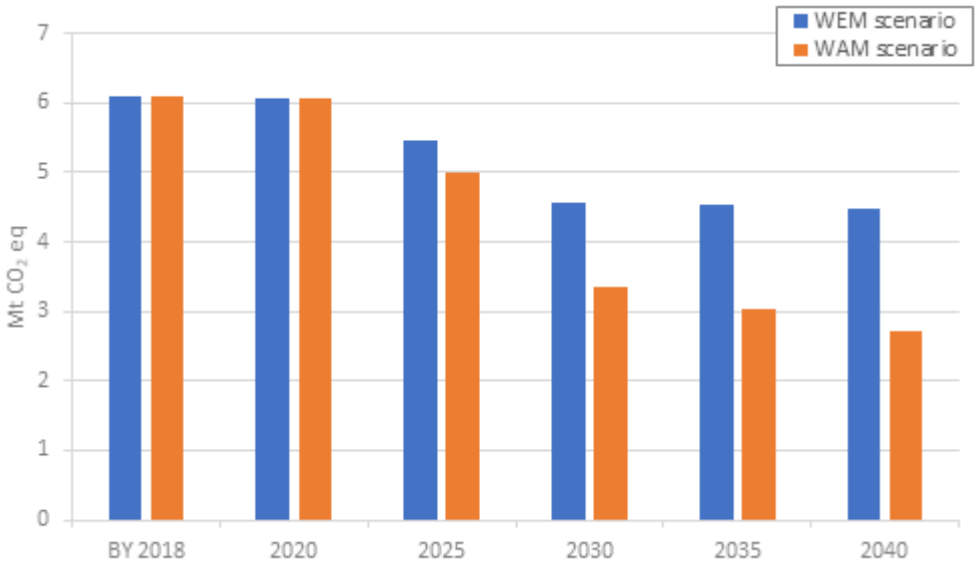


Figure 4-10. Projection of the WEM and WAM scenarios in transport sector

4.3 Industrial processes and product use

4.3.1 Overview of the industrial processes and product use sector

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, the industry consists of four activities: manufacturing; extracting (mining and quarrying); supply of electricity, gas and steam; supply of water, sewerage, waste management and remediation activities. After the economic recession in the early 1990s, Lithuania's industrial production and the economy started to grow, as reflected by the GDP growth. Lithuania was struck by the global economic crisis causing a significant reduction in industrial production in 2009. From 2010 the country economy started to recover, which led to an increase in the industrial production (Figure 4-11).

Dominating industry in Lithuania is manufacturing. Manufacturing constituted 92% of the total industrial production (excluding construction) in 2018.

In 2018 four most important subsectors within manufacturing cumulatively produced 64% of production:

- Manufacture of food products and beverage (23%);
- Manufacture of refined petroleum products (17%);
- Manufacture of wood products and furniture (14%);
- Manufacture of chemicals and chemical products (10%).

GHG emissions from industrial processes and product use (IPPU) amounted to 15.6% of the total GHG emissions (excl. LULUCF) in 2018, totalling 3 184 kt CO_2 eq. Emissions from IPPU include CO_2, N_2O and fluorinated gases (F-gases – HFCs, SF_6 and NF_3) emissions. Emissions of total GHG from the industrial processes and product use sector have decreased from 4 460 kt CO_2 eq. in 1990 to 3 184 kt CO_2 eq. in 2018 (Figure 4-12).

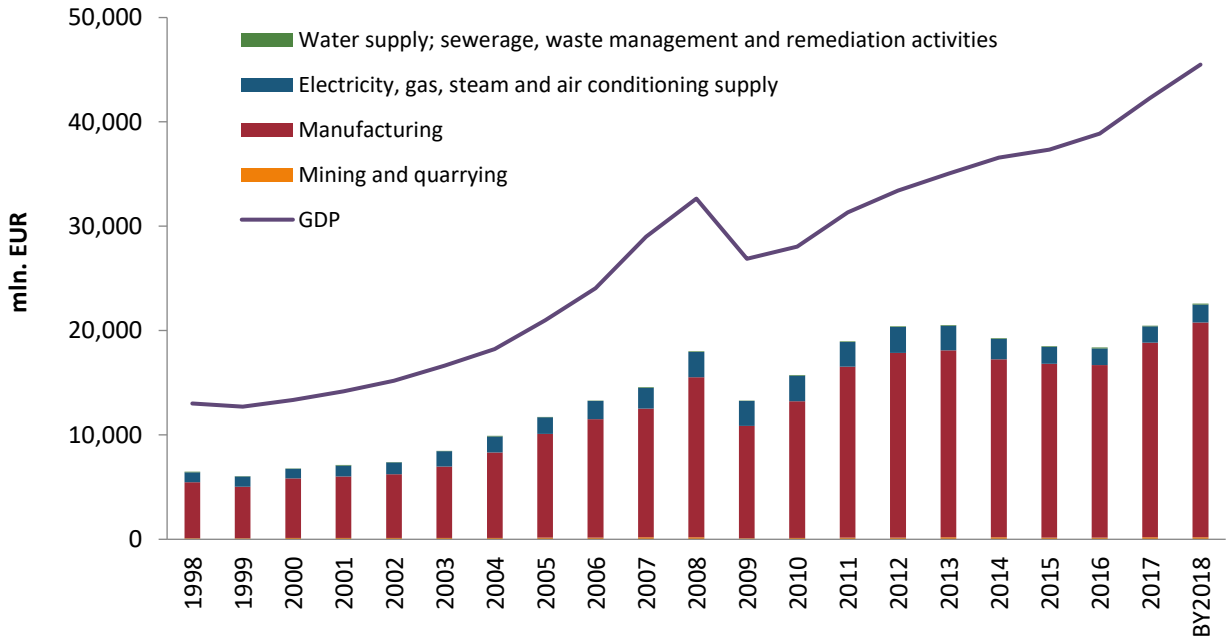


Figure 4-11. Industrial production (except construction) and GDP during production at constant prices[16]

[16] https://osp.stat.gov.lt/statistiniu-rodikliu-analize#/

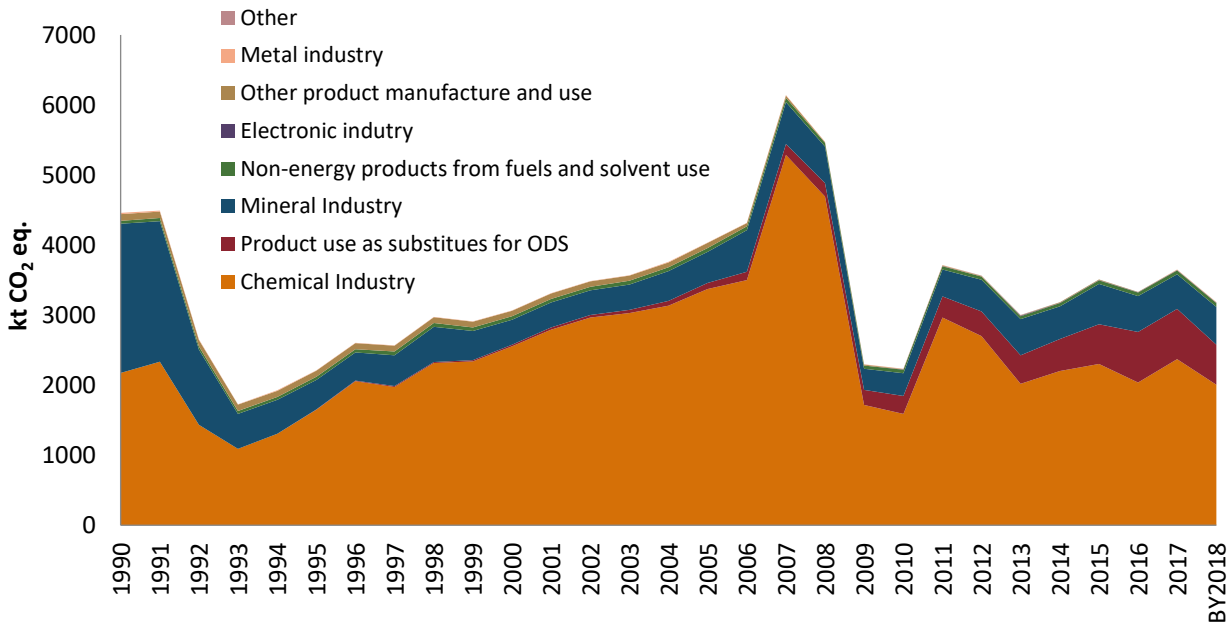


Figure 4-12. GHG emissions in Industrial processes and product use sector in 1990-2018

Main sources responsible for the highest emissions in IPPU sector are ammonia production (CO_2), nitric acid production (N_2O), cement production (CO_2) and F-gases use in refrigeration and air conditioning equipment (HFCs).

Emissions of chemical industry in 2018 were 2 003 kt CO_2 eq., and it was 63% of IPPU sector emissions. CO_2 emissions from ammonia production contributed 13 % to the total national CO_2 emissions (excl. LULUCF) in 2018. 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 2017 ammonia production decreased by 16 % and CO_2 emissions decreased by 15 % in 2018.

Nitric acid production is the main source of N_2O emissions in the IPPU sector. Nitric acid is produced in a single company and accounted for 6% in the total national N_2O emissions (excl. LULUCF) in 2018. 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 till 2010 and started to increase because of the increase of production capacity. From 2011 emissions began to decrease because the project (Nitrous Oxide Emission Reduction Project at GP Nitric Acid Plant Fertiliser Factory) of catalyst installation has been finished. Comparing with 2017 nitric acid production decreased by 16 % and N_2O emissions decreased by 23%.

Emissions of the mineral industry were 539 kt CO_2 eq. in 2018, and it was 17% of the IPPU sector emissions. Cement production is the biggest source of GHG emissions in the mineral industry being 511 kt CO_2 eq. (95%). Portland cement is produced in a single company, which produces more than 1 million tonnes of portland cement per year.

In 2018 the emissions from consumption of F-gases were estimated at 572 kt CO_2 eq. (18% from the aggregated emissions from IPPU sector). The main sources of HFCs emissions are commercial refrigeration, industrial refrigeration, transport refrigeration and mobile air-conditioning. Emissions from equipment in those sectors cover up to 87% of the total F-gases emissions in 2018. Emissions from commercial refrigeration and industrial refrigeration equipment account respectively for 35% and 10%, from mobile air-conditioning and transport refrigeration account for

26% and 18% of the total Lithuanian F-gases emissions in 2018. The rest F-gases are emitted from stationary air conditioning, domestic refrigeration, foam blowing, fire extinguishers and other F-gases containing equipment such as electrical equipment, metered dose inhalers etc. (about 11%).

4.3.2 Methodology and key assumptions

The GHG emissions projections from IPPU sector with existing PaMs 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 80% of total IPPU sector emissions in 2018.

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 4-6. Emission factors (EF) in industry sector, t CO_2 eq/t production

Industrial Processes	EF
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
Nitric acid production, t/t	0.00064
Lubricant use, t/TJ	0.590
Paraffin wax use, t/TJ	0.590
Solvent 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[17] 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. While 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. These differences in methodologies lead to differences in estimated total GHG and EU ETS emissions in the chemical industry.

All projected data were available for the 2020, 2025, 2030, 2035 and 2040. The data in between were interpolated. The base year for the GHG IPPU projections is 2018.

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 4-7) of F-gases Regulation (EU) No 517/2014[18], that creates bans, controls on the use and emissions of F-gases and EU MAC Directive[19], 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.

[17] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_3_Ch3_Chemical_Industry.pdf

[18] 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

[19] 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

Table 4-7. Percentage to calculate the maximum quantity of hydrofluorocarbons 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%
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 4-8. 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, CH_4	Tier 1, 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, NF_3	Tier 2, 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

4.3.2.1. Scenario “with existing measures” (WEM)

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 due to planned GHG reduction projects (Table 4-9).

Table 4-9. Base year and planned ammonia and nitric acid production, natural gas consumption volume

Planned production	BY 2018	2020	2025	2030	2035	2040
Ammonia production, kt	948	1 063	1 146	1 146	1 146	1 146
Natural gas consumption, thous. m^3	1 054 586	1 340 786	1 255 000	1 185 000	1 165 000	1 130 000
Nitric acid production, kt	1 050	1 166	1 319	1 319	1 319	1 319

Mineral Industry

The mineral industry’s projected emissions are based on industrial companies’ projections. Taking into account planned maximal production capacities and implemented best available technologies according to companies’ environmental permits.

A significant share of GHG emissions in mineral industry sector belongs to the CO_2 emissions from cement production. In 2013 company finished cement production modernization project, where wet cement production was transformed to dry cement production process. It was planned that the

transition will allow reducing CO_2 emissions (including emissions from fuel combustion) by quarter: wet production process – 1.2 t CO_2/t of clinker, dry production process - 0.85 t CO_2/t of clinker[20].

The projections of CO_2 emissions from clinker production were based on activity data provided by the company (Table 4-10). It is assumed that projected clinker production from 2020 clinker production volume will remain stable until 2040.

Table 4-10. Base year and projected volume of mineral industry, kt

Planned production	BY 2018	2020	2025	2030	2035	2040
Clinker production	952	1 500	1 500	1 500	1 500	1 500
Lime production	48	80	80	80	80	80
Glass production	88	83	99	100	100	100
Mineral wool production	93	88	92	94	96	98

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 production during the 2018-2020 period will increase about 66% and 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 6 % compared to 2018 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 one company's authorities and it is projected that mineral wool production will be increasing gradually during the projected period.

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 2500 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 2500 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.

[20] http://www.cementas.lt/index.php?id=137

- 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.

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 2018 due to forecasts promise very little economic growth (Table 4-11).

Projections of solvent use are based on the population trends up to the year 2040 (Table 4-11). Emissions from Solvent use sector are projected to decrease a little due to projection of population show a decreasing trend.

Table 4-11. Base year and projected parameters of non-energy products from fuels and solvent use, kt

Projected parameters	BY 2018	2020	2025	2030	2035	2040
Lubricant use	25.9	25.9	25.9	25.9	25.9	25.9
Paraffin wax use	3.51	3.51	3.51	3.51	3.51	3.51
Population in Lithuania, million	2 801	2 759	2 585	2 452	2 376	2 307

Metal Industry

The projections of CO_2 emissions from cast iron production were based on activity data provided by two companies (Table 4-12). According to companies' data it is assumed that cast iron production will start to increase from 2020 onwards.

Table 4-12. Base year and projected volume of metal industry, kt

Planned production	BY 2018	2020	2025	2030	2035	2040
Cast iron production	2.2	1.6	1.8	2.1	2.4	2.6

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 2018 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 4-13).

Emissions from 2.E.3 subcategory are calculated applying the 2006 IPCC Guidelines Tier 2 method using plant specific emission factors. The projected consumption of NF_3 gases were based on activity data provided by the company, which is an established European manufacturer and distributor of PV cells and modules in Lithuania. It is assumed that consumption of NF_3 gases after 2020 will remain stable until 2040 as the company's maximum production/use capacity will remain unchanged (Table 4-13).

Table 4-13. Projected amount of NF_3 and SF_6 gases consumption of electronics industry, t

Planned use of gases	2018 BY	2020	2025	2030	2035	2040
SF_6	0.520	0.520	0.520	0.520	0.520	0.520
NF_3	0.159	0.159	0.159	0.159	0.159	0.159

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 4-14).

Table 4-14. Projected amount of SF_6 gases consumption of electrical equipment and other product manufacture and use, t

Planned use of gases	2018 BY	2020	2025	2030	2035	2040
SF_6	0.021	0.034	0.034	0.034	0.034	0.034

Other

CO_2 emissions from carbonates use in flue gas desulphurisation (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 power plant. The company has reported that limestone use has not been foreseen since 2019, so emissions will not occur after 2019 (Table 4-15).

4.3.2.2 Scenario “with additional measures” (WAM)

The WAM scenario is based on the additional measures provided by the Ministry of the Economy and Innovation of the Republic of Lithuania and Ministry of Environment of Republic of Lithuania, 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 PaMs 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.

4.3.3 Projections of GHG emissions

4.3.3.1. Scenario “with existing measures” (WEM)

GHG emissions projections for IPPU sector are presented in the table below. The largest source of GHG emissions is chemical industry emissions. 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 2018 emissions from IPPU sector will increase by 20 %in 2020, by 7% in 2030 and by 2% in 2040.

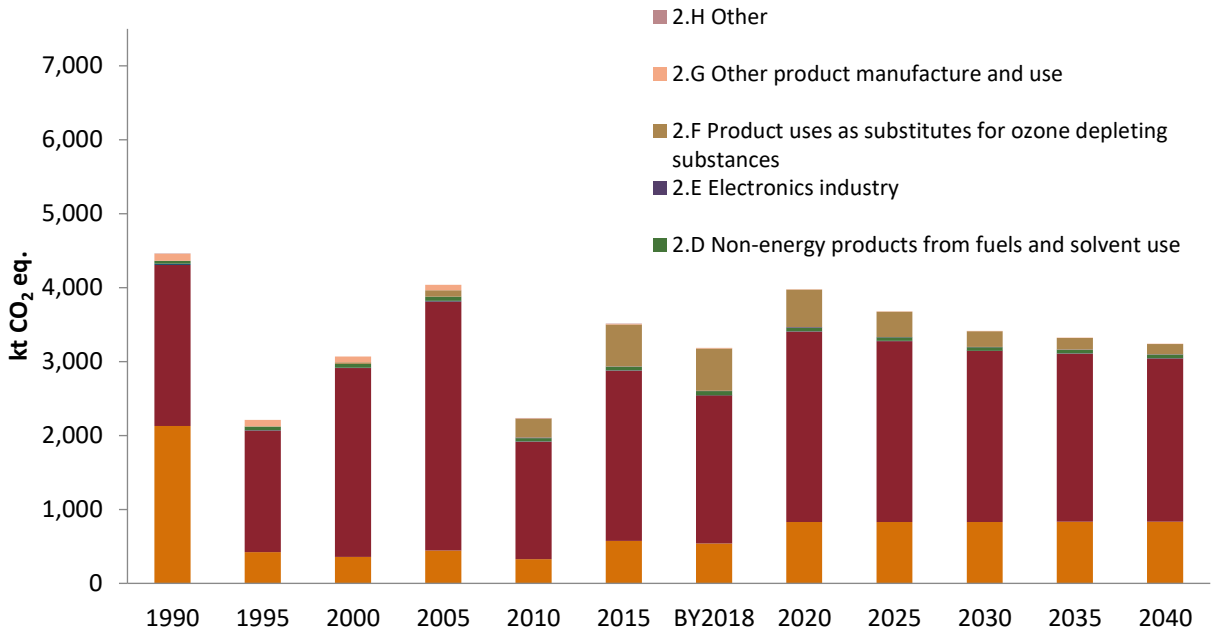


Figure 4-13. Total historical and projected GHG emissions from IPPU sector in 1990-2040, kt CO_2 eq.

Table 4-15. The total emissions in IPPU sector in case of WEM scenario, kt CO_2 eq.

	BY 2018	2020	2025	2030	2035	2040
2.A Mineral Industry	539.49	829.49	831.64	832.02	832.33	832.63
2.B Chemical Industry	**2003.46**	**2578.55**	2445.37	2313.87	2277.10	2211.79
2.C Metal Industry	1.86	1.42	1.60	1.83	2.06	2.27
2.D Non-energy products from fuels and solvent use	56.18	50.19	48.18	46.65	45.77	45.62
2.E Electronics Industry	5.96	5.96	5.96	5.96	5.96	5.96
2.F Product uses as substitutes for ozone depleting substances	571.71	508.25	341.96	208.04	156.93	137.60
2.G Other product manufacture and use	5.59	5.86	5.73	5.64	5.58	5.53
2.H Other Production	NO	NO	NO	NO	NO	NO
Total	**3184.25**	**3979.72**	**3680.43**	**3414.00**	**3325.74**	**3241.39**

Chemical Industry

The main GHG emissions source in IPPU sector remains nitric acid and ammonia production (Figure 4-13, Table 4-15) based on projected production volume data provided by chemical industry, the GHG emissions will increase by 10% in 2040 compared with 2018.

Mineral Industry

As volume of mineral industry is expected to increase for projected period, the GHG emissions will grow accordingly by approximately 54% compared to the base year in 2040.

Product uses as substitutes for ozone depleting substances (ODS)

The projections of F-gases emissions for most sub-categories were based on 1990-2018 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 2018-2040 are presented in Table 4-16.

Table 4-16. Projected emissions from consumption of HFCs in 2018-2040, kt CO_2 eq.

	BY 2018	2020	2025	2030	2035	2040
2.F.1.a Commercial Refrigeration	199.78	168.73	99.63	58.83	34.74	20.51
2.F.1.b Domestic Refrigeration	1.56	2.42	1.75	0.94	0.77	0.70
2.F.1.c Industrial Refrigeration	56.79	47.41	29.06	18.81	13.49	11.30
2.F.1.d Transport Refrigeration	100.44	102.48	84.31	70.87	62.51	58.77
2.F.1.e Mobile AC	146.31	138.31	84.12	20.59	9.89	10.61
2.F.1.f Stationary AC	17.61	16.69	12.81	9.03	5.55	4.78
2.F.2 Foam blowing	38.00	17.75	14.73	12.02	12.02	12.02
2.F.3 Fire extinguishers	3.72	2.47	1.22	0.82	0.82	0.82
2.F.4 Metered Dose inhalers	7.49	11.99	14.33	16.12	17.14	18.07
Total	**571.71**	**508.25**	**341.96**	**208.04**	**156.93**	**137.60**

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 assume 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 in 2020 is expected due to the entering into force of the new prohibition on the use of HFCs with GWP of 2500 and more to service or maintain refrigeration equipment. According to GHG inventory data, currently in Lithuania commercial and industrial refrigeration equipment contains HFC-32, HFC-125, HFC-143a and HFC-134a gases. Due to HFC-125 and HFC-143a gases GWP is higher than 2500, the use of these gases to service and maintain refrigeration equipment will be prohibited from 2020. Furthermore, refrigerators and freezers for commercial use that contain HFCs with GWP of more than 150 will be prohibited to place on the market from 2022 (HFC-32, HFC-134a). Implementation of F-gases quota system will reduce amount of HFCs placed on the market by 79% between 2015 and 2030 (see Table 4-7). 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 23% compared to F-gases emissions in these sectors in 2018. The emissions from mobile air-conditioning will decrease also taking into account implementation of EU 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 2017. Emissions from Transport Refrigeration account for up to 18% of the total Lithuanian F-gas emissions in base year of 2018 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 Regulation (EU) No 517/2014. 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.

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. Comparing with base year 2018 CO_2 emissions from non-energy products from fuels and solvent use category will decrease by 19% in 2040 (Table 4-15).

Metal Industry

It is assumed that GHG emissions from metal industry will grow together with increasing cast iron production (Table 4-15).

Electronics industry

The projected consumption of NF_3 and SF_6 gases were based on activity data provided by companies. It is assumed that emissions after 2020 will remain stable until 2040 (Table 4-17).

Table 4-17. Projected emissions from consumption of NF_3 and SF_6 gases in Electronics industry (CRF 2.E.), kt CO_2 eq.

	BY 2018	2020	2025	2030	2035	2040
2.E.1 Semiconduct manufacture	5.93	5.93	5.93	5.93	5.93	5.93
2.E.3 Photovoltaics	0.03	0.03	0.03	0.03	0.03	0.03
Total	**5.96**	**5.96**	**5.96**	**5.96**	**5.96**	**5.96**

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 4-18. Projected SF_6 emissions from Electrical equipment (CRF 2.G.1), Other non-specified (CRF 2.G.2) and N_2O from product uses (CRF 2.G.3), kt CO_2 eq.

	BY 2018	2020	2025	2030	2035	2040
2.G.1 Electrical equipment	0.32	0.63	0.63	0.63	0.63	0.63
2.G.2 Other non-specified	0.16	0.16	0.16	0.16	0.16	0.16
2.G.3 N_2O from product uses	5.11	5.08	4.95	4.85	4.78	4.75
Total	**5.59**	**5.87**	**5.74**	**5.64**	**5.57**	**5.54**

Consumption of the SF_6 gases in electrical equipment and accelerators is projected to be equal to 2018 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.

4.3.3.2 Scenario "with additional measures" (WAM)

The WAM scenario is based on the additional measures provided by the Ministry of the Economy and Innovation of the Republic of Lithuania and Ministry of Environment of Republic of Lithuania, 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 emissions from agriculture sector for WEM and WAM scenarios are provided in the table and figure below.

Table 4-19. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	2020	2025	2030	2035	2040
WEM scenario	3979.7	3680.4	3414	3325.7	3240.8
WAM scenario	3979.7	3589.6	3233.8	3145.5	3060.6

Difference	0	90.8	180.2	180.2	180.2
	0%	2%	5%	5%	6%

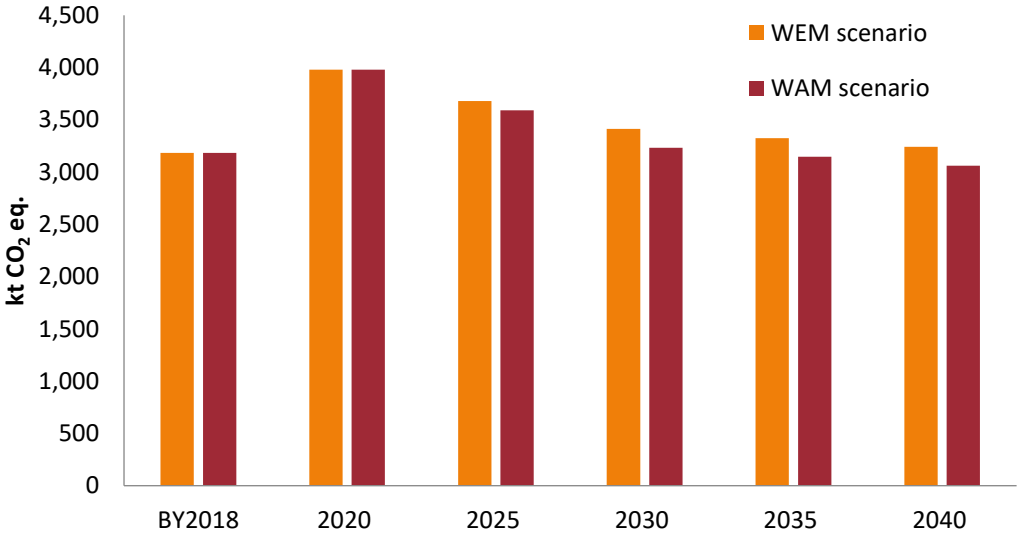


Figure 4-14. Projection of the WEM and WAM scenarios in IPPU sector

4.4 Agriculture

4.4.1 Overview of the Agriculture sector

GHG emissions from agriculture sector in Lithuania include: methane (CH_4) emissions from enteric fermentation of domestic livestock; CH_4 and nitrous oxide (N_2O) (direct and indirect) emissions from manure management; direct and indirect N_2O emissions from managed agricultural soils; carbon dioxide (CO_2) emissions from soil liming and application of urea. Direct N_2O emissions from agricultural soils include emissions that occur from application of inorganic nitrogen (N) containing fertilizers, application of organic fertilizers (manure, sewage sludge and compost), N deposited on pasture, range and paddock soils by grazing animals, nitrogen that is returned to soil with crop residues, N mineralized from loss in soil organic C, and cultivation of organic soils. Indirect N_2O emission sources include emissions from nitrogen atmospheric deposition and from nitrogen leaching and run-off, which are closely related to circumstances that influences direct N_2O emissions.

In 2018 total GHG emissions in agriculture sector contributed 4 229 kt CO_2 eq. which is 21% of the total GHG emission in 2018 (excl. LULUCF). Agriculture sector is the major source of CH_4 and N_2O emissions. CH_4 emissions constituted almost 58% of the total CH_4 emissions in 2018 (excl. LULUCF). 86% of agriculture sector CH_4 emissions resulted from enteric fermentation and 13% from manure management. Agriculture sector N_2O emissions contributed 85% of the total N_2O emissions in 2018 (excl. LULUCF). The major portion of N_2O emissions resulted from agricultural soils subcategory – 92% of the total N_2O emissions from agriculture sector. The rest of N_2O emissions resulted from manure management (8%). Agriculture sector also includes CO_2 emissions which take a small share from the total agricultural emissions – 0.6%. These emissions occur during liming of soil and application or urea fertilizers. The share of GHG emissions from agriculture sector by categories is presented in figure below.

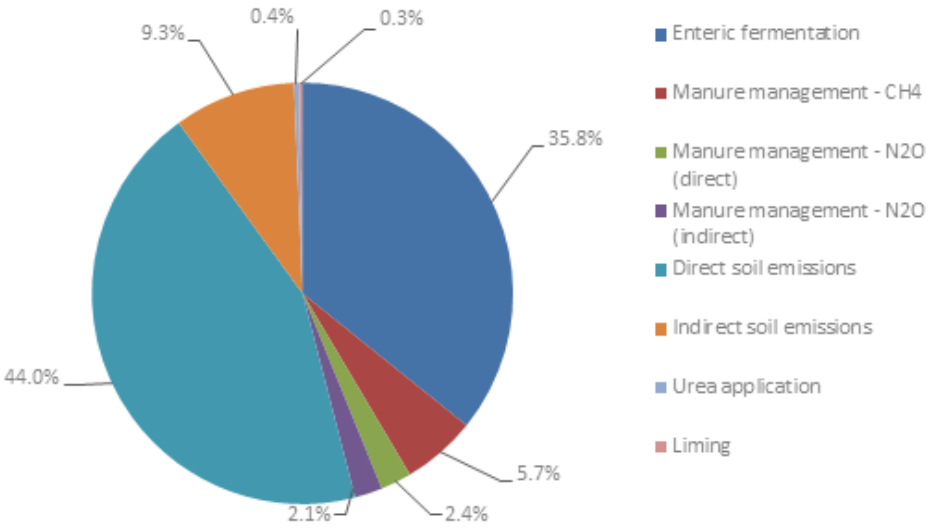


Figure 4-15. The share of GHG emissions by categories in agriculture sector in 2018, %

In 2018 the total GHG emissions in agriculture sector have decreased by 51% comparing with the 1990.

4.4.2 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)[21], Lithuanian institute of agrarian economics[22] and Institute of animal science[23]. Scenario with additional measures (WAM) is based on additional measures provided by the MoA.

All projected data were available for the years of 2020, 2030 and 2040. The data in between were interpolated. The base year for the GHG agriculture projections is 2018.

Summary table of assessed emissions from agriculture sector, methods applied and emission factors are provided in the table below.

Table 4-20. Methods and emissions factors used to estimate emission from agriculture sector

CRF	Source	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

[21] The Ministry of Agriculture of the Republic of Lithuania. Available: http://www.zum.lt/index.php?842077961

[22] https://www.laei.lt/?lng=en

[23] http://gi.lsmuni.lt/en/index.html

4.4.2.1 Scenario “with existing measures” (WEM)

Activity data projections

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. Projected values of livestock population are presented in table below.

Table 4-21. Projected number of livestock population in Lithuania, thous. heads

Livestock categories	BY 2018	2020	2025	2030	2035	2040
Dairy cattle	264.5	240.9	234.9	229.0	209.5	190.0
Non-dairy cattle	414.1	393.7	401.9	410.0	405.0	400.0
Swine	592.0	550.8	550.4	550.0	600.0	650.0
Sheep	178.5	152.1	176.1	200.0	200.0	200.0
Goats	14.3	15.2	15.1	15.0	15.0	15.0
Horses	13.9	12.8	13.4	14.0	13.0	12.0
Fur-bearing animals*	1 320.4	1 412.5	1 377.8	1 343.1	1 335.8	1 328.4
Poultry	11 626.9	11 953.3	13 314.4	14 675.4	15 997.9	17 320.4

*Fur-bearing animals include rabbits, minks, nutrias and foxes populations

It is projected that dairy cattle population will decrease by 28% from 265 thous. heads in 2018 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.

Population of non-dairy cattle will decrease by 3% from 414 thous. heads in 2018 to 400 thous. heads in 2040. It is projected that after 2020 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 population of swine will be increasing from 2030 during the whole period. Swine population from the 2018 until 2040 will increase by 10%.

As sheep and goats farming are becoming more environmental friendly way to maintain landscape, also farmers gains more experience in creating added value form sheep and goats production it is assumed that population of sheep and goats will increase. It is projected that sheep population will increase 12% from 178 thous. heads in 2018 to 200 thous. heads in 2040, goats population will increase 5% from 14 thous. heads in 2018 to 15 thous. heads in 2040. Horse population will decrease by 14% from 14 thous. heads in 2018 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 6% from 1 202 thous. heads in 2018 to 1 278 thous. heads in 2040.

It is projected that overall poultry population will increase by 49% in 2040 compared to 2018. It is expected that broiler population will increase by 67% in 2040 compared to 2018. Layer hen's population will increase by 12% assuming that the situation in the domestic market will remain without major changes. It is expected that turkey's population will increase by 20% in 2040 compared to 2018 due to high price difference between chicken and turkeys in the domestic market. It is projected that ducks and geese's will decrease respectively around 3 times and 2 times in 2040 compared to 2018.

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 4-22. Projected values of livestock production

Livestock production	BY 2018	2020	2025	2030	2035	2040
Milk production, kg/yr	5 934	6 120	6 710	7 300	7 850	8 400
Milk fat content, %	4.16	4.22	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 42% in 2040 compared with 2018. Milk fat will increase by increase by 3% during projected period comparing with the 2018.

Table 4-23. Projected values of distribution of manure management systems, %

Manure management systems	BY 2018	2020	2025	2030	2035	2040
Dairy cattle						
Solid storage	37.1	36.0	35.0	34.0	32.5	31.0
Liquid	32.6	34.0	37.5	41.0	45.0	49.0
Pasture	30.3	30.0	27.5	25.0	22.5	20.0
Non-dairy cattle						
Solid storage	35.9	36.5	37.3	37.7	38.4	39.0
Liquid	21.6	20.4	19.3	18.3	17.2	16.0
Deep bedding	11.3	11.5	11.6	11.7	11.8	12.0
Pasture	31.2	31.6	31.8	32.3	32.6	33.0
Swine						
Solid storage	9.4	7.7	7.1	6.4	5.7	5.0
Liquid	59.3	54.3	52.1	49.7	47.3	45.0
Deep bedding	1.9	1.7	1.4	1.0	0.5	0.0
Anaerobic digesters	29.5	36.3	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 2018. As small farms 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 2018.

For non-dairy cattle it is projected that solid and deep bedding manure management system will increase respectively by 3% and 1% in 2040 compared to 2018. Liquid system will decrease by 6%

in 2040 compared to 2018. It is expected that grazing period will increase by 2% in 2040 compared to 2018.

For swine category it is projected that solid and deep bedding manure management systems will gradually decrease respectively by 4% and 2% in 2040 compared to 2018. As anaerobic digesters are promoted it is expected that this manure management system will increase by 21% in 2040 compared to 2018. 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 14% in 2040 compared to 2018.

Crops residue projections

For calculation of N_2O emissions from crop residue the projected activity data of harvested crops and area of crops harvested for the year 2020, 2030 and 2040 were provided by the MoA. 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 4-24. Projected amount of crops harvested and area harvested

Harvested crops (thous. tons)	**BY 2018**	**2020**	**2025**	**2030**	**2035**	**2040**
Winter wheat	1 993.1	3 965.1	3 456.9	2 948.7	2 653.9	2 359.0
Spring wheat	845.8	495.0	512.7	530.4	517.1	503.9
Triticale	153.3	407.0	355.5	304.0	307.0	310.1
Barley	619.6	601.0	581.0	561.0	563.8	566.6
Oats	182.4	262.0	247.6	233.3	244.9	256.6
Rape	433.5	922.6	878.1	833.6	874.0	914.5
Peas	213.7	193.0	214.0	234.9	270.2	305.4
Beans	149.7	188.0	197.0	206.0	226.6	247.2
Buckwheat	53.4	48.0	51.4	54.9	63.1	71.3
Perennial grasses up to 5 years (exl. Alfalfa, clover and their mixtures)	889.0	845.0	887.3	929.5	1 068.9	1 208.4
Area harvested (thous. ha)						
Winter wheat	463.1	741.8	649.1	556.4	500.7	445.1
Spring wheat	309.7	159.3	157.7	156.0	152.1	148.2
Triticale	57.1	107.5	101.3	95.0	96.0	96.9
Barley	225.9	178.0	174.0	170.0	170.9	171.7
Oats	103.0	100.5	105.5	110.6	116.1	121.6
Rape	205.3	285.8	279.5	273.2	286.3	299.3
Peas	106.2	86.1	99.0	111.9	128.7	145.4
Beans	69.9	58.7	69.0	79.2	87.1	95.1
Buckwheat	52.7	39.9	44.9	49.9	57.4	64.9
Perennial grasses up to 5 years (exl. Alfalfa, clover and their mixtures)	134.9	130.0	136.5	143.0	164.5	185.9

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[24].

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 52% in 2040 compared to 2018. It is expected that area harvested of barley and spring rape 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"[25] and "Farm to fork"[26] strategies will encourage to convert agriculture land to grasslands, therefore it is projected that perennial grasses will increase by 36% in 2040 compared to 2018.

Inorganic and organic N fertilizer projections

Projections of consumption of inorganic and organic N fertilizers were provided by the MoA. 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 4-25. Projected amount of inorganic and organic N fertilizers consumption, kt N

Activity data	BY 2018	2020	2025	2030	2035	2040
Inorganic N fertilizers	174.1	178.3	164.9	146.6	132.8	119.1
Urea application	10.1	10.5	9.9	8.8	8.0	7.2
Animal manure	30.1	29.4	29.9	30.9	31.0	31.0
Compost	0.101	0.111	0.127	0.144	0.166	0.187
Sewage sludge	0.571	0.761	0.761	0.762	0.766	0.770

It is projected that the consumption of inorganic N fertilizers will increase by 2% during the period of 2018-2020, 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 33% 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.

The use of organic N fertilizers will increase by 3% in 2040 compared to 2018. The major increase will be in the consumption of compost and sewage sludge compared to animal manure applied to soils.

Liming materials projections

The projected amount of limestone and dolomite applied to the soils were provided by the MoA. Projections of liming materials were based on the changes of crops area. Projected activity data are provided in the table below.

Table 4-26. Projected amount of limestone and dolomite consumption, tones

[24] 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

[25] 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

[26] 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

Activity data	BY 2018	2020	2025	2030	2035	2040
Limestone	18 657.8	30 991.6	31 004.9	31 018.2	31 178.2	31 338.1
Dolomite	6 801.1	5 024.5	5 026.7	5 028.8	5 162.0	5 257.9

In general it is projected that agriculture soil liming will increase by 43% during the projected period. Consumption of limestone will increase by 68% in 2040. However, consumption of dolomite will decrease by 25% 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[27]. In order to improve soil quality it is projected that in general soil liming consumption will be increasing in 2018-2040 period.

4.4.2.2 Scenario "with additional measures" (WAM)

The main focus in the agriculture sector is on the more effective and precise use of inorganic N fertilizers and the education of farmers. Also the growth of the agriculture sector is based on technologies that are territorially and environmentally balanced, climate-friendly, resilient, competitive and innovative. Sustainable farming, keeping organic farming areas, rational use of inorganic N fertilizers, and their replacement with organic N fertilizers, promoting use of biogas plants are the most important measures in reducing GHG emissions[28].

Additional measures used to evaluate GHG emissions projection according to WAM scenario are provided in the Chapter 2.4.4 Agriculture in the Table 2-12.

All additional measures were provided by the MoA. As the major share of GHG emissions from agriculture sector comprise from agriculture soils most of the additional measures focus on more effective use of fertilizers and application of environmentally friendly technologies.

4.4.3 Projections of GHG Emissions

4.4.3.1 Scenario "with existing measures" (WEM)

GHG emissions projections for agriculture sector are provided for five subsectors: enteric fermentation, manure management, agricultural soils and CO_2 emissions from liming and urea. Table below presents aggregated GHG emissions from 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 2018 emissions from agriculture sector will decrease by 4% in 2030 and by 12% in 2040.

Table 4-27. Projected total GHG emissions from agriculture sector, kt CO_2 eq.

Agriculture sector categories	BY 2018	2020	2025	2030	2035	2040
Enteric fermentation	1 513	1 415	1 442	1 467	1 419	1 366

[27] 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

[28] https://epilietis.lrv.lt/uploads/epilietis/documents/files/NECP_draft_version_20181214.pdf

Manure management	431	405	382	392	392	389
Agriculture soils	2 259	2 411	2 322	2 160	2 066	1 962
Urea application	16	17	16	14	13	11
Liming	11	16	16	16	16	16
Total GHG emissions	**4 231**	**4 263**	**4 177**	**4 050**	**3 905**	**3 744**

The figure bellow represents GHG emissions trend during the historical and projected period.

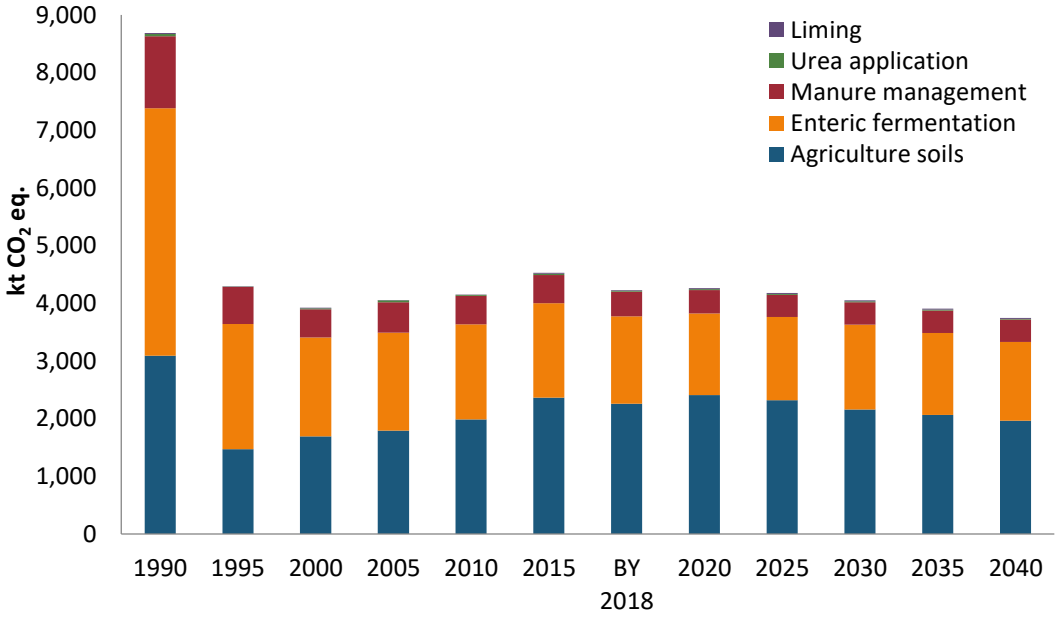


Figure 4-16. Historical and projected GHG emissions from agriculture sector by categories

Enteric fermentation

To project CH_4 emissions from enteric fermentation emission factors of 2018 were used, except for dairy cattle. Projected emissions from enteric fermentation for each livestock category are provided in the table below.

Table 4-28. Projected CH_4 emission from enteric fermentation, kt CO_2 eq.

Livestock categories	BY 2018	2020	2025	2030	2035	2040
Dairy cattle	842.0	781.1	790.5	798.4	756.0	708.8
Non-dairy cattle	593.9	564.6	576.3	588.0	580.8	573.6
Swine	19.3	18.0	18.0	18.0	19.6	21.2
Sheep	45.2	38.6	44.7	50.8	50.8	50.8
Goats	1.8	1.9	1.9	1.9	1.9	1.9
Horses	6.3	5.7	6.0	6.3	5.9	5.4
Fur-bearing animals	4.8	4.8	4.4	4.0	4.0	3.9
Total	**1 513.2**	**1 414.8**	**1 441.8**	**1 467.3**	**1 418.8**	**1 365.6**

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 the 2018.

Figure below shows the share of CH_4 emissions from livestock enteric fermentation generated by different livestock categories. In the 2018 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 main source of CH_4 emissions from enteric fermentation. It is projected that emissions from enteric fermentation will decrease by 10% in 2040 compared with 2018.

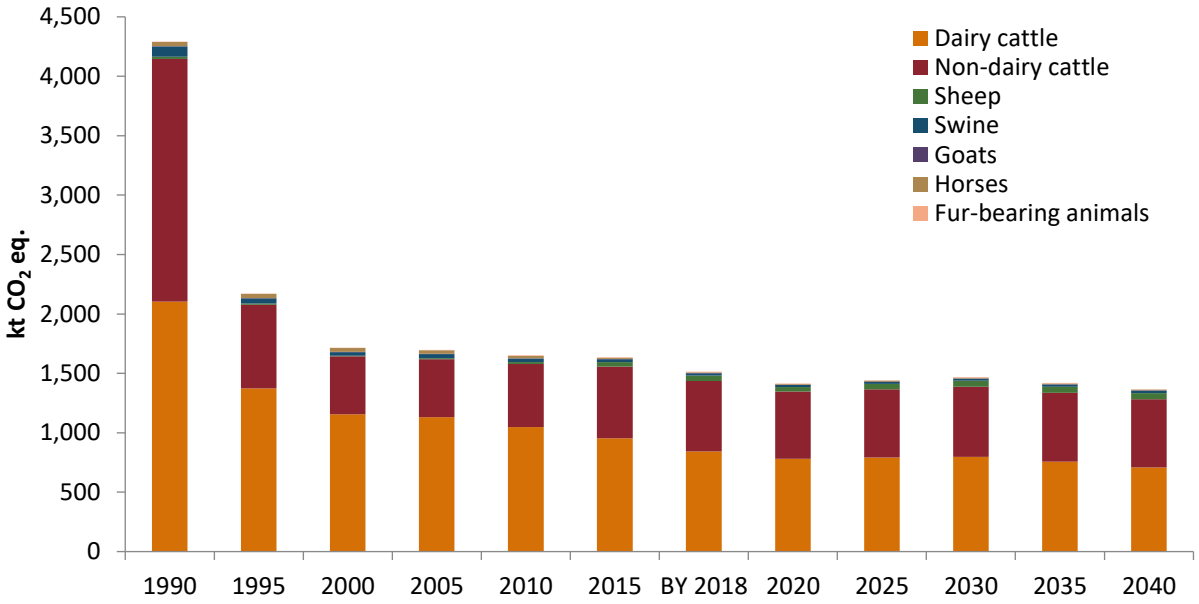


Figure 4-17. Historical and projected CH_4 emissions from enteric fermentation

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 2018 were used.

Table 4-29. Projected CH_4 emission from manure management, kt CO_2 eq.

Livestock categories	By 2018	2020	2025	2030	2035	2040
Dairy cattle	84.9	80.9	70.2	76.8	77.7	77.2
Non-dairy cattle	70.5	65.1	59.1	59.4	57.5	55.7
Swine	55.1	46.9	34.3	32.3	33.4	34.0
Sheep	1.8	1.6	1.8	2.0	2.0	2.0
Goats	0.0	0.0	0.0	0.0	0.0	0.0
Horses	0.5	0.5	0.5	0.5	0.5	0.5
Poultry	7.1	7.0	7.9	8.7	9.4	10.1
Fur-bearing animals	20.7	22.4	22.3	22.1	22.0	21.8
Total	240.7	224.5	196.1	201.9	202.6	201.5

According to 2018 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 16% in 2040 compared to 2018.

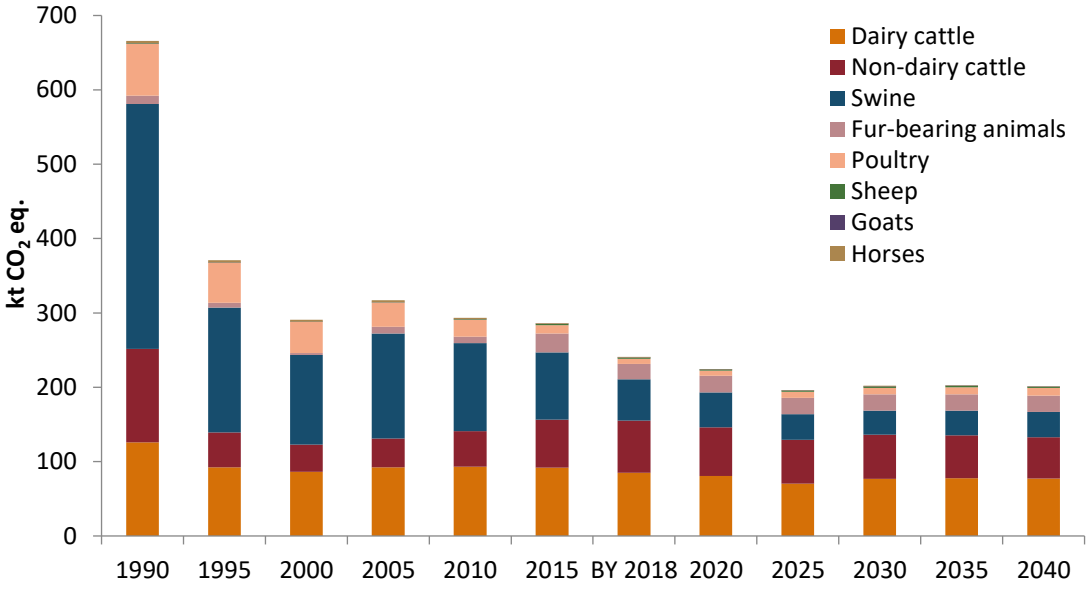


Figure 4-18 Historical and projected CH_4 emissions from manure management

Figure above shows the share of CH_4 emissions from manure management generated by different livestock categories.

Direct and indirect N_2O from manure management

N_2O emissions from manure management systems include both direct and indirect emissions (Table 4-30 and Table 4-31). 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 2018 data the highest N_2O emissions from manure management occur among dairy cattle, non-dairy cattle and fur-bearing animals and constitute 90% 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 4-30. Projected direct N_2O emission from manure management, kt CO_2 eq.

Manure management system	BY 2018	2020	2025	2030	2035	2040
Liquid system	31.5	29.8	31.9	34.0	34.4	34.3
Solid storage system	56.1	52.8	52.6	52.2	50.1	47.9
Other systems*	13.2	12.7	13.3	13.8	13.9	14.1
Total	100.8	95.4	97.8	100.0	98.4	96.3

*Other systems include – deep bedding, with/without litter, etc.

Table 4-31. Projected indirect N_2O emission from manure management, kt CO_2 eq.

Manure management system	BY 2018	2020	2025	2030	2035	2040
Liquid system	38.5	36.1	37.4	38.7	39.3	39.4
Solid storage system	35.4	33.0	33.1	33.0	31.7	30.4
Other systems	15.8	15.7	17.2	18.7	19.9	21.2
Total	89.6	84.7	87.7	90.4	90.9	90.9

Direct N_2O emissions from manure management will decrease by 4% in 2040 compared to 2018; however, indirect N_2O emissions will increase by 1.5% during the same period.

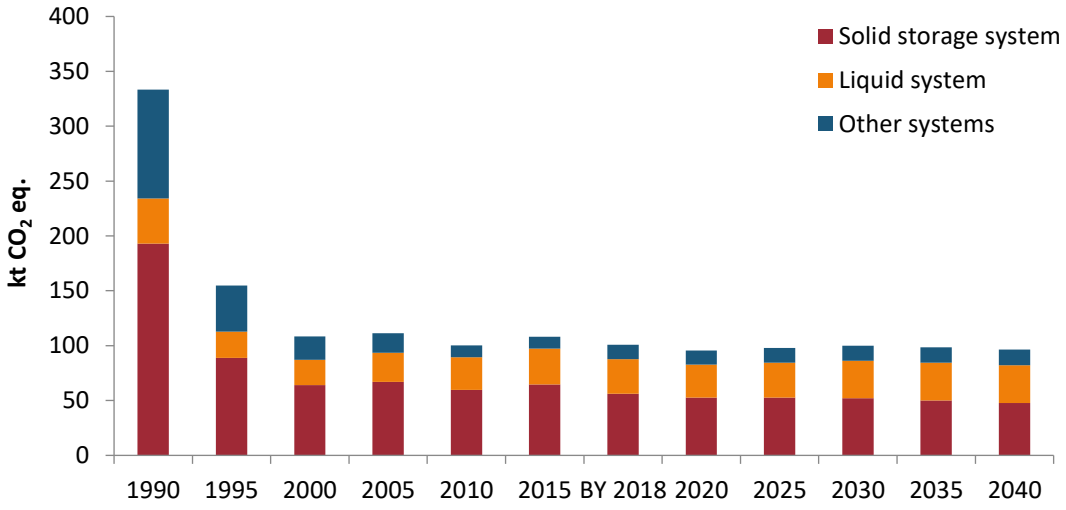


Figure 4-19. Historical and projected direct N_2O emissions from manure management

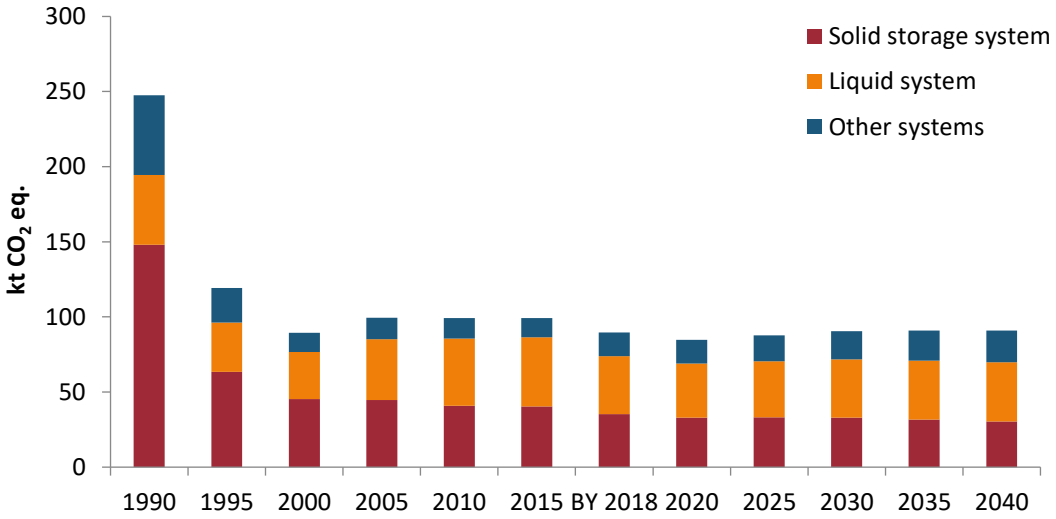


Figure 4-20. Historical and projected indirect N_2O emissions from manure management

Figure 4-19 and Figure 4-20 shows the share of direct and indirect N_2O emissions from manure management generated by different manure management systems. The majority of these emissions comprised from solid storage and liquid manure management systems.

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 4-32. Projected total direct and indirect N_2O emissions from agricultural soils, kt CO_2 eq.

Agricultural soils subcategories	BY 2018	2020	2025	2030	2035	2040
Direct N_2O emissions from agricultural soils						
Inorganic N fertilizers	815.3	834.8	772.1	686.3	622.0	557.7
Organic N fertilizers	145.1	140.1	144.5	148.7	149.6	149.7
Urine and dung from grazing	143.8	134.1	130.2	126.6	116.6	107.1
Crop residue	275.1	386.5	371.8	357.1	364.7	372.3
Mineralized N from loss of C stocks	NO	NO	NO	NO	NO	NO
Cultivation of organic soils	484.3	496.3	526.0	491.8	482.0	460.0
Total direct N_2O emissions	1863.6	1991.8	1944.6	1810.5	1734.9	1646.8
Indirect N_2O emissions from agricultural soils						
Atmospheric deposition	100.8	96.8	82.4	76.9	71.7	66.4
Leaching and runoff	295.0	322.2	294.5	272.1	258.2	244.2
Total indirect N_2O emissions	395.8	419.0	376.8	349.0	330.0	310.6

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 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 4-24). The activity data for other crops remained constant. In 2018 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.

The share of the total N_2O emission from agricultural soils category is presented in figures below.

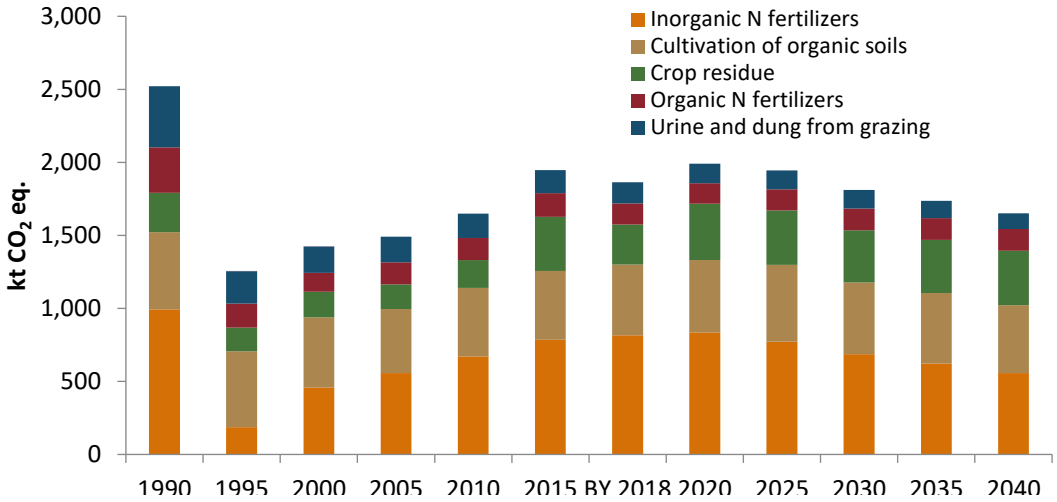


Figure 4-21. Historical and projected N_2O emissions from direct agricultural soils subcategories

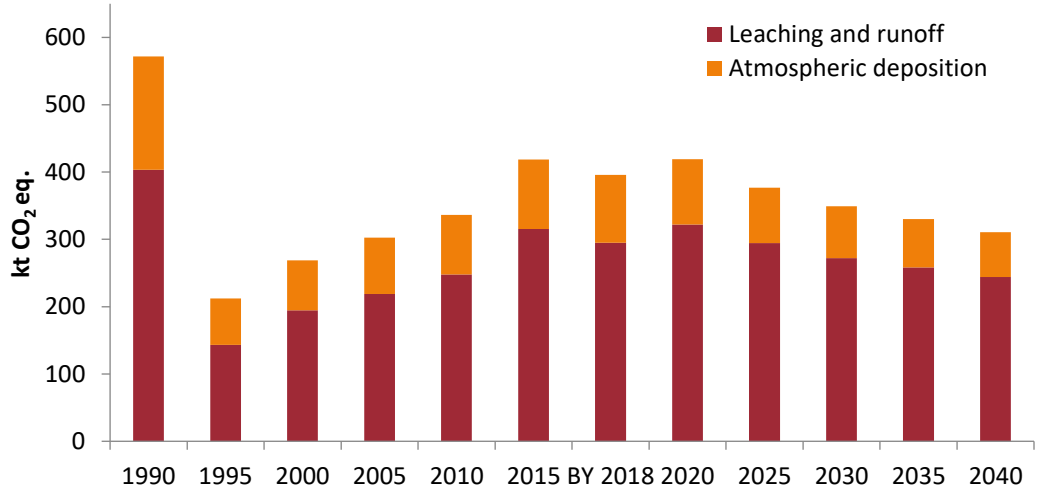


Figure 4-22. Historical and projected N_2O emissions from indirect agricultural soils subcategories

The figures above show decrease in total direct and indirect N_2O emissions from agricultural soils. It is expected that direct N_2O emissions from agricultural soils will decrease by 12% in 2040 compared to 2018. Indirect N_2O emissions from agricultural soils during the same period will decrease by 21%.

CO_2 emissions from liming

Default emission factor of limestone and dolomite were taken from 2006 IPCC Guidelines. Projections of applied liming materials to soils were provided by the MoA.

Table 4-33. Projected CO_2 emissions from liming application, kt

Liming application	BY 2018	2020	2025	2030	2035	2040
CO_2 emissions	11.5	16.0	16.0	16.0	16.2	16.2

Figure below shows historical and projected emissions from agriculture soils liming.

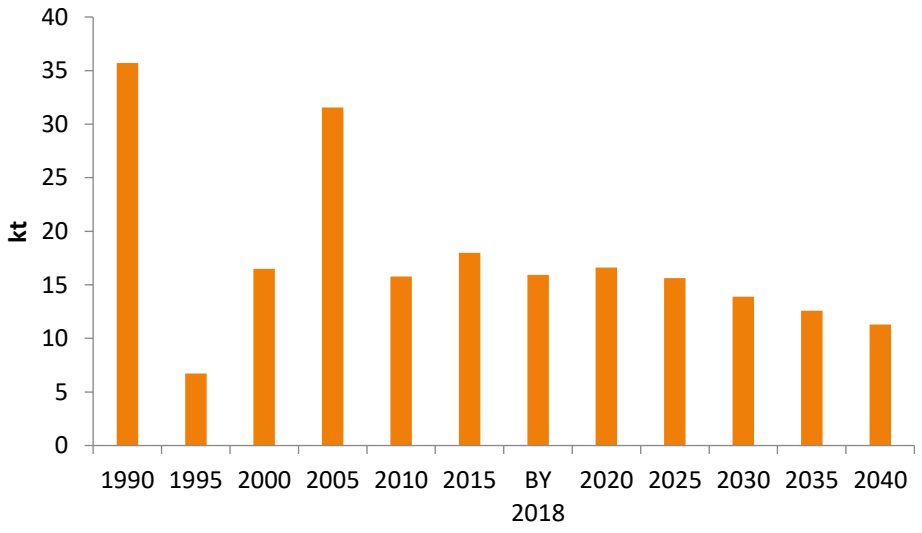


Figure 4-23. Historical and projected CO_2 emissions from agricultural soils liming

It is projected that CO_2 emissions from liming materials application will slightly increase during the projected period. It is expected that CO_2 emissions will increase by 41.6% in 2040 compared to the 2018.

CO_2 emissions from urea application

Default emission factor for urea application was taken from 2006 IPCC Guidelines. Projection of urea application to soils was provided by the MoA.

Table 4-34. Projected CO_2 emissions from urea application, kt

Urea application	BY 2018	2020	2025	2030	2035	2040
CO_2 emissions	15.9	16.6	15.6	13.9	12.6	11.3

Figure below shows historical and projected emissions from urea application.

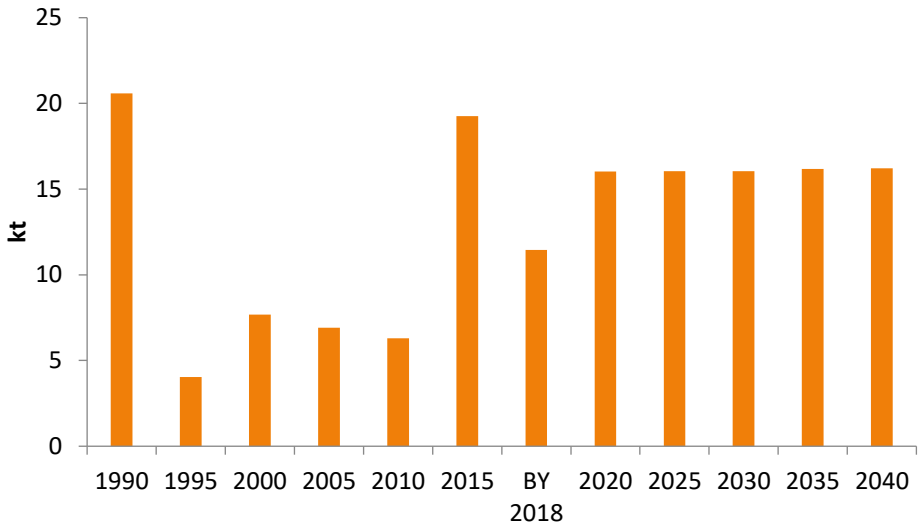


Figure 4-24. Historical and projected CO_2 emissions from urea application

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 2018.

4.4.3.2 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 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, also increase of air pollution taxes.

The emissions from agriculture sector for WEM and WAM scenarios are provided in the table and figure below.

Table 4-35. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	2020	2025	2030	2035	2040
WEM scenario	4 262.8	4 176.8	4 049.6	3 905.2	3 743.9
WAM scenario	4 262.8	4 023.1	3 725.9	3 608.7	3 490.4

Difference (WEM-WAM), ktCO2eq.	0.0	153.7	323.7	296.5	253.5
Difference (WEM/WAM),%	0%	4%	9%	8%	7%

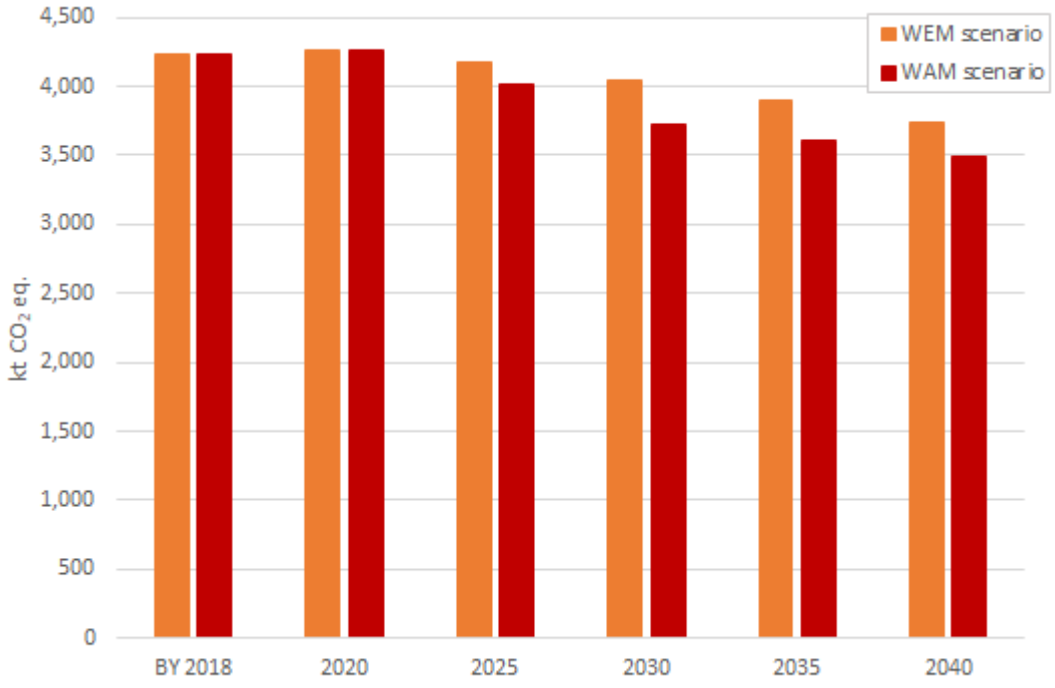


Figure 4-25. Projection of the WEM and WAM scenarios in agriculture sector

4.5 Land use, land use change and forestry

4.5.1 Overview of the LULUCF sector

In general, historical GHG emissions from sources and removals in sinks in 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. Emissions and removals in LULUCF sector in Lithuanian fluctuate not only due to the land use changes, but also environmental impacts – for example in 1996 and 1997 after the long-lasting droughts and subsequent pest invasions forest land category resulted not only in decreased GHG sink but also became a source of GHG emissions for the short time period. Slightly decreasing living biomass carbon stock changes in forest land in the recent years are also related to reduce growing stock volume increment, which is not only limited by the aging forests but also strongly affected by natural conditions.

Forest land

Forest coverage in Lithuania was expanding continuously since 1948, however, data on forest coverage in Lithuania during inter-war period is very limited and the exact numbers are still unknown. Expert judgement made by the authors of "The Chronicle of Lithuanian Forests. XX Century"[29] allows us to presume forest coverage to be around 21% in 1938; even though some authors argue that only small part of heavily afforested areas of Vilnius region (south-eastern part of Lithuania) were included into this number at that time, and some 150 thous. ha could be unaccounted. The lowest forest coverage has been accounted during the World War II and through occupation period, because no forest preservation policy existed at that time. During the period when Lithuania was part of Soviet Union, forest accounting was rather thorough – unfortunately only in State owned forests. Forests belonging to collective farms and being less than 10 ha were disregarded as well as those belonging to small farms and being less than 1 ha. After restoration of Independence in 1991, there were no legal obstacles for implementation of forest accounting. However, the land reform has been also started at that time, so the State Forest Inventory (SFI) has been suspended or even discontinued as less important. In 1996, when the new cycle of SFI has been started there were found numerous areas of naturally afforested areas that were missing in the previous inventories or in State land accounting related documents. After Lithuania joined the EU and Common Agricultural Policy has started, annual afforestation and reforestation areas started to increase, but the most significant increase has been estimated from 2010 and for the last 8 years fluctuated between 1.2 to 6.8 thous. ha annually. In addition to this, highest removals in forest land were estimated at the same period from 1990, reaching up to -10,171 kt of CO_2 eq. per year in 2011. However, NFI measurements show a decreasing trend of growing stock volume change in the latest years, which may be caused due to aging forest stands and thus decreasing growing stock increment and GHG removals in forest land decreased to -7,224.7 kt CO_2 eq. in 2018.

Agricultural land (cropland and grassland)

There were significant changes between cropland and grassland area during the reporting period since 1990. Early 90's had introduced significant reforms in agriculture sector as well as in others after Lithuania gained Independence from Soviet Union and planned economy had to be switched to the market economy. The main target was re-establishment of private ownership and management. Even though legal acts were adopted for dismemberment of the collective farms, but they did not ensure their replacement by at least equally productive private farms or corporations and as a result 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. Area of grasslands prevailed and started to increase afterwards substituting the area of abandoned cropland. Cropland and grassland areas have changed dramatically in Lithuania since 2005 as a result of introduced Single Area Payment Scheme (SAPS), starting in 2004. SAPS is a form of support whereby direct payment is made for agricultural land irrespective to the type of production carried out on the land, and this might be one of the reasons of decrease in grasslands area. Furthermore, in 2004 when Lithuania became the member of EU, communities Structural Funds became available. In order to use funding from EU Structural Funds efficiently, the Single Programming Document (SPD) of Lithuania for 2004-2006 was prepared. The strategy provided in the SPD was divided into priorities and implemented on the basis of one or several measures. During 2004-2006, 191 million EUR was allocated to implement the measures of the Rural and Fisheries Development priority. According to the support contracts signed, the largest amount of funding (95 million EUR) was allocated to beneficiaries who submitted applications for the measure named "Investments into Agricultural Holdings". These measures resulted in

[29] Lietuvos Respublikos aplinkos ministerija, Miškų departamentas. Lietuvos miškų metraštis. XX amžius. Vilnius, 2003

agricultural land management, hence increase in croplands area and decrease in grasslands that were ploughed for agricultural purposes. Areas of cropland continued to increase resulting in decreasing grassland areas until 2018.

Wetlands

The total CO_2 emissions from wetlands have been ranging since 1990. Even though the area of wetlands was slightly decreasing till 2018, there was the tendency of increasing CO_2 emissions. The CO_2 emissions in wetlands were 859.4 kt CO_2 eq. in 2018; the highest emissions from this category were reported in 2015 and reached 965.1 kt CO_2 (due to forest land conversion to wetlands). The largest emissions from wetlands category originate from wetlands remaining wetlands – peat extraction areas (in 2018 emissions were 859.4 kt CO_2). Emissions from conversion of grassland, cropland and forest land to flooded land were not assessed annually and were minor comparing to the total emissions.

Settlements

The area of settlements in Lithuania has been increasing with low extent. In 1990 the land of settlements category had occupied 351 kha of country land, thus, till 2018 area of settlements increased by 33 kha. However, if to compare the intensity of area conversion to settlements, it was certain that area where settlements remained settlements was not changing distinctly and occupied on the average of 338 kha. The increase in the area of land converted to settlements was evident. In 1991 the area of land converted to settlements was 0.4 kha, thus, in 2018 distribution of area reached 37.9 kha (cumulative area of 20 year conversion period). Emissions from settlements category has an increasing trend due to the increasing conversions: total GHG emissions from settlements were 16.6 kt CO_2 eq. in 1990 and reached 728.5 kt CO_2 eq. in 2018.

Other Land

This category is included for overall land area consistency checking. All land not classified as *Forest land, Croplands, Grasslands, Wetlands and Settlements* were defined as *Other land* and reported together as a separate category in the CRF Reporter. Conversions to other land from forest land, cropland and grassland to other land occurred as after the quarries (sand, gravel, etc.) have been established in previous land use categories.

The total CO_2 emissions from other land have been ranging in not a high scope but one CO_2 emissions increase peak were denoted in 1994, where CO_2 emissions have reached 197.7 kt CO_2 eq. Despite the peak, CO_2 emitted from other land area was ranging from 26.6 kt CO_2 eq. (in 1992) to 98.2 kt CO_2 eq. (in 2009), however, the total GHG emissions in 2018 were 48.3 kt CO_2 eq. Intense CO_2 emissions at peak event could be explained by high emissions from loss of dead organic matter (litter) accumulated in forest and intensive mineralization of forest soil organic matter, resulting in significant decrease of organic carbon in relevant carbon stocks.

Harvested wood products

According to the estimates of Lithuania's National GHG Inventory Report, harvested wood products pool has been acting as a CO_2 sink in the entire reporting period from 1990 to 2018, reaching the highest amount of GHG removed in 2003: – 1,518.4 ktCO_2 eq. Note that annual carbon balance of HWP's varies substantially, depending on the economic situation and market demand and in 2018 it reached 808.3 ktCO_2 eq.

Historical emission trends

Historical emission trends are provided using inventory data reported in the National Inventory Report (NIR), submitted in 2021 which comprise 1990-2019 accounting period. Past emission trends up to 2018 (base year is 2018) for all land use categories are provided in the picture below.

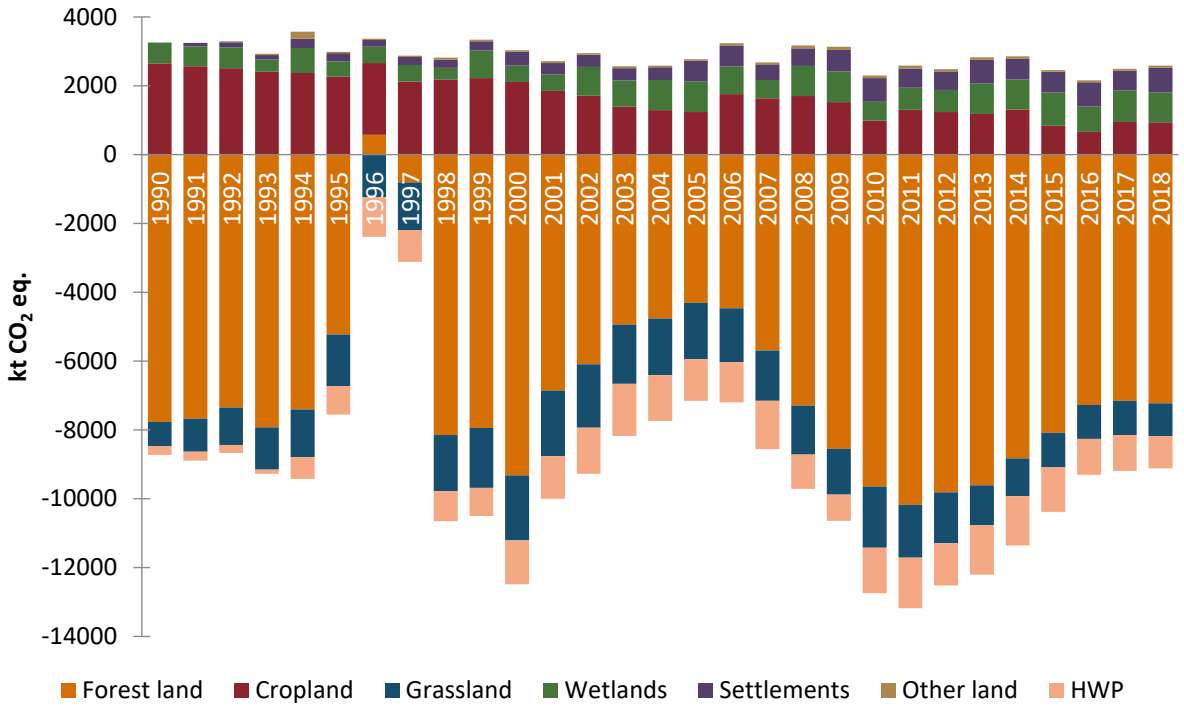


Figure 4-26. Total GHG emissions/removals from LULUCF sector for the period 1990 – 2018, kt CO_2 eq.

LULUCF sector for 1990–2018 as a whole acted as a net CO_2 sink except in 1996 when emission constituted to 1,000.4 kt CO_2 eq. (Figure 4-26). 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. During the entire reporting period LULUCF sector have been able to remove around 26% of the total CO_2 emissions in Lithuania, the share fluctuating from 7% in 1990 and 1991 to approx. 25-30% since 2010 (Figure 4-27). Largely these removals should be contributed to forest land with the significant addition from grassland and harvested wood products in recent years.

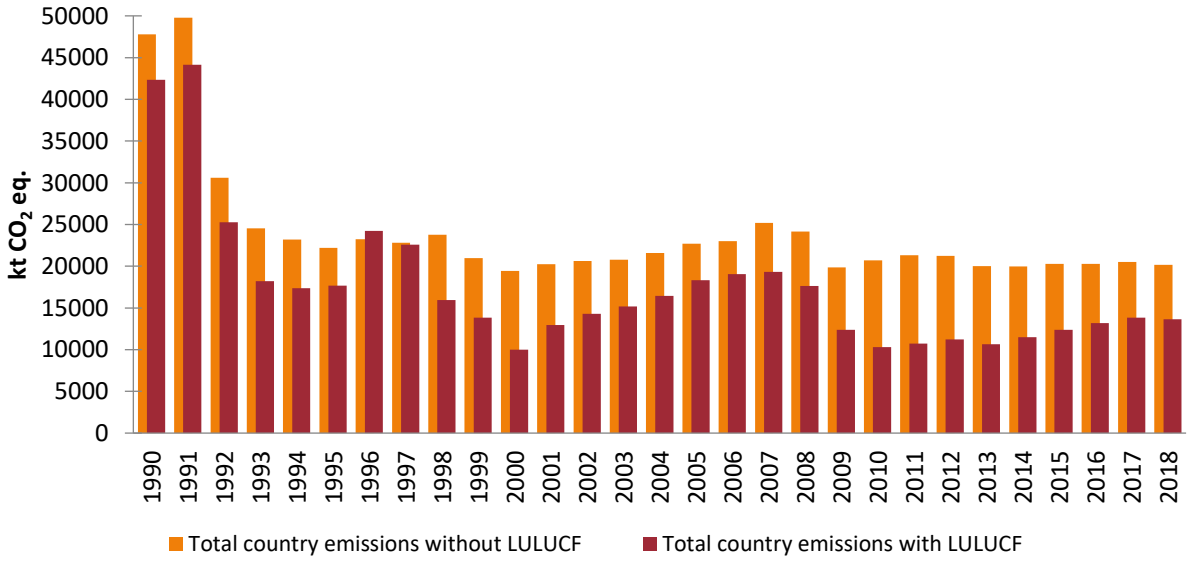


Figure 4-27. Total GHG emissions in Lithuania with and without LULUCF sector for the period 1990 – 2018, ktCO_2 eq.

For the first Commitment Period (CP) Lithuania has chosen to report emissions and removals from activities in article 3.3 of the Kyoto Protocol specified as afforestation (A), reforestation (R) and deforestation (D), together with the only activity under article 3.4 of the Kyoto Protocol – forest management (FM). Lithuania has been successfully implementing the commitments under the Kyoto Protocol – to reduce GHG emissions by 8% below 1990 level during the first commitment period of 2008-2012. By 2012, GHG emissions in Lithuania have been reduced by 55.5% compared with 1990. In 2018 greenhouse gas emission reduction in Lithuania was 57.8%, comparing to 1990.

The area subjected to AR was 53.83 thous. ha in 2018 (Figure 4-28) and the aim, set in the National Forestry Development Programme for 2012-2020, to afforest 3 000 ha of abandoned agricultural land and land not suitable for agricultural purposes is being successfully implemented. There could be two moments distinguished in the time period of 1990-2018 describing the AR trend line. The first period of human induced afforestation/reforestation has started in 1990-2000 and is related to Lithuanian history. After the restoration of Independence in 1990's forest expansion was the key priority among politicians therefore afforested and reforested areas constituted to more than 500 ha annually. But this number was steadily decreased after 1994. Another two different increase in AR area periods were recorded in 2002-2009 (stable increase approx. 1,600 ha annually) and 2010-2018 (continuously decreasing annual afforestation areas, from nearly 5 thous. ha to 1 thous. ha). Increase in afforestation/reforestation activities in State Forest Enterprises since 2001 was the result of increased funding for such activities while increase of afforestation/reforestation since 2009 is mostly due to the introduction of EU support for such activities for private land owners.

In the beginning of 2013, cumulative deforested area since 1st of January 1990 was 1,565.5 ha and increased to 4,584.9 ha in 2018 (Figure 4-28). Deforestation was mainly caused by the forest area conversions to settlements (road constructions, cities expansion etc.), other lands (to areas needed for national defence purposes) and wetlands (flooding etc.) land use categories. Areas of deforestation are under very strict regulation and control legitimated by the Forest Law (original text adopted in 1994) and Government Resolution No 1131 dated on September, 2011. In general, forest conversion to other land is very rare i.e. only for road building or settlements establishment and also requires special procedure of compensation. Statutory way of compensation is afforestation of non-forest land up to 3 times larger than used to be deforested. Deforestation activity has caused emissions of 1,354.1 kt CO_2 eq. in 2018 and was significantly above the removals from afforestation/reforestation activities due to the large areas of forest converted to other land for the country defence purposes. Net emissions from Article 3.3 activities were 933.7 kt CO_2 eq. in 2018.

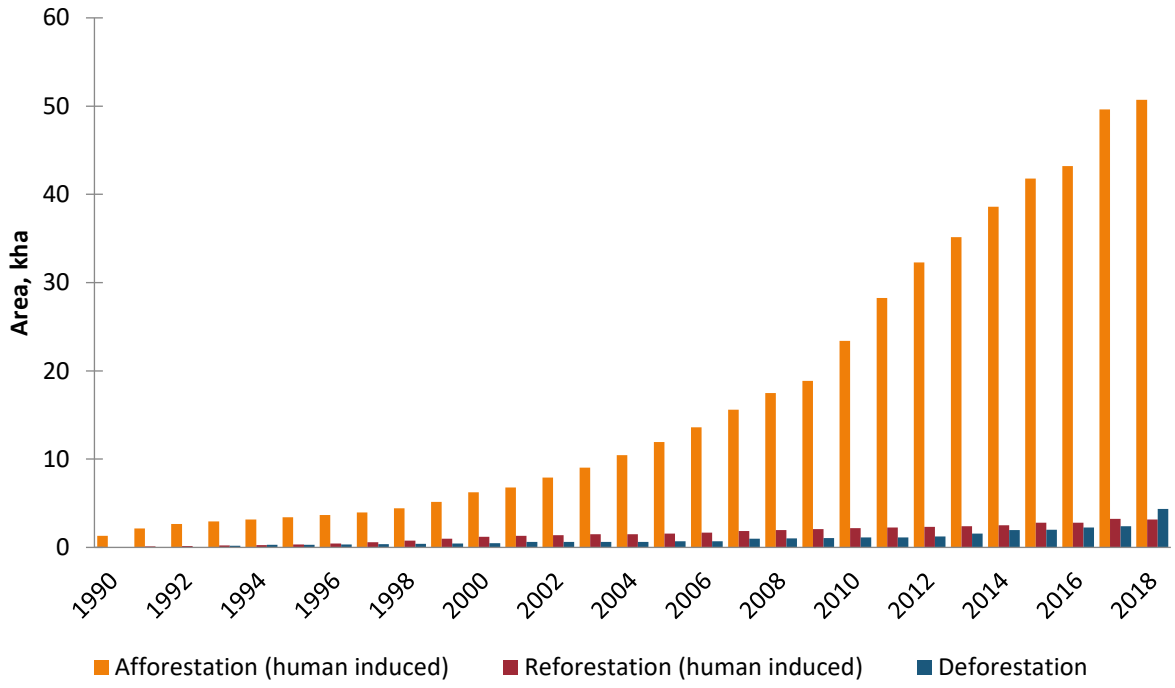


Figure 4-28. Cumulative area of afforestation, reforestation and deforestation, 1990 – 2018

The area subjected to forest management was 2,158.9 thous. ha in 2018. Net removals from Article 3.4 activity (FM) were -5,788.5 kt CO_2.

4.5.2 Methodology and key assumptions

Methodology for estimation of projected GHG emissions and removals is the same as used for annual GHG inventory report 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 2021, 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 calculated as well. 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 fire. Default emission factors of CO_2, CH_4 and N_2O are applied from 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 4-36. 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	CO_2; N_2O	T1; T2	D

soils			
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

4.5.2.1 Scenario "with existing measures" (WEM)

Scenario with existing measures include measures already adopted and implemented, meaning that significantly fewer measures are 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 sin 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 are forecasted taking into account the change in growing stock volume increment inventoried by the NFI in 2002-2018 and its use. This data were 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 20.03 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 the 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 goal of forest coverage increase up to 34.2 % by 2020 and actual converted areas estimated preliminary for 2019 for the projections of 2019 and 2020. Afterwards, starting in 2021, annual land converted t forest land area is 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 preliminary 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.

4.5.2.2 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 practise 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, increase is 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) are 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.

4.5.3 Projections of GHG emissions and removals

Two scenarios were elaborated: with existing measures (WEM) and with additional measures (WAM). 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 for National Greenhouse Gas Inventories.

Total projections of GHG emissions and removals from LULUCF sector under WEM and WAM scenarios are provided in Figure 4-31. It is clear from the Figure that both for WEM and WAM scenarios a declining LULUCF carbon sink is projected. Decline can be explained with 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 of the Republic of Lithuania 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.

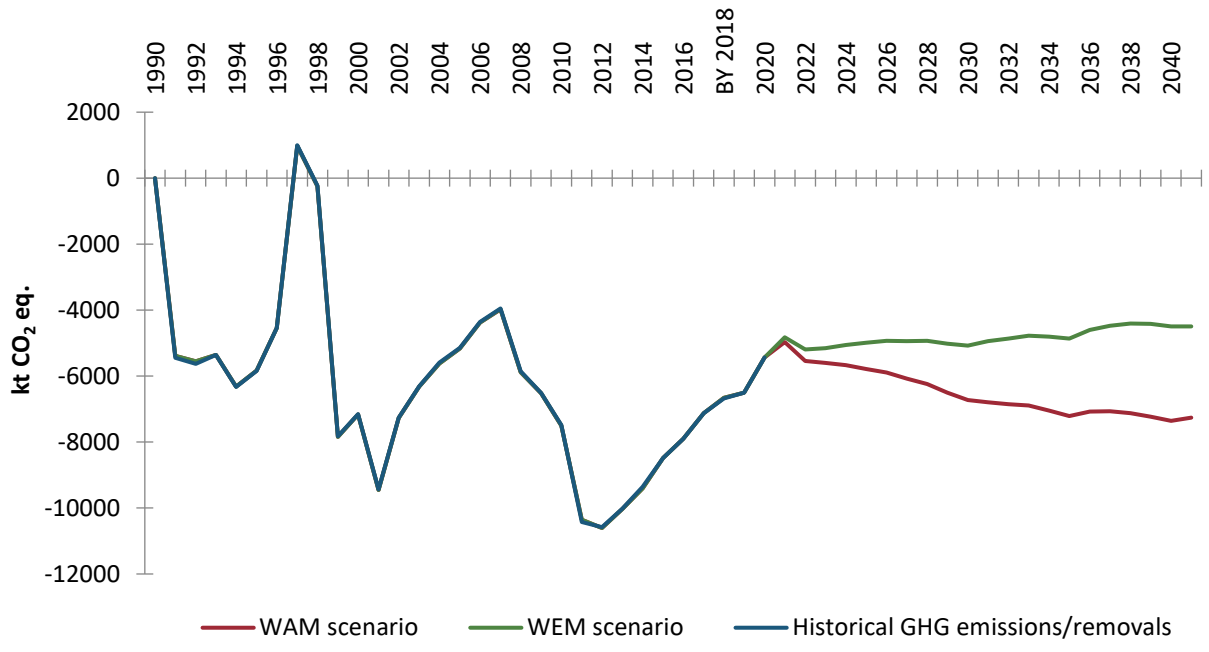


Figure 4-29. Total GHG emissions and removals from LULUCF sector under WEM and WAM scenarios

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.

4.5.3.1 Scenario “with existing measures” (WEM)

According to the WEM scenario forest land area should reach 34.2% of the total country area in 2020 as 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 -5,434.06 kt CO_2 eq. in 2019 to -4,497.34 kt CO_2 eq. in 2040.

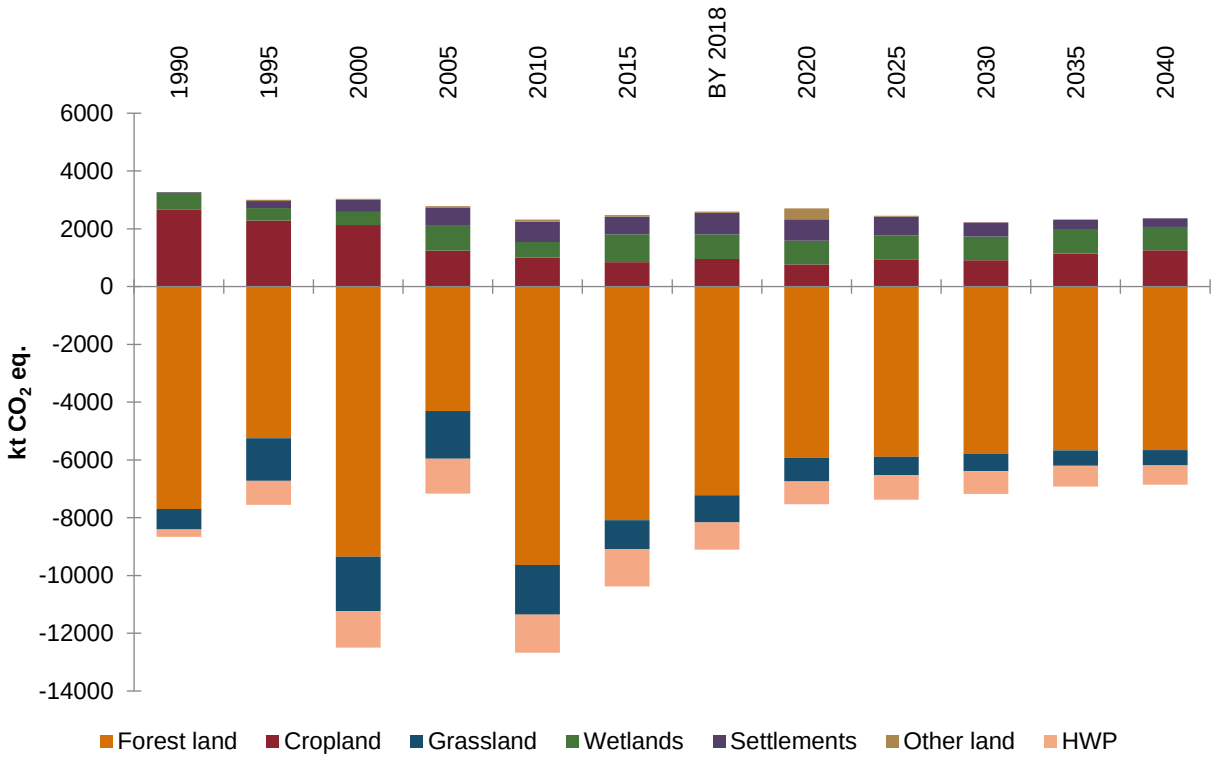


Figure 4-30. Historical (1990 – 2018) and projected (2019 – 2040) GHG emissions and removals from LULUCF sector (WEM scenario)

4.5.3.2. Scenario “with additional measures” (WAM)

More controversial scenario is with additional measures which include adopted PaMs to mitigate climate change, which are planned to implement from the start of the new commitment period (2021) and included in the NECP for 2021–2030 Forest land area could be 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 is included in projections of forest land GHG emissions/removals balance. Felling rates are 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 is 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) should result in increased carbon sequestration in mineral soils of cropland remaining cropland subcategory. Total cropland emissions are projected to decrease until 2030. However, emissions are projected to increase from 2031 onwards. It is 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 -5,434.24 kit CO_2 eq. in 2019 to -7,261.97 kt CO_2 eq. in 2040.

Figure 4-31. Historical (1990 – 2018) and projected (2019 – 2040) GHG emissions and removals from LULUCF sector (WAM scenario)

4.5.3.3. Accounted emissions and removals from LULUCF sector

In accordance with the commitment under Regulation (EU) 2018/841, the annual difference in GHG emissions and removals in the LULUCF sector (by applying the special accounting rules provided for in this Regulation) has to be negative, i.e. the sector has to generate more removals than emissions or at least the cumulative quantity of GHG removals and emissions has to be equal to zero starting from 2021. The cumulative quantity of GHG emissions and removals is accounted for by deducting the fixed reference levels from GHG removals or emissions calculated in the categories of annually managed forest land, managed cropland and managed grassland in the period from 2021 to 2030 and adding the quantity of GHG removals or emissions from afforested and deforested land. The reference level for managed forest land means projected GHG removals or emissions from forests, based on forest use tendencies between 2000 and 2009 and the structure of stand age classes for that period. The established indicative reference level of managed forest land (GHG removals of -5,164.6 kt CO_2 eq/year) is set in the Commission Delegated Regulation. Reference levels for managed cropland and managed grassland and

pastures are the average of GHG emissions/removals between 2005 and 2009. The calculated reference level for managed cropland reaches 1,857.0 kt of GHG emissions of CO_2 eq/year, and the reference level for managed grassland and pastures is -1,186.4 kt of GHG removals of CO_2 eq/year.

Taking in to the account of the accounting rules under Regulation (EU) 2018/841, Lithuania's LULUCF sector is projected to generate a total of -1,736.1 kt CO_2 eq of GHG removals each year in the period from 2021 to 2025 under WEM scenario, part of which can be used to meet the GHG emission reduction commitments by the non-ETS sectors. From 2026 to 2030, Lithuania's LULUCF sector is projected to generate a total of -1,707.1 kt CO_2 eq of GHG removals each year under WEM scenario, part of which can be used to meet the GHG emission reduction commitments by the sectors outside the EU emission trading scheme. According to the projected and accounted GHG emissions and removals under WAM scenario, potential credits from the LULUCF accounting categories could be up to -2,362.1 kt CO_2 eq of GHG removals each year for 2021-2025 period and -3,194.1 kt CO_2 eq of GHG removals each year for 2026-2030 period.

Table 4-37. Accounted emissions/removals from LULUCF accounting categories as set in Regulation (EU) 2018/841

Category	***Scenario***	***Total cumulative emissions/removals (kt CO_2 eq)***	
		2021-2025	***2026-2030***
Effort Sharing Sectors [3]	WEM		
LULUCF: Afforested land	WEM	-5410,09	-4740,59
LULUCF: Deforested land	WEM	812,47	812,47
LULUCF: Managed cropland	WEM	-5034,82	-4618,15
LULUCF: Managed grassland	WEM	5100,73	4717,91
LULUCF: Managed forest land, including harvested wood products [4]	WEM	-2413,40	-2694,69
LULUCF Managed forest land, including harvested wood products assuming instantaneous oxidation	WEM	-1736,10	-2201,59
LULUCF: Managed wetland [5]	*WEM*	*NA*	*188,70*
		2021-2025	***2026-2030***
Effort Sharing Sectors [3]	WAM		
LULUCF: Afforested land	WAM	-5410,09	-4740,59
LULUCF: Deforested land	WAM	812,47	812,47
LULUCF: Managed cropland	WAM	-8164,27	-11976,20
LULUCF: Managed grassland	WAM	5067,16	4642,65
LULUCF: Managed forest land, including harvested wood products [4]	WAM	-2414,25	-2695,40
LULUCF Managed forest land, including harvested wood products assuming instantaneous oxidation	WAM	-1736,95	-2202,30
LULUCF: Managed wetland [5]	WAM	NA	188,70

4.6 Waste

This chapter includes information on the methods used for greenhouse gas projections, as well as assumptions on activity data considering the existing and planned waste management and treatment PaMs. The projections described in this chapter include projections on Solid Waste

Disposal, Biological Treatment of Solid Waste, Waste Incineration and Wastewater Treatment and Discharge.

These sources results emissions of methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2). Major source of CH_4 emissions is Solid Waste Disposal and Wastewater Treatment and Discharge, source of N_2O is human sewage and source of CO_2 is Waste Incineration.

4.6.1 Overview of the Waste sector

Solid Waste Disposal on land including disposal of sewage sludge is the largest GHG emission source from Waste Sector. It contributed around 70% of the total GHG emission from Waste Sector in 2018. GHG emissions occurring due to solid waste and sewage sludge disposal on land were increasing slightly from 1990 to 2001 and then started to decrease due to reduction of disposed waste, extraction of landfill gas and anaerobic digestion.

In order to achieve targets set in the National Waste Management Plan the mechanical-biological treatment (MBT) plants have been launched and the construction of two incineration facilities have started in 2016. The reduction of amount of waste disposed in landfills has been significant (1.8 time) since the launch of MBT plants as biodegradable waste separated during pre-treatment undergoes either biological treatment or is incinerated. There are three municipal solid (MSW) waste incinerators, the operation of which will lead to a further reduction in landfilling. Moreover, in order to encourage resource efficiency in waste management and divert waste from landfill a landfill tax has been introduced from January 2016.

Biological Treatment of waste includes composting and anaerobic digestion. In the initial stage up to year 2011 the amount of composting waste, though gradually increasing, remained comparatively low. From 2011, establishment of regional waste management systems and construction of new waste management facilities resulted in significant intensification of waste composting activities. In 2016 regional MBT facilities were put into operation resulting in another upsurge of waste composting activities.

Wastewater Treatment and Discharge contributed around 20% of GHG emissions from Waste Sector in 2018. Wastewater in Lithuania is treated in aerobic treatment systems with minimum CH_4 generation. However, 24.1% of population still does not have connection to public sewerage systems and emissions from sewage collected from septic tanks are significant.

Waste Incineration without energy recovery is used in Lithuania on comparatively small scale contributing during the period 1990-2018 on average 0.1% of the total waste GHG emission.

In 2018 total GHG emissions in Waste Sector contributed 857 kt CO_2 eq. which are 4% of the total GHG emission in 2018 (excl. LULUCF).

The share of GHG emissions from waste sector by subsectors is presented in figure below.

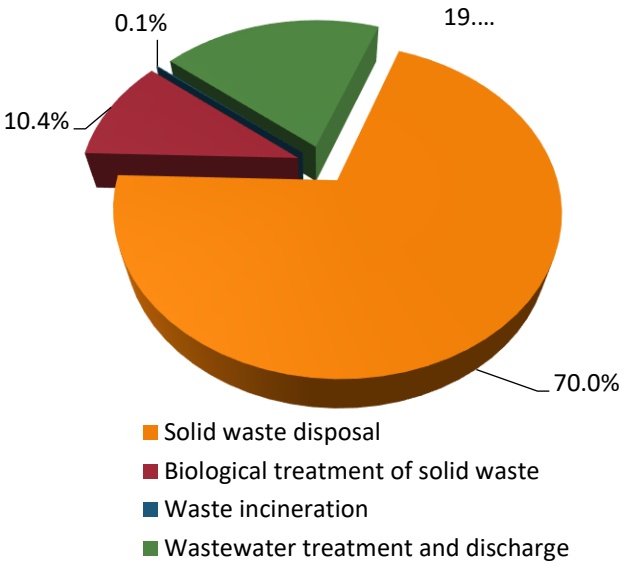


Figure 4-32. The share of GHG emissions by subsectors in waste sector (%)

In 2018 total GHG emissions resulting in waste sector decreased approximately by 44% compared 1990 level.

4.6.2 Methodologies and key assumptions

Methane emission arising from *Solid Waste Disposal* on land is calculated applying the IPCC (Intergovernmental Panel on Climate Change) 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; therefore CH_4 actually emitted part is smaller than the 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.

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 emission factors (see the table below). CH_4 emissions from anaerobic digestion are calculated using the IPCC 2006 default EF of 5% CH_4 of biogas produced.

Table 4-38. Emission factors from biological treatment of waste (IPCC default)

Type of biological treatment	CH_4 EF (g CH4/kg waste treated)	N_2O EF (g N2O/kg waste treated)
Composting	10	0.6

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 not connected to centralized sewer networks and N_2O emissions from human sewage. CH_4 and N_2O emissions are calculated applying IPCC Tier 1 method, using IPCC default values.

Carbon dioxide, CH_4 and N_2O emissions from *Waste Incineration* are calculated based on the IPCC 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 from waste sector, method applied and emission factors is provided below.

Table 4-39. 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

Projections of GHG emissions from Waste Sector are based on the National Waste Management Plan[30] for 2014-2020, the Landfill Directive[31], data provided by the Ministry of Environment, the Environmental Protection Agency, the Regional Waste Management Centers[32], and the Environmental Protection Agency[33].

4.6.2.1 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 generated per capita. The data on population trends was received from the European Commission and generated the amount of MSW per capita 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.

[30] https://www.e-tar.lt/portal/lt/legalAct/TAR.9945210D6571/ZtaLvZPcai

[31] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01999L0031-20180704

[32] The Regional Waste Management Centres. Available: *http://ratca.lt*

[33] The Environmental Protection Agency. Available: *http://gamta.lt/cms/index?lang=en*

Table 4-40. Base year and projected amount of waste generation and disposal

Parameter	Units	BY 2018	2020	2025	2030	2035	2040
Generation of municipal waste	kt	1300.5	1302.4	1200.6	1120.6	1062.2	1008.2
Municipal waste generated per capita	kg/capita	464	472	465	457	447	437
Disposal to landfills	%	25	23	14	5	5	5

Constantly decreasing share of CH_4 recovery 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.

The projected data on CH_4 recovery presented in Figure below.

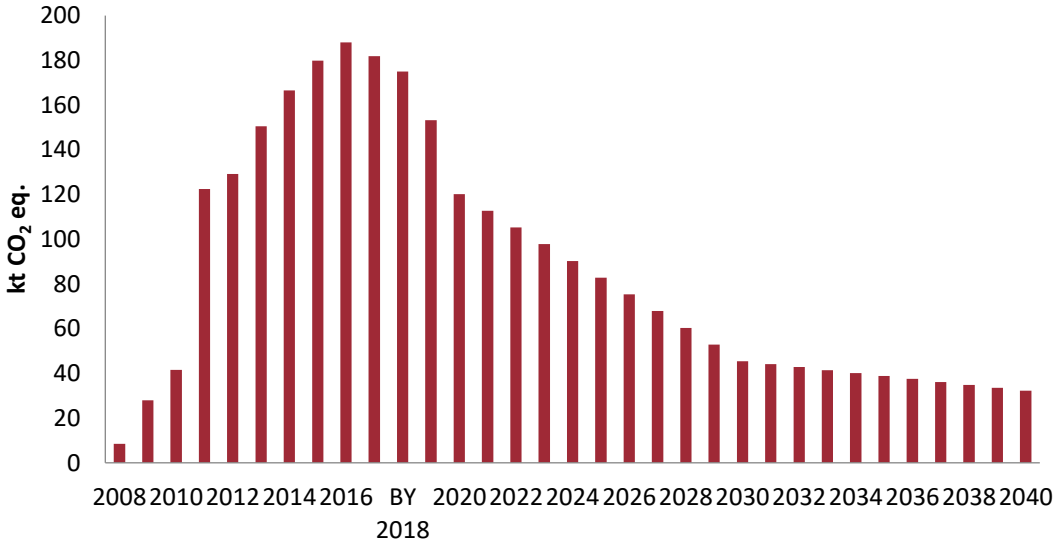


Figure 4-33. Projected CH4 recovery from landfills

The composition of landfilled waste is left as 2018 and remains stable during the 2019-2040 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 year 2021. 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 and figure below.

Table 4-41. Projected amount of waste undergoing biological treatment

	BY 2018	2020	2030	2040
Total amount of waste, tonnes	382 041	442 913	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 – 2000 inhabitants. These investments will help to further develop waste water 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 waste water 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, and 81.9 g/capita/day in 2007, 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 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.

4.6.2.2 Scenario “with additional measures” (WAM)

Lithuania is taking steps towards realising 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.

This can be facilitated by the development of, and access to, innovative financial instruments and funding for eco-innovation. 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 the sustainable management and efficient use of natural resources by 2030.

4.6.3 Projections of GHG emission

4.6.3.1 Scenario "with existing measures" (WEM)

GHG emissions projections are provided in four subsectors: disposal in landfills, biological treatment of solid waste, incineration of waste and wastewater treatment and discharge. In the WEM scenario the amount of waste disposed in landfills is expected to continue on a decreasing trend, mainly as a result of the requirements of the Landfill Directive, but also because waste incineration and other forms of treatment are becoming more important.

Historical and projected GHG emissions are presented in the table and figure below.

Table 4-42. Projected GHG emissions from waste sector (kt CO_2 eq.)

	BY 2018	2020	2025	2030	2035	2040
Solid waste disposal*	600	561	417	321	236	183
Biological treatment of waste	89	103	94	97	101	104
Waste incineration	1	2	2	2	2	2
Wastewater treatment and discharge	167	155	129	107	103	101
Total	**857**	**821**	**641**	**526**	**442**	**389**

*Including emissions from sewage sludge and CH_4 recovery

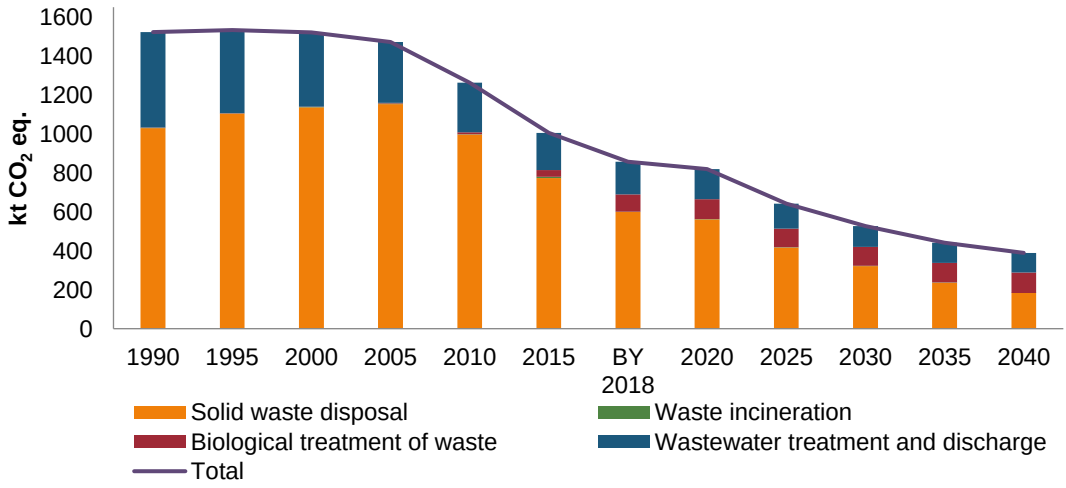


Figure 4-34. Historical and projected GHG emissions from waste sector

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.

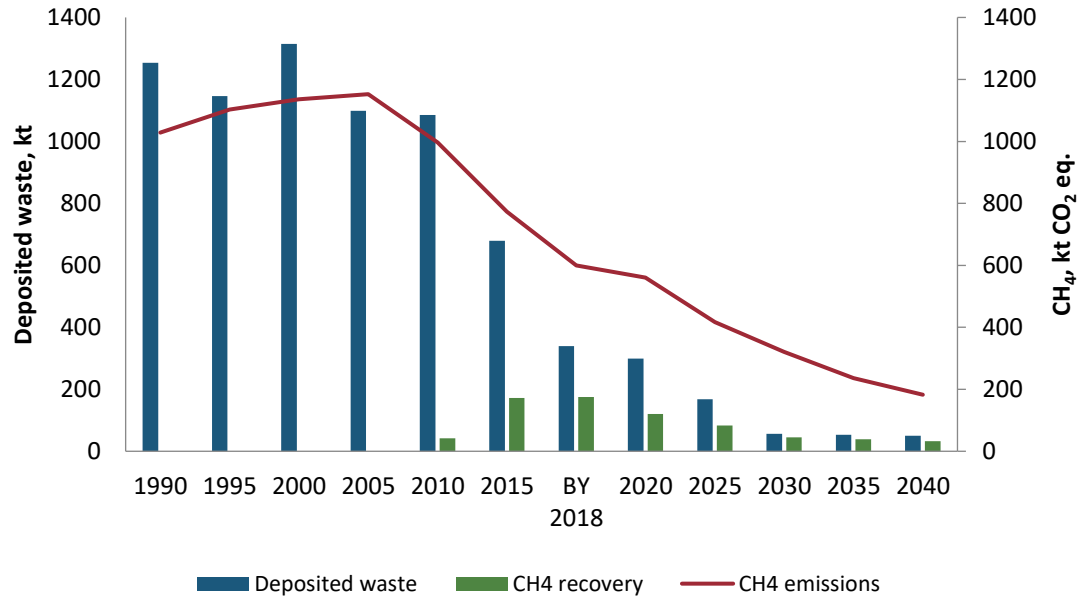


Figure 4-35. The historical and projected CH_4 emissions, CH_4 recovery and deposited waste

Biological treatment of solid waste

One of the main national targets is to reduce the amount of biodegradable waste going to landfills; for this reason, the mechanical-biological treatment plants have been launched in 2016. As was expected, the amount of biodegradable waste going to landfills was reduced, resulting in lower emissions. However, the GHG emissions from the biological treatment of waste will grow due to the increase in treated waste.

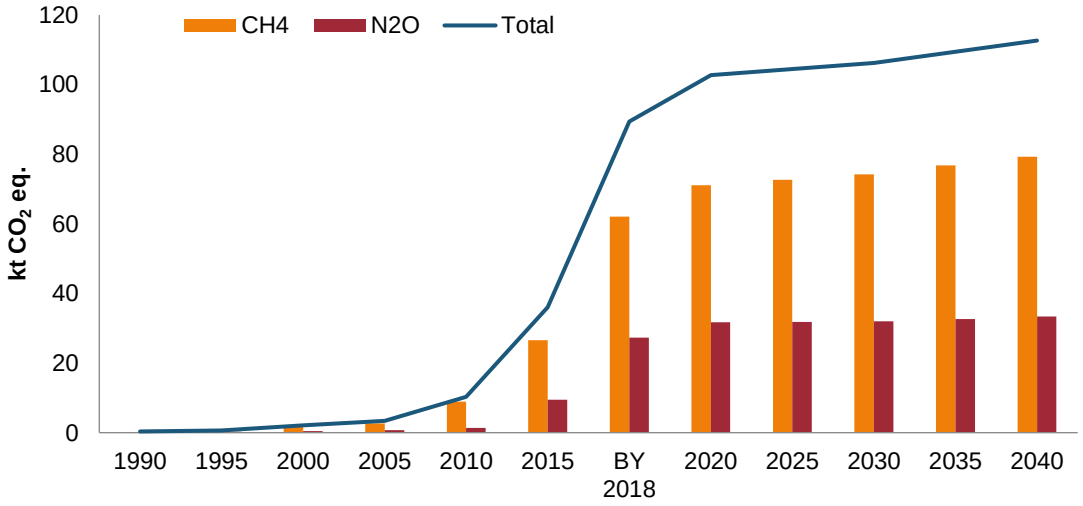


Figure 4-36. Historical and projected emissions from biological treatment of waste

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 is septic tanks. CH_4 emissions will decrease due to increased population connected to centralized sewer networks and are projected to be 66 kt CO_2 eq. by 2040.

The N_2O emissions from human sewage were calculated based on the protein consumption constant value. Emissions will drop due to a decrease in the population, and it is projected to be 35 kt CO_2 eq. by 2040.

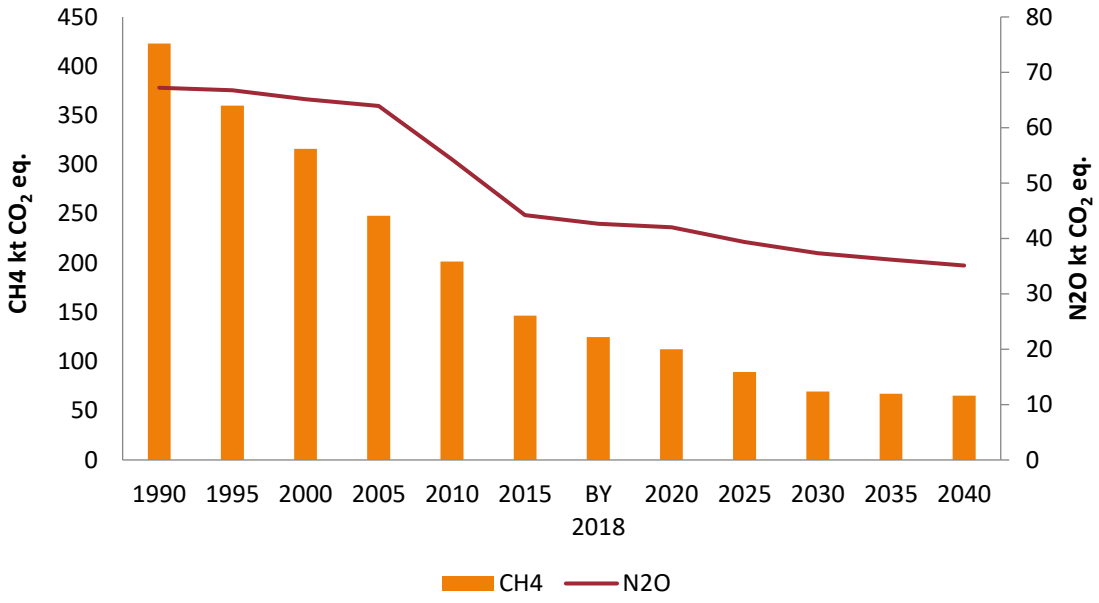


Figure 4-37. Historical and projected CH4 and N2O emissions

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.

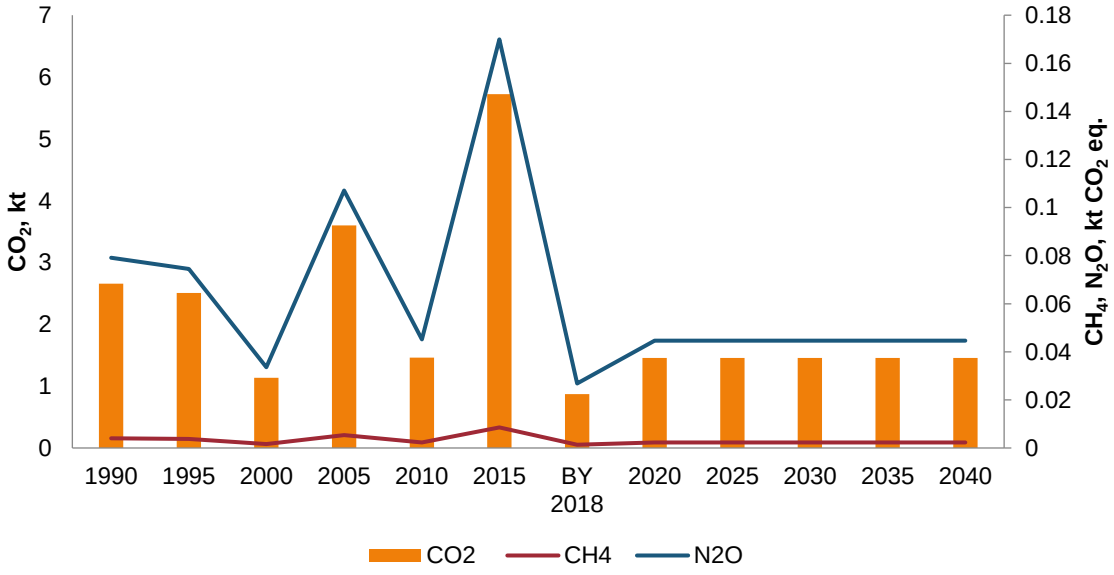


Figure 4-38. Historical and projected emissions from waste incineration

4.6.3.2 Scenario “with additional measures” (WAM)

In order to further reduce the amount of waste disposed of, it is planned to establish financial incentives to encourage repairing of bicycles, shoes, leather goods, clothing, furniture, etc. by considering the possibilities of alleviating the tax burden in order to encourage re-use of old items.

The emissions from Waste sector for WEM and WAM scenarios are presented in the table below.

Table 4-43. Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq

	2025	2030	2035	2040
WEM scenario	641	526	441	389
WAM scenario	638	523	439	387
Difference	3	3	2	2
	0.5%	0.6%	0.5%	0.5%

4.7 Sensitivity analysis

Sensitivity analysis in IPPU, Agriculture and Waste sectors has been done using main parameters used in EU REF scenario[34]. These parameters were used in one scenario (SEN) in sensitivity analysis, provided as “Scenario 1”. On the contrary, sensitivity analysis in LULUCF sector is provided in another scenario “Scenario 2” as this sector is not included in Total ESR emissions. Sensitivity of EU ETS carbon price is provided in “Scenario 3” because ETS carbon price is obtained not from EU REF scenario, but from Recommended parameters for reporting on GHG projections in 2021.

4.7.1 Energy sector

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 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 4-44.

Table 4-44. Carbon price used for GHG sensitivity analysis

	Carbon price (in constant €2016/tCO$_2$)					
	BY 2018	2020	2025	2030	2035	2040
Stable price used in projections	16	25	25	25	25	25
EC recommended[35]	16	25	28	30	40	53

Results of the EU ETS GHG emissions sensitivity analysis are presented in Figure 4-39.

Sensitivity analysis results showed considerable margin between GHG emissions projected using stable carbon price and increasingly high carbon price in 2040. A distinction can be explained due to increase of expenditures for GHG emissions from installations. The operators will most likely consider switching to use 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.

[34] Draft non-CO_2 GHG emission scenario using energy sector drivers from the PRIMES Draft Reference v1 scenario (October 2020), agricultural sector drivers from CAPRI scenario 2020 (7 Oct 2020), and drivers for waste, industry and F-gas sectors developed in GAINS in consistency with PRIMES model macroeconomic projections.

[35] Recommended parameters for reporting on GHG projections in 2021

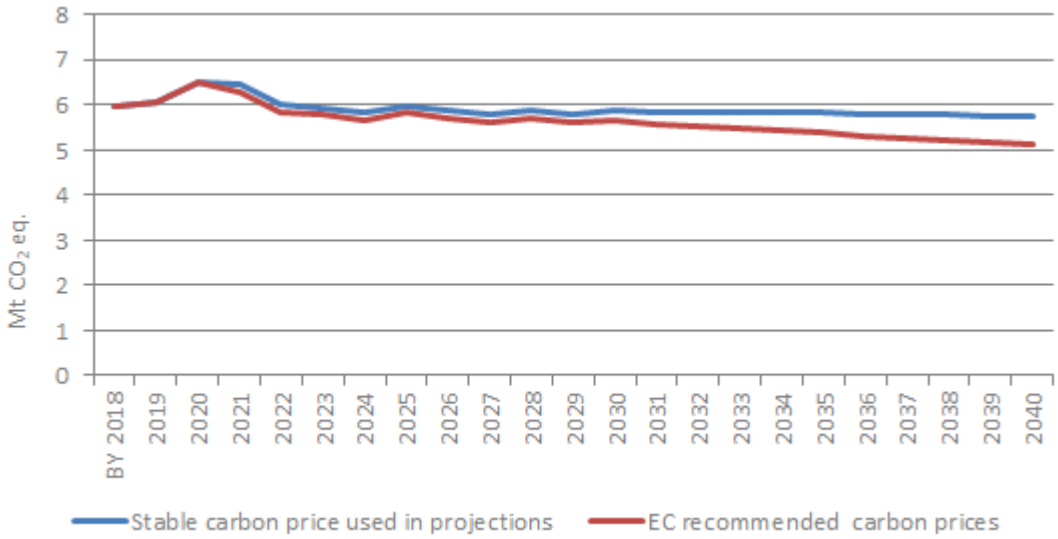


Figure 4-39. Results of carbon price impact on GHG emissions in Lithuania's EU ETS sectors

Results show that because of increase of EUAs price up to 53 EUR/t CO_2 the biggest reduction of GHG will be seen in Public electricity and heat production sectors and in Manufacturing industries and construction sectors. This is because at a current state fossil fuel fired combustion units are still vastly used in these sectors and there is a potential to replace them with biomass using units or to change electricity production sources from thermal CHPs into wind or solar power plants.

4.7.2 Industrial processes and product use sector

Sensitivity analysis for IPPU sector emissions are based on the scenarios, where amount of nitric acid production (Table below) are based on the values given by the European Commission.

Table 4-45. Values given by European Commission

Indicator	2020	2025	2030	2035	2040
Amount of nitric acid production, kt	1236	1273	1296	1310	1325

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 4.3.2.

Table 4-46. GHG emission per subcategory, kt CO_2 eq.

Subcategory	2020	2025	2030	2035	2040
Nitric acid production (WEM)	221.14	250.26	250.26	250.26	250.26
Nitric acid production (SEN)	234.47	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.

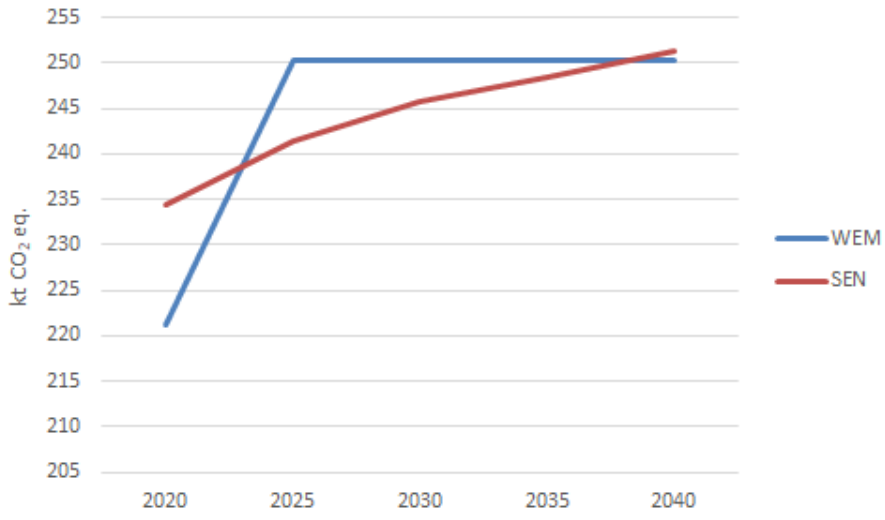


Figure 4-40. Sensitivity analysis for GHG emissions

4.7.3 Agriculture sector

Sensitivity analysis for Agriculture sector emissions are based on the scenarios, where livestock population, consumption of inorganic N fertilizers and other important data (table below) are based on the values given by the European Commission.

Table 4-47. Values given by European Commission

Indicator	2020	2025	2030	2035	2040
Livestock data					
Dairy cattle, thous. heads	222.7	233.7	190.7	172.9	164.3
Milk production, kg/head	6 740.6	7 049.2	8 056.8	8 652.9	8 902.0
Non-dairy cattle, thous. heads	382.0	432.1	417.1	431.9	452.7
Swine, thous. heads	540.1	707.6	677.2	667.0	627.7
Horses, thous. heads	17.8	17.8	17.8	17.8	17.8
Sheep and goats, thous. heads	155.2	165.5	176.1	186.8	197.7
Agriculture soil data					
Inorganic N fertilizer, kt N	154.0	159.6	163.7	163.7	168.5
Crop residues, kt N	84.0	84.0	84.0	84.0	84.0
Cultivation of histosols, M ha	0.14	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 form agriculture sector (table and figure below). The methodology for calculating WEM scenario is provided in Chapter 4.4.2.1.

Table 4-48. GHG emission per subcategory, kt CO_2 eq.

Subcategory	2020	2025	2030	2035	2040
Enteric fermentation (WEM)	1 414.8	1 441.8	1 467.3	1 418.8	1 365.6
Enteric fermentation (SEN)	1 378.7	1 523.3	1 372.6	1 351.1	1 369.0
Manure management (WEM)	404.6	381.6	392.3	391.9	388.8

Manure management (SEN)	400.1	412.5	380.0	377.7	381.6
Agriculture soils (WEM)	2 410.8	2 321.7	2 160.1	2 065.7	1 962.0
Agriculture soils (SEN)	2 404.3	2 343.7	2 146.4	2 061.1	1 977.4
Total Agriculture (WEM)	4 262.8	4 176.8	4 049.6	3 905.2	3 743.9
Total Agriculture (SEN)	4 215.6	4 311.2	3 928.9	3 818.6	3 755.5

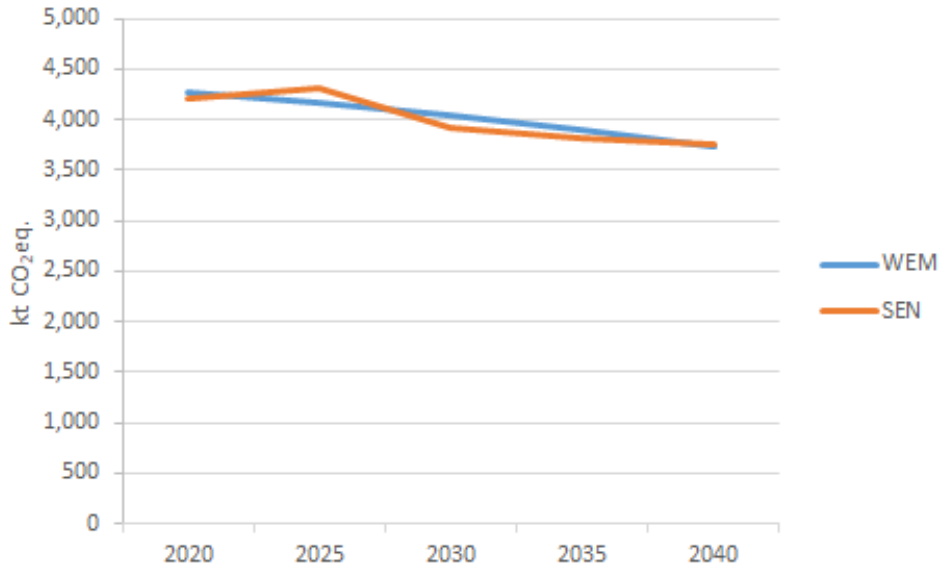


Figure 4-41. Sensitivity analysis for GHG emissions

4.7.4 LULUCF sector

Sensitivity analysis for LULUCF sector emissions are 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 4-49. Values given by European Commission

Indicator	2020	2025	2030	2035	2040
Growing stock volume change, thous. m^3	5,925.1	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 4.5.2.1.

Table 4-50. GHG removals per subcategory, kt CO_2 eq.

Subcategory	2020	2025	2030	2035	2040

Forest land (WEM)	-5,926.3	-5,895.4	-5,782.7	-5,671.5	-5,662.3
Forest land (SEN)	-5,520.0	-6,025.9	-5,969.5	-5,671.0	-5,681.1
HWP (WEM)	-784.5	-854.8	-779.3	-717.6	-664.5
HWP (SEN)	-314.6	-611.0	-806.9	-685.0	-587.8
LULUCF (WEM)	-4,829.2	-4,928.4	-4,945.2	-4,603.4	-4,497.3
LULUCF (SEN)	-3,953.0	-4,815.1	-5,159.5	-4,570.2	-4,439.3

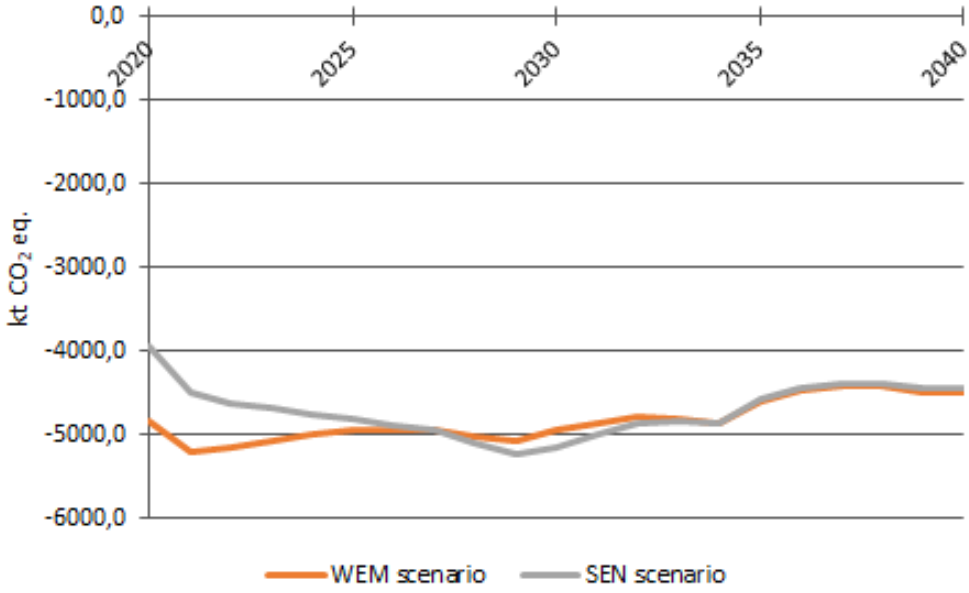


Figure 4-42. Sensitivity analysis for GHG removals in LULUCF sector

4.7.3 Waste sector

Sensitivity analysis for Waste sector emissions are 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 given by the European Commission.

Table 4-51. Values given by European Commission

Indicator	2020	2025	2030	2035	2040
Amount of MSW, kt	1330	1321	1311	1308	1312
Population not connected to centralized WW collection,%	29.1	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 4.6.2.1. The subcategory Waste incineration is not affected by the change of variables.

Table 4-52. GHG emission per subcategory, kt CO_2 eq.

Subcategory	2020	2025	2030	2035	2040
Solid waste disposal (WEM)	560.7	417.0	321.0	235.6	182.5
Solid waste disposal (SEN)	560.7	419.0	323.9	238.5	186.6

Biological treatment of solid waste (WEM)	102.7	94.2	96.9	100.8	104.4
Biological treatment of solid waste (SEN)	103.5	98.0	103.4	110.7	116.5
Wastewater treatment and discharge (WEM)	154.6	128.7	106.7	103.5	100.6
Wastewater treatment and discharge (SEN)	190.0	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.

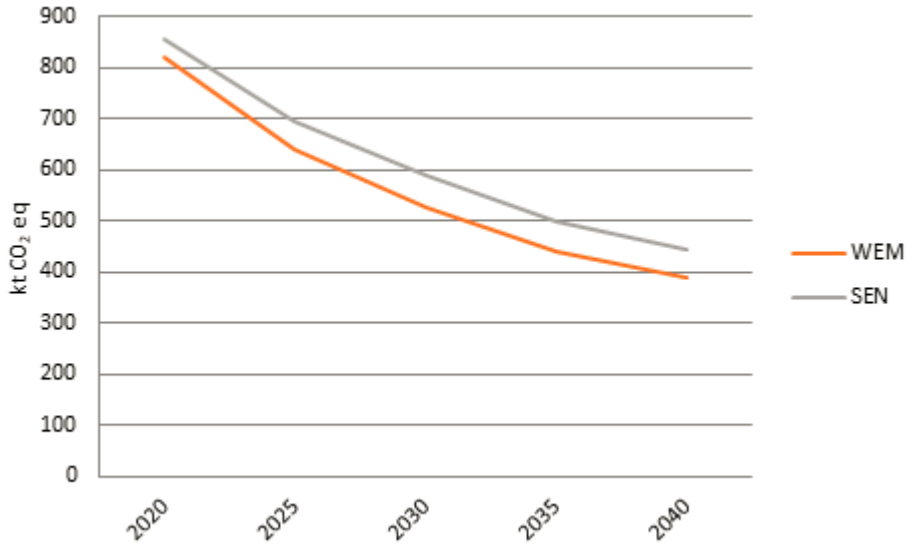


Figure 4-43. Sensitivity analysis for GHG emissions

4.8 Total projected GHG emissions

For the projections of GHG emissions up to 2040 the base year of 2018 was chosen (NIR 2021 March submission data). Lithuania provides GHG projections for 2020, 2025, 2030, 2035 and 2040. As a result of global economic crisis national GHG emissions decreased considerably in 2009. In 2010 the GHG emissions as it was expected increased following closure of Ignalina NPP in 2009. However, because of electricity imports and slower economic growth during recovery from crisis period the GHG emissions did not increase further.

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 could result in lower GHG emissions in 2040 if compared WAM and WEM scenarios.

Total historic and projected GHG emissions in Lithuania are presented in Figure 4-44, Tables 4-53 and 4-54.

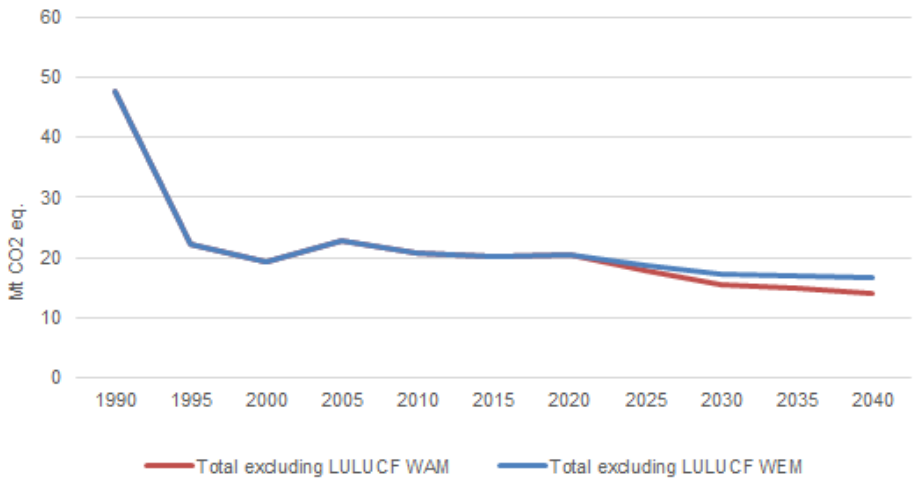


Figure 4-44. Aggregated projected GHG emissions by 2040, Mt CO_2 eq.

Table 4-53. Projected GHG emissions in case of WEM scenario, kt CO_2 eq.

Sector	BY 2018	2020	2025	2030	2035	2040
Energy	11 877	11 496	10 306	9 361	9 310	9 252
IPPU	3 184	3 980	3 680	3 414	3 326	3 241
Agriculture	4 231	4 263	4 177	4 050	3 905	3 744
LULUCF	-6 511	-4 829	-4 928	-4 945	-4 603	-4 497
Waste	857	820	641	526	441	389
Total excluding LULUCF	20 149	20 558	18 804	17 351	16 982	16 625
Total including LULUCF	13 638	15 729	13 876	12 405	12 379	12 128

Table 4-54. Projected GHG emissions in case of WAM scenario, kt CO_2 eq.

Sector	BY 2018	2020	2025	2030	2035	2040
Energy	11 877	11 476	9 722	7 884	7 524	7 173
IPPU	3 184	3 980	3 590	3 234	3 146	3 061
Agriculture	4 231	4 263	4 023	3 726	3 609	3 490
LULUCF	-6 511	-4 972	-5 895	-6 791	-7 076	-7 262
Waste	857	820	638	523	439	387
Total excluding LULUCF	20 149	20 538	17 973	15 367	14 717	14 110
Total including LULUCF	13 638	15 566	12 078	8 576	7 641	6 848

According to projected GHG emissions in case of WAM scenario, additional implemented measures will result in total **2515 kt CO_2 eq.** (excluding LULUCF) decrease compared to WEM scenario in 2040.

4.9 GHG emissions from the EU ETS and ESD sectors

In 2018 the EU ETS emissions in Lithuania amounted to 5 953 kt of CO_2 and constituted 29.5% of total GHG emissions in Lithuania (excluding LULUCF). The main sources of the EU ETS GHG emissions are public electricity and heat production, petroleum refining, manufacturing industries and construction as well as emissions from industrial processes. In 2018 the EU ETS scope covered 86 installations and 1 aircraft operator.

For GHG projections the emissions from the EU ETS sectors were calculated according to the emissions reported by installations in 2018. Emissions from total 86 installations were distributed according to sectors from which they were originated. These sector-categorized emissions were

used as base year for further calculation of the EU ETS GHG emissions in Lithuania up to year 2040. It was assumed that the sector split would remain mostly the same and that the carbon price will not do any impact for GHG emissions, except for EU ETS companies in pipeline transportation and commercial/institutional subsectors.

Results of projected GHG emissions in the EU ETS sectors are presented in Figure 4-45, Tables 4-55, 4-56.

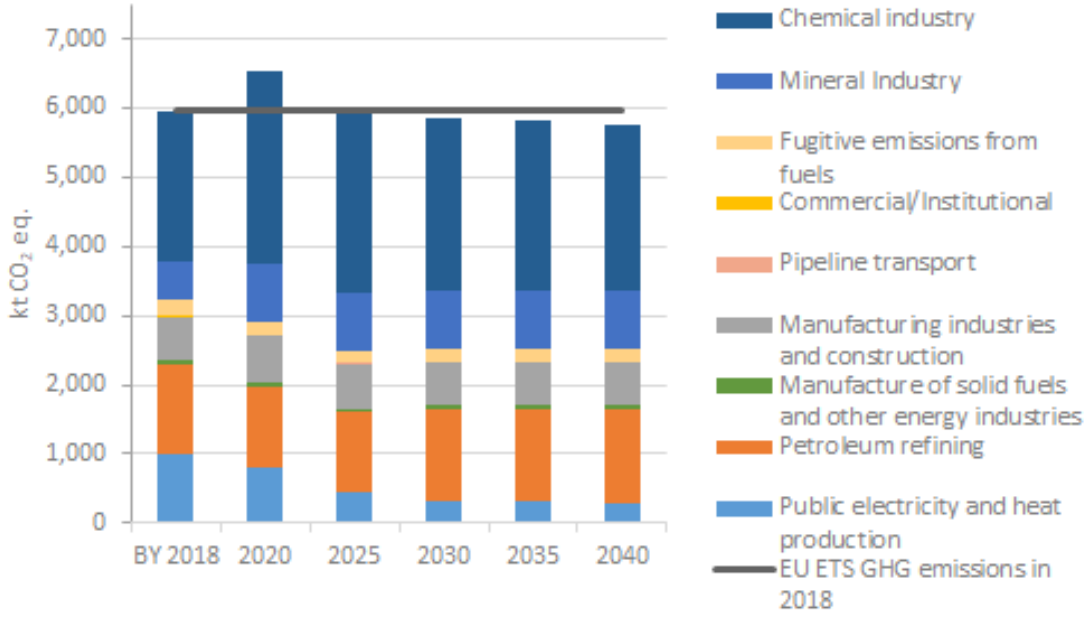


Figure 4-45. Projected GHG emissions in the EU ETS sectors (WEM Scenario), kt CO_2 eq.

In order to adjust the EU auctioned EUAs supply and stabilize the price of EUAs, the EP and the Council Decision concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC was adopted in May 2015, according to which the market stability reserve operates from 1st of January 2019 and other measures of reformed EU ETS will be approved for the period 2021–2030. These measures will affect the EU and Lithuanian ETS operators.

It is predicted that the shortage of EUAs will appear in the fourth phase of EUA market during the period of 2021–2030. The biggest shortage of EUAs will remain in sectors that are at the highest risk of carbon leakage: cement, ammonia production, oil refining, glass industry, where fossil fuels are still used.

Compared to WEM scenario, support for additional RES capacities for industry (LT+) would result in little decrease in GHG emissions in WAM scenario in manufacturing industries and construction sector. Furthermore, promoting the substitution of polluting technologies with cleaner ones would reduce GHG emissions in chemical industry processes in WAM scenario.

Table 4-55. Projected GHG emissions in the EU ETS sector, kt CO_2 eq. (WEM scenario)

Sector	BY 2018	2020	2025	2030	2035	2040
Public electricity and heat production	987.35	788.35	442.82	305.02	302.96	300.7
Petroleum refining	1 312.38	1 190.68	1 158.20	1 344.81	1343.47	1 343.47
Manufacture of solid fuels and other energy industries	46.11	49.72	49.72	49.72	49.72	49.72
Manufacturing industries and	634.42	677.55	656.55	624.81	628.19	628.39

construction						
Pipeline transport	4.75	4.35	3.42	3.02	2.25	1.67
Commercial/Institutional	4.87	2.74	2.41	2.20	1.62	1.20
Fugitive emissions from oil	250.87	205.21	186.16	198.33	189.22	189.22
Cement production	511.33	805.25	805.25	805.25	805.25	805.25
Mineral industry (other non-cement production)	25.43	23.25	25.39	25.78	26.08	26.39
Chemical industry	2 176.05	2 773.15	2 638.99	2 505.75	2 467.69	2 401.07
Total	5 953.57	6 520.26	5 968.92	5 864.70	5 816.44	5 747.10

Table 4-56. Projected GHG emissions in the EU ETS sector, kt CO_2 eq. (WAM scenario)

Sector	BY 2018	2020	2025	2030	2035	2040
Public electricity and heat production	987.35	788.35	442.82	301.80	299.74	297.52
Petroleum refining	1 312.38	1 190.68	1 158.20	1 344.81	1 343.47	1 343.47
Manufacture of solid fuels and other energy industries	46.11	49.72	49.72	49.72	49.72	49.72
Manufacturing industries and construction	634.42	677.55	648.97	606.93	601.87	594.02
Pipeline transport	4.75	4.36	3.78	3.69	2.75	2.04
Commercial/Institutional	4.87	2.74	2.41	2.20	1.62	1.20
Fugitive emissions from oil	250.87	205.21	186.16	198.16	189.22	189.22
Cement production	511.33	805.25	805.25	805.25	805.25	805.25
Mineral industry (other non-cement production)	25.43	23.25	25.39	25.78	26.08	26.39
Chemical industry	2 176.05	2 773.15	2 578.27	2 384.32	2 346.25	2 279.64
Total	5 953.57	6 520.27	5 900.99	5 722.83	5 665.98	5 588.98

The EU ETS GHG projection results show that GHG emissions in 2040 will decrease by 3% and will be equal in total 5 747.1 kt CO_2 eq., if carbon prices remain stable (according to WEM scenario). The EU ETS GHG emissions sensitivity according to EUAs price changes was analysed in Chapter 4.7.1.

Sectors which do not fall under the scope of the EU ETS contribute the major proportion of GHG emissions in Lithuania. Those sectors are transport (except pipeline transport, international aviation and CO_2 from domestic aviation), non-ETS industry, agriculture, waste and non-ETS energy. The Effort Sharing legislation establishes binding targets of annual GHG emissions for Member States for the periods 2013–2020 and 2021-2030. The EU Member States' national targets will collectively deliver a reduction of around 10% in total the EU emissions from the sectors not covered by the EU ETS by 2020 and of 30% by 2030, compared with 2005 levels[36].

Projected emissions in the non-ETS sectors are presented in Figures 4-46, 4-47 and Tables 4-57, 4-58.

[36] Effort Sharing Regulation: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.156.01.0026.01.ENG

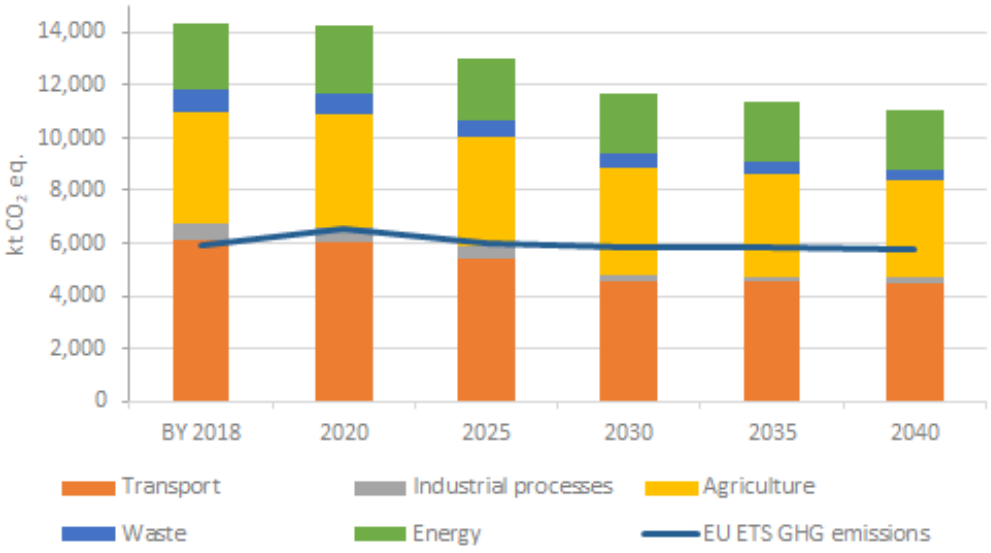


Figure 4-46. Projected GHG emissions in non-ETS sectors (without LULUCF) (WEM scenario), kt CO_2 eq.

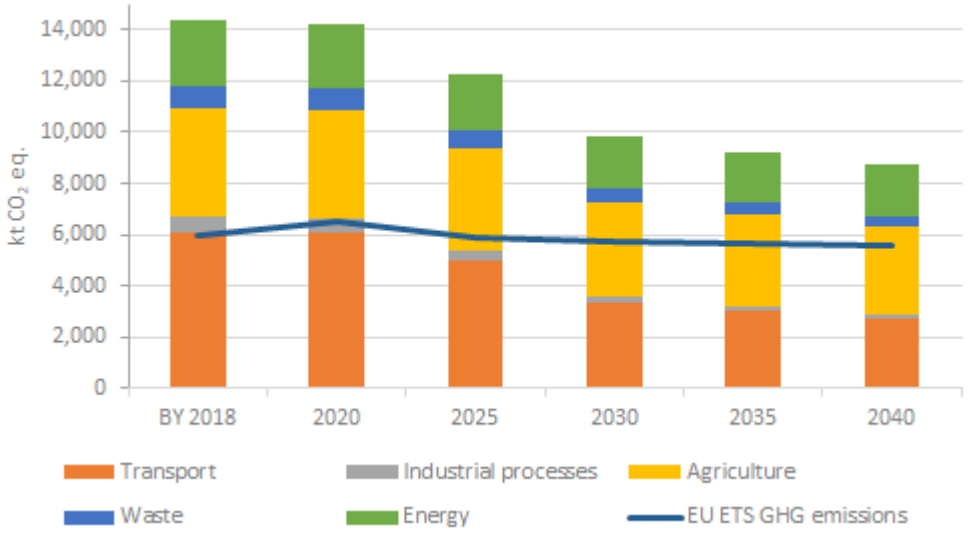


Figure 4-47. Projected GHG emissions in the non-ETS sectors (without LULUCF) (WAM scenario), kt CO_2 eq.

WEM and WAM scenarios differences result in decrease in GHG emissions by 15.8% in the ESR sectors in 2030. The main drivers behind this decrease are yearly car pollution tax, support for the purchase of commercial vehicles powered by alternative energy sources, limitation of transport with an internal engine in defined city zones and more effective and precise use of inorganic N fertilizers in agriculture sector. These measures together with other smaller additional measures will determine lower total GHG emissions in the ESR sectors (9 834.23 kt CO_2 eq. in WAM scenario in 2030 and 8 708.95 kt CO_2 eq. in 2040).

Table 4-57. Projected GHG emissions from the ESR sectors, kt CO_2 eq. (WEM scenario)

Sector	BY 2018	2020	2025	2030	2035	2040
Energy	2543.05	2 523.12	2 355.65	2 282.38	2 269.54	2 252.89
Transport	6 090.79	6 052.29	5 448.80	4 507.58	4 480.21	4 441.35
Industrial processes	644.02	572.66	404.42	269.10	217.30	197.32

Agriculture	4 231.08	4 262.82	4 176.76	4 049.64	3 905.21	3 743.89
Waste	857.18	819.54	641.37	526.13	441.37	389.00
Total	14 366.11	14 230.44	1 3027.01	11 675.74	11 354.53	11 065.36
Reported in 2020 submission	14 594.64	14 550.75	14 166.67	13 648.51	13 300.24	13 071.57
Difference between data in 2021 and 2020	-228.53	-320.31	-1 139.66	-1 972.77	-1 945.71	-2 006.21

Table 4-58. Projected GHG emissions from the ESR sectors, kt CO_2 eq. (WAM scenario)

Sector	**BY 2018**	**2020**	**2025**	**2030**	**2035**	**2040**
Energy	2 543.05	2 503.08	2 226.33	2 022.92	2 008.13	1 986.33
Transport	6 090.79	6 052.31	5 001.61	3 351.94	3 025.24	2 706.84
Industrial processes	644.02	572.66	374.28	210.33	158.53	138.56
Agriculture	4 231.08	4 262.82	4 023.10	3 725.88	3 608.69	3 490.37
Waste	857.18	819.54	638.28	523.16	438.89	386.86
Total	14 366.11	14 210.42	12 263.59	9 834.23	9 239.48	8 708.95
Reported in 2020 submission	14 698.49	14 503.78	12 555.74	10 211.30	9 475.89	8 871.18
Difference between data in 2021 and 2020	-332.38	-293.36	-292.15	-377.07	-236.41	-162.23

Total projected ESD and ESR emissions in case of two scenarios (WEM and WAM) are shown in the Figure 4-48. These emissions are compared with the annual emission allocations (AEAs) set by the Commission under Decision 2013/162/EU and adjusted by the Decision 2013/634/EU for the ESD sectors in the period of 2013-2020[37]. For the period of 2021-2030, ESR emission reductions are compared with the projected AEAs according to European Parliament and of the Council under Regulation 2018/842 and Commission Implementing Decision (EU) 2020/2126. According to projected GHG emissions included in the ESD sector, Lithuania should be in compliance with the AEAs for the period 2019-2020. The period 2021-2030 is seen as a challenge, because the GHG reduction target becomes negative, but Lithuania should also comply with its 2030 GHG reduction targets if existing PaMs work as expected. According to Regulation (EU) 2018/842 of the European Parliament and of the Council, Lithuania may use up to 6 500 kt CO_2 eq. of LULUCF credits to comply with its GHG emission reduction targets during 2021-2030. The estimated difference between AEAs and projected GHG emissions (WEM) is 429.2 kt CO_2 eq. in 2019 and 1 009.6 kt CO_2 eq. in 2020. Concerning the period 2021-2030, the difference between AEAs and WEM scenario is 1 937.3 kt CO_2 eq. in 2021 and 81.5 kt CO_2 eq. in 2030. The ESR projected GHG emissions comparing with submitted in 2020 differentiate up to 14.5% in case of WEM scenario and by 2-3.7% in case of WAM scenario in 2020-2030 (Tables 4-57 and 4-58). The main reason of the difference in WEM scenario is new measures adopted from late 2019 till early 2021. Reasons in WAM scenario are recalculations due to data estimation methodological improvements, activity data updates and adopted measures which were not even included as additional in submission 2020.

[37] https://ec.europa.eu/clima/policies/effort_en

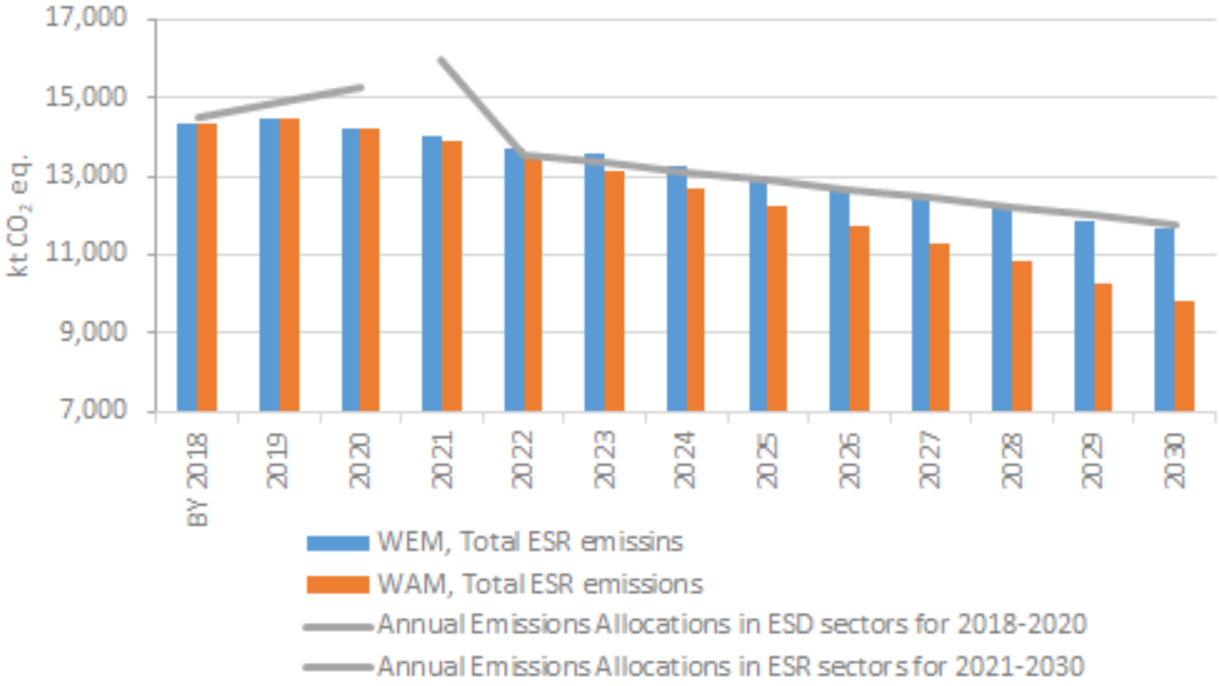


Figure 4-48. Comparison of WEM and WAM scenarios and AEAs set for Lithuania in the ESR sectors for the period of 2018-2020 and AEAs for the period of 2021-2030.

6. Comparison between submissions

The methodology and assumptions used for the preparation of the projections 2021 are different from that used for the preparation of the emission projections for the Projection 2020 report. The main differences in methodology and assumptions are as follow:

a. The base year in the Projection 2020 is 2016; while in the Projection 2021 was 2018.
b. The projected GHG emissions were higher in the Projection 2020 than in current submission:

Table 5-1. Changes in projections since Projection 2020 report, kt CO_2 eq.

	2020	2025	2030	2035	2040
Energy without transport					
WEM 2021	5 437.38	4 851.51	4 807.27	4 784.71	4 765.61
WEM 2020	5 653.34	5 186.81	5 025.41	5 016.72	4 994.11
Difference	**-215.96**	**-335.29**	**-218.14**	**-232.01**	**-228.50**
WAM 2021	5 417.34	4 714.61	4 526.71	4 493.77	4 461.47
WAM 2020	5 613.15	4 875.23	4 585.69	4 556.50	4 522.89
Difference	**-195.81**	**-160.62**	**-58.98**	**-62.73**	**-61.42**
Transport					
WEM 2021	6 058.34	5 454.08	4 553.51	4 525.45	4 486.09
WEM 2020	6 186.80	6 318.77	6 180.70	5 977.66	5 856.60
Difference	**-128.45**	**-864.70**	**-1 627.19**	**-1 452.21**	**-1 370.50**
WAM 2021	6 058.37	5 007.24	3 357.62	3 030.07	2 711.05
WAM 2020	6 179.99	5 187.92	3 675.59	3 179.53	2 769.28
Difference	**-121.61**	**-180.68**	**-317.98**	**-149.46**	**-58.23**
Industrial processes					
WEM 2021	3 979.72	3 680.43	3 414.00	3 325.74	3 240.75
WEM 2020	3 929.25	3 710.31	3 556.85	3 488.73	3 446.80
Difference	**50.47**	**-29.87**	**-142.85**	**-162.99**	**-206.05**
WAM 2021	3 979.72	3 589.58	3 233.80	3 145.54	3 060.55
WAM 2020	3 929.25	3 619.30	3 376.50	3 308.38	3 266.45
Difference	**50.47**	**-29.72**	**-142.70**	**-162.84**	**-205.90**
Agriculture					
WEM 2021	4 262.82	4 176.76	4 049.64	3 905.21	3 743.89
WEM 2020	4 399.42	4 364.48	4 303.83	4 345.78	4 378.79
Difference	**-136.60**	**-187.71**	**-254.19**	**-440.56**	**-634.89**
WAM 2021	4 262.82	4 023.09	3 725.88	3 608.68	3 490.37
WAM 2020	4 399.42	4 125.53	3 755.97	3 718.42	3 680.86
Difference	**-136.60**	**-102.44**	**-30.09**	**-109.74**	**-190.50**
LULUCF					
WEM 2021	-4 829.22	-4 928.37	-4 945.17	-4 603.38	-4 497.34
WEM 2020	-4 662.88	-3 877.40	-3 329.11	-3 042.34	-2 771.84
Difference	**-166.33**	**-1 050.97**	**-1 616.06**	**-1 561.04**	**-1 725.50**
WAM 2021	-4 971.96	-5 895.22	-6 791.32	-7 075.87	-7 261.97
WAM 2020	-4 662.88	-4 114.44	-3 936.08	-4 002.86	-4 384.94
Difference	**-309.08**	**-1 780.78**	**-2 855.24**	**-3 073.00**	**-2 877.02**

	2020	2025	2030	2035	2040
Waste					
WEM 2021	819.54	641.37	526.13	441.37	389.00
WEM 2020	857.02	686.00	567.33	463.33	382.26
Difference	**-37.48**	**-44.63**	**-41.20**	**-21.96**	**6.74**
WAM 2021	819.54	638.28	523.16	438.89	386.86
WAM 2020	857.02	661.95	527.46	411.20	318.39
Difference	**-37.48**	**-23.67**	**-4.31**	**27.69**	**68.47**
Total excluding LULUCF					
WEM 2021	20 557.81	18 804.16	17 350.55	16 982.47	16 625.35
WEM 2020	21 025.83	20 266.37	19 634.11	19 292.21	19 058.56
Difference	**-468.02**	**-1 462.21**	**-2 283.56**	**-2 309.74**	**-2 433.21**
WAM 2021	20 537.80	17 972.81	15 5367.17	14 716.95	14 110.30
WAM 2020	20 978.83	18 469.93	15 921.22	15 174.02	14 557.86
Difference	**-441.04**	**-497.12**	**-554.05**	**-457.07**	**-447.57**

c. In order to reflect historical or base year more accurately the projected activity data for the Projection 2021 was updated for all sectors.
d. Some additional measures introduced in the Projection 2020 were approved by government, which also led to GHG emissions decrease in the Projection 2021.
e. Obtained projected activity data from petroleum refinery and LNG terminal as well as natural gas transmission and distribution enterprises.
f. Private car exploitation time shortened from 20 years to approximately 10-11 years in private cars model.
g. The projection for population was taken from EU Reference Scenario in Projection 2021, while in the Projection 2020 it was taken from the Comprehensive Plan of the Territory of the Republic of Lithuania.
h. The projected GDP growth rate for the Projection 2021 was taken from EU reference Scenario, however for the Projection 2020 it was obtained from the study “Baltic Energy Technology Scenarios 2018” prepared by Nordic Council of Ministers.

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