


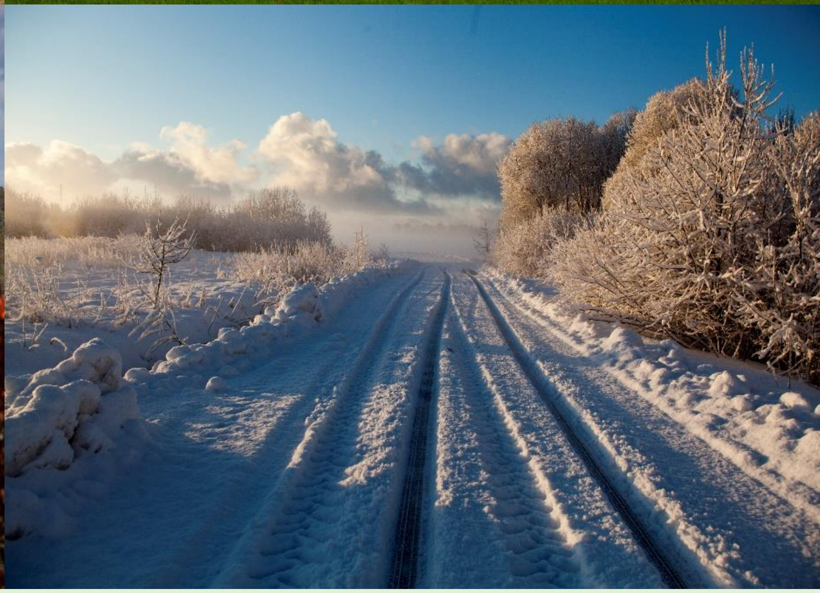

LATVIA'S EIGHT NATIONAL COMMUNICATION

and FIFTH BIENNIAL REPORT

under the United Nations Framework Convention on Climate Change

2022

DATA SHEET

Title

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INTRODUCTION

This report represents eight National Communication (NC8) and the fifth Biennial Report (BR5) of the Republic of Latvia required under Article 12 of the United Nations Framework Convention on Climate Change (UNFCCC), Article 7.2 of the Kyoto Protocol (KP) (Appendix 1) and according to the Decision 2/CP.17 of the Conference of the Parties (COP) under the UNFCCC. This report provides a comprehensive overview of climate change-related activity in Latvia during the period from 2017 until 2020. Information in this report has been prepared according to UNFCCC decision 6/CP.25 “Revision of the UNFCCC reporting guidelines on national communications for Parties included in Annex I to the Convention”.

Latvia has chosen to submit its BR5 and common tabular format (CTF) tables as defined in the UNFCCC biennial reporting guidelines for developed country Parties (UNFCCC decision 19/CP.18) as an Annex 1 to NC8. For the CTF submission to the UNFCCC, the electronic reporting facility provided by the UNFCCC secretariat has been used as required by UNFCCC decision 19/CP.18. In order to avoid duplication of information, overlapping contents has been limited as much as possible and mostly are concentrated in the NC8.

Latvia’s NC8 provides the latest information of climate change, its impacts and mitigation options:

- Summary of information about national profiles (government structure, population, geographic, climate, economic, energy, transport, industry, waste, building, agriculture and forestry profiles) and circumstances relevant to greenhouse gas (GHG) emissions and removals on a sectorial basis (Chapter 2);
- Information on most recent GHG inventory, National system and National registry (Chapter 3);
- An overview of actual climate change mitigation policies and measures (Chapter 4);
- Projections of GHG emissions until 2040 and the total effects of policies and measures (Chapter 5);
- Latvia’s vulnerability assessment, climate change impacts and adaptation measures (Chapter 6);
- Information on financial resources and transfer of technology (Chapter 7);
- Information about climate research activities and systematic observation (Chapter 8);
- An overview of education, training and public awareness related to climate change issue (Chapter 9).

Latvia`s BR5 includes information on GHG emissions and trends, progress made in achieving quantified economy-wide emission reduction target (QEWERT) for 2020 under the UNFCCC, information on policies and measures in place to meet mitigation targets and promote climate change adaptation, provisions for financial, technological and capacity-building support to developing countries.

Since the publication of the Seventh National Communication (NC7) under the UNFCCC in 2017, Latvia’s climate change policy has advanced. At the national level, progress is seen in many sectors. Since NC7 the sectorial policy documents have been updated containing the necessary measures which ensure that Latvia achieves national target for 2020 and lays out a pathway towards meeting the long-term energy and climate objectives set by the EU. To reduce vulnerability of people, economy, infrastructure, construction and environment to the impacts of climate change and to promote the use of opportunities created by climate change Latvian National Plan for Adaptation to Climate Change until 2030 has been developed in the period since the NC7 and adopted by Cabinet of Ministers in 2019.

EXECUTIVE SUMMARY

1. EXECUTIVE SUMMARY

1.1 National Circumstances

Population of Latvia was 1 907 675 at the beginning of 2020. Since 1990, the population has decreased by about 760 465. At the beginning of 2020 in Rīga, the capital of Latvia, the population was 621 120 people, constituting 32.6% or one third of the entire population of the country. At the beginning of 2020 the population density in Latvia was 30 people per 1 km².

Latvia is situated on the edge of the Eastern European Plain near the Baltic Sea between 55° 40' and 58° 05' Northern latitude and between 20°58' and 28°14' Eastern longitude. The territory covers an area of 64 589 km² in total. Its length in the North – South direction is 210 km, and the width in the West – East direction – 450 km. Latvia is a typical lowland country and its terrain is characterized by flat, low areas and hilly elevations. There are more than 3 000 lakes and 12 000 rivers in Latvia. The total forest area (including afforested lands) in 2020 was 32 415 km², cropland 14 652 km² and grassland 10 347 km², wetland 3 995 km², settlements 3 127 km².

The main driver of climate conditions in Latvia is the received radiation from Sun. Latvia is located in the moderate climate zone, characterised by seasonality and a different length of daytime. In 1991-2020 normal period annual mean air temperature in Latvia is +6.8 °C. Lowest annual mean air temperature (+5.7 °C) is in the Alūksne and Vidzeme Uplands, but highest is in coastal areas of Baltic Sea: +7.5... +7.9 °C, thus, illustrating how the proximity to the Baltic Sea and elevation changes impact climatic conditions notably, but with exception of Rīga, where due to influence of city "heat island" is the highest annual mean air temperature: +8.0 °C. Air temperature has a seasonal nature – February being the coldest month with average air temperature -3.1 °C and July being the warmest with +17.8 °C.

As the economy of Latvia is small and open there is significant dependence on the trends of global economy. Foreign trade is important, with exports of goods and services accounting for about 60% of the gross domestic product (GDP). The services sector had the dominating share in Latvia value added (VA) total followed by manufacturing and construction, while the agriculture sector and other industries had a minor role. In 2020 the most important sectors in the manufacturing industry were wood processing, food and beverages, electrical appliances, fabricated metal products, chemical industry and non-metallic minerals.

In 2020, the total primary energy consumption was 4.38 Mtoe. Like many other EU countries Latvia depends on the import of primary sources, however, Latvia's dependency has decreased from 86% (in 1990) to 57.9% (in 2020), mainly due to increasing the use of wood biomass and other renewable energy sources (RES).

The structure of primary energy sources has changed over years. The first crucial changes took place by 1995 when natural gas, and sometimes also biomass, replaced residual fuel oil for generating electricity and heat, and coal for heat production. Further vital changes began in 2010 when through different state support measures natural gas and other fossil fuels started to be replaced by biomass (solid and gaseous) for heat production in district heating systems, in this period biomass started to be used also for power production in combined heat and power plants (CHP) mode. Wider use of solid biomass also begun in some industries.

In 2020, three types of energy sources dominate in the supply of primary energy sources in Latvia: oil products (31.8%), which are mainly petrol and diesel fuel used in the transport sector; natural gas (21.1%), mainly used (around two thirds of consumption) for generating electricity and heat in CHPs and the rest of consumption being rather equally divided between industry, services and household end-use sectors; biomass (36.5%), used mainly for heating in different sectors as well as and generating electricity and heat in CHPs.

In 2020, RES consumption has increased by 24% compared to 2010. The consumption of biogas and liquid biomass has been the fastest growing, while solid biomass accounts for about 79% of total RES consumption in 2020.

The above changes in the structure of primary energy sources have vitally decreased the carbon intensity of primary energy sources (measured as CO_2 t/toe in primary sources), allowing reduction of CO_2 emissions in the energy sector.

In 2020, the final energy consumption was 4.0 Mtoe. The transport sector's share in the final energy consumption was 28.5%. The other largest share in the final energy consumption was in the residential sector, constituting 28.3% but share of industry was about 24%.

Passenger transport (as measured in passenger kilometres) has grown considerably from 2000 to 2019 (on average by 1.1% per year). The rapid growth was ensured by the trends developing up to 2007, when the average annual growth reached 4.3% per year. The growth rate was due to the rapidly increasing number of passenger cars up to 2007. Due to the economic recession, mobility indicators declined sharply between 2008 and 2010, but from 2013 onwards the growth rate stabilized. Due to the Covid-19 pandemic in 2020, passenger traffic decreased, especially for the public transport.

The year 2019 showed the increase of freight traffic (measured in tonne-kilometres) against 2000 (41.2%). This trend was mainly driven by the growth of road transport (approximately 2.4 times) which by far exceeded the increase in rail freight traffic (12.8%).

Road transport constitutes the largest share of energy consumption in domestic transport. In 2020, passenger cars, trucks, buses and motorcycles used about 96.7% of the total consumption in domestic transport. Due to the decrease in rail freight transport over the last five years the share of rail transport in the total consumption decreased and in 2020 it constituted only 3.1%. The remaining 0.2% was made up by domestic air and water transport.

1.2 Greenhouse Gas Inventory Information

As a Party to UNFCCC and the KP as well as EU, Latvia has an obligation to prepare, publish and submit GHG inventories on an annual basis.

The annual submission (National inventory report and Common reporting format tables) contains emission estimates for the timeseries since 1990 till year prior to the previous year (x-2).

The GHG inventory is prepared according to the UNFCCC Decision 24/CP.19 Annex I reporting guidelines "Guidelines for the preparation of national communications by Parties included in Annex I of the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories on annual inventories" (UNFCCC reporting guidelines), the 2006 IPCC Guidelines for National Greenhouse Gas inventories (2006 IPCC Guidelines), 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (IPCC Wetlands Supplement) and 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (IPCC KP Supplement).

Since the NC7 Latvia has developed a number of measures to improve the national GHG inventory system and produce more accurate and comprehensive emission estimation, mainly due to activity data and emission factor improvement in all sectors. These measures are described in chapter 3.1.5 and are reported on sectorial basis.

Latvia's most recent inventory covers the year 2020 and was submitted to the UNFCCC secretariat on 14 April 2022. The inventory results for the period between 1990 and 2020 are summarised below and illustrated in Figure 1.1.

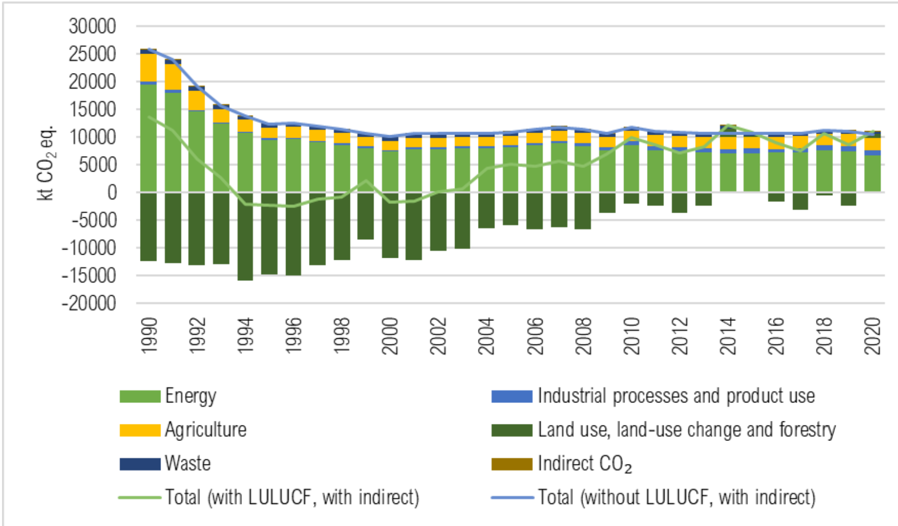


Figure 1.1 GHG emission time series for 1990–2020 (kt CO_2 eq.)

Total GHG emissions including indirect CO_2, without land use, land use change and forestry (LULUCF) sector had considerably decreased during the time period 1990–2000 (61.1%) when the national economy of Latvia transformed from central planning economy to a market economy (1990–1995) which affected all sectors of the national economy. Energy and Agriculture sectors had in this period the largest decrease of GHG emissions against 1990, respectively 62.1% and 66.3%. Reforms accomplished in Latvia have left a positive effect on economic development. GDP, between 1996 and 2000, has increased by 5.2% in average per year. Nevertheless, GHG emissions continued to decrease in this period due to fuel switch in energy sector from low quality fossil fuels (coal and heavy fuel oils) to natural gas and biomass.

Because of the rapid growth of Latvia's economy in the period 2000-2007, GDP growth by 82.2% and also resulted in the growth of total GHG emissions by 17.7%. Due to the active implementation of climate policies and measures (e.g., the increase of energy efficiency in buildings, promoting the use of renewable energy resources within EU ETS policy etc.) GHG emissions decreased.

In 2020, total GHG emissions including indirect CO_2, without LULUCF, compared to 2019, have decreased by 5.9%. This decrease was determined mainly due to emissions decrease in Energy sector (by 9.1%), in IPPU (by 2.6%) and in Waste sector (by 0.9%). However, including indirect CO_2, with LULUCF GHG emissions have increased by 27.5%.

Annual fluctuations in the emissions, particularly in Energy sector, have been notable. These have arisen especially from variation in the energy demand for heating depending on weather conditions (heating degree days), availability of hydro resources in national hydro energy power plants, imports of electricity, and the annual structure and volume of domestic energy (electricity and heat) production.

The major source of GHG emissions in 2020, excluding LULUCF, was CO_2 (6994.11 kt), accounting for 67.0% of the total emissions, accordingly CH_4 constituted 16.4%, N_2O – 14.1%, and fluorinated gases – 2.5% of total emissions. The main GHG emission source by sector in Latvia is Energy sector (64.8%) followed by Agriculture (21.5%), IPPU (8.3%), Waste (5.2%) and indirect CO_2 emissions (0.1%).

The most important source of CO_2 emissions (kt) in 2020 was fossil fuel combustion – 90.4%, including Energy Industries – 19.0%, Manufacturing Industries and Construction – 8.7%; Transport – 43.9% and Other sectors (Agriculture, Forestry, etc.) – 18.6%. Other anthropogenic emission sources of CO_2 are Industrial Processes and Product Use – 8.6%, Agriculture 1.0% and Waste 0.0006%. In 2020, the net CO_2 removal of the LULUCF sector was 758.81 kt. In 2020, CO_2 emissions without LULUCF have decreased by 64.4% compared to 1990.

The second most important GHG in Latvia is CH_4. In 2020, CH_4 emissions without LULUCF have decreased by 52.6% comparing to 1990. Main sources of CH_4 emissions in Latvia are Enteric Fermentation of livestock, Solid Waste disposal sites and Energy sector. Other important sources of CH_4 emissions are leakage from natural gas pipeline systems and combustion of biomass.

Since 1990, total N_2O emissions without LULUCF have decreased by 43.0%. Agricultural soils are the main source of N_2O emissions in Latvia generating 83.8% of all N_2O emissions (kt) in 2020. Other N_2O emission sources are from Transport sector and, biomass, liquid and other solid fuel combustion in other Energy sectors, also IPPU and Waste sectors.

Emissions for the following hydrofluorocarbons (fluorinated gases) are estimated in Latvia: HFC-23, HCF-32, HFC-125, HFC-134a, HFC-143a, HFC-152a, HFC-227ea, HFC-245fa, HFC-365mfc, and also sulphur hexafluoride (SF_6). The most consumed gas is HFC-134a, applied in stationary freezing devices and air conditioning equipment. Although the amount of fluorinated gases and the emissions caused by commercial use and industrial processes are rather small, above-mentioned cannot be underestimated in the light of the GHG Global Warming Potential. In 2020, emissions of fluorinated gases have increased by 1407.7%, compared to 1995. Since 1995 HFC emissions have increased significantly due to substitution of ozone depleting substances in refrigeration and air conditioning as well as due to increase of cars, trucks and buses equipped with mobile air conditioners. SF_6 emissions from electrical equipment contributed to 11.94 kt CO_2 eq. in 2020.

In the period from 1990 to 2020 precursors have decreased: NO_x by 66.7%, CO by 78.1%, NMVOC by 62.4% and SO_2 by 96.5%. Taking into account the amount of precursors in a great extent are determined by the fuel combustion in Energy sector. The decrease of emissions in the period of 1990-1995 was mainly caused by the rapid decrease of fuel consumption in Energy sector. However, in the subsequent years there were different causes for the reduction of different emissions of precursors. The reduction of SO_2 is mainly due to use of fuels with lower content of sulphur as well as fuel switching from solid and liquid types of fuel to natural gas and biomass. And generally, the reduction of NO_x is due to decrease of total fuel consumption that was caused by transformation of national economy as well as the energy efficiency and air control measures and also solid fuels and heavy liquid fuels replacement with natural gas and biomass fuels.

National system for GHG inventory and projections

Latvia's GHG inventory and projections submitted in 2022 are compiled according to the Regulation of the Cabinet of Ministers No. 737 adopted on 12 December 2017 "Development and management of national system for greenhouse gas inventory and projections" (CoM Regulation No. 737). The legislative act determined the institutions that are responsible for GHG inventory and projections preparation, regulates institutional cooperation for establishment and management of the national GHG inventory and projections system, including data collection mechanism and the reporting procedure as well as the procedures of Quality Assurance/ Quality Control (QA/QC) for GHG inventory and projections preparation. In 2021, CoM Regulation No. 737 was updated in order to improve the preparation of projections by improving system for long term modelling (including the establishment and maintenance of energy-climate modelling and economic modelling systems). Other agreements regarding responsibilities were maintained and continued to be in force according to CoM Regulation No. 737.

In 2022, Latvia has started to work on amendments of CoM Regulation No. 737 to address reporting requirements according to the Paris Agreement for period 2021-2030. The new CoM Regulation No. 675 "GHG inventory, projections and adaptation to climate change reporting systems" which replaces CoM Regulation No. 737 was adopted on 25 October 2022. The new CoM Regulation No. 675 was developed with the aim to improve the monitoring and reporting system for GHG emissions and CO_2 removals within the framework of the Paris Agreement, which will contain data to be submitted for 2021 and beyond. The CoM Regulation No. 675 establishes certain procedures for preparation and reporting on national adaptation measures, the use of proceeds from auctions of emission allowances, financial and technological support provided to developing countries, information on approximate and annual GHG inventory, policies, measures and GHG projections reporting and QA/QC procedures.

National registry

European Union Registry (EU registry) in Latvia is governed by the applicable EU laws on GHG emission trading also guaranteeing compliance with the decisions approved in the addendum to the Conference of the Parties serving as the meeting of the Parties to the KP (13/CMP.1 and 15/CMP.1). The EU registry software has been designed and coordinated with the requirements of the Data Exchange Standards (DES) for the Registry Systems under the KP. According to the Law on Pollution section 32, the national GHG emission unit's registry shall be established and maintained by the Latvian Environment, Geology and Meteorology Centre (LEGMC). The EU registry serves to guarantee accurate accounting for all allowances issued under the EU ETS.

1.3 Policies and Measures

Policy framework

MEPRD is the leading administrative institution in Latvia in the field of environmental protection as well as it ensures planning and coordination process of state and regional development, local governments' development and supervision, and territorial development planning. MEPRD has overall responsibility for national climate policy and compliance with the EU and UNFCCC requirements. MEPRD also coordinates the national green investment schemes. Institutions supervised by the MEPRD – State Environmental Service, Environment State Bureau, LEGMC, as well as state LLC Latvian Environmental Investment Fund – ensure implementation of the climate policy within their competences.

Latvia's participation in global climate policy efforts and actions is a key priority. Latvia's climate policy is based on international agreements: the UNFCCC and its KP (Doha amendment), Paris Agreement and the common polices of the EU, such as the EU 2020 Climate and Energy Package and Effort Sharing Decision (ESD) No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their GHG emissions to meet the Community's GHG emission reduction commitments up to 2020, followed by 2030 Climate and Energy Policy Framework, 2050 long-term strategy and the European Climate Law.

Key cross-sectorial policy documents, approved by the Parliament of Latvia (Saeima), such as "Sustainable Development Strategy for Latvia until 2030" (approved on 10 June 2010), "National Development Plan 2021-2027" (approved on 2 July 2022), "National energy and climate plan 2021-2030" (approved on 4 February 2020) and "Strategy of Latvia for the Achievement of Climate Neutrality by 2050" (approved in 2020) promotes the implementation of EU climate policy and targets.

Latvia's climate policy for period till 2020 was defined in the framework policy document "Environmental Policy Strategy 2014-2020" (approved by Cabinet of Ministers on 26 March 2014) which determines the national target for 2020 (12.16 million tons CO_2 eq.) and the overall goals of climate policy: (i) ensure Latvia's contribution to global change mitigation, taking into account Latvia's environmental, social and economic interests, and (ii) promote Latvia's ability to adapt to climate change and its impacts.

Most recent Latvia's climate policy is defined in the framework policy document "Environmental Policy Strategy 2021-2027" (approved by Cabinet of Ministers on 31 August 2022) which determines the approximate national target for non-ETS for 2027 (8.37 million tons CO_2 eq.), and national emission reduction (9.85 million tons CO_2 eq. without LULUCF). "Environmental Policy Strategy 2021-2027" sets the overall goals of climate policy: (i) ensure Latvia's progress towards achieving climate neutrality, and (ii) promote climate resilience and adaptation to climate change.

Other ministries are involved in issues related to the development and implementation of the climate change policy in line with their competencies, particularly, Ministry of Finance (MoF), Ministry of Economics (MoE), Ministry of Transport (MoT), Ministry of Agriculture (MoA), and Ministry of Education and Science (MES), as well as institutions supervised by the relevant ministries. Besides, in the implementation of climate adaptation policy important role have Ministry of Interior (MoI), Ministry of Health (MoH), Ministry of Welfare (MoW) as well.

Under the EU 2020 Climate and Energy Package, EU committed to reduce its GHG emissions by 20% by 2020 from 1990 levels. The majority of the reduction was reached within sectors covered by the EU ETS. Latvia's quantified obligation under the 2020 Climate and Energy Package for sectors not covered by the EU ETS is positive growth limited by +17% compared to 2005 in line with the ESD. Latvia has fulfilled the national annual targets for non-ETS activities set out in the ESD.

Latvia has national legislation to ensure the fulfilment of its commitments under the KP. A separate act provides an administrative framework for participation in Joint Implementation (JI) and Clean Development Mechanism (CDM) project activities and in emissions trading under the KP. Latvia strives to implement its climate policies in such a way that the social, environmental and economic impacts on other countries, and on developing countries in particular, are minimised.

Sectorial policies and measures (PaMs)

In the **energy sector** the main PaMs include the EU ETS, increasing a deployment of RES and energy efficiency and saving measures. The EU ETS is an EU-wide measure, while RES and energy efficiency are supported by various national measures: investment co-financing (EU Structural Funds, national green investment schemes, state and municipalities budgets), fuel and electricity taxation, electricity feed-in tariffs, other regulatory measures, informing energy end-use consumers. Regulatory measures to promote energy efficiency improvement include energy efficiency requirements for district heating systems (DHS), development of metering and billing of electricity and district heat for end-use consumers, re-casted Law on the energy performance of buildings, establishment of energy efficiency classes (both residential and non-residential buildings), further development of national Construction Standards, development of energy management systems practice (in large enterprises and large electricity consumers, in state administration institutions and municipalities fulfilling certain qualification criteria). Investment co-financing programmes have covered supply and all end-use sectors - DHS, households, industry, public sector, commercial tertiary sector – and have been focused on both renewable energy sources and energy efficiency.

Within the **transport sector** the regulatory measures with important impact relate to biofuel blend obligation, mandatory annual inspections of technical conditions of motor vehicles, public procurement to promote clean and energy efficient road transport. Starting from 1 January 2017 the reform of cars annual taxation introduces the taxation based on CO_2 emissions specific values. Regarding excise tax, increase of duty rates is taken place (e.g., in 2020 the rates for diesel and gasoline will be around 24% higher compared to 2015). First activities that are related to support of electric vehicles started in 2014, when Electromobility Development Plan 2014-2016 was in action, and Investment support programme to promote electric vehicles and charging infrastructure was co-financed by national green investment scheme (CCFI) in 2014-2015, continued in EU Funds 2014-2020 planning period by the deployment process of national electric vehicles charging infrastructure network, which was completed in 2021.

The most significant part of CO_2 emissions from **industrial processes and product use sector** are included in the EU ETS. Implementation of Best Available Techniques (BAT), framework procedures is laid out in the Law on Pollution, and is the measure which is particularly important one for GHG emissions reduction in industrial processes. EU regulations on F-gases constitute the most significant emission reduction measure in the sector beyond the EU ETS. Law on Pollution, transposing the appropriate EU directives, also lays down the procedures, by which emission of volatile organic compounds from installations, in which organic solvents are used, shall be limited.

Within the **agriculture sector** most of the measures fall under the sphere of the EU's Common Agricultural Policy (CAP). The measures include regulatory measures, particularly implementation of Nitrates Directive (ND) 91/676/EEC and Water Framework Directive (WFD) 2000/60/EEC. The concrete measures are focused on providing good agriculture practice – crop fertilization plans, management of nitrate use at vulnerable territories, improvement of manure management systems, requirements of manure spreading and integrated farming. Economic measures driven by CAP are introduction of leguminous plants on arable land, organic farming and maintenance of amelioration systems.

Within the **LULUCF sector,** the possibility to reduce GHG emissions in cropland are limited and the most important measures are restoration and modernization of amelioration systems, support to introduction and promotion of integrated horticulture, growing of legumes as well as other agro-environment related measures. Forests including afforestation have considerably bigger mitigation potential and the most important measures in forest land are restoration and modernization of amelioration system, afforestation and improvement of stand quality in naturally afforested areas, support to regeneration of forest stands after natural disturbances to avoid formation of naturally regenerated stands with significantly smaller GHG mitigation potential, as well as improvement of ecological value and sustainability of forest ecosystems by supporting pre-commercial thinning ensuring formation of resilient, diverse and valuable forest stands. The particular regulations define a procedure of calculation and compensation and criteria for negative effect caused by deforestation; however, it is not directly associated with the cost of GHG mitigation.

Within the **waste management** sector, the most important policies and measures relate to the separate waste collection and preparation for re-use, recycling and material recovery, management of certain types of hazardous waste. EU Funds 2021-2027 planning period envisages the investment support to increase re-using, recycling and regeneration of various sorts of waste thus reducing the amount of waste disposed to landfills. In order to promote recycling and reuse the Natural Resources Tax Law sets the rate for waste disposal, the rate for solid municipal waste in 2022 will be 80 euros per one ton.

Cross sectorial policies and measures

Latvia is implementing cross-sectorial climate change mitigation policies and measures that affect several sectors of the national economy simultaneously. Such cross-sectorial policies include the EU ETS, national green investment schemes, applying of fiscal instruments (CO_2 tax in synergy with air polluting emissions taxation), green procurement, public information programmes.

Effect of policies and measures on longer term trends

Majority of current climate and energy policies in Latvia also contribute to the reduction of GHG emissions in the longer term. For example, buildings have long lifetimes, and therefore, the regulations for the energy efficiency of new and existing buildings, a renovation of existing buildings, use of low-emissions heating in them, have long-lasting impacts. Measures that promote investments in renewable energy and that improve the competitiveness of renewable energy sources also reduce GHG emissions in the longer term. Long-term impacts relate also to improving public transport infrastructure. Prohibiting certain F-gases or halting the disposal of biodegradable waste in landfills can be expected to lead to permanent changes in current practices, and therefore to yield long-term emission reductions.

1.4 Projections

The “with existing measures” (WEM) and “with additional measures” (WAM) projections correspond to the Latvia`s report on policies and measures and projections that was submitted to EC on 11 March 2022. The WEM projection includes measures that were implemented or adopted until the year 2020.

GHG emissions in Latvia have been projected up to 2040. GHG emission projections of Latvia up to 2040 are based upon the long-term macroeconomic projection developed by the MoE. The baseline socio-economic scenario projects that the growth rates of exports and the manufacturing industry will remain based mainly on both the increased competitiveness of Latvian producers and the growing external demand. According to this scenario it is expected that GDP, similarly to private consumption, will increase during 2020-2040. Latvia`s population is expected to continue to decrease by 8.8% from 1.908 to 1.740 million in 2020-2040.

Total GHG emissions (without LULUCF, with indirect CO_2) under WEM scenario will decrease by 2.6% up to 2030 and 20.0% up to 2040, compared to 2020. Compared to 1990, total GHG emissions (without LULUCF, with indirect CO_2) are expected to decrease by 60.7% in 2030 and by 67.7% in 2040. The Energy sector (including Transport) will account for the biggest share amounting to 65.0% of the total projected GHG emissions in 2030, followed by the Agriculture sector with its share amounting to 22.2%, IPPU with 8.2% share, Waste sector with 4.4% and indirect CO_2 emissions with 0.1%.

The WEM scenario projects that in 2030 the greatest part of the non-ETS sector emissions will be from Transport sector (35.8%), then Agriculture sector with 29.4%, Other non-ETS Energy sector (including Energy industries, Manufacturing industries and construction, Commercial/Institutional, Agriculture/Forestry/Fishing etc.) – 19.7%, Residential and Waste sector accordingly 6.3% and 5.9% and non-ETS IPPU sector with 2.9% of total non-ETS emissions. In 2030, share of Agriculture will increase by 2.7% against 2020 from total non-ETS emissions. The share of Transport, Other non-ETS Energy, non-ETS IPPU, Residential and Waste sector in the total non-ETS sector emissions will almost not change up to 2030 (Figure 1.2).

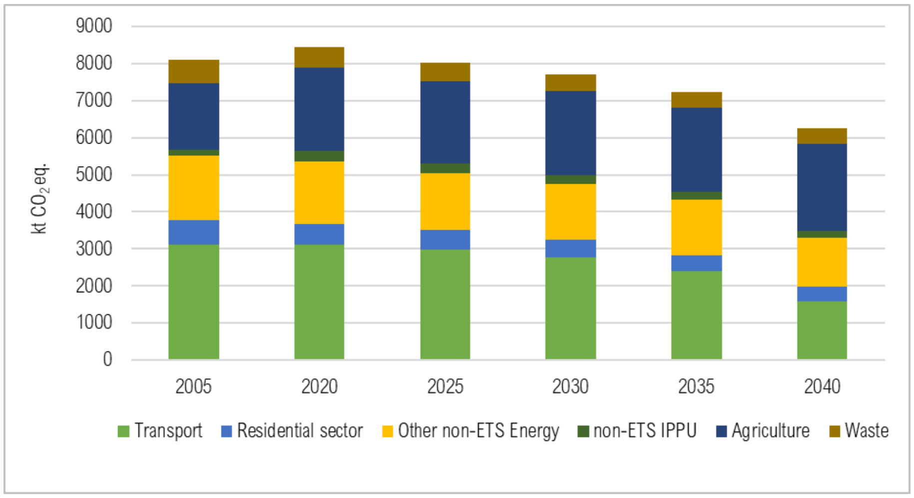


Figure 1.2 GHG emissions in the non-ETS sector by category based on the latest GHG inventory for year 2005 and 2020 and the WEM projection (up to 2040)

Total GHG emissions (without LULUCF, with indirect CO_2) under the WAM scenario in 2030 are projected to decrease by 4.2%, compared to WEM scenario, but in 2040 emissions are projected to decrease by 6.7%. The additional GHG emission mitigation measures under the WAM scenario allow a significant reduction of projected emissions mainly in the Transport sector. Thus, in 2030 under the WAM scenario emissions in the Transport sector are projected to decrease by 6.7% and in 2040 by 10.3% than in the respective years under the WEM scenario. The main reason for the decrease is wider biofuel and electricity use. In addition, the WAM scenario envisages energy efficiency improvement support programmes for residential, commercial and industry sectors, as well as electricity production by utilising RES slightly increases, compared to WEM scenario, due to additional solar PV and wind power capacities.

The total estimated reduction of GHG emissions from the implemented measures by 2020 is 2739 kt CO_2 eq. The largest contributors to reducing GHG emissions by 2020 are the energy transformation sector (87%), followed by the transport sector (5.5%), industry (4.1%) and the household and tertiary sector (3.4%). The estimated effect from the implemented measures in the WEM scenario for 2030 is 1427 kt CO_2 eq. The largest contributors are the energy transformation sector (51.5%), the transport sector (41.5%) and the household and tertiary sector (7%).

1.5 Vulnerability Assessment, Climate Change Impacts and Adaptation Measures

Recently, the LEGMC, the Latvian National Hydrometeorological and Climate Service and maintainer of the national hydrological (surface and underground), meteorological and air quality monitoring network, has taken a number of important steps to improve weather, climate and climate change characterization. The network of weather observing stations has been fully automated, enabling more detailed weather observations, particularly in extreme weather events. Similarly, to other countries in Latvia the digitization of historical meteorological observations, which provides additional information on climate research, is underway. A number of climate change studies have been carried out after the report “Climate Change Scenarios for Latvia”, in which LEGMC developed climate change scenarios for Latvia for the period until the year 2100. In these studies, past and future changes of the snow cover, the Standard precipitation index and maximum wind gusts have been analysed. LEGMC is participating in the implementation of the project in which it is planned to renew and improve Latvia's climate change scenarios for 2100, in order to ensure policy planning in line with the latest forecasts, as well as the assessment of Latvia's coastal erosion, taking into account climate change scenarios, in order to adapt the planning of coastal use and develop suitable solutions to prevent coastal erosion. It is also intended to develop a common warning platform, which will include a system for estimation of the impact of meteorological and hydrological parameters, by assimilating information and data provided by society, municipalities, social media and other involved organizations.

Past observations and the analysis of climate change scenarios show notable climate change tendencies, such as a long-term warming trend. In Latvia, the years 2019 and 2020 were two consecutive warmest years in the history of observations (since 1924), but the third warmest was the year 2015. Not only had the mean air temperature increased, but also the extreme values. There have been warm winters in recent years, for example, the winter of 2019/2020 was even exceptionally warm - its mean air temperature was +2.7°C (5.1°C above normal) and in some regions of Latvia there was no snow cover throughout the winter. Also, the frequency and intensity of heat waves are increasing during the summer, for example, the summer of 2021 in Latvia due to the heat wave in June and July was the warmest on record and a new record of tropical nights was set – 19 nights in Riga. In general, due to the increase of air temperature the values of winter-specific temperature climate indices have decreased, while the length of the vegetation period and the values of extreme heat indices have increased.

Since 1961 there has been an increase in precipitation amount, particularly during the winter and spring seasons. The intensity of rainfall is also increasing. While the average precipitation amount is increasing, there have also been periods of severe drought in recent years, such as in the summer of 2018 due to which the year 2018 became the driest on record.

The most significant changes in the recent climate are related to extreme values. They indicate that in the future in Latvia uncharacteristic and extreme weather conditions are more likely to occur. It is therefore essential to identify risks and develop adaptation measures in various economic sectors.

Vulnerabilities

Climate change in Latvia affects both its natural capital (species, habitats, ecosystems), as well as the health, welfare and safety and economic activities of the population. Research results on risk and vulnerability assessment and identification of the adaptation measures in six areas – construction and infrastructure, civil protection and emergency assistance, health and welfare, biodiversity and ecosystems services, agriculture and forestry, tourism and landscape planning were published in 2016 and 2017.

Extreme climate events may have major consequences on urban and terrestrial environment. Storms and heavy rainfalls causing large number of damages will impact the general functioning of society, including functioning of rescue services. The main climate change related risks are damages by storm surges to buildings and roads at the coast and in cities at river mouths, damages caused by heavy rainfall induced precipitation floods and spring/ice-drift floods, snowstorm induced overloads to building constructions, damages to power transmission networks and transport communications (railway, road), indoor overheating, increase in heat stroke events, exacerbations of chronic (cardiovascular, diabetes, etc.) and respiratory diseases and more death cases, increase of acute intestinal infections, insect-born infectious diseases become endemic. Water courses and bodies will suffer increase of contamination and eutrophication, increase in water temperature and a longer stratification period, decrease in the volume of dissolved oxygen in the bottom layer. It is anticipated emergence of new species, including pests, risk of spread of pests and pathogens or increasing their vital capacity. The changes in biodiversity, e.g., in the distribution patterns of species and habitats may have considerable impact changing the operational conditions of other sectors. A gradual shift in average conditions that favour rare or new pests may be particularly problematic for agriculture and forestry, besides, these sectors is impacted by storms, damages to plantings by black frost, desiccation, in its turn, lack of winter frost makes logging difficult. Tourism sector is impacted by change of the length and characteristics of winter and summer tourism seasons. Within the research it is estimated also these impacts of climate changes that may bring potential benefits to some sectors, such as reduced demand for heating, increase in the population and economic value of roes and the Baltic herring; increased productivity of crops as well as longer season will allow to introduce varieties demanding little longer vegetation period, etc.; longer period of the visibility of the summer landscape and the diversification and increase in summer tourism offerings (activities, events), and some others. On the other hand, these benefits can be gained only if the relevant sectors adapt to the new conditions.

Adaptation

Latvian National Plan for Adaptation to Climate Change until 2030 (NAP) was adopted by Order of the Cabinet of Ministers No. 380 on 17 July 2019. Overall climate change adaptation priority of Latvia is to reduce vulnerability of people, economy, infrastructure, construction and environment to the impacts of climate change. To meet this aim, the NAP has more than 80 concrete adaptation measures and 5 Strategic goals to address climate change risks:

- Human life, health and wellbeing are protected from the adverse effects of climate change;
- Economy is capable to adapt to the adverse effects of climate change and is able to use the opportunities offered by climate change;
- Infrastructure and construction are climate-resilient and planned according to potential climate risks;
- Latvia's nature, cultural and historical heritage have been preserved and the negative impact of climate change has been minimized;
- Providing information based on scientific reasoning, to facilitate the integration of climate change adaptation aspects into sectoral policies and spatial development planning.

Latvia is actively integrating climate change adaptation policy and measures into decision making process and territorial development planning and spatial planning procedures. The importance of preventive measures is underlined. Further development of current legislation, e.g., construction standards, land-use guidelines etc., shall take into consideration climate change related impacts. Apart from that, Latvia integrates climate change adaptation goals into sectoral policies, plans and programs, for example, references to NAP are included in “Strategy of Latvia for the Achievement of Climate Neutrality by 2050”, “Latvia’s National Energy and Climate Plan 2021–2030”, “National Development plan 2021–2027”, “Latvian National Plan of Civil Protection” etc. Climate change adaptation aspects are also included in the “Environmental policy strategy 2021–2027” approved by Cabinet of Ministers on 31 August 2022.

1.6 Financial Resources and Transfer of Technology

Support to developing countries plays an important role in reaching the agreed goal of limiting the global average temperature increase below 2°C above pre-industrial levels, achieving the transformation to low GHG emissions economies, and supporting climate-resilient sustainable development. At the same time, it should be emphasized that Latvia, as well as some of the other EU Member States due to strict budgetary constraints have limited opportunities to participate in the financing of climate change and to support developing countries.

In Latvia’s situation climate finance is defined as voluntary action as Latvia is Annex I country with economy in transition (EIT) according to UNFCCC classification, which does not oblige to allocate financial support to developing countries according to Paris Agreement Article 9.

In 2019, the total contributions through bilateral channels were made in amount of 88 528,38 EUR (99 105,26 USD) as a capacity-building activities in Georgia, Kyrgyzstan and Uzbekistan, and cross-cutting project in Moldova.

In 2020, climate finance contributions were made through bilateral channels in total amount of 93 761,00 EUR (107 093,45 USD) as grant bilateral projects implemented in Uzbekistan, Moldova, Ghana and Vietnam. The applied financial instrument is an established national level annual grant mechanism for development cooperation based on the set goals of the national development cooperation policy 2016-2020.

Due to the restrictions of financial resources and global COVID-19 situation in years 2019-2020 the technology support and transfer were under reconsideration process.

Latvia is evaluating opportunities to contribute achieving the common climate finance goal of annual 100 BUSD by 2025 to support developing countries by diversifying ways for national financial contribution and expanding targeted prioritized regions and recipient countries covering climate change mitigation and adaptation trends.

1.7 Research and Systematic Observation

Science and innovation are one of the key resources to achieve the state development goals. Research policy is being developed in accordance with the national Guidelines for Science, Technology Development and Innovation and the national Research and Innovation Strategy for Smart Specialisation (RIS3). The focus is to create science, technology and innovation system that develops excellent and competitive international research, increases innovation capacity and international cooperation and stimulates social and economic transformation towards higher added value and resource-efficiency. The Latvia's research system is developed in line with European Research Area (ERA).

The strategic objective "Advanced Research and Innovation and Higher Education" of the National Development Plan 2014–2020 (NDP2020) sets the increase of investment in research and development (R&D) with targeted efforts to attract human resources, develop innovative ideas, improve the research infrastructure, facilitate co-operation between higher education, science and the private sector, through the commercialisation of knowledge, promote the creation of innovative and internationally competitive products with high added value.

Total research financing over the last few years has been rising from 0.51% in 2017 up to 0.71% (share of GDP) in 2020. The total R&D funding is growing. The total volume of the R&D financing over the last 4 year period (2017-2020) constituted around 727 MEUR (around 182 MEUR annual average, that is about 27% more than in the period 2011-2015).

Science funding is granted both institutionally (basic funding of research) and on a competitive basis. Competitive research funding is allocated for projects by the National Research Programmes, national Fundamental and Applied Research Programme, European International Programmes, bilateral co-operation programmes.

Since 2001, priority directions in science are to finance fundamental and applied research in order to purposefully implement the national science policy and to use the financial resources effectively. On 13 December 2017, nine priority directions in science for the period 2018-2021 have been approved by the government.

Climate change is recognised as one of the significant challenges currently facing society. Climate change related issues are dealt within several priority directions in science, particularly "Energy supply safety strengthening, energy sector development, energy efficiency, sustainable transport"; "Climate change, nature protection and environment"; "Local natural resources and their sustainable use for development of knowledge-based bioeconomy".

Climate change mitigation and adaptation issues are covered by a wide range of research from fundamental research to applied research performed in number of research programmes and projects.

National Research Programmes (NRP) are being implemented in the priority directions of science. The NRP system in Latvia was launched in 2005. Relevant sectorial ministries are involved in setting the objectives and tasks of the Programmes. NRPs in energy and environmental science are most directly linked to the climate change issue. In the period of 2018-2021 a total of nine NRPs are implemented in different sectors. Among them, two NRPs have direct focus on climate change mitigation: NRP "Energy" and NRP "Sustainable Spatial Development and Rational Use of Land Resources".

Energy efficiency and renewable energy resources, research on climate change related impacts and risks, research in agriculture and forestry sector to mitigate GHG emissions, climate change adaptation issues, including assessment of socio-economic impacts, are addressed in a number of projects of the national Fundamental and Applied Research Programme.

An important contribution to climate change mitigation and adaptation related research is provided by the sectoral studies commissioned by responsible state authorities (MEPRD, MoE, MoT, MoA). The aim of these studies is to provide the analytical knowledge basis for the development of national policies and measures as well as for improvement of the monitoring of GHG emissions (e.g., better substantiation of GHG emission specific factors). These studies also address promotion of the climate friendly governance and management practices. In its turn, the LEPF provide financing for specially focused programmes for promoting and strengthening the co-operation between the research institutions and the state environmental authorities.

Use of EU ERDF funding is in line with the National Operational Programme "Growth and Employment" of EU Funds planning period for 2014-2020 (implementation up to 2023 including), elaborated based on the NDP2020. Thanks to the EU funds, there is a growing portfolio of research funding instruments. For instance, Practical research programme supports industry-oriented research projects in the areas of Latvia's RIS3 strategy, lead partners of the projects are both science institutions as well as private companies willing to develop new technologies and products. Another activity – support for R&D infrastructure and institutional capacity building – focuses to support smart specialization areas/ smart technology centres in Latvia's universities and scientific institutes having high competence. Postdoctoral research grants and Innovation grants to students provide an opportunity for young researchers to develop their research capacity and career while contributing to the goals of Latvia's RIS3 strategy. All these EU Funds supported activities include climate change issues related research. Particularly the projects related to energy efficiency in different sectors of energy end-uses, use of renewable energy resources, clean vehicles and sustainable mobility, but not just these topics, have to be noted.

Latvian research institutions and organizations actively participate in the Baltic Sea region research programmes, such as Baltic Research Programme (funded by EEA and Norwegian Financial Mechanism), joint Baltic-Nordic Energy Research Programme, as well as the joint Baltic Sea research and development programme BONUS 2020.

Latvian research institutions and organizations actively participate in EU horizontal programmes, both H2020 (including European Research Area Network (ERA-NET)), LIFE programme, Interreg programmes, the latest plays significant role in promoting the practical implementation of research developments. In its turn, the LIFE programme financed projects have provided highly valuable contribution to climate change issues related to agriculture sector, sustainable use of soils and peatlands.

The Baltic Sea Region Adaptation Strategy and Action Plan (2013) analysed the scenarios of how climate change affects the society and the potentials for active action. An important contribution to the further analysis of the risks and vulnerabilities of climate change, identification of appropriate adaptation measures, long-term analysis of their benefits and costs was provided by research conducted under the framework of the EEA Financial Mechanism 2009-2014 programme "National Climate Policy" in the project "Development of proposals for the National Climate Change Adaptation Strategy by identifying scientific data and measures for adaptation to climate change, as well as impact and cost assessment". The risks and vulnerabilities studies have been performed within the NRP "EVIDEnT" and a range of projects of NFARP.

One of the most important sources of monitoring data on climate change is the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT). LEGMC has developed the digital climatic atlases based on the use of EUMETSAT satellite observation data for climate data monitoring data sets. For example, the data set used in the Solar Radiation Atlas (developed in cooperation with meteorology authorities of Lithuania, Estonia and Poland) and Satellite Climate Atlas. EUMETSAT data have been also used for monitoring of sunshine duration and solar radiation and for the update of the Latvian national construction standard "Building Climatology" recalculating direct and diffused solar radiation.

Membership in the European Medium-Term Weather Forecast (ECMWF) provides a unique opportunity for observational data sets and model data to be used in climate studies. ECMWF data together with data from European Union's Earth observation programme "Copernicus" are used in LEGMC Marine data portal, where one can learn about hydrological and meteorological forecasts for central part of the Baltic Sea. LEGMC has used ECMWF reanalysis in a number of studies, for example, data are currently used in the sea surface temperature analysis for characterisation of past climate change. ECMWF data have also been used in the study for updating Latvia national construction standard "Building Climatology", recalculating snow loads for the entire territory of Latvia.

Within the framework of the "National Climate Policy" programme of the EEA Financial Mechanism, in 2014-2021 important activities have been carried out to improve the system of inventory of GHG emissions. The implemented activities contributed both to the improvement of the GHG inventory system and its synergy with air pollution data, development of a unified air pollution, GHG inventory data and projection database, and expert capacity building.

1.8 Education, Training and Public Awareness

Education Development Guidelines for 2014-2020 set the overarching goal – qualitative and inclusive education for the development of personality, human well-being and sustainable development of the state. Education Development Guidelines for 2021-2027, adopted in June 2021 and titled "Future skills for future society", emphasise the usability of knowledge and skills as an outcome of education and refer to actual EU and global initiatives, such as OECD National Skills Strategies project and EC European Skills Agenda 2025.

The National Operational Programme "Growth and Employment" of EU Funds planning period for 2014-2020 includes "Education, skills and lifelong learning" as one of the Priority Axes. The investments are aimed to strengthen higher education system, increase number of modernized study programmes of STEM, improve study environment of both general education institutions and vocational education and training institutions, develop work environment based education as well as achieve others related goals. Improving governance at all levels of the education system is a top priority.

Climate change is already anchored in the education and public awareness policies and practices that are continuously being developed. The environmental policy framework document - Environmental Policy Guidelines 2014-2020, followed by the Environmental Policy Guidelines 2021-2027 - pays high attention to education, training and awareness issues.

Environmental Protection Law defines both education for sustainable development and environmental education. The Law provides the matters regarding environmental education and education for sustainable development shall be included in the mandatory curriculum of the subject or course standard in accordance with the specific character of each subject by agreeing thereupon and ensuring succession on different education levels. Thus, environmental education and education for sustainable development are included in general and vocational/professional education state curricula and climate change issues are part of this curricula. To ensure teachers qualification, a course in sustainable development shall be included in the higher education study programmes for all teachers.

EEA Financial mechanism 2009-2014 programme "National climate policy" small grant scheme "Capacity Building in the Field of Research and Measures for Enhancing Society's Understanding about Climate Change and its Consequences" had provided in 2016 important contribution for development of climate education modules and materials both in higher education, school programmes and continuing education (professional audiences, staff of state and municipal institutions, etc.).

In accordance with the Environmental Protection Law, in May 2004 the Latvian Council of Environmental Science and Education - a coordinating and advisory inter-sectoral institution – was established.

At all (pre-school, primary and secondary school) levels, the Environmental Education Fund (EEF) works under the programme of "Eco-schools" of the international organisation Foundation for Environmental Education. In the 2021/2022 school year more than 170 education institutions in Latvia are involved in the Eco-shools movement at different stages - the International Green Flag award, the Certificate of Eco-school award or Thanks expression. Besides, „Young Environmental Reporters" co-ordinated by EEF should be noted as well.

In its turn, The Baltic Sea Project is the first regional project within the UNESCO Associated Schools Network.

Regarding the activities in Latvia`s regions, the projects, led by the Vidzeme region planning authority, such as "Energy Groups in schools" (pilots) and "Effective energy consumption in education institutions (schools)" that had developed teaching materials, provided practical exercises for the audience, organised school competitions as well as included cross-border (Vidzeme region – South Estonia) experience exchange should be particularly noted as an example.

Universities and other higher education institutions provide climate change education as part of different degree programmes. The Environmental Protection Law states a course in environmental protection shall be included in the mandatory part of all study programmes of universities, higher education institutions and colleges. On the other hand, by integrating within the content of various courses, the environmental science is run as an interdisciplinary theme.

There are particular study programmes in the study field "Environmental protection": in April 2022 there were 14 such programmes (different degree levels) in 6 higher education institutions in Latvia. Academic studies and research are closely related within these programmes.

A broad range of non-governmental organisations (NGO) are actively involved in the capacity building of climate change issues through research, education, training and media activities. Advisory Councils is one of the most effective tools for public participation and NGO representation. In particular, the Environmental Advisory Council and the joint Advisory Council of national green investment schemes of the MEPRD - Climate Change Financial Instrument (CCFI) and Emissions Allowances Auctioning Instrument (EAAI) - have to be mentioned. Due to the interdisciplinary nature of climate change, specific climate change adaptation issues are necessarily included in the agenda of other advisory councils as well. LEPF implements specially focused programmes for promoting and strengthening the co-operation between the NGO sector and the state environmental authorities.

The climate change policy, in particular the policies and measures to meet EU and Latvia long-term climate neutrality 2050 target and related Latvia`s national mid-term 2030 target are kept high on the agenda of mass media.

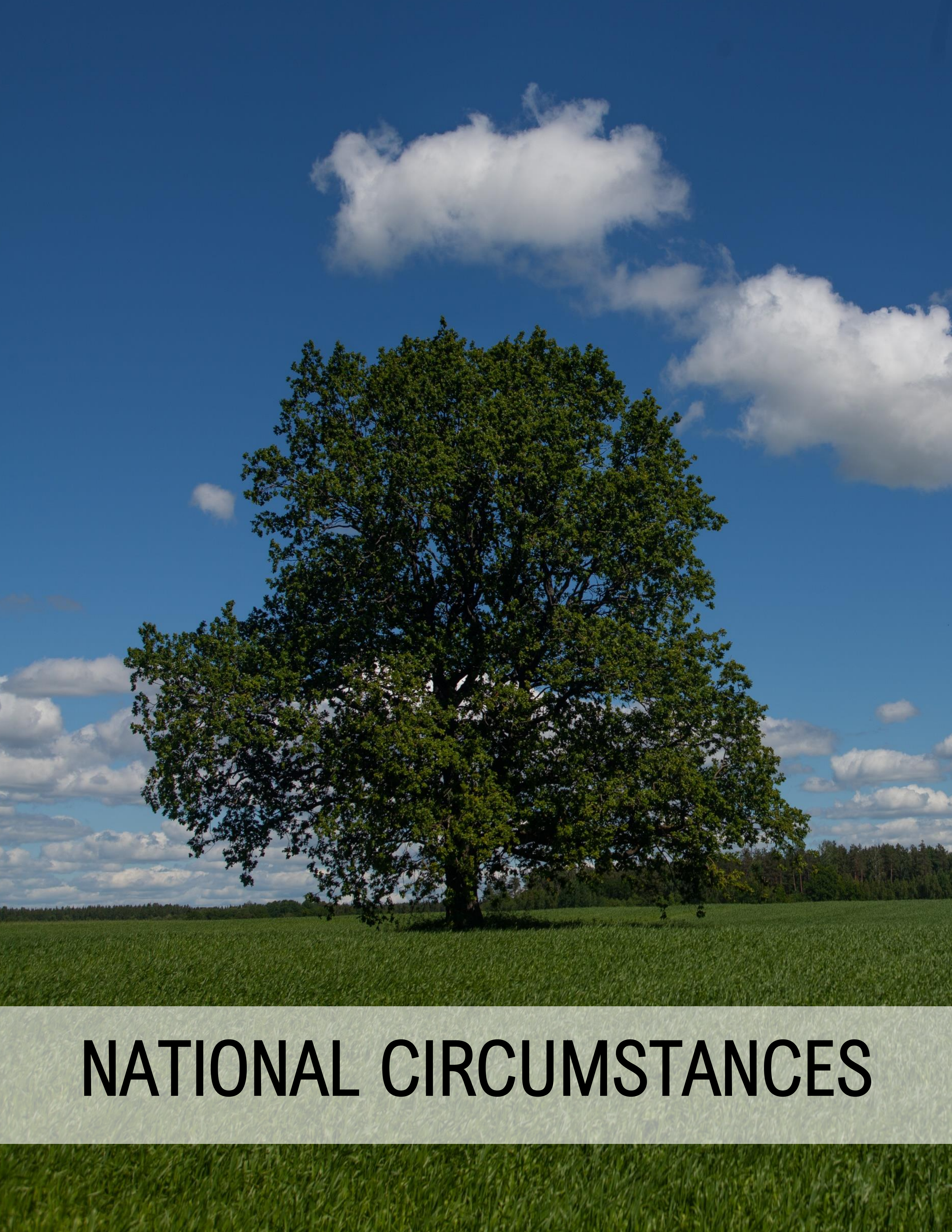
In the period since 2010, several large-scale public information and training programmes focusing on climate issues have been implemented. Information, education, public awareness raising in the frame of the projects regularly (annually) supported by the LEPF financed programmes are ensured as well. Also, the demonstration of nearly-zero energy public building (the projects co-financed by the EAAI) are important.

Climate Change portal[2] and related Climate Change analysis Tool had been elaborated by the support of EEA Financial Mechanism for 2009-2014 programme "National Climate Policy". The portal provides up-to-date information elaborated to various target groups - households, municipalities, businesses, pupils and researchers. Climate Portal, run by LEGMC, provides the information to a wide range of audiences. In its turn, Climate change and agriculture website, run by the MoA**,** provides the information on climate change impact and climate change mitigation and adaptation policies in the agriculture and forestry sectors. Important resources are also websites of NGOs, specialised in the field of their competence, e.g., CO_2 footprint calculators by NGO "Pasaules dabas fonds" and Environmental Education Fund.

Campaigns are important for raising climate change awareness, popularising the environmental protection aspects, sustainable way of living and consumption. Particularly the European Mobility Week, "International Earth Day", the "Earth hour", "International Passive House Open Days", events of the "International Water Day", event of the Latvia's Great Cleanup (Latvijas Lielā Talka), the "Nature Concert Hall", the campaign "My Sea", events organised by Society "Pēdas" (Footprints) have to be noted.

In 2019-2021, active elaboration of SECAPs for the period up to 2030 has started in Latvia. The new SECAPs are adopted by more than 20 Latvian local municipalities, including capital city Rīga and several largest cities.

[2] https://klimatam.lv/en/



NATIONAL CIRCUMSTANCES

2. NATIONAL CIRCUMSTANCES REFERING TO GHG EMISSIONS AND REMOVALS

2.1 Government Structure

Latvia is a parliamentary republic. The unicameral parliament (Saeima), with 100 members, is elected in general, equal, direct, secret and proportional elections for a four-year period. The Saeima, and also the people, have the right to legislate, in accordance with the procedures, and to the extent, provided for by the Constitution. Draft laws may be submitted to the Saeima by the President, the Cabinet of Ministers, committees of the Saeima, by not less than five members of the Saeima, or, in accordance with the procedures and in the cases provided for in the Constitution, by one-tenth of the electorate.

The Saeima elects President for a term of four years. The President represents the State in international relations, appoints and also receives the diplomatic representatives. The President has the right to initiate legislation. The President proclaims laws passed by the Saeima. The President, by means of a written and reasoned request to the Chairperson of the Saeima, may require a law to be reconsidered.

The candidate for the post of the Prime Minister who is invited by the President invites ministers to form the Government. The Prime Minister is responsible before the Saeima. Cabinet of Ministers is a collegial institution. Cabinet of Ministers, within the scope of its competence, considers policy planning documents, external and internal legal acts, orders of the Cabinet of Ministers, informative statements, national positions and official opinions of the State. Ministries are top-level direct administration institutions that are directly subordinated to a respective minister - Member of the Cabinet of Ministers. There were 13 ministries in Latvia in 2020, as well as the State Chancellery.

Up to 30 June 2021 there were 119 local municipalities in Latvia – 9 republic cities (republikas pilsētas) and 110 local municipalities (novadi). In the 1 July 2021 new division of administrative territories have come into force, which have decreased the number of local municipalities due to joining a most part of municipalities in larger local units. From the 1 July 2021, Latvia's administrative division consists of 43 municipalities: (i) territories of 7 state cities (valstpilsētas) and (ii) 36 territories of local municipalities (novadi). Territories of local municipalities consists from rural territories divided in parishes (pagasti) and towns (pilsētas), as well as three of local municipalities include also territory of state cities. At the moment there are no regional (second level) municipalities in Latvia.

The overall responsibility for climate change policy making lies within the MEPRD, and a number of other national institutions are involved in the implementation of this policy, including the MoF, MoE, MoT, MoA, MES, and institutions supervised by relevant ministries.

Matters related to the UNFCCC fall within the administrative responsibility of the MEPRD, which acts as the national focal point to the UNFCCC.

More information about the institutional framework of Latvia's climate policy is presented in chapter 4 of this report.

2.1.1 Implementation of climate policy within the government structure

In Latvia, there are two ministries responsible for the climate and energy policy: MEPRD and MoE.

MEPRD Climate Change Department (CCD) was established in 2005 and it is directly subordinated to the Deputy Secretary for Climate Action. CCD develops legislation and climate policy planning documents as well as defends Latvia's interests in the EU and internationally. CCD cooperates with other ministries to ensure the integration of GHG and climate resilience objectives into sectoral policies, to promote changes in the Latvian economy. CCD also monitors the operation of the EU Emission Trading Scheme in Latvia, coordinates the preparation of national GHG inventory as well as develops the operation of climate change financial instruments (including Emission allowances auctioning instrument).

The main functions of CCD are:

- to develop Latvia`s climate policy including developing of policies for promotion of climate change mitigation and adaptation, to work on a development planning documents and legislation as well as to promote the integration of climate policy aspects into other sectoral policies;
- to represent Latvia's interests in the development of international and EU climate policy and to coordinate the implementation of the UNFCCC, it`s KP and the Paris Agreement, as well as to fulfil the other international commitments related to climate policy;
- to ensure coordination of the data and information collection system for climate change mitigation and adaptation, preparation of relevant submissions to the EU and the UNFCCC;
- to develop financial instruments aimed at achieving climate policy goals and coordinate their implementation, including Climate Change Financial Instrument, Emission allowances auctioning instrument and the Modernization Fund;
- to ensure the operation of the EU ETS and KP flexible mechanisms in Latvia;
- to ensure the management of Latvia's GHG emission units and Latvia's participation in the GHG emission unit trading;
- to ensure that the public, merchants and state and local governmental institutions are informed about climate change, mitigation and adaptation to climate change;
- to organize and coordinate projects on international cooperation in the field of climate change including preparation of international agreements and coordination of their implementation;
- to coordinate national and international projects in the field of climate policy within the competence of the MEPRD, including participation in the implementation of the programme "Climate change mitigation, adaptation and environment".

MEPRD Environmental Protection Department is subordinated to the Deputy Secretary on Environmental Protection. The Department of Environmental Protection deals with policy development in the field of substances that deplete the ozone layer and F-gases in Latvia.

MoE Department of Sustainable Energy Policy is responsible for promoting the production and use of renewable energy through the development of national policies, relevant legal and regulatory frameworks and support programs.

The main functions of MoE Department of Sustainable Energy Policy are:

- to plan, develop and coordinate energy policy by developing policy planning documents and draft legislation in following areas: electricity, heat production, transport energy from sustainable energy sources and energy climate policy;
- to participate in the development and improvement of the legal framework of the EU as well as to cooperate with the EU institutions and international organizations the areas mentioned in the paragraph above;
- to make a proposal for state aid policy;

- In co-operation with the co-responsible institutions and structural units of the MoE, as well as the social partners, to prepare the National Climate and Energy Plan for 2030, as well as long-term policy planning documents within the competence of Department of Sustainable Energy Policy.

2.2 Population Profile

Population of Latvia was 1,907,675 at the beginning of 2020. During the last three decades, since 1990, the population has decreased by about 760 465. In all the decades the average decline was about 1.1% per year though different tendencies could be observed in urban and rural population. In the period 1990-2000 the urban population showed more rapid average annual decrease than the rural, but in the period 2010-2020 the situation was reverse – the rural exceeded that of the urban. In 2020 the urban population constituted 68.0% and the rural – 32.0% (Figure 2.1). At the beginning of 2020 in Rīga, the capital of Latvia, the population was 621,120 people, constituting 32.6% of the entire population of the country.

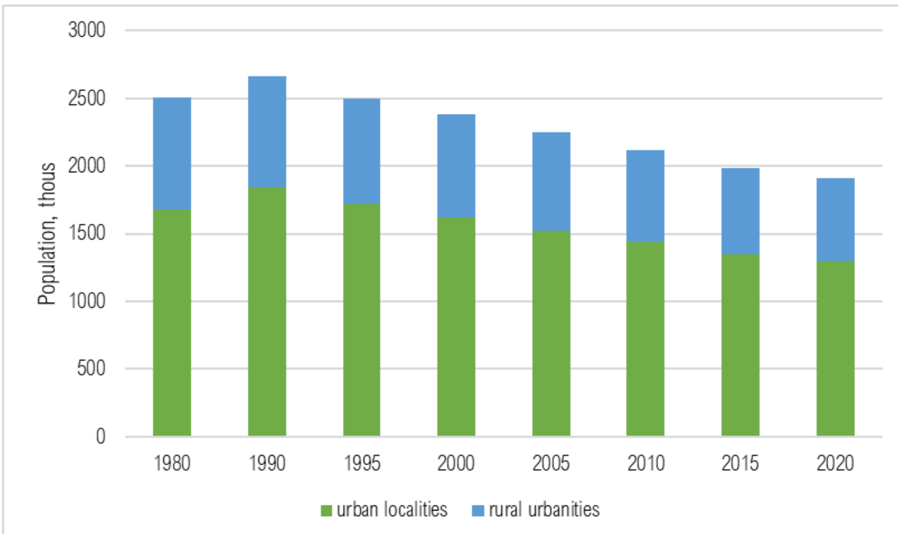


Figure 2.1 Changes in Latvian population in 1980–2020

At the beginning of 2020 the population density in Latvia was 30 people per 1 km², but in 1990–1992 it was 41 persons. The population density fluctuated between 3-4 persons per 1 km² (Rucava region and Rugāji region) up to 2 043 people per 1 km² (Rīga), but in the regions near Rīga (Stopiņi region) it was 216 people per 1 km² (Figure 2.2).

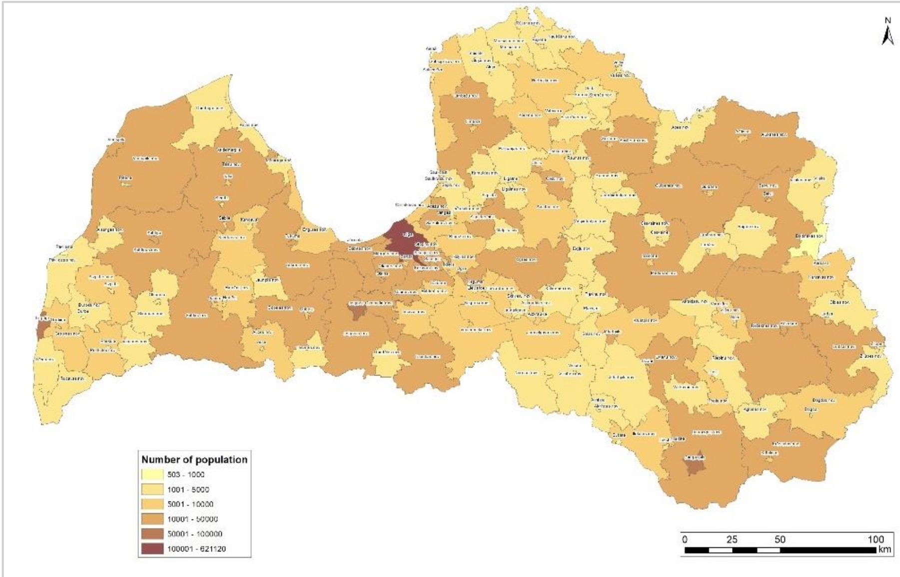


Figure 2.2 Distribution of the Latvian population at the beginning of 2020

The aging of the population continues. The ratio of the working age population has decreased by 3.5% points in 2020 compared to 2015. At the same time the ratio of people above the working age has increased by 6.1% points (Figure 2.3). Migration vitally affects the decrease of the working age population. In 2020, 10147 people of the working age emigrated and 7084 immigrated however the number of emigrants has decreased since the last National Communication when the number of emigrants on working age exceeded the number of immigrants by almost 3 times.

Figure 2.3 Changes in demographic dependency ratio in Latvia in 1990–2020

At the beginning of 2020 the number of households in Latvia was 825.4 thousand which was by 1.4% less than in 2000. The average size of households has shrunk. In 2000, it was 2.53 people, while it was 2.28 persons in 2020.

In 2020 Latvia`s GHG emissions per capita was 5.5 tons of carbon dioxide equivalent. Among the EU Member States Latvia has third lowest GHG emissions per capita in 2020[3].

2.3 Geographic Profile

Latvia is situated on the edge of the Eastern European Plain near the Baltic Sea between 55°40' and 58°05' Northern latitude and between 20°58' and 28°14' Eastern longitude. The total length of the border of Latvia amounts to 1,368 km on land and 498 km along the Baltic Sea coast. Latvia borders with Estonia in the North, with Lithuania in the South, with Belarus - in the South East and with Russian Federation - in the East.

The territory covers an area of 64589 km^2 in total. Its length in the North – South direction is 210 km, and the width in the West – East direction – 450 km. Latvia is a typical lowland country and its terrain is characterized by flat, low areas and hilly elevations. The average height above sea level is 87 m and the highest peak is Gaiziņkalns (311.6 m above sea level). Latvia also has more than 3 000 lakes and 12 000 rivers. According to the National Forest inventory (NFI) the total forest area (including afforested lands) in 2020 was 32415.1 km^2, cropland 14651.6 km^2 and grassland 10347.1km^2, wetland 3995.2 km^2, settlements 3126.9 km^2.

About 35% of the territory of Latvia is located closer than 50 km from the shores of the Baltic Sea or the Gulf of Riga. The closeness of the sea, the characteristics of the atmospheric circulation and the prevailing air masses, as well as the characteristics of the relief determine the climatic and weather conditions, as well as the distribution of temperature and precipitation. The location in the respective latitudes determines the solar radiation or energy supply, the ratio of day and night lengths. Geologically, Latvia is located on the continental part of the Eurasian lithosphere plate, near its western edge, on the north-western edge of the European continental plain, and is characterized by low absolute and relative elevations.

Latvia’s geographical situation and climate features determine that building heating is necessary around 210 days per annum. As the consequence of Latvia’s geographical location, a large proportion of fuel resources utilized in stationary combustion equipment is used for heating of buildings, and the relatively large fluctuations in the emissions from year to year are due to changes in heating degree days.

2.4 Climate Profile

The main driver of climate conditions in Latvia is the received radiation from Sun. Latvia is located in the moderate climate zone, characterised by seasonality and a different length of daytime. The overall nature of the climate in Latvia is also influenced by the circulation of the atmosphere – the prevailing winds and the amount of rainfall depend largely on the transfer of air masses from the Atlantic. Latvia's climate is also affected by a number of other factors, such as terrain forms, the distance to the Baltic Sea and the Gulf of Riga and urbanisation, resulting in differences between the individual regions of Latvia. Climate is characterised by long-term statistics of meteorological parameters such as air temperature, precipitation amount, wind, snow cover.

Solar radiation

The Sun is the most powerful source of energy and heat that is vital for life on Earth. As an alternative energy source, which may be used in the national economy, the energy generated by the sun is dependent on solar radiation intensity. In Latvia, due to seasonality, the duration of the daytime and hence sunshine varies greatly throughout the year. The sunniest month in Latvia is July, with an average of 289 hours of sunshine, while the

[3] https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer

least sunshine is in December – only 24 hours (Figure 2.4). According to the 1991-2020 normal the total annual sunshine duration in Latvia is 1856 hours, with local variation from 1693 hours in Zosēni (Vidzeme Upland) up to 2030 hours in Liepāja (south-west Latvia).

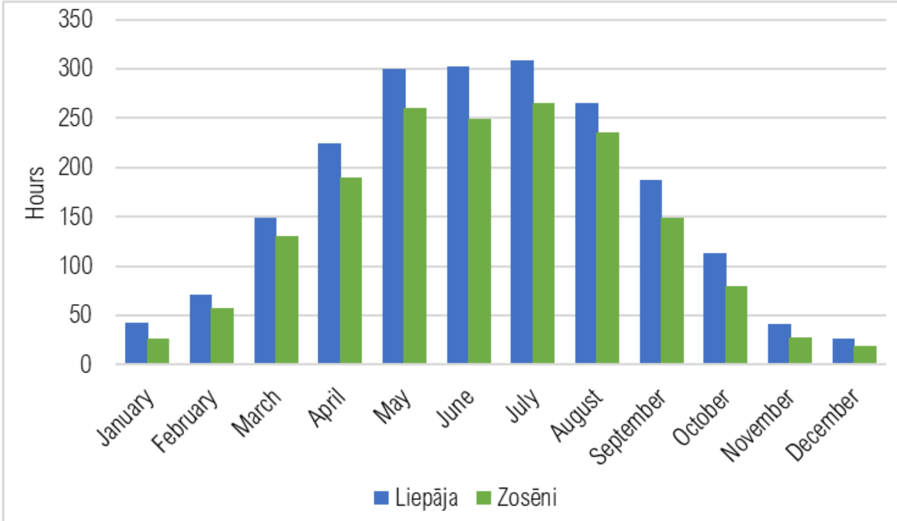


Figure 2.4 Monthly sunshine duration normal (1991-2020) in Liepāja and Zosēni

Air temperature

In 1991-2020 normal period annual mean air temperature in Latvia is +6.8 °C. Lowest annual mean air temperature (+5.7 °C) is in the Alūksne and Vidzeme Uplands, but highest is in coastal areas of Baltic Sea: +7.5... +7.9 °C, thus, illustrating how the proximity to the Baltic Sea and elevation changes impact climatic conditions notably. The only exception to this territorial distribution is Riga, where due to influence of city "heat island" is the highest annual mean air temperature: +8.0 °C. Over the course of the year, the warmest month in Latvia is July, with mean air temperature of +17.8 °C. Meanwhile, the coldest month of the year, with mean air temperature of -3.1 °C, is February. The highest air temperature recorded so far in Latvia is +37,8 °C, which was observed in Ventspils on 4 August 2014, while the lowest (-43.2 °C) was observed on 8 February 1956 in Daugavpils.

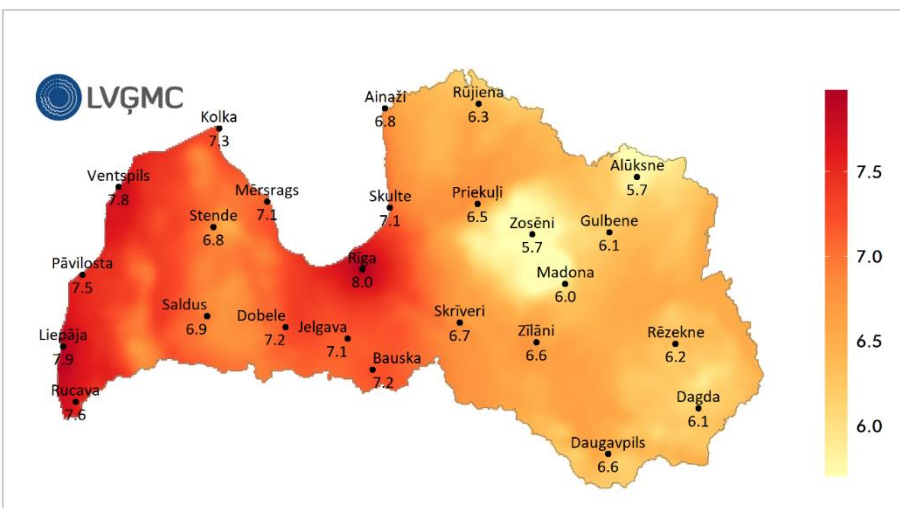


Figure 2.5 Annual average air temperature normal for 1991-2020 period, °C

Precipitation

The normal of the annual precipitation amount for 1991-2020 period in Latvia is 685.6 mm. The territorial distribution of precipitation amount is affected by the terrain and prevailing wind directions, so the highest annual precipitation amounts are recorder on the western slopes of Vidzeme and Rietumkursa Uplands, where annual precipitation normal is 878.5 mm in Sigulda and 777.7 mm in Rucava. At the same time, the smallest annual precipitation amount is in the Zemgale plain – in Dobele and Bauska annual precipitation is below 600 mm, 580.5 and 590.1 mm respectively. The highest number of days with precipitation are in the autumn and winter seasons, when weather conditions are most affected by cyclones moving eastward from the Atlantic, while the smallest – is in the spring season. The largest precipitation amount due to the convective processes is observed in summer months – in August and July average precipitation is 76.8 and 75.7 mm, while the driest months are in the spring – the driest of them all, with average precipitation amount of 35.8 mm, is April.

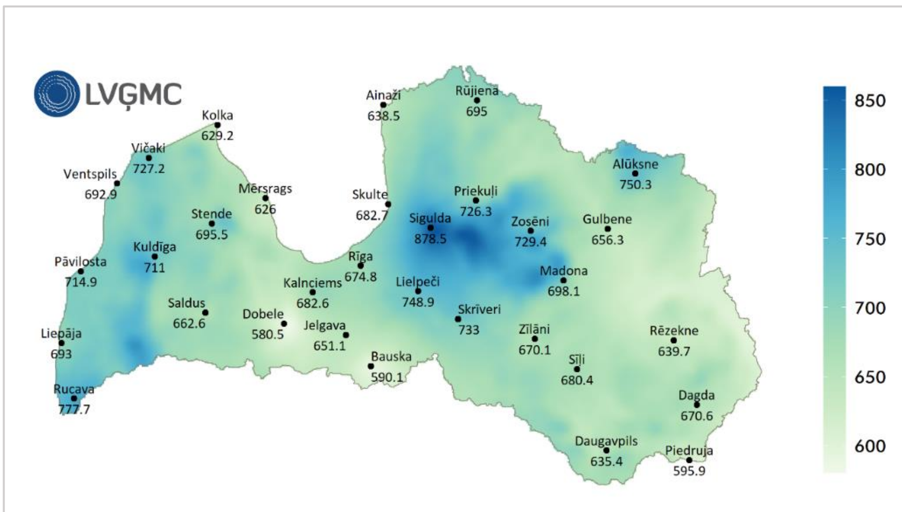


Figure 2.6 Annual precipitation amount normal for 1991-2020 period, mm

Snow cover

In winter, a large part of the precipitation is in the form of snow. The seasonal snow cover stores large quantity of water, which afterwards greatly influences the water cycle. Hence, the snow cover characteristics are directly related to the development of hydro-electric power generation and assessment of flood risk. The snow cover duration and its depth have a pronounced effect on the growth of natural and cultivated plants, recreational and winter sports and road maintenance.

On average Latvia has 77 days a year with a snow cover. The longest period with snow cover is in Alūksne – 119 days a year, but the shortest period is in Rucava – on average only 49 days a year. The first snow cover onset usually is in November, but sometimes the first snow cover can be observed already in October. The earliest snow cover on record was registered on 23 September 1973 in Rēzekne. The snowiest month is usually February, with an average of 20 days with snow cover and average thickness of the snow cover in Latvia – 10 cm. Snow cover thickness in February is from 4 cm in Liepāja and Rucava up to 21 cm in Alūksne. The last snow cover in most of the country melts in April, but sometimes a snow cover can disappear even in February or March, while the latest recorded snow cover was observed on 29 May 1953 in Kazdanga.

Wind

Annual average wind speed in 1991-2020 period in Latvia is from 2.3 m/s in Madona to 4.4 m/s in Ventspils. Mean wind speed is closely related to distance from sea – higher mean wind speed is observed in coastal areas, but calmest regions are the eastern uplands. There is also a pronounced seasonality in the mean wind speed: the fastest average wind speed is in the autumn and winter months, when cyclone activity is greater, while the slowest mean wind speed is in the spring and summer. The windiest months in Latvia are January and December with mean wind speed 3.6 m/s, but the slowest mean wind speed of 2.5 m/s is in July and August.

Maximum wind gusts are characterized by short-term wind speed peaks, which in most cases have a more destructive effect than the mean wind speed. The peak wind gusts are not only related to the activity of the autumn and winter seasons of cyclones and storms, but also to the convective processes of summer, when thunderstorms are accompanied by strong gusts and even whirlwinds. Average annual peak wind gusts speed is from 8.6 m/s in Daugavpils and Skrīveri to 11.5 m/s in Ventspils.

2.5 Economic Profile

As a member of the European Union and euro area, Latvia's economy is integrated with the economies of other EU countries. Reforms implemented in Latvia and integration in the EU have left a positive impact on the economic development of the country. Rapid economic growth was observed in 2000-2007. A substantial inflow of foreign capital from 2005 to 2007 stimulated significant increase in the private consumption and investments in Latvia. The average growth rate of the GDP in 2000 – 2007 was around 8.5%.

Since the second half of 2007, the growth rates began to decrease which was determined by the processes influencing both internal (weakening of domestic demand) and external (decrease of growth rates globally) economic environment. As the economy of Latvia is small and open there is significant dependence on the trends of global economy. During the crisis, the GDP decreased by one fifth. Since 2010, the economic recession in Latvia has stopped, and the growth resumed. From 2011 to 2019, the GDP increased on average by 3.0% annually (Figure 2.7).

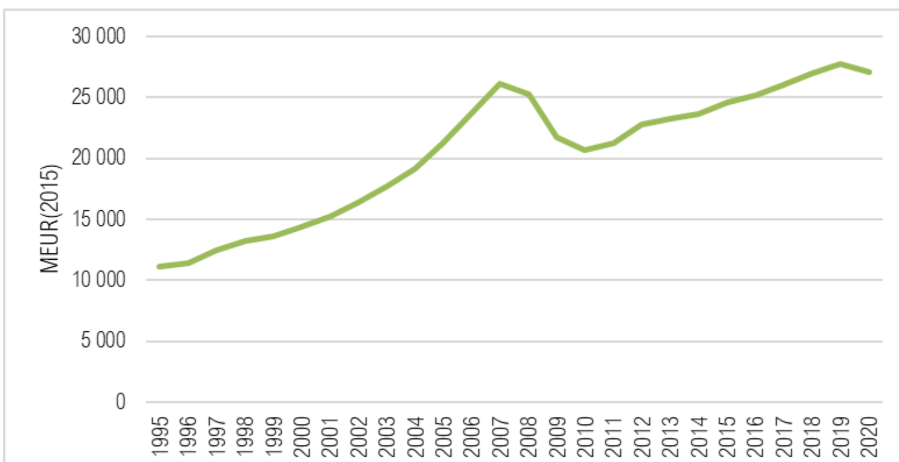


Figure 2.7 Gross Domestic Product, 1995 – 2020 (at 2015 prices)

The Covid-19 pandemic, which began in Latvia in March 2020, had a significant impact on economic development. In total, GDP in Latvia in 2020 decreased by 2.2% compared to 2019.

In Latvia, the services sector had the dominating share (around 72.7% in the year 2020) in total value added (VA) followed by manufacturing and construction (around 18.9%), while the agriculture sector (5.0%) and other industries (3.4%) had a minor role. During the last 10 years only minor changes in the relative contribution of the above mentioned sectors in total VA may be noted, e.g. the contribution of the manufacturing and construction services sector increased by 0.7% points, whereas the contribution of services sector and other industries decreased by 0.2% points and 1.4% points, respectively. Over the last twenty years, we can see an increase in the share of investment in total value added in the service sector, which has a positive effect on the trend in GHG emissions in the energy sector.

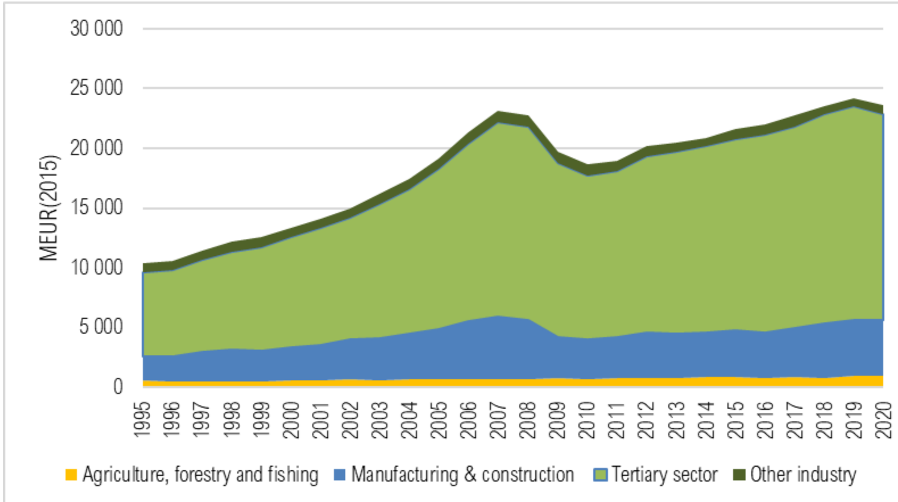


Figure 2.8 Value added by sectors in Latvia 1995-2020

External trade of Latvia experienced a dynamic development after the crisis in 2008 - 2009. Starting from 2010, exports have grown faster than imports and in 2020 it was about 1.9 times higher than in 2010. The export-import balance has been balanced from a markedly negative in 2003-2008 and, starting from 2017, is close to zero.

Figure 2.9 Export and import in Latvia, million EURO

Exports are one of the main drivers of economic growth, and their dynamics are closely linked to external demand and the pace of economic development in partner countries. More than two thirds of Latvia's exports are exports of goods and the rest is exports of services. This proportion has not changed significantly in recent years.

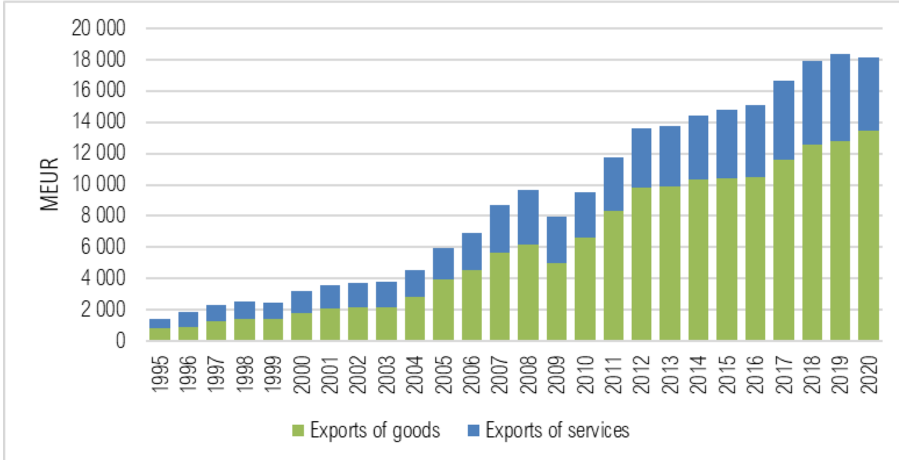


Figure 2.10 Export of Latvian goods and services, million EURO

Over the last five years the main exported goods have remained relatively stable and in 2020 they are wood and its products (16%), electrical equipment and appliances (13%), machinery and equipment (6%), crops (5%), vehicles (4%). In 2020, the main exported services included transportation (30%), information and computing services (18%), construction (8%). The Covid-19 pandemic, which started in Latvia in March 2020, significantly reduced air transport services and travel services.

The most important export partners of Latvia's goods in 2020 were Lithuania, Estonia, Russian Federation, Germany, Sweden, the United Kingdom, Denmark, Poland and the Netherlands. Latvia exported 2/3 of all goods to these countries.

In 2020, the main export groups to the EU countries were wood and wood products and electrical appliances and equipment.

Imports of goods and services have developed similarly to exports over the last five years. Since 2017, imports of services have grown faster, but imports of goods have grown more moderately. In turn, in 2020, due to Covid-19, imports of services decreased significantly, while imports of goods practically remained at the previous year's level. The main import partners of Latvia are Lithuania, Germany, Poland, Estonia, Russian Federation, the Netherlands, China and Finland. In total, the products of these countries in 2020 accounted for almost 2/3 of Latvian imports.

2.6 Energy Profile

National energy development guidelines for 2016–2020 set objectives and courses of action for 2016–2020. The two main energy policy objectives for Latvia are:

- enhancing energy supply safety that implies available to consumers stable energy supply, reducing geopolitical risks, diversifying the sources and routes, developing interconnections and infrastructure of the state internal energy supply;
- sustainable energy that ensures sustainability within the meaning of economic, social and environmental sustainability. The plans for achieving the above are by improving energy efficiency, introducing smart technologies and promoting highly efficient production technology and renewable energy technologies. In relation to the renewable energies, targets have been laid down in Latvia for the time period until 2020: the share of the RES in gross final energy consumption in 2020 is 40%.

Consumption of primary sources in Latvia is ensured by local and renewable energy sources (biomass (solid, liquid and gaseous), peat, hydropower, wind and solar) and imported sources (oil products, natural gas, coal, etc.).

Consumption of primary energy sources declined sharply up to 1995 when it decreased by about 42% compared with 1990 (Figure 2.11). The main reason was vital structural changes in economy. In the years up to 2000 it dropped further by about 19%, but starting with 2001 consumption of primary energy sources started to grow, reaching the greatest consumption in 2007. Due to the economic recession, energy consumption by 2009 decreased by about 8.4% compared to 2007. Starting with 2010, the economic recovery began and, at the same time, energy efficiency measures were implemented more widely. As a result, primary energy consumption in 2020 is 4.6% lower than in 2010, while GDP has increased by 29.5% over this period.

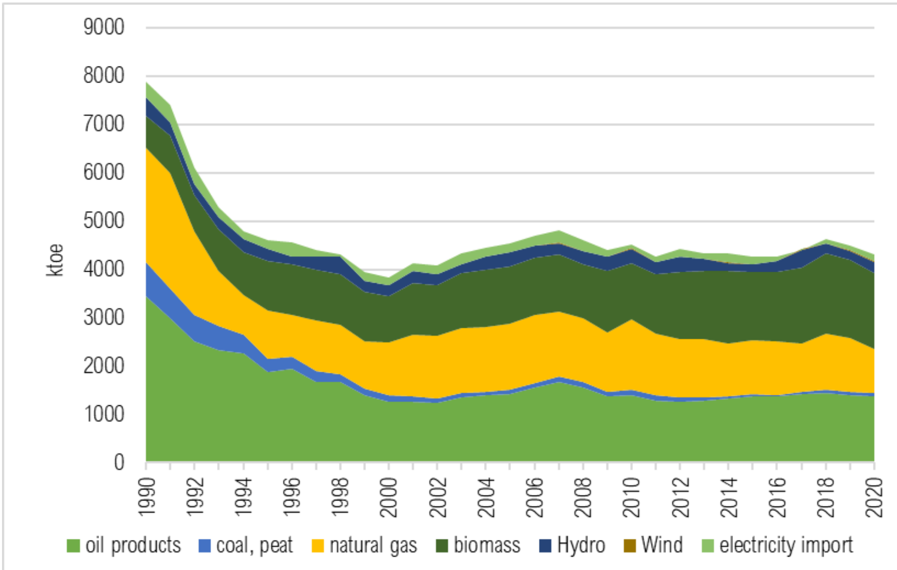


Figure 2.11 Consumption of primary energy sources in Latvia in 1990-2020

The structure of primary energy sources has changed over years. The first crucial changes took place by 1995 when natural gas, and sometimes also biomass, replaced residual fuel oil for generating electricity and heat, and coal for heat production. Further vital changes began in 2010 when through different state support measures natural gas and other fossil fuels started to be replaced by biomass (solid and gaseous) for heat production in district heating systems and power production. Wider use of solid biomass also begun in some industries.

Today three types of energy sources dominate in the supply of primary energy sources in Latvia: biomass (36.5%), used mainly for heating in different sectors and generating electricity and heat in CHPs; oil products (31.8%), which are mainly petrol and diesel fuel used in the transport sector; natural gas (21.1%), mainly for generating electricity and heat in CHPs.

Like many other EU countries Latvia depends on the import of primary sources, however, Latvia's dependency has decreased from 88.9% (in 1990) to 45.5% (in 2020), mainly due to increasing the use of wood biomass and other RES. At present RES take a considerable share in the balance of Latvia's primary sources. The main and widely used sources are solid biomass and hydropower, to a lesser degree also biogas, liquid biofuels, wind energy, and solar energy. The share of renewable energy in the supply of primary energy sources has grown from 31.0% (in 2000) to 42.1% (in 2020).

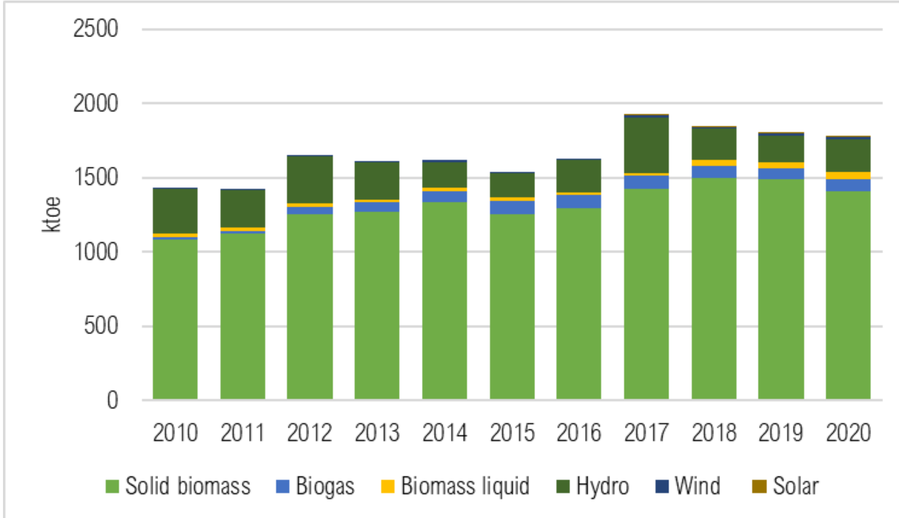


Figure 2.12 Renewables energy consumption in Latvia in 2010-2020

In 2020, RES consumption has increased by 24% compared to 2010. The consumption of biogas and liquid biomass has been the fastest growing, while solid biomass accounts for about 79% of total RES consumption in 2020.

The above changes in the structure of primary energy sources have vitally decreased the carbon intensity of primary energy sources (measured as CO_2 t/toe in primary sources), allowing reduction of CO_2 emissions in the energy sector. The carbon intensity in primary sources has decreased from 2.37 t CO_2/toe in 1990 to 1.47 t CO_2/toe in 2020, or by 38%. Implementation of energy efficiency policies in various consumer sectors and growth in RES utilisation significantly contributes to limiting the GHG emissions in energy sector.

Electricity generation was 5.7 TWh in 2020. It consisted of electricity produced in hydro power plants (45.7%), electricity produced from natural gas in combined heat and power plants (CHP) (36%), electricity produced in solid and gaseous biomass CHP (15.2%) and wind (3.1%). In recent years, electricity production from solid and gaseous biomass CHP has grown the fastest. The power system is interconnected with the power systems in Estonia, Lithuania, Russian Federation and Belarus. Net imports from the neighbouring countries vary considerably from year to year, mainly due to variations in hydropower production in Latvia.

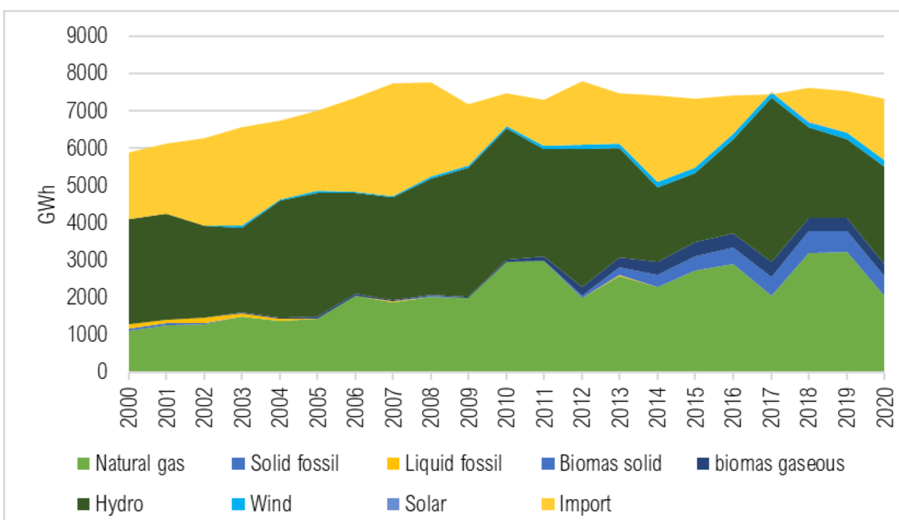


Figure 2.13 Electricity supply by production mode in Latvia in 2000-2020

The final energy consumption underwent trends similar to those of the consumption of primary energy sources, namely, in 2000 it was by about 49% lower than in 1990 (Figure 2.14). Starting with 2001, increase in the final energy consumption (FEC) was observed. Starting with 2010, programmes to increase energy efficiency in buildings (residential and public) and industry were implemented. Consequently, with GDP growing by 29.5% in 2020 compared to 2010, the FEC decreased by 7.4%. In 2020 it was 3.8 Mtoe.

The greatest changes occurred in the residential sector where energy consumption in 2000 – 2020 decreased by about 16% and its share in the final energy consumption decreased by about 11.4% points and in 2020 was 29.4%. The other largest share in the final energy consumption was in the transport sector, constituting 27.6% in 2020 and the increase was by 4.5% points against 2000. In industry the final energy consumption had grown by 50% in 2000-2020 and in 2020 its share was about 23% of the total consumption and the increase was by about 5.2% points, compared with 2000.

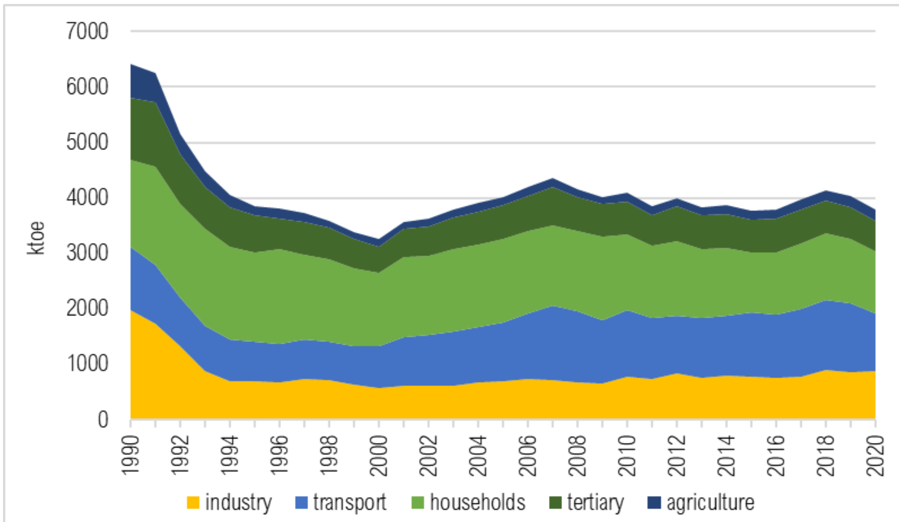


Figure 2.14 Final energy consumption by sector in Latvia in 1990-2020

When analysing the total final consumption as to structural fuel and energy changes in the period 2000-2020, the following key factors could be underlined:

- The share of DH fell from 18.4% to 14%, the main causes – the measures taken for improving energy efficiency in buildings (residential and public) connected to DH system which led to decrease in the DH consumption (in absolute units).
- The consumption of oil products increased by 27% but the share grew from 32.5% to 34.9%, the main cause – rapid increase in the number of private cars and travelled vehicle km.
- The growth in the number of electric appliances in households and services sector, as well as the development of industrial sector raised the total electricity consumption by around 45.7%, while its share in the total final consumption increased by 2.8% points;
- If the consumption of biomass has increased by about 19.6% and its share in the FEC in 2020 was 25.6%, then the consumption of natural gas has decreased by 1.8% and its share in the FEC in 2020 is 8.4%.

2.6.1 Energy market

Latvia started opening its electricity market on 1 July 2007 when amendments to the Electricity Market Law took effect ensuring the right to electricity consumers to change the electricity trader. The next important step was taken on 1 November 2012 when all electricity consumers which were legal entities were obliged to purchase electricity for agreed price from the trader, and thus about 24500 entities, consuming about 75% of electricity, bought it in the free market. The market liberalization was completed on 1 January 2015 as all individual consumers (households) could become the free market participants.

According to the electricity trade register of the Public Utilities Regulation Commission (hereinafter referred to as the Regulator), 16 active traders for households and 24 legal entity consumers were registered for the sale of electricity in January 2022. The consumption of electrical energy is about 6.6 TWh and the major consumers in 2020 are tertiary sector (40.1%), manufacturing and building sector (28.6%) and residential sector (26.8%).

The Latvian bidding area of electricity exchange Nord Pool started its operation on 3 June 2013. Currently, Nord Pool bidding areas are opened in all three Baltic States; and electricity trade is carried out in a uniform and consistent manner throughout the Baltic Sea region. Market participants of the Nord Pool Latvian open electricity bidding area may submit their quotes for transactions that will take place the following day (day-ahead market) or intraday market. The existence of both markets not only ensures greater liquidity of the Latvian electricity market, but also a more efficient utilisation of network transfer capability, and transparent energy price that the market participants can rely upon.

In fulfilment of common rules for the internal market in electricity, Latvia has separated the electricity distribution and transmission functions from the electricity trade and production company. As of 1 July 2007, functions of the electricity distribution system operator are performed by Sadales tīkls AS, independent subsidiary of Latvenergo AS (MoE is the holder of capital shares). In Latvia, the Regulator has issued 11 licences in total to distribution system operators, of which Sadales tīkls AS provides the service in 99% of the territory of the country.

On 1 January 2012, Augstsprieguma tīkls AS started operating outside the Latvenergo Group as an independent transmission system operator, all capital shares of which are held by MoF. Assets of the transmission system are owned by Latvijas Elektriskie tīkli AS, subsidiary of Latvenergo AS, which started its operation on 1 April 2011. Until 2020, Augstsprieguma tīkls AS rented transmission system assets from Latvijas Elektriskie tīkli AS, but on 8 October 2019 Cabinet of Ministers adopted the decision on supporting Latvijas Elektriskie tīkli AS in contributing in the form of capital shares in the share capital of Augstsprieguma tīkls AS, and as a result of that Augstsprieguma tīkls AS will obtain in property transmission system assets – poles, lines, high-voltage substations, related real estates and other. Augstsprieguma tīkls AS is the only transmission system operator in Latvia and is operating in conditions of natural monopoly.

Efficient electricity transmission interconnections are one of the most important preconditions for optimal functioning of the electricity market. The Latvian electricity market, just like the energy market of the Baltics, is currently connected to the common European energy market with two sea cables connecting the Estonian and Finnish power systems – Estlink I, with the transmission capacity of 350 MW, and the Estlink II, with the transmission capacity of 650 MW.

Since April 2017, the natural gas market has been fully liberalised, which is mainly related to the purpose of creating an effectively functioning and integrated EU energy market, ensuring high flexibility of the system, as well as strengthening energy security. In order to promote the development of competition and independence of operators of the transmission and distribution system, and at the same time observing the amendments to the Energy Law adopted on 11 February 2016, the historical natural gas monopoly Latvijas Gāze AS had to separate its natural gas transmission and storage infrastructure from the natural gas trading and distribution functions, namely legally separated natural gas transmission and storage system operator Conexus Baltic Grid AS and distribution system operator GASO AS were created. Natural gas consumption in recent years has been around

40 PJ, of which around 65-68% is consumed by the CHPs and district heating enterprises, while the rest is consumed in approximately equal proportions by the residential, tertiary and manufacturing sectors.

One of the most significant processes in the natural gas sector is the establishment of a single regional natural gas market of the Baltic States and Finland on 1 January 2020. This was possible due to the completion of the Estonia-Finland interconnection (Balticconnector) project in 2019 and its commercial use since 1 January 2020. Balticconnector is a gas pipeline between Finland and Estonia that will enable the natural gas markets of the Baltic countries and Finland to be connected, and allow the integration of these markets with the EU common energy market.

At present, a single gas transmission tariff zone is functioning in Finland, Estonia and Latvia. The single natural gas market started functioning with two balancing zones – the combined Latvian and Estonian balancing zone and Finland. Further diversification of supplies of natural gas, as well the creation of a highly liquid and integrated regional natural gas market in Latvia and in the entire Baltic region are considered to be one of the most important future priorities on the natural gas market.

2.7 Transport Profile

Transport sector demand and supply are influenced primarily by developments in economy, demographic factors, employment patterns and the provision of infrastructure.

The main types of transport include rail transport, road transport (public and private), air transport (domestic and international) and water transport (domestic and international). Road transport constitutes the largest share of energy consumption in domestic transport. In 2020, passenger cars, trucks, buses and motorcycles used about 96.7% of the total consumption in domestic transport. Due to the decrease in rail freight transport over the last five years the share of rail transport in the total consumption decreased and in 2020 it constituted only 3.1%. The remaining 0.2% was made up by domestic air and water transport. The share of road transport energy consumption in total domestic transport consumption has increased by 4.1% points over the last five years, while rail transport has decreased by 4.0% points. The share of electricity is only about 0.7% of total energy consumption in domestic transport.

The infrastructure of roads, railway, seaports and airports forms the Latvian transport network. In 2020, the total road length, excluding streets and forest roads, in Latvia was 50036 km, out of which 20061 km were national roads and 29 975 km municipal roads. The average road density was 1.094 km per 1 km^2, but the average density of the national road network is 0.310 km per 1 km^2.

The total length of Latvian rail network is 1860 km, out of which 350 km are double-track and 250 km are electrified. In 2019, approximately 95% of the structure of rail freight transport was international rail freight transport, mainly from Latvia's neighbouring countries (Russian Federation and Belarus) to Latvian ports (East-West transit corridor). The share of domestic transport was only 5%, which can be explained by the relatively short transport distances.

Latvian ports are important logistics hubs in the Baltic region. Latvia has three big ports (Ventspils, Rīga and Liepāja), the ratio of which in total cargo turnover constituted 97% in 2019, and seven small ports (Engure, Jūrmala, Mērsrags, Pāvilosta, Roja, Salacgrīva, Skulte). The three big ports are outspokenly ports of export as the cargos shipped from them (mainly transit cargos from Russian Federation, Belarus and other CIS countries) exceed greatly the volume of the cargos received.

Though air transport is not of significance for local transportation, the development of Riga International Airport plays an important role in the development of other sectors, especially tourism. Riga International Airport is the biggest international airport in the Baltic States and the number of passengers it serves increases continuously; it reached 5.4 million passengers in 2019.

2.7.1 Passenger Transport

Passenger transport (as measured in passenger kilometres) has grown considerably from 2000 to 2019 (on average by 1.1% per year). The rapid growth was ensured by the trends developing up to 2007, when the average annual growth reached 4.3% per year. The growth rate was due to the rapidly increasing number of passenger cars up to 2007. Due to the economic recession, mobility indicators declined sharply between 2008 and 2010, but from 2013 onwards the growth rate stabilized (Figure 2.15). Due to the Covid-19 pandemic in 2020, passenger traffic decreased, especially for the public transport.

In 2019, most of passenger movement was ensured by road transport: passenger cars – 83.8%, buses – 12.0% and railway – 4.2%. These modes of transport have demonstrated different trends since 2000 (see Figure 2.15). The passenger kilometres travelled by passenger cars in Latvia increased steadily in the period under consideration (by 27.3%) and their share in the total passenger transport increased by 6.3% points, while rail and tram travel decreased by around 48.6% and their share in passenger transport decreased by 2.4% points and passenger kilometres travelled by bus decreased by around 41.2%, but their share decreased by 3.8% points. As a result, the share of public transport in total passenger traffic in 2019 is 6.3% points lower than in 2000, which has a negative impact on the change in GHG emissions in the transport sector. Due to the slow pace of replacement of private cars by new, more efficient and alternative fuel ones (CNG, BEV and PHEV), it has not been possible to decouple the increase in GHG emissions from the increase in travelled vehicle km.

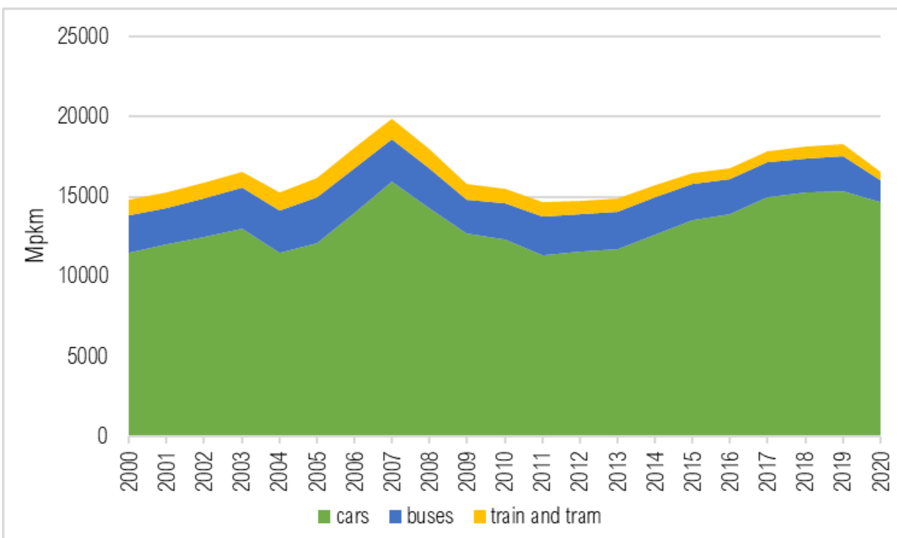


Figure 2.15 Passenger travel by transport mode

2.7.2 Freight traffic

The year 2019 showed the increase of freight traffic (measured in tonne-kilometres) against 2000 (41.2%) (see Figure 2.16). This trend was mainly driven by the growth of road transport, excluding in cross-trade, (approximately 2.4 time) which by far exceeded the increase in rail freight traffic (12.8%). It has to be noted that the volume of rail freight strongly depends on the import and export shipment volumes in the ports and harbours of Latvia. In Latvia, the dominant position in inland transportation is taken by trucks due to transporting over short distances (less than 300 km). Rail freight transport ensures mainly export and import freight transportation from and to the ports of Latvia. In 2020, the share of road freight traffic in the total freight transportation (measured in tonne-kilometres) was 54.0%, which was by 31.2% more than in 2000. The share of rail freight traffic constituted 46.0%. It should be noted that the share of rail transport in 2020 decreased by 15.7% points compared to 2019.

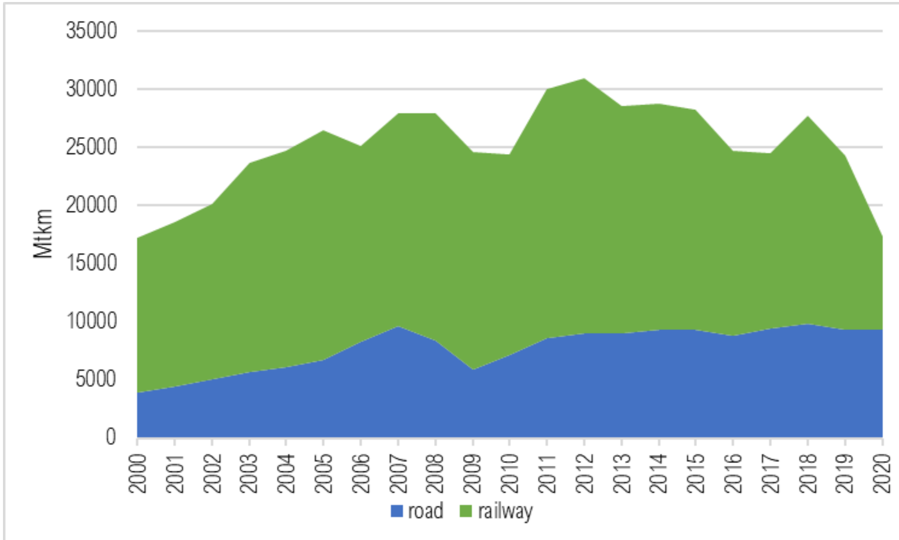


Figure 2.16 Freight traffic by transport mode

2.8 Industry

The manufacturing industry is one of the largest sectors of Latvian economy. In 2020 it generated 12% of total VA. The manufacturing industry employed about 12.8% of total employment. It was also vitally important for promoting foreign trade of Latvia as export made about 2/3 of the industry turnover.

The share of export in the total sold production in 2020 differed significantly among different sectors. The lowest export share (around 38.5%) had food and beverage sector, while the highest one (around 90%) had machinery and transport equipment production sector. Nearly 66% of all exported products were sold in the markets of the EU countries (EU-27), while export to CIS countries was 11% of total export of the manufacturing industry.

The development of the manufacturing industry is promoted by the improvement of the competitiveness of Latvian producers, as well as the dynamics of demand in the largest export markets. The growth of value added in the manufacturing industry was particularly high in 2017 and 2018 when value added, compared to the previous year, increased by 6.7% and 7.7% respectively. In 2019 growth rate decreased and the VA increase, compared to 2018, was 2.1%. In its turn, in 2020 total VA of manufacturing industry already had decrease by 0.9%, however different sectors manifested different trends. The decrease of production volumes was observed in transport equipment, metal and food and beverages production sectors but at the same time the production volumes increased in wood processing, manufacturing of electronic and optical appliances and manufacturing of paper and printing.

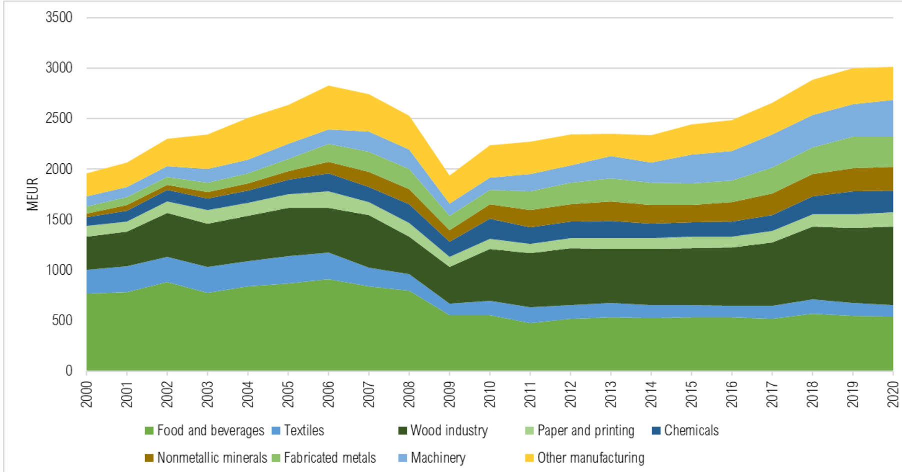


Figure 2.17 VA in the manufacturing industry, MEUR (2015)

During the 20-year period the VA in manufacturing industry increased by average 2.4% annually. The 2008-2009 economic recession had a substantial impact upon the manufacturing industry – the VA in 2009 was about 27% lower than in 2007 (Figure 2.17). After the recession of those years, the manufacturing industry successfully recovered and had good VA growth up to 2019.

In 2020, the significant contributions in the manufacturing industry as to VA production were provided by wood processing (25.0%), food and beverages (17.5%), fabricated metal products (9.6%), non-metallic minerals (5.8%), electrical appliances, machinery and equipment (12.0%), chemicals and pharmaceuticals (8.7%). Compared to 2007, the most substantial changes in the structure of VA production were decrease in the shares of food and beverages by 11.9 percentage points and textiles industry by 2 percentage points, while it increased in wood processing by 6.3 percentage points, electrical appliances, machinery and equipment by 3.2 percentage points and fabricated metal products by 1.7 percentage points (Figure 2.17).

In 2020, the most important sectors in the manufacturing industry as to the number of jobs were food and beverages (20.1%), wood processing (20.0%), fabricated metal products (11.2%), light industry (8.5%), chemicals and pharmaceuticals (7.1%), non-metallic minerals (5.3%).

Energy consumption in industry

In 2020, the VA in the manufacturing industry is 59.2% higher than in 2000. At the same time, thanks to the implementation of energy efficiency improvement measures in the sector, the final energy consumption has grown less. In 2020, the final energy consumption is 50.8% higher than in 2000.

Changes in the final energy consumption were different in different sectors (Figure 2.18). Decrease is observed in such sectors as primary metals (by 99%) due to the closure of the only metal production plant in 2016, food and beverages, paper and printing sectors by 43%, textiles – by 91%, transport equipment – by 44%. At the same due to the rapid growth of production energy consumption of wood industry have grown by about 6 times. Energy consumption growth took place also in non-metallic minerals – by 2.7 times, chemicals – by 22%, rubber and plastics – by 36%.

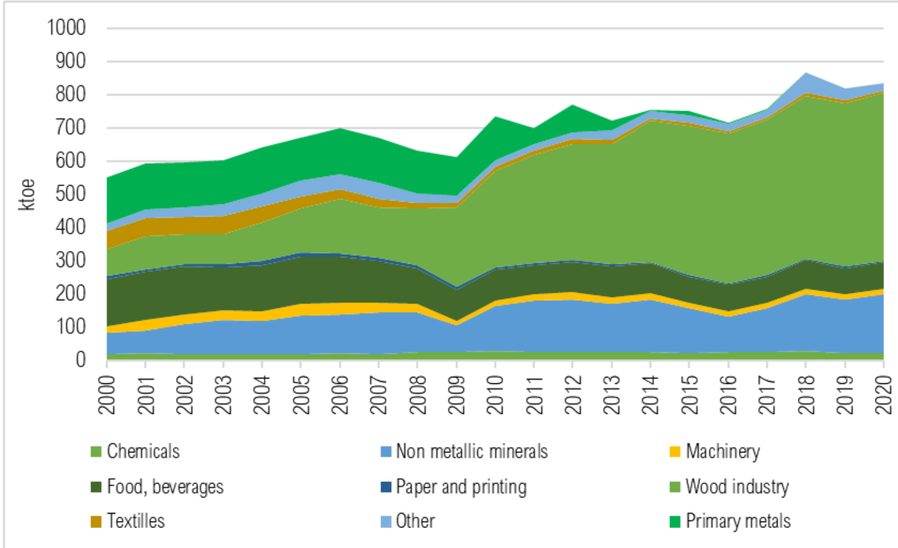


Figure 2.18 Final energy consumption in manufacturing by sectors, ktoe

The changes in energy consumption caused substantial changes regarding the share of total consumption by each sector. Decrease in the share of food and beverage sector, textiles, steel production and the increase of wood and wood products sector share in the total consumption are seen. In 2020, wood and wood products and non-metallic minerals sectors together consumed about 80% of the total final energy consumption in the manufacturing industry.

In the period 2000-2020 substantial changes occurred also in the consumption of types of energy and the structure of the energy sources consumed. Electricity consumption increased by 30.6%, but its share decreased by 2.8 percentage points and was 18.4% in 2020. Consumption of natural gas decreased by 57.4%, but its share by 26.9 percentage points and constituted 10.6% in 2020. Consumption of oil products (residual fuel and diesel oil) dropped by 79.2% and its share by 23 percentage points and was 3.7% in 2020. Consumption of solid biomass increased more than seven times and in 2020 its share was 56% of total energy consumption in the manufacturing industry (Figure 2.19).

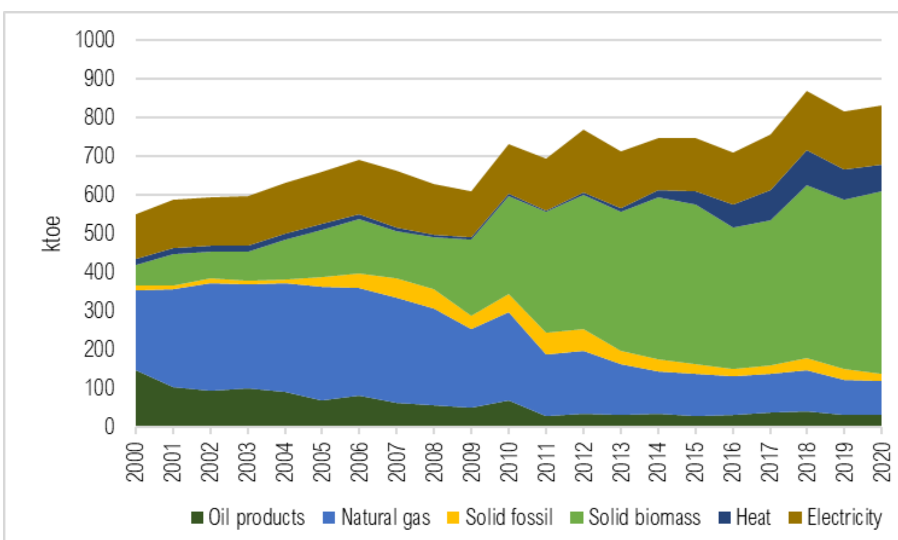


Figure 2.19 Final energy consumption in manufacturing

In 2020, the share of fossil fuels in the total final energy consumption in manufacturing industry was only about 17%. Compared to 2000, the share of fossil fuels has decreased by about 49.6 percentage points.

Implementation of energy efficiency improvement measures and replacing fossil fuels with solid biomass fuels and electricity has made it possible to limit the growth of GHG emissions in the manufacturing industry.

2.9 Waste

Waste management has acquired prior significance in the environmental protection policy as one of the instruments for sustainable use of natural resources. The main directions in the waste management are the development collecting system for biodegradable waste and the development of system for the collection and treatment of hazardous waste.

At the moment 10 non-hazardous waste polygons and two polygons for hazardous waste got "A" category permits according to integrated pollution prevention and control (IPPC) directive. Biogas collection and use for energy production from biodegradable waste and sludge is set as one of waste management priorities in Latvia.

The new EU policy period is marked by new strategic goals. These goals have been included in the main planning document for waste sector - "National Waste Management Plan for 2021-2028". In particular, in 2015, the EC adopted an action plan for the transition to a circular or circular economy. It is envisaged that the measures contained in the action plan could not only promote the sustainable management of natural resources and prevent environmental degradation, but also bring significant savings to the economy and reduce annual GHG emissions.

In 2020 approximately 5000 separate collection points and approximately 90 waste sorting areas were in operation.

At the beginning of 2020, waste management for 110 municipalities and 9 cities in Latvia is provided by 41 companies. 74 municipalities are served by municipal companies, while 35 are served by private companies.

Table 2.1 Generated waste in Latvia (kt)

Year	Municipal (all non-hazardous) waste	Hazardous waste	Total
2006	1420.46	54.37	1474.83
2007	1386.57	41.61	1428.18
2008	1368.79	46.40	1415.16
2009	1033.91	55.56	1089.47
2010	1131.40	55.09	1186.49
2011	1535.06	58.48	1593.53
2012	1799.44	85.12	1884.56
2013	1902.01	109.23	2011.24
2014	2128.73	80.98	2209.70
2015	2087.51	86.60	2174.11
2016	1980.28	63.66	2043.94
2017	2141.21	68.76	2209.97
2018	1587.74	118.14	1705.88
2019	1698.71	115.46	1814.17
2020	1605.95	150.03	1455.97

Objectives of the "National Waste Management Plan 2021-2028" plan are:

- Objective 1 - to prevent the generation of waste and to ensure the total amount of waste generated significant reduction by maximizing all the best available waste prevention options and best available techniques by increasing resource efficiency and promoting more sustainable consumer behaviour model development;
- Objective 2 - to ensure the rational use of waste as a resource based on the basic principles of the circular economy and encouraging the return of resources as far as possible back into economic circulation in a way that benefits the economy;
- Objective 3 - to ensure that the waste generated is not hazardous or poses little risk the environment and human health by promoting appropriate product policies that are hazardous and harmful to the environment restrictions on substances and improving consumer awareness;
- Objective 4 - to ensure the reduction of landfills and disposal of waste in a way that is safe for human health and the environment.

The main treatment operation for municipal solid non-hazardous waste is disposal. According to the EU requirements and "National Waste Management Plan 2021-2028" it is planned to reduce waste disposal till 10% from generation in year 2035. To reach this target complex actions need to be implemented:

1. Waste sorting at source;
2. Increase biodegradable waste pre-treatment;
3. Biodegradable waste recycling;
4. Increase production of refused derived fuel production;
5. Increase waste incineration capacity.

Table 2.2 Disposed solid waste amounts 2002-2020 (kt)

Year	Total disposed solid waste amount	Disposed in polygons (MCF=1)	Stored in bioreactor	Disposed in deep unmanaged sites (urban area, MCF=0.8)	Disposed in shallow unmanaged sites (rural area, MCF=0.4)
2002	658.00	217.46	NO	303.97	136.57
2003	578.90	207.74	NO	256.07	115.05
2004	631.70	282.84	NO	240.71	108.15
2005	610.90	370.43	NO	165.89	74.53
2006	670.00	454.39	NO	148.78	66.84
2007	775.10	553.27	NO	153.09	68.78
2008	704.80	566.89	NO	95.12	42.74
2009	637.50	549.50	NO	60.71	27.28
2010	605.40	586.90	NO	12.73	5.72
2011	548.70	543.50	NO	2.60	2.60
2012	529.50	525.50	NO	1.98	1.98
2013	534.20	534.20	NO	NO	NO
2014	505.20	505.20	NO	NO	NO
2015	503.90	503.90	NO	NO	NO
2016	515.70	353.90	161.90	NO	NO
2017	517.90	230.60	287.20	NO	NO
2018	508.80	219.30	289.50	NO	NO
2019	506.39	202.78	303.61	NO	NO
2020	494.35	218.61	275.74	NO	NO

2.10 Building Stock and Urban Structure

2.10.1 Residential buildings

Due to climatic conditions in Latvia heating is required for about 192 - 206 days a year depending on region of the country, and, thus, the share of building sector in the total final energy consumption constitutes about 30%. In the Information System of the National Real Estate Cadastre (NREC IS), 1.37 million buildings were registered with the total area of 206.6 million m^2, including various auxiliary buildings. In 2020, the total area of residential buildings was 90.1 million m^2. The major part was multi-dwelling (three and more dwellings) buildings (56.6%), while single-dwelling buildings constituted about 42.5%.

The population concentration around capital Rīga is high, as the floor space in Rīga and its suburbs constitutes about 51% of total residential building floor space in Latvia.

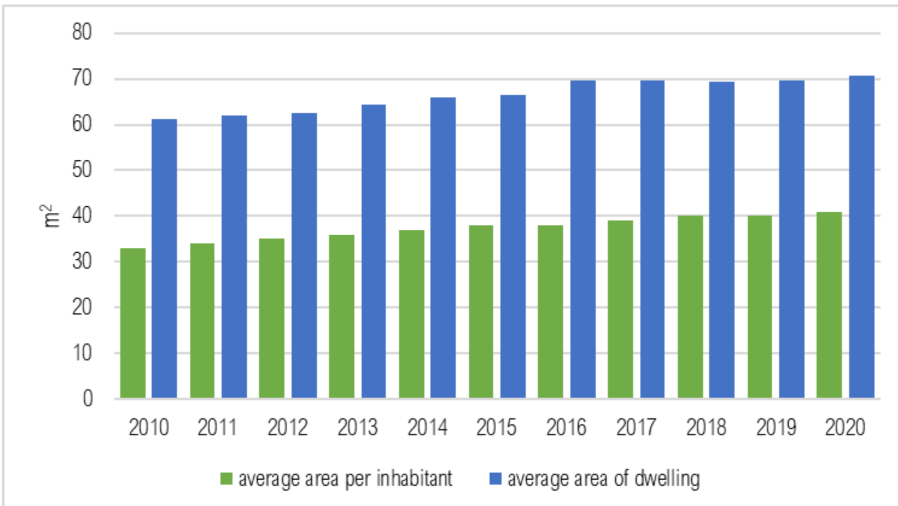


Figure 2.20 Changes in the floor space of households

The increase in the welfare of the population has contributed to the improvement of the living conditions of the population and, as a result, an increase in both the average area of dwelling and the area per inhabitant (Figure 2.20). In 2010-2020, the first indicator grew by 15.5%, and the other - by 24.2%. The increase in the values of these indicators determines the increase in energy consumption for heating residential buildings.

Figure 2.21 shows multi-apartment residential buildings by the period of construction. It reveals that about 45% were built by 1940. After 1979, just over 17% of the total number of multi-storey residential buildings has been built. After 2003, an average of 3.5 thousand dwellings have been put into operation per year, but in total about 60 thousand dwellings have been put into operation during this period.

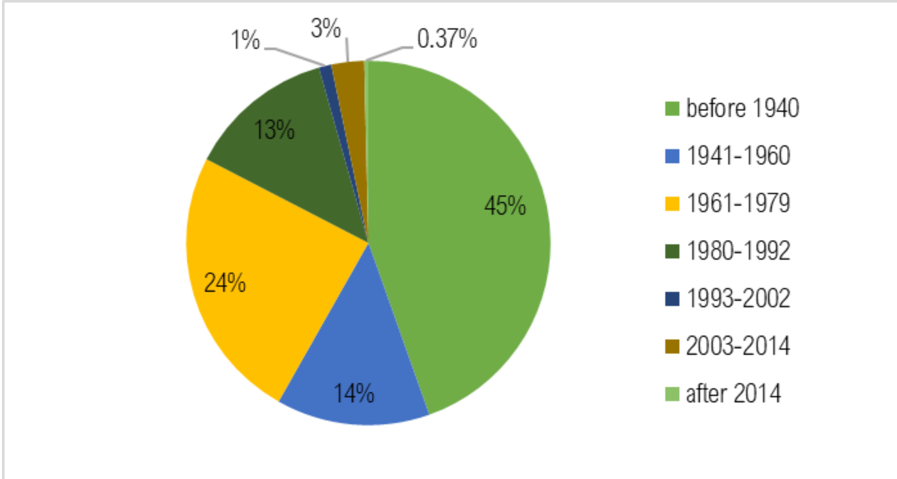


Figure 2.21 Residential buildings by the period of construction

In each period slightly different building materials and technologies were used and each period had different requirements for thermal insulation which tightened over years. Changes in the thermal and technical requirements of building envelopes since 1980 are shown in the following figure. As shown in the figure, the increase in requirements has significantly reduced the energy consumption for heating (Unit consumption per m^2 for space heating, kwh/m^2/year) in new residential buildings over time.

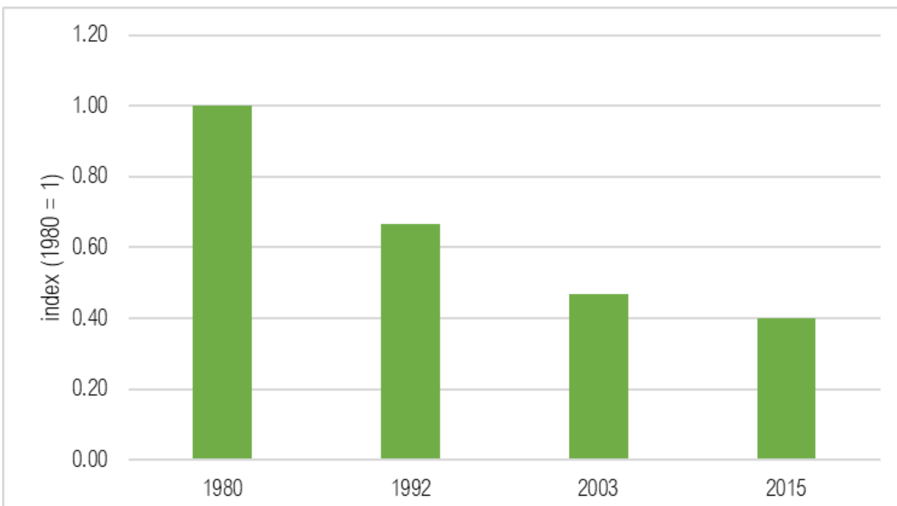


Figure 2.22 Impact of strengthening thermal engineering regulatory requirements for building envelope on unit consumption per m^2 for space heating in new residential buildings

Renovation of existing residential buildings, increasing energy efficiency, and strengthening the thermal regulatory requirements for building envelopes for new buildings have reduced specific energy consumption for heating by about 35% over a 20-year period, or an average of 2.4% per year. This has been one of the factors in limiting GHG emissions in households.

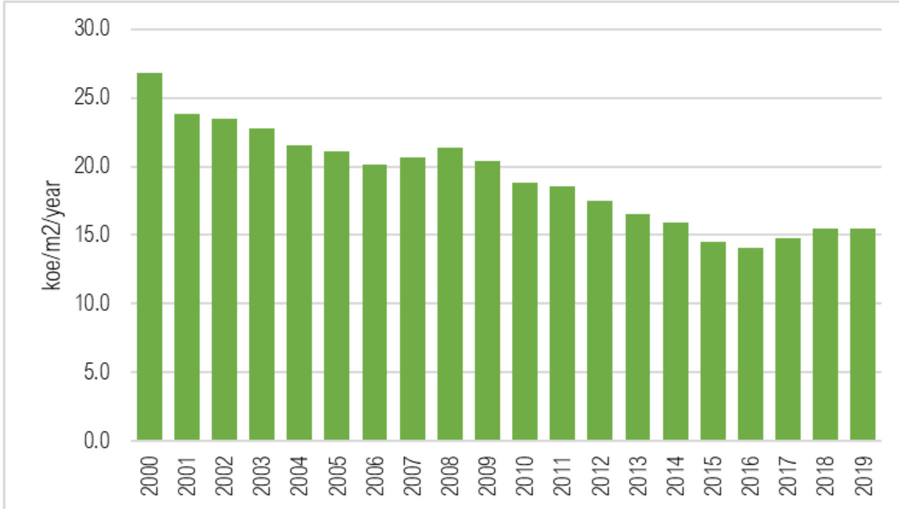


Figure 2.23 Unit consumption per m^2 for space heating with climatic corrections

Different energy sources were used for heating residential houses. In 2019, the three most important sources were wood biomass (53.9%), district heating (35.3%) and natural gas (8.1%) (Figure 2.24). Coal consumption for heating in households has declined over the past decade.

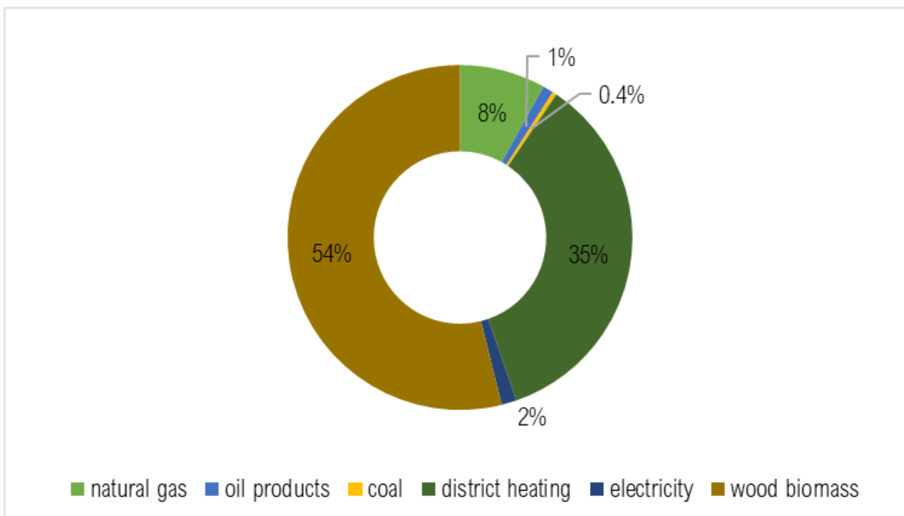


Figure 2.24 Energy sources for heating residential buildings in 2020

The low share of fossil fuels and the high proportion of solid biomass and DH for household heating are favourable conditions for non-growth of GHG emissions in households.

2.10.2 Non-residential buildings

The NREC IS data provide information on slightly more than 31 thousand registered commercial and public buildings, with the total area of 27.1 million m^2 which require energy for maintaining the microclimate.

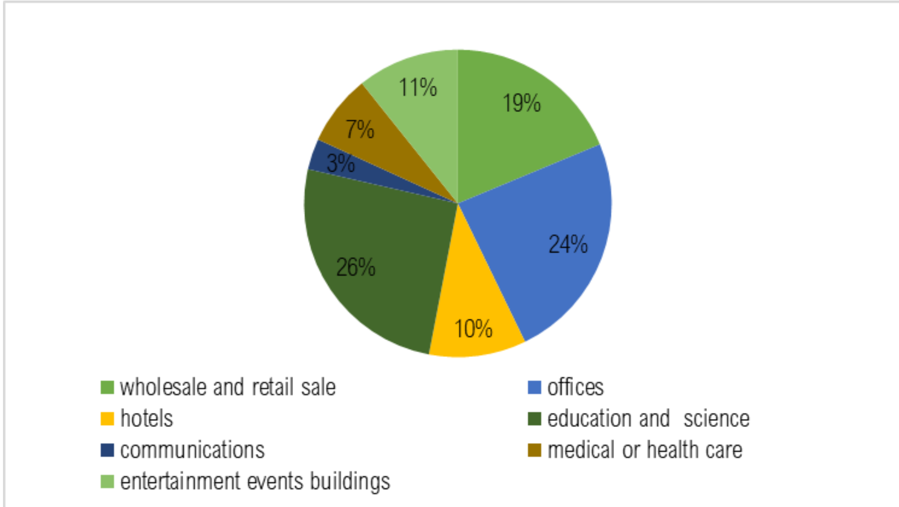


Figure 2.25 Types of non-residential buildings by area use

For the heating of commercial and public buildings in 2019, the main types of fuel and energy are district heating, natural gas and biomass. Compared to 2000, the share of coal consumption for space heating has significantly decreased and the share of natural gas consumption has increased. These structural changes in energy consumption have helped to limit the increase in GHG emissions as the sector expands.

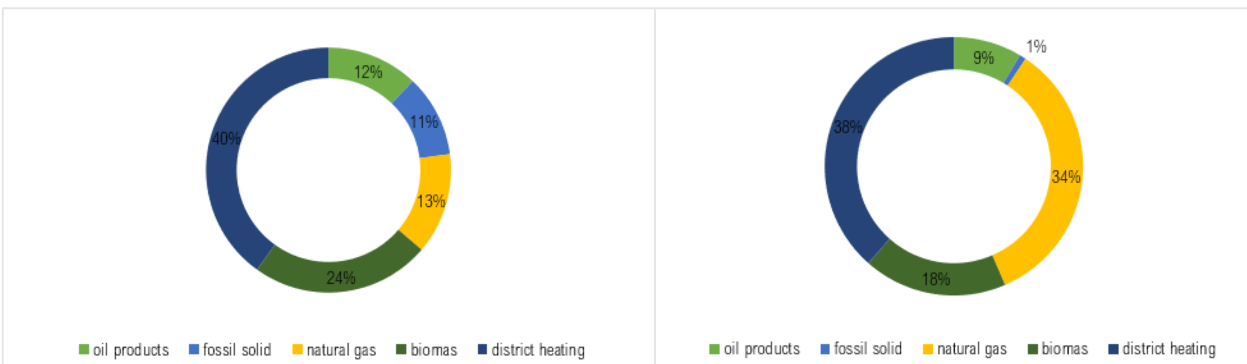


Figure 2.26 Energy sources for heating commercial and public buildings in 2000 and 2019

2.11 Agriculture

Agricultural land is one of the most significant natural resources in Latvia. Climatic conditions and soil fertility are suitable for different branches of agricultural production, including grain, rape and vegetable production. Historically the dairy sector has always been a priority in agricultural sector of Latvia; however, beef, veal and pork production also are developing. During the last years the number of sheep and poultry has increased gradually. Consequently, farming is one of the main economic activities in the rural areas. This leads to conclusion that agriculture is the second largest GHG emission sector after the Energy sector with a 21.5% share of the total GHG emissions in 2020.

Annual emissions have been reduced in Latvia by 54.9% since 1990 due to decrease mainly in the number of livestock, sown area and nitrogen fertilizers. In 2020, agricultural soils were responsible for 51.6% of the total emissions from agriculture. The second largest emission source was enteric fermentation by contributing 38.0% of the total agricultural emissions. Manure management constituted 7.2% from the agricultural emissions in 2020. Liming and urea application were less significant emission sources producing 3.2% of the total agricultural emissions in 2020. Largest share creates nitrous oxide emissions constituted 54.9% following by methane emissions with 41.9% of the total GHG emissions from agricultural sector. Remaining 3.2% of the total GHG emissions from agriculture originated from liming and urea fertilization. The most important source of methane emissions is dairy cattle, because of the significance of dairy sector in Latvia. Largest sources of nitrous oxide emissions from soils are organic soils, nitrogen fertilizers and crop residues. At the end of 2020, in Latvia there were 73 thousand agricultural holdings with the average size of 39.4 ha. Agricultural area on average per holding increased from 19.6 ha in 2010 to 26.9 ha in 2020 or by 37%. The total utilised agricultural area in the country has grown by reaching 1 969.0 thousand ha in 2020. In 2020 areas of meadows and pastures continued to reduce. The structure of sown area is represented in the Figure 2.27.

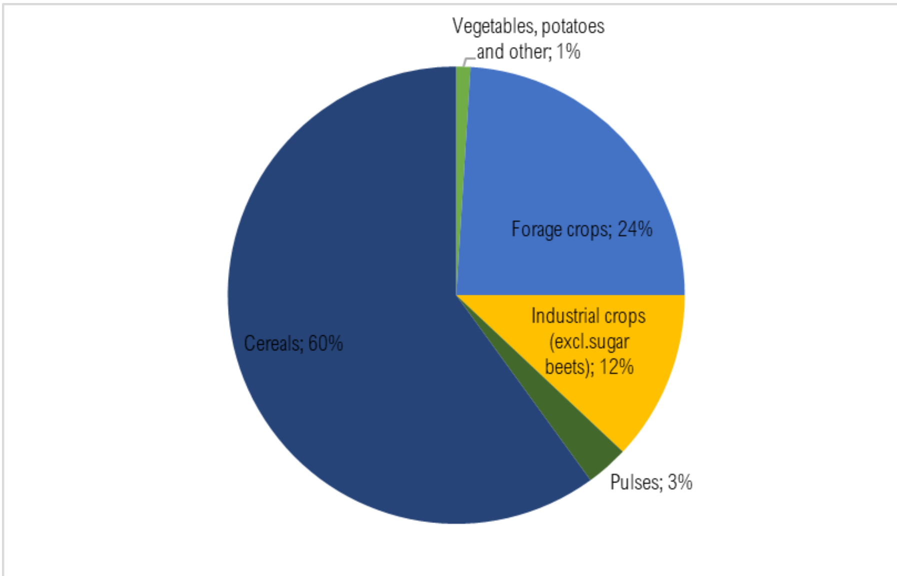


Figure 2.27 The structure of sown area in 2020

The total sown area increased by 44.9% during the time period 2000-2020 (Figure 2.28). Additionally, consumption of nutrients per hectare of sown area increased – of nitrogen from 64 kg in 2019 to 66 kg in 2020 or by 3.1%, of phosphorus from 21 kg to 24 kg or by 14.3%, of potassium from 25 kg to 28 kg or by 12.0%.

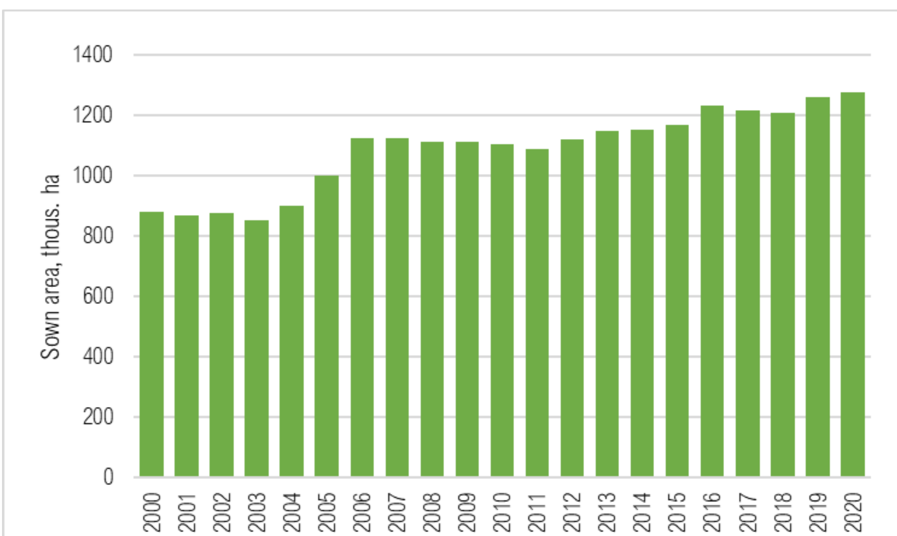


Figure 2.28 Sown area (thous.ha)

In the end of 2020, the number of cattle increased by 3,7 thousand or 0.9%, while the number of dairy cows decreased by 2,4 thousand or 1.7% (Figure 2.29). Last year the total number of cattle was 399.0 thousand, of which 136.0 thousand were dairy cows. During the year, the number of poultry has increased by 147.5 thousand or 2.6%, in turn, the number of pigs has decreased – by 7.4 thousand or 2.3%, the number of sheep – by 7.9 thousand or 7.9%, the number of goats – by 0.2 thousand or 1.8%, the number of horses – by 0.01 thousand or 0.1%. From 2000 to 2020 non-dairy cattle continued to increase, while population of dairy cattle showed tendency to decrease[4].

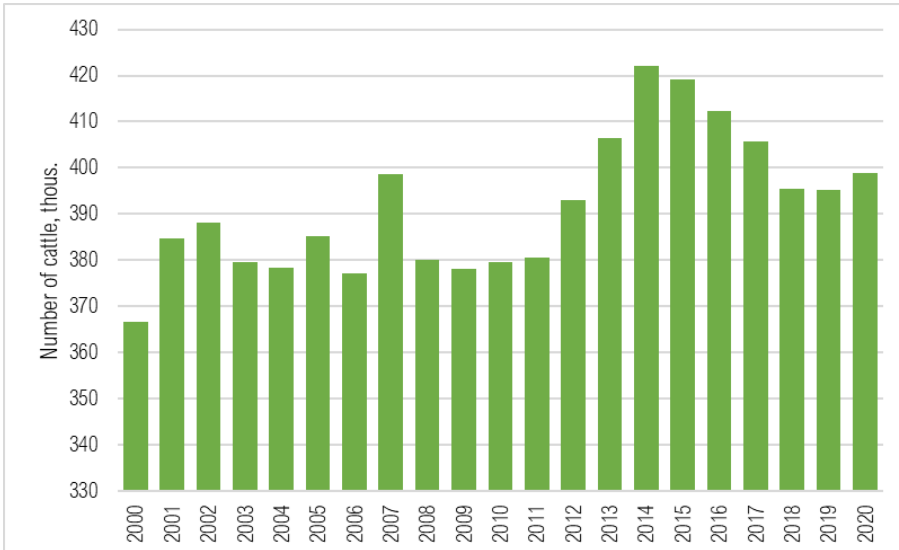


Figure 2.29 The population of cattle

2.12 Forestry

The total area of Latvia is 6.46 million ha including 6.22 million ha of land area. According to the NFI 51% of the land area is forest (excluding forest infrastructure, e.g., road networks and seed orchards), 38% is farmland (including 27% of cropland and 11% of grassland), 7% are wetlands, including water bodies, and 4% are settlements. Amelioration ditches are reported as forest, cropland, grassland, settlement or wetland depending from dominant affected land use category. Latvia is among the most densely forested countries in Europe. Since the beginning of last century, the forest area of Latvia has almost doubled by occupying 3,248,892 ha in 2015. In terms of property share – 48% are state owned forests, the remaining forests are under private ownership (about 135000 owners) with an average property size of 11.1 ha. Forests are of major importance for the national economy of Latvia as well as provide different ecosystem services including purification of air by capturing CO_2 and recreation.

The species dominating in the forests in Latvia are – pine, spruce and birch occupying 73.4% from the total forest area. Though, coniferous forests dominate in state owned forests. In the result of fast overgrowing of agricultural and coniferous forest felling areas with deciduous trees the share of birch and other broadleaves is increasing in the forest stand of Latvia. Forest resources constitute the main national wealth.

As the forest area in Latvia has been constantly increasing over the past 20 years, continuing the trend of previous century, when forest area more than doubled. The volume of timber in the forest, the growing stock has also

[4] AGRICULTURE OF LATVIA. Collection of Statistics. Riga, Central Statistical Bureau of Latvia, 2022. Available: https://admin.stat.gov.lv/system/files/publication/2022-06/Nr_15_Latvijas_Lauksaimnieciba_2022_%2822_00%29_LV_EN_0.pdf

increased substantially. 84% of Latvia's forest area (79% of the growing stock) were available for wood supply in 2020 without restrictions. In 2020, total growing stock volume in Latvia was 682 million m^3 including 368 million m^3 or 54% of total growing stock volume in state owned forests. According to the National Forest inventory, growing stock gross increment, including natural mortality and harvested trees, during previous 5 years was in average 26.2 million m^3 per year (8.4 m^3 ha^{-1}), natural mortality – 6.2 mill. m^3 (2.0 m^3 ha^{-1}) and harvest rate – 17.4 mill. m^3; respectively, the net increase of growing stock during the previous 5 years was 2.6 mill. m^3 yr^{-1}.

In Latvia, traditional forest management cycle (up to 120 years depending on tree species and site index) consist of following stages: regeneration (till age of 5-10 years); tending of young stands (till age of 20-40 years); forest thinning (till age of 40-90 years); regenerative felling (from 50-120 years age, depending from dominant species, management regime and site index). All of the above mentioned forest management cycle stages are regulated according to laws and relevant regulations. All the forests owned and managed by the state are certified by Programme for the Endorsement of Forest Certification (PEFC) promoting sustainable forest management and partly Forest Stewardship Council (FSC) certified assuring that products come from responsibly managed forests that provide environmental, social and economic benefits.

In Latvia, the reforms in forestry sector were started in 1998 when the CoM Regulation adopted the Forest Policy. The main goal defined in the policy is to ensure a sustainable management of Latvian forests and it is being accomplished by documents of policy planning and regulations: the Forest Law, Forest-based Sector Development Guidelines (2015-2020) and other forest related regulations. In the context of forest policy "sustainable management" means the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems. The Forest Policy underlines that forest is an important part of Latvian environment and economics. The goals of the policy are:

- to ensure that the area of forest is not decreasing by setting limits to the forest land transformation;
- to ensure maintenance and increase of productivity of forest lands;
- to encourage afforestation of agriculturally non-effective land.

The Forest Law (adopted in 2000 with latest changes in 2017) is the central law of the forest sector of Latvia, stating the following goals:

- to promote economically, ecologically and socially sustainable management and utilization of forests by ensuring equal rights to all owners and legal possessors of forest, ownership privacy, independence in economic actions and equal duties;
- to regulate terms of management.

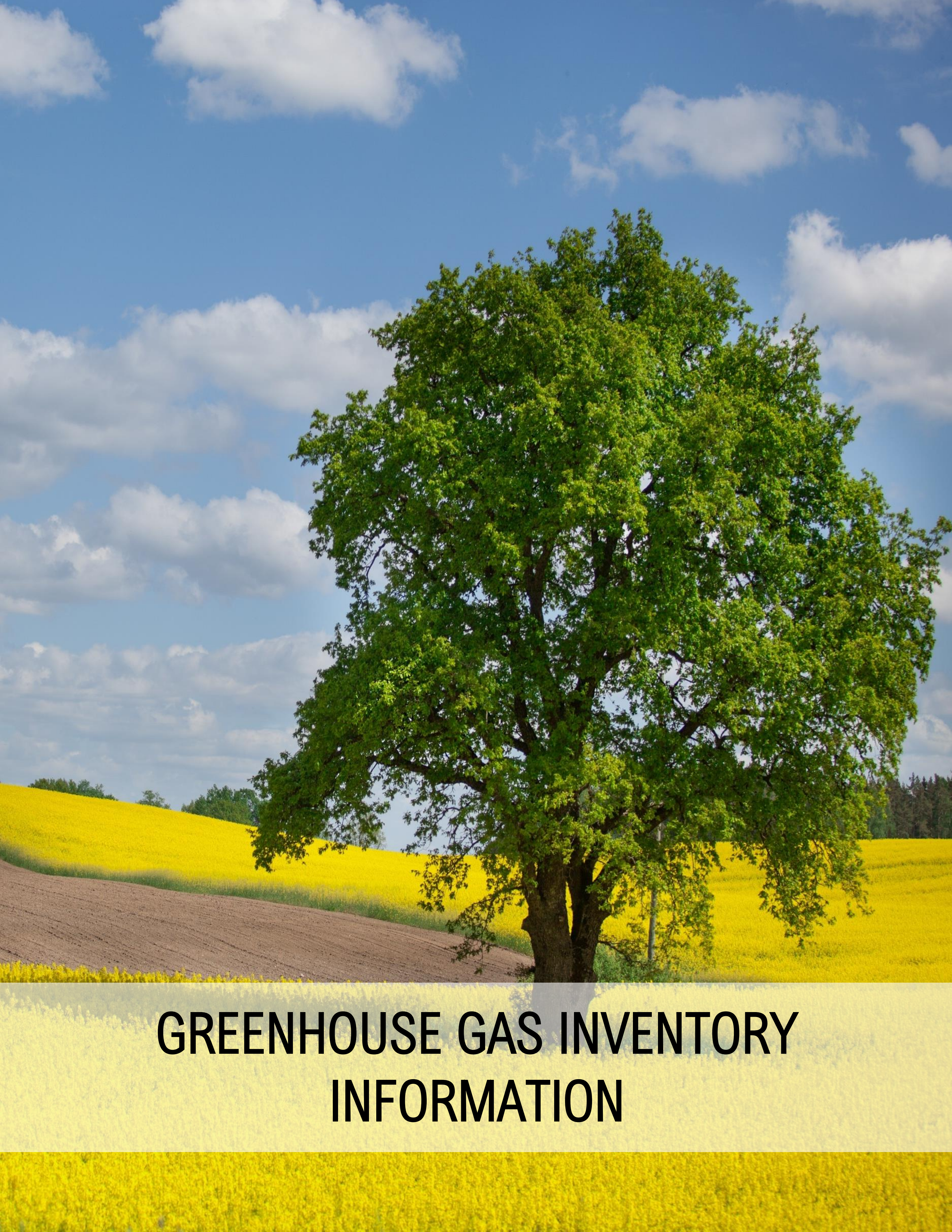
According to the Forest Law the Cabinet of Ministers defines terms of evaluation of a sustainable forest management by meeting criteria and indicators of Pan-Europe. Following the definitions of this Law, the responsibility of a forest owner or legal possessor is to regenerate forest stand after regenerative felling.

The Regulation on Determination Criteria of Compensation and Calculation of Deforestation defines a procedure of calculation and compensation and criteria for negative effect caused by deforestation. It defines that the compensation to the government should be paid if the land that is registered with National Real Estate Cadastre information system as the forest area deforested. The compensation should be paid for:

- decrease of carbon dioxide attraction potential (can be compensated with afforestation);

- reduction of biological diversity;
- decrease of quality of the environmental and natural resource protection zones and sanitary protection zone functions.

Forest-based Sector Development Guidelines (2015-2020) is a medium-term policy planning document. Guidelines consist of the forest-based sector development medium-term strategic goals, guidelines of policy development, directions of actions to achieve these goals, problems hindering achievement of these goals, and results in policies. Forest-based Sector Development Guidelines (2015-2020) are the main document of growth and development of Latvian forestry sector. The development solutions included in this document give fundamental investment in achieving goals of other planning documents.



GREENHOUSE GAS INVENTORY INFORMATION

3. GREENHOUSE GAS INVENTORY INFORMATION

This chapter provides information on GHG emission inventory for the time period 1990-2020, the national system for development of GHG inventory and the national emission trading registry. The GHG data presented in the chapter is consistent with Latvia's GHG inventory submitted to UNFCCC secretariat on 14 April 2022 (2022 Submission).

Information within the UNFCCC is provided in the form of the CTF tables (CTF Table 1: Emission trends) enclosed to Annex 1 of this report (Common tabular format workbook for the BR5).

3.1 Summary Tables and Descriptive Summary of GHG Emission Trends

3.1.1 Overall Greenhouse Gas Emission Trends

Total GHG emissions, without LULUCF, with indirect CO_2, during the time period from 1990-2020 have decreased by 59.6%. GHG emission time series for 1990-2020 are shown in Figure 3.1.

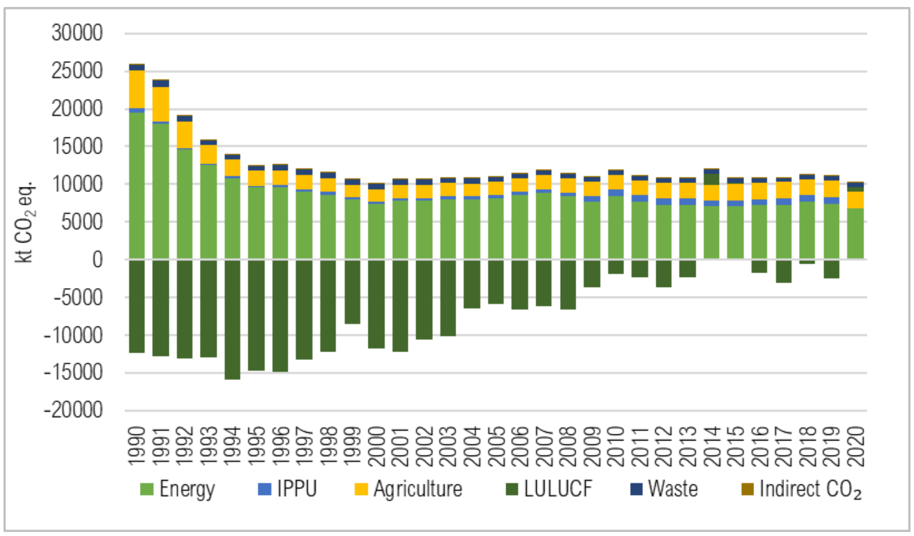


Figure 3.1 GHG emission time series for 1990–2020 (kt CO_2 eq.)

The major source of GHG emissions in 2020, without indirect CO_2, without LULUCF was CO_2 (6994.11 kt), accounting for 67.0% from the total emissions, accordingly CH_4 constituted 16.4%, N_2O – 14.1%, and fluorinated gases – 2.5% from total emissions.

The Energy sector caused 64.8% from total GHG emissions, Agriculture – 21.5%, Industrial processes and product use – 8.3% and Waste sector – 5.2%.

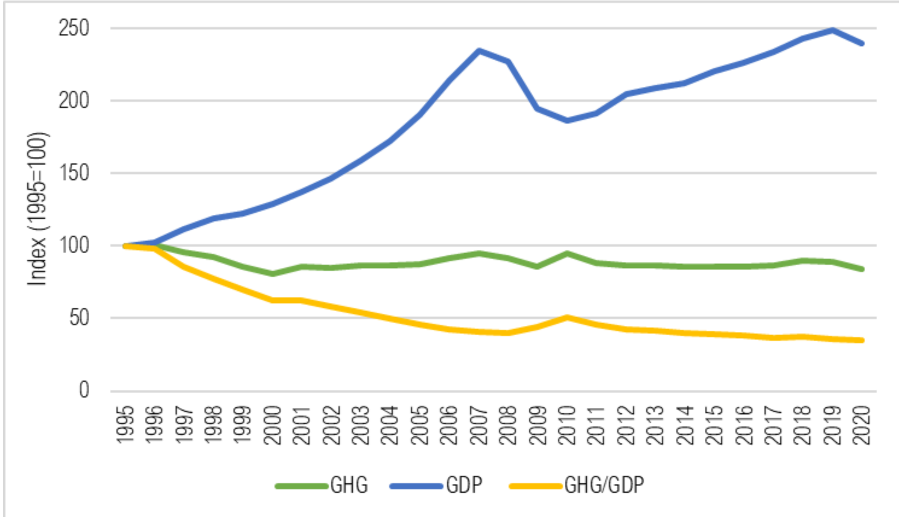


Figure 3.2 GHG emissions relative to GDP, 1995 – 2020, excluding LULUCF

Since 2000 GHG emissions have increased relatively less than gross domestic product (GDP) in spite of large annual fluctuations. The decreasing trend of relation GHG/GDP, which characterizes GHG intensity of Latvia`s economy, was observed till 2008 when it was stopped by economic recession. A fall of this indicator resumed after 2010. In 2020, the relation GHG/GDP has decreased by 65.0%.

The main sources of GHG emissions and CO_2 removals in 1990 – 2020 are outlined in Table 3.1 and Table 3.2, whereas emissions per sectors are provided in Table 3.3 and Table 3.4.

The **Energy sector, including Transport,** is the most significant source of GHG emissions with a 64.8% share of the total emissions in 2020. This reflects extensive consumption of energy for a long heating period, as well as energy consumption for transport of emissions in the energy sector. GHG emissions fluctuate in the latest years mainly due to economic trends, the energy supply structure and climate conditions. Total emissions in Energy sector in 2020 decreased by 65.2% if compared to the base year and by 9.1% if compared to 2019. In 2020, large part of the Energy sector emissions are emitted in the Transport sector (45.8%), Other Sectors (22.5%) and Energy Industries (20.2%). In 2020, total GHG emissions in the Transport sector compared to 1990 have increased by 2.2% but decreased by 6.7% compared to 2019. The decrease of emissions in 2020 in the Transport sector was caused mainly by the decreasing of road transport and railways emissions.

Agriculture is the second most significant source of GHG emissions in 2020, with 21.5% of Latvia's total GHG emissions excluding LULUCF. Emissions from agriculture include CH_4 and N_2O emissions from enteric fermentation, manure management and agricultural soils, and CO_2 emissions from liming and urea application. In 2020, GHG emissions increased by 2.2%, compared to 2019, due to the increase of livestock productivity and fertilizer use for crops. Annual emissions have reduced approximately by 54.9% since 1990 due to decrease in agricultural production. In 2020, given in kt CO_2 eq., N_2O contributed 54.9%, CH_4 contributed 41.9% of total GHG emission from the Agriculture sector, remaining 3.2% refer to CO_2 emissions from liming and urea application.

Emissions from **Industrial Processes and Product Use (IPPU)** (referred to as non-energy related ones) include CO_2, CH_4, N_2O and F-gases (HFCs and SF_6). The category constitutes 8.3% of the total GHG emissions excluding LULUCF in 2020. Compared to 1990, emissions from IPPU increased by 32.3%, but compared to 2019 emissions decreased by 2.6%.

The largest decrease in IPPU sector emissions occurred between 1991 and 1993, when industry was affected by a crisis. Emission fluctuations in product use sectors are also linked to the economic situation of the country. In the last years emissions fluctuated due to activity in industrial production processes and F-gases. F-gases emissions from 2.F Product use as substitutes for ozone depleting substances (ODS) constitute 2.4% from total GHG emissions, including indirect CO_2, excluding LULUCF in 2020. Emissions from HFC and SF_6 have grown significantly since 1995 by 1407.7%. Compared to 2019, total F-gas emissions (including SF_6) decreased by 3.0%.

In 2020, NMVOC emissions from the **Solvent Use** sector decreased by 5.0%, compared to 2019. Solvent Use sector was a significant NMVOC emission source and covered 33.0% (11.09 kt) from total Latvia's NMVOC emissions.

In 2020, emissions from the **Waste sector** were 547.25 kt CO_2 eq. contributing 5.2% of total GHG emissions (excluding LULUCF, including indirect CO_2). Solid waste disposal and wastewater handling are the main sources of GHG emissions in Waste sector producing accordingly 69.3% and 19.1% of all sector emissions. Incineration and Biological treatment of solid waste together contributes only 11.6% of GHG emissions from Waste sector in 2020. GHG emissions from Waste sector have been fluctuated from 1990-2020. Compared to 1990, emissions from Waste sector decreased by 25.2% but compared to 2019 emissions decreased by 0.9%.

Indirect CO_2 emission sources in Latvia are NMVOC emissions from the road traffic evaporation - cars, CH_4 and NMVOC emissions from natural gas leakages, as well as NMVOC emissions from gasoline distribution that are reported separately under the Energy sector. Together they constitute 13.10 kt CO_2 eq. that is 0.1% from Latvia`s total GHG emissions without LULUCF, with indirect CO_2 in 2020.

Net GHG emissions from **LULUCF** in 2020 were 646.6 kt CO_2 eq. Aggregated net removals of the GHG reduced by 105% in 2020 in comparison to 1990 mostly due to ageing of forests resulting in the increase of harvest rate and natural mortality and reduction of increment in ageing forests. However considerable role in the increase of the GHG emissions has conversion of forest land to settlements, as well as conversion of naturally afforested lands to cropland and grassland. The land use conversion to cropland is associated mostly with removal of woody vegetation from naturally afforested farmlands abandoned in 1980s and 1990s. Although the increment of living biomass in forest land remaining forest and afforested land is still larger than the carbon losses due to commercial felling and natural mortality, the gap between gains and losses is decreasing, causing reduction of the net removals of CO_2 in forest land. Hence the total growing stock of living biomass is still increasing in forest lands (by 2.2 mill. m^3 in 2020). Increase of the GHG emissions in 1999 and 2014 is associated with temporal increase of harvesting rate in forest land. Notably that the net GHG emissions from drained organic soils equals to 1.7 mill. tons CO_2 eq, therefore the most of the net removals in living biomass are compensated by the emissions from soil.

Reporting under Article 3, paragraphs 3 and 4, of the KP. Under the KP the second period (2013-2020) emissions and removals resulting from forestry activities in Article 3.3 (Afforestation/Reforestation and Deforestation activities) and Article 3.4 (Forest Management) are included in accounting. Latvia has chosen accounting at the end of the period. In 2020, net annual emissions from forest management, afforestation/reforestation and deforestation activities were -701.3 kt CO_2 eq. Decrease of the net annual CO_2 removals is mostly because of reduction of the net CO_2 removals in living biomass due to increase of harvests and mortality in ageing stands, as well as due to deforestation activities. Removals of CO_2 in living biomass is the most significant driver to have negative balance of the net GHG emissions during the accounting period, however, with reduction of CO_2 removals the role of other GHGs increases, particularly, N_2O and CH_4 emissions from organic soil is a key category of emissions. More information on accounting for the KP LULUCF activities for the second commitment period can be found in Latvia`s 2022 Submission, Table ES.3 Emissions and removals for activities under Articles 3.3 and 3.4 of the KP.

Table 3.1 Aggregated GHG emissions by gases (1990 – 2011), kt CO_2 eq.

GHG EMISSIONS	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
	kt CO_2 equivalent									
CO_2 emissions excluding net CO_2 from LULUCF	19661.40	9133.78	7081.47	7810.47	8309.83	8637.10	8197.89	7456.01	8554.09	7810.79
CO_2 emissions including net CO_2 from LULUCF	6259.44	-6741.08	-5815.80	892.17	583.19	1357.88	530.74	2692.01	5557.43	4401.83
CH_4 emissions excluding CH_4 from LULUCF	3623.78	2179.95	1885.83	1870.14	1823.41	1868.53	1855.33	1872.33	1805.89	1755.17
CH_4 emissions including CH_4 from LULUCF	4178.85	2736.88	2449.24	2379.40	2374.80	2378.51	2365.16	2397.18	2335.87	2294.52
N_2O emissions excluding N_2O from LULUCF	2583.07	1117.44	1026.99	1138.28	1139.44	1189.91	1166.62	1191.00	1220.54	1221.39
N_2O emissions including N_2O from LULUCF	3129.12	1689.38	1606.67	1716.94	1726.06	1770.74	1748.12	1774.03	1807.71	1806.83
HFCs	NO, NA	17.13	64.60	105.20	132.80	154.49	178.32	188.60	214.05	215.86
PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Unspecified mix of HFCs and PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
SF_6	NO, NA	0.17	0.88	3.78	4.07	4.55	5.23	7.33	7.35	7.47
NF_3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Total (without LULUCF)	25868.25	12448.48	10059.78	10927.87	11409.54	11854.58	11403.40	10715.26	11801.93	11010.68
Total (with LULUCF)	13567.40	-2297.51	-1694.41	5097.49	4820.91	5666.17	4827.58	7059.14	9922.42	8726.50
Total (without LULUCF, with indirect)	25908.66	12480.51	10084.56	10949.22	11426.12	11872.88	11421.27	10732.18	11818.20	11021.60
Total (with LULUCF, with indirect)	13607.81	-2265.48	-1669.63	5118.83	4837.49	5684.47	4845.45	7076.07	9938.69	8737.42

Table 3.2 Aggregated GHG emissions by gases (2012 – 2020), kt CO_2 eq.

GHG EMISSIONS	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from 1990 to latest reported year (%)
					kt CO_2 equivalent					
CO_2 emissions excluding net CO_2 from LULUCF	7519.41	7368.44	7171.96	7262.10	7210.32	7214.95	7859.36	7648.67	6994.11	-64.43
CO_2 emissions including net CO_2 from LULUCF	2731.58	3830.10	7436.04	6216.77	4280.56	2784.86	5864.89	3844.95	6235.31	-0.39
CH_4 emissions excluding CH_4 from LULUCF	1798.84	1821.78	1868.48	1772.69	1795.90	1826.73	1742.30	1743.03	1718.06	-52.59
CH_4 emissions including CH_4 from LULUCF	2349.71	2386.75	2473.92	2412.01	2472.15	2541.12	2532.84	2518.54	2500.35	-40.17
N_2O emissions excluding N_2O from LULUCF	1288.45	1314.00	1355.13	1403.93	1402.18	1413.41	1359.75	1443.00	1473.61	-42.95
N_2O emissions including N_2O from LULUCF	1878.84	1909.59	1942.07	1999.44	2006.64	2026.92	1986.78	2065.33	2096.69	-32.99
HFCs	216.01	229.53	243.65	254.52	275.02	267.87	263.09	255.11	248.91	100.00
PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
Unspecified mix of HFCs and PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
SF_6	7.78	8.50	8.58	10.12	9.89	10.32	10.54	13.82	11.94	100.00
NF_3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
Total (without LULUCF)	10830.48	10742.25	10647.80	10703.36	10693.31	10733.28	11235.04	11103.63	10446.63	-59.62
Total (with LULUCF)	7183.91	8364.47	12104.26	10892.85	9044.26	7631.09	10658.15	8697.75	11093.20	-18.24
Total (without LULUCF, with indirect)	10843.10	10757.75	10668.38	10720.39	10711.08	10752.40	11246.84	11116.30	10459.72	-59.63
Total (with LULUCF, with indirect)	7196.52	8379.97	12124.84	10909.89	9062.02	7650.22	10669.95	8710.42	11106.30	-18.38

Table 3.3 Aggregated GHG emissions by sectors (1990 – 2011), kt CO_2 eq.

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
	kt CO_2 equivalent									
1. Energy	19494.38	9578.59	7397.85	8137.43	8571.57	8905.96	8444.76	7733.32	8508.00	7638.44
2. IPPU	655.98	227.13	286.55	371.16	423.70	445.50	457.00	455.93	749.44	846.92
3. Agriculture	4985.80	2004.23	1678.46	1793.20	1792.71	1874.63	1837.59	1859.29	1878.76	1890.81
4. LULUCF	-12300.85	-14745.99	-11754.19	-5830.39	-6588.63	-6188.41	-6575.82	-3656.12	-1879.51	-2284.18
5. Waste	732.09	638.53	696.91	626.08	621.56	628.49	664.04	666.71	665.73	634.51
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total emissions (including LULUCF)	13567.40	-2297.51	-1694.41	5097.49	4820.91	5666.17	4827.58	7059.14	9922.42	8726.50

Table 3.4 Aggregated GHG emissions by sectors (2012 – 2020), kt CO_2 eq.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from 1990 to latest reported year (%)
	kt CO_2 equivalent									
1. Energy	7322.10	7244.12	7066.82	7178.05	7249.80	7234.47	7686.97	7458.18	6780.35	-65.22
2. IPPU	905.11	848.75	863.37	791.23	690.99	768.38	893.97	891.77	868.15	32.34
3. Agriculture	1974.19	2032.98	2109.78	2158.16	2166.93	2179.77	2096.21	2201.39	2250.88	-54.85
4. LULUCF	-3646.58	-2377.78	1456.45	189.49	-1649.05	-3102.18	-576.89	-2405.88	646.57	-105.26
5. Waste	629.07	616.41	607.84	575.91	585.60	550.66	557.90	552.29	547.25	-25.25
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total emissions (including LULUCF)	7183.91	8364.47	12104.26	10892.85	9044.26	7631.09	10658.15	8697.75	11093.20	-18.24

3.1.2 Emission Trends by Gas

Further paragraphs provide detailed information on direct GHG and precursors emissions.

3.1.2.1 Carbon Dioxide Emissions and Removals

Carbon dioxide (CO_2) is the main GHG causing climate change. In 2020, CO_2 emissions constituted 67.0% of Latvia's total GHG emissions (without indirect CO_2 emissions). In 2020, total CO_2 eq. emissions without LULUCF and indirect CO_2 emissions decreased by 64.4%, compared to 1990 (Figure 3.3).

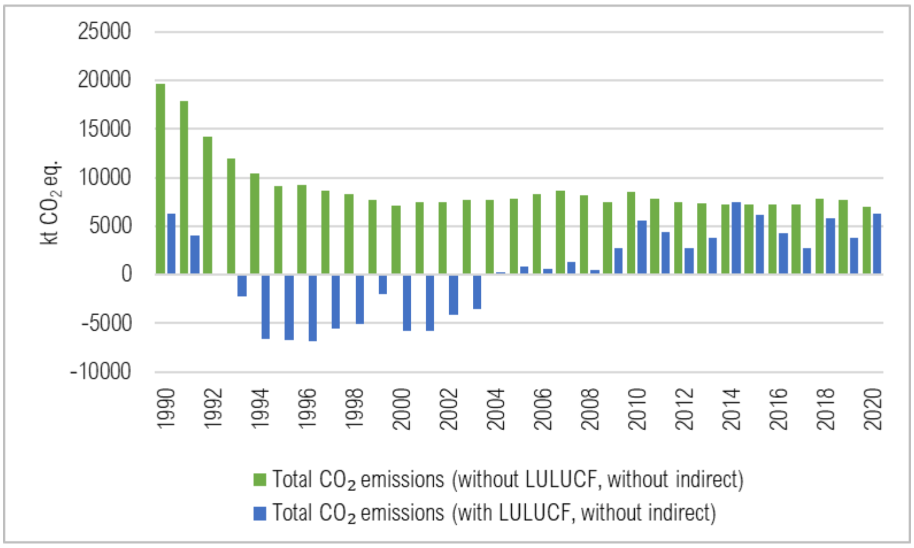


Figure 3.3 CO_2 emissions and removals 1990 – 2020 (kt CO_2 eq.)

The most important source of CO_2 emissions (kt) in 2020 was fossil fuel combustion – 90.4%, including Energy Industries – 19.0%, Manufacturing Industries and Construction – 8.7%; Transport – 43.9% and Other sectors (Agriculture, Forestry, etc.) – 18.6%.

Other anthropogenic emission sources of CO_2 are Industrial Processes and Product Use – 8.6%, Agriculture 1.0% and Waste 0.0006%. Detailed distribution of CO_2 emissions and removals and development in 1990-2020 are shown in Figure 3.4.

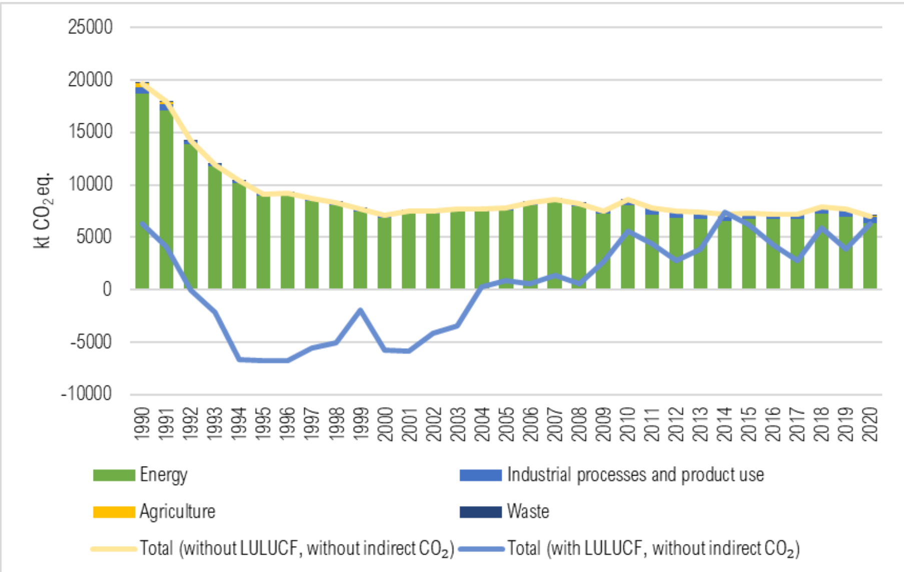


Figure 3.4 CO_2 emission development by sector 1990-2020 and CO_2 emissions by sector in 2020

Taking into account that a large proportion of fuel resources utilised in stationary combustion equipment is used for heating of buildings, relatively large fluctuations in emissions from year to year are due to changes in heating degree days. Year 2010 was one of the coldest in past years, so emissions have increased. As 2011 was warmer than previous year, the used fuel consumption and emissions decreased, compared to 2010. Similar fluctuations in CO_2 emissions from Energy sector can be observed through later years as well. Emission decrease can also be contributed to the increase of energy efficiency in buildings that reduces use of heat and power in them. EU ETS policy promotes use of renewable energy resources, therefore there is a decrease of fossil fuels and increase use of biomass.

3.1.2.2 Methane Emissions

Methane (CH_4) emissions without and with CH_4 from LULUCF had decreased by accordingly 52.6% and 40.2% in 2020, compared to 1990 (see Figure 3.5).

Main sources of CH_4 emissions in Latvia are Enteric Fermentation of Livestock, Solid Waste Disposal Sites and Energy sector. Other important sources of CH_4 emissions are leakage from natural gas pipeline systems and combustion of biomass. CH_4 emissions in 2020 contributed to 16.4% of total GHG emissions (excluding LULUCF, excluding indirect CO_2). Methane emissions (kt) decreased 52.6% in 2020 since 1990.

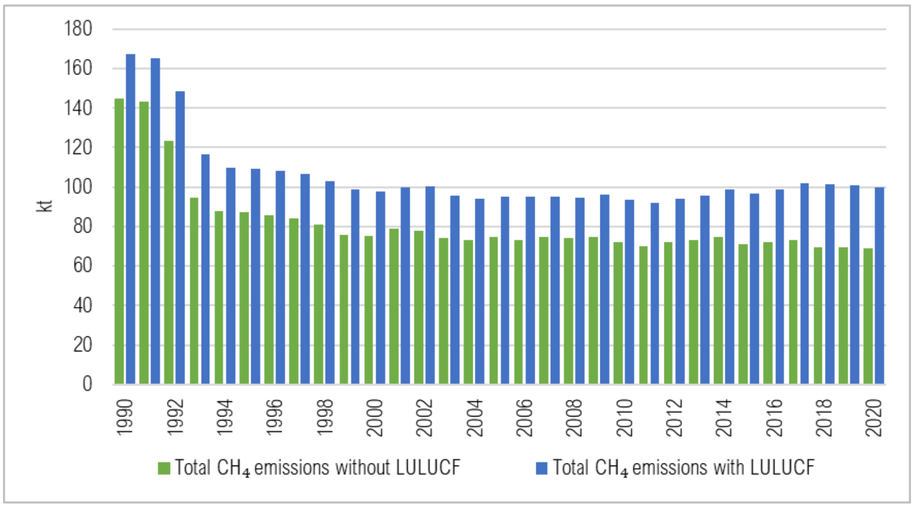


Figure 3.5 CH_4 emissions 1990 – 2020 (kt)

Detailed distribution of CH_4 emissions and emission development in 1990-2020 are shown in Figure 3.6.

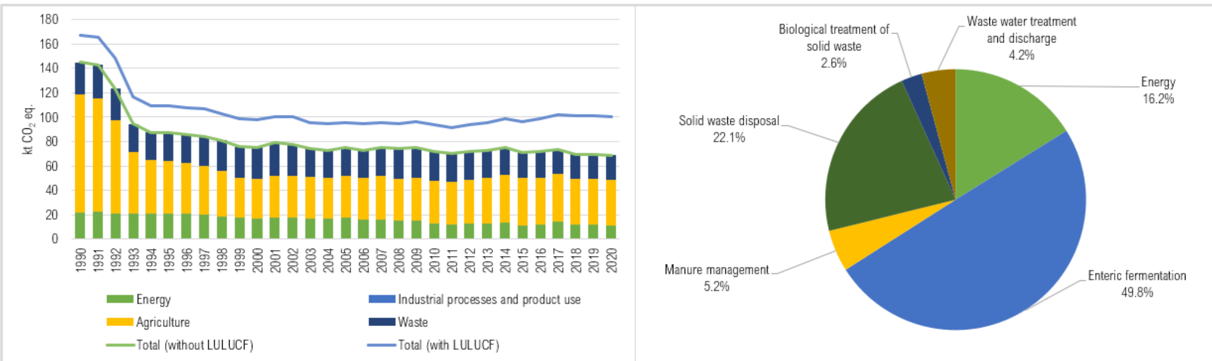


Figure 3.6 CH_4 emission development by sector 1990-2020 and CH_4 emissions by sector in 2020

3.1.2.3 Nitrous Oxide Emissions

Nitrous oxide (N_2O) emissions without and with N_2O from LULUCF had decreased by accordingly 43.0% and 33.0% in 2020, compared to 1990 (see Figure 3.7).

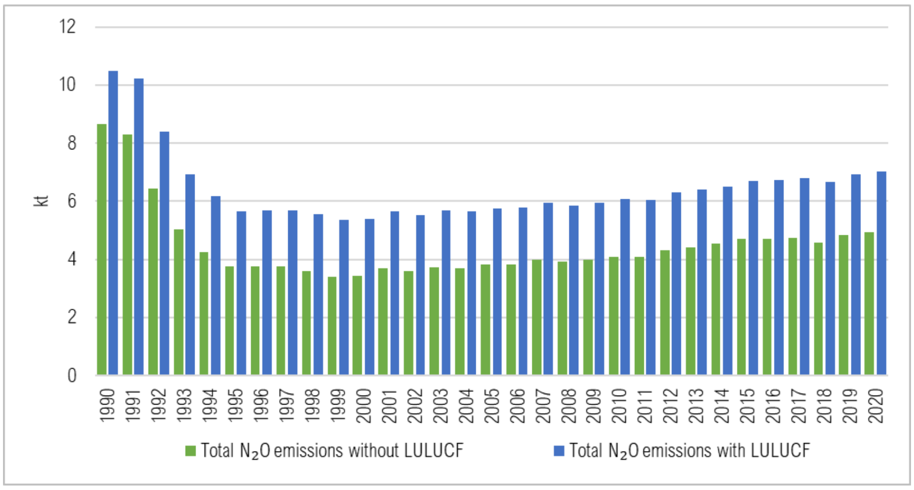


Figure 3.7 N_2O emissions 1990 – 2020 (kt)

Agricultural soils are the main source of N_2O emissions in Latvia generating 83.8% of all N_2O emissions (kt) in 2020. Other N_2O emission sources are from Transport sector and, biomass, liquid and other solid fuel combustion in other Energy sectors, also IPPU and Waste sectors. Since 1990 total N_2O emissions had decreased by 43.0% in 2020, mainly due to decrease in the emissions from agriculture.

Detailed distribution of N_2O emissions and emission development in 1990-2020 is given in Figure 3.8.

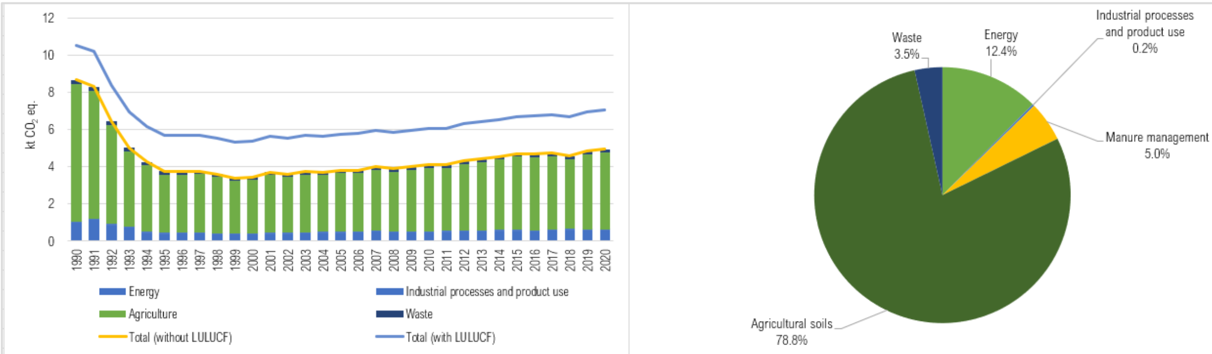


Figure 3.8 N_2O emission development by sector 1990-2020 and N_2O emissions by sector in 2020

3.1.2.4 Hydrofluorocarbons and Sulphur Hexafluoride Emissions

Emissions for the following hydrofluorocarbons (fluorinated GHG) are estimated in Latvia: HFC–23, HFC–32, HFC–125, HFC–134a, HFC–143a, HFC–152a, HFC-245fa, HFC-365mfc, HFC–227ea and SF_6. The base year for F-gas reporting under KP is 1995.

The most consumed gas is HFC-134a, applied in stationary freezing devices and air conditioning equipment. Although the amount of fluorinated gases and emissions caused by commercial use and industrial processes are rather small, the meaning of the said cannot be underestimated in the light of the GHG Global Warming Potential.

Emissions from HFCs and SF_6 consumption are reported for the period of 1995-2020. Total HFCs emissions decreased by 2.4% in 2020, compared to 2019. Since 1995 HFC emissions have increased significantly due to substitution of ozone depleting substances in refrigeration and air conditioning as well as due to increase of cars, trucks and buses equipped with mobile air conditioners. SF_6 emissions from electrical equipment contributed to 11.94 kt CO_2 eq. in 2020 (see Figure 3.9). Emissions of the PFCs and NF_3 does not occur (NO) in Latvia for all time series.

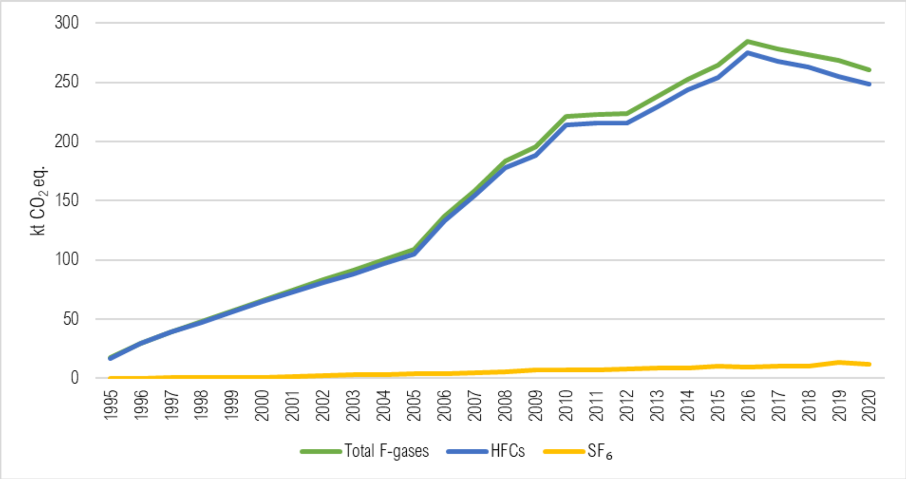


Figure 3.9 Development in HFC and SF_6 emissions in 1995-2020

3.1.3 Information on Indirect Greenhouse Gas Emissions

Emissions from precursors are presented in Table 3.5.

Table 3.5 Precursors emissions 1990-2020 (kt)

	NO_x	CO	NMVOC	SO_2
	kt			
1990	95.98	469.90	89.24	100.45
1991	92.44	430.41	85.22	81.68
1992	75.81	425.09	76.72	69.79
1993	65.84	388.08	70.82	65.74
1994	55.93	363.97	66.25	66.71
1995	51.09	341.40	64.83	49.39
1996	50.82	347.09	65.14	55.67
1997	48.41	318.38	61.57	43.96
1998	44.80	300.82	59.00	39.84
1999	43.45	302.28	56.51	32.21
2000	42.03	282.92	55.02	17.75
2001	45.13	286.44	57.92	14.30
2002	44.11	286.42	56.59	12.98
2003	45.72	272.61	55.92	11.32
2004	45.32	263.92	55.51	9.28
2005	45.00	235.00	51.80	8.74
2006	46.23	250.59	50.59	8.33
2007	46.18	218.55	50.46	8.12
2008	41.98	201.95	45.47	6.58
2009	39.29	207.45	44.22	6.61
2010	40.41	164.72	40.74	4.31
2011	37.98	164.92	41.05	4.27
2012	38.24	163.24	40.41	4.41
2013	37.51	144.82	38.85	3.91
2014	37.15	138.25	38.64	3.85
2015	36.46	113.41	35.84	3.56
2016	34.72	111.29	34.55	3.43
2017	35.00	116.99	35.13	3.59
2018	36.21	138.40	39.14	3.83
2019	34.48	119.29	35.67	3.67
2020	31.95	102.71	33.56	3.51

In the period from 1990 to 2020 precursors have decreased: NO_x by 66.7%, CO by 78.1%, NMVOC by 62.4% and SO_2 by 96.5%.

Starting from 2001, fluctuations in NO_x, NMVOC and CO emissions can be observed as a reason of increasing firewood consumption in Residential sector as well as fuel consumption in Transport sector in particular years. SO_2 emissions decreased significantly because of fuel switch and approved legislation.

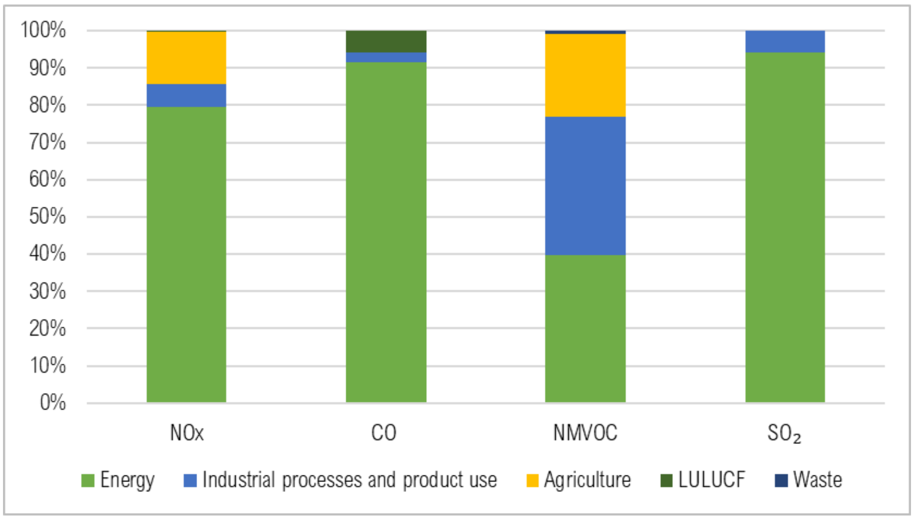


Figure 3.10 Precursors by sector in 2020 (% of total precursors in sector)

In 2020, the most important sector producing precursors (including LULUCF) was Energy sector (including fugitive emissions). Fuel combustion in Energy sector causes the largest part of NO_x emissions (79.4% from total NO_x emissions in 2020), but IPPU and Agriculture sectors make 6.1% and 14.1%, accordingly. Small part of NO_x emissions is produced in LULUCF sector (0.3% from total NO_x emissions).

91.5% of CO emissions appear in Energy sector, mainly from fuel combustion in Residential and Commercial/Institutional subsectors (72.9% from all CO emissions). The remaining part of CO emissions come from LULUCF sector (5.8%), IPPU sector (2.7%) and Waste sector (0.0006%).

The major part of SO_2 emissions (94.2%) are from Energy sector (fuel combustion), but the other sulphur dioxide emissions - from Industrial processes (5.7%) from Cement production, and a negligible part of SO_2 comes also from Waste sector (Waste incineration).

The largest amounts of NMVOC emissions are produced in Energy sector (39.8%; fuel combustion mainly in Residential sector) and 37.0% from total NMVOC emissions in 2020 are produced in IPPU sector, mainly from solvent use. In addition, 22.5% of NMVOC emissions are produced in Agriculture sector, but the remaining 0.8% in Waste sector. In Agriculture sector, CO and SO_2 emissions, and in LULUCF sector, NMVOC and SO_2 emissions do not appear.

3.1.4 Accuracy/Uncertainty of the Data

The uncertainty estimates of the 2022 Submission have been made according to the Approach 1 method presented in the 2006 IPCC Guidelines. The Approach 1 is based on emission estimates and uncertainties or activity data and emission factors.

The uncertainty analysis was done for all sectors: Energy, IPPU, Agriculture, Waste and LULUCF. Uncertainties are estimated for direct GHG, e.g., CO_2, CH_4, N_2O and F-gases.

The uncertainty calculation is based on Excel file, which is sent to sectoral experts for updating annually. Responsible experts are requested to go through uncertainties and make updates if necessary. When information is received by experts, the inventory compiler summarizes all the uncertainties and does the uncertainty analysis. For each source, the combined uncertainty for activity data and emission factors was estimated and given in per cent.

Detailed descriptions of uncertainty assessment are included in 2022 Submission in the chapters of each sub sector.

3.1.5 Changes since the Seventh National Communication

Since the publication of the NC7 improvements affecting the emission time series were introduced in the GHG inventory due to activity data improvement and emission factor changes. The explanations of the latest recalculations are included in the 2022 Submission. More information about recalculation results is provided in Latvia's National Inventory Report 1990-2020 which was submitted to the UNFCCC secretariat on 14 April 2022, Chapter 10 Recalculations and improvements. The main changes in NC8 compared to NC7 are outlined in Table 3.6.

Table 3.6 Main changes in NC8 compared to NC7

Sector	Changes in NC8 compared to NC7
Energy	Changes in activity data due to updates by Central Statistical Bureau (CSB) and Natural gas provider. CO_2 emission factors for Coal, Landfill gas, Sludge gas and Other biogas were corrected. Developed and implemented new residential stationary wood combustion technology split "Model for calculating wood consumption and emissions using Tier 2 methodology from stationary wood combustion technology in residential sector".
Transport	Distribution of vehicles fleet by sub-classes and average milage was corrected according to additional statistical information of the Road Traffic Safety Directorate of Latvia. Recalculations have been done for national and international aviation due to corrected average specific fuel consumption of LTO. Average specific fuel consumption calculated based on Eurocontrol's data. Changes were made because of the switch form older to the latest COPERT versions.
IPPU	Used CKD correction factor was corrected in Cement production. Lime kiln dust (LKD) was introduced into emission estimation in Lime production. In Lime production derived EF for dolomite lime and hydraulic lime were used to calculate emissions. Used EF were corrected in Solvent use sector. Results of F-gas research was implemented into GHG inventory. The MAC Directive was included in calculations of F-gas emissions. The latest estimations from DETIC (Belgian-Luxemburg Association of producers and distributors of soaps, cosmetics, detergents, cleaning products, hygiene and toiletries, glues and related products) were included in N_2O From Product Uses. Changes in activity data are done due to updates of national F-gas database and Chemical database.
Agriculture	Changes in activity data due to updated animal's statistics by CSB. Changes were done, based on the corrected numbers of nitrogen that is lost due to volatilisation of NH_3 and NO_x due to use EMEP/EEA 2019 Guidelines instead of EMEP/EEA 2016 Guidelines.

Sector	Changes in NC8 compared to NC7
	Information about organic soil areas (2009-2020), as well as information on crop residues dry matter fraction and fraction of above-ground residues annually removed from field are updated. Recalculations are done due to updated information about organic soil areas, as well as updated information on sewage sludge applied to managed soils data, updated information about other organic N (including digestate) amount used to managed soils and N amount in crop residues. Weight numbers were corrected based on herd structure studies of main dairy cattle breeds. Changes of emissions from manure management are done for estimation of indirect nitrous oxide emissions from manure management, based on updating of Tier 2 methodology assumptions to calculate N that is lost due to volatilisation of NH_3 and NO_x from the livestock buildings and manure storage facilities. Improvements were done due to implementation of country specific emission factors to calculate N_2O emissions from cultivation of organic soils.
LULUCF	Significant improvements are done in the LULUCF sector mainly by implementation of national emission factors for calculation of GHGs from organic soil. The activity data are also significantly improved, for instance spatial data on land use changes based on periodic observations of the NFI are systematized using harmonized approach avoiding the most of the temporal changes, e.g., natural ingrowth of trees in grassland. Accounting of biomass is improved by implementation of new county specific biomass expansion factors for the most common species. Improvement of the country specific biomass expansion factors also led to better estimates of carbon transfers due to commercial felling and natural mortality.
Waste	Changes are done for unmanaged waste disposal sites for CH_4 emissions. Disposed waste time series was prolonged till 1950. Reestimation of year 1975 disposed amount was done. Changes in calculations are done due to updated activity data, reevaluation of MCF factors and new activity data estimation for composted amount in households. Emissions of Anaerobic Digestion at Biogas Facilities were calculated for the first time.

3.2 National inventory system under Article 5, paragraph 1, of the Kyoto Protocol

3.2.1 Institutional Arrangements

Ministry of Environmental Protection and Regional Development (MEPRD) is designated as the single national entity with overall responsibility for the Latvian GHG inventory.

The contact person at MEPRD is Agita Gancone, address: Peldu street 25, Riga, LV – 1494, Latvia, E-mail: Agita.Gancone@varam.gov.lv.[5]

[5] Since January 1, 2023 new ministry - Ministry of Climate and Energy (MoCE) - is established and therefore MEPRD is replaced by MoCE as a single national entity with overall responsibility for the Latvian GHG inventory. The contact person at MoCE is Agita Gancone, address: Maskavas street 165, Riga, LV – 1019, Latvia, E-mail: Agita.Gancone@kem.gov.lv.

National inventory arrangements are described below. The description is prepared according to requirements for reporting on national inventory systems under the KP, European Union Monitoring Mechanism Regulation (EU MMR) and UNFCCC Annex I inventory reporting guidelines. Latvian national GHG inventory system is designed and operated according to the KP to ensure the transparency, consistency, comparability, completeness and accuracy of inventory. Inventory activities include planning, preparation and management. The inventory phases are:

- collecting activity data;
- selecting methods and emission factors appropriately;
- estimating anthropogenic GHG emissions by sources and removals by sinks;
- implementing uncertainty assessment and identification of key categories;
- implementing QA/QC activities.

CoM Regulation No. 737 (12 December 2017) which has now replaced by CoM Regulation No. 675 (25 October 2022) sets provisions to make information on the legislative arrangements and enforcement and administrative procedures, established pursuant to the implementation of the KP. Above mentioned regulations are available online at portal of legal acts of the Republic of Latvia[6]. Information on KP-LULUCF is also publicly available at LEGMC homepage[7].

Principles and rules to ensure that implementation of activities under Article 3, paragraph 3, Forest management under Article 3, paragraph 4, and any elected activities under Article 3, paragraph 4, of the KP also contributes to the conservation of biodiversity and sustainable use of natural resources are included in different sectoral legislative acts (for example):

- Law on forests[8]. Forest law regulates sustainable management of all the forests of Latvia, by guaranteeing equal rights, immunity of ownership rights and independence of economic activity, and determining equal obligations to all forest owners or lawful possessors (Law of Forests is legal base for different Regulations of Ministers, which set rules for -compensation for deforestation, -timber harvesting, -nature protection in forests etc);
- Natural Resources Tax Law[9]. Purpose of the natural resources tax is to promote economically efficient use of natural resources, to restrict pollution of the environment, to reduce manufacturing and sale of environment polluting substances, to promote implementation of new, environment-friendly technology, to support sustainable development in the economy, and also to ensure environmental protection measures financially;
- Environmental Protection Law.[10] The purpose of this Law is to ensure the preservation and recovery of the quality of the environment, and also sustainable use of natural resources;
- Others.

A schematic model for the national inventory system (NIS) according to the CoM Regulation No.737[11] (12.12.2017) is shown in Figure 3.11.

[6] https://likumi.lv/ta/id/336733-siltumnicefekta-gazu-inventarizacijas-sistemas-prognozu-sistemas-un-sistemas-zinosanai-par-pielagosanos-klimata-parmainam
[7] https://videscentrs.lvgmc.lv/lapas/zinojums-par-klimatu
[8] Available at: https://likumi.lv/ta/en/en/id/2825
[9] Available at: https://likumi.lv/ta/en/en/id/124707-natural-resources-tax-law
[10] Available at: https://likumi.lv/ta/en/en/id/147917-environmental-protection-law
[11] Since 25 October 2022 CoM Regulation No.737 is replaced by CoM Regulation No.675

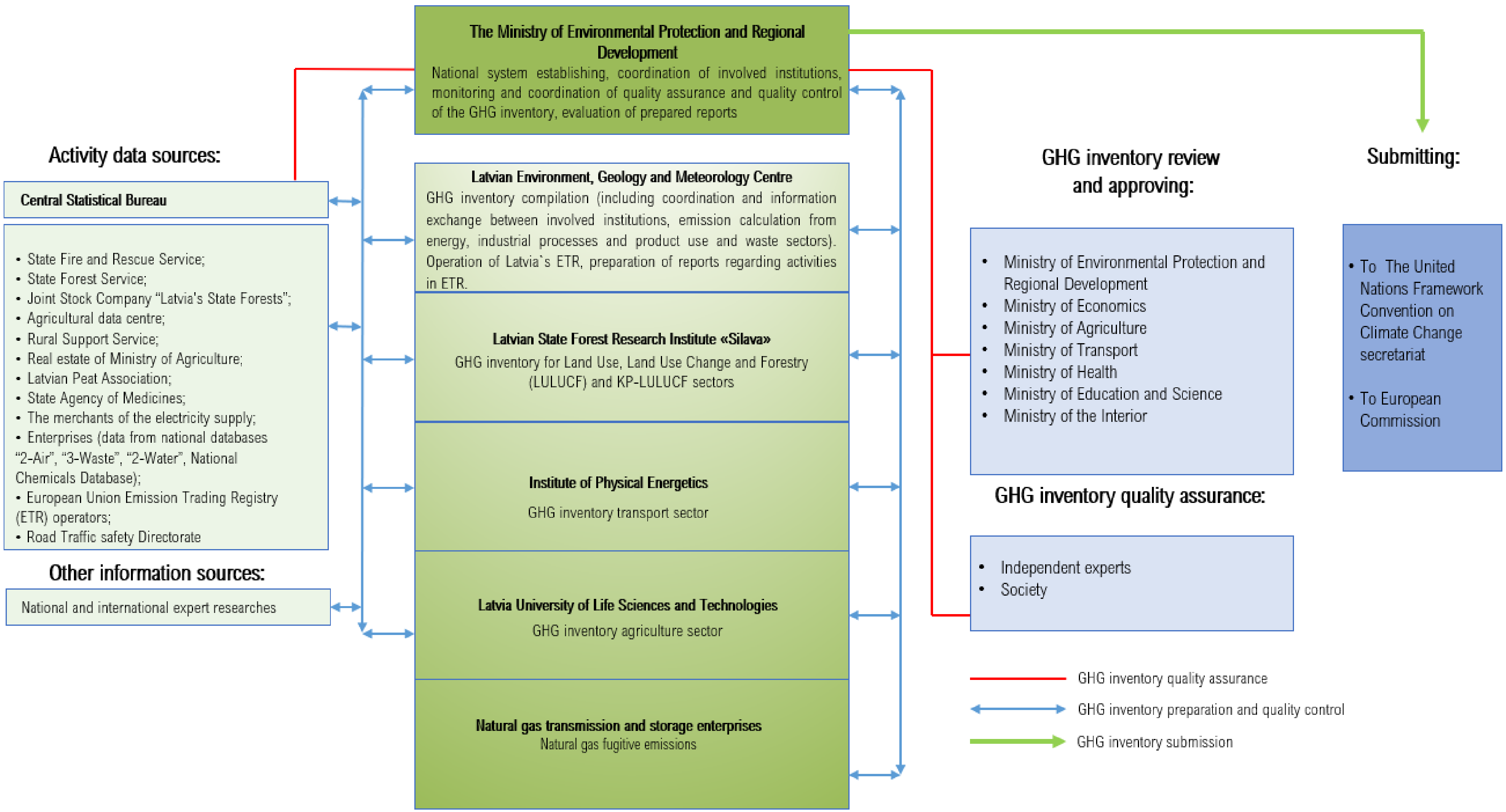


Figure 3.11 The structure of Latvia`s GHG Inventory System

The MEPRD CCD is responsible for:

- Preparation of legal basis for maintaining the National System;
- Informing the inventory compilers about the requirements of the national system;
- Overall coordination of GHG inventory process;
- Final checking and approving of the GHG inventory before an official submission to the EC and UNFCCC;
- Formal agreements with inventory experts and third part experts that evaluate quality assurance process;
- Coordinating the work with the involved experts, institutions, EC and UNFCCC (including coordination of the UNFCCC inventory reviews);
- Timely submission of GHG inventory to the UNFCCC and EC;
- Keeping of archive of official submissions to UNFCCC and EC.

LEGMC is a governmental limited liability company responsible for:

- Activity data collection for Energy, Industrial Processes and Product Use and Waste sectors (activity data are mainly collected from the other institutions and LEGMC (Air and Climate division, Chemicals and Hazardous Waste division, Inland Waters division) use them to calculate emissions);
- Preparation of the emission estimates for the Energy, Industrial Processes and Product Use and Waste sectors;
- Preparation of QC procedures for relevant categories and documentation, archiving of used materials for emission calculation;
- LEGMC Air and Climate Division compiles the final NIR using information from all involved institutions as well as summarizes emission data in CRF Reporter;
- Quality manager from LEGMC Air and Climate division performs the overall QC/QA procedures for all sectors according to the QA/QC plan;
- Maintenance of archive with information for preparation of GHG inventory, official submissions to UNFCCC and EC;
- LEGMC is the National Emissions Trading Authority in Latvia and prepares relevant information for GHG inventory from registry – on emission reduction units, certified emission reductions, temporary certified emission reductions, long term certified emission reductions and assigned amount units for annual inventory submissions in accordance with guidelines for preparation of information under the Article 7 of the KP (SEF tables).

Calculation of emissions and removals from the LULUCF, KP-LULUCF sector were done by Latvian State Forest Research Institute (LSFRI) "Silava". LSFRI "Silava" is responsible for activity data collection, estimation of emissions/removals, preparation of QC procedures as well as documentation and archiving of used materials for calculations.

Institute of Physical Energetics (IPE) calculates emissions from Transport sector. IPE is responsible for activity data collection, emission estimation from Transport, preparation of QC procedures as well as documentation and archiving of used materials for calculations.

Emission calculations from Agriculture sector were done by Latvia University of Life Sciences and Technologies (LULST). LULST is responsible for collecting of necessary activity data cooperating with Central Statistical Bureau (CSB), preparation of the emission estimates, preparation of QC procedures as well as documentation and archiving of used materials for calculations.

Natural gas enterprises are responsible for data providing and the calculation of annual gas leakage estimates for LEGMC to report 1B2b Natural gas.

The main data supplier for the Latvian GHG inventory is the CSB.

For ensuring the continuity of the functions of the national system, the delegation contracts are signed between the MEPRD, LEGMC, LSFRI "Silava", IPE and LULST.

Before the final Latvia's GHG inventory was submitted to EC and UNFCCC secretariat, draft GHG inventory (submitted on 15 January) was sent for comments and approval to responsible ministries. Based on received comments inventory was improved.

Several sectoral meetings were held before and during preparation of inventory, to discuss and agree on the methodological issues, problems arisen and improvements need to be implemented. There were also discussions on the different problems that came up during the last inventory preparation to find the solutions on how to improve the overall system.

3.2.2 Quality Assurance/Quality Control Procedures

QA/QC procedures are an important component in the development of GHG emission inventory preparation. The basic aim of the QA/QC process is to ensure the high-quality of the inventory and to contribute to improvement of the inventory. The quality requirements set for annual inventories (transparency, consistency, comparability, completeness, accuracy, timeliness and continuous improvement) are fulfilled by implementing the QA/QC process consistently in conjunction with the inventory process.

The quality of result depends on four main stages – planning, preparation, evaluation and improvements, and is ensured by inventory experts during compilation and reporting of inventory.

The inventory planning stage includes the setting of quality objectives and elaboration of the QA/QC plan for the coming inventory preparation, compilation and reporting work.

Based on QA/QC process, the main findings and conclusions about the quality and improvements of the inventory have to be applied into Latvia`s GHG inventory system for making decisions about the annual inventory process and next inventory preparation.

The outcomes of the QA/QC process results in a reassessment of inventory or source category uncertainty estimates. For example, if data quality is found to be lower than previously thought and this situation cannot be rectified in the timeframe of the current inventory, the uncertainty estimates are re-evaluated. Based on QC results, estimation of emissions is improved and uncertainties are reduced.

The main elements of QA/QC plan according to CoM Regulation No. 737[12] are:

- Quality objectives of the annual GHG inventory;
- Time frame for the preparation of the annual GHG inventory;
- Improvement plan of the annual GHG inventory;
- List of key categories (Level 1) for which sectoral experts and quality control experts must carry out quality control procedures;
- List of key categories (Level 2) that needs to be taken into account during planning of improvements and preparation of GHG inventory improvement plan;

[12] Since 25 October 2022 CoM Regulation No.737 is replaced by CoM Regulation No.675

- Quality control procedures of the annual GHG inventory;
- Quality assurance procedures of the annual GHG inventory;
- Verification procedures of the annual GHG inventory;
- Information regarding sectoral instructions for inventory preparation;
- Information regarding documentation and archiving procedures.

In 2018, QA/QC program was updated by Order No. 1-2/160 (03.10.2018) of MEPRD according to CoM Regulation No. 737 (12.12.2017) which is now replaced by CoM Regulation No.675 (25.10.2022). According to CoM Regulation No. 737 (12.12.2017) and MEPRD Order 1-2/160 (03.10.2018) all institutions involved in inventory process are responsible for implementing QC procedures. Mainly Tier 1 general inventory QC procedures outlined in Table 6.1 of the 2006 IPCC Guidelines are used. The setting of quality objectives is based on the inventory principles taking into account the available resources. The general and category-specific QC procedures are performed by sectoral experts during inventory calculation and compilation according to the QA/QC and verification plan.

MEPRD as national entity is responsible for overall QC procedures and quality assurance of national system, including the UNFCCC and EU reviews.

The centralized archiving system (common archiving (FTP) folder, maintained by LEGMC) is created where experts have to upload and download all necessary information for inventory preparation, inter alia spreadsheets that need to be filled for quality control and quality assurance. Instruction for experts how to prepare NIR to ensure comparability of NIR and CFR is prepared and available to experts.

Quality Assurance activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. According to CoM Regulation No. 737[13] (12.12.2017) MEPRD is responsible for ensuring QA procedures for GHG inventory. The QA reviews are performed after the implementation of QC procedures to the finalised inventory. The inventory QA system comprises reviews to assess the quality of the inventory.

3.2.3 The Inventory Methodology and Data

Latvia's GHG emissions inventory is based on:

- 2006 IPCC Guidelines;
- 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (IPCC Wetlands Supplement);
- 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (2013 IPCC Kyoto Protocol Supplement);
- EMEP/CORINAIR Guidebook 2007 and EMEP/EEA 2009;
- EMEP/EEA air pollutant emission inventory guidebook 2016;
- EMEP/EEA air pollutant emission inventory guidebook 2019.

The main sources for emission factors are guidelines mentioned above as well as national studies for country specific parameters and emission factors (e.g., CO_2 emission factors, aspects influencing SO_2 emission factors, distribution of animal waste management systems, average N excretion and etc.).

Table 3.7 presents the main data sources used for activity data as well as information on actual calculations.

[13] Since 25 October 2022 CoM Regulation No.737 is replaced by CoM Regulation No.675

Table 3.7 Main data sources for activity data and emission values

Sector	Data Sources for Activity Data	Emission Calculation
Energy	Central Statistical Bureau Energy Balance; IEA/ OECD – EUROSTAT – UNECE Annual questionnaires; National database “2-Air”; Research of experts, Natural gas enterprises	LEGMC Air and Climate division, plant operators
Transport	CSB Energy Balance; IEA/AIE – EUROSTAT – UNECE Annual questionnaires; Data of Road Traffic safety Directorate; Research of experts.	IPE
IPPU	National production and sales statistics; Direct information from enterprises operating with pollutants; Central Statistical Bureau; National Chemicals Database; Assumptions by experts; State Agency of Medicines; Research by experts; GHG report under EU ETS National database “2-Air”.	LEGMC Air and Climate division, plant operators
Agriculture	National agricultural statistics obtained from CSB; National studies.	LULST in collaboration with MoA
LULUCF; LULUCF KP	NFI SFS Ministry of Agriculture of Republic of Latvia Central Statistical Bureau SFRS National studies and expert judgments	LSFRI "Silava" in collaboration with MoA and LULST
Waste	LEGMC “3-Waste” and “2-Water” databases; Methane recovery installations; CSB.	LEGMC Chemicals and Hazardous Waste division, LEGMC Inland Waters Division

The process for selecting emission factors and methodology for development of emission estimates as well as the process for recalculating previously submitted inventory data and the procedure for the official consideration and approval of the inventory are available in 2022 Submission under chapters 1.2-1.4 or relevant sectoral chapters.

3.2.4 Key Category Analysis

Key categories are the emissions/removals, which have a significant influence on the total inventory in terms of the absolute level of emissions and the trend of emissions or both. Level Assessment identifies source category whose level has a significant effect on total national emissions. Trend Assessment identifies sources that are the key because of their contribution to the total trend of national emissions.

It is important to identify key categories so that the resources available for inventory preparation may be prioritized and the best possible estimates are prepared for the most significant source categories.

For 2022 Submission, Approach 1 and Approach 2 according to the 2006 IPCC Guidelines are used to identify key categories for period of time 1990-2020. The identification was divided in two parts, key categories excluding LULUCF and key categories including LULUCF source categories. The starting point for the choice of source categories with LULUCF is the list presented in the 2006 IPCC Guidelines. In Latvia`s case list of IPCC categories is modified to reflect particular national circumstances, for example, types of fuels in transport, more disaggregated agricultural categories (by animal species) and more disaggregated LULUCF categories (by taking into account soil type etc.) Such modifications have been made to clarify the key categories. Key category analysis is an important element for planning and prioritization of necessary inventory improvements. The base year for CO_2, CH_4, and N_2O GHG emissions is 1990. Indirect CO_2 emissions are not included in the key category analysis.

Summary of key categories is shown in Table 3.8. Key categories are identified by Approach 1 and Approach 2 (level and trend) in order to provide additional insight into the reasons why particular categories are key.

Table 3.8 Key categories in 2022 Submission

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	N_2O	L1, L2, T1, T2		X
1.A.1.a Public Electricity and Heat Production - Biomass Fuels	CH_4	T2		X
1.A.1.a Public Electricity and Heat Production - Gaseous Fuels	CO_2	L1, L2, T1, T2	X	X
1.A.1.a Public Electricity and Heat Production - Liquid Fuels	CO_2	T1, T2	X	X
1.A.1.a Public Electricity and Heat Production - Peat	CO_2	T1, T2	X	X
1.A.1.a Public Electricity and Heat Production - Solid Fuels	CO_2	T1	X	X
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	L1		X
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries - Peat	CO_2	T1		X
1.A.2.a Iron and Steel - Gaseous Fuels	CO_2	T1, T2	X	X
1.A.2.a Iron and Steel - Liquid Fuels	CO_2	T1	X	X
1.A.2.a Iron and Steel - Other fossil fuels	CO_2	T1, T2		X
1.A.2.c Chemicals - Liquid Fuels	CO_2	T1, T2	X	X
1.A.2.d. Pulp, Paper and Print - Gaseous Fuels	CO_2	T1	X	X
1.A.2.e Food Processing, Beverages and Tobacco - Gaseous Fuels	CO_2	L1, T1	X	X
1.A.2.e Food Processing, Beverages and Tobacco - Liquid Fuels	CO_2	T1, T2	X	X
1.A.2.e Food Processing, Beverages and Tobacco - Solid Fuels	CO_2	T1	X	X
1.A.2.f Non-metallic Minerals - Gaseous Fuels	CO_2	L1, T1	X	X
1.A.2.f Non-metallic Minerals - Liquid Fuels	CO_2	T1, T2	X	X
1.A.2.f Non-metallic Minerals - Other Fossil Fuels	CO_2	L1	X	X
1.A.2.f Non-metallic Minerals - Solid Fuels	CO_2	L1, T1	X	X
1.A.2.g Other - Biomass Fuels	N_2O	T2		X
1.A.2.g Other - Biomass Fuels	CH_4	T2		X
1.A.2.g Other - Gaseous Fuels	CO_2	L1, T1, T2	X	X
1.A.2.g Other - Liquid Fuels	CO_2	L1, T1, L2, T2	X	X
1.A.3.b Road Transportation - Diesel Oil	CO_2	L1, L2, T1, T2	X	X
1.A.3.b Road Transportation - Diesel Oil	N_2O	L1, L2, T1, T2		X
1.A.3.b Road Transportation - Gasoline	CO_2	L1, L2, T1, T2	X	X
1.A.3.b Road Transportation - LPG	CO_2	L1, T1, T2	X	X
1.A.3.c Railways - Liquid Fuels	CO_2	L1, T1	X	X
1.A.3.c Railways - Liquid Fuels	N_2O	T2		X
1.A.4.a Commercial/Institutional - Gaseous Fuels	CO_2	L1, L2, T1, T2	X	X
1.A.4.a Commercial/Institutional - Liquid Fuels	CO_2	L1, L2, T1, T2	X	X
1.A.4.a Commercial/Institutional - Peat	CO_2	T1		X
1.A.4.a Commercial/Institutional - Solid Fuels	CO_2	T1, T2	X	X
1.A.4.a Commercial/Institutional - Liquid Fuels	N_2O	T2	X	X
1.A.4.b Residential - Biomass Fuels	CH_4	L1, L2, T1, T2	X	X

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
1.A.4.b Residential - Gaseous Fuels	CO_2	L1, L2, T1, T2	X	X
1.A.4.b Residential - Liquid Fuels	CO_2	L1, L2, T1	X	X
1.A.4.b Residential - Solid Fuels	CO_2	T1, T2	X	X
1.A.4.b Residential - Solid Fuels	CH_4	T2		X
1.A.4.c Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	L1, T1, T2	X	X
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	L1, L2, T1, T2	X	X
1.A.4.c Agriculture/Forestry/Fisheries - Liquid Fuels	N_2O	L1, L2, T1, T2		X
1.A.4.c Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	T1	X	X
1.B.2.b Natural Gas	CH_4	L1, L2, T1, T2	X	X
2.A.1. Cement Production	CO_2	L1, L2, T1, T2	X	X
2.A.2. Lime Production	CO_2	T1, T2	X	X
2.A.4. Other process uses of carbonates	CO_2	T1		X
2.C.1 Iron and Steel Production	CO_2	T1		X
2.D.3. Solvent Use	CO_2	L1, T2		X
2.F.1. Refrigeration and air conditioning	HFCs	L1, L2	X	X
3.A.1 Enteric Fermentation - Cattle	CH_4	L1, L2, T1, T2	X	X
3.B.1.1 Manure Management - Cattle	CH_4	L1, L2, T1, T2	X	X
3.B.2.1 Manure Management - Cattle	N_2O	L1, L2, T1, T2		X
3.B.2.3 Manure Management - Swine	N_2O	T2		X
3.B.5 Indirect N_2O emissions from Manure Management	N_2O	L1, L2, T2	X	X
3.D.1. Direct N_2O emissions from managed soils	N_2O	L1, L2, T1, T2	X	X
3.D.2 Indirect N_2O Emissions from managed soils	N_2O	L1, L2, T1, T2	X	X
3.G. Liming	CO_2	L1, L2, T1, T2	X	X
4.A.1 Forest Land Remaining Forest Land – Carbon stock change, dead wood	CO_2	L1, L2, T1, T2	X	
4.A.1 Forest Land Remaining Forest Land – Carbon stock change, living biomass	CO_2	L1, L2, T1, T2	X	
4.A.1 Forest Land Remaining Forest Land – Carbon stock change, organic soil	CO_2	L1, L2, T1, T2	X	
4.A. Forest land – 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils, total organic soils	CO_2	L1, L2	X	
4.A. Forest land – 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils, total organic soils	N_2O	L1, L2, T1, T2	X	
4.A. Forest land – 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils, total organic soils	CH_4	L1, L2, T1, T2	X	
4.A.2 Land Converted to Forest Land – Carbon stock change, living biomass	CO_2	L1, T1	X	
4.B. Cropland 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	L1, L2, T2	X	
4.B.1 Cropland remaining Cropland – Carbon stock change, organic soil	CO_2	L1, L2, T1, T2	X	
4.B.1 Land converted to Cropland – Carbon stock change, forest land converted to cropland, dead organic matter	CO_2	L1	X	

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
4.B.1 Cropland remaining Cropland – Carbon stock change, living biomass	CO_2	L1, L2	X	
4.B.2 Land converted to Cropland – Carbon stock change, organic soil	CO_2	L1, L2, T1, T2	X	
4.C. Grassland – 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4	L1, L2, T2	X	
4.C.1 Grassland remaining Grassland – Carbon stock change, organic soil	CO_2	L1, L2, T1, T2	X	
4.C.1 Grassland remaining Grassland – Carbon stock change, living biomass	CO_2	L2, L2, T1, T2	X	
4.C.2 Land converted to Grassland – Carbon stock change, organic soil	CO_2	L1, L2, T1, T2	X	
4.C.2 Land converted to Grassland – Carbon stock change, forest land converted to grassland, living biomass	CO_2	L1	X	
4.C.2 Land converted to Grassland – Carbon stock change, forest land converted to grassland, dead organic matter	CO_2	L1, L2	X	
4.D. Wetlands 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils, Peat extraction from lands, rewetted organic soils	CO_2	L2, T2	X	
4.D. Wetlands 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils, Peat extraction from lands, rewetted organic soils	CH_4	L1, L2, T2	X	
4.D. Wetlands 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils, Peat extraction from lands, drained organic soils	CO_2	L1, L2, T1	X	
4.D.1 Wetlands remaining Wetlands – Carbon stock change, dead organic matter	CO_2	L1, T1	X	
4.D.1 Wetlands remaining Wetlands – Carbon stock change, living biomass	CO_2	T1, T2	X	
4.D.1 Wetlands remaining Wetlands – Carbon stock change, organic soils	CO_2	L1, L2	X	
4.D.2 Land Converted to Wetland - Carbon stock change, organic soils	CO_2	L2, T2	X	
4.E.1 Settlements remaining Settlements – Carbon stock change, living biomass	CO_2	L1, L2, T1, T2	X	
4.E.2 Land converted to Settlements – Carbon stock change, dead organic matter	CO_2	L1	X	
4.E.2 Land converted to Settlements – Carbon stock change, living biomass	CO_2	L1, L2, T2	X	
4.E.2 Land converted to Settlements – Carbon stock change, mineral soils	CO_2	L1	X	
4.E.2 Land converted to Settlements – Carbon stock change, organic soils	CO_2	L1, L2, T1, T2	X	
4.E.2 Lands converted to settlements – Direct nitrous oxide (N_2O) emissions from nitrogen (N) mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	N_2O	L1, L2, T1, T2	X	
4.G. Harvested Wood Products	CO_2	L1, L2, T1, T2	X	
5.A.1. Managed Waste Disposal on Land	CH_4	L1, L2	X	X
5.A.2. Unmanaged Waste Disposal Sites	CH_4	L1, L2, T1, T2	X	X
5.B.1. Composting	CH_4	L1, L2, T1, T2		X
5.B.1. Composting	N_2O	L2, T2		X
5.B.2. Anaerobic digestion at biogas facilities	CH_4	L2		X
5.D.1 Domestic Wastewater	CH_4	L1, L2, T1, T2	X	X
5.D.1 Domestic Wastewater	N_2O	L1		X

IPCC category/Group	Gas	Identification criteria	with LULUCF	without LULUCF
5.D.2 Industrial Wastewater	CH_4	T1, T2	X	X

3.3 National Registry

The Union Registry serves to guarantee accurate accounting for all allowances issued under the EU ETS. The registry keeps track of the ownership of allowances held in electronic accounts, just as a bank has a record of all its customers and their money.

Directive 2009/29/EC adopted in 2009, provides for the centralization of the EU ETS operations into a single European Union registry operated by the EC as well as for the inclusion of the aviation sector. At the same time, and with a view to increasing efficiency in the operations of their respective national registries, the EU Member States (27) who are also Parties to the KP plus UK, Iceland, Liechtenstein and Norway decided to operate their registries in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Party registries - in particular Decision 13/CMP.1 and Decision 24/CP.8.

The consolidated platform which implements the national registries in a consolidated manner (including the registry of the EU) is called the Union registry and was developed together with the new EU registry on the basis the following modalities:

Each Party retains its organization designated as its registry administrator to maintain the national registry of that Party and remains responsible for all the obligations of Parties that are to be fulfilled through registries;

Each Kyoto unit issued by the Parties in such a consolidated system is issued by one of the constituent Parties and continues to carry the Party of origin identifier in its unique serial number;

Each Party retains its own set of national accounts as required by paragraph 21 of the Annex to Decision 15/CMP.1. Each account within a national registry keeps a unique account number comprising the identifier of the Party and a unique number within the Party where the account is maintained;

Kyoto transactions continue to be forwarded to and checked by the UNFCCC International Transaction Log (ITL), which remains responsible for verifying the accuracy and validity of those transactions;

The transaction log and registries continue to reconcile their data with each other in order to ensure data consistency and facilitate the automated checks of the ITL;

The requirements of paragraphs 44 to 48 of the Annex to Decision 13/CMP.1 concerning making non-confidential information accessible to the public is fulfilled by each Party through a publicly available web page hosted by the Union registry;

All registries reside on a consolidated IT platform sharing the same infrastructure technologies. The chosen architecture implements modalities to ensure that the consolidated national registries are uniquely identifiable, protected and distinguishable from each other, notably:

With regards to the data exchange, each national registry connects to the ITL directly and establishes a secure communication link through a consolidated communication channel (VPN tunnel);

The ITL remains responsible for authenticating the national registries and takes the full and final record of all transactions involving Kyoto units and other administrative processes in order for those actions not to be disputed or repudiated;

With regards to the data storage, the consolidated platform continues to guarantee that data is kept confidential and protected against unauthorized manipulation;

The data storage architecture also ensures that the data pertaining to a national registry are distinguishable and uniquely identifiable from the data pertaining to other consolidated national registries;

In addition, each consolidated national registry keeps a distinct user access entry point (URL) and a distinct set of authorisation and configuration rules.

Following the successful implementation of the Union registry, the 28 national registries concerned were re-certified in June 2012 and switched over to their new national registry on 20 June 2012.

The European Union Transaction Log (EUTL) automatically checks, records and authorises all transactions between accounts in the Union Registry. This ensures that all transfers comply with EU ETS rules.

The EUTL is the successor of the Community Independent Transaction Log (CITL), which had a similar role before the Union Registry was introduced.

The following changes to the national registry have occurred since the NC7 (Table 3.9).

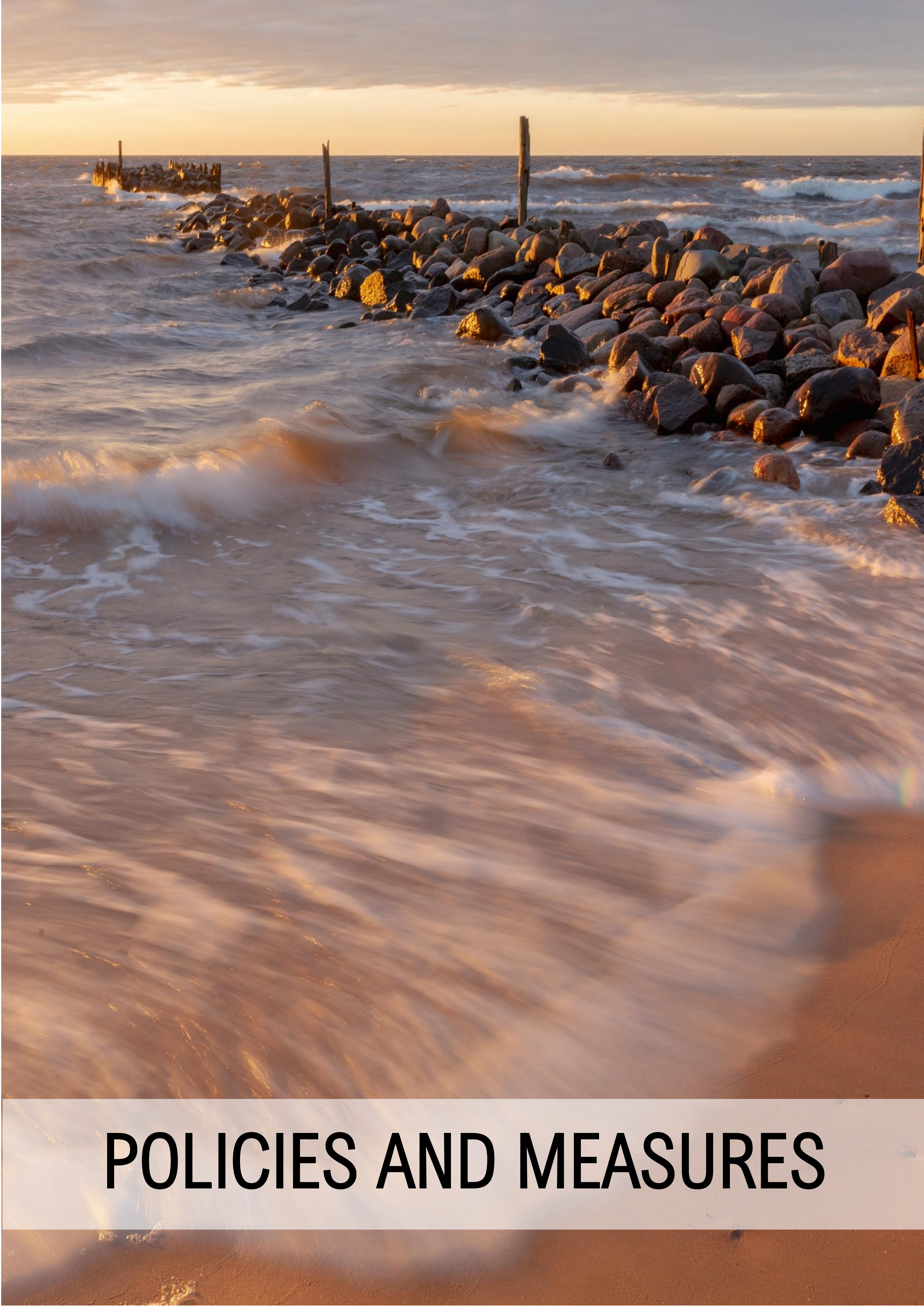
Table 3.9 Changes to the EU national registry

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	No changes since 2014. Jeļena Lazdāne-Mihalko National Administrator Latvian Environment, Geology and Meteorology Centre Address: Maskavas street 165, Riga, LV-1019 Tel.: +371 67032015 e-mail: Jelena.Lazdane@lvgmc.lv Aiva Puļķe National Administrator Latvian Environment, Geology and Meteorology Centre Address: Maskavas street 165, Riga, LV-1019 Tel.: +371 67032015 e-mail: Aiva.Pulke@lvgmc.lv
15/CMP.1 annex II.E paragraph 32.(b) Change regarding cooperation arrangement	No change of cooperation arrangement occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	There has been 6 new EUCR releases (versions 12.4, 13.0.2, 13.2.1, 13.3.3, 13.5.1 and 13.5.2) after version 11.5 (the production version at the time of the last chapter 14 submission). No changes were applied to the database, whose model is provided in Annex A. No change was required to the application backup plan or to the disaster recovery plan. No change to the capacity of the national registry occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	The changes that have been introduced with versions 12.4, 13.0.2, 13.2.1, 13.3.3, 13.5.1 and 13.5.2 compared with version 11.5 of the national registry are presented in Annex B. It is to be noted that each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and are carried out prior to the relevant major release of the version to Production (see Annex B). No other change in the registry's conformance to the technical standards occurred for the reported period.

15/CMP.1 annex II.E paragraph 32.(e) Change to discrepancies procedures	No change of discrepancies procedures occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(f) Change regarding security	The use of soft tokens for authentication and signature was introduced for the registry end users.
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	No change to the list of publicly available information occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	The registry internet address changed during the reported period. The new URL is https://unionregistry.ec.europa.eu/euregistry/LV/index.xhtml
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	No change of data integrity measures occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	Changes introduced since version 8.0.8 of the national registry are listed in Annex B. Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production. The site acceptance test was carried out by quality assurance consultants on behalf of and assisted by the EC.

References

- Cabinet of Ministers Regulation No. 737 “Development and management of national system for greenhouse gas inventory and projections” (in Latvian): https://likumi.lv/ta/id/295801-siltumnicefekta-gazu-inventarizacijas-un-prognozu-sagatavosanas-nacionalas-sistemas-izveidosanas-un-uzturesanas-noteikumi
- Cabinet of Ministers Regulation No. 675 “GHG inventory, projections and adaptation to climate change reporting systems” (in Latvian): https://likumi.lv/ta/id/336733-siltumnicefekta-gazu-inventarizacijas-sistemas-prognozu-sistemas-un-sistemas-zinosanai-par-pielagosanos-klimata-parmainam
- LATVIA’S SEVENTH NATIONAL COMMUNICATION and THIRD BIENNIAL REPORT under the United Nations Framework Convention on Climate Change, December 2017, https://unfccc.int/NC7
- Latvia`s National Inventory Report 2022, https://unfccc.int/ghg-inventories-annex-i-parties/2022



POLICIES AND MEASURES

4. POLICIES AND MEASURES

4.1 Climate policy framework

Latvia's climate policy is based on EU, the UNFCCC, KP and the Paris Agreement requirements. Common policies of the EU play a major role in the implementation of international agreements.

At national level climate policy is defined in government policies and programmes. Under the UNFCCC, the EU and its Member States committed to achieve a joint quantified economy-wide GHG emissions reduction target (QEWERT) -20 % below the 1990 by 2020 ("the Cancun pledge"). There are no separate targets for Member States under the Convention. EU plans to achieve UNFCCC target through EU legislation. In 2009, under the EU 2020 Climate and Energy Package, the EU introduced a clear internal rule to achieve the 20% reduction of total GHG emissions from 1990 level. The main instruments of the EU climate change mitigation policies are the EU ETS and the ESD.

The EU ETS target is to be achieved by the EU as a whole. The vast majority of emissions within the EU which fall outside the scope of the EU ETS are non-ETS emissions addressed under ESD. The ESD target was divided into national targets from 2005 level, to be achieved individually by each MS. Latvia's emission reduction target for 2020 includes the positive limit +17% compared to 2005 established for ESD sector in line with Decision No 406/2009/EC. The data presented in this report shows that Latvia has reached this ESD target (More information available in BR5, chapter III.II EU target compliance architecture).

The EU ETS and ESD is currently under revision to ensure that it will contribute to the EU's new target for 2030. The Commission has the power to initiate an infringement proceeding against a MS that fails to fulfil its commitments and obligations under EU law.

KP was amended with new quantified emission limitation and reduction commitments for the second commitment period 2013 to 2020 which continue the commitments determined for the KP first period. Latvia's emissions reduction target for the KP second commitment period was defined based on its emissions reduction obligation under the ESD. This target covered only non-ETS emissions and amounted 76 633 439 tonnes of CO_2 eq. Additionally, Latvia was responsible for the emissions and removals from the LULUCF activities based on Decision 2/CMP.7 during the second KP commitment period. The fulfilment of the commitment will be confirmed after international reviews and the True-Up Period between 2022 and 2024.

Articles 3.3 and 3.4 of the KP. KP Articles 3.3 and 3.4 concern emissions and removals from LULUCF activities. The accounting for the emissions and removals under Article 3, Paragraphs 3 and 4 will be done at the end of the second commitment period. Article 3.3 activities (afforestation/reforestation /deforestation) are based on land-use changes, and reporting these activities is mandatory for the Annex I Parties. Under the Article 3.4 Latvia is accounting Forest Management in the second commitment period. According to appendix to the annex to decision 2/CMP.7[14] Latvia's FM reference level (FMRL) for the second commitment period is -16302 kt CO_2 eq. a year, including HWP, and -14255 kt CO_2 eq. a year, assuming instantaneous oxidation of HWP. For Submission 2022 Latvia has made the technical correction to the FMRL that is 14829.11 kt CO_2 eq.; respectively FMRL after the corrections (FMRLcorr) is -1472.89 kt CO_2 eq.

The emissions/removals from ARD are added to or subtracted from the assigned amount in full, whereas the net emissions/removals from FM are subtracted from the FMRL before the corresponding addition/subtraction. Also, additions to the assigned amount resulting from FM shall not exceed 3.5% of the

[14] Decision 2/CMP.7. Available: http://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf

base year emissions times eight (FM cap). The FM cap value is 7394.54 kt CO_2 eq. and applies for the whole commitment period.

Summary table on accounting for activities under the Articles 3.3 and 3.4 of the KP is available in Submission 2022, chapter ES.2.2 KP-LULUCF activities, Table ES.3. General information on KP-LULUCF is available in 2022 Submission chapter 11 KP-LULUCF.

The Paris Agreement was adopted in December 2015 and entered into force in November 2016. The Latvia ratified the agreement in February 2017. The Paris Agreement aims to limit the rise in global average temperature to well below 2 °C relative to pre-industrial levels and to pursue efforts by which warming could be limited to below 1.5 °C and is an international, legally binding agreement on climate change. The Parties are obliged to prepare their NDC every five years and the most recent goal must always be more ambitious than the previous one. Progress in relation to the objectives is to be reviewed every five years. The first global review ("stocktake") will be in 2023. The EU's joint NDC under the Paris Agreement is to reduce GHG emissions by at least 55 % by 2030 from the 1990 level.

4.2 The Policy Making Process

Procedure of the policy development process in Latvia is determined by the Rules of Procedure of the Cabinet of Ministers and Rules of Procedure of the Parliament (Saeima).

Draft laws may be submitted to the Saeima by the President, the Cabinet of Ministers or committees of the Saeima, by not less than five members of the Saeima, or, in accordance with the procedures and in the cases provided for in the Constitution, by one-tenth of the electorate.

Ministries develop state policies and draft legal acts. General principles are established for coordinating their contentual development and for adopting a legislative document at the governmental level. This several-step process includes drafting by responsible department of particular ministry, presentation of draft in Advisory Boards of the particular ministry, submitting the draft document to the Meeting of the State Secretaries, which announces draft legal acts on which the ministries and other institutions have to present opinion, Meeting of the Committee of the Cabinet of Ministers if necessary according to the procedure for the particular document, and the decision of the Cabinet of Ministers.

MEPRD is the leading state administrative institution in the field of environmental protection which includes protection of environment and nature, maintenance and rational utilization of natural resources as well as it ensures planning and coordination process of state and regional development, local governments' development and supervision, territorial development planning and implementation of e-Government. In order to ensure that environment protection requirements are set for certain polluting activities by application of the system of permits, the MEPRD and institutions supervised by MERPD carry out control over implementation of the environmental requirements and compliance to them.

MEPRD is the institution that has the overall responsibility for national climate policy and compliance with the EU, UNFCCC, KP and Paris Agreement requirements. Issues related to development and implementation of the climate change policy are carried out by MEPRD, MoF, MoE, MoT, MoA, MES and institutions supervised by the relevant ministries.

MEPRD also coordinates acquisition of funds of the national green investment schemes (Climate Change Financial Instrument, 2009-2015, and currently Emission Allowance Auction Instrument). Supervision of practical implementation of these instruments is performed by the "Environmental Investment Fund Ltd.". The MEPRD is the holder of 100% of shares of it.

Institutions supervised by the MEPRD – State Environmental Service and Environment State Bureau, as well as companies supervised by the MEPRD - LEGMC and State Enterprise Latvian Environmental Investment Fund ensure implementation of the climate policy within framework of their competence.

4.3 National and Regional Programmes

The National Development Plan 2014–2020 (NDP2020) is hierarchically the highest national-level medium-term planning document. NDP2020 is closely related to the Sustainable Development Strategy of Latvia until 2030 (Latvia2030) and the LNRP for the Implementation of the EU2020 Strategy.

The goal of NDP2020 is to agree upon the most important medium-term priorities, areas of action, objectives and the indicators of their implementation. The NDP2020 defines the strategic objectives based on which the National Operational Programme (NOP) "Growth and Employment" has been elaborated. The relevant Specific Objectives and Measures of the NOP are included in the WEM scenario.

The NDP2020 ensures the sustainable use of the energy resources required by the national economy by promoting the availability of a market for the resources, a decrease of the energy intensity and emission intensity in certain sectors, and an increase of the proportion of renewable energy resources in the total consumption, while focusing on competitive energy prices. One of the measurable outcomes for the goal is Intensity of GHG emission in the economy (tCO_2 eq. per 1000LVL GDP) – 1.13 in 2020 and 1.07 in 2030.

The National Development Plan 2021–2027 (NDP2027) has been developed in accordance with the Latvia2030 and the UN Sustainable Development Goals (SDGs) so that the quality of life improves for each individual, and society as a whole over the next seven years.

NDP2027 defines the strategic aims committed to achieve in Latvia by 2027. It outlines sectoral policies and key reforms, as well as public investments from the state budget, local government budget, European Union (EU) funds and other financial sources (including from foreign and national funds and programmes).

NDP2027 states because people create a sustainable living environment and move toward a circular economy by saving energy and sustainably using resources, the principle of "energy efficiency first" should be applied when deciding on policies and infrastructure investments. Significant energy savings can be achieved through effective GHG reduction measures that increase the energy efficiency of buildings and energy production, and improve heat retention. Low-emission or zero-emission transport (including railway) also contribute. To measure outcomes of goal it suggested to follow GHG reduction trajectory towards the 2030 target.

National Reform Programme of Latvia for the Implementation of the "Europe 2020" Strategy (approved 26.04.2011) defines that, agreeably to the ESD, GHG emission increase in Latvia non-ETS sector in total shall not increase +17% in year 2020, comparing to 2005. Total GHG emission in Latvia, including both EU ETS and non-ETS sectors, accordingly the Programme, shall not increase in year 2020 by more than 12.16 million tons CO_2 eq.

In April 2019 Cabinet of Ministers approved the eighth Progress Report on the Implementation of the National Reform Program of Latvia, which is prepared annually and submitted to the EC. The Progress Report contains an updated medium-term macroeconomic scenario, described in the National Reform Programme of Latvia (approved by the Cabinet of Ministers on 26 April 2011), evaluates the progress of Latvia in addressing the recommendations issued by the EU Council in 2018, gives a detailed description of policy directions, including national quantitative targets of Latvia in the context of the Europe 2020 strategy, reflects information on the investments of EU funds and Latvia's investment needs in the 2021-2027.

In 26 March 2014 Cabinet of Ministers adopted Latvia's **Environmental Policy Strategy 2014-2020**. The Strategy is the national level planning document for the environmental sector that includes directions for low-carbon policies development, low-carbon technology implementation and sustainable land management in farming. The general climate policy objectives under the section No. 6 “Climate” are defined as follows: (1) to provide contribution of Latvia to prevention of global climate change by taking into account Latvia’s environmental, social and economic interests, and (2) to promote Latvia’s preparedness for adaptation to climate change and its impacts.

The following policies and measures are defined by the Strategy as the most important to mitigate climate change:

- implementation of GHG emissions reduction measures in all sectors of economy, alongside with promoting sustainable, low carbon capacity and cost-effective development;
- integration of the climate policy targets in the policy of other sectors by setting the responsibilities of each sector and promoting cooperation between the state, local governments and the private sector;
- raising public awareness about the climate changes and adaptation to them as well as involving people in the policy development and its implementation.

In order to measure settled policies and measures following targets have been defined:

- Limited or stabilised total LV GHG emissions – 12.16 ($MtCO_2$ eq.) in 2020;
- Limited or stabilised non-ETS GHG emissions – 9.9 ($MtCO_2$ eq.) in 2020;
- Reduced ETS GHG emissions – 2.26 ($MtCO_2$ eq.) in 2020;
- Fulfilment of the CO_2 removals target in forestry – 16.30 ($MtCO_2$ eq.) in 2020 (for every year in 2013-2020)[15].

To reach the above quantitative targets, the Strategy sets the following concrete activities, such as execution of ETS activities, ensuring the supply of economically and ecologically sustainable biomass, sustainable use of biomass for energy production, use of RES and energy efficiency in DH, energy efficiency in buildings, efficiency of lighting infrastructure, integrating climate issues in the transport policy at national and local level, development of environmentally friendly transport infrastructure and the use of RES in public transport, Green Public Procurement, low carbon emitting technologies and sustainable farming practices in agriculture, ensuring of CO_2 removal in forest lands, carbon removal in wood products with long useful lifetime. These activities are implemented based on interministerial co-operation and depending on the competence of particular ministry (MEPRD, MoA, MoE, MoT) and by involving local governments in the field of their competence.

Sustainable Development Strategy of Latvia until 2030 (Latvia2030) is the hierarchically highest long-term development planning document in Latvia. The development of Latvia's sustainable development strategy is ensured by the Cabinet of Ministers and approved by the Saeima. Latvia2030 determines the country's long-term development priorities and spatial development perspective. It sets the objectives:

- To become one of the leaders of the EU in terms of distribution of innovative and exportable enterprises;
- To ensure energy independence of the state by increasing the provision of energy resources and integrating in the EU energy networks;
- To become the EU leader in the preservation, increase and sustainable use of natural capital including GHG emission mitigation.

Latvia2030 sets out indicators to be reached till 2030 (Table 4.1).

[15] The final value will be recalculated after 2020 as part of technical corrections.

Table 4.1 Latvia2030 indicators

Indicator	2030
Energy dependence – net import of energy resources/gross domestic energy consumption plus bunkering (%)	<50
Greenhouse gas emissions per year (against amount of emissions per base year) (Kyoto Protocol)	<45
Forest cover (area of forests, % from the whole state territory)	55

National Energy and Climate Plan 2021-2030 (NECP) is a document for the long-term planning of energy and climate policy laying down the basic principles, goals and action lines of Latvia's national energy and climate policy for the next ten years, as per the outlined long-term lines of development.

In order to implement the objective, it is necessary:

1) to promote the efficient use of resources and their self-sufficiency and diversity;

2) to ensure a considerable reduction in the consumption of resources, in particular fossil and unsustainable resources, and a simultaneous transition to the use of sustainable, renewable and innovative resources ensuring equal access to energy sources to all community groups;

3) to stimulate the development of research and innovation that contributes to the development of the sustainable energy sector and mitigation of climate change.

Main targets are shown in Table 4.2.

Table 4.2 Policy outcomes and main performance indicators in Latvia

Policy outcome in each dimension of the Plan	Actual value	Target value	
	2017	2020	2030
1.1. GHG emission reduction target (% compared to 1990)	-57	-	-65
1.1.1. Non-ETS activities (% compared to 2005)	+7	+17	-6
1.1.2. LULUCF accounting categories (million t)	-	0	-3.1
1.1.3. Transport energy life-cycle GHG emission intensity reduction (%)	0.8	6	≥6
1.2. Share of energy produced from RES in gross final energy consumption (%)	39	40	50
1.3. Share of energy produced from RES in gross final energy consumption in transport (%)	2.5	10	7[16]
1.4. Share of advanced biofuels & biogas in gross final energy consumption in transport (%)	0	-	3.5
2.1. Mandatory national target — cumulated final energy savings (Mtoe)	0.45	0.85	1.76
2.2. Building renovation target (total renovated m^2)	398.707	678.460	500.000

Strategy for Sustainable Use of Peat Resources 2020-2030 (adopted in Cabinet of Ministers on 24 November 2020) covers main aspects for sustainability of the peat extraction and production. It addresses assessment of GHG emissions from the use of peatlands as one of the main issues. Therefore, one of the main indicators

[16]The target can be reached by setting an obligation for fuel suppliers, within the scope of which it is allowed to use advanced biofuel and/or biogas, which is produced from the raw materials listed in Annex IX to Directive 2018/2001, electricity obtained from RES, hydrogen obtained from RES, processed carbon fuels, as well as other biofuels or biomass fuels which are not produced from food or animal feed crops

for successful implementation of the Peat Strategy is to achieve a GHG emission zero increase compared to the average level of GHG emissions in 2005-2009 in LULUCF sector.

Member States shall publish the first version of **Long-term strategy for building renovation** by 30 April 2014 and update the strategy every three years and submit each version to the Commission as part of the National Energy Efficiency Action Plans. On 11 November 2020 Cabinet approved latest Long-term strategy for building renovation. Strategy addresses issues concerning energy efficiency in buildings, plan investments, and consider future projections for building sector till 2050.

4.3.1 Participation in the flexible mechanisms of the Kyoto protocol

Latvia as a Party to the KP has a possibility to participate in the flexible mechanisms provided for in the Protocol. In years 2009-2013 in case of Latvia especially important was the international emissions trading mechanism, in which Latvia had acted as a seller. Government of Latvia ensured that every AAU sold was used for "greening" purposes which means climate change mitigation, promotion of low carbon economy development by application of innovative environmental technologies, increase of RES use and improvement of energy efficiency as well as capacity building for climate change policy design and implementation. Revenues obtained from the sale of GHG emissions allowances (national CCFI) were directed by open tenders in years 2010-2015 to investment projects' assistance focused on reduction of CO_2 emissions by improving energy efficiency and use of RES (see the description of the particular measures below). Important, the special "soft" programs were focused on general public and stakeholders' capacity building, promotion of public understanding on the importance and possibilities of GHG emissions' reduction as well as on supporting R&D, innovative environmentally friendly energy technologies pilot projects. In total, the funds of CCFI used for co-financing the projects and coverage of related administration costs constituted ~208 MEUR, thus CCFI had an important role for providing green investments in Latvia.

4.3.2 EU ETS allowances auctioning

For the EU Emissions Trading System (ETS) third period from 2013 until 2020 Latvia has auctioned near 17.46 million combined emission allowances (EUA) and aviation allowances (EUAA) in the primary market on the common auction platform and gained 190.90 MEUR from these auctions. In addition to the auctions in the primary market, in 2018 Latvia auctioned 3.13 million EUA in the secondary market resulting in a total revenue of 60.66 MEUR. According to provisional estimates of the MEPRD Latvia could gain near 700 MEUR from auction revenues in the 4th EU ETS period from 2021 to 2030. These revenue projections are calculated by taking into account the approximate volume of allowances to be auctioned in the ETS 4th period on the common auction platform; the potential impact of the market stability reserve; the possible average yearly auction price of one emission allowance (which in fact can vary significantly depending on the actual market situation). This figure may also change in the light of the EC's planned initiatives in 2021 related to the "Fit for 55" Package under the Commission Work programme 2021.

All auction revenues are channelled into the state budget program – the Emissions Allowances Auctioning Instrument (EAAI), which has been established in 2016. The operational strategy for the EAAI was adopted in July, 2021.The EAAI is aimed at tackling global climate change, supporting adaptation to the consequences of climate change and reducing GHG emissions in accordance with national legislation. During the third EU ETS period four open tenders for projects have been organized from 2016 till 2018 with total available EAAI co-funding in amount of 50 MEUR. The projects focused on the following GHG emissions reduction activities:

- rebuilding, reconstruction and renovation of protected architectural monuments of national importance;
- construction of new low-energy buildings, as well as the rebuilding or renovation of existing buildings into low-energy buildings;
- introducing and demonstrating smart urban technologies;

- supporting the construction of new and sustainable low-energy energy self-sufficient buildings and ensuring the demonstration and promotion of technologies necessary for low-carbon development in Latvia.

As a result of the above-mentioned project activities, a total GHG emissions reduction of 899.5 tCO_2 has been achieved as of 2021. More information is available in chapter 4. Policies and Measures, 4.4.2 Energy.

In 2021, the first year of the 4th EU ETS period, Latvia auctioned 1,146,500 EUA and 20,500 EUAA, in the amount of 62.45 MEUR. In 2021 one more tender - supporting the introduction of electric vehicles and plug-in hybrid vehicles - with an available funding of 10 MEUR has been organised through the EAAI.

In general, till the end of 2021, Latvia has auctioned approximately 18.6 million emission allowances (EUA and EUAA) in the primary market on the common auctioning platform and gained 253.35 MEUR from these auctions. All unspent revenues from the auctioning of emission allowances are being accumulated and will be spent in coming years.

4.3.3 Participation in EEA Financial Mechanism 2009-2014 and 2014-2021

Programme “National Climate Policy”

The objective of the Programme was to support Latvia in developing a comprehensive national climate policy covering non-ETS sector as regards emissions, and all sectors as regards adaptation. Within Programme the Latvian institutional capacity in national climate policy development and implementation was strengthened, including information analysis, scenario development, society involvement, policy analyses and development of documents for integrated climate change mitigation and adaptation to climate change management. The Programme included both pre-defined projects and open calls. Within the framework of the Programme two pre-defined projects were implemented:

1. “Development of the National System for GHG Inventory and Evaluation and Reporting on Policies, Measures and Projections”;
2. “Development of Proposals for National Adaptation Strategy, including Identification of Scientific Data, Measures for Adapting to Changing Climate, Impact and Cost Evaluation”.

Programme "Climate Change Mitigation, Adaptation and Environment"

On April 23 2019, an agreement has been signed between the Ministry of Foreign Affairs of the Kingdom of Norway and the Ministry of Finance of the Republic of Latvia on the implementation of the Norway Grants programme "Climate Change Mitigation, Adaptation and Environment" (Programme) in Latvia.

The total allocation for the Programme: ~16.5 million euros (Norway Grants allocation 14 million (85%) and national co-financing ~2.5 million (15%) euros). Objective: Climate change mitigated and vulnerability to climate change reduced.

The following activities have been planned in the Programme:

by the spring of 2024, the Programme will contribute towards addressing climate and environmental issues in accordance with 18 February 2020 Cabinet of Ministers Regulation No. 93 "Regulations for the implementation of the Norwegian Financial Mechanism 2014-2021 programme "Climate Change Mitigation, Adaptation and Environment"", which includes:

- two pre-defined projects:
    1. MEPRD project “Integration of climate change policy in sectoral and regional policies” implemented in partnership with the CSB of Latvia, LEGMC and the Norwegian Environment Agency;

2. Ministry of Agriculture project "Enhancement of sustainable soil resource management in agriculture" implemented in partnership with the University of Latvia, the LSFRI "Silava", the State Plant Protection Service and the Norwegian Institute for Bioeconomy Research.

- an Open Call "Mitigation of Risks Related to Historically Contaminated Sites" dedicated on remediation of polluted sites;
- Initiatives under the Fund for Bilateral Relations;
- Programme administrative costs.

Pre-defined projects:

MEPRD project "Integration of climate change policy in sectoral and regional policies" envisages:

- the development and implementation of various tools for integrating climate change policies into sectoral and regional policies where within the framework of the project, a regional data collection and reporting system, an electronic database on ozone-depleting substances and F-gases will be developed;
- the national warning system will be improved, the latest data on Latvian coastal erosion will be developed, as well as other results will be achieved.

The Ministry of Agriculture project "Enhancement of sustainable soil resource management in agriculture" aims to improve climate policy planning and update national soil data, thus promoting sustainable land management and strengthening climate change adaptation capacity.

Programme "Local Development, Poverty Reduction and Cultural Cooperation"

On 14 December 2017 Memorandum of Understanding has been signed between Iceland, Liechtenstein, the Kingdom of Norway and the Republic of Latvia on the implementation of the EEA Grants 2014 – 2021 programme "Local development, poverty reduction and culture cooperation". The Programme Operator is MEPRD.

The total allocation for the Programme: ~11.8 million euros (EEA Grants allocation 10 million euros (85%) and national co-financing ~1.8 million euros (15%)).

Programme areas:

- Local Development and Poverty Reduction;
- Cultural Entrepreneurship, Cultural Heritage and Cultural Cooperation;
- Good Governance, Accountable Institutions, Transparency.

Programme activities:

- Seven pre-defined projects to strengthen economic development at local and regional level, to enhance cooperation among local governments, and to implement integration related measures for asylum seekers;
- Small grant scheme "Support for business ideas in Latgale" to facilitate employment in the Latgale region;
- Open call shall aim at improving access to professional contemporary arts and culture in the regions.

The Programme will contribute towards reduction of economic and social disparities by implementing several outcomes such as strengthened economic development at local and regional level as well as integrity and accountability of public administration at local level improved.

The Programme is implemented by:

- MEPRD;

- Programme Partner – the Ministry of Culture;
- The Donor Programme Partner – The Norwegian Association of Local and Regional Authorities;
- Arts Council Norway as the partner for the programme area "Cultural Entrepreneurship, Cultural Heritage and Cultural Cooperation".

More information on EEA and the Norwegian Financial Mechanism programs is available in MEPRD homepage[17].

4.3.4 Low-Carbon Development Strategy

"Strategy of Latvia for the Achievement of Climate Neutrality by 2050" (Strategy) was approved by Cabinet of Ministers in January 2020. It sets direction towards climate change mitigation and low carbon development in Latvia.

Strategy has been submitted to the EC according to the requirements of the Energy Union Governance Regulation. The Strategy has been translated and submitted to the UNFCCC in 2020 (in line with the Paris Agreement).

The main goal of the Strategy is to reach climate neutrality in Latvia by 2050. The Strategy identifies strategic lines of action but does not reach the level of detail of the concrete measures, which is going to be identified by elaboration of shorter-term sectoral planning documents such as current NECP.

The milestones are included indicating GHG emission reduction for each decade. The key principles of low carbon development to be applied horizontally when preparing shorter term policy documents are included in the Strategy.

The implementation of the Strategy will be coordinated by MEPRD. MEPRD, MoE, MoA, MoT, MES, MoW, MoF, Cross-Sectoral Coordination Centre will be responsible authorities for the implementation of the Strategy. The targets of the climate neutrality will be considered and incorporated in the sectorial strategies, programmes of financial support, research programmes for the next period 2021-2027 and beyond. The Latvia climate neutrality 2050 will be reach in cost effective, integrated and smart way taking into account the priorities of each of sectors.

In accordance with the Energy Union Governance Regulation a Member State shall report to the Commission information on assessment of the contribution of the policy or measure to the achievement of the long-term strategy referred to in Article 15.

However, as within the Strategy it is said that specific measures and the contribution of different sectors of national economy to achieving the objective of climate neutrality will be specified in subsequent NECPs, as well as in sectoral planning documents of a shorter term, assessment of the contribution of the policy to achievement of the long-term strategy is performed by assessment of NECPs. As NECP consists of exact policies and measures that contribute to GHG reduction and CO_2 removals, it also implements the targets set out in Strategy.

4.4 Policies and Measures and their Effects

In the last years Latvia's national climate policy has undergone more integration with the planning and decision making processes in energy production and consumption, transport, agriculture, waste management, forestry and land-use sectors.

The Table 4.3 below presents the policy planning key documents relevant for the climate policy in the sectors and selects the priority goals of them which have positive impact to meet national climate policy objectives.

[17] https://www.varam.gov.lv/en/european-economic-area-and-norwegian-financial-mechanisms

Table 4.3 Climate change policy directions

Sectors	Goals of sectorial policies related to climate change	Policy planning documents
Energy	❖ To increase a deployment of RES and energy efficiency and saving measures ❖ To promote energy efficiency improvement including energy efficiency requirements for DHS ❖ To develop metering and billing of electricity and district heat for end-use consumers ❖ To further develop national Construction Standards ❖ To develop energy management systems practice (in large enterprises and large electricity consumers, in state administration institutions and municipalities fulfilling certain qualification criteria)	Latvian Energy Long Term Strategy 2030-Competitive Energy for Society Energy Policy Strategy 2016-2020 National Development Plan 2014-2020 National Development Plan 2021-2027 National Energy and Climate Plan 2021-2030 National Air Pollution Mitigation Action Plan 2020-2030
Transport	❖ To promote the use of RES within the transport sector ❖ To promote the energy efficient and clean vehicles ❖ To promote the energy-efficiency of transport system by the choices of more environmentally friendly modes of transport ❖ To further develop alternative fuels and their infrastructure ❖ To promote energy efficient railway ❖ To develop multi-modal public transport system	Transport Development Strategy 2014-2020 Alternative Fuels Development Plan 2017-2020 National Development Plan 2014-2020 National Development Plan 2021-2027 National Energy and Climate Plan 2021-2030 Transport Development Strategy 2021-2027 National Air Pollution Mitigation Action Plan 2020-2030
IPPU	❖ To increase energy and resource efficiency in industrial processes ❖ To introduce principles of cleaner production	
Agriculture	❖ To introduce balanced livestock feeding ❖ To arrange requirements of manure management and spreading ❖ To introduce precise fertiliser application ❖ To promote biomethane production ❖ To promote crop fertilisation plans ❖ To manage nitrate use at vulnerable territories ❖ To introduce leguminous plants on arable land ❖ Organic farming ❖ To maintain amelioration systems ❖ To promote integrated farming	Common Agricultural Policy Rural Development Programme 2014-2020

Sectors	Goals of sectorial policies related to climate change	Policy planning documents
Waste	❖ To decrease municipal waste disposal till 10% in 2035 from generated amount ❖ To reduce waste generation ❖ To increase biological waste treatment ❖ To develop and upgrade quality of sewerage system services	Waste management Plan 2021-2028 River Basins management Plans 2021-2027
Forestry	❖ To increase productivity of forests ❖ To promote afforestation of nutrient-poor soils ❖ To expand use of wood products ❖ To reduce natural disturbances	Forests and Forest based Industries Development Strategy 2015-2020

The calculation of GHG emissions projections for the Energy sector with the MARKAL-Latvia model enables simultaneously to calculate air pollutant emissions and to assess the impact of the GHG mitigation PaMs on the amount of these emissions in the scenarios. The implementation of energy efficiency measures in all sectors contributes not only to the reduction of GHG emissions, but also to the reduction of air pollutant emissions. Some GHG emission reduction measures, such as increased use of solid biomass for energy generation in energy industries, manufacturing and residential and tertiary sectors, might increase air pollutant emissions (fine particulate matter $PM_{2,5}$ and NMVOC emissions). In order to mitigate this negative impact, additional provisions for the implementation of these measures are laid down. Support programmes for the substitution of fossil fuels with solid biomass require the replacing the used combustion equipment (energy industries, manufacturing, tertiary and residential sector) by such biomass utilising equipment that corresponds to the stringent emission limit values.

4.4.1 Institutional arrangements for monitoring GHG mitigation policy

Latvia's institutional, legal, administrative and procedural arrangements used for domestic compliance, monitoring, reporting, archiving of information and evaluation of the progress towards economy-wide emission reduction target is described in Annex 1 of NC8 (Latvia's Fifth Biennial Report to the UNFCCC) (section IV "Progress in achievement of quantified economy-wide emission reduction target"). According to the amendment of Law on Pollution (2018), MEPRD in cooperation with MoA, MoT, MoE and other ministries each year prepare and submit by 31 December an Informative Report to the Cabinet of Ministers (The Government of Latvia) on achievement of the commitments regarding GHG emission reduction and CO_2 removals. The following information is included in the Informative Report: 1) the summary information regarding historical GHG emissions from GHG inventory as well as GHG projections, policies and measures; 2) an evaluation of the achievement of the commitments related to reduction of GHG emissions and CO_2 removals; 3) if necessary, proposals regarding additional measures for the reduction of GHG emissions and CO_2 removals, corresponding to the sectoral policy planning documents for the relevant period, which are cost-efficient and have been evaluated from a socioeconomic point of view. In case progress towards any target is deemed insufficient by the Cabinet of Ministers, it decides on actions to be taken in order to course-correct. For example, in 2020, the Cabinet of Ministers decided that a strategy has to be developed for the LULUCF sector to determine actions for reaching national targets.

According to Latvia`s policy planning document and legislation development procedures, MEPRD has to evaluate and comment on policy planning documents and project submissions prepared by other ministries or enterprises in their preparation phase (strategic environmental impact assessment). If there is a risk that certain PaMs could increase GHG emissions, MEPRD indicates the impact of those PaMs on the achievement of the GHG emission reduction targets.

4.4.2 Energy

4.4.2.1 Policies and measures in the WEM projection

Within the energy sector, GHG emissions are in practice reduced in two ways:

1) the primary energy consumption is reduced by cutting the end use in different sectors or by increasing the conversion efficiency of electricity and heat production plants and the efficiency of transmission and distribution systems;
2) fuels and energy use are shifted to renewable energy sources.

The “with existing measures” (WEM) projection includes all energy policy measures implemented before 2021. The main policies include the EU ETS, the increase in renewable energy and the energy efficiency improvement measures. The EU ETS is an EU-wide domestic measure, while improvement of energy efficiency and shift to RES are supported by various national policies and measures, such as regulatory framework, direct governmental intervention (investment co-financing programmes), information and awareness raising measures, and others. WEM projection includes also fiscal (taxation) measures, see in the chapter 4.4.9.

European Union emissions trading system (EU ETS)

The EU ETS, established by the Directive 2003/87/EC, is in operation as from the 1 January 2005. It is considered here as a domestic measure. The third trading period covered 2013-2020. In 2020 61 stationary installations (owned by 43 legal operators) participated in EU ETS. In addition to emissions from energy production, the EU ETS also includes emissions from industrial processes. The EU ETS covered only CO_2 emissions. The fourth trading period covers 2021-2030 and will be implemented according to the Directive 2018/410/EU. There are 52 stationary installations (37 operators) included in the list of the first sub-period (2021-2025) of the fourth trading period.

Energy Efficiency

Energy efficiency improvement concern all sectors of the economy. Energy Audits/Energy Management Schemes (EMS) have proven to be efficient measures along with other ones. For both residential and non-residential buildings (both existing, undergoing renovation and new ones) building codes and regulations play an important role. Subsidies (investment co-financing) for renovation of buildings and related technologies and innovative modes of operation of them are one of the key-policies. Also important are the measures that aim to cause a behavioural change.

Energy Audits and EMS. The Energy Efficiency Law (in force from the 29 March 2016) includes the framework for the mandatory implementation of the energy audits/EMS:

- **Energy Audits and Energy Efficiency Improvement in Large Enterprises** (the transposition of the energy auditing framework defined by the Energy Efficiency Directive 2018/2002/EU);
- **EMS in Enterprises – Large Electricity Consumers (LEC)** (national measure, mandatory implementation of EMS in the enterprises that are LECs, the enterprise is considered as a LEC if its own annual electricity consumption is above 500 MWh in two subsequent years);
- **EMS in state administration institutions:** mandatory implementation of EMS in those state direct administration institutions which have buildings with total heating area 10000 m^2 and above;
- **EMS in municipalities**: mandatory implementation of EMS in local municipalities, based on such threshold criteria as number of population and territorial development index. At the end of 2020, 17 municipalities, including largest cities (valstpilsētas), have the duty to implement EMS. Municipalities implements EMS also on voluntary basis.

Both the large enterprises, the LECs, the obliged state authorities and the municipalities implementing the EMS (both mandatory and voluntary) shall provide to the responsible state authority (State Construction Control Bureau of Latvia) the annual report on implemented measures and energy savings reached. Particular provision relates to the large enterprises and the LECs. At least three energy efficiency measures (or all, if only one or two measures are stated) stated by the energy audit or EMS, which have the highest energy savings or the highest economical return, shall be implemented both by large enterprises (up to the 1 April 2020 for the first audit/EMS period) and by LECs (up to the 1 April 2022 for the first audit/EMS period). The mitigation impact due to the EMS implementation is evaluated respectively 66.5 kt CO_2 eq. in 2025 (of that 64.8 kt CO_2 eq. in commercial sector and 1.7 kt CO_2 eq. in public sector), 58.2 kt CO_2 eq. in 2030 (of that 56 kt CO_2 eq. in commercial sector and 2.2 kt CO_2 eq. in public sector) and 58.5 kt CO_2 eq. in 2035 (of that 56 kt CO_2 eq. in commercial sector and 2.5 kt CO_2 eq. in public sector).

Latvia uses **Energy Efficiency Obligation Scheme (EEOS)** in accordance with the provisions of the Energy Efficiency Directive 2018/2002/EU. The EEOS framework is stated by the Energy Efficiency Law, in April 2017 the detailed procedures had been adopted by the government. The obliged parties for the EEOS start period and the first period (up to 31 December 2020) were electricity retail sellers which (1) sold at least 10 GWh of electricity in 2016, or (2) sold at least 10 GWh of electricity in any of years related to this EEOS period. The mitigation impact due to the EEOS is evaluated respectively 46 kt CO_2 eq. in 2025 and 42 kt CO_2 eq. in 2030 and afterwards.

Voluntary energy efficiency agreements. The general framework is stated by the Energy Efficiency Law. Pursuant to the Law, in October 2016 the detailed procedures had been adopted by the government, having the following main provisions - at least 10% of energy efficiency improvement, development of energy efficiency action plan, agreement duration at least 5 years, reporting of energy savings. The participants of the agreement can be private companies, associations representing them, municipalities and associations/unions of municipalities, planning regions. At the moment the practice of the voluntary agreements is in the start phase: currently three voluntary agreements are in the operational implementation - two with municipal district heating utilities (duration – 5 years, signed in December 2017 and March 2018) and one with the local municipality (duration – 10 years, signed in December 2020).

Public Procurement Law states the particular section "Special rules with respect to energy efficiency". Energy efficiency, environmental protection and climate change mitigation provisions are included in the technical specifications for public supply and service contracts. Pursuant to the Law, the minimum energy efficiency requirements for goods and services to be procured by the state direct administration institutions are stated. The Law also states the general framework for the **green public procurement** that is detailed by the relevant governmental regulation. Regarding energy consumption, the green procurement regulation relates to: (1) ICT equipment, including computers and printers, indoor lighting, street lighting, traffic signals (stated green public procurement criteria are mandatory), and (2) electricity, construction works, heat boilers, electronic equipment in health care sector (stated green procurement criteria can be applied on voluntary basis).

Energy use in residential and other buildings

Policies and measures for buildings and housing aim at improving energy efficiency as well as increasing the use of RES. Policy measures include legal standard setting, economic instruments, the dissemination of information and education. The measures target both new, undergoing renovation and existing buildings. The total mitigation impact due to the implementation of the presented below set of measures focused to energy efficiency improvement in buildings is evaluated respectively 47.8 kt CO_2 eq. in 2025, 48.8 kt CO_2 eq. in 2030 and 50.8 kt CO_2 eq. in 2035.

Energy Performance of Buildings (EPB) Directive 2002/91/EC, aimed to reduce CO_2 emissions by improving the energy efficiency of buildings, was implemented in Latvia by the Law on the Energy Performance of Buildings that came into force in April 2008. The recast Law on the Energy Performance of Buildings is in force from the 9 January 2013 and is amended to transpose the relevant EU Directives. The Law, in accordance with the provisions of the EPB Directive 2010/31/EC, the Energy Efficiency Directive 2012/27/EU and the Directive 2018/844 amending both noted Directives, provides the general legal framework of setting the mandatory minimum energy performance requirements for buildings, the general principles of energy efficiency certification of buildings, verification of buildings heating HVAC systems and air conditioning systems, etc. The governmental regulations on the energy efficiency of buildings includes the following:

- regulation on the energy certification of buildings (energy efficiency classes and energy performance indicators, etc.);
- regulation on the minimal requirements for existing, in exploitation, buildings (both residential and non-residential ones);
- new national Construction Standard LBN 002-19 “Thermotechnics of Building Envelopes”.

The mitigation impact due to the implementation of the requirements of energy efficiency performance in buildings (see more details below) is evaluated respectively 2.9 kt CO_2 eq. in 2025, 3.9 kt CO_2 eq. in 2030 and 5.9 kt CO_2 eq. in 2035.

Energy Performance Indicators (EPI) for buildings

In 2013, six energy efficiency classes (A-F) for residential and non-residential buildings had been introduced. In its turn, on 16 April 2021 new regulation regarding energy certification of buildings came into force. The 2021 Regulation adjusts the specific energy consumption values for heating (kWh per m^2 per year) depending on the heated area of the building (before only unified approach had been applied), thus provides for cost-effective values in smaller buildings. The new Regulation introduces EPI for both: (1) energy consumption for heating, and (2) non-renewable primary energy consumption.

New Buildings. The nearly-zero energy building shall correspond to the A class. The Latvia’s Construction Standard LBN 002-19 “Thermotechnics of Building Envelopes” (in force from 1 January 2020) has provided the transition period to the nearly-zero energy building, as presented in the Table 4.4 below. The nearly-zero energy building values need not be applied if application of the relevant requirements is either technically or functionally impossible and benefit analysis on the useful lifetime of the relevant building indicates to losses. The presented in the Table 4.4 values for 2021 and afterwards correspond to the re-casted values provided by the noted in the previous paragraph new regulation.

Regarding **the buildings to be reconstructed or renovated,** the EPI values are directly included in the Latvia’s Construction Standard LBN 002-19. These EPI values are as follows:

- for multi-apartment residential buildings – should not exceed 90 kWh per m^2 per year (from 21 November 2015 till 31 December 2020); from the 1 January 2021 – should not exceed 80 kWh per m^2 per year;
- for one-apartment and two-apartment residential buildings – should not exceed 100 kWh per m^2 per year (from 21 November 2015 till 31 December 2020); from the 1 January 2021 – should not exceed 90 kWh per m^2 per year;
- for buildings which are in the ownership of the State or local government and in the possession of the authorities and where the State or local government authorities are located - should not exceed 110 kWh per m^2 per year (from 21 November 2015 till 31 December 2020), from the 1 January 2021 – should not exceed 90 kWh per m^2 per year;
- for other non-residential buildings - should not exceed 110 kWh per m^2 per year (from 21 November 2015 till 31 December 2020), from the 1 January 2021 – should not exceed 100 kWh per m^2 per year.

Table 4.4 Minimum permissible level of energy performance of buildings: EPI for heating of new buildings (source: Latvian Construction Standard LBN002-19)

Time period of approval of a construction intention	for residential buildings		for non-residential buildings	
	multi-apartment buildings	one-apartment or two-apartment buildings	buildings which are in the ownership of the State or local government and in the possession of the authorities and where the State or local government authorities are located	other non-residential buildings
Until 31 December 2016	≤ 70 kWh/m^2 per year	≤ 80 kWh/m^2 per year	≤ 100 kWh/m^2 per year	≤ 100 kWh/m^2 per year
From 1 January 2017 to 31 December 2017	≤ 60 kWh/m^2 per year	≤ 70 kWh/m^2 per year	≤ 90 kWh/m^2 per year	≤ 90 kWh/m^2 per year
From 1 January 2018 to 31 December 2018	≤ 60 kWh/m^2 per year	≤ 70 kWh/m^2 per year	≤ 65 kWh/m^2 per year	≤ 90 kWh/m^2 per year
From 1 January 2019 to 31 December 2020	≤ 50 kWh/m^2 per year	≤ 60 kWh/m^2 per year	nearly zero-energy building ≤ 45 kWh/m^2 per year	≤ 65 kWh/m^2 per year
From 1 January 2021	nearly zero-energy building ≤ 40 kWh/m^2 per year	nearly zero-energy building ≤ 50-60 kWh/m^2 per year (depending on the heated area)	nearly zero-energy building ≤ 45-50 kWh/m^2 per year (depending on the type of use and heated area)	

The Latvian Construction Standard (LCS) "Thermotechnics of Building Envelopes" systematically increases the requirements. In April 2014 the provisions of the re-cast Energy Performance of Buildings Directive (2010/31/EU) were transposed. In turn, on 1 January 2020 the new LCS LBN002-19 is in force that incorporates directly the EPI reference levels for heating (in kWh per m^2 annually) for new buildings and buildings ongoing renovation/reconstruction. The mitigation impact due to the increased minimum thermal insulation standards of buildings are included in the evaluation of the impact of requirements of energy efficiency performance in buildings presented above.

Information of end-users

The **individual heat energy metering** has become compulsory. It enables residents to supervise their individual consumption and the energy costs thus encouraging users to save energy. The provision to install heat meters or heat cost allocators in each apartment or set of premises that is invoiced separately in the multi-apartment and multi-purpose building, to that heating is supplied from a common heat source or a district heating (DH) system, has been introduced in several steps. From the 31 December 2016 it applies to new buildings and buildings to be converted or renovated, if funded by EU funds, State or municipal budgets. In its turn, from the 1 January 2021 it applies to all existing, in exploitation, buildings, on condition if the individual accounting is economically justified and remotely readable devices shall be installed (for the devices, installed before the 1 January 2021, a remote readability must be ensured by the 1 January, 2027).

Informing Energy Consumers of Residential Sector. The measure motivates to renovate buildings in the frame of the ERDF co-financed measure of increasing energy efficiency in multi-apartment buildings (see below). The programme "Let's live warmer!" had started in EU Funds 2007-2013 planning period. Currently the implementation of the 2014-2020 planning period of EU Funds is on-going. Wide scope of methods are applied by the programme "Let's live warmer!" to reach and to inform and consult communities of the apartments' owners regarding conditions and benefits of energy efficiency increase and the best practices of it, to present the typical faults during energy efficient renovation process, etc. Important, the programme consult on not only renovation but also the practice of maintaining the apartment building after renovation. The NECP2030 provides for the continuation of ""Let's live warmer!" programme for the next period as well. In its turn, **energy audits of multi-apartment buildings** provide reasoned quantitative information. The financial support for the preparation of technical documentation related to buildings' energy efficient renovation is stated as the eligible cost for multi-apartment building renovation projects co-financed by the ERDF. As the presented information measure closely links with the investment co-financing programme, the mitigation impact is included in the investment support programme "Increasing energy efficiency in multi-apartment buildings" presented below.

Informing end-users on efficient appliances and smart use of them

- **Labelling of appliances.** The national legislative framework by the transposition of the Ecodesign Directive 2009/125/EC and of the revised Labelling Directive 2010/30/EU had been implemented in 2011. The provisions, stated by the Energy Labelling Regulation 2017/1369/EU and particular Commission Regulations on eco-design and labelling for particular goods, are implemented directly by the responsible parties;
- smart power metering is provided: at the end of 2021 the national power distribution grid company SC "AS Sadales tīkls" has almost finished the transition programme to smart power meters, namely, already around 90% of all clients have had smart power meters in total covering 94% of electricity consumption.

Investment co-financing

The following investment support programmes are included in the WEM projection:

- energy efficiency increase in residential buildings;
- energy efficiency increase in public (both state and municipal ones) buildings;
- investment support programmes in public sector with high demonstration value (national EAAI);
- energy efficiency increase in manufacturing industry buildings and technologies.

All these programmes include also the possible installation of local RES-utilising heat and/or electricity production technologies. Implementation of these programmes is on-going and will be finished in 2023.

Increasing energy efficiency in multi-apartment buildings had actively started in 2009 (EU Funds planning period of 2007-2013, implementation up to 2015 including), co-financed by the ERDF. It had been renovated almost 800 multi-apartment buildings (including 55 social residential ones). In EU Funds planning period of 2014-2020 the measure is continued. Within on-going programme the annual specific heat energy consumption for heating after renovation of the building shall not exceed 90 kWh per m^2. Also, the installation of building-scale RES-heat technologies might be done in combination with energy efficiency improvement of the building itself and its engineering systems. The assistance is provided as the complex financial instrument: (1) grant, up to 50% of eligible cost of the project (2) repayable low-interest loan, issued by the "Development Finance Institution Altum" Joint Stock Company, and (3) "Development Finance Institution Altum" Joint Stock Company guarantee for the loan, issued by the commercial institution. The implementation of the approved projects of the 2014-2020 planning period will finish in 2023, resulting in improvement of energy efficiency for at least 19.6 thousand households (around a thousand of multi-apartment buildings). The support is provided within the framework of the NOP "Growth and Employment" of the 2014-2020 planning period. The basic financing is allocated within the Thematic Objective No4 “Supporting the shift towards a low-carbon economy in all sectors”, the Specific Objective 4.2.1.1 “To increase energy efficiency in multi-apartment buildings”. The mitigation impact due to the implementation of noted investment co-financing programme for 2014-2020 planning period is evaluated 26 kt CO_2 eq. in 2025 and afterwards.

Regarding single-family buildings, the CCFI, within the **programme for Renewable Energy Technologies in Households,** had provided the support for 1760 projects (of which 93% relate to local renewable heat production and 7% relate to local power production by wind and solar PV).

Increasing energy efficiency in municipal buildings. Investment support programmes in public buildings of different use, owned by municipalities, had been important focus of the national CCFI, implemented in the period 2010-2015. The measure is continued in EU Funds planning period of 2014-2020 by the ERDF co-financing. In both periods eligible investments include energy efficiency investments in a building envelope and engineering systems, reconstruction of local heat supply infrastructure and heat supply switch to RES technologies as well as local RES technologies for power production. The financing is allocated within the framework of the NOP “Growth and Employment”, the Specific Objective 4.2.2. “To facilitate the increase of energy efficiency in municipal buildings, according to the integrated development programme of the municipality”.

Increasing energy efficiency in State public buildings. The buildings of certain types of use (particularly the buildings of higher education and vocational education, health care and culture sectors) were included as the beneficiaries for investment support within the national CCFI, implemented in the period of 2010-2015. Continuing, the wide investment support is provided in EU Funds planning period of 2014-2020 by the ERDF co-financing for wide range of beneficiaries, both providing state services and fulfilling state delegated tasks. In addition to energy efficiency improvement of the building and its engineering systems, reconstruction of local heat supply infrastructure and installation of local RES technologies (both heat production, power production and cooling) is promoted. Implementation of the projects will be finished in 2023. The support is provided within the framework of the NOP “Growth and Employment”, the Specific Objective 4.2.1.2 “To increase energy efficiency in state buildings”.

Increasing Energy Efficiency in General Education and Vocational Education Institutions. The national CCFI, implemented in 2010-2015, had particular programme targeted to vocational education institutions. Continuing, the investment support is provided in EU Funds planning period of 2014-2020 by the ERDF co-financing. The NOP “Growth and Employment”, Thematic Objective No8 “Education, Skills and Lifelong Learning”, the Specific Objective 8.1.2 “To improve study environment of general education institutions” provides complex support that includes different eligible activities aimed both to buildings (both buildings of schools and dormitories) and their engineering and lighting systems. Thus, the support includes the energy efficiency and building-scale RES technologies related measures. In its turn, the Specific Objective 8.1.3 “To increase number of fully modernised vocational education institutions” provides similar complex support for vocational educational establishments. Within these 2 programmes around 125 education establishments will be fully modernised (30 gymnasiums/secondary schools, 24 vocational educational institutions as well as a range of regional primary schools). The implementation of projects will be finished in 2023.

The mitigation impact due to the implementation of noted investment co-financing programmes (both municipal and state buildings, including education sector ones) for 2014-2020 planning period is evaluated 10.7 kt CO_2 eq. in 2025 and afterwards.

Investment Support Programmes in public sector with high demonstration value to reduce GHG emissions: national EAAI. Application of smart technologies and smart management of the building is in the focus of them. Currently several EAAI programmes are implemented focused to:

1. promote GHG emission reduction by energy efficiency and RES-heat technologies measures in the buildings having status of architectural monuments of state significance;

2. demonstrate nearly zero energy public buildings (construction of new buildings as well as reconstruction of existing ones) comprising smart technologies;
3. promote the use of smart technologies for energy efficiency (efficient outdoor lighting) in urban environment.

Implementation of projects in 2018-2021, few projects will be finished in 2022 as well. The mitigation impact due to the implementation of investment co-financing programmes by EAAI is evaluated 2 kt CO_2 eq. in 2025 and afterwards.

Efficient use of energy resources, reduction of energy consumption and transfer to RES in manufacturing industry. Investment support for industrial buildings and technologies had been important focus of national CCFI, implemented in 2010-2015, eligible investments included both energy efficiency investments in a buildings and their engineering systems, in production technologies and in local RES technologies for heat as well as power production. Continuing, the investment support is provided in EU Funds planning period of 2014-2020 by the Cohesion Fund co-financing for new, innovative energy-saving technology, measures increasing energy efficiency and share of RES (RES utilising technologies, both heat and power production). The implementation of the projects shall be finished in 2023. The support is provided within the framework of the NOP "Growth and Employment", the Specific Objective 4.1.1. The mitigation impact due to the implementation of noted investment co-financing programme for 2014-2020 planning period is evaluated 5.3 kt CO_2 eq. in 2025 and afterwards.

Soft Loan Programme to Improve Energy Efficiency and Promote Renewable Energy in Businesses are important part of the complex financial instrument provided for the commercial sector. Starting from 2017, loans are issued by the "Development Finance Institution Altum" Joint Stock Company for wide range of interested parties – individual merchants, micro enterprises, SMEs, large enterprises, state and municipalities owned companies. The loan is available also for energy service companies (ESCO). The areas, for which the loan is available, are: energy efficiency (payback period of the project should be 5-7 years), renewable energy (payback period 15 years), green non-residential buildings (payback period 15 years). The main criterion is adequate flow of money – payment of loan due to cost savings. Main conditions of the loan: up to 2.85 MEUR and up to 90% of the project costs (borrowers own contribution is from 10%), fixed loan rate, 4.3%-6.5%, is applied, "credit holidays" up to 12 months can be applied. The mitigation impact of this loan programme is included in the mitigation impact of the investment support in manufacturing industry presented in the paragraph above.

Investments Support Programme to Improve Energy Efficiency in Food Processing Enterprises. The support is provided within the framework of the Measure 04.2 "Investments" of the national Rural Development Programme for 2014-2020, co-financed by the EAFRD. Regarding the results of energy efficiency improvement project, the general provision is to reach at least 20% of energy savings in existing buildings or as a result of other energy efficiency improvement measures (improvement of lighting, heating & conditioning equipment, production technologies, etc., compared to the replaced technology). In turn, for new buildings the thresholds of heat penetrability specific values for particular elements of building envelope are defined. The support might be used also for implementation of RES technologies in the enterprise. The mitigation impact due to the implementation of noted investment co-financing programme for 2014-2020 planning period is evaluated 0.9 kt CO_2 eq. in 2025 and afterwards.

Renewable Energy

Pursuant to the Directive 2009/28/EC on the promotion of the use of energy from renewable sources, Latvia's target had been to increase the share of renewable energy in the gross final energy consumption (GFEC) from 32.6% in 2005 up to 40% in 2020. **Latvia had fulfilled this 2020 renewable energy target.** Latvia had reached the following shares of renewable energy in 2020:

- share of renewable energy in GFEC -42.13%;

- share of renewable energy in electricity -53.36%;
- share of renewable energy in heating & cooling -57.09%;
- share of renewable energy in transport -6.73%.

The total mitigation impact due to the implementation of the renewable energy related WEM measures is evaluated respectively 303 kt CO_2 eq. in 2025, 269 kt CO_2 eq. in 2030 and 189 kt CO_2 eq. in 2035.

Renewable electricity production

The **feed-in tariff system (FIT)** for the production of electricity from RES came into force already in 1996. Thereafter the principles of determining and calculation of FIT were changed several times. After adoption of Electricity Market Law (in 2005), preferential FIT for renewable electricity producers are prescribed by this Law and governmental regulations issued pursuant to it. From the 26 May 2011 the new RES electricity producers, as well as from the 10 September 2012 the new RES-CHP producers have no rights to qualify for the FIT. The legislative provisions are adopted to ensure a controlled closure of the FIT scheme. Thus, the preferential FIT is continuing in relation to the existing RES and CHP plants only which had obtained the FIT rights before noted above data.

WEM projection considers the long-term impact of FIT on the development of RES-electricity capacity. The total RES-electricity capacity developed under the FIT scheme is around 240 MW (of which small hydro – around 11.5%, wind – 27%, solid biomass – 37%, biogas – 24.5%). The mitigation impact due to the implementation of the FIT scheme is evaluated respectively 227 kt CO_2 eq. in 2025, 193 kt CO_2 eq. in 2030 and 113 kt CO_2 eq. in 2035.

Production of Renewable Energy in Agriculture sector. In EU Funds planning period of 2007-2013 the wide development of grid-connected biogas plants, producing power in CHP mode by utilising biogas, fermented from biomass of agriculture sector origin, had took place. The financial support was provided for the agriculture sector entities by national Rural Development Programme, co-financed by EAFRD. These plants receive also FIT support. In its turn, in EU Funds planning period of 2014-2020, the measure is continued at small scale.

Renewables in district heating

District heating (DH) is the source of around 40% of all space heating in Latvia. Providing RES-based and efficient DH system is both one of the key tasks of Latvia's energy policy and important measure to reduce GHG emissions in public electricity and heat production sector.

In 2016, **the energy efficiency requirements for DH systems** have been adopted as the governmental regulation. The minimum efficiency requirements are stated for the following: (1) heat production boilers (respectively, 92% - gaseous fuel, 85% - liquid fuel, 75% -solid fuel), (2) CHP units (respectively, 80% - gaseous and liquid fuels, 75% - solid fuels), (3) solar heat collectors (respectively, 70% - vacuum tube collectors, 75% - flat plate collectors), (4) heat pumps (shall correspond at least class "C"), (5) annual maximum heat losses in DH pipeline network (from 1 January 2018 – not higher than 19%, from 1 January 2019 – not higher than 17%).

Investment co-financing in DH systems. The wide investment co-financing programme had started in 2009 (in EU Funds planning period of 2007-2013, implementation of approved projects finished in 2015) by the Cohesion Fund for two objectives: (1) development of efficient biomass utilising heat production units and heat supply efficiency improvements in DH systems pipeline networks and (2) development of biomass utilising CHP units. In its turn, EU Funds planning period of 2014-2020 the co-financing of investment by Cohesion Fund is provided for: (i) new RES utilising heat production sources (both additional RES capacities to supply new DH consumers and replacement of existing fossil fuel capacities); (ii) reconstruction for increase of energy efficiency of existing heat production sources utilising RES; (iii) construction (widening) and renovation of DH pipeline systems. RES-utilising heat production technologies include both combustible (biomass) and solar heat ones. The implementation of the projects will be finished in 2023. The support is provided within the framework of the NOP "Growth and Employment", the Specific Objective 4.3.1. "To promote energy efficiency and use of local RES in district heating systems". In total, from the 2009, the new RES capacities of 37 MW electrical capacity and around 400 MW heat capacity will be installed.

The mitigation impact due to the implementation of the measures in DH sector is evaluated 76 kt CO_2 eq. in 2025 and afterwards.

Based on the analysis of the results of the implemented measures in the energy sector, as a good experience effectively replicable by other Parties could be considered policies and measures for buildings and housing aim at improving energy efficiency as well as increasing the use of RES. Policy measures include legal standard setting, economic instruments, the dissemination of information and education. The programme "Let's live warmer!" had started in EU Funds 2007-2013 planning period. Currently the implementation of the 2014-2020 planning period of EU Funds is on-going. Wide scope of methods are applied by the programme "Let's live warmer!" to reach and to inform and consult communities of the apartments'. The measure motivates to renovate buildings in the frame of the ERDF co-financed measure of increasing energy efficiency in multi-apartment buildings. In addition, regarding the buildings to be reconstructed or renovated, the Energy Performance Indicators values are directly included in the Latvia's Construction Standard LBN 002-19. Such an integrated implementation of measures will give the opportunity to achieve greater benefits from implemented measures.

Interaction of PaMs with other policies and measures at the national level

Interaction of different PAMs are given in both the description of PaMs of the energy sector and the description of GHG projections. Some of the interactions are described below.

The informative measures ("Let's live warmer!", energy audits) are implemented and provide GHG emission mitigation together with the investment co-financing of the energy efficiency improvement measures in residential buildings. Since many residential buildings in Latvia are connected to district heating systems, the implementation of energy efficiency measures in residential buildings affects the necessary RES-utilising new capacity to be installed in energy industries sector. There is also a close interaction between the measures to increase energy efficiency and the measures to increase RES utilization for power production. The implementation of energy efficiency measures in the demand sector allows to reduce the required RES-utilising capacities and also costs in the supply sector.

4.4.2.2 Policies and measures in the WAM projection

Energy use in residential and other buildings

The total mitigation impact due to the implementation of the measures in buildings is evaluated respectively 33.1 kt CO_2 eq. in 2025 and 38.1 kt CO_2 eq. in 2030 and afterwards.

Energy Efficiency in Apartment Buildings. As planned by the NDP2027, in EU Funds planning period of 2021-2027 the support (co-financing) for energy efficiency improvement of apartment buildings is to be continued. The NDP2027 envisages to improve energy efficiency in around 24 thousand households in total. The mitigation impact due to the implementation of the measure is evaluated 22 kt CO_2 eq. in 2025 and afterwards.

The following measures **regarding public buildings** are planned by the NDP2027 to be implemented in EU Funds planning period of 2021-2027:

- energy efficiency improvement and implementation of RES utilizing technologies, including smart management systems, in **municipal buildings;**
- energy efficiency improvement, including implementation of RES utilizing technologies and smart energy management systems, in **state public buildings.**

The mitigation impact due to the implementation of both measures in public buildings is evaluated 9 kt CO_2 eq. in 2025 and afterwards.

Energy use in industrial buildings and technologies. As planned by the NDP2027, in EU Funds planning period of 2021-2027 the financial instrument with the grant part for energy efficiency improvement and RES utilizing technologies in manufacturing industry sector is to be continued. The mitigation impact due to the implementation of the measure is evaluated respectively 2.1 kt CO_2 eq. in 2025 and 7.2 kt CO_2 eq. in 2030 and afterwards.

Renewable energy supply

Programme for Solar (PV) Energy. This particular measure, to be co-financed in EU Funds planning period of 2021-2027, is planned as the complex financial instrument with the grant part. The wide range of target groups is envisaged as the beneficiaries – commercial sector, municipal sector as well as energy communities. The mitigation impact due to the implementation of the measure is evaluated respectively 10 kt CO_2 eq. in 2025 and 15 kt CO_2 eq. in 2030 and afterwards.

Table 4.5 Summary of policies and measures in Energy sector

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
Implementation of the EU Emissions Trading Scheme*	Energy Supply	CO_2	Increase in renewable energy; Reduction of losses; Efficiency improvement in the energy transformation sector; Efficiency improvement in industrial end-use sectors	Regulatory Economic	Implemented	Limitation of amount of emission allowances allocated for ETS operators	2005	MEPRD	NE	NE	NE
Energy Efficiency Requirements for District Heating (DH) Systems*	Energy Supply	CO_2	Reduction of losses	Regulatory	Implemented	The energy efficiency requirements are defined both for DH production technologies and heat losses in DH pipeline network	2018	Ministry of Economics	NE	NE	NE
Investment Support Programme for DH Systems: 2014-2020 EU Funds programming period*	Energy Supply	CO_2	Increase in renewable energy in the heating and cooling sector; Reduction of losses; Efficiency improvement in the energy transformation sector	Economic	Implemented	Co-financing of investment by EU Cohesion Fund (National Operational Programme) is provided for: (i) new RES utilising heat production sources; including the replacement of existing fossil fuel capacities); (ii) energy efficient reconstruction of existing heat production sources utilising RES; (iii) construction (widening) and renovation of DH pipeline systems	2017	Ministry of Economics	76	76	76
Energy Performance of Buildings*	Energy Consumption	CO_2	Energy efficiency improvement of buildings	Regulatory	Implemented	Energy efficiency classification system for both residential and non-residential buildings. The mandatory energy	2013	Ministry of Economics	2.9	3.9	5.9

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
						performance indicators (kWh/m^2/year) for new buildings and buildings to be reconstructed/ renovated.					
Increased minimum thermal insulation standards of buildings*	Energy Consumption	CO_2	Energy efficiency improvement of buildings	Regulatory	Implemented	The Latvian Construction Standard (LCS) systematically increases the requirements for the thermotechnics of building envelopes, In April 2014 the provisions of the re-cast Energy Performance of Buildings Directive (2010/31/EU) were transposed. In 1 January 2020 the LCS LBN002-19 "Thermotechnics of Building Envelopes" is in force that incorporates directly the energy performance indicators for heating (in kWh per m^2 annually) for new buildings and buildings ongoing reconstruction	2014	Ministry of Economics	IE	IE	IE
Informing Energy Consumers of Residential Sector (Multi-apartment buildings)*	Energy Consumption	CO_2	Energy efficiency improvements of buildings	Information	Implemented	The informative programme "Let's live warmer!" motivates to renovate buildings in the frame of the ERDF co-financed measure of increasing energy efficiency in multi-apartment buildings. Wide scope of methods applied to inform and	2010	Ministry of Economics	IE	IE	IE

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
						consult regarding benefits of energy efficiency increase and the best practices to do it, as well as on the good practice of maintaining the apartment building after renovation.					
Labelling of Appliances*	Energy Consumption	CO_2	Energy efficiency improvements of appliances	Regulatory, Information	Implemented	The national legislative framework by the transposition of the Ecodesign Directive 2009/125/EC and of the revised Labelling Directive 2010/30/EU had been implemented in 2011. The provisions, stated by the Energy Labelling Regulation 2017/1369/EU and particular Commission Regulations on eco-design and labelling for particular goods, are implemented directly.	2011	Ministry of Economics	NE	NE	NE
Investment Support Programme to Increase Energy Efficiency in Apartment Buildings: 2014-2020 EU Funds programming period*	Energy Consumption	CO_2	Energy efficiency improvements of buildings	Economic	Implemented	The financial instrument and the co-financing of investment by EU ERDF (National Operational Programme) is provided for energy efficient renovation of buildings and their engineering systems, reconstruction of heat supply system, energy control, including smart metering, as well as	2016	Ministry of Economics	26	26	26

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
						building scale RES technologies.					
Investment Support Programme to Increase Energy Efficiency in Public (State and Municipal) Buildings: 2014-2020 EU Funds programming period*	Energy Consumption	CO_2	Energy efficiency improvements of buildings	Economic	Implemented	the co-financing of investment by EU ERDF (National Operational Programme) is provided for energy efficiency improvement of the buildings and their engineering systems, reconstruction of local heat supply infrastructure and switch to RES, energy control, including smart metering, building-scale RES technologies.	2016	Ministry of Economics (state buildings), MEPRD (municipal buildings)	10	10	10
Increasing energy efficiency in general and vocational education institutions: EU Funds Programming Period 2014-2020*	Energy Consumption	CO_2	Energy efficiency improvements of buildings	Economic	Implemented	The co—financing by the ERDF (National Operational Programme) provides the complex support for education institutions that includes also energy efficiency improvement in buildings and their engineering systems and building-scale RES technologies (both schools and dormitories)	2016	Ministry of Education and Science	0.7	0.7	0.7
Investment Support Programmes in Public Sector to reduce GHG emissions: national EAAI*	Energy Consumption	CO_2	Energy efficiency improvements of buildings; Demand management/reduction	Economic	Implemented	Co-financing by the national EAAI the energy efficiency measures which have high demonstration value, such as reconstruction practice to low energy buildings, new nearly	2016	MEPRD	2	2	2

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
						zero and self-sufficient buildings, as well as efficient urban outdoor lighting. Focus on smart technologies application.					
Investment Support in Manufacturing Industry sector to promote energy efficiency and RES use: 2014-2020 EU Funds programming period*	Energy Supply; Energy Consumption	CO_2	Increase in renewable energy; Efficiency improvement in industrial end-use sectors	Economic	Implemented	the co-financing of investment (both in buildings, their engineering systems and production technologies) by EU Cohesion Fund (National Operational Programme) is provided for new, innovative energy-saving technology, measures increasing energy efficiency and share of RES (RES utilising technologies, both heat and power production). The financial assistance is provided in the form of financial instrument	2016	Ministry of Economics	5.3	5.3	5.3
Investment Support to Improve Energy Efficiency in Food Processing Enterprises: 2014-2020 EU Funds programming period*	Energy Consumption	CO_2	Efficiency improvement in industrial end-use sectors	Economic	Implemented	the co-financing of investment by EU EAFRD (National Rural Development Programme) is provided for energy efficiency improvement of both buildings, their engineering systems and production technologies	2015	Ministry of Agriculture	0.9	0.9	0.9

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
Green Public Procurement*	Energy Consumption	CO_2	Efficiency improvements of buildings; Efficiency improvement in services/ tertiary sector; Efficiency improvement of appliances	Regulatory	Implemented	Public Procurement Law states the general framework for the green public procurement that is detailed by the relevant governmental regulation.	2016	Ministry of Finance; MEPRD: Ministry of Economics	NE	NE	NE
Energy Efficiency Obligation Scheme (EEOS)*	Energy Consumption	CO_2	Efficiency improvement of appliances; Demand management/reduction	Regulatory	Implemented	Energy efficiency improvement in electricity end use. The obliged parties for the EEOS start period and the first (till 31.12.2020) period are electricity retail sellers (10 GWh electricity sold annually)	2017	Ministry of Economics	46	42	42
Energy Management System (EMS) in Commercial Sector*	Energy Consumption	CO_2	Demand management/reduction; Efficiency improvement in industrial and services/ tertiary end-use sectors	Regulatory	Implemented	Mandatory implementation of: 1) Energy Audit in Large Enterprises (transposition of EED 2012/27/EU). (2) EMS for enterprises - Large Electricity Consumers that have its own annual electricity consumption above 500 MWh in two subsequent years	2017	Ministry of Economics	64.8	56	56
Energy Management System (EMS) in Public Sector*	Energy Consumption	CO_2	Demand management/reduction; Energy efficiency improvements of buildings; Efficiency improvement in municipal end-use sector.	Regulatory: Voluntary/ negotiated agreements	Implemented	Mandatory implementation: (1) in those state direct administration institutions which have buildings with total heating area 10000 m^2 and above; (2) local municipalities, based on such threshold criteria as number of population and territorial development index.	2017	Ministry of Economics	1.7	2.2	2.5

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
						Municipalities implement EMS also on voluntary base					
Voluntary Energy Efficiency Agreements*	Energy Consumption	CO_2	Energy efficiency improvement in end-use sectors	Voluntary/negotiated agreements	Implemented	Framework defined by the Energy Efficiency Law and relevant governmental regulation: at least 10% of energy efficiency improvement, development of energy efficiency action plan, agreement duration at least 5 years, reporting of energy savings.	2016	Ministry of Economics	NE	NE	NE
Preferential Feed-in Tariffs for Renewable Electricity*	Energy Supply	CO_2	Increase in renewable energy	Economic	Implemented	FIT support for RES electricity producers (wind, small hydro, biomass, biogas), including RES electricity in CHP mode. The legislative provisions are adopted to ensure a controlled closure of the FIT scheme.	1996	Ministry of Economics	227	193	113
Taxation of CO_2 emissions*	Energy Consumption; Energy Supply	CO_2	Efficiency improvement in the energy transformation sector; Increase in renewable energy; Efficiency improvement in industrial and services/ tertiary end-use sectors	Fiscal	Implemented	The subject of CO_2 taxation is CO_2 emitting activities (installations) which correspond to EU ETS activities however the amount of the activity (installation) is below the threshold defined for inclusion in EU ETS. The tax shall not be paid for the CO_2 emissions which emerges (i) from the installations participating in the EU ETS,	2005	Ministry of Finance	NE	NE	NE

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
						and (ii) while using renewable energy sources.					
Investment Support Programme to Increase Energy Efficiency in Apartment Buildings: 2021-2027 EU Funds Programming Period	Energy Consumption	CO_2	Energy efficiency improvements of building	Economic	Planned	As planned by the NDP2027, in EU Funds planning period of 2021-2027 the support (co-financing) for energy efficiency improvement of apartment buildings is to be continued in the form of complex financial instrument	2023	Ministry of Economics	22	22	22
Investment Support Programme for Solar (PV) Energy: 2021-2027 EU Funds programming period	Energy Supply	CO_2	Increase in renewable energy	Economic	Planned	Implementation of solar PV technologies in both commercial and public (municipalities) sectors. Co-financing of investment is envisaged by the NDP2027	2023	Ministry of Economics	10	15	15
Investment Support Programme to Increase Energy Efficiency in Public (State and Municipal) Buildings: 2021-2027 EU Funds programming period	Energy Consumption	CO_2	Energy efficiency improvements of buildings; Demand management/reduction	Economic	Planned	As planned by the NDP2027, in EU Funds planning period of 2021-2027 the support (co-financing) for energy efficiency improvement in state and municipal public buildings is to be continued.	2023	Ministry of Economics (state buildings), MEPRD (municipal buildings)	9	9	9
Investment Support in Manufacturing Industry sector to	Energy Supply;	CO_2	Increase in renewable energy; Efficiency	Economic	Planned	As planned by the NDP2027, the financial instrument with the grant part for energy efficiency	2023	Ministry of Economics	2.1	7.2	7.2

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
promote energy efficiency and RES: 2021-2027 EU Funds programming period	Energy Consumption		improvement in industrial end-use sectors			improvement and RES utilizing technologies in manufacturing industry sector is to be continued.					

* a mitigation action is included in the "with measures" projection.

4.4.3 Transport

4.4.3.1 Policies and measures in the WEM projection

The WEM projection includes all measures that were implemented before 2021 in the transport sector to cut down the emissions. The WEM projection contains the following policies:

- promoting the use of RES within the transport sector;
- promoting the energy efficient and clean vehicles;
- promoting the energy-efficiency of transport system by the choices of more environmentally friendly modes of transport.

Taxation of fuels, utilised in the transport sector (see in the chapter 4.4.9 below), as the inter-sectorial policy promoting all noted above policies, are included in the WEM scenario as well.

Promoting the use of RES within the transport sector

Biofuel Blend Obligation. To ensure growth of the share of RES in the transport sector, on the 1 October 2009 Latvia had introduced the Biofuel Blend Obligation. The Table below presents the requirements in force from 2018. Blended biofuels shall correspond to the sustainability criteria. Exemptions are made for: (1) diesels utilised: (i) in case of winter climate, namely, in the period from 1 November till 1 April, (ii) in sea and air transport engines; and (2) gasoline utilised: (i) in cars participating in sport competitions, (ii) in air transport engines. The mitigation impact due to the implementation of the measure is evaluated respectively 145 kt CO_2 eq. in 2025, 137 kt CO_2 eq. in 2030 and 230 kt CO_2 eq. in 2035.

Table 4.6 Biofuel Blend Obligation in Latvia

	From 1 April 2018 till 31 December 2019	From 1 January 2020
Bioethanol blend, mandatory for the gasoline of "95" trademark	4.5-5% (volume) of total volume	At least 9.5% (volume) of total volume
Biodiesel blend	(a) 4.5-7% (volume), of total volume, if the biodiesel produced from rapeseed oil, mixed (b) at least 4.5% (volume) of total volume, if the paraffinic diesel, produced from biomass, mixed	At least 6.5% (volume) of total volume

Electricity taxation: exemption for the electricity use. The **Electricity Tax Law** states the exemption for the electricity used for carriage of goods and public carriage of passengers including on rail transport and public transport in towns.

The Alternative Fuels Development Plan for 2017-2020 provided for the development of the electric vehicles charging infrastructure as well as LNG and CNG fuelling infrastructure.

Electromobility development. The national CCFI programme (open call announced in 2014, implemented up to the 31 March 2015) had co-financed the acquisition of around 170 new battery electrical vehicles (EV), having zero emissions, as well as the installation of 11 publicly available EV charging points. In April 2017 the Alternative Fuels Development Plan for 2017-2020 had been approved which include the development of a country-wide EV charging infrastructure network as one of the measures. The implementation of a single national level fast charging infrastructure coverage (139 EV direct current fast charging stations with capacity up to 50 kW) has been co-financed by the ERDF within the framework of the NOP "Growth and Employment" of the EU Funds planning period of 2014-2020, the Thematic Objective No 4 "Supporting the shift towards a low-carbon economy in all sectors", the Specific Objective 4.4.1, the implementation of the measure has been finished in December 2021.This country-wide EV charging network "e-mobi" is maintained by the Road Traffic Safety Directorate. The mitigation impact due to the implementation of the EV charging infrastructure is evaluated respectively 39 kt CO_2 eq. in 2025, 87 kt CO_2 eq. in 2030 and 670 kt CO_2 eq. in 2035.

Soft Loan Programme for Sustainable Transport. Loans are issued by the "Development Finance Institution Altum" Joint Stock Company of the loans programme's areas is sustainable transport. The activities can include, for instance, electrical vehicles, biogas-based transport. The main criterion is adequate flow of money – payment of loan due to cost savings. Main conditions of the loan: up to 2.85 MEUR and up to 90% of the project costs; fixed loan rate, 4.3%-6.5% is applied, payback in transport area should be up to 7 years. E.g., using this loan, the electric car-sharing fleet (100 cars) had been established by the Latvian trade mark company "Figsy" in July 2020. The mitigation impact is included in the measure of Electromobility development presented above.

The total impact of the promotion of biofuels utilising and electrical vehicles due to the measures above is evaluated respectively 184 kt CO_2 eq. in 2025, 224 kt CO_2 eq. in 2030 and 900 kt CO_2 eq. in 2035.

Promoting energy efficient and clean vehicles

Mandatory annual systematic inspection of technical conditions of motor vehicles ensures that only those vehicles that comply with technical and environmental requirements are being allowed to take part in road transport. An important element of the policy is to reduce administrative burden for owners of new cars. From the 1 January 2018 the provision is introduced in the Road Traffic Law that first two inspections of new car are performed bi-annually (the first of the inspections not later than 24 months after the relevant car has been registered in Latvia for the first time). In its turn, third and subsequent periodic technical inspections shall be performed on an annual basis. Mandatory systematic inspection of technical conditions relates also to tractors/tractor equipment. The mitigation impact due to the implementation of the measure is evaluated respectively 3 kt CO_2 eq. in 2025 and 3.5 kt CO_2 eq. in 2030 and afterwards.

The annual taxation on vehicles based on the specific emissions is the important policy to promote low-emission vehicles. This policy is introduced in Latvia in several steps, starting from the 1 January 2017:

- the car annual operation tax, based on the specific CO_2 emissions of the car (plus fixed supplement for those engines capacity of which exceeds 3500 cm^3), is being calculated for the new cars (in force from 01.01.2017) and for the cars firstly registered from 01.01.2009 (in force from 01.01.2019). For the cars with the specific CO_2 emissions up to 50 grams per km zero tax rate is applied;
- for light duty (gross weight up to 3500 kg) vehicles, registered after 2011, the annual operation tax, based on the specific CO_2 emissions (including the noted above fixed supplement), has been adopted in November 2020 and came into force 01.01.2021;
- for the older cars (registered before 2009) the annual operation tax is differentiated based on engine capacity, maximal power of engine and the gross weight of the car. The same differentiation is provided for light duty vehicles, registered before 2011;
- for buses with gross weight above 3500 kg and heavy duty vehicles with gross weight above 3500 kg the annual operational tax, based on EURO class, has been adopted in November 2020 as well and came into force 01.01.2021;
- for light buses annual operational tax continues to be differentiated based on the gross weight.

Latvia also provides people with more information about the CO_2 emissions of passenger cars. **New passenger cars labelling on fuel economy rating** provides information regarding fuel consumption (litres per 100 km or km per litre) and CO_2 emissions (grams per km). The governmental regulation on new passengers' cars labelling came into force 01.01.2003. In its turn, in July 2004 government had adopted the regulation transposing the requirements of the Directive 2003/73/EC. The mitigation impact due to the implementation of the measure is evaluated respectively 3.85 kt CO_2 eq. in 2025, 7.7 kt CO_2 eq. in 2030 and 15.5 kt CO_2 eq. in 2035.

Promoting the energy efficiency of transport system

The legal provisions on **public procurement** of road transport vehicles are stated by the:

- Public Procurement Law: the section "Special Rules for Procurement in the Field of Road Transport",
- Law on the Procurement of Public Service Providers: the section "Special Provisions for Procurements in the Field of Road Transport";
- Law on Public Transport Services: the section "Special Vehicle Procurement Rules Applicable to the Carrier";
- in its turn, the procurement of tyres of the highest fuel efficiency class (or of the highest class regarding noise or road adherence, if grounded by safety or public health considerations) in state direct administration institutions is stated by the particular governmental regulation.

In June 2010 Latvia had transposed the provisions of the Directive (EU) 2009/33/EC. The Public Procurement Law stated when organising a procurement of road transport vehicles, the contracting authority shall take into account the impact of their operation on the energy sector and environment and for this purpose shall evaluate at least the energy consumption and the amount of emissions of carbon dioxide, nitrogen oxides, non-methane hydrocarbons and particulate matters. In turn, the government determined the categories of such road transport vehicles the procurement whereof should be subject to the noted requirements. Public Transport Service Provider when purchasing road transport vehicles shall take into account the effect of the putting into operation thereof on energy consumption and the environment, including CO_2 and noxious air emissions, and, in addition, may take into account also the possibility to operate the vehicle by the fuel having high biofuel blend (above 10%), by pure biofuel or by electric power, if such operation is technically possible and economically justified.

In its turn, in September 2021 the provisions of the **Directive 2019/1161/EU** regarding the procurement targets for the share of clean vehicles were transposed. The Directive defines a "clean vehicle" as follows:

- Clean light-duty vehicle: any car or van meeting the following emission thresholds:
    - until 31 December 2025: no more than 50g/km CO_2 and up to 80% of applicable real driving emission (RDE) limits for NO_x and PN;
    - from 1 January 2026: only zero-emission vehicles.
- Clean heavy-duty vehicle: any truck or bus using one of the following alternative fuels: hydrogen, battery electric (including plug-in hybrids), natural gas (both CNG and LNG, including biomethane), liquid biofuels, synthetic and paraffinic fuels, LPG.

Table 4.7 The minimum (at least) share of clean vehicles in the total number of particular vehicles covered by the public procurement contracts

	September 2021- 2025	2026 - 2030
share of clean light duty vehicles (M1, M2 and N1 categories)	22%	22%
share of clean trucks (N2 and N3 categories)	8%	9%
share of clean urban buses[18]	35%	50%

The mitigation impact due to the implementation of the public procurement is evaluated respectively 11 kt CO_2 eq. in 2025 and 35 kt CO_2 eq. in 2030 and afterwards.

[18] Buses (vehicle category M3) – half of the target to be fulfilled by procuring zero-emission buses

Development of the infrastructure of environmentally friendly public transport (PT) in cities in EU Funds planning period of 2014-2020 is co-financed by the Cohesion Fund within the framework of the NOP "Growth and Employment". The increase of number of environmentally friendly vehicles of PT (trams and buses of M2 and M3 categories) and length of tram lines is on-going. Thus, more effective urban transport infrastructure will be developed promoting the use of PT. These investments result in at least 20 km new and improved tram lines and purchase or upgrade of 123 environmentally friendly buses. The implementation of the projects will be finished in 2023. The mitigation impact due to the implementation of the measure is evaluated respectively 2.5 kt CO_2 eq. in 2025, 3.9 kt CO_2 eq. in 2030 and 5.8 kt CO_2 eq. in 2035.

4.4.3.2 Policies and measures in the WAM projection

The directions of the actions in the WAM projection are:

- further development of alternative fuels and their infrastructure;
- promotion of energy efficient railway;
- development of multi-modal public transport system.

Biomethane production and utilisation. As planned by the NDP2027, in EU Funds planning period of 2021-2027 the target groups of this particular measure are both biomethane producers (particularly upgrade to biomethane quality of biogas produced by processing agriculture sector raw materials) and biomethane consumers. The NDP2027 plans to support investment for the biogas upgrade equipment and the infrastructure to ensure utilisation of biomethane in the transportation sector. The financial support is planned to be provided as the financial instrument with the grant part. The mitigation impact due to the implementation of the measure is evaluated respectively 22 kt CO_2 eq. in 2025 and 74 kt CO_2 eq. in 2030 and afterwards.

Electrification and energy efficiency improvement of railway. Railway electrification is stated as one of the indicative investment projects of the NDP2027. The Specific Objective "To develop a sustainable, climate-resilient, smart, secure and diverse TEN-T infrastructure" plans the measure, objectives of that are construction, reconstruction and renewal of railway infrastructure and improvement of energy efficiency in railway passenger transport.

Latvia's NECP2030 provides to promote the creation of multimodal public transport points to combine the diversity of public transport (road, rail, bicycle). NDP2027 plans the establishment of the multi-modal public transport system having the rail transport as the central element; integration of planned "Rail Baltica" line in the existing transport network of state and municipalities, creating multi-modal passenger centres which will promote reachability of regions, mobility of population and will ensure accessibility. The mitigation impact due to the implementation of the measure related to the railway sector is evaluated respectively 9 kt CO_2 eq. in 2025, 14 kt CO_2 eq. in 2030 and 17 kt CO_2 eq. in 2035.

Table 4.8 Summary of policies and measures in Transport sector

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implement-tation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
Biofuel Blend Obligation*	Transport	CO_2	Low carbon fuels; Increase in renewable energy	Regulatory	Implemented	To ensure growth of the share of RES in the transport sector, on the 1 October 2009 Latvia had introduced the Biofuel Mix Obligation. Mixed biofuels shall correspond to the sustainability criteria.	2010	Ministry of Economics	145	137	230
Excise Tax*	Transport	CO_2	Efficiency improvements of vehicles; Low carbon fuels; Demand management/ reduction	Fiscal	Implemented	The duty is imposed on gasoline, diesel oil, LPG and natural gas. Currently the use of natural gas vehicles is promoted (in the period 01.01.2021-31.12.2026 the reduced rate - around 19% of the base rate – is applied for natural gas). Also unleaded gasoline with 70-85% (volume) of bioethanol mix and pure biodiesel has reduced rate of duty.	1993	Ministry of Finance	NE	NE	NE
Annual taxation of vehicles: cars taxation based on specific CO_2 emissions*	Transport	CO_2	Efficiency improvements of vehicles; Modal shift to public transport or non-motorized transport	Fiscal	Implemented	Currently the annual operation tax, based on the specific CO_2 emissions, is being calculated for the cars firstly registered from 01.01.2009 and for the light duty vehicles (LDV) firstly registered from 01.01.2012. For the cars and LDV with the specific CO_2 emissions up to 50 grams per km zero tax rate is applied. For the older cars and LDV the tax is differentiated based on engine capacity, maximal power of engine and the gross weight of the car. In its turn, for buses with gross weight above 3500 kg and heavy DV with gross weight above 3500 kg the annual operational tax is based on EURO class.	2017	Ministry of Finance, Ministry of Transport	NE	NE	NE
New Passenger Cars Labelling on Fuel Economy Rating*	Transport	CO_2	Efficiency improvements of vehicles; Low carbon fuels	Information; Regulatory	Implemented	The labelling of new cars regarding fuel consumption (litres per 100 km or km per litre) and CO_2 emissions (grams per km).	2003	Ministry of Economics	3.85	7.7	15.5

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implement-tation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
Systematic inspection of the technical conditions of motor vehicles*	Transport	CO_2	Efficiency improvements of vehicles	Regulatory	Implemented	Mandatory annual technical inspections of motor vehicles ensure that only those vehicles that comply with technical and environmental requirements are being allowed to take part in road transport.	1996	Ministry of Transport	3	3.5	3.5
Development of the infrastructure of environmentally friendly public transport (PT) in cities: 2014-2020 EU Funds Programming Period*	Transport	CO_2	Modal shift to public transport	Economic	Implemented	The measure is co-financed by the Cohesion Fund (National Operational Programme) and provides for the increase of number of environmentally friendly vehicles of PT (trams and buses of M2 and M3 categories) and of length of tram lines. Thus, more effective urban transport infrastructure will be developed promoting the use of PT.	2016	Ministry of Transport	2.5	3.9	5.8
Electric Vehicles (EV) Charging Infrastructure Development: EU Funds Programming Period of 2014-2020*	Transport	CO_2	Electric cars	Economic	Implemented	Development of country-wide EV charging infrastructure is supported by the EU ERDF (National Operational Programme). As a result single national level fast charging infrastructure coverage are ensured promoting the development of EV market and increase of EVs in road transport.	2016	Ministry of Transport	39	87	670
Public Procurement: clean vehicles*	Transport	CO_2	Low carbon fuels/electric cars	Regulatory	Implemented	In June 2010 Latvia had transposed the provisions of the Directive (EU) 2009/33/EC, thus the contracting authority, when organising a procurement of road transport vehicles, shall take into account the impact of their operation on the energy sector (energy consumption) and environment (at least carbon dioxide, nitrogen oxides, non-methane hydrocarbons and particulate matters emissions). In turn, in September 2021 the provisions of the Directive 2019/1161/EU regarding the	2010	Ministry of Economics, Ministry of Transport, Ministry of Finance	11	35	35

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implement-tation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
						procurement targets for the minimum (at least) share of clean vehicles in the total number of particular vehicles covered by the contracts were transposed.					
Promotion of Biomethane production and utilisation in transport sector	Transport	CO_2	Low carbon fuels	Economic	Planned	As planned by the NDP2027, in EU Funds planning period of 2021-2027 the target groups of this particular measure are both biomethane producers (particularly upgrade to biomethane quality of biogas produced by processing agriculture sector raw materials) and biomethane consumers. The NDP2027 plans to support investment (financial instrument with the grant part) to ensure utilisation of biomethane in the transportation sector.	2022	Ministry of Economics	22	74	74
Development of Latvian railway network infrastructure	Transport	CO_2	Electric vehicles; Modal shift to public transport	Economic	Planned	Development of railway infrastructure including electrification, is stated as one of the indicative investment projects of the NDP2027. The Specific Objective "To develop a sustainable, climate-resilient, smart, secure and diverse TEN-T infrastructure" of the NDP2027 plans the measure, objectives of that are construction, reconstruction and renewal of railway infrastructure and improvement of energy efficiency in railway passenger transport. Also, creation of multimodal public transport points/centres to combine the diversity of public transport (road, rail, bicycle) having the rail transport as the central element is planned.	2023	Ministry of Transport	9	14	17

* a mitigation action is included in the "with measures" projection.

4.4.4 International bunkers

Policies and measures in the WEM projection

GHG emissions from international transport are not included in the total national GHG emissions hence the PaMs influencing GHG emissions from international aviation and maritime activity are described under a separate section and not under the Transport section.

Latvia has participated in International Maritime organization (IMO) work and effectively implements and applies the conventions adopted within the framework of the IMOs.

During the 70th session of Marine Environment Protection Committee session (MEPC70) in 2016 IMO member states approved a Roadmap for Developing a Comprehensive IMO Strategy on Reduction of GHG emissions from Ships. According to the Roadmap, by 2023 IMO member states should come to an agreement on a final strategy on short, medium, and long-term measures, taking into account the results from the IMO Data Collection System.

In April 2015, an EU regulation was adopted on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport. The regulation took effect 1 January 2018 and applies to ships above 5000 gross tonnage in respect to their CO_2 emissions during their voyages to and from ports in the EU. Regulation was implemented in Latvia by the governmental regulation that came into force in January 2019.

At the IMO a similar mandatory data collection system for fuel consumption, as well as other additional specified data, entered into force on 1 March 2018 and applies to all ships with 5000 gross tonnage and above.

The mandatory data collection system is intended to be the IMO's first step in a three-step approach to decrease GHG emissions from shipping. The second step was to analyse the data collected, which will provide the basis for the third step: further measures to enhance energy efficiency and address GHG emissions from international shipping.

In 2018, IMO adopted an initial strategy on the reduction of GHG emissions from ships, setting out a vision which confirms IMO's commitment to reducing GHG emissions from international shipping and to phasing them out as soon as possible.

The initial strategy represents a framework for Member States, setting out the future vision for international shipping, the levels of ambition to reduce GHG emissions and guiding principles.

The Initial Strategy identifies levels of ambition for the international shipping sector noting that technological innovation and the global introduction of alternative fuels and/or energy sources for international shipping will be integral to achieve the overall ambition. Reviews should take into account updated emission estimates, emissions reduction options for international shipping, and the reports of the Intergovernmental Panel on Climate Change (IPCC). The strategy sets out three levels of ambition:

1. Carbon intensity of the ship to decline through implementation of further phases of the energy efficiency design index (EEDI) for new ships to review with the aim to strengthen the energy efficiency design requirements for ships with the percentage improvement for each phase to be determined for each ship type, as appropriate;
2. Carbon intensity of international shipping to decline to reduce CO_2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008;
3. GHG emissions from international shipping to peak and decline to peak GHG emissions from international shipping as soon as possible and to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008 whilst pursuing efforts towards phasing them out as called for in

the Vision as a point on a pathway of CO_2 emissions reduction consistent with the Paris Agreement temperature goals.

In October 2018, IMO approved a follow-up programme, intended to be used as a planning tool in meeting the timelines identified in the initial IMO strategy. The initial strategy refers to a range of candidate short-, mid- and long term measures that will be considered by IMO. Short-term measures are adopted at MEPC 76 in 2021; mid-term measures could be finalized and agreed between 2023 and 2030; and long-term measures, beyond 2030. Short-term measures include the following new provisions in Annex VI to the MARPOL Convention: (i) Attained Energy Efficiency Existing Ship Index (EEXI); (ii) Annual operational carbon intensity indicator (CII) and CII rating.

Latvia has participated actively in ICAO's work to limit emissions from international aviation traffic. At the ICAO Assembly in October 2016, a global carbon offsetting scheme for international aviation was adopted ("Carbon Offsetting and Reduction Scheme for International Aviation" (CORSIA)). By this decision, aviation became the first industrial sector to have a global market-based measure scheme in place. CORSIA is a market-based mechanism designed to contribute to two global aspirational goals for the international aviation sector: to increase aviation fuel efficiency 2% per year through 2050; and to achieve carbon-neutral growth in the international civil aviation industry after 2020. Under the Scheme, airlines are obligated to cap emissions growth beyond 2020 by buying carbon offsets

Participation in CORSIA offsetting is voluntary during the Pilot Phase (2021-2023) and the First Phase (2024-2026). Latvia is among the nations that have voluntarily participated in the scheme.

As a member of the European Union, Latvia is implementing the EU ETS for aviation. The aviation sector has been part of the EU ETS since 2012. The original legislation covers all flights in and out of the European Economic Area (EEA). However, for 2012-2016, in order to support the development of a global measure by the ICAO for reducing aviation CO_2 emissions, the EU provided a derogation limiting obligations solely to flights within the EEA and to flights within the EEA outermost regions.

In light of the adoption of a Resolution by the 2016 ICAO Assembly on the global measure CORSIA, pending the ICAO's adoption of the relevant CORSIA instruments and subsequent decisions by the EU on the possible implementation of CORSIA in the EU, and to provide continued momentum to the international process, the EU decided in 2017 to extend the current derogation from EU ETS obligations for flights to and from third countries until 31 December 2023, subject to review. The review should consider how to implement the ICAO global measure in Union law through a revision of the EU ETS legislation. The review would take due account of the necessary consistency with EU climate objectives and commitments under the Paris Agreement.

In October 2018, the ICAO Council adopted the Standards and Recommended Practices (SARPs) for CORSIA. As of 1 January 2019, aircraft operators will be required to monitor and report their emissions for CORSIA. To this end, the EU has put in place a legally binding monitoring, reporting and verification (MRV) framework based on the CORSIA SARP and the existing MRV framework under the EU ETS.

4.4.5 Agriculture

4.4.5.1 Regulatory measures

Implementation of the **Nitrates Directive (ND) 91/676/EEC and Water Framework Directive (WFD) 2000/60/EEC** in to national legislation promoted several measures to reduce GHG emissions and indirectly affected ammonia emissions set in the National Emission Ceilings Directive 2001/81/EC which is considered as non-GHG mitigation benefit. Legal norms arising from Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources have been included in Law on Pollution that set base to regulation on protection of water and soil from pollution with nitrates caused by agricultural activity.

The Law sets requirement to the Cabinet of Ministers to regulate the criteria for determination and managing of highly vulnerable territories with increased requirements for the protection of water and soil. Law on Pollution also classifying polluting activities into Categories A, B, and C, considering the quantity and effect or the risk of pollution caused to human health and the environment. In agriculture sector polluting activities requiring a Category A permit are farms for the intensive rearing of pigs and poultry with more than 40 000 places for poultry or with more than 2 000 places for production pigs with weight over 30 kg (with more than 750 places for sows). These farms shall apply the best available techniques to prevent pollution.

The purpose of Law on Environmental Impact Assessment (30 May, 2001) is to prevent or reduce the negative impact of the implementation of the activities of a planning document thereof on the environment. Objects requiring Impact Assessment in agriculture sector are installations for the intensive rearing of pigs or poultry with more than 85000 places for broilers; 60000 places for hens; 3000 places for production pigs (over 30 kilograms); and 900 places for sows.

According to Law on Pollution several requirements regarding agricultural practice and manure spreading were introduced in the Regulations of the Cabinet of Ministers No.834 adopted on 23 December 2014 "Regulations on protection of water and soil from pollution caused by nitrates from agricultural activities" and Regulations of the Cabinet of Ministers No.829 adopted on 23 December 2014 "Specific requirements for carrying of polluting activities in animal sheds". Requirements included in Regulations that could be linked to mitigation measures of GHG emissions are described below.

Crop fertilisation plans

Crop fertilisation planning is based on the knowledge of physical and chemical properties of soil and involves performing soil tests, designing a fertilisation plan and its practical implementation as well as calculating the balance of N, which plays an important role in efficient farming. The main purpose is to ensure optimum crop fertilisation, increase crop growth and yields, meanwhile decreasing the amount of unabsorbed N results in economic and environmental losses, as N_2O emissions are produced. In Latvia, if the managed agricultural land in vulnerable territories is larger than 20 ha and more, or farmer grows vegetables, potatoes, fruit trees or fruit bushes in an area of 3 ha and more in vulnerable territories, farms need to prepare fertilisation plans based on N content in manure and requirements for certain crop fertilization and expected yield. A crop fertilization plan must also be developed for those farms in the territory of Latvia that professionally use plant protection products.

Management of nitrate use at vulnerable territories

Management of nitrates in vulnerable territories and requirements for pollution decrease caused by nitrates from agricultural sources include restriction for nitrogen usage, reduction of nitrogen leaching and indirect N_2O emissions. The limit of nitrogen usage is 170 kg of nitrogen from manure and digesters per hectare. Restrictions on the spread of organic fertilizers amount also are determined to the entire territory of Latvia.

Requirements of manure management and spreading

An appropriate manure management system allows storing manure in an environment-friendly way, avoiding/reducing N_2O emissions. The measure consists of renovating/improving an existing manure management system or constructing a new system. Requirements refer to farms with more than 10 AU (animal units), and 5 AU in vulnerable territories.

The main target is to increase nutrient uptake efficiency and decrease nutrient run-off and N_2O emissions. Incorporation of manure promote denitrification and decrease direct and indirect N_2O emissions.

4.4.5.2 Common Agricultural Policy driven economic measures

The latest reform of the Common Agricultural Policy (CAP) introduced the green payment, to deal with the environmental impacts of agriculture. The green measures include crop diversification, maintaining permanent grasslands and introduction of ecological focus areas. In Latvia, the current programming period until 2020, also envisaged financial support for introducing mitigation measures of GHG emissions with a focus on climate and environmentally friendly agricultural practices or the green component.

Crop diversification is designed to encourage a diversity of crops on holdings which have arable land. Land that is considered as Ecological Focus Area may include: buffer strips, nitrogen fixing crops, and other. Buffer strips promote minimizing of nitrogen leaching, however introduction of leguminous plants on arable land led to the fertility improvement of the farm's agro system by fixing atmospheric nitrogen.

The purpose of Law on Agriculture and Rural Development (1 May, 2004) is to provide a legal basis for agricultural development and to specify sustainable agricultural and rural development policy in accordance with the CAP of the European Union.

According to the law and resulting regulations – Regulations of the Cabinet of Ministers No.126 (10.03.2015) and Regulations of the Cabinet of Ministers No. 598 adopted on 30 September 2014, Regulations of the Cabinet of Ministers No. 600 adopted on 30 September 2014 following mitigation measures of GHG emissions are implemented in Latvia.

Introduction of leguminous plants on arable land

Growing leguminous plants considerably increase the accumulation of symbiotically fixed atmospheric nitrogen in soil. Legumes can fix up to 300 kg N ha^{-1} and this N amount is equivalent obtained by means of fertilisers. In addition, legumes provide the aftercrop with the N accumulated in soil, which reduces the amount of N to be applied in the next season.

Legumes are able to enrich soil with N. Interest in growing legumes grows with rising N fertilizer prices. The replacement of the N fertilizer with legumes depends on (1) the quantity of legume returned to the soil, (2) the content of symbiotically fixated N in the residues, (3) the availability of N residue from legume to the subsequent crops and (4) the amount of residue incorporated to soil.

However, legumes have higher N_2O and CO_2 emissions compared to cereals and grasses. N_2O can be released from N during the growing season, but larger amounts are released from the decomposition after cropping season. The main aim of the measure is to expand arable land and increase number of farms where leguminous plants are included in crop rotation thus contributing to atmospheric nitrogen fixation and reduction of application of inorganic nitrogen fertilizers.

Organic farming

This measure includes environmentally friendly farming methods with low influence on nature, improved cropland management and reduction of synthetic fertiliser use. Benefits of this measure are decreased nitrate leaching and increased biodiversity. The state ensures support to organic farmers through subsidies. The main aim of the measure is also to promote transition of small and medium-sized conventional dairy farms to the organic farming system and extend grazing season, thus facilitating low emission dairy farming.

Maintenance of amelioration systems

The measure involves the renovation of existing amelioration systems or the construction of new systems in wet arable lands. An amelioration system allows draining excessive water from the area of the root of a crop; as a result, oxygen can access the root as well as an optimum moisture regime sets in. The soil structure which is improved by amelioration system ensures better fertiliser absorption and less nitrogen run-off, thus affecting N_2O emissions.

Promotion of biomethane production

The purpose of measure is to use bioresources (mainly or only manure) to produce biogas which is burnt to generate electrical and/or thermal energy. By implementing this measure, the manure is efficiently used, odour is reduced and high-quality fertilizer called digestate is obtained. In agriculture, animal waste is a good raw material for the process, same as food waste, energy crops and crop residues. An anaerobic digester can be built to serve one single farm or collect waste from neighbouring farms. There are a couple of differences in the technology process. Solution depends on the type of manure on the farm, climate zone, investment opportunities and existing equipment. The main aim of the measure is to ensure the installation of biogas production and biogas purification (biomethane production) facilities on farms that do not yet have biogas production and purification facilities.

4.4.5.3 Market driven economic measures

Precision fertiliser application

Precision fertiliser application is a set of activities that involve the use of the newest technologies (the GPS, the GIS, sensors, software, applications, specially equipped fertiliser spreaders, etc.) in planning fertiliser application rates and in fertiliser spreading. This measure leads to fertiliser savings which results in reduction of N_2O emissions. The main advantages of this activity are (1) increase in yields providing optimum crop fertilisation, (2) financial saving by ensuring that field areas with sufficient crop nutrients are not over-fertilised, (3) environmental benefits by N_2O emissions decrease and decrease in nitrate leaching. The implementation of measure can reach fertilizer savings to 15-80%. The main aim of the measure is to expand arable land and increase number of medium-sized crop and livestock farms were fertilisation planning and practical implementation that is based on knowledge about agrochemical properties of soil have not been done previously.

Integrated farming

Regulations of the Cabinet of Ministers No. 1056 adopted on 15 September 2009 set requirements for integrated farming in Latvia. The implementation of integrated farming is set of activities that involve rotation of crops, soil agrochemical tests, development of crop fertilization plans, fields monitoring and limited crop protection chemicals. This measure is based on environmentally friendly cultivation technology and optimal use of fertilizers by ensuring crop health, yield and soil fertility. The rules specify the farming and storage requirements for farmers who want to label products, certifying that they have been grown using integrated breeding methods. Farmers who grow the products using the integrated farming method must register in The State Plant Protection Service.

Precision livestock feeding

Feed planning is a set of concerted activities: acquiring information about livestock needs (productivity tests), designing feed recipes, doing feed tests and preparing the feed. Feed planning means optimising the content of nutrients in the feed according to what is needed for animals, i.e., according to their sex, age and reproductive status. This measure reduces the negative impact on the environment, as a balanced diet and animal performance influence the pace of production of N from manure, which, in its turn, affects N_2O emissions.

The largest and widest rural consultancy enterprise covering the whole territory of Latvia – Latvian Rural Advisory and Training Centre provides program "LĒDA". The program also offers a Rational Evaluator function that displays economic information, key nutrient relationships, and timetables for specific feed levels to show if these feed rate components have reached their goal values. The cattle feeding plans are developed by a livestock consultant using the computer program "LĒDA". The program offers: catering plan for animal groups; catering plan for each animal individually; information of feed needed during the period; advice on ways to buy a meal plan and feed; formation on expected milk yield or live weight gain; fodder costs per litter of milk production; lactation curve.

Information regarding mitigation actions and their effects in Agriculture sector is summarized in Table 4.9.

Table 4.9 Summary of policies and measures in Agriculture sector

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
Management of nitrate vulnerable territories*	Agriculture	N_2O	Reduction of fertilizer/manure use on cropland	Regulatory	Implemented	Restriction for nitrogen usage, reduction of nitrogen leaching. Water protection against pollution caused by nitrates from agricultural sources. Rules for management of vulnerable zones.	2014	Ministry of Agriculture (National government)	NE	NE	NE
Crop fertilization plans*	Agriculture	N_2O	Reduction of fertilizer/manure use on cropland	Regulatory	Implemented	Restriction for nitrogen usage, reduction of nitrogen leaching.	2012	Ministry of Agriculture (National government)	NE	NE	NE
Requirements for manure storage and spreading*	Agriculture	N_2O	Improved animal waste management systems	Regulatory	Implemented	Specify the requirements for storing of manure and spreading of manure.	2014	Ministry of Agriculture (National government)	NE	NE	NE
Increase of land area under organic farming relative to total agricultural land*	Agriculture	CH_4, N_2O	Other activities improving cropland management (Agriculture)	Economic	Implemented	Farming methods with environmentally friendly influence on nature, reduction of synthetic nitrate use and leaching, increased biodiversity. The state support for organic farmers through subsidies. National Development Plan of Latvia for 2014-2020 (NDP2020) set the plan to increase organic agriculture area to 15% by 2030 in relation to total agricultural area. The National Development Plan 2014–2020 is hierarchically the highest national-level medium-term planning document.	2014	Ministry of Agriculture (National government)	NE	NE	NE
Extensified crop rotation*	Agriculture	N_2O	Other activities improving cropland	Economic	Implemented	Support to use green manure in crop rotation	2015	Ministry of Agriculture	NE	NE	NE

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
			management (Agriculture)					(National government)			
Support for evolving of precision agriculture technologies in crop growing farms to reduce nitrogen use*	Agriculture	N_2O	Other activities improving cropland management (Agriculture)	Economic, Voluntary Agreement	Implemented	Measure is associated with promoting of nitrogen fertilizer use reduction and consequently with reduction of nitrogen amount in the run-off. This will reduce N_2O emissions from use of synthetic fertilizers and indirect N_2O emissions from soils. Voluntary/negotiated agreements, because financial support for farmers is available, if a farmer develop precision agriculture technologies in the farm with the aim to reduce GHG emissions.	2014	Ministry of Agriculture (National government)	NE	NE	NE
Maintenance of amelioration systems*	Agriculture	N_2O	Other activities improving cropland management (Agriculture)	Voluntary Agreement	Implemented	Financial support for reconstruction or renovation of a drainage system is defined in Regulations of the Cabinet of Ministers No. 600 (2014), that establishing procedures for receiving payments for investments in the development of agricultural and forestry infrastructure. The measure is implemented in extensively managed croplands on mineral soils, where high yields are not possible due to unfavourable conditions during spring time, which are caused by wearing of existing drainage systems. This will reduce indirect N_2O emissions from N leaching and runoff from agricultural land.	2014	Ministry of Agriculture (National government)	NE	NE	NE

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
Support for evolving of precision livestock feeding approach in cattle breeding farms to develop feeding plans and promote high quality feed use to increase the digestibility*	Agriculture	CH_4, N_2O	Improved livestock management (Agriculture)	Economic, Voluntary Agreement	Implemented	The main aim of measure is to promote high quality feed use for animals to increase the digestibility and reduce CH_4 emissions. Voluntary/negotiated agreements, because financial support for farmers is available, if a farmer develop precision livestock feeding technologies in the farm with the aim to reduce GHG emissions.	2015	Ministry of Agriculture (National government)	NE	NE	NE
Introduction of legumes into conventional crop rotations*	Agriculture	N_2O	Other activities improving cropland management (Agriculture)	Economic, Voluntary Agreement	Implemented	Measure is associated with establishing procedures for receiving payments for climate and environmentally friendly farming practices, including legumes in crop rotation. Financial support is defined in Regulations of the Cabinet of Ministers No. 126 (2015).	2015	Ministry of Agriculture (National government)	NE	NE	NE
Requirements for the protection of soil and water from agricultural pollution caused by nitrates*	Agriculture	N_2O	Reduction of fertilizer/manure use on cropland (Agriculture)	Regulatory	Implemented	Restriction for nitrogen usage, reduction of nitrogen leaching. Reduction of non-direct N2O emissions	2014	Ministry of Agriculture (National government)	NE	NE	NE
Promote organic dairy farming and extended grazing (low emission dairy farming)	Agriculture	CH_4; N_2O	Improved livestock management	Economic; Voluntary/negotiated agreements	Planned	The main aim of the measure is to promote transition of small and medium-sized conventional dairy farms to the organic farming system and extend grazing season thus facilitating low emission dairy farming.	2022	Ministry of Agriculture (National government)	NE	NE	NE
Support for fertilisation planning	Agriculture	N_2O	Reduction of fertilizer/manure use on cropland	Economic; Voluntary/negotiated agreements	Planned	The main aim of the measure is to expand arable land and increase number of medium-sized crop and livestock farms were fertilisation	2022	Ministry of Agriculture (National government)	NE	NE	NE

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
						planning and practical implementation that is based on knowledge about agrochemical properties of soil have not been done previously.					
Promote inclusion of leguminous plants in crop rotation for nitrogen fixation	Agriculture	N_2O	Other activities improving cropland management	Economic; Voluntary/negotiated agreements	Planned	The main aim of the measure is to expand arable land and increase number of farms where leguminous plants are included in crop rotation thus contributing to atmospheric nitrogen fixation and reduction of application of inorganic nitrogen fertilizer.	2022	Ministry of Agriculture (National government)	NE	NE	NE
Promote and support for precision application of inorganic nitrogen fertilisers	Agriculture	N_2O	Other activities improving cropland management	Economic; Voluntary/negotiated agreements	Planned	The main aim of the measure is to expand arable land and increase number of farms were precision technologies for application of inorganic nitrogen fertilisers are used in the planning of fertiliser schemes and spreading.	2022	Ministry of Agriculture (National government)	NE	NE	NE
Promote and support for direct incorporation of organic fertilisers into the soil	Agriculture	CH_4; N_2O	Improved animal waste management systems	Economic; Voluntary/negotiated agreements	Planned	The main aim of measure is to expand arable land where organic fertilisers are directly incorporated into the soil thus promoting more efficient use of organic fertilisers.	2022	Ministry of Agriculture (National government)	NE	NE	NE
Promote feed ration planning and improvement of feed quality	Agriculture	CH_4; N_2O	Improved livestock management	Economic; Voluntary/negotiated agreements	Planned	The main aim of measure is to increase number of cows whose feed rations are balanced for reduced crude protein level without loss in milk production. As wee as to increase number of cows	2022	Ministry of Agriculture (National government)	NE	NE	NE

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
						whose are fed with feed with high digestible energy.					
Maintenance and modernization of amelioration systems on agricultural land	Agriculture	CH_4; N_2O	Other activities improving cropland management	Economic; Voluntary/negotiated agreements	Planned	The main aim of the measure is to increase arable land area with improved and maintained amelioration systems, thereby reducing N leaching and run-off from agriculture.	2022	Ministry of Agriculture (National government)	NE	NE	NE
Promote the production of biogas and biomethane and the use of biomethane	Agriculture	CH_4	Improved animal waste management systems	Economic; Voluntary/negotiated agreements	Planned	The main aim of the measure is to ensure the installation of biogas production and biogas purification (biomethane production) facilities on farms that do not yet have biogas production and purification facilities.	2022	Ministry of Agriculture (National government)	NE	NE	NE

* a mitigation action is included in the "with measures" projection.

4.4.6 Waste Management

The most important document that describes the Latvian progress and planned policies on waste management is "Waste management Plan 2021-2028", approved by the CoM Regulation. The waste management system is one of the most important directions of the EU and Latvian legislation on environmental protection. In general, this is governed by the Latvian more than 40 laws and regulations, including the Waste Management Law, the Law on Regulators of Public Utilities, the Municipalities Law and the Natural Resources Tax Law. The Regulations of the Cabinet of Ministers, which have an effect on GHG emissions within the waste sector:

- Regulations of the Cabinet of Ministers No. 1032 adopted on 27 December 2011 "Regulations Regarding the Construction of Landfill Sites, the Management, Closure and Re-cultivation of Landfill Sites and Waste Dumps ";
- "Regulations Regarding Separate Waste Collection, Preparation for Re-use, Recycling and Material Recovery";
- Regulations of the Cabinet of Ministers No. 485 adopted on 21 June 2011 "Procedures for the Management of Certain Types of Hazardous Waste";
- Regulations of the Cabinet of Ministers No. 401 adopted on 24 May 2011 "Requirements for Incineration of Waste and Operation of Waste Incineration Plants";
- Regulations of the Cabinet of Ministers No. 470 adopted on 21 June 2011 "Mining waste management procedures".

In order to promote recycling of waste and reuse of products Natural Resources Tax Law sets the tax rate for waste disposal (Table 4.10).

Table 4.10 The tax rates for waste disposal from 1 January 2017

Waste type	Unit	Year 2017 (euros)	Year 2018 (euros)	Year 2019 (euros)	Year 2020 (euros)	Year 2021 (euros)	Year 2022 (euros)	Year 2023 (euros)
Municipal and industrial waste, which are not hazardous	tonne	25.00	35.00	43.00	50.00	65.00	80.00	95.00
Hazardous waste (also industrial hazardous waste)	tonne	45.00	50.00	55.00	60.00	70.00	85.00	100.00

*Measure is included "with additional measures" projection

Information regarding mitigation actions and their effects in Waste sector is summarized in Table 4.11.

Table 4.11 Summary of policies and measures in Waste sector

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
Increase biological waste preparation for treatment to 210 000 t per year	Waste management/waste	CH_4	Reduced landfilling (Waste management/waste) 210 000 t per year	Economic, planning	Planned	Increase biological waste preparation for treatment. Implementation of separate collection of biological waste. Waste management Plan 2021-2028.	2022	MEPRD (National government)	NE	NE	52
Increase preparation of Refused derived fuel to 130 000 t per year*	Waste management/waste	CH_4	Reduced landfilling (Waste management/waste) 130 000 t per year	Economic, planning	Planned	Increase preparation of refused derived fuel (RDF). Develop installations for RDF productions. Waste management Plan 2021-2028.	2022	MEPRD (National government)	IE	IE	IE
Increase biological waste treatment to 110 000 t per year*	Waste management/waste	CH_4	Reduced landfilling (Waste management/waste) 110 000 t per year	Economic, planning	Planned	Increase biological waste treatment capacity. Waste management Plan 2021-2028.	2022	MEPRD (National government)	IE	IE	IE

*The estimation of PaM mitigation impact is included in PaM - *Increase biological waste preparation for treatment to 210 000 t per year*.

4.4.7 Industrial Processes and Product Use

Implementation of BAT is the PAM which is particularly important one for GHG emissions reduction in IPPU. Requirements set in Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) are overtaken with national Law on Pollution. Law on Pollution states principal framework for the implementation of BAT. Namely, conclusions on the best available techniques are a description of the BAT specified by the EC for the sector of industry or polluting activity, as well as the emission levels associated with the BAT, consumption levels of raw materials, monitoring of the polluting activity and the remediation measures of the site applicable to the polluting activity. Operator of pollution activity shall use the conclusions regarding the BAT as the basis. The Law's section 21 "BAT and Choice Thereof in Respect of Category A Polluting Activities" states that (1) BAT are applicable to the most effective and progressive technological and operational methods development stage in which is shown the actual applicability of specific methods in order to prevent and – in cases where prevention is impossible – reduce emissions and the impact on the environment as a whole, and they are intended in order to specify the basic principle for the calculation of emission limits, (2) the concept "techniques" shall include the technology used and the way in which the installation is designed, built, maintained, operated or decommissioned, (3) techniques are available if they are economically and technologically substantiated and, irrespective of whether they have previously been used or introduced in production in Latvia, it is possible to implement them in a specific industrial sector, taking into account the relevant costs and advantages, (4) techniques are the best if they include such technologies and methods by the application of which it is possible to ensure the highest level of environmental protection at large. The responsible authority - the State Environmental Service - is checking the operators` applications for receiving polluting activity permits, including the operator's proposal regarding the choice of BAT.

F-gases

The most important EU regulations affecting the amount of F-gases are:

- The Regulation (EU) No 517/2014 of The European Parliament and of the Council on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006;
- The Directive 2006/40/EC of the European Parliament and of the Council relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC.

Also, technical development has affected the development of emissions. The F-gas Regulation follows two tracks of action:

- improving the prevention of leaks from equipment containing F-gases. Measures comprise: containment of gases and proper recovery of equipment; training and certification of personnel and of companies handling these gases; labelling of equipment containing F-gases; reporting on imports, exports and production of F-gases. Several bans on the placing in the market, maintenance and service products and equipment containing HFCs with high GWPs are requirements of the Regulation;
- avoiding F-gases in some applications where environmentally superior alternatives are cost-effective. Measures include restrictions on placing in the market and use of certain products and equipment containing F-gases.

Latvia's GHG projections, policies and measures are compiled according to the Regulation of the Cabinet of Ministers No.563 on special restrictions and prohibitions regarding activities with ozone-depleting substances (ODS) which was in force until 1 November 2021 and F-gases set requirements for F-gas operators according to the Regulation (EU) No 517/2014. National Regulation No.563 was related to containment, use, recovery and destruction of certain F-gases. These rules accompany the provisions relating to the labelling of products and equipment containing these gases, to the notification of information, to prohibitions on commercialisation, as well as to the training and certification of personnel and enterprises. The Regulation No.563 prescribed specific restrictions and prohibitions on the handling of ODS and F-gases, as well as the responsible institutions for implementation of the European Parliament and of the Council Regulation (EC) No.1005/2009 and Regulation (EC) No.842/2006.

The new CoM Regulation No. 704 "Requirements for operations with ozone-depleting substances and fluorinated greenhouse gases" which replaces CoM Regulation No. 563 was adopted on 1 November 2021. The new CoM Regulation No. 704 was developed with the aim to improve the accuracy and quality of F-gases data and to implement more precisely Regulation (EU) No 517/2014.

Solvent Use

Law on Pollution laying down the procedures by which emission of volatile organic compounds from installations, in which organic solvents are used, shall be limited. Legal norms arising from the following directives have been included in this Law:

- Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control),
- Directive 2004/42/EC of the European Parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC,
- CoM Regulation No.186 adopted on 2 April 2013 "Regulations to limit emission of volatile organic compounds from installations, in which organic solvents are used" contains legal norms arising from Directive 2010/75/EU and Regulations of the Cabinet of Ministers No.231 adopted on 3 April 2007 "Regulations regarding the limitation of emissions of volatile organic compounds from certain products" contains legal norms arising from Directive 2004/42/EC.

Table 4.12 Summary of policies and measures in IPPU sector

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
Reduce emissions of fluorinated greenhouse gases*	Industry/industrial processes	HFCs, SF_6	Replacement of fluorinated gases by other substances (Industrial Processes)	Regulatory	Implemented	Prevent and minimise emissions of fluorinated GHG. Bans on the placing on the market, maintenance and service products and equipment containing HFCs with high GWPs.	2015	MEPRD (National government)	NE	NE	NE

* a mitigation action is included in the “with measures” projection.

4.4.8 Land use, Land use Change and Forestry

Rural Development Programme 2014-2020 (hereinafter RDP 2014-2020) is the most important tool contributing to the climate change mitigation in LULUCF sector. Rural Development Strategic Plan 2023-2027 was approved on 11 November 2022. The climate change mitigation measures in LULUCF sector are designated on the base of consultations with non-governmental organizations and taking into account national circumstances, in order to pursue the economic development, especially in sensitive areas of agriculture sector and contribution to implementation of the biological diversity and water protection targets. RDP 2014-2020 sets three long-term strategic rural development policy goals:

- competitiveness of agriculture;
- sustainable management of natural resources and climate policies;
- balanced development in rural areas.

Following climate change mitigation measures are included in the RDP 2014-2020:

- restoration and modernization of amelioration systems in cropland;
- support to introduction and promotion of integrated horticulture;
- growing of legumes;
- maintenance of biodiversity in grasslands (conversion of cropland to grassland);
- restoration and modernization of amelioration systems in forest land;
- afforestation and improvement of stand quality in naturally afforested areas;
- regeneration of forest stands after forest fires and other natural disturbances and preventive measures in forests;
- improvement of ecological value and sustainability of forest ecosystems by support to pre-commercial thinning.

There are several regulations adopted for implementation of the measures listed in the RDP 2014-2020, particularly:

- Regulations of Cabinet of Ministers No. 171 from 7 April 2015 on assignment, administration and supervising of the European Union support for improvement of environment, climate and rural landscape during the 2014-2020 planning period;

- Regulations of Cabinet of Ministers No. 455 from 4 August 2015 on assignment, administration and supervising of the European Union support for implementation of the "Investments into increase of the forest area and vitality of forests" measure;

- Regulations of Cabinet of Ministers No. 381 from 14 June 2016 on assignment, administration and supervising of the state and European Union support for implementation of the activity "Establishment and improvement of equipment and communication systems for monitoring of forest health, fires, pests and diseases" within the scope of sub-measure "Support for preventive forest measures and regeneration of forest in case of forest fires, natural disturbances and other extreme events" implemented under as a part of the measure "Investments in forest development and improvement of forest vitality".

Quantitative effect of the measures is estimated using tier 1 and tier 2 methods, and these estimates are highly uncertain, while positive effect is proved. Further development of the methodologies will lead to reduction of the uncertainties and might increase or reduce the proposed effect.

Information regarding mitigation actions and their effects in LULUCF sector is summarized in Table 4.13.

Table 4.13 Summary of policies and measures in LULUCF sector

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
Restoration and modernization of amelioration systems in cropland	LULUCF	CO_2	Retaining of high productivity in croplands (Other LULUCF)	Economic	Planned	The measure will be implemented in croplands, where high yields are possible due to amelioration and wearing out of the amelioration systems would lead to reduction of carbon input in soil with plant residues. After reconstruction of amelioration systems fields will be maintained as a conventional production systems with considerable input of organic material.	2022	MoA	99	364	694
Establishment of new orchards	LULUCF	CO_2	Increase of carbon stock in cropland	Economic	Planned	The measure is aimed of maintenance of area of the orchards. Without financial support area of orchards would decrease resulting in reduction of carbon stock in cropland.	2022	MoA	4	15	28
Undergrowth plants in winter crops	LULUCF	CO_2	Increase of soil carbon stock in cropland	Economic	Planned	More efficient utilization of nutrients and increase of carbon input into soil due to prolongation of vegetation period and increased removals CO_2 in plants.	2022	MoA	35	127	243
Green fallow before winter crops	LULUCF	CO_2	Increase of carbon stock in soil in soil	Economic	Planned	Increased carbon stock in soil due to increase of efficient vegetation period and bigger carbon input in soil. The measure is efficient in case if fallows are used before winter crops.	2022	MoA	200	733	1399

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
Legumes in cereals dominant crop rotations	LULUCF	CO_2	Increase of carbon stock in soil	Economic	Planned	Increase of carbon stock in soils due to increase of carbon input into soil with residual biomass; reduction of N_2O emissions in agriculture sector.	2022	MoA	35	242	462
Restoration and modernization of amelioration systems in forest land	LULUCF	CO_2; CH_4	Improved forest management, maintaining of high carbon input and low CH_4 emissions	Economic	Planned	Restoration of malfunctioning amelioration systems and preventive maintenance of amelioration ditches, which secures continuously high removals of CO_2 in following forest generation and low level of CH_4 emissions from soil.	2022	MoA	108	284	549
Afforestation of nutrient poor soils in grassland and cropland	LULUCF	CO_2	Improvement of forest management	Economic	Planned	Increase of carbon stock in soil, living and dead biomass pools by afforestation of croplands and grasslands.	2022	MoA	86	189	360
Pre-commercial thinning	LULUCF	CO_2	Improved forest management	Economic	Planned	Support to pre-commercial thinning of forest stands to contribute to additional increment during 20 years period; growing stock in 40-60 years old coniferous stands (thinned at 20-40 years age) and research trials is by 15-25% higher than in non-thinned stands. Support to forest thinning will result in rapid and significant increase of all carbon pools in thinned stands.	2022	MoA	252	884	1688
Restoration of forests after	LULUCF	CO_2	Improved forest management	Economic	Planned	Support to reconstruction and regeneration of forest stands	2022	MoA	15	30	57

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
natural disturbances						damaged by natural disturbances like wind, snow, water and fire. The measure will reduce forest regeneration period and quicker increase of all carbon pools including the total potential of CO_2 removals by proper selection of species.					
Restoration of former peat extraction sites	LULUCF	CO_2	Restoration of degraded peatlands	Economic	Planned	Abandoned peat extraction sites are considerable source of GHG emissions. Afforestation, establishment of perennial energy crops in combination with extraction of the remaining peat layer with following flooding or rewetting of areas, where growing of perennial crops for biomass production is not possible, may lead to significant reduction of GHG emissions.	2022	MEPRD	132	485	926
Cropland drainage*	LULUCF	CO_2; CH_4	Other activities improving cropland management (Other LULUCF)	Economic	Implemented	Restoration of malfunctioning drainage systems in cropland. The measure has to be implemented in extensively managed croplands on mineral soils, where high yields are not possible due to unfavourable conditions during spring time, which are caused by wearing of existing drainage systems. After reconstruction of drainage systems fields are	2015	MoA	6.1	6.1	NE

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
						returned to a conventional production systems with considerable input of organic material in soil due to higher yields and crop rotations. Only CO_2 is considered due to the fact that country specific methods for accounting of reduction of CH_4 are not elaborated and use of the default IPCC values might lead to considerable overestimation of positive impact of the measure.					
Production of legumes*	LULUCF	CO_2	Increase of soil carbon stock (Other LULUCF)	Economic	Implemented	Support to use of legumes as green manure and fodder in crop rotation. Reduces GHG emissions in LULUCF and agriculture sector.	2015	MoA	66.0	66.0	NE
Extensified crop rotation*	LULUCF	CO_2	Improved management of organic soils (Other LULUCF)	Economic	Implemented	Support to use green manure in crop rotation. Measure is aimed to increase carbon input into soil in conventional production systems and increase of soil carbon stock.	2015	MoA	33.0	33.0	NE
Drainage in forest*	LULUCF	CO_2	Retaining high productivity in forests (Other LULUCF)	Economic	Implemented	Restoration of malfunctioning forest drainage systems. The measure avoids deterioration of the growth conditions and ensures continuously high growth rate in drained forests avoiding at the same time increase of CH_4 emissions.	2015	MoA	15.0	15.0	NE

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
Afforestation*	LULUCF	CO_2	Afforestation and reforestation (LULUCF)	Economic	Implemented	Support to afforestation of low valued farmlands. The measure ensures increase of carbon stock in living and dead biomass, and HWP in long term. Soil carbon stock changes and GHG emissions from soil are not considered due to lack of scientific substantiation of the GHG emission reduction.	2016	MoA	48.0	48.0	NE
Forest thinning*	LULUCF	CO_2	Improve forest management (Other LULUCF)	Economic	Implemented	Support to pre-commercial thinning of forest stands. According to the study results (the research programme on impact of forest management measures on GHG emissions and CO_2 removals 2011-2015) early thinning in coniferous stands, as it is done now according to national regulations, contributes to additional increment during 20 years period; respectively, growing stock in 40-60 years old coniferous stands and research trials is by 15-25% higher than in non-thinned stands. Private forest owners are not motivated to implement early thinning due to the fact that is not resulting in direct incomes, therefore, this measure is often avoided to save	2016	MoA	28.0	28.0	NE

Name of policy or measure	Sectors affected	GHGs affected	Objective and/or activity affected	Type of instrument	Status of implementation	Brief description	Start year of implementation	Implementing entity	Estimate of mitigation impact, kt CO_2 eq.		
									2025	2030	2035
						money. Support to forest thinning will result in rapid and significant increase of carbon stock.					
Forest regeneration*	LULUCF	CO_2	Improving forest management (Other LULUCF)	Economic	Implemented	Support to reconstruction and regeneration of low valued and diseased forest stands after natural disturbances. The measure speeds up increase of living and dead biomass carbon pool, and increase the total potential increase of carbon pools by selection of tree species with high growth potential.	2016	MoA	18.0	18.0	NE

* a mitigation action is included in the “with measures” projection.

4.4.9 Energy taxation

Energy taxation is one of a key instruments of the national energy and climate policy. The important milestone of the taxation policy had been Latvia's joining the EU and the transposition of the Directive 2003/96/EC on the Community framework for the taxation of energy products and electricity.

Energy taxation consists of several elements:

- taxation of electricity;
- taxation of fuels;
- taxation of emissions (CO_2 and air polluting noxious emissions).

Taxation of electricity

Taxation levied on electricity has been introduced starting from the 01.01.2007. Implementation of the taxation related to the transposition of the Directive 2003/96/EC (according the Directive 2004/74/EC, Latvia had two years transition period, up to the 1 January 2007).

The procedure is prescribed by the Electricity Tax Law. The basic rate is 1.01 EUR/MWh (not changed after the adoption of the Law). It shall be taxable electricity supplied to an end user, as well as electricity, which is supplied for own consumption, except for the cases specified in the Law. Tax shall apply to entities who are engaged in the generation, distribution, supply, selling of electricity as well as purchasing electricity in spot exchange. The exemption applies for the autonomous producers, who generate and consume electricity for their own needs and fulfil the following requirements: the total generation capacity does not exceed 2 MW, and energy resources taxable with excise duty, coal taxable with the nature resource tax or electricity taxable with the electricity tax is used for the generation of the electricity.

The following tax exemptions had been made for the electricity by the basic version of the Law:

- electricity obtained from (i) renewable energy resources, (ii) in hydro power plants; (iii) in CHP plants complying with the efficiency criteria specified in the regulatory enactments;
- electricity used for the following purposes: (i) electricity generation, (ii) generation in CHP mode, (iii) the carriage of goods and public carriage of passengers, including on rail transport and in public carriage of passengers in towns, (iv) household users, (v) street lighting services.

The Amendments of the Law, in force from the 1 January 2017, had cancelled the most part of tax exemptions stated above. Currently three exemptions are in force:

- the carriage of goods and public carriage of passengers, including on rail transport and in public carriage of passengers in towns;
- electricity consumed by household users;
- electricity consumed for street lighting services.

Taxation of fuels utilized for energy production

Excise duty on natural gas. The excise duty on natural gas is the most important duty taking into account the natural gas is the dominating fossil fuel in energy production in Latvia. The taxation was in force for the short period in 2010 (from 1 January 2010 till 31 August 2010) and had been re-introduced from the 1 July 2011. Sections 6[1]& 15[1] of the Law on Excise Duties determine the rates of duty. In the period from 1 July 2011 till 31 December 2013 the unified rate (17.07 EUR per 1000 m^3) was applied`. Starting from the 1 January 2014 the differentiated rates are applied, reduced rate promotes the industrial production and agriculture raw materials pre-treatment processes, as well as greenhouses, industrial scale poultry holdings (poultry houses) and incubators.

Table 4.14 Excise Tax rates for Natural Gas utilized for energy production

Aim of utilisation of natural gas (NG)	Rate, EUR	
	2014 - 31 March 2017	from 1 April 2017
Utilised as fuel	17.07 EUR/1000 m^3	1.65 EUR/1 MWh highest calorific value (HCF)
Utilised as fuel to provide (see note 1) (i) industrial production processes as well as other processes related to production, (ii) the operation of technological equipment for agriculture raw materials pre-treatment, (iii) necessary climate condition in the premises of industrial production and agriculture sector's raw materials pre-treatment (iv) utilised by entities placed in industrial parks	5.65 EUR/1000 m^3	0.55 EUR/1 MWh, HCF
Utilised to provide heating of greenhouses, industrial scale poultry holdings (poultry houses) and incubators (see note 2)	Exempted	Exempted till 30 April 2020 From the 1 May 2020 - 0.55 EUR/1 MWh, HCF.
Used for other purposes (not as fuel), utilised in two ways (including processes of chemical reduction, electrolytic and metallurgy processes)	Exempted	
Amount of NG used by the operator of NG transmission, storage and distribution system for the technological needs of NG supply, including losses during supply[19]	Exempted	

Notes:
(1) As the industrial production it is stated the production processes which corresponds to the Annex I, part C "Manufacturing industry", chapters 10.-22 and 24-33 of the Regulation No 1893/2006; the agriculture sector raw materials pre-treatment processes correspond to the Annex I, part A "Agriculture, Forestry and Fishery", section 01.63 of the given Regulation.
(2) includes the production processes which corresponds to the Annex I, part A, sections 01.13, 01.19, 01.25, 01.28, 01.47

Excise duty on oil products. Sections 5 &14 of the Law on Excise Duties determine the rates of duty for mineral oils and their substitutes utilised for heat energy production. There are:

- stable rate for residual fuel oil - the current rate is in force from the 01.01.2007;
- the rate for kerosene and diesel (gas oil), if used for heat energy production, was increased from the 1 July 2010 and in the period until 30 June 2021 it was stable, from the 1 July 2021 the rate is slightly increased.

The exempt is made for the oil products utilised for electricity production and for production in CHP mode.

The oil gasses and other hydrocarbons, if supplied to persons who use them as heating fuel or in gas furnaces and other equipment (not as transport fuel), are exempted from the duty as well.

Duty on coal, coke and lignite (brown coal). The procedure of taxation applicable for these fuels is prescribed by the Natural Resources Tax Law. The taxation was introduced starting from the 1 January 2007 (the basic rate was 0.1565 EUR/GJ or 4.27 EUR/ton if information of specific heating value was not available). The current rate, in force from the 1 January 2020, is 0.76 EUR/GJ or 21.3 EUR/ ton if information of specific heating value of coal is not available. Up to the 31 December 2019 zero tax rate had been stated for coal, coke and lignite utilised for electricity production and in CHP mode.

[19] At the same time, there is stated by the Natural Resources Tax (Section 14) the following tax rate shall be applied for the volume of natural gas pumped into geological structures (as underground natural gas storage) in the current tax period - 0.0143 EUR for pumping 100 m3 of natural gas. This type of taxation has been introduced starting from 01.01.2006.

Table 4.15 Taxation on oil products utilized as fuels for energy production

Fuel	Rate, EUR per 1000 litres				
	On 30 June 2010	1 July 2010-31 March 2017	from 1 April 2017	from 1 January 2020	From 1 July 2021
residual fuel oil	15.65	15.65	15.65	15.65	15.65
kerosene and diesel (gas oil)	21.34	56.91	56.91	56.91	60
oil products with at least 5% mix of rapeseed oil or biodiesel (produced in Latvia or imported from EU member state)	21.34	21.34	21.34	21.34	cancelled
"pure" biodiesel or "pure" paraffinic diesel from biomass					21

Taxation of fuels utilized in transport sector

Law on Excise Duties establishes procedure by which duty shall be imposed both on gasoline and diesel oil and on natural gas as well as on biofuels (see the Law's sections indicated above).

The increase of tax rates for gasoline and diesel took place, the change during last 10 years is presented in the Table 4.16 below.

In its turn, currently the use of natural gas vehicles is promoted. The taxation of natural gas was introduced starting from the 1 July 2010. The reduced rate for natural gas - 1.91 EUR per MWh – is stated for the period 1 January 2021 -31 December 2025. From the 1 January 2026 tax rate of 10 EUR per MWh will be applied.

From the 1 February 2021 equal tax rate are applied to all biodiesels which are fully produced from biomass as well as to paraffinic diesel produced from biomass.

Table 4.16 Excise duties for fuels utilised in transport sector

Fuel	Duties, EUR per 1000 litres				
	2011	2015	2018-2019	1 January 2020 – 31 January 2021	From 1 February 2021
Unlead gasoline	382.75	411.21	476	509	509
Unlead gasoline with 70-85% (volume) of bioethanol produced from agriculture origin raw materials	114.83	123.36	30% of the base rate (if mixed in Latvia or imported from EU member state)		360
Lead gasoline	426.86	455.32	594	594	594
Diesel oil (including diesel oil with any mix of biodiesel)	332.95 233.35 (30% mix, cancelled from 1 January 2015)	332.95	372	414	414
Pure rapeseed biodiesel	0	0	0 (if produced in Latvia or imported from EU member state)		330
Another pure biodiesel and paraffinic diesel produced from biomass	332.95	332.95	372	414	330
Oil gasses and other hydrocarbons (EUR per 1000 kg)	128.06	161	244	285	285

Fuel	Duties, EUR per 1000 litres				
	2011	2015	2018-2019	1 January 2020 – 31 January 2021	From 1 February 2021
Natural gas (EUR per 1 MWh, highest calorific value)	99.6 EUR per 1000 m^3		9.64	9.64	1.91 (01.01.2021-31.12.2025) 10 (from 01.01.2026)

Emissions taxation

The procedure of emissions taxation is prescribed by the Natural Resources Tax Law. The policy is to promote the internalization of external costs.

The subject of CO_2 emissions taxation is such CO_2 emitting activities (installations) which correspond to EU ETS activities however the amount of the activity (installation) is below the threshold defined for inclusion in EU ETS. The tax shall not be paid for the emissions of CO_2 which emerges (i) while using RES, (ii) from the installations participating in EU ETS. The CO_2 emissions taxation was introduced from the 1 July 2005 as the national measure. In the period from 1 January 2017 till 31 December 2019 the tax rate was 4.5 EUR per ton of CO_2 emissions. From the 1 January 2020 tax rate per ton of CO_2 emission was 9 EUR. This rate is raised up to 12 EUR (in 2021) and 15 EUR (from the 1 January 2022) per ton of CO_2 emissions.

Taxation on noxious air polluting emissions creates synergy with CO_2 taxation and have an impact on reduction of PM_{10}, SO_2, NO_x NH_3, H_2S and other non-organic compounds which have non-GHG mitigation benefit, like reduced emissions of other pollutants or health and welfare benefits.

The subject of taxation is person which has a duty to receive a polluting activity permit or certificate. The taxable are emissions of PM_{10} (75 EUR/ton), CO (7.83 EUR/ton), NH_3, H_2S and other non-organic compounds (18.50 EUR/ton), SO_2, NO_x, VOC, C_nH_m (85.37 EUR/ton), heavy metals and vanadium[20] (1138.30 EUR/ton). Rates until 2021 are indicated in the brackets. Amendments, adopted in 2020, have increased the rate for the following emissions:

- PM_{10} (2021 – 105 EUR/ton, 2022 – 120 EUR/ton, from 2023 – 135 EUR/ton);
- NH_3, H_2S and other non-organic compounds (2021 – 50 EUR/ton, 2022 – 70 EUR/ton, from 2023 – 90 EUR/ton);
- SO_2, NO_x (2021 - 125 EUR/ton, 2022 – 140 EUR/ton, from 2023 – 160 EUR/ton).

As the general principle, the household sector are not taxpayers of emission taxes (as the general principle, the taxpayer shall be a person who has an obligation to obtain a pollution permit or register a category C (lower) polluting activity. In dominating cases the capacity of combustion equipment in household sector is below the threshold and the household sector might be taxpayer only in a specific cases).

4.4.10 Policies and measures no longer in place

The climate policies and measures developed over the past years are well-established. Most of the policy documents mentioned in the NC7 have been renewed for next planning period. Policies and measures implemented have been adapted and strengthened over time.

The general policies of NC7 are still in place. For particular measures focus point has been specified, at the same time general objectives of the measures remain.

[20] Cd, Ni, Sn, Hg, Pb, Zn, Cr, As, Se, Cu and their compounds recalculated for the relevant metal; V_2O_5 recalculated to vanadium

4.4.11 Information on minimization of adverse impacts

Latvia reports the information on minimization of adverse impacts in accordance with Article 3, paragraph 14 in line with paragraphs 23-25 of the Annex to decision 15/CMP.1. Parties included in Annex I that are in the position to do so, shall incorporate information on how they give priority, in implementing their commitments under Article 3, paragraph 14, to the 6 actions, based on relevant methodologies referred to in paragraph 11 of decision 31/CMP.1.

Comprehensive description of Latvia's approach to minimizing adverse social, environmental and economic impacts on developing countries, in accordance with the reporting guidelines for supplementary information is available in 2022 Submission in chapter 15 "Information on minimization of adverse impacts in accordance with Article 3, Paragraph 14".

References

- Alternatīvo degvielu attīstības plāns 2017.-2020.gadam (Alternative Fuels Development Plan for 2017-2020, in Latvian): http://polsis.mk.gov.lv/documents/5893
- ALTUM ("Development finance institution Altum", Joint Stock Company: Loans for energy efficiency in business sector, in Latvian): https://www.altum.lv/lv/pakalpojumi/uznemumiem/aizdevumi-uznemumu-energoefektivitatei/aizdevumi-uznemumu-energoefektivitate/
- Annexes to the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions https://eur-lex.europa.eu/resource.html?uri=cellar%3A91ce5c0f-12b6-11eb-9a54-01aa75ed71a1.0001.02/DOC_2&format=PDF
- AS "Sadales tīkls" (power distribution system operator information on smart metering, 10th December 2021, in Latvian): https://sadalestikls.lv/lv/preses-relizes/relize/sadales-tikls-iedzivotaji-arvien-biezak-izmanto-vieda-skaititaja-datus-sava-elektribas-paterina-analizei
- Būvniecības valsts kontroles birojs (State Construction Control Bureau of Latvia, in Latvian): (i) List of municipalities implementing EMS: https://www.bvkb.gov.lv/lv/pasvaldibas;; (ii)Voluntary agreements: https://www.bvkb.gov.lv/lv/brivpratiga-vienosanas; (iii) Mandatory procurement of electricity: https://www.bvkb.gov.lv/lv/elektroenergijas-obligata-iepirkuma-mehanisma-uzraudziba-un-kontrole
- Cabinet of Ministers Ordinance No 335 (18.05.2021) on Emissions Allowances Allocation for 2021-2025: List of Installations and Allowances (in Latvian): https://likumi.lv/ta/id/323330
- Cabinet of Ministers Regulation No 563 (12.07.2011) on special restrictions and prohibitions regarding activities with ozone-depleting substances and fluorinated greenhouse gases (Noteikumi Nr563 Noteikumi par īpašiem ierobežojumiem un aizliegumiem attiecībā uz darbībām ar ozona slāni noārdošām vielām un fluorētām siltumnīcefekta gāzēm) in Latvian, available at https://likumi.lv/doc.php?id=233736
- Cabinet of Ministers Regulation No 704 (01.11.2021) on requirements for operations with ozone-depleting substances and fluorinated greenhouse gases (Noteikumi Nr704 Prasības darbībām ar ozona slāni noārdošām vielām un fluorētām siltumnīcefekta gāzēm) in Latvian, available at https://likumi.lv/ta/id/327117-prasibas-darbibam-ar-ozona-slani-noardosam-vielam-un-fluoretam-siltumnicefekta-gazem
- Cabinet of Ministers Regulation No 186 (02.04.2013) on how to limit emission of volatile organic compounds from installations, in which organic solvents are used" (Kārtība, kādā ierobežojama gaistošo organisko savienojumu emisija no iekārtām, kurās izmanto organiskos šķīdinātājus) contains legal norms arising from Directive 2010/75/EU, in Latvian, available at https://likumi.lv/doc.php?id=256096
- Cabinet of Ministers Regulation No 231 (03.04.2007) on the Limitation of Emissions of Volatile Organic Compounds From Certain Products" (Noteikumi par gaistošo organisko savienojumu emisijas ierobežošanu no noteiktiem produktiem) contains legal norms arising from Directive 2004/42/EC, in Latvian, available at https://likumi.lv/doc.php?id=155476
- Ceļu satiksmes drošības direkcija (Road Traffic Safety Directorate): e-mobi charging network (in Latvian): http://www.e-transports.org/index.php/features-mainmenu-47/team
- Central Statistical Bureau Republic of Latvia: https://data.stat.gov.lv/pxweb/en/OSP_PUB/START__NOZ__EN__ENA/ENA020
- Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources, 1991. Available: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A31991L0676.
- Dabas resursu nodokļa likums (Natural Resources Tax Law, consolidated version in Latvian): https://likumi.lv/doc.php?id=124707
- Darbības programma "Izaugsme un nodarbinātība", ES fondu 2014.-2020.plānošanas periods (national Operational Programme "Growth and Employment" of the EU Funds planning period of 2014-2020, consolidated version in Latvian): https://www.esfondi.lv/upload/EK%20programmas/dp-30.06.2021.pdf
- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy, 2000. Available: https://ec.europa.eu/environment/water/water-framework/index_en.html
- Directive 2001/81/EC of the European Parliament and of the Council on national emission ceilings for certain atmospheric pollutants, 2001. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32001L0081

- Elektroenerģijas nodokļa likums (Electricity Tax Law, consolidated version in Latvian): https://likumi.lv/ta/id/150692
- Elektroenerģijas tirgus likums (Electricity Market Law, consolidated version in Latvian): http://likumi.lv/doc.php?id=108834
- Emisiju kvotu izsolīšanas instruments: Projektu konkursi (national Emissions Allowances Auctioning Instrument: Project Open Tenders, in Latvian): https://www.varam.gov.lv/lv/projektu-konkursi-0
- Energoefektivitātes likums (Energy Efficiency Law, consolidated version in Latvian): http://likumi.lv/doc.php?id=280932
- Environmental Policy Strategy 2014-2020 (Vides Politikas Pamatnostādnes 2014-2020.gadam)". Approved by the Cabinet of Ministers, 26 March 2014: https://likumi.lv/ta/id/265262-par-vides-politikas-pamatnostadnem-2014-2020-gadam, in Latvian
- Ēku energoefektivitātes likums (Law on the Energy Performance of Buildings, consolidated version in Latvian): http://likumi.lv/doc.php?id=253635
- Klimata pārmaiņu finanšu instruments: Projektu konkursi (national Climate Change Financial Instrument: Project Open Tenders, in Latvian): https://www.varam.gov.lv/lv/projektu-konkursi
- Latvian Environment, Geology and Meteorology Centre (LEGMC): EU ETS web-page (in Latvian): https://videscentrs.lvgmc.lv/lapas/emisijas-kvotu-tirdzniecibas-sistema
- Latvia's National Energy and Climate Plan 2021-2030 (NECP2030): https://energy.ec.europa.eu/system/files/2020-04/lv_final_necp_main_en_0.pdf; http://polsis.mk.gov.lv/documents/6645
- Latvia's National Development Plan 2014–2020: http://www.pkc.gov.lv/sites/default/files/images-legacy/NAP2020%20dokumenti/NDP2020_English_Final.pdf
- Latvia's National Development Plan 2021-2027: https://pkc.gov.lv/sites/default/files/inline-files/NAP2027__ENG.pdf
- Latvia's National Reform Programme of Latvia for the Implementation of the "Europe 2020" Strategy. Approved by the Cabinet of Ministers, 26 April 2011: https://ec.europa.eu/info/sites/info/files/2019-european-semester-national-reform-programme-latvia_en.pdf
- Latvijas Lauku Attīstības Programa 2014.-2020.gadam (Latvia Rural Development Programme for 2014-2020, consolidated version in Latvian): https://www.zm.gov.lv/zemkopibas-ministrija/statiskas-lapas/latvijas-lauku-attistibas-programma-2014-2020-gadam-?id=23436#jump
- Likumi (Legal Acts of the Republic of Latvia): https://likumi.lv/
- Likums "Par akcīzes nodokli' (Law "On Excise Duties", consolidated version in Latvian): https://likumi.lv/ta/id/81066
- Likums "Par piesārņojumu" (Law on Pollution, in Latvian): : https://likumi.lv/doc.php?id=6075
- MEPRD. Annual Informative Reports "Use of Auctionings Revenues", years 2021-2019: http://varam.gov.lv/lat/fondi/ekii/likumdosana, in Latvian
- MEPRD. Order No. 265 (21 October 2016) "Strategy for the Use of Emissions Allowances Auctioning Instrument": http://varam.gov.lv/lat/fondi/ekii/likumdosana/, in Latvian
- MEPRD. The European Economic Area and the Norwegian Financial Mechanisms, https://www.varam.gov.lv/en/european-economic-area-and-norwegian-financial-mechanisms
- Ministry of Environmental Protection and Regional Development (MEPRD, 2020). "Informative Report on the Results of the Climate Change Financial Instrument Operation in Year 2019": https://www.varam.gov.lv/sites/varam/files/content/files/Fondi/Fondi%20un%20ES/varamzino_kpfi_darbiba_2019.pdf, in Latvian
- Strategy for Sustainable Use of Peat Resources 2020-2030 (Par Kūdras ilgtspējīgas izmantošanas pamatnostādnēm 2020.-2030. gadam). Approved by the Cabinet of Ministers, 24 November 2020: https://likumi.lv/ta/id/319013-par-kudras-ilgtspejigas-izmantosanas-pamatnostadnem-20202030-gadam
- Strategy of Latvia for the Achievement of Climate Neutrality by 2050 https://ec.europa.eu/clima/sites/lts/lts_lv_en.pdf
- Sustainable Development Strategy of Latvia until 2030, https://pkc.gov.lv/sites/default/files/inline-files/LIAS_2030_en_1.pdf

PROJECTIONS

5. PROJECTIONS AND THE TOTAL EFFECTS OF POLICIES AND MEASURES

5.1 Projections

The projections presented in this chapter correspond to the Latvia`s report on policies and measures and projections that submitted to EC on 11 March 2022. The scenarios underlying the emission projections have incorporated new insights with regard to economic and demographic developments, sector developments, fossil fuel prices, the CO_2 price and policies when compared with the previous projection of the NC7. Recent statistics were also taken into account.

Last historical year for GHG emissions is 2020 from Latvia's National Inventory Report 1990-2020 which was submitted to the UNFCCC secretariat on 14 April 2022. Improvements and corrections planned for the next inventory submission are provided in Chapter 10 Recalculations and improvements in GHG inventory mentioned above.

GHG emissions are projected for years 2025, 2030, 2035 and 2040 in Latvia. The projections are based on the policies and measures approved by the Latvia parliament and government up to the year 2020, which means that it is a projection "with measures" (WEM). In addition to this scenario, there are also projected emissions with planned policies and measures. These are the measures which are principally announced by the high-level strategic development documents but still the implementation of these measures has not been elaborated in details yet and legal regulations have not been adopted but are expected to be adopted and implemented from a specific future year onwards. This is the scenario "with additional measures" (WAM).

In addition to the projections, four sensitivity scenarios have been assessed for the Energy, Agriculture, Waste (including wastewater) and LULUCF sectors to evaluate the impact of GDP and population growth rate as well as changes in sectorial assumptions.

GHG emission projections of Latvia up to 2040 are based upon the long-term macroeconomic projection developed by the MoE. The baseline socio-economic scenario projects that the growth rates of exports and the manufacturing industry will remain based mainly on both the increased competitiveness of Latvian producers and the growing external demand. According to this scenario it is expected that GDP, similarly to private consumption, will increase during 2020-2040. The population in Latvia is expected to continue to decrease by 8.8% from 1.908 to 1.740 million in 2020-2040 (Table 5.1).

Table 5.1 The main macroeconomic parameters applied for projecting GHG emissions

	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Population, thousand	2668.14	2500.58	2381.72	2249.72	2120.50	1986.10	1907.68	1849.68	1799.00	1760.97	1738.07
Gross domestic product, constant prices, MEUR (2015)	NE	11133.20	14353.45	21243.45	20727.04	24572.13	26651.53	30503.73	34277.10	38217.14	42153.43
Total primary energy consumption, PJ	329.95	193.02	160.65	189.67	188.94	178.89	178.67	176.56	174.08	168.43	158.54
			1996-2000	**2001-2005**	**2006-2010**	**2011-2015**	**2016-2020**	**2021-2025**	**2026-2030**	**2031-2035**	**2036-2040**
Private consumption, annual changes per period, %	-	-	-	8.0	1.5	3.3	1.1	3.6	2.4	2.2	2.0
GDP growth, annual changes per period, %	-	-	5.2	8.2	-0.01	3.5	1.7	3.8	2.4	2.2	2.0

Total GHG emissions (without LULUCF, with indirect CO_2) under WEM scenario will decrease by 2.6% up to 2030 and 20.0% up to 2040, compared to 2020 (Table 5.2). Compared to 1990, total GHG emissions (without LULUCF, with indirect CO_2) are expected to decrease by 60.7% in 2030 and by 67.7% in 2040. The projected emissions change trends differ across different sectors.

The Energy sector (including Transport) will account for the largest share amounting to 65.0% of total projected GHG emissions in 2030, followed by the Agriculture sector with its share amounting to 22.2%, IPPU with 8.2% share, Waste sector with 4.4% and indirect CO_2 emissions with 0.1%. In 2040, the share of Agriculture, IPPU and Waste sectors will increase in total GHG emissions, constituting 28.0%, 10.1% and 5.0% respectively. At the same time the contribution of the Energy sector to total emissions will decrease.

Table 5.2 Actual and projected GHG emissions per sector under WEM scenario, kt CO_2 eq.

Sector	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Energy excluding transport	16453.98	7473.87	5184.16	5024.56	5229.75	4027.42	3671.75	3991.83	3860.62	3554.52	3160.54
Transport	3040.40	2104.71	2213.69	3112.87	3278.25	3150.63	3108.60	2992.79	2763.48	2399.04	1597.02
IPPU	655.98	227.13	286.55	371.16	749.44	791.23	868.15	870.70	836.72	827.83	845.62
Agriculture	4985.80	2004.23	1678.46	1793.20	1878.76	2158.16	2250.88	2215.64	2261.66	2272.41	2339.64
LULUCF	-12300.85	-14745.99	-11754.19	-5830.39	-1879.51	189.49	646.57	1946.97	4703.73	4439.99	5219.29
Waste	732.09	638.53	696.91	626.08	665.73	575.91	547.25	507.51	451.85	429.71	418.18
Indirect CO_2	40.41	32.03	24.78	21.35	16.27	17.04	13.10	12.93	11.84	9.97	9.40
Gas	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
CO_2 emissions without net CO_2 from LULUCF	19661.40	9133.78	7081.47	7810.47	8554.09	7262.10	6994.11	7286.11	6940.77	6325.03	5196.95
CO_2 emissions with net CO_2 from LULUCF	6259.44	-6741.08	-5815.80	892.17	5557.43	6216.77	6235.31	7951.59	10267.29	9371.84	9015.62
CH_4 emissions without CH_4 from LULUCF	3623.78	2179.95	1885.83	1870.14	1805.89	1772.69	1718.06	1679.19	1639.28	1576.07	1552.70
CH_4 emissions with CH_4 from LULUCF	4178.85	2736.88	2449.24	2379.40	2335.87	2412.01	2500.35	2355.87	2410.07	2368.19	2363.84
N_2O emissions without N_2O from LULUCF	2583.07	1117.44	1026.99	1138.28	1220.54	1403.93	1473.61	1382.17	1421.28	1443.58	1474.66
N_2O emissions with N_2O from LULUCF	3129.12	1689.38	1606.67	1716.94	1807.71	1999.44	2096.69	1986.98	2027.69	2044.64	2064.13
HFCs	NO, NA	17.13	64.60	105.20	214.05	254.52	248.91	220.64	162.65	128.47	126.32
SF_6	NO, NA	0.17	0.88	3.78	7.35	10.12	11.94	10.36	10.36	10.36	10.36
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
PFC_s	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Indirect CO_2	40.41	32.03	24.78	21.35	16.27	17.04	13.10	12.93	11.84	9.97	9.40
Total (without LULUCF)	25868.25	12448.48	10059.78	10927.87	11801.93	10703.36	10446.63	10578.47	10174.34	9483.52	8360.99
Total (with LULUCF)	13567.40	-2297.51	-1694.41	5097.49	9922.42	10892.85	11093.20	12525.44	14878.06	13923.51	13580.27
Total (without LULUCF, with Indirect CO_2)	25908.66	12480.51	10084.56	10949.22	11818.20	10720.39	10459.72	10591.40	10186.17	9493.49	8370.39
Total (with LULUCF, with Indirect CO_2)	13607.81	-2265.48	-1669.63	5118.83	9938.69	10909.89	11106.30	12538.37	14889.90	13933.48	13589.67

Compared to the base year 1990, CO_2 emissions (without LULUCF, without indirect CO_2) are projected to decrease by 64.7% in 2030 and by 73.6% in 2040. CH_4 emissions are projected to decrease by 54.8% in 2030 and by 57.2% in 2040, compared to 1990. N_2O emissions are projected to decrease by 45.0% in 2030 and by 42.9% in 2040, compared to 1990 (Figure 5.1).

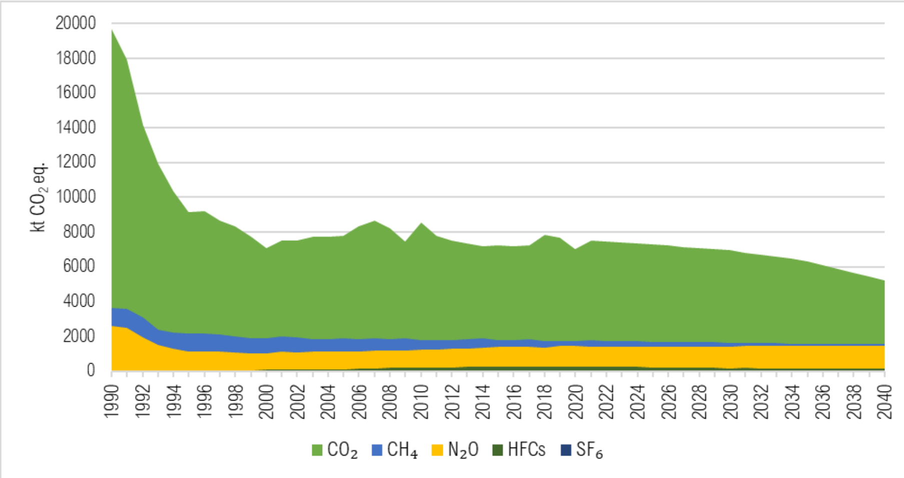


Figure 5.1 GHG emissions by gas according to the latest emission inventory (1990-2020) and the WEM projection (up to 2040)

The Figure 5.2 shows GHG emissions distribution between ETS and non-ETS sectors. In 2020, the ETS share from total GHG emissions has decreased by 6.7%, compared to 2005, and it was 19.3%. The share of the non-ETS sector was 80.7% in 2020. The projection of the ETS sector will decrease by 13.0%, compared to 2005, while in the non-ETS sector 4.8% decrease is projected in 2030 against 2005. The share of the non-ETS sector is projected as 75.6% in 2030.

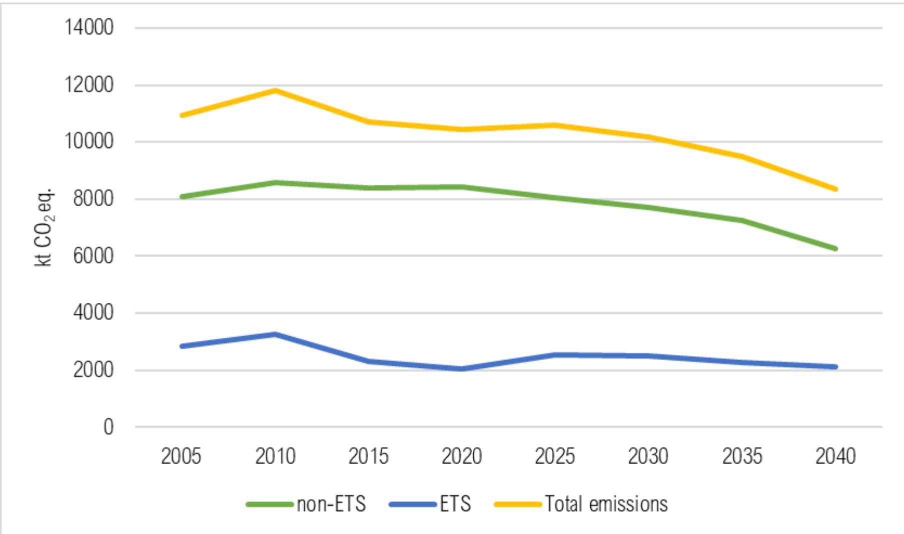


Figure 5.2 GHG emissions according to the latest GHG emission inventory (2005-2020) and the WEM projection (up to 2040) in the EU ETS and non-ETS sectors

Figure 5.3 reveals that part of the non-ETS sector emissions in 2020 is composed by Transport (36.8%), Agriculture (26.7%), and Other non-ETS Energy (20.1%), Residential sector (6.5%), Waste (6.5%) and non-ETS IPPU sector (3.3%). The WEM scenario projects that in 2030 the greatest part of the non-ETS sector emissions will be from Transport sector (35.8%), then Agriculture sector with 29.4%, Other non-ETS Energy sector (including Energy industries, Manufacturing industries and construction, Commercial/Institutional, Agriculture/Forestry/Fishing etc.) – 19.7%, Residential and Waste sector accordingly 6.3% and 5.9% and non-ETS IPPU sector with 2.9% of total non-ETS emissions. In 2030, share of Agriculture will increase by 2.7% against 2020 from total non-ETS emissions. The share of Transport, Other non-ETS Energy, non-ETS IPPU, Residential and Waste sector in the total non-ETS sector emissions will almost not change up to 2030.

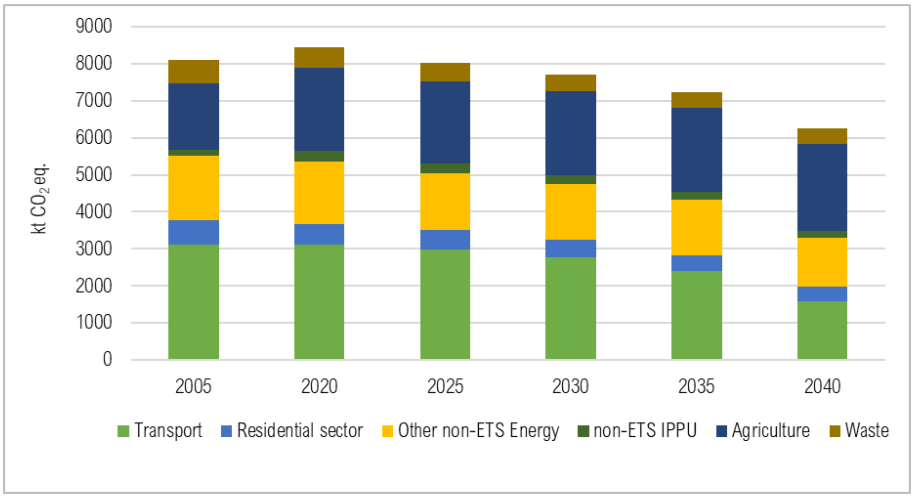


Figure 5.3 GHG emissions in the non-ETS sector by category based on the latest GHG inventory for year 2005 and 2020 and the WEM projection (up to 2040)

Projected GHG emissions for the WAM scenario, calculation based on the implementation results of additional policies and measures, are seen Total GHG emissions (without LULUCF, with indirect CO_2) under WAM scenario will decrease by 6.7% up to 2030 and 25.3% up to 2040, compared to 2020. Compared to 1990, total GHG emissions (without LULUCF, with indirect CO_2) are expected to decrease by 62.3% in 2030 and by 69.9% in 2040.

Table 5.3 shows the projected emissions under the WAM scenario by sectors and the difference with the WEM scenario.

Total GHG emissions (without LULUCF, with indirect CO_2) under WAM scenario will decrease by 6.7% up to 2030 and 25.3% up to 2040, compared to 2020. Compared to 1990, total GHG emissions (without LULUCF, with indirect CO_2) are expected to decrease by 62.3% in 2030 and by 69.9% in 2040.

Table 5.3 Actual and projected GHG emissions per sector under WAM scenario, kt CO_2 eq.

Sector	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Energy excluding transport	16453.98	7473.87	5184.16	5024.56	5229.75	4027.42	3671.75	3946.56	3765.42	3387.08	3060.50
Transport	3040.40	2104.71	2213.69	3112.87	3278.25	3150.63	3108.60	2853.40	2578.26	2224.27	1431.79
IPPU	655.98	227.13	286.55	371.16	749.44	791.23	868.15	870.70	836.72	827.83	845.62
Agriculture	4985.80	2004.23	1678.46	1793.20	1878.76	2158.16	2250.88	2144.44	2136.90	2133.17	2174.74
LULUCF	-12300.85	-14745.99	-11754.19	-5830.39	-1879.51	189.49	646.57	1514.21	3838.22	3574.48	4437.78
Waste	732.09	638.53	696.91	626.08	665.73	575.91	547.25	507.51	434.94	355.13	287.73
Indirect CO_2	40.41	32.03	24.78	21.35	16.27	17.04	13.10	12.40	11.06	9.51	8.82
Gas	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
CO_2 emissions without net CO_2 from LULUCF	19661.40	9133.78	7081.47	7810.47	8554.09	7262.10	6994.11	7117.10	6677.59	6004.20	4950.72
CO_2 emissions with net CO_2 from LULUCF	6259.44	-6741.08	-5815.80	892.17	5557.43	6216.77	6235.31	7349.83	9138.60	8185.50	7987.88
CH_4 emissions without CH_4 from LULUCF	3623.78	2179.95	1885.83	1870.14	1805.89	1772.69	1718.06	1673.15	1613.10	1484.58	1399.52
CH_4 emissions with CH_4 from LULUCF	4178.85	2736.88	2449.24	2379.40	2335.87	2412.01	2500.35	2349.83	2383.89	2276.70	2210.66
N_2O emissions without N_2O from LULUCF	2583.07	1117.44	1026.99	1138.28	1220.54	1403.93	1473.61	1301.36	1288.55	1299.87	1313.46
N_2O emissions with N_2O from LULUCF	3129.12	1689.38	1606.67	1716.94	1807.71	1999.44	2096.69	1906.16	1894.96	1900.94	1902.93
HFCs	NO, NA	17.13	64.60	105.20	214.05	254.52	248.91	220.64	162.65	128.47	126.32
SF_6	NO, NA	0.17	0.88	3.78	7.35	10.12	11.94	10.36	10.36	10.36	10.36
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
PFC_s	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Indirect CO_2	40.41	32.03	24.78	21.35	16.27	17.04	13.10	12.40	11.06	9.51	8.82
Total (without LULUCF)	25868.25	12448.48	10059.78	10927.87	11801.93	10703.36	10446.63	10322.60	9752.25	8927.49	7800.38
Total (with LULUCF)	13567.40	-2297.51	-1694.41	5097.49	9922.42	10892.85	11093.20	11836.82	13590.46	12501.97	12238.16
Total (without LULUCF, with Indirect CO_2)	25908.66	12480.51	10084.56	10949.22	11818.20	10720.39	10459.72	10335.01	9763.30	8937.00	7809.21
Total (with LULUCF, with Indirect CO_2)	13607.81	-2265.48	-1669.63	5118.83	9938.69	10909.89	11106.30	11849.22	13601.51	12511.49	12246.98

Total GHG emissions (without LULUCF, with indirect CO_2) under the WAM scenario in 2030 are projected to decrease by 4.2%, compared to WEM scenario, but in 2040 emissions are projected to decrease by 6.7%. The additional GHG emission mitigation measures under the WAM scenario allow a significant reduction of projected emissions mainly in the Transport sector. Thus, in 2030 under the WAM scenario emissions in the Transport sector are projected to decrease by 6.7% and in 2040 by 10.3% than in the respective years under the WEM scenario.

The main reason for the decrease is wider biofuel and electricity use. In addition, the WAM scenario envisages energy efficiency improvement support programmes for residential, commercial and industry sectors, as well as electricity production by utilising RES slightly increases, compared to WEM scenario, due to additional solar PV and wind power capacities.

Agriculture is the other sector revealing emissions reduction under the WAM scenario. Reduction compared to the WEM scenario is 5.5% in 2030 and 7.0% in 2040.

In any of the sectors the trends in the projected emission changes under the WEM and WAM scenario are different as well as the range of the applied additional measures and impacts. Projected emission changes are discussed in detail in the following sections on analysis of projections.

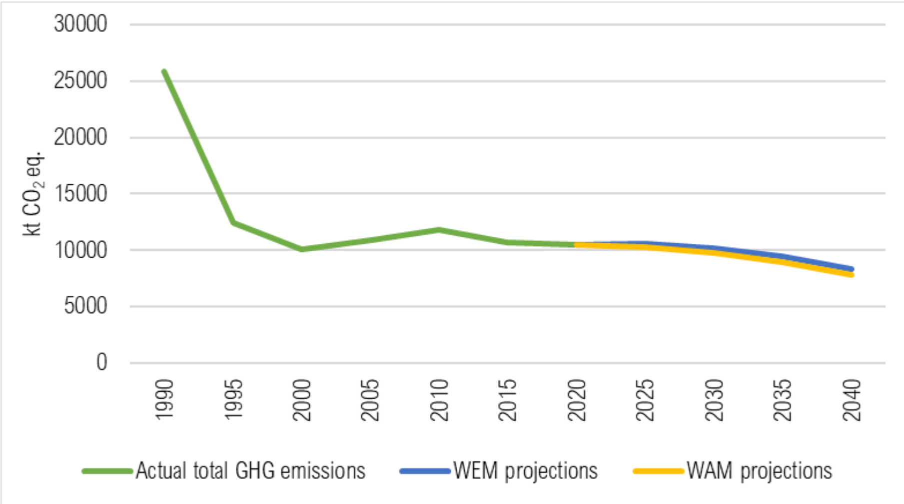


Figure 5.4 Actual GHG emissions and comparison of WEM and WAM projections

GHG projections reported in NC8 are based on the latest available information about development trends and plans in different GHG inventory sectors. Compared to projections in NC7 (see Figure 5.5) with present projections, in NC8 emissions are projected to be 16.6% lower in 2030 by 16.2%. Projections in NC8 are lower for all sectors, except for IPPU, where GHG emissions in 2030 are projected to be higher by 2.5% than in NC7. The slightest difference is in the Energy (excluding Transport) sector where GHG emissions in 2030 are projected to be only by 5.0% lower than in NC7. In other sectors emissions are projected to be lower by 15-33% for 2030 in NC8, compared with those in NC7. Further information about projections of precursors emissions is reported in Annex 1 of NC8 (Latvia's Fifth Biennial Report to the UNFCCC - section VI "Projections").

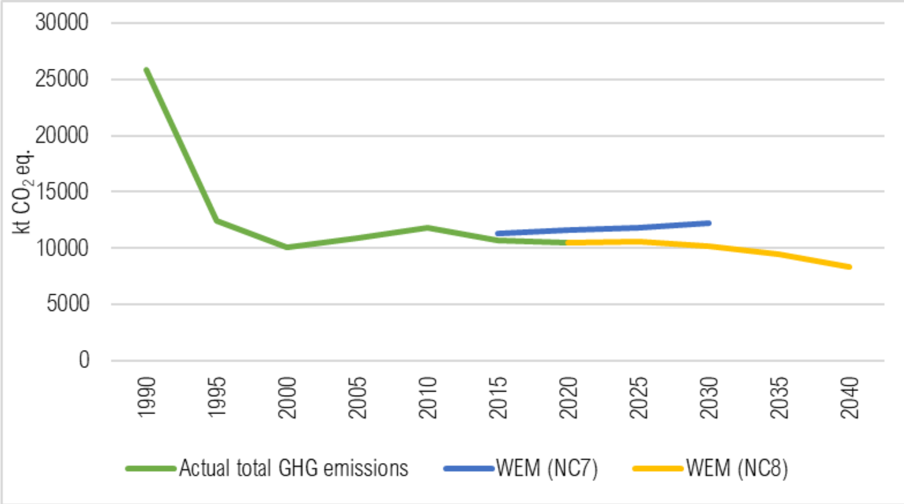


Figure 5.5 Actual GHG emissions and comparison of WEM projections between NC7 and NC8

The above differences in GHG emissions projections are due to several reasons (Figure 5.5). First, these are recalculations of actual emissions reported in the national GHG inventory that change historical emissions trends. Second, these are new assumptions about socio-economic indicators used in GHG emissions calculation (the population, GDP and trends regarding value added) (Table 5.4). Third, the fact that during the period between the submitted GHG projections a range of different GHG emissions reduction measures have been implemented that have reduced the actual emissions in 2020 and which impact will be felt also up to 2030. Measures have been carried out with greater impact upon emissions reduction, i.e., wide use of RES for energy production and energy efficiency measures in all energy consumption sectors. It may be noted that while all additional measures stated in NC7 were under the WAM scenario, in NC8 are already all included under the WEM scenario.

Table 5.4 Comparison of projections between NC7 and NC8

	2025	2030
NC7 Population, thousand people	1916.47	1915.72
NC8 Population, thousand people	1849.68	1799.00
Difference between NC7 and NC8	-66.79	-116.72
NC7 Annual GDP growth rates, per cent	4.4	3.3
NC8 Annual GDP growth rates, per cent	3.8	2.4
Difference between NC7 and NC8	-0.6	-0.9
NC7 Primary energy consumption (Total), PJ	203.07	203.25
NC8 Primary energy consumption (Total), PJ	176.56	174.08
Difference between NC7 and NC8	-26.51	-29.17

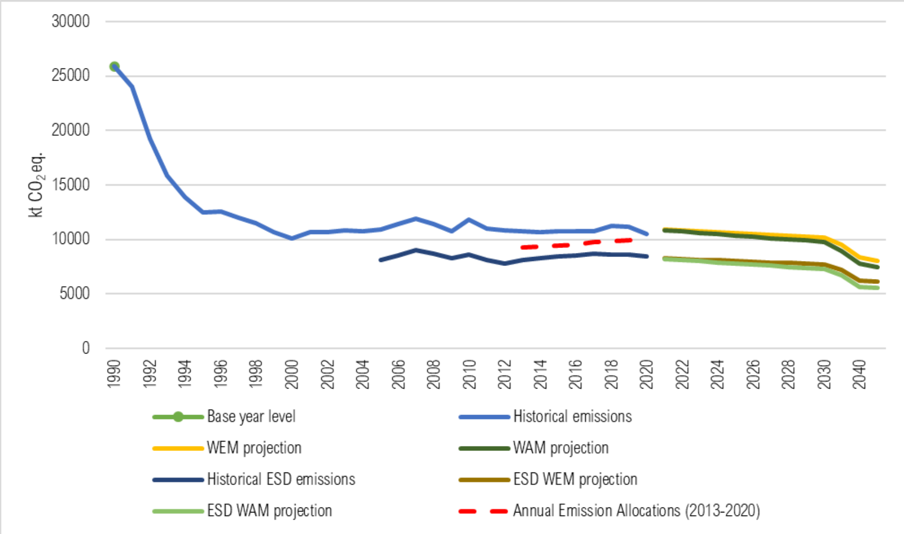


Figure 5.6 Comparison of historical and projected GHG emissions, kt CO_2 eq.

Total GHG emissions including indirect CO_2, without LULUCF sector had considerably decreased during the time period 1990–2000 when the national economy of Latvia transformed from central planning economy to a market economy (1990–1995). Till 2020 emissions are fluctuating, but after 2021 there is slight decrease of total emissions both in WEM and WAM scenarios. Similar situation could be observed in ESD emissions. Figure 5.6 shows that Latvia met ESD target with national measures in 2013-2020. More information progress in achievement of quantified economy-wide emission reduction target available in BR5 chapter IV.

5.1.1 Energy

"With existing measures" projection

Energy sector development is strongly influenced by the measures to reduce GHG emission aimed at improving energy efficiency and increasing RES share in energy production. The changes affect both energy supply and demand side. Part of these changes are due to implementation of policy measures, while others are due to technological developments and changes in the energy and fuel markets.

Future energy final consumption is determined not only by the planned energy efficiency measures, but also by the projected economics development trends. As a relatively significant increase in private consumption is forecasted, it is projected the living space per capita and thus the total heated area in the residential sector will increase. The total area of buildings in the service sector is also expected to increase. On the other hand, the WEM scenario includes the implementation of building renovation support programmes and higher energy efficiency requirements for the construction of new buildings.

In the medium term (2021-2027), the economic baseline scenario projects GDP growth of an average of 2.8% annually, a prerequisite for that is the benefits of economic competitiveness based on technological improvements, production efficiency and innovation. In the long term (from 2028 to 2050), the annual growth rates of the economy will be slower and limited up to 2%. On average, manufacturing industry maintains a faster growth rate both in the medium and long term compared with the average of national economy, growth will be synchronously linked to the use of the latest state-of-art technological processes, digitalisation, process optimisation, etc. Consequently, long-term energy consumption in industry will be determined by two trends. On the one hand, industrial production output will increase resulting in increase of energy consumption as well, at the same time the use of more efficient technologies and the implementation of energy efficiency improvement programmes will provide possible offset of the consumption increase.

Energy sector's (excluding transport) both historical and future calculated GHG emissions projections in the WEM scenario are presented in the Table 5.5. The emissions in the energy sector are mainly (slightly more than 90%) CO_2 emissions from the combustion of fossil fuels.

Table 5.5 Energy sector (excluding transport) emissions by gas according to WEM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	16454	3672	3992	3861	3555	3161
CO_2	15705	3251	3678	3532	3250	2862
CH_4	526	274	255	269	244	234
N_2O	223	147	59	60	61	65

Energy sector (excluding transport) total emissions in the WEM scenario could increase by about 5% by 2030, but then they decrease and in 2040 are about 14% less than in 2020. As the district heating system to supply heat energy is widely developed in Latvia, energy consumption and thus GHG emissions in the energy industry sector are affected due to this factor. District heating emissions historically have varied according to the heating demand (cold or warm winters). Year 2020 was the warmest one in the last 15 years (heating degree days 18% less than the multi-year average) and was therefore one of the key factors in the sharp reduction of GHG emissions in the energy industry sector. It has to be underlined, that the average heating degree days are applied to project the heat energy consumption used in GHG emissions projection calculation.

The second factor, influencing GHG emissions in the energy industry sector, is electricity final consumption and electricity import from neighbouring countries.

It is projected, due to the substitution of fuels with electricity (mainly in transport and residential sectors) as well as due to the increase in industrial production, electricity consumption will increase both by 2030 and beyond. As Latvia has not stated the political goal to provide full self-sufficiency in the produced electricity, the amount of imported electricity varies from year to year depending on the projected price in the common, with neighbouring countries, electricity market. Namely, electricity import fluctuates between 10% and 15% of the total annual electricity supply. The WEM scenario does not project an increase until 2030 in the amount of electricity produced utilising the RES, this will happen after 2030. As a result, the projected GHG emissions in the energy industry sector will remain at around 2018 until 2030, but will gradually decline thereafter.

On average, manufacturing industry maintains a faster growth rate both in the medium and long term compared with the average of national economy, growth will be synchronously linked to the use of the latest state-of-art technological processes, digitalisation, process optimisation, etc. Consequently, long-term energy consumption in industry will be determined by two trends. On the one hand, industrial production output will increase resulting in increase of energy consumption, at the same time the use of more efficient technologies and the implementation of energy efficiency improvement programmes will provide possibility to offset the increase in energy consumption. Projected GHG emissions in the manufacturing industry sector in 2030 are about 12% lower compared to 2020.

In the WEM projection, the emissions from individual heating of residential and commercial buildings will decrease until 2030, mainly due to the implementation of energy efficiency improvement support programmes. The calculated GHG emission projections in the residential and commercial and service sector in 2030 are about 13% lower than in 2020.

CH_4 emission constitutes around 7% of total GHG emissions in the Energy sector (excluding transport). The main source of CH_4 emission is incomplete combustion of biomass that is mainly caused by fireplaces and small heating boilers in residential and commercial sector. In its turn, CH_4 emissions amount from power and heating plants are small.

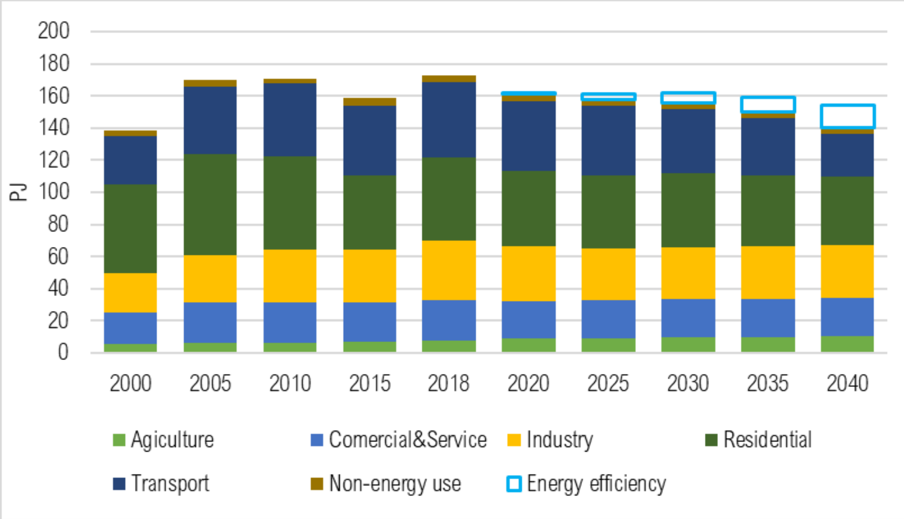


Figure 5.7 FEC development in sectors under the WEM scenario, PJ

The both the assumption about the economic growth rate and change in population number and policies and measures included in the WEM scenario result the FEC in 2030 will be per 3.1% lower, compared to 2020. The calculated FEC projections anticipate that in 2030 Residential and Transport will be the main FEC sectors consuming respectively 29.5% and 25.6% of total FEC. In its turn, Industry will consume 20.6% and Commercial and Service sector 15.1% of total FEC. The rest will be consumed in agriculture sector and for the non-energy consumption needs.

As seen in Figure 5.7, the implemented energy efficiency policy allows to save about 5.9 PJ in energy end-use in 2030 (meaning that without implementation of energy efficiency measures the FEC in 2030 will be per 5.9 PJ higher). Energy efficiency measures mainly focus on energy efficiency improvements in buildings (both residential and public ones), but also in industry sector energy efficiency is improved as well.

"With additional measures" projection

As presented above, in chapter 4, WAM scenario envisages additional energy efficiency measures, namely, the financial support programmes for energy efficient renovation of both residential buildings and state and municipal administration buildings and energy efficiency improvement for manufacturing. These measures provide around 2.3 PJ additional energy savings in 2030, compared to WEM scenario. Thus, the FEC in the WAM scenario is per about 1.7% lower, compared to WEM scenario.

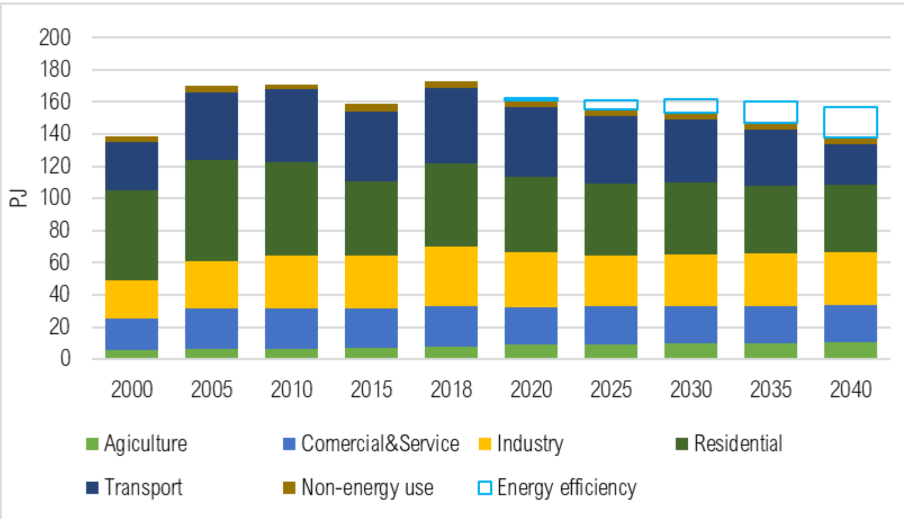


Figure 5.8 FEC development in sectors under the WAM scenario, PJ

The WAM scenario projections in 2030 higher electricity consumption compared to the WEM scenario, as electricity consumption in railway increases due to planned electrification projects in this sector. At the same time, electricity production by utilising RES also slightly increases in the WAM scenario, compared to WEM scenario, due to additional solar PV and wind power capacities. As a result, in the WAM scenario the calculated GHG emission projections in the Energy sector (excluding transport) in 2030 are about 2.5% lower compared to the WEM scenario.

Table 5.6 Energy sector (excluding transport) emissions by gas according to WAM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	16454	3672	3947	3765	3387	3061
CO_2	15705	3251	3635	3442	3090	2767
CH_4	526	274	252	264	235	228
N_2O	223	147	59	60	62	66

5.1.2 Transport

"With existing measures" projection

The WEM projection for the transport sector includes all of the measures that were already being used within the transport sector to cut down on emissions in January 2020 (see also chapter 4.4.3).

Irrespective of mobility and indicators characterizing the transport sector development in the period 2020-2030 – the growth of total passenger-kilometres by 10.8% and of total freight tonne-kilometres by 12.1% – the total projected GHG emissions under WEM scenario in inland transportation will decrease by 11.1% in 2030 against the 2020 level (Table 5.7).

The emission reductions will be achieved by domestic and EU-wide policy measures, including improving vehicle technology and renewing the vehicle fleet.

Most GHG emissions in the transport sector are caused by road transport, which accounts for 95.3% of the total emissions in 2030. Thus, the main emission impacting factor in the transport sector is the penetration rate of new technologies (electric (PHV and BEV), CNG) with higher demands for emission limits and replacing the stock of the existing vehicles.

Table 5.7 Transport emissions by gas according to WEM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	3040	3109	2993	2763	2399	1597
CO_2	2940	3069	2943	2714	2353	1558
CH_4	20	3	4	4	4	2
N_2O	80	37	46	45	42	37

Navigation and local aviation account for a very small share (less than 1%) of total GHG emissions in the Transport sector.

"With additional measures" projection

WAM scenario envisages promotion of biomethane production and utilisation in road transport. Thus, in the WAM scenario, part of the CNG consumption is substituted by biomethane. This measure reduces the projected GHG emissions from road transport by about 3% by 2030, compared to WEM scenario,

In addition, the WAM scenario envisages the construction of the first phase of the electrification project of the railway network. In total, the calculated GHG projection in the WAM scenario in 2030 is 6.7% lower, compared to the WEM scenario.

Table 5.8 Transport emissions by gas according to WAM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	3040	3109	2853	2578	2224	1432

	1990	2020	2025	2030	2035	2040
CO_2	2940	3069	2815	2542	2191	1406
CH_4	20	3	4	4	4	2
N_2O	80	37	34	32	29	24

International Bunkers

According to the most recent GHG emission inventory, the fuel consumption for international aviation was 2443 TJ and for international marine transportation 8669 TJ in 2020.

GHG emissions projections in international bunkering in the WEM scenario foresee emissions' gradual increase both in aviation and navigation. Emission increase in aviation is caused by the increase of number of both flights and served passengers in the Riga International Airport, establishing this trend the continuous increase of flights during the time period 2015-2019 and airport development plans are considered.

Table 5.9 International bunkers emissions by gas according to WEM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	1794	906	1284	1325	1362	1392
CO_2	1737	827	1199	1237	1272	1300
CH_4	2	1	1	1	1	1
N_2O	55	78	84	87	89	91

These projected emissions of marine and aviation bunkers do not take into account the impact of the measures described in chapter 4.4.4 which aim at improving energy efficiency and increasing the use of alternative fuels.

5.1.3 Industrial Processes and Product Use

"With existing measures" and "With additional measures" projection

GHG emissions from the use of raw materials in technological equipment and which are not directly related to the combustion of fuel are accounted under industrial processes, including emissions from solvent use and F-gases. As already stated above, the macroeconomic projections envisage growth of the manufacturing sector by 2030. As most emissions from IPPU come from the mineral industry (cement production), then the growth of the construction sector and cement production are the main driving forces for GHG emissions projection. In cement production projected emissions will increase by 10.8% in 2030, compared to 2020.

Total projected GHG emissions under WEM scenario in IPPU will decrease by 3.6% in 2030 and by 2.6% in 2040, compared to 2020 (Table 5.10).

Table 5.10 IPPU emissions according to WEM and WAM scenarios projections

	1990	2020	2025	2030	2035	2040
WEM scenario	655.98	868.15	870.70	836.72	827.83	845.62
WAM scenario	655.98	868.15	870.70	836.72	827.83	845.62

As it can be seen in Table 5.10. WEM and WAM scenario is the same. IPPU sector emission projections on a gas-by-gas basis are presented in Table 5.11.

Table 5.11 IPPU sector emissions by gas according to WEM and WAM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	655.98	868.15	870.70	836.72	827.83	845.62
CO_2	651.07	603.67	636.25	660.36	685.72	705.70
CH_4	0.07	NO	NO	NO	NO	NO
N_2O	4.84	3.62	3.45	3.36	3.28	3.24
HFCs	NO	248.91	220.64	162.65	128.47	126.32
SF_6	NO	11.94	10.36	10.36	10.36	10.36

GHG emissions in IPPU under the WEM scenario are projected taking into account that the production processes of enterprises will comply with the requirements provided for in the Law on Pollution. In compliance with the requirements of this law enterprises have to organise the production process by implementing the best and most modern technologies providing for the lowest level of GHG emissions.

F-gases

Currently emissions from refrigeration and air conditioning equipment constitute the mayor part of total F-gas emissions (97.4% in 2020) and it is expected that emissions from these appliances will constitute the biggest share from F-gas emissions in the future. It is projected that the trend of F-gas emissions will decrease not as a straight line, but with some fluctuations. Fluctuations in F-gas emissions are because of used F-gas amounts in past. It is expected that emissions will gradually decrease due to prohibitions regarding placing on the market certain F-gases according to EC regulation on F-gases (517/2014) as well as according to prohibition to mobile air-conditioning systems designed to contain F-gases with a global warming potential higher than 150 from a certain date.

Solvent Use

The use of solvents and products containing solvents results in emissions of non-methane volatile organic compounds (NMVOC). NMVOC emissions are regarded as an indirect GHGs as it over a period of time will oxidize into CO_2 when emitted to the atmosphere.

CO_2 emissions projections in the Solvent use sector are based on two parts. For Domestic solvent use subsector projections are based on number of inhabitant development scenario and private consumption development scenario. Emissions from other subsectors are based on gross domestic product development scenario. The structure and emission calculation are performed according to EMEP/EEA 2019 and 2006 IPCC Guidelines.

The CO_2 emissions from Solvent use sector are projected to increase slightly during the period 2020-2040. For instance, emissions of CO_2 have increased by 22%, from 24.38 kt in 2020 to 29.78 kt CO_2 in 2040. In 2020, the main share of total emissions from Solvent use sector contributed Paint application subsector (33.8% or 3.75 kt).

5.1.4 Agriculture

"With existing measures" projection

Projections of GHG emissions from agriculture sector with existing measures (WEM) are based on projected livestock population, main harvested crops and area harvested, used lime materials, consumption of inorganic and organic N fertilizers. Agriculture sector emission projections on a gas-by-gas basis in WEM scenario are presented in Table 5.12.

Table 5.12 Agriculture sector emissions by gas according to WEM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	4985.80	2250.88	2215.64	2261.66	2272.41	2339.64
CO_2	364.84	70.97	29.94	33.74	36.88	72.79
CH_4	2411.36	944.85	965.19	968.08	954.24	955.35
N_2O	2209.60	1235.05	1220.51	1259.84	1281.29	1311.51

It is projected that there will be an increasing trend of total GHG emissions in the Agriculture sector during the period 2020-2040. The most rapid increase of emissions is related to of N_2O emission from soils where it is expected that emission will increase by 1230.0 kt in 2030. All emissions from the agriculture sector projected with WEM scenario are represented in Table 5.13.

Table 5.13 Projected GHG emissions from agriculture sector in WEM scenario (kt CO_2 eq.)

Subcategory	1990	2020	2025	2030	2035	2040
Enteric fermentation	2221.5	856.0	862.3	866.6	858.5	859.9
Manure management	472.6	163.0	190.5	184.8	177.3	176.9
Soils	1926.8	1160.8	1132.9	1176.5	1199.7	1230.0
Liming and urea application	364.8	71.0	29.9	33.7	36.9	72.8
Total	4985.8	2250.9	2215.6	2261.7	2272.4	2339.6

Historical and projected CH_4 emissions from enteric fermentation are included in Table 5.14.

Calculation results show the increase of enteric fermentation emission till 2030. After 2030 the intensity of annual enteric fermentation CH_4 emission growth rate will decrease.

Table 5.14 Projected CH_4 emission from enteric fermentation (kt)

Subcategory	1990	2020	2025	2030	2035	2040
CH_4 emission from enteric fermentation	88.86	34.2	34.5	34.7	34.3	34.4

An important parameter that causes the total amount of enteric fermentation CH_4 emission is the population of ruminant livestock. Population of cattle results in more than 90% of CH_4 emission by enteric fermentation in Latvia. It is projected that dairy cows will decrease. However, projections show that in 2030 the average annual milk yield per dairy cow will significantly increase.

A rapid increase of dairy cows' productivity will lead to an increase of gross energy (GE) intake and, consequently, to higher enteric fermentation CH_4 emission per dairy cow. For the purposes of inventory and projections GE for dairy cattle is calculated on the basis of milk yields, therefore average milk yield per cow is one of key indicators for calculation of CH_4 emissions.

Projections also show the increase of the cattle number by 20.8% in 2020 and 32.5% in 2030 comparing to 2014 that also will promote the increase of enteric fermentation CH_4 emission in the period 2020-2035. Detailed information of projected livestock numbers and dairy cow productivity is included in Table 5.15.

Table 5.15 Projections of the livestock number (thous.) and milk yield per dairy cow (kg)

Projected item	1990	2020	2025	2030	2035	2040
Dairy Cattle	535.1	136.0	127.5	125.4	121.6	119.4
Milk yield	3437	7163.0	8583	9001	9288	9536
Cattle	904.2	263.0	247.2	244.1	239.5	237.6
Sheep	164.6	91.9	109.2	115.1	119.9	125.3
Goats	5.4	11.5	12.1	11.9	11.7	11.6
Horses	30.9	8.3	6.3	5.5	5.0	4.8
Swine	1401.1	306.8	284.5	274.7	268.7	262.3
Poultry	10321.1	5837.9	5349.1	5319.3	5295.8	5270.9

Historical and projected CH_4 emissions from manure management are included in Table 5.16. Projections show that manure management CH_4 emission will decrease after 2030.

Table 5.16 Projected CH_4 emission from manure management (kt)

Subcategory	1990	2020	2025	2030	2035	2040
CH_4 emission from manure management	7.59	3.60	4.12	4.06	3.83	3.82

The main activity data for calculation of CH_4 emission from manure management is livestock population, mainly cattle, swine and poultry, and animal waste management systems distribution. It is expected that agricultural production levels of dairy farming and swine production will be intensified with the aim to improve production efficiency. This will lead to livestock concentration in big farms with preference to slurry or liquid manure management system (Table 5.17). Manure management CH_4 emission factors for slurry based systems are noticeably higher due to high methane conversion factor comparing to solid manure storage, pasture or anaerobic digesters that are also typical manure management systems for Latvia.

Table 5.17 Projections of manure management systems (MMS) distribution (share) for dairy cattle and swine

MMS	1990	2020	2025	2030	2035	2040
Dairy cattle						
Liquid	0.054	0.315	0.533	0.588	0.637	0.709
Solid	0.831	0.405	0.312	0.264	0.217	0.136
Pasture	0.115	0.056	0.043	0.037	0.030	0.019
Anaerobic digesters	0.000	0.224	0.112	0.111	0.116	0.136
Swine						
Liquid	0.285	0.464	0.661	0.674	0.679	0.679
Solid	0.715	0.040	0.030	0.018	0.012	0.009
Pasture	0.000	0.000	0.000	0.000	0.000	0.000
Anaerobic digesters	0.000	0.496	0.309	0.308	0.309	0.312

Historical and projected N_2O emissions from manure management are represented in Table 5.18. Slight fluctuations of N_2O emissions from manure management in projected time series are related to relatively small emission factors for Latvia's typical manure management systems. In general projections show decreasing trend of manure management nitrous oxide emissions from manure management.

Table 5.18 Projected N_2O emission from manure management (kt)

Subcategory	1990	2020	2025	2030	2035	2040
N_2O emission from manure management	0.95	0.25	0.29	0.28	0.27	0.27

Main activity data for calculation of emissions from manure management are livestock population data and animal MMS data as well as excreted nitrogen rate per domestic animal. For inventory purposes Latvia uses country specific nitrogen excretion values, these values are also used for projections. Data on MMS are calculated on the basis of results of agricultural census data, national research projects results and livestock numbers in the herd. In recent years cattle farms have turned to liquid slurry management system due to closing down of small farms and reflecting the trend to use this management system in the developed countries, however, liquid slurry produces more methane and promotes an increase of this kind of emissions. One of the measures to reduce emissions from manure management is to use manure for biogas production. Latvia uses anaerobic digesters as MMS for dairy and non-dairy cattle, swine and poultry that help to reduce a rapid increase of emissions of N_2O from manure management.

Historical and projected N_2O emissions from agricultural soils are represented in Table 5.19. Emission in this category will increase during 2020-2040.

Table 5.19 Projected N_2O emissions from soils (kt)

Subcategory	1990	2020	2025	2030	2035	2040
N_2O emissions from soils	6.50	3.90	3.80	3.95	4.03	4.13

The main activity data for calculation of projected N_2O emission from agricultural soils contain the used amount of synthetics and organic nitrogen fertilizers, an area of harvested crops and the yield, and the cultivated area of organic soils. The calculated amounts of mineral nitrogen fertilizers are linked to a planned significant increase of yields. Projected activity data for calculation of N_2O emissions from agricultural soils are included in Table 5.20.

Table 5.20 Projected activity data for estimation of GHG emissions from agricultural soils

Activity data	2020	2025	2030	2035	2040
Used N with synthetic fertilizers, kt	84.3	86.6	91.1	94	97.6
Used N with manure, kt	12.8	14.1	14.0	13.9	14.9
Organic soils, ha	159.6	162.8	162.8	162.8	162.8

Activity data	2020	2025	2030	2035	2040
Wheat yield, thous t	2659.6	2364.7	2599	2765.1	2962.4
Barley yield, thous t	308.8	272.7	269.8	266.5	263.2
Rye yield, thous t	178.4	116.9	116.7	116.4	116.0
Oats yield, thous t	287.9	167.9	174.4	180.4	186.2
Legumes yield, thous t	137.2	130.2	138.6	145.7	153.7
Rape yield, thous t	451.3	362.1	394.5	424.5	453.0
Total sown area, thous ha	1277.1	1230.4	1250.2	1256.7	1272.2

"With additional measures" projection

Agriculture sector emission projections on a gas-by-gas basis in WAM scenario are presented in Table 5.21.

Table 5.21 Agriculture sector emissions by gas according to WAM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	4985.80	2250.88	2144.44	2136.90	2133.17	2174.74
CO_2	364.84	70.97	29.94	33.74	36.88	72.79
CH_4	2411.36	944.85	962.53	965.46	951.70	944.44
N_2O	2209.60	1235.05	1151.97	1137.70	1144.59	1157.51

In order to identify protentional of additional GHG emission reducing-measures in Latvia, the following measures were evaluated:

- Promotion of organic dairy farming (low emission dairy farming). The main aim of the measure is to promote transition of small and medium-sized conventional dairy farms to the organic farming system, thus facilitating low emission dairy farming;
- Support for fertilisation planning. The main aim of the measure is to expand arable land and increase number of medium-sized crop and livestock farms were fertilisation planning and practical implementation that is based on knowledge about agrochemical properties of soil have not been done previously;
- Promote inclusion of leguminous plants in crop rotation for nitrogen fixation. The main aim of the measure is to expand arable land and increase number of farms where leguminous plants are included in crop rotation thus contributing to atmospheric nitrogen fixation and reduction of application of inorganic nitrogen fertilizers;
- Promote and support for precision application of inorganic nitrogen fertilisers. The main aim of the measure is to expand arable land and increase number of farms were precision technologies for application of inorganic nitrogen fertilisers are used in the planning of fertiliser schemes and spreading;
- Promote and support for direct incorporation of organic fertilisers into the soil. The main aim of measure is to expand arable land where organic fertilisers are directly incorporated into the soil thus promoting more efficient use of organic fertilisers;
- Promote feed ration planning and improvement of feed quality. The main aim of measure is to increase number of cows whose feed rations are balanced for reduced crude protein level without loss in milk production. As wee as to increase number of cows whose are fed with feed with high digestible energy;
- Maintenance and modernization of amelioration systems on agricultural land. The main aim of the measure is to increase arable land area with improved and maintained amelioration systems, thereby reducing N leaching and run-off from agriculture;
- Promote the production of biogas and biomethane and the use of biomethane. The main aim of the measure is to ensure the installation of biogas production and biogas purification (biomethane production) facilities on farms that do not yet have biogas production and purification facilities.

Projected emissions in WAM scenario are included in Table 5.22. Emissions in WAM scenario are from 3% in 2025 till 7% in 2040 lower comparing to WEM scenario.

Table 5.22 Projected GHG emissions from agriculture sector in WAM scenario (kt CO_2 eq.)

Subcategory	1990	2020	2025	2030	2035	2040
Enteric fermentation	2221.5	856.0	862.1	866.4	858.4	851.4
Manure management	472.6	163.0	183.9	178.4	171.1	170.7
Soils	1926.8	1160.8	1068.5	1058.3	1066.8	1079.8
Liming and urea application	364.8	71.0	29.9	33.7	36.9	72.8
Total	4985.8	2250.9	2144.4	2136.9	2133.2	2174.7

5.1.5 Waste Management

"With existing measures" and "With additional measures" projection

The calculation of the activity data and emission projections was done on the basis of the following main assumptions and the existing policies and plans:

- Projections on the country's population and macroeconomic parameters;
- The requirements set in the Waste Framework Directive (2008/98/EC) on recycling and disposal of municipal waste

Consequently, composting and other recycling activities will increase. Latvia is developing a separate waste collection system and increasing the amount of recycled waste. Treatment of biodegradable waste is set one of priorities in Waste management Plan 2021-2028.

To project activity data for waste water handling sector, following assumptions and existing policies were used:

- Projections of national population, GDP of manufacturing industry and private consumption;
- Urban Waste Water Directive 271/91/EEC (UWWTD), implemented in the Latvian legislation in 2002 with Regulations of the Cabinet of Ministers No. 34 adopted on 22 January 2002 "Regulations Regarding Discharge of Polluting Substances into Water". According to conditions of accession European Union in 2004, there were 3 deadlines designated for Latvia to implemented UWWTD – 31 December of 2008 for agglomerations larger than 100 000 of population equivalent (p.e.), 31 December of 2011 for agglomerations 10 000 – 100 000 p.e. and 31 December for agglomerations 2 000 – 10 000 p.e. At the moment, all the deadlines of full implementation have been met, and UWWTD is fully implemented. Almost all agglomerations, regulated by UWWTD, are in compliance within its requirements;
- Regulations of the Cabinet of Ministers No. 403 adopted on 21 June 2016 "The Implementing Rules of Specific Aid Objective 5.3.1. "Developing and Improving of the Water Supply and Sewerage Systems and the Quality of Services to Provide Connectivity" of Operational Program "Growth and Jobs", designated targets and financial resources (~126 million euro from Cohesion Fund of Europe Union) to increase number of population, connected to a centralized waste water collection and treatment system in a certain agglomerations. This measure should be fully implemented until 31 December of 2022.

Waste sector emission projections on a gas-by-gas basis in WEM scenario are presented in Table 5.23.

Table 5.23 Waste sector emissions by gas according to WEM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	732.09	547.25	507.51	451.85	429.71	418.18
CO_2	0.57	0.04	0.03	0.03	0.03	0.03
CH_4	666.82	495.72	454.41	398.24	374.22	360.56

	1990	2020	2025	2030	2035	2040
N_2O	64.70	51.49	53.07	53.58	55.46	57.59

Waste sector emission projections on a gas-by-gas basis in WAM scenario are presented in Table 5.24.

Table 5.24 Waste sector emissions by gas according to WAM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	732.09	547.25	507.51	434.94	355.13	287.73
CO_2	0.57	0.04	0.03	0.03	0.03	0.03
CH_4	666.82	495.72	454.41	379.90	294.63	225.11
N_2O	64.70	51.49	53.07	55.01	60.47	62.60

Only WEM scenario applies for waste water handling sector, additional measures are not planned. Projected emissions (WEM scenario) from subsectors of waste sector are included in the following Table 5.25 (kt CO_2 eq.).

Table 5.25 Projected GHG emissions from waste sector in WEM scenario (kt CO_2 eq.)

Sector	1990	2020	2025	2030	2035	2040
5.A. Solid Waste Disposal	314.75	379.1	330.49	284.85	268.79	262.35
5.B. Biological Treatment of Solid Waste	28.62	63.42	62.93	62.00	62.00	62.00
5.C. Incineration and Open Burning of the Waste	0.59	0.04	0.03	0.03	0.03	0.03
5.D. Waste Water Treatment and Discharge	388.13	104.68	114.06	104.96	98.89	93.80
Total Waste emissions	**732.09**	**547.24**	**507.51**	**451.85**	**429.71**	**418.18**

Projections show that total GHG emissions according to WEM scenario will decrease till 400 kt CO_2 eq. annually. The largest contributing subsectors are 5.A. Solid Waste Disposal and 5.D. Waste Water Treatment and Discharge; while the Solid Waste Disposal will gradually loose its contribution in total emissions of the sector, the significance of Waste Water Treatment and Discharge subsector is projected to decrease.

Table 5.26 Projected GHG emissions from waste sector in WAM scenario (kt CO_2 eq.)

Sector	1990	2020	2025	2030	2035	2040
5.A. Solid Waste Disposal	314.75	379.1	330.49	266.51	189.20	126.90
5.B. Biological Treatment of Solid Waste	28.62	63.42	62.93	63.44	67.01	67.01
5.C. Incineration and Open Burning of the Waste	0.59	0.04	0.03	0.03	0.03	0.03
5.D. Waste Water Treatment and Discharge	388.13	104.68	114.06	104.96	98.89	93.80
Total Waste emissions	**732.09**	**547.24**	**507.51**	**434.94**	**355.13**	**287.73**

Solid waste disposal

Solid waste disposal (SWD) is the most essential GHG emission source in the waste sector (69.1% from total in 2020). Within SWD methane (CH_4) is the most important GHG, other GHG emissions (CO_2, N_2O) are not calculated.

Under the WEM and WAM scenarios the decrease of the volume of biodegradable waste within the total volume of disposed waste is taken into account. In WAM scenario additional measures (production of refuse derived fuel (RDF) and biological treatment increase) are taken into account to decrease biodegradable waste disposal. Projected amounts of biodegradable waste are indicated in the Waste management Plan 2021-2028, requirements set in the Waste Framework Directive (2008/98/EC) on recycling and disposal of municipal waste. CH_4 recovery is extrapolated till 2040. After 2020 growth of CH_4 recovery is not projected, because that could be the maximum of available landfill gas.

Biological processing of solid waste

Composting corresponds to biological processing of solid waste. In compliance to 2006 IPCC Guidelines emissions of two gases - methane (CH_4) and nitrogen monoxide (N_2O), are important regarding waste composting.

Projected CH_4 and N_2O emissions from composting are calculated according to 2006 IPCC Guidelines. Emission factors are multiplied with composted waste amounts. Composted waste amount in households is projected according to changes in population, but industrially composted amounts are projected according to time series from 2003 till 2019. From year 2023 increase of industrial composted amounts till 130 000 tons is projected due to information about direct investments in Latvia waste companies.

Waste water treatment and discharge

According to calculated projections, CH_4 emissions from waste water handling (waste water treatment and discharge) will slowly increase). No significant further decrease of emissions is expected in the domestic waste water treatment and discharge sector, since main measure (UWWTD) is already practically implemented, and expected increase of CH_4 emissions is due to foreseen economic GDP growth in the manufacturing industry sector, which is source of CH_4 emissions from industrial waste water treatment and discharge sector.

Emissions of N_2O in the waste water treatment and discharge sector will gradually increase. Main driving force of this increase is projected rise of protein consumption, which is activity data for N_2O emission calculation from domestic waste water treatment and discharge, as result of projected increase of private consumption from macroeconomic projections. Emissions of N_2O from industrial waste water treatment and discharge will increase together with projected rise of GDP for manufacturing industry too, but because of these emissions are negligible in comparison with N_2O emissions from domestic waste water t sector, they do not affect significantly total N_2O emission projections.

5.1.6 Land use, Land use Change and Forestry

"With existing measures" and "With additional measures" projection

This chapter provides projections for GHG emissions and removals for the period up to 2040. Taking into account the best available data, two emission projection scenarios on the future projections of the GHG emissions and CO_2 removals in LULUCF sector are provided. "With existing measures" (WEM) scenario represents projections with existing measures, which are proposed in the Rural Development Programme 2014-2020.

LULUCF sector emission projections on a gas-by-gas basis in WEM scenario are presented in Table 5.27.

Table 5.27 LULUCF sector emissions by gas according to WEM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	-12300.85	646.57	1946.97	4703.73	4439.99	5219.29
CO_2	-13401.95	-758.81	665.48	3326.52	3046.81	3818.68
CH_4	555.06	782.29	676.68	770.79	792.12	811.14
N_2O	546.05	623.09	604.80	606.42	601.06	589.47

LULUCF sector emission projections on a gas-by-gas basis in WAM scenario are presented in Table 5.28.

Table 5.28 LULUCF sector emissions by gas according to WAM scenario projections

	1990	2020	2025	2030	2035	2040
Total emissions, kt CO_2 eq.	-12300.85	646.57	1514.21	3838.22	3574.48	4437.78
CO_2	-13401.95	-758.81	232.72	2461.01	2181.30	3037.17
CH_4	555.06	782.29	676.68	770.79	792.12	811.14
N_2O	546.05	623.09	604.80	606.42	601.06	589.47

The net impact of the existing measures (WEM scenario) during the whole impact period (till 2040) is 13163 kt CO_2; the total affected area – 256 kha; including 61 kha in cropland and grassland, 180 kha in forest land and 15 kha in wetlands. The average annual impact is 2.6 tonnes CO_2 ha^{-1} (658 kilotons CO_2 eq. $year^{-1}$ in all affected areas till 2040, Table 5.29). The most efficient measure is afforestation (97.3 kt CO_2 eq. $year^{-1}$ in average, and 23.4 kt CO_2 eq. $year^{-1}$ till 2040). The most efficient measure in short term is forest thinning (64.8 kt CO_2 eq. $year^{-1}$ till 2040) According to Tier 1 based methodology, duration of the impact of the measures in cropland is 20-30 years; duration of impact of the measures in forest land is 76-102 years (calculated as average rotation length for different species appearing in the forest management related measures). The most of the impact of WAM scenario measures is expected after 2040 due to long lasting effect of the measures in affected forest lands. In total forest lands contributes to 90% of the proposed climate change mitigation effect of the WAM measures.

Table 5.29 LULUCF emissions according to WEM scenario projections

Category	1990	2020	2025	2030	2035	2040
4.A. Forest land	-16911.59	-2610.22	-2523.32	-341.84	-908.63	-136.32
4.B. Cropland	2567.26	1524.42	2392.68	2710.58	2769.30	2849.26
4.C. Grassland	1139.65	1365.31	1417.16	1475.81	1551.40	1587.36
4.D. Wetlands	1042.57	1493.78	1591.55	1616.81	1629.59	1640.47
4.E. Settlements	27.38	596.88	548.85	531.42	481.67	417.95
4.G. Harvested wood products	-166.11	-1726.14	-1479.95	-1289.04	-1083.34	-1139.42
LULUCF	-12300.85	646.57	1946.97	4703.73	4439.99	5219.29

Table 5.30 Summary of potential cumulative impact of the additional measures in WAM scenario

Land use category	2025	2030	2035	2040
4.A. Forest land	462.00	1694.00	3234.00	4522.00
4.B. Cropland	703.96	2581.20	4927.74	7274.29
4.C. Grassland	0.00	0.00	0.00	0.00
4.D. Wetlands	132.30	485.10	926.10	1367.10
4.E. Settlements	0.00	0.00	0.00	0.00
4.G. Harvested wood products	0.00	0.00	0.00	0.00
LULUCF total	1298.26	4760.30	9087.84	13163.39

In WEM and WAM scenario, the net annual GHG emissions in LULUCF sector in 2030 would increase to 4703 kt CO_2 eq., in 2035 – they would increase to 4440 kt CO_2 eq. (Figure 5.9).

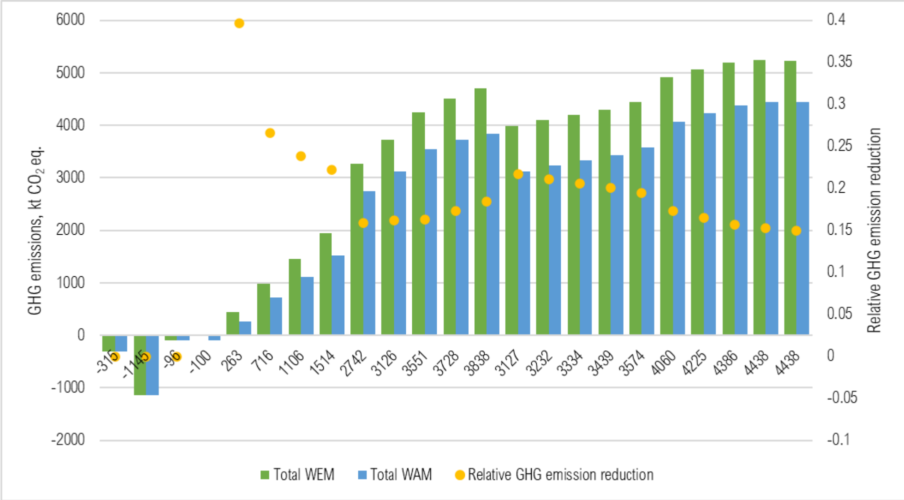


Figure 5.9 Comparison of GHG emissions in WEM and WAM scenario and relative GHG emission reduction in LULUCF sector

The measures considered in WEM scenario have minor effect on the GHG emissions in LULUCF sector in long term and they will not affect the general trend of reduction of the net CO_2 removals. The main drivers for the reduction of CO_2 removals in LULUCF sector is continuously high GHG emissions from organic soils in cropland and grassland, as well as GHG emissions due to peat production for horticulture, which can't be compensated by forest lands in long term. Ageing of forest leads to decrease of increment and increase of mortality and harvest rate. Deforestation due to restoration of economic activity in rural regions is another driver, having increasing role in the total GHG balance. The largest net sink of CO_2 removals in LULUCF sector contributing to nearly 2 million tonnes of CO_2 eq. removals annually is HWP; however, there is still huge potential to increase removals in living biomass by sustainable intensification of forest management.

5.2 Sensitivity Analysis

Performing GHG emissions calculations in different sectors, it has to be taken into account that there are sector-specific key drivers which influence emissions projected amount as well as uncertainties regarding the future trends of parameters, used for GHG emissions projecting, exist. Therefore, the availability of sensitivity analyses around the chosen baseline (WEM scenario) would be particularly useful to show how changes in key drivers would affect emissions. Four sensitivity analysis regarding GHG emissions projections have been carried out. GDP and population assumptions impacts on projected GHG emissions have been analysed in Energy and Waste sector. In Energy sector the projected higher GDP growth rates and higher population in the alternative scenario affect parameters such as floor area in residential sector, passenger kilometres and freight transportation (tkm) in transport, value added in manufacturing and others parameters. In Agriculture sector the sensitivity analysis is used to determine how different projection approaches of milk yield can impact the total emissions outcome under a given set of assumptions. In sensitivity analysis of LULUCF is considered the implementation of the proposed changes in forest management regulations affecting threshold values for the tree diameters sufficient for regenerative felling and forest regeneration requirements. The scenario of sensitivity considers increased intensity of early tending and pre-commercial thinning and reduced intensity of thinning in pre-mature forest stands. For this report sensitivity analysis is not made for IPPU sector because it is not mandatory however it is planned in the next reporting cycle.

5.2.1 Energy

Energy use and hence the GHG emissions are sensitive for the assumptions made on economic growth. Sensitivity analysis has therefore been carried out for the WEM projection varying the economic growth rate and number of population. To evaluate the impact of macroeconomic's indices on GHG emissions volume in the Energy sector, the GHG emissions are calculated for the alternative scenario (WEM_HD), for constructing of which the indices (GDP, number of population, value added) of the "optimistic scenario", developed by the MoE, are used.

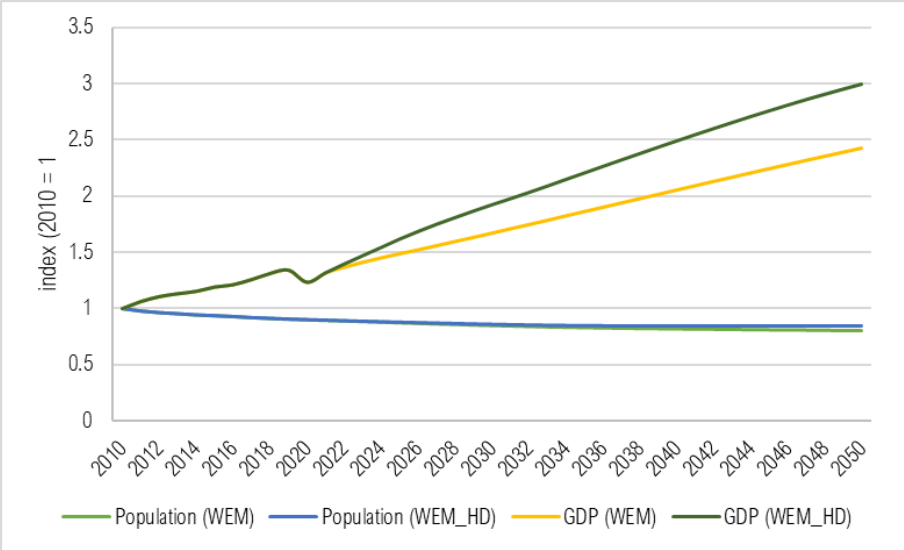


Figure 5.10 Comparison of macroeconomic's indices used in the modelled WEM and alternative (WEM_HD) scenarios

The alternative scenario (WEM_HD) assumes in 2030 the higher GDP per about 15% and higher number of population (per about 0.9%) against the WEM scenario level at 2030. At the end of the period (2050), this gap in the WEM_HD scenario against the WEM scenario increases, respectively GDP by 23% and population by 5%. A faster increase in GDP is based on the assumption of a more rapid use of innovative technologies and a more rapid growth in production productivity. The projected higher GDP growth rates and higher population in the WEM_HD scenario affect parameters such as floor area in residential sector, passenger kilometres and freight transportation (tkm) in transport, value added in manufacturing and others parameters.

As shown by the Figure 5.11 below, the assumptions on more rapid GDP growth rate and on stabilisation of population number result in 2030 in the increase of calculated FEC per 6.3% against the WEM scenario level at 2030. This increase of FEC varies in different sectors, being in 2030 in the range 3-10% against WEM scenario levels. The highest impact is seen in the industry, in which the higher Value Added in the WEM_HD scenario causes per 10.4% higher FEC in 2030 against the WEM scenario level. High impact is seen also in transport and residential sector in which in 2030 FEC in the alternative WEM_HD scenario increases per 7% and 5.2% respectively against the WEM scenario level.

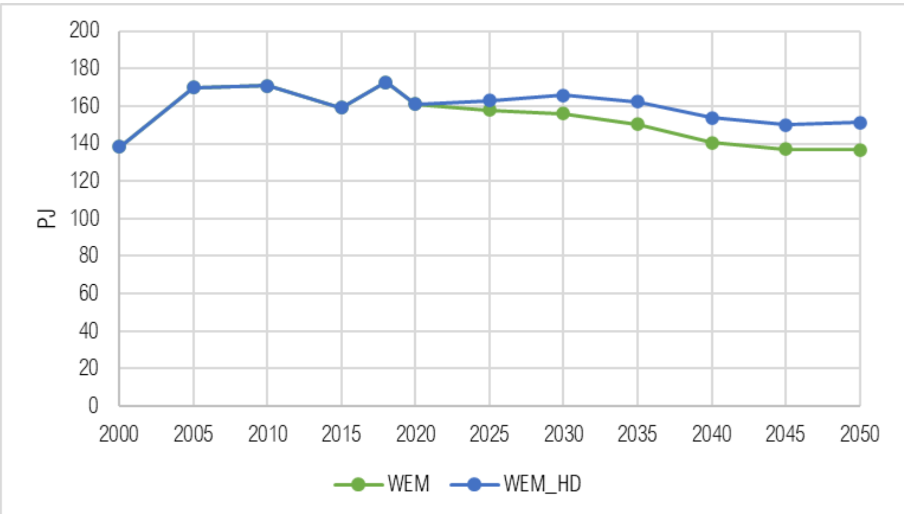


Figure 5.11 Comparison of calculated final energy consumption projections in the modelled WEM and alternative (WEM_HD) scenario

In its turn, higher energy end-use volume results in higher GHG emissions in the case the additional policies and measures aimed to decrease GHG emissions are not implemented. Calculated GHG emissions projections in 2030 in the alternative (WEM_HD) scenario is per about 5.3% or per 275 kt CO_2 eq. higher, compared to WEM scenario. The highest impacts on GHG emissions increase in the WEM_HD scenario are provided by industry (11.7%) and road transport (6.8%) sectors.

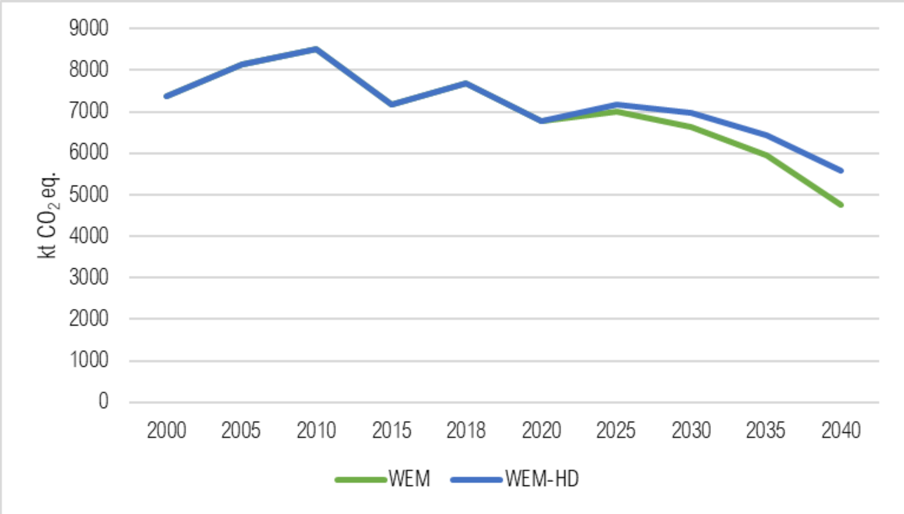


Figure 5.12 Comparison of calculated GHG emissions projections in the modelled WEM and alternative (WEM_HD) scenarios

5.2.2 Agriculture

The sensitivity analysis is used to determine how different projection approaches of milk yield can impact the total emissions outcome under a given set of assumptions. Then specified activity data are included in GHG emission calculation algorithms according to 2006 IPCC Guidelines.

Sensitivity analysis has been carried out with the aim of assessing the impact of dairy cow productivity projections. In the baseline scenario, milk yield is predicted with a logarithmic function by setting the milk yield target value of 10 tonnes from one dairy cow in 2050. The milk target value is based on expert judgment, assuming findings that the intensity and size of farms will increase. In addition to assessing the impact of economic factors, projections of milk yield should include information on the average herd size, the proportion cow breeds, the number of organic dairy farms, feeding strategies and other biological features. In the sensitivity analysis version of the milk yield, milk yield projection is based on the milk yield models approved and used in animal sciences.

Results of a sensitivity analysis are included in Figure 5.13. Results of the sensitivity analysis show that agricultural emissions could reach 2261.7 kt CO_2 eq. in 2030. Total emissions could be by 1.6% lower than in the base scenario.

All other parameters of projections for both scenarios are similar to inputs for the WEM scenario projections.

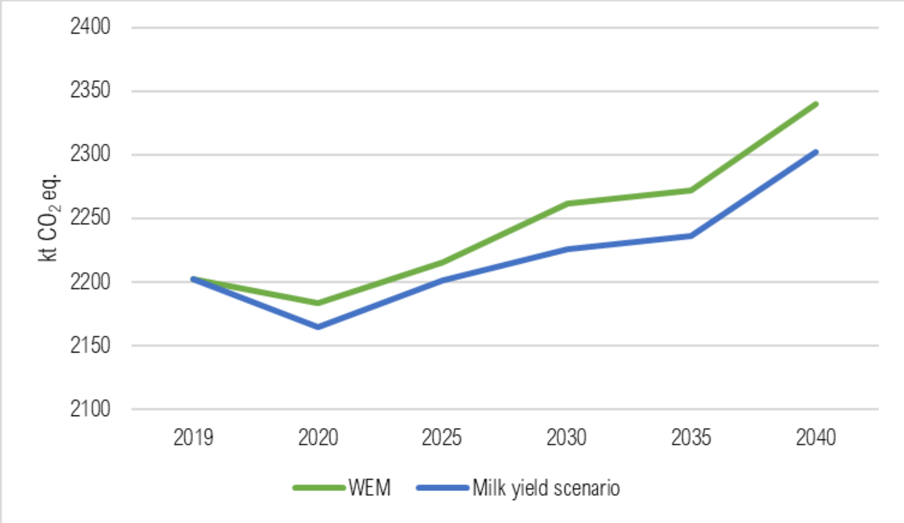


Figure 5.13 Sensitivity analysis of GHG emission projections for agriculture sector

5.2.3 Land use, land use change un forestry

Two scenarios are compared in the sensitivity analysis – WEM scenario and scenario considering implementation of the proposed changes in forest management regulations (intensified scenario) affecting threshold values for the tree diameters sufficient for regenerative felling and forest regeneration requirements. The second scenario considers increased intensity of early tending and pre-commercial thinning and reduced intensity of thinning in pre-mature forest stands. The second scenario ensures considers increase of growing stock in forest land after 2050 (Figure 5.14).

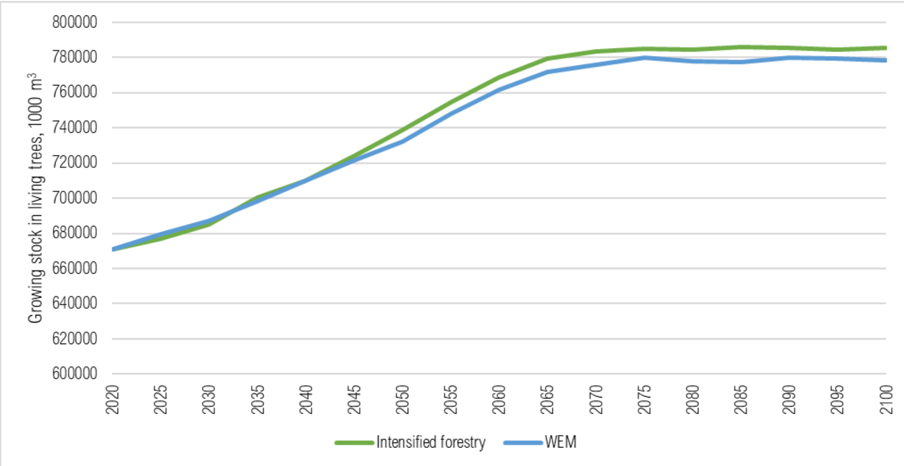


Figure 5.14 Comparison of growing stock in forest in the compared scenarios

The scenario analysis is based on the report "Proposals for increase of management efficiency and forest value in Latvia in long term and support to elaboration of strategic environment impact assessment" by G. Šņepsts (2020). No additional measures are considered in this scenario in forest lands.

Summary of the GHG fluxes in the intensified scenario is provided in Table 5.31 and Figure 5.15. In spite of increase of growing stock in the intensified scenario the net GHG emissions in forest lands increases due to reduction of carbon stock in dead wood due to decreased mortality rate in forests.

Table 5.31 Summary of GHG emissions in the intensified scenario

	2020	2025	2030	2035	2040
Forest	-6034.5	-4003.3	-1630.9	-1992.0	-1275.7
Cropland	2116.6	2392.7	2710.6	2769.3	2849.3

	2020	2025	2030	2035	2040
Grassland	1386.4	1417.2	1475.8	1551.4	1587.4
Wetlands	1557.8	1591.6	1616.8	1629.6	1640.5
Settlements	877.7	548.8	531.4	481.7	417.9
Net emissions	-95.9	1947.0	4703.7	4440.0	5219.3

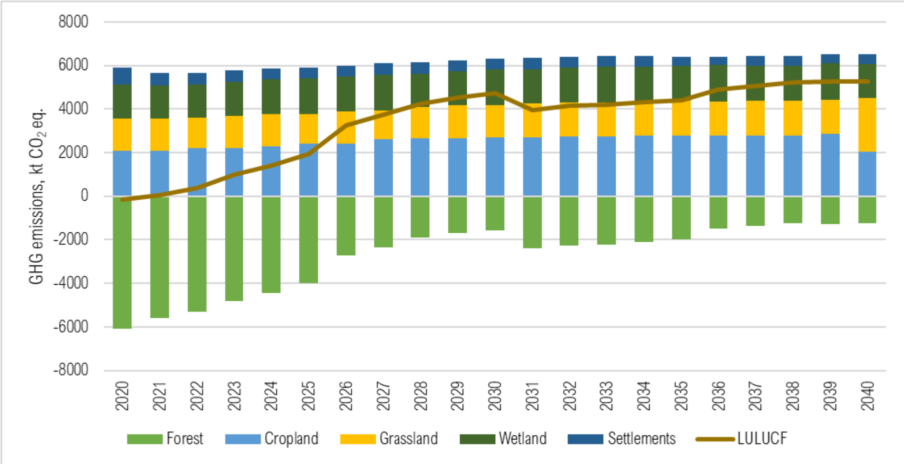


Figure 5.15 Net GHG emissions in LULUCF sector considering implementation of intensified scenario

5.2.4 Waste Management

Solid waste disposal

One of the main parameters to determining GHG emissions in SWD sector is biological waste content in disposal waste. For sensitivity analyses assumption that biological content is decreased faster by 10% for each 5 years in disposed waste.

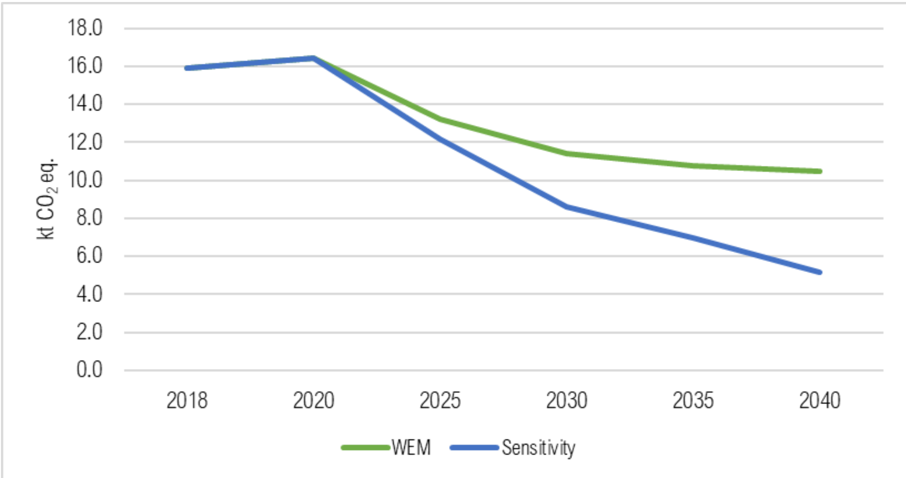


Figure 5.16 Results of SWD sensitivity analysis WEM scenario compared to sensitivity scenario

Results of analysis (Figure 5.16) show that in 2035, taking into account the different biological content in disposal waste, the total fluctuations in the SWD sector will be almost 3.8 kt CO_2 eq. by WEM scenario.

Macroeconomic factors, such as projections of value added for manufacturing industry and private consumption, are very important driving force, affecting activity data for emission calculation from the sector. Thus, they were selected for sensitivity analysis.

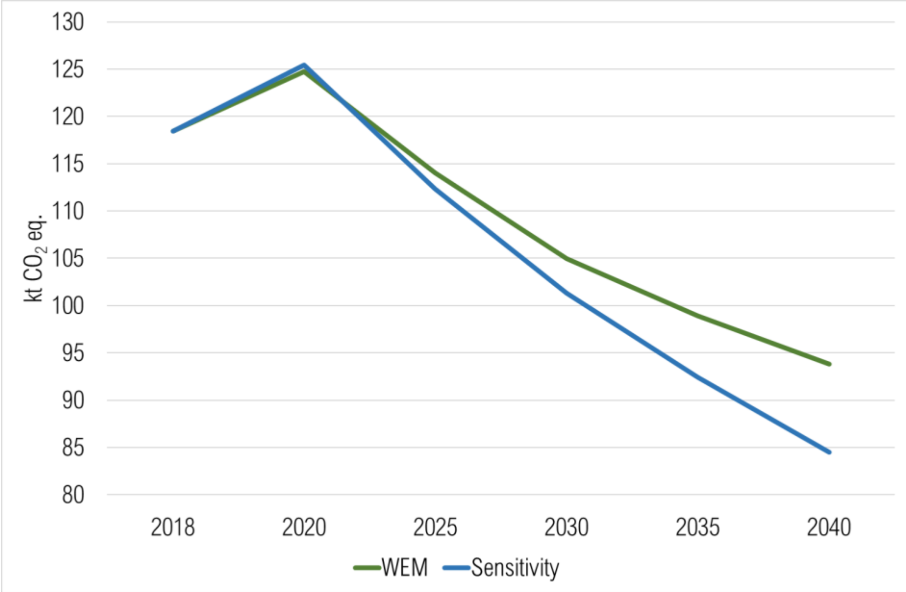


Figure 5.17 Results of sensitivity analysis on emissions in the waste water handling sector on the assumptions of the lower GDP and private consumption growth

The results of analysis (Figure 5.17) show that assumed slower growth rate of GDP and private consumption produce lower emissions – for example, 6.4% lower emissions by the 2020 and 16.2% lower emissions by the 2030.

5.3 Total effect of policies and measures

This chapter provides an overview of the impact due to already implemented policies and measures (PaMs) on the actual GHG emissions as well as the impact of implemented and planned PaMs on GHG emission projections.

The aggregated estimates for the GHG reduction impacts of already implemented individual PaMs, presented in chapter 4, are 602 kt and 727 kt CO_2 eq. for 2020 and 2030 (without LULUCF), respectively. It has to be underlined, the presented impact includes only the policies and measures implemented in Energy and Transport sectors.

Table 5.32 The total effect of the PaMs calculated based on estimated impact of PaMs for the year 2020, 2025 and 2030 (kt CO_2 eq./year)

GHG	Implemented measures		Planned measure	
	Total effect of PaMs in 2020	Total effect of PaMs in 2030	Total effect of PaMs in 2025	Total effect of PaMs in 2030
CO_2	600	710	69	131
N_2O	2	5	69	125
CH_4	0	12	7	27
Total	602	727	145	283

The planned measures will reduce GHG emissions increasingly after 2025 reaching an additional annual reduction of 283 kt CO_2 eq. in 2030. The impact assessment from the planned measures includes the Energy, Transport, Agriculture and Waste sectors. The total effect of the policies and measures by gas is shown in Table 5.32.

Considering the implemented measures, in the Energy sector the largest contribution in GHG emissions reduction is provided by the investment support measures to switch from fossil fuels to RES to produce the electricity and heat energy in the district heating system (Table 5.33). The energy efficiency improvement measures implementation in industry also provides a considerable contribution.

Table 5.33 Estimated effects of policies and measures implemented in Energy and Transport, by sector (kt CO_2 eq./year) (summary of account in chapter 4)

Sector	2020	2030
Electricity and District heating	306	269
Residential and Service sector	33	45
Industry	113	104
Transport	150	274

The total effect of policies and measures contains noticeable uncertainties. The impact estimates of individual policies and measures are not fully additive, which may result in an overestimation of the mitigation impact in certain sectors. To avoid overlapping of estimates, the several individual measures are considered as the single package and thus the impact of the whole package is evaluated. This approach is applied for particular cases if such combination of measures is applicable and rational, e.g., the typical case of such package comprises the information measures and economic measures (investment support programmes).

It should also be paid attention to the overlapping effect when evaluating the effect due to implementation of such measures as energy efficiency improvement in buildings and fossil fuel replacement by RES in heat supply. These are typical interacting measures and the overall impact of them usually is less than the total impact obtained as the summed impacts of individual measures.

The top-down evaluation method is another possibility both to avoid such overestimation and provide possibility to evaluate the impact of those types of policies and measures, which cannot be evaluated by bottom-up method, e.g., fiscal policies. In Latvia's Energy (including Transport) sector the top-down evaluation method has been done by applying MARKAL-LV model.

The assessment has been made by calculating the GHG emission trajectory for the no-action scenario ("without measures" scenario (WOM)) and the scenario with the existing policies (WEM scenario). In Figure 5.18, the WEM scenario shows the actual historical emissions for the period 2000–2020 and the calculated GHG emission projections by 2030, while the WOM scenario shows the GHG emission trajectory calculated with the model without implemented policies and measures after 2000.

In addition to the effects of the measures described in the policies and measures chapter, the assessment also takes into account the effects of cross-sectoral instruments, mainly taxes.

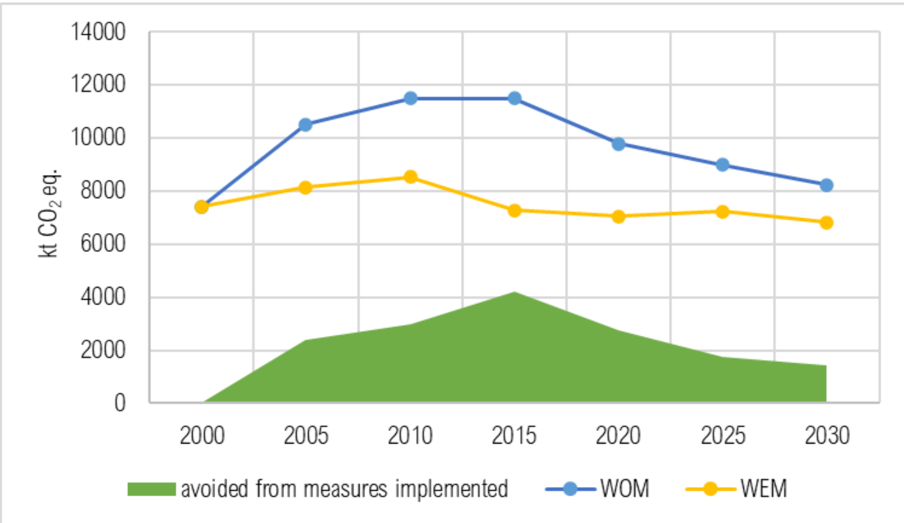


Figure 5.18 Estimated emissions "without measures" compared with historic and projected emissions "with existing measures"

The total estimated reduction of GHG emissions from the implemented measures by 2020 is 2739 kt CO_2 eq. The largest contributors to reducing GHG emissions by 2020 are the energy transformation sector (87%), followed by the transport sector (5.5%), industry (4.1%) and the household and tertiary sector (3.4%). The estimated effect from the implemented measures in the WEM scenario for 2030 is 1427 kt CO_2 eq. The largest contributors are the energy transformation sector (51.5%), the transport sector (41.5%) and the household and tertiary sector (7%).

5.4 Methodology

A summary information on the models used for the projections is provided in BR5 Table 7 (Description of implemented models for GHG projections).

5.4.1 Energy

To model the complex development of the Latvian energy system and perform calculation of GHG projections it is used internationally widely-applied partial equilibrium, bottom-up, dynamic, linear programming optimisation model MARKAL code for the energy-environmental system optimisation which we have been adapting to Latvia's circumstances since 1995 by creating the MARKAL-Latvia country model and applying it for the national level studies.

The MARKAL model is driven by useful energy demands, expressed in energy units or energy demands expressed as energy services in other units (e.g., lumen hours for lighting). The model integrates the end-use sectors and the supply side, holding descriptions of different energy sources and carriers that pass through the energy system's stages – transformation and distribution processes, energy end-use processes in all economic sectors, including a set of technological and energy efficiency options as well as associated emissions. The model is based on the minimization of the long term discounted cost of all modelled energy-environmental system. The system's cost includes investment and operation and maintenance costs for all technologies, plus costs of all fuels, minus the revenue from exported fuels, minus the salvage value of all residual technologies at the end of the modelled horizon. The model covers 11 periods of 5 years each, so that the modelled horizon covers 2000 to 2050, inclusive.

In the MARKAL-Latvia model the energy demand is divided in five main sectors – industry, residential, agriculture, commercial & service and transport – and further divided in subgroups or subsectors, e.g., energy consumption in the residential sector is divided into space heating and hot water in single or multifamily houses, the use of particular electrical appliances. The projection is calculated for each of these subsectors by linking directly or indirectly via elasticities and/or other indicators (e.g., energy intensities or specific consumption and changes in them, the number of households, persons per households, household area, etc.) to the economic development scenario (GDP, value added, private consumption, population). In the years 2000, 2005, 2010, 2015 and 2016, the actual installed capacities and activity levels of technologies are imposed, thus providing that the model results exactly represent the real system being modelled.

MARKAL determines future investments and activity of technologies at each time period, while ensuring demands, emission caps and sets of other different constraints.

Projection on prices of energy resources, as well as useful energy demand (energy service demand) or other secondary parameters, like the area of heated premises of buildings or mileage of cars that reflects the required amount of energy are needed as the input data in MARKAL model. Consumption of electricity and district heating is calculated internally within the model.

The model structure is adapted, so that emissions can be calculated not only by the type of fuel, but also by sector and corresponding type of technologies.

Demand for energy is directly linked with economic development, thus, the projected changes of consumption of useful energy are related to the long-term macroeconomic projections. For the purpose of developing energy demand scenario, the long-term macroeconomic projection up to year 2030 developed by the MoE, has been used. This projection has been applied in projecting electricity consumption, heat consumption, as well as fuel consumption in individual sectors.

Price projection of imported energy resources (oil products, natural gas, coal) have been developed based upon information from International Energy Agency World Energy Outlook (IEA WEO 2018, Existing Policy scenario). Prices of local energy resources depend on the geographical location of usage; therefore, the price may differ. Projection of average prices of these fuels have been developed based upon available statistics, various studies, taking into account the projection price trends of imported energy resources. Solid biomass (wood) is split to four price groups with difference available amounts of sources. Actual prices of energy resources are projected without taking into account taxes. All implemented taxes in Latvia are further added in the model.

5.4.2 Industrial Processes and Product Use

GHG emissions projections in the IPPU sector are calculated using top-down accounting model. The model includes both the projection of activity data and GHG emission calculation. For calculation of GHG emissions the historical emissions factors of the latest submitted inventory are applied and these factors are constant for all projected time period. In its turn, the necessary activity data are projected based on the historical data and the macro-economic parameters characterising the development of particular branch of industry sector (value added or industrial production index).

F-gas projections calculation is based on Microsoft Excel top-down accounting model. The structure and emission calculation are performed according to 2006 IPCC Guidelines and adjusted for projection estimation incorporating parameters according to macroeconomic projections.

The use of F-gases is projected taking into account:

- number of inhabitants, households and the number of freezing equipment (refrigerators and freezers) used;
- the development of the service sector and the amount of stationary refrigeration used in it;
- changes in the number of road transport which determine the amount of the used air conditioning systems in motor vehicles.
- The projection of F-gases under the WEM scenario is based on the assessed impacts of the EC Regulation on F-gases (517/2014) repealing Regulation 842/2006 and the EC directive on emissions from air conditioning systems in motor vehicles (2006/40/EC) (MAC Directive).

Solvent use. CO_2 emissions projections in the solvent use sector are based on number of inhabitant development scenario as well as based on number of entries in National Chemicals Database at LEGMC development scenario. The structure and emission calculation are performed according to EMEP/EEA 2019 and 2006 IPCC Guidelines.

5.4.3 Agriculture

Projections of emissions with existing measures are based on primary activity data provided by MoA in collaboration with LULST. Econometric scenario based model Latvian Agricultural Sector Analysis Model (LASAM) is used for the activity data generation of Latvian agriculture. LASAM provides an outlook for animal farming, producing projections in dairy, beef, sheep, goat, pig, poultry and horse farming and crop farming based on regression analysis principles. LASAM estimates a projection of the utilised agricultural (UUA) area and the structure of UUA, allow calculating the use of fertilisers in the agriculture sector. The source data for the calculations within the model are gathered from CSB, EUROSTAT, domestic use balance sheets and FADN. The exogenous price projections until 2025 are gathered from the DG AGRI of the EC and Food and Agriculture Organization of the United Nations, further projected by the team of LULST. The macroeconomic projections are integrated from the projected values of MoE.

Secondary data projections including manure management system distribution, nitrogen excretion of livestock, use of organic fertilizer nitrogen and nitrogen content in crop residues are done by LULST experts based on results of pre-defined project “Development of the National System for Greenhouse Gas Inventory and Reporting on Policies, Measures and Projections” under 2009–2014 EEA Grants Programme “National Climate Policy”. Methodological approach used for manure management distribution projections are available in Priekulis et.al 2015. Projections of managed organic soils are provided by LSFRI “Silava”.

Projections of GHG emissions from the agriculture sector in Latvia are estimated according to the 2006 IPCC Guidelines.

5.4.4 Land Use, Land Use Change and Forestry

The main data source for land use and carbon stock changes is NFI programme. Other data sources and research data are used as supplementary data sources, for quality assurance purposes as well as to provide activity data for those sources which are not covered by the NFI programme.

Area of organic soils in croplands and grasslands is updated according to the inventory of historical data about farmlands published in 2018. Area of cropland and grassland in LULUCF reporting is synchronized with Agriculture reporting, including recalculation of cultivated organic soils.

The NFI and research data are used to estimate time series for areas and gross increment. Mortality data are calculated on the base of the NFI data and AGM model outputs (Lazdiņš et.al., 2019). Distinction between forest land remaining forest land and areas converted to forest land is made according to the age of dominant species in forests on afforested land – if age of dominant species is less than zero in 1990, it is considered as land converted to forest, in other cases it is considered as forest land remaining forest land.

Changes of organic carbon in litter and soil organic matter in naturally dry and wet soils are assumed to be zero according to research data on carbon stock in forest soil in 2006 and 2012. Carbon stock changes are reported separately on naturally dry and wet mineral and organic soils and drained mineral and organic soils. Conversion of forests on drained organic soils to forest on naturally wet soil is reported as rewetting.

The activity data for calculation of emissions due to incineration of harvesting residues in clear-cuts was based on the study until 2010. Now a questionnaire for private forest owners on utilization of harvesting residues is used. According to this questionnaire in 2005-2009 about 7% of residues are left for incineration and in 2010-2015 – 4.13% of the residues are incinerated. In case of on-site incineration of harvesting residues during commercial harvesting, all emissions also are applied to the forest land remaining forest land category, because no commercial felling takes place in young stands (younger than 20 years) on land converted to forest land.

5.4.4.1 Activity data

Forest land

Calculations of carbon stock changes and GHG emissions in forest lands are based on activity data provided by the NFI (area, living biomass and dead wood) and Level I forest monitoring data (soil organic carbon). National statistics (State forest service) are used to estimate historical commercial felling (1990-2011) related emissions and removals, but since 2012 NFI data are used to estimate emissions due to commercial felling. The calculation of GHG emissions and CO_2 removals in historical forest lands is based mainly on research report “Elaboration of the model for calculation of the CO_2 removals and GHG emissions due to forest management" and factors and coefficients elaborated within the scope of the research program on impact of forest management on GHG emissions and CO_2 removals (Lazdiņš et.al., 2013).

Cropland

Total area of cropland in Latvia in 2019 is 1467.7 kha, including 1368.2 kha of cropland remaining cropland. Activity data for calculations of emissions from organic soils are provided by research project (Petaja et.al., 2018). Area of land remaining cropland is estimated using NFI data.

Grassland

Total area of grassland in Latvia in 2019 is 1031.9 kha, including 457.4 kha of grassland remaining grassland. Grassland remaining grassland is divided into mineral and organic soils. Area of the grassland is estimated using research data (Krumšteds et.al, 2019) on the base of NFI data analysis.

It is assumed that mineral soils are neither a source nor sink of CO_2. Organic soils and amelioration ditches in grasslands are accounted as a source of methane also as it is recommended in IPCC 2014 Chapter 2.

Settlements

Under the settlements category emissions from soil, litter, living and dead biomass due to conversion of land use type are reported. Removals in living and dead biomass in settlements are accounted using the NFI.

The total area of settlements is estimated according to the information provided by the NFI. Total area of settlements in 2019 was 311.0 kha including 262.5 kha. Increase of area of settlements (mainly deforestation) is generally associated with road construction. All road categories, including forest roads are reported in the settlements category; therefore, the deforested area is considerably higher than official statistics, where forest roads are not accounted as deforested area. Area of organic soils in settlements is determined according to forest type before deforestation and digitized historical soil maps.

Wetlands

According to the 2006 IPCC Guidelines wetlands include land that is covered or saturated by water for all or part of the year and that does not fall into the forest land, cropland, and grassland or settlement categories. Total area of managed wetlands including peat-lands drained for peat extraction is reported according to the research results (Lazdiņš et.al 2019). Total area of wetlands in 2019 is 399.7 kha, including 32.7 kha of peat extraction sites and 4.1 kha of flooded lands.

5.4.4.2 Methodologies and emission factors

Methodologies in calculation of the GHG emissions are based on the Latvia`s National GHG inventory for 1990-2020.

Forest land

Carbon stock change in living and dead woody biomass is based on data provided by the NFI. Emissions from drained organic soils are accounted using emission factor 0.52 tonnes C ha^{-1}, 2.8 kg N_2O-N ha^{-1} and 2.5 kg CH_4 ha^{-1} yr^{-1}.

GHG emissions from rewetted forest sites are estimated using default emission factors – 0.5 tonnes C ha^{-1} and CH_4 emissions – 216 kg CH_4-C ha^{-1} yr^{-1}. CO_2 emissions are calculated using equation 3.3 complemented by equations 3.4 and 3.5 of the IPCC Wetlands Supplement. Emission factor for CO_2-C (0.5 tonnes CO_2-C ha^{-1} yr^{-1}) is taken from table 3.1 of the IPCC Wetlands Supplement. N_2O emissions from rewetted organic soils according to Tier 1 method are assumed to be negligible and are not estimated. CH_4 emissions are calculated applying Tier 1 method using equation 3.7 of the IPCC Wetlands Supplement. Default emission factor (216 kg CH_4-C ha^{-1} yr^{-1}) from table 3.3 of the IPCC Wetlands Supplement is used.

Cropland

Carbon stock change in living and dead woody biomass is based on data provided by the NFI. Carbon stock in living and dead biomass is calculated using the same coefficients as in calculations of carbon stock changes in forested land.

Net carbon stock changes in mineral soil in cropland are reported as not occurring because no significant changes in management systems took place since 1990 and according to Tier 1 method of the 2006 IPCC Guidelines Chapter 5 the carbon stock changes in mineral soil should be reported in case of changes in management practice.

CO_2 emissions from drained organic soils in croplands are calculated using national CO_2 emission factor - 4.80 t CO_2-C ha^{-1} yr^{-1}.

Unlike to cropland remaining cropland carbon stock change in living biomass in forest land converted to cropland is calculated as losses in living biomass due to felling of trees, considering average carbon stock in living biomass in forest land remaining forest in a particular year. Losses in dead wood are accounted similarly, as loss of average carbon stock in dead wood in a particular year. Carbon stock in litter is considered as constant value 12.14 ± 2.8 tonnes C ha^{-1}. Instant oxidation method is applied to living biomass, dead wood and litter carbon pools.

The initial carbon stock in mineral forest soil at 0-30 cm depth (reference C stock) is 82.6 ± 7.8 tonnes ha^{-1} according to study results (Lazdiņš et al. 2013). Initial carbon stock at 0-30 cm depth in grassland is considered 77 ± 6.9 tonnes ha^{-1}. The carbon stock in forest land converted to cropland after transition period of 20 years according to the equation 2.25 is 79.4 t C ha^{-1} at 0-30 cm depth (default reference soil organic C stock for mineral soils 115 t C ha^{-1} according to the Table 2.3 in the 2006 IPCC Guidelines was used for calculation). Respectively, reduction of carbon stock in mineral soils is 3.3 t ha^{-1} or 0.16 t C ha^{-1} annually.

In organic soil of forest land converted to cropland, grassland converted to cropland and wetlands converted to cropland the factor for cropland remaining cropland (4.80 t C ha^{-1} annually) is used to estimate carbon stock changes.

Grassland

Woody biomass increment are taken from the NFI, but the historical data sets are recalculated (Jansons, 2007). Mortality factors are taken from forest land assuming that mortality in grassland is equal to average mortality in forest land. Decay period for dead wood is considered 20 years according to 2006 IPCC Guidelines.

National CO_2 emission factor (4.40 t CO_2-C ha^{-1} yr^{-1}) for drained organic soils in grassland is used. Emission factors for CH_4 emissions from drained organic soil and amelioration ditches are, respectively, 57.80 kg CH_4-C ha^{-1} yr^{-1} and 1165 kg CH_4 ha^{-1} yr^{-1} according to research results and Table 2.4 in IPCC Wetlands Supplement.

N_2O and CH_4 emissions from biomass burning are calculated according to the Tier 1 methodology in 2006 IPCC Guidelines using country specific activity data.

Methane emissions from ditches on organic soils have been included in estimates also for lands converted to grasslands and it is calculated with the same approach as grassland remaining grassland.

Settlements

The CO_2 removals are accounted for living and dead biomass categories in settlements remaining settlements based on the NFI data. Removals are accounted based on weighted gross increment, mortality factors, BEFs, carbon content and wood density in a particular year in forest land. For emissions from dead wood pool in settlements remaining settlements 20 years transition period is considered.

Emissions from soils in settlements remaining settlements are calculated according to 2006 IPCC Guidelines Tier 1 method. It is assumed that inputs equal outputs so that settlement mineral soil C stocks do not change in settlements remaining settlements. Emissions from organic soils in settlements remaining settlements are calculated using equation 2.26 in IPCC 2006. Emissions from organic soils are calculated using emission factors for cultivated organic soils. Annual emission factor for cultivated organic soils in cool temperate climatic temperature regime is 7.9 tonnes C ha^{-1} yr^{-1}.

The emissions (losses in carbon pools) are reported under category forest land converted to settlements. Carbon stock changes associated with commercial felling, including removal of woody vegetation on forest infrastructure (roadsides, ditches etc.) are accounted considering that losses in living biomass are equal to average growing stock in forest land remaining forest in a particular year. Similarly, dead wood stock in forest land remaining forest in a particular year is considered as carbon losses from dead wood due to conversion of forest land to settlements. Instant oxidation method is considered for living and dead wood carbon pools. Carbon stock changes in dead biomass are accounted considering that all dead biomass converts to emissions in the year of the land use change. Average carbon stock in dead biomass (12.14 tonnes C ha^{-1} in litter and 6.0 tonnes C ha^{-1} in dead wood).

The change in soil C stocks for land converted to settlements is computed using equation 2.24 in 2006 IPCC Guidelines, which combines the change in soil organic C stocks for mineral soils and organic soils. Change in soil organic C stocks in mineral soils is estimated using Equation 2.25 in 2006 IPCC Guidelines. Emission from mineral soil is accounted assuming that carbon accumulated in upper 30 cm (82.6 tonnes C ha^{-1}) partially turns into emissions within 20 years (0.8 tonnes C h^{-1} annually). The impact factor (F_{LU} x F_{MG} x F_I) is 0.8.

Wetlands

Latvia reports CO_2 emissions associated only with industrial peat extraction and flooded or rewetted land in this category. The rest of the area of wetlands is not managed and CO_2 emissions are not calculated, exception is area with woody vegetation located adjacent to water courses or water body and which does not fit to definition of forest land category.

Emission factor for carbon stock changes (1.2 tonnes C ha^{-1} yr^{-1}) due to amelioration is taken from recent studies (Lazdiņš, A., Lupiķis, A., 2019). N_2O emissions from peat extraction fields equals to 0.44 kg N_2O-N h^{-1} yr^{-1}, CH_4 emissions from amelioration ditches equals to 542 kg CH_4 ha^{-1} yr^{-1} (area of ditches 5%) and from the remaining area 10.83 kg CH_4 ha^{-1} yr^{-1}. CO_2 emissions from rewetted and flooded areas equals to 0.5 tons C ha^{-1} yr^{-1}, DOC emissions – 0.24 tons C ha^{-1} yr^{-1} and CH_4 – 216 kg C ha^{-1} yr^{-1}. Emissions from rewetted and flooded lands are estimated according to IPCC 2014 Wetlands supplement.

Carbon content in air dry peat (0.45 tonnes C per tonne of peat) is considered according to Table 7.5 of 2006 IPCC Guidelines. Moisture of peat reported in national statistics is considered 40%.

Direct N_2O emissions

Direct N_2O emissions from amelioration of organic soils are estimated for forest land and wetlands. Direct N_2O emissions from N mineralisation associated with loss of soil organic matter from change of land use or management are estimated for settlements remaining settlements and land-use change to croplands and settlements.

Direct emissions of N_2O due to amelioration of organic soils are calculated according to Equation 2.7 of the IPCC 2014 and country specific factors, e.g. for wetlands, as mentioned above.

N_2O emissions from land converted to another land-use category on drained organic soils are calculated in the same way as emissions from land remaining in a land-use category.

Direct N_2O emissions in cropland and grassland are calculated in agriculture sector.

Indirect N_2O emissions

Indirect N_2O emissions corresponding to land-use change from N mineralisation associated with loss of soil organic matter from change of land use or management are estimated for land-use change to croplands and settlements with mineral soils. Indirect N_2O emissions from land use change to cropland are calculated according to 2006 IPCC Guidelines. Amount of N_2O-N emissions produced from leaching and run-off as a result from land use change to cropland are estimated by Tier 1 methodology using equation 11.10, which is supplemented by equation 11.8 from 2006 IPCC Guidelines.

Indirect N_2O emissions from land use change to settlements are also accounted using the 2006 IPCC Guidelines Tier 1 method. Amount of N_2O-N emissions produced from leaching and run-off as a result from land use change to settlements are estimated using equation 11.10 supplemented by equation 11.8 from 2006 IPCC Guidelines. For estimation of annual amount of N mineralised in mineral soils as a result of leaching/run-off associated with loss of soil carbon thorough land use change to settlements, C:N ratio 15 for soil organic matter based on expert judgement is utilized. Loss of 20% of soil carbon in land converted to settlement is used to estimate carbon stock changes. Default values of fraction of all N added to mineralised in managed soils due to leaching and run-off (0.3 kg N (kg of N additions)$^{-1}$) and emission factor for N_2O emissions from N leaching and run-off (0.0075 kg N_2O-N (kg N leached and run-off)$^{-1}$) are taken from table 11.3 of 2006 IPCC Guidelines.

CH_4 emissions

Drained organic soil in forest land is source of CH_4 emissions. CH_4 emissions are calculated by equation 2.6 in IPCC 2014. The CH_4 emission factor for organic soils of drained forest land (table 2.3 and table 2.4 in IPCC 2014) is 2.5 kg CH_4 ha^{-1} yr^{-1} and emission factor for amelioration ditches is 217 kg CH_4 ha^{-1} yr^{-1}. Fraction of the total area of drained organic soil that is occupied by ditches is 0.025 (Table 2.4 in IPCC 2014).

Drained organic soil in cropland is another source of CH_4 emissions. CH_4 emissions are calculated by equation 2.6 in IPCC 2014. The emission factor for organic soils (Table 2.3 and Table 2.4 in IPCC 2014) is 0 ± 2.8 kg CH_4 ha^{-1} yr^{-1} and emission factor for amelioration ditches 1165 ± 830 kg CH_4 ha^{-1} yr^{-1}; respectively, only CH_4 emissions from ditches are calculated.

Emission factors for CH_4 emissions from drained organic soil and amelioration ditches in grassland are respectively 16 kg and 1165 kg CH_4 yearly according to Tables 2.3 and 2.4 in IPCC 2014. In grassland, emission factors for CH_4 emissions from drained organic soil and amelioration ditches are, respectively, 57.80 kg CH_4-C ha^{-1} yr^{-1} and 1165 kg CH_4 ha^{-1} yr^{-1} according to research results and Table 2.4 in IPCC 2014. Fraction of the total area of drained organic soil that is occupied by ditches is 0.05 (Table 2.4 in the IPCC 2014).

Harvested wood products (HWP)

The net emissions from the harvested wood products are calculated according to the methodology elaborated by Rüter, S., 2011. The methodology corresponds to Tier 2 for HWP in IPCC 2014b. Three main HWP groups are used in calculations – sawnwood, wood based panels and paper and paperboard.

The proportion is calculated to estimate share of harvesting stock extracted due to deforestation and is used to calculate share of domestic industrial roundwood. This proportion is applied to HWP to estimate how much HWP could be produced from wood obtained in deforested areas. Instant oxidation is applied to the proportion of HWP potentially produced from the wood obtained in deforested areas.

The coefficients and numeric values used in calculation are default conversion factors recommended in IPCC 2014b. Input data in calculation are extrapolated to 1900.

5.4.5 Waste Management

Solid waste disposal

Two separate IPCC Waste Model (2006) calculations were used. One for unmanaged sites (closed dumpsites) and other for managed (landfills since 2002). For unmanaged sites calculation method for bulk wastes was used, because there is no correct information about disposed waste content available. According to the Ltd "Virsma" research 2011– DOC factor for these calculations was used as 0.17. Other factors are default from IPCC guidelines.

For managed sites method "waste by composition" in IPCC Waste Model (2006) was used. DOC and k values and other factors are taken from IPCC 2006 guidelines. Waste composition is taken from Ltd "Virsma" research 2011 (Table 5.34).

Table 5.34 Average waste composition in landfills in Latvia (%)

	Paper	Plastics	Organic (food, hygiene waste, other organics)	Wood	Textile, rubber	Minerals (ceramics)	Glass	Metals
Average in Country	6.40	8.54	47.90	2.11	3.35	8.69	20.64	2.36

Composting

Projected CH_4 and N_2O emissions from composting are calculated according to 2006 IPCC Guidelines. Emission factors are multiplied with composted waste amounts. Composted waste amount in households is projected according to changes in population, but industrially composted amounts are projected according to time series from 2003 till 2019. From year 2020 increase of industrial composted amounts till 130 000 tons is projected due to information about direct investments in Latvia waste companies.

Waste water handling

Following approaches were used for projections of activity data to estimate projected emissions of GHG from waste water handling sector:

For CH_4 emissions from domestic/commercial waste water handling subsector:

- Projections of national population;
- Expected distribution of national population by type and level of treatment, based on historical trends and requirements of UWWTD;
- Projections of sewage sludge production based on its correlation with private consumption and historical trend of share of anaerobic sludge.

For N_2O emissions from domestic/commercial waste water handling subsector:

- Projections of national population;
- Projections of protein consumption based on its correlation with private consumption;
- Expected rate of national population served by modern centralized treatment plants, based on historical trends and requirements of UWWTD.

For CH_4 and N_2O emissions from industrial waste water handling subsector, projections of GDP for manufacturing industry sector. Based on projected activity data emission projections were calculated according to 2006 IPCC Guidelines. Country-specific emission factors were used to calculate CH_4 emissions, but for emissions of N_2O default IPCC emission factors were used. No changes in emission factors were made for emission projections.

More detailed description of methodology and emission factors can be found in the Latvian National Inventory Report submitted on 14 April 2022 to UNFCCC secretariat.

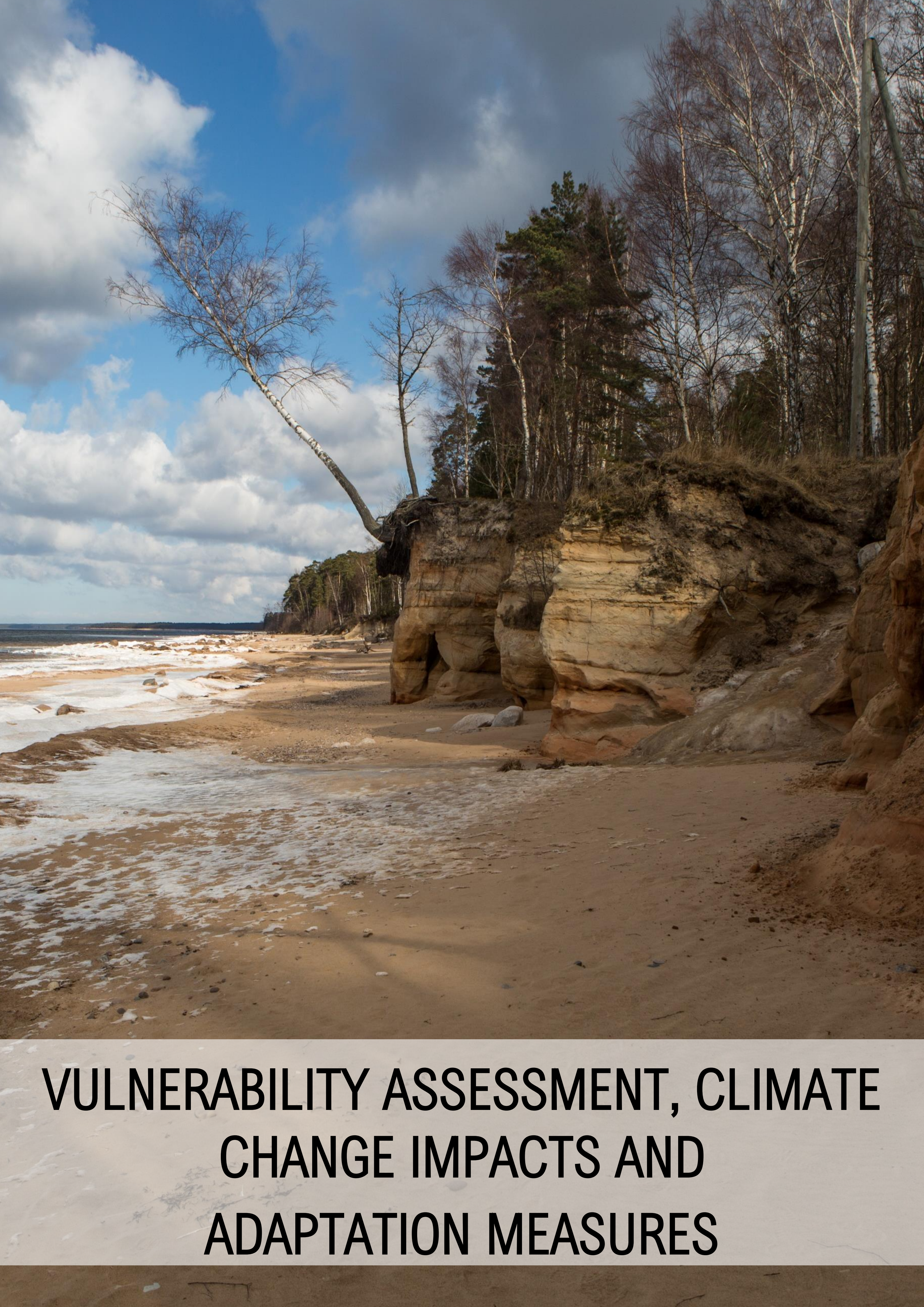
5.5 Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17

Within EU, supplementarity obligations under the KP require that any international credit purchases by Member States must be in addition to emission abatement action taken domestically. The use of flexible mechanisms within the EU takes place by operators in the EU ETS and by governments in their achievement of Kyoto targets. Latvia has fulfilled its KP target for the first commitment period. The target was met on the basis of the domestic policies and measures (including EU-ETS).

In the True-up Period Report (report upon expiration of the additional period for fulfilling commitments by the Latvia) in section IV (Other information) the total quantity of units in the retirement account as well as the total quantity of units requested to be carried over to the second commitment period was reported. There are no plans to use credits to meet national climate targets. For more information see chapter 4.3.1.

References

- Jansons, J. (2007). Methods utilized to recalculate historical forest increment data – research report [Online]. LSFRI Silava. p. 21.
- Krumšteds, L. L., Ivanovs, J., Jansons, J., & Lazdiņš, A. (2019). Development of Latvian land use and land use change matrix using geospatial data of National forest inventory. Agronomy Research, 17. https://doi.org/10.15159/AR.19.195.
- "Latvia's National Inventory Report Submission under UNFCCC and the Kyoto Protocol Common Reporting Formats (CRF) 1990 – 2020" (Riga: Latvian Environment, geology and meteorology centre)
- Lazdiņš A. (2012), Forest Data National Modelling Tool in Latvia (Swedish Environmental Protection Agency, Sweden, Stockholm, Valhallavägen 195, room Sarek, 2012); Andis Lazdiņš, Jānis Donis, and Līga Strūve, Latvia's National Methodology for Reference Level of Forest Management Activities (English Summary) (LSFRI Silava, 2012).
- Lazdiņš, A., Butlers, A., & Lupiķis, A. (2019). Contribution of LIFE REstore project to improvement of activity data for accounting greenhouse gas emissions due to management of wetlands. Sustainable and Responsible Management and Re-Use of Degraded Peatlands in Latvia, 23.
- Lazdiņš et al. 2013. Mežsaimniecisko darbību ietekmes uz siltumnīcefekta gāzu emisijām un CO_2 piesaisti novērtējums. Pārskats par 2013. gada darba uzdevumu izpildi (Evaluation of impact of forest management practices on greenhouse gas emissions and CO_2 removals. Report on performance of tasks in 2013).
- Lazdiņš, A., & Lupiķis, A. (2019). LIFE REstore project contribution to the greenhouse gas emission accounts in Latvia. In A. Priede & A. Gancone (Eds.), Sustainable and responsible after-use of peat extraction areas (pp. 21–52). Baltijas Krasti.
- Lazdiņš, A., Šņepsts, G., Petaja, G., & Kārkliņa, I. (2019). Verification of applicability of forest growth model AGM in elaboration of forestry projections for National forest reference level. Proceedings of the 9th International Scientific Conference Rural Development 2019, 289–294. https://doi.org/10.15544/RD.2019.065
- Lazdiņš A. & Zariņš J. 2013. Greenhouse gas emissions in Latvia due to incineration of harvesting residues and forest fires (Meža ugunsgrēku un mežizstrādes atlieku dedzināšanas radītās siltumnīcefekta gāzu emisijas Latvijā), In: Referātu Tēzes. Presented at the 71st Scientific Conference of University of Latvia, Section "Ģeogrāfija, ģeoloģija, vides zinātne". University of Latvia, Riga, pp. 133–137.
- Lazdiņš et al. 2013. Support for the climate research programme. Report on performance of tasks in 2013 (Atbalsts klimata pētījumu programmai. Pārskats par 2013. gada darba uzdevumu izpildi) Salaspils, 2013.
- Līpiņš L. 2004. Assessment of wood resources and efficiency of wood utilization (Koksnes izejvielu resursu un to izmantošanas efektivitātes novērtējums), Latvia University of Agriculture.
- Reporting on Policies and Measures under Article 18 of Regulation (EU) No. 2018/1999 of the European Parlament and of the Council, available at https://reportnet.europa.eu/public/country/LV
- Rüter S., (2011), "Projection of Net-Emissions from Harvested Wood Products in European Countries" (Hamburg, 2011)
- Petaja, G., Okmanis, M., Polmanis, K., Stola, J., Spalva, G., & Jansons, J. (2018). Evaluation of greenhouse gas emissions and area of organic soils in cropland and grassland in Latvia – integrated National forest inventory data and soil maps approach. Agronomy Research, 16(4), 1809–1823. https://doi.org/10.15159/ar.18.183
- Priekulis J., Aboltins A.., Laurs A., Melece L. Research in manure management in Latvia / 14th International scientific conference "Engineering for rural development" : proceedings, Jelgava, Latvia, May 20 - 22, 2015 Latvia University of Life Sciences and Technologies. Faculty of Engineering. - Jelgava, 2015. - Vol.14, p.88-93. Available: http://tf.llu.lv/conference/proceedings2015/Papers/015_Laurs.pdf
- Simon Eggleston et al., eds., "2006 IPCC Guidelines for National Greenhouse Gas Inventories. Agriculture, Forestry and Other Land Use," in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, vol. 4 (Japan: Institute for Global Environmental Strategies (IGES), 2006), 678.
- Takahiro Hiraishi et al., "2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands" (Switzerland, 2013), http://www.ipcc-nggip.iges.or.jp/public/wetlands/pdf/Wetlands_Supplement_Entire_Report.pdf.



VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

6. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

6.1 Climate modelling, projections and scenarios, observed patterns of climate change

6.1.1 Climate change modelling, projections and scenarios

Monitoring of climate change and climate change adaptation system in Latvia consists of two parts. The first is based on climate change analysis, while the second is based on a sectoral vulnerability assessment:

1. **Climate change monitoring** is carried out by summarizing and analysing selected meteorological parameters and climate indexes, their changes over time and trends.

2. **Climate change impact monitoring** database maintains the selected climate change impact indicators, in order to monitor sector's vulnerability to observed climate change.

In Latvia the LEGMC is the Latvian National Hydrometeorological and Climate Service and is responsible institution for developing of climate change monitoring, modelling, projections and scenarios.

LEGMC performs climate monitoring by continuous climate change data collection, as well as monitoring extreme events, data storage and analyses of long-term observation results. LEGMC ensures implementation of the "State Environmental Monitoring Programme 2015 – 2020" which consists of four parts: 1) air and climate change monitoring, 2) water (surface and groundwater) monitoring, 3) land (incl. coastal zone erosion) monitoring, and 4) biodiversity monitoring. LEGMC observation network is established and connected with interactive map where data from meteorological observations is provided. Regarding flood risks in Latvia, LEGMC has developed flood risk management plans and early flood warning systems for all river basin districts of Latvia. Flood risk information system and maps are published online[21,22].

LEGMC prepares reports and provides information to the public, to the State and local governments, and to international organizations. It also provides services for customers, including national aviation authorities, Latvian National Armed Forces, civil protection authorities and energy companies. Climate change information is presented in various formats, tailored to the user needs. LEGMC regularly publishes 10-day weather data, summarizing the recent climatic events and putting them in context of climate change. LEGMC also actively publishes information on social networks, regarding climate monitoring, projections and advances in the climate change research. Information regarding specialized climate indices is prepared for various stakeholders, for example standard precipitation index (SPI) for agriculture and insurance companies.

LEGMC experts have also conceptually designed a system for monitoring adaptation to climate change on a national scale. Such monitoring system is essential for further development of national political strategies, since it consists of data and indicators that measure vulnerability of different economic sectors (e.g., health and welfare, agriculture, forestry, civil engineering) due to climate change.

Regarding climate modelling, projections and climate change scenarios, LEGMC has performed a detailed analysis of long-term historical climate data and, in collaboration with the Finnish Meteorological Institute, developed future change scenarios (until year 2100)[23]. Climate change scenarios correspond to the projected values of either average or high amounts of GHG emissions based on the Fifth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC 5th Assessment Report). Multiple climate models are adapted to territory of Latvia by bias correction and statistical downscaling methods. Results are

[21] https://videscentrs.lvgmc.lv/iebuvets/pludu-riska-un-pludu-draudu-kartes
[22] https://videscentrs.lvgmc.lv/iebuvets/hidrologiskas-prognozes
[23] http://www4.meteo.lv/klimatariks/zinojums.pdf

extensively analysed by team of analysts and climatologists, and improved by comparing them to the latest climate change monitoring results. Work has begun on the development of future climate change scenarios for Latvia based on the Shared Socioeconomic Pathways (SSP) scenarios from the Sixth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC 6th Assessment Report).

For wider public the visualization of the climate change scenarios is available online in the Climate Change Analysis Tool http://www4.meteo.lv/klimatariks/. Climate Change Analysis Tool allows to explore current and projected future climate scenarios in Latvia in the form of maps and graphs. Maps display 30-year average values of the selected climate indices. A summary report of these results is available as well as all the data is freely downloadable for further scientific research.

6.1.2 Observed patterns of climate change

Recently the LEGMC have carried out several studies of climate changes. In the report "Climate Change Scenarios for Latvia" LEGMC has analysed past climate changes in Latvia and developed climate change scenarios for Latvia for the period until the year 2100. Following this report, a number of further studies have been developed, analysing past and future changes to parameters that were not covered by the above-mentioned report: snow cover, the Standard precipitation index and maximum wind gusts. Projected climate changes for future time periods are based on the RCP 4.5 and RCP 8.5 scenarios developed for the IPCC 5th Assessment Report. The conclusions in this chapter are based on the results described in conclusions of LEGMC's reports.

Under the impact of recent climate change, one may observe a uniform increase of air temperature, expressed in mean, minimum and maximum air temperature values. Most changes have been observed in winter and spring seasons. Under the impact of the general air temperature increase the length of growing season and the number of summer days and tropical nights has increased while the number of frost days and ice days has decreased. Upon analysing climate model projections for future periods, a further temperature increase is clearly seen. Under its impact the length of growing season and the number of summer days and tropical nights will continue growing, and the number of frost days and ice days will be falling.

In the period from 1961 to 2010 an increase in precipitation, especially in winter and spring seasons is observed. Also, precipitation intensity has increased, which in turn has increased both the intensity and frequency of extreme precipitation events. Up to 2100 a further increase in precipitation amount is expected, and it will be more determined by the projected precipitation intensity increase. The increase in precipitation amount is also seen in the future forecasts of the Standard precipitation index, however droughts will also persist. Therefore, it is apparent that changes are expected to occur in both the average precipitation amount and extremes.

In Latvia there has been a significant decrease in the average thickness of the snow cover, as well as a statistically significant negative trend in the number of days with a snow cover. Based on climate models forecasts', the reduction in the average snow cover thickness in Latvia will continue. On the other hand, there is no notable change in the thickness of the annual maximum snow cover.

In the long-term period, average wind speed curve is trending slightly downwards and, although climate model projections show an uncertainty, they mostly confirm continuation of this tendency up to the end of the 21st century.

There is no notable trend in peak wind gusts in the long-term period, although there is an increase in number of days with wind gusts at least 15 m/s. In future climate projections peak wind gusts appear to be declining.

Analysis of recent climate and future climate change scenarios shows notable climate change tendencies. Most significant changes are related to the extreme values of climate variables, indicating that in the future Latvia will more often face uncharacteristic and extreme weather conditions.

Table 6.1 summarizes the observed and projected changes in the Latvian climate based on the recently developed reports.

Table 6.1 Previous and future changes (according to the RCP4.5 and RCP8.5 scenarios) in climate variables in relation to the long-term mean climate variable values in the past

Climate variables	Previous changes (1981-2020 with respect to 1961-1990)	Future changes (2071-2100 with respect to 1961-1990)
Maximum air temperature	Annual mean value of maximum air temperature has increased by 1.1°C, while maximum and minimum value - by 1.4°C	Annual mean maximum air temperature, according to moderate and significant climate change scenarios, can increase by 3.4-5.4°C, while a more rapid increase for extreme values is projected - annual maximum temperature by 3.6-5.7°C. Annual minimum value of maximum air temperature can increase by 6.5-9.5°C
Mean air temperature	Annual mean and maximum value of minimum air temperature have increased by 1.1°C and 1.2°C respectively, while minimum value - by 1.6°C	Until the end of century, annual mean air temperature can increase by 3.5- 5.5°C, while annual maximum value – by 3.2-5.4°C. Annual minimum value of mean air temperature is projected to increase by 7.5-11°C
Minimum air temperature	Annual mean and maximum value of minimum air temperature have increased by 0.9°C and 0.6°C respectively, while minimum value - by 2.1°C	Most significant increase is projected for annual minimum air temperature: 9.5-13.5°C, while for annual mean and maximum values - from 3.1°C and 3.6°C, respectively, to 5.6°C
Summer days	Due to observed climate change there is increase in number of summer days by 7 days	By the end of 21st century, the projected increase of summer days on average is 31 to 53 days
Tropical nights	Latvia has always had a small number of tropical nights, so no valid conclusions about the trends in changes of the number of such nights can be made, however, an increase in the frequency of such nights has been observed during the last couple of decades	The number of tropical nights by year 2100 can increase by 4 to 14 nights

Climate variables	Previous changes (1981-2020 with respect to 1961-1990)	Future changes (2071-2100 with respect to 1961-1990)
Growing season length	The general increase in air temperatures has also affected the length of the growing season - by an average of 4 additional days per year since 1961	It is expected that by 2100 the increase of air temperatures will affect the duration of the growing season – the scenarios project an extension of the growing season by 27 to 49 days
Frost days	During the observed period, the average number of frost days in Latvia has decreased by 8 days per year	The number of frost days may decrease by an average of 52 to 81 days per year and according to significant climate change scenario in the most part of Latvia the reduction is projected at over 80 days per year
Ice days	Similar to frost days, the average number of ice days in Latvia has decreased on average by 13 days per year	By 2100, the number of ice days will probably decrease by 32 to 46 days. It is important to note that certain models already project a number of ice days within the range from 0 to 10 in the near future
Precipitation totals	The past climate change has resulted in the increase of the amount of precipitation in Latvia by an average of 5%, or about 35 mm	By the end of the century, an increase of the total annual precipitation by 13 to 16% (about 80-100 mm) is projected according to moderate and significant climate change scenarios respectively
Highest 1-day precipitation amount	On average, the annual maximum diurnal precipitation amount in Latvia has increased by about 2 mm	The maximum amount of one-day precipitation amount probably will increase by 3 to 6 mm
Highest 5-day precipitation amount	In last 60 years, the maximum 5-day precipitation amount on average has increased by 3 mm	The maximum amount of 5-day precipitation amount may increase by 9 to 12 mm
Simple daily intensity index	At the end of the discussed period, the simple daily intensity index is higher by 0.2 mm/per day than at the beginning of the period	The scenarios project an increase of the intensity of precipitation – by about 0.1 to 1.3 mm/per day
Heavy precipitation days	Within the discussed period, the average number of days with heavy precipitation has increased by 2 days	By the year 2100, the number of days with heavy precipitation will increase by an average of 3 to 5 days

Climate variables	Previous changes (1981-2020 with respect to 1961-1990)	Future changes (2071-2100 with respect to 1961-1990)
Very heavy precipitation days	Contrary to the trend of increased precipitation amount and intensity, number of days with very heavy precipitation has on average decreased by 1 day	According to the climate change scenarios, the number of days with very heavy precipitation will increase by 2 to 3 days
Dry year and season rate	The past increase in SPI (Standardized precipitation index) values have resulted in decrease in rate of dry years by 10% since 1961	In future rate of dry seasons and years will continue decrease, but by the year 2100 in summer is projected an increase in dry season rate
Wet year and season rate	Meanwhile the past increase in SPI values have resulted in increase in rate of wet years by 4% reaching average 20% in last 30 years	The rate of wet seasons will continue to increase. Even in summer where is projected decrease in SPI values and increase of dry summer rate, only in RCP 8.5 scenario is projected decrease and only 1%
Average snow cover thickness	Average snow cover in Latvia since 1961 has reduced by 3 cm	By the end of century average snow cover is projected to decrease by 3.9 to 5.2 cm, that is more than 50% of 1961-1990 average thickness (6.6 cm)
Number of days with snow cover	Number of days with snow cover has decreased by 23 days	Due to technical nature of snow cover scenarios, there is not developed projections for this variable
Annual-mean wind speed	Since 1966, average wind speed in Latvia has decreased by 11%. However, extremes of the maximum mean wind speed values are be observed both at the start and the end of the period	In the future, a decrease in the mean wind speed by 3 to 7% is projected, however projections show uncertainty
Stormy days	Stormy days in Latvia are observed very rarely, and up to recently, the number of such days on average in Latvia has decreased by 1 day	Only small changes in the mean number of stormy days are projected for Latvia, so no valid conclusions about changes in numbers of stormy days can be made
Calm days	Due to the decrease in mean wind speed, the number of calm days has increased by about 21 days	Most climate models project increase in the number of calm days in Latvia on average by 2 to 24 days
Daily peak wind gusts	Annual average daily wind peak gust speed has decreased by 0.5 m/s	By the end of century decrease in average daily wind peak gust speed by 2.6 to 3.0 m/s is projected

6.2 Assessments of risks and vulnerability to climate change

In Latvia assessments have been carried out on primary and secondary impacts of climate change, risks and vulnerability, which include also cost – benefit analysis for adaptation measures, indicators and draft for the monitoring system. The analysed sectors are as follows:

- biodiversity and ecosystem services;
- forestry and agriculture;
- tourism and landscape planning;
- health and welfare;
- building and infrastructure planning;
- civil protection and emergency planning.

Assessments include consideration of:

- historical climate change impacts from 1961 and future scenarios until 2100;
- risk and vulnerability assessment;
- identification of adaptation measures and cost–benefit analysis;
- identification of adaptation indicators;
- engagement of stakeholders, determination of their responsibilities.

Climate change in Latvia affects both its natural capital (species, habitats, ecosystems), as well as the health, welfare and safety and economic activities of the population. Latvian National Plan for Adaptation to Climate Change until 2030 (NAP, adopted by Cabinet of Ministers in 2019), based on climate change risk and vulnerability assessments, identifies risks and measures in such vulnerable sectors as health and welfare, agriculture and forestry, civil protection and disaster management, buildings and infrastructure, biodiversity and ecosystem services etc. Main risks in sectors are summarized in Figure 6.1, but overall, the most significant risks caused by climate change in Latvia with a higher probability of occurrence are as follows:

- changes in seasons, including the vegetation period growing season;
- fire hazard;
- proliferation of pests and pathogens, tree diseases, expulsion of local species, entering of new species;
- spread of diseases of the respiratory system;
- spread of infectious diseases, heat strokes;
- flood caused by precipitation, wind surges;
- occurrence of disturbances in electricity supply;
- increased run-off, hydropower variations;
- reduction of frost, black frost, drying of soil;
- eutrophication;
- damages to infrastructures, overheating of equipment;
- decreased run-off during summer.

Building and infrastructure planning:

Building

- Increase in damages caused to buildings by flood along the seaside and river estuaries in cities
- Increase in damage caused to buildings by precipitation flood
- Increase in overload on the roofs of buildings due to snow cover
- Damages of the foundations of buildings and ground due to groundwater level fluctuations
- Indoor overheating growth

Transport infrastructure

- Increase in damages caused to ports, roads by flood along the seaside and river estuaries in cities
- Increase in damage on roads due to floods caused by heavy rainfall (along with road freezing period decrease)
- Increased melting of asphalt and other road surface damages
- Increased bending of rails, material deterioration and instability of embankments due to heat

Energy

- Electricity transmission and distribution network damages due to wind gusts
- Indoor overheating and growth of electricity demand in summer
- Energy demand decrease in winter

Tourism and landscape planning:

- Risk of changing the length and characteristics of winter tourism season
- Flood risk (rising water levels in rivers and lakes)
- Coastal flooding and erosion risk along the coastline of the Baltic Sea and the Gulf of Riga
- Risk of the change of the length of the summer tourism season

Civil protection and disaster management planning

- Flooding and ice buildup
- Flood caused by heavy rainfalls
- Storms and wind surges at the sea
- Forest and peat fires

Health and welfare:

- Increased spread of acute intestinal infections, outbreak of such infections
- Increased spread of chronic diseases (CVD, diabets, etc.) and increased mortality
- Increased spread of illnesses and/or infectious diseases caused by carriers of diseases become endemic
- Increased morbidity and mortality rates caused by diseases of respiratory system in particular for various risk groups
- Increased frequency of heat strokes
- Internal migration, migration of foreign population to Latvia
- Housing availability and provision

Biodiversity and ecosystem services:

- Eutrophication of watercourses and water abodies
- Ecologically sensitive species are taken over by ecologically plastic species
- Spread of expansive and invasive foreign species non-characteristic to Latvia, infectious diseases and harmful organisms of plants
- Opportunities for entry of new species
- Increase in water temperature and longer stratification period, decrease in the amount of dissolved oxygen at the ground layers
- Storm surges along the coastline, rising water levels in rivers and lakes

Agriculture, Forestry and Fishery:

Agriculture

- Destruction of crop fields, plantations due to black frost
- Spread of crop diseases, harmful organisms (including new) and spread of pests, animal parasites (including new species)
- Spread of previously non-characteristic disease agents and carriers, including spread of invasive foreign insect species
- Drying and faster drying of soil/plants
- Flooding of agricultural land under intense precipitation condition
- Risk of long-term heat waves

Forestry

- Spread of tree diseases (including new)
- Spread of tree pests (including new)
- Risk of frost damage (including frost hardiness loss)
- Hindered forest exploitation due to lack of winter freeze
- Risk of storms
- Risk of fire
- Risk of tree damage due to freezing precipitation, windthrows and snow breaks
- Faster drying of soil/plants

Fishery

- Increase in water temperature in water bodies, eutrophication
- Ecologically sensitive species are taken over by ecologically plastic species
- Opportunities for entry of new species (including invasive species)
- Flood risk in open-type fish-breeding farms

Figure 6.1 Main climate change related risks in Latvia (Latvian National Plan for Adaptation to Climate Change until 2030)

6.3 Climate change impacts and risks of different sectors

6.3.1 Construction and infrastructure

According to risk and vulnerability assessment, buildings and infrastructure in Latvia are exposed to different climate change impacts. According to climate change scenarios assessments, likelihood of key hazards (especially related to air temperature, water level rising, changing wind and precipitation patterns), is high. Most significant changes are related to extreme values of climate variables, indicating that in the future Latvia will more often face weather conditions uncharacteristic and extreme for its territory. Exposure of buildings to key hazards is likely to increase. In Latvia, several impacts of climate change (including extreme climate events) are important for buildings:

- Increase in average annual air temperature, increase in the frequency and duration of heat waves, extension of the meteorological summer, increase in the maximum value of the daily maximum temperature;
- Decrease of the frost days and the number of days without thaw;

- Increase in precipitation and increase in the maximum amount of precipitation per day, increase in the number of days with very heavy precipitation, increase in the maximum amount of precipitation per five days, increase in snowfall above normal;
- Long-term average sea level rise and development of coastal erosion, as well as groundwater level fluctuations affected by changes in precipitation and sea level, and changes in river run-off patterns.

The most significant risks are showed in Figure 6.1. According to risk and vulnerability assessments climate change **risks** to construction sector in Latvia have the following consequences: damage to buildings on the sea coast and estuaries (due to coastal erosion and flooding); damage to buildings in estuaries; the need for repair of buildings or irreparable damage; declining value of buildings and increase of insurance prices; damage to buildings in cities with insufficient sewerage capacity, damage to buildings in floodplains of waterways; damage to building structures (increased microcracking due to load, moisture damage); roof collapse; mould; the threat to the stability of the structures of buildings and their foundations (the greatest threat is to old buildings, the stability and waterproofing of the foundations); increase in demand for indoor cooling; investments for installation of room cooling and ventilation; increase in electricity consumption and costs in summer, etc.

6.3.2 Civil protection and emergency management

According to risk and vulnerability assessments (Process analysis research centre, 2017) civil protection and emergency management is exposed to different **climate change impacts**: changing temperature, heat waves, drought, heavy precipitation, flood, changing participation patterns, and especially extreme weather events.

In Latvia, the following impacts of climate change and extreme weather events are the most important for civil protection and disaster management planning:

Increase in the number of summer days, tropical nights, duration and frequency of heat waves, continuous increase in the frequency and duration of droughts.

Increase in maximum wind gusts.

Increase in the number of days with very heavy precipitation, an increase in the maximum daily precipitation and a decrease in the amount of annual precipitation in the form of snow.

Sea level rise, change of river runoff regime from the current peak in spring to high runoff also in autumn facilitated by the changes on the amount of precipitation, drought in summer.

According to climate change scenarios assessment, likelihood of key hazards (especially related to air temperature, changing precipitation patterns and weather extremes), is high. Most significant changes are related to extreme values of climate variables, indicating that in the future Latvia will more often face weather conditions uncharacteristic and extreme for its territory. Exposure of to civil protection to key hazards are likely to increase.

Risks (see the Figure 6.1) caused by climate change in civil protection and disaster management planning, which have a relatively very high or high level of probability and the most negative consequences in Latvia are:

- Forest and peat bog fires - risks with medium consequences currently, but with a very high probability will increase in the future;
- Storms and storm surges - risks with severe consequences that may increase in the future (medium probability). The analysis of long-term trends shows very significant declining trends in the number of stormy days in most parts of Latvia. At the same time, we need to take into account overall trends of increase of frequency and recurrence of extreme events over time (IPCC, 2014);
- Heavy rainfall and floods caused by it - risks with relatively lower consequences, which will increase (high probability);

- Floods caused by spring floods and ice jams - risks with relatively lower consequences and a medium probability of occurrence, however, this risk is expected to decrease over time in both the probability of occurrence and the consequences.

It should be noted that compared to today and in view of the projected future trends in climate change in Latvia, it is expected that both the probability of the occurrence and the consequences of spring flood risk will decrease in the future, but the consequences for all other risks will only increase. In general, net economic losses in 2100, due to the 4 mentioned main risks, will double compared to the current situation.

In the field of civil protection and emergency management, extreme weather and climate events are of crucial importance and in future the exposure of civil protection to key hazards is likely to increase, especially due to weather extremes. The rare extreme events are those that have the greatest impact and cause the greatest damage to human welfare (EEA, 2017).

6.3.3 Health and welfare

According to risk and vulnerability assessments (Ltd. "Estonian. Latvian & Lithuanian Environment", 2016) health and well-being is exposed to different **climate change impacts**: changing temperature, heat waves, flood and extreme weather events.

Impacts of climate change (including extreme ones) that are important for health and well-being in Latvia are the following:

- Increase in the average temperature, as a result of which the spring / summer / autumn seasons could be extended, while the duration of winter will decrease;
- Increase in the total annual amount of precipitation, increase in the frequency of heavy rains, increase in the water temperature of rivers, lakes and other water bodies;
- Increase in the frequency and duration of heat waves.

According to climate change scenarios assessment, likelihood of key hazards (especially related to air temperature and weather extremes), is high. Most significant changes are related to extreme values of climate variables, indicating that in the future Latvia will more often face weather conditions uncharacteristic and extreme for its territory. Exposure of health sector to key hazards is likely to increase. The most significant **risk** factors with the comparatively highest level of risk and the highest probability of occurrence are "increased risk of heat stroke" and "risk of exacerbation of chronic diseases (cardiovascular diseases, diabetes, etc.) and possible increase in number of deaths" (see the Figure 6.1). Regarding risks to human health, the most negative impacts in the context of climate change are expected from the cardiovascular diseases.

In Latvia, impacts of climate change will potentially be felt most by vulnerable groups in society (families with young children, the elderly, people with chronic diseases (including physical and mental health problems), people with disabilities, poor and low-income people, people living in remote areas far from economically active regional centres, etc.).

Extreme weather events can also affect the health of people and households that are not at risk of poverty or social exclusivity. Impacts on health caused by the negative effects of climate change can affect the productivity of economically active household members, their ability to participate in the labour market.

Climate change has a major impact on people's physical and mental health and on socio-economic welfare. Impact effects can occur both directly (for example, flood or heat waves caused injuries, death cases, material damage), and indirectly, and can be identified only from long-term observations (e.g., physical and mental disorders, changes in social behaviour).

The impact on different social groups in Latvia may vary, depending on the specific geographic location and the ability of people to overcome the risks of climate change. High population in large cities (particularly in capital city Rīga) creates a high load on the environment, infrastructure, health and social care. Moreover, the high concentration of people at certain locations causes potentially greater losses, especially in the event of extreme climate change. The effect of "urban heat islands" caused by the urban environment and increasing due to climate change, should be considered. In contrast, the effects of climate change on rural areas may be associated with the lack of access to the necessary assistance and services, as well as with overall coping with climate risks. In Latvia, climate change will most likely affect groups of people already at risk of exclusion (families with young children, elderly people, people with chronic diseases, people with disabilities, poor people, etc.). Without the necessary support and assistance, their socioeconomic situation may deteriorate significantly, which in general can further increase social inequality in the country. Thus, climate change can be a threat to the basic value and productivity of the human capital in Latvia.

6.3.4 Biodiversity and ecosystem services

According to risk and vulnerability assessments (Ltd. "Estonian. Latvian & Lithuanian Environment", 2016), biodiversity and ecosystem services in Latvia is exposed to different **climate change impacts**, especially related to changing temperature, water and solid mass related.

The most significant impacts of climate change that may affect biodiversity and ecosystem services in Latvia are the following:

- increase in air temperature, increase in the minimum air temperature in winter;
- earlier onset of the spring, extension of the summer season;
- increase in water temperature and water level, increase in the frequency of surface water level fluctuations;
- changes in precipitation (increase in certain seasons), greater probability of more frequent and longer periods of drought, decrease of snow cover;
- increased frequency of extreme weather events and weather contrast.

Biodiversity and ecosystem services in Latvia in the context of climate change will be potentially affected by the several major **risks** (Ltd. "Estonian. Latvian & Lithuanian Environment", 2016) (see Figure 6.1). The highest probability of occurrence and the most explicit consequences are "the risk of contamination and eutrophication in water courses and water bodies" and "the risk of increase in water temperature and a longer stratification period, as well as a decrease in the volume of dissolved oxygen in the bottom layer", which will directly affect ecosystem services related to water courses and water bodies and their biological resources. In general, future climate change will have an impact on the direct provision of ecosystem services (such as uncultivated freshwater / marine plant and animal food) and regulatory ecosystem services (such as lifecycle maintenance, conservation of habitats and gene pools).

Climate change has additional impacts on already endangered biodiversity. At present, there is a risk that Latvia's natural biodiversity will decrease in the future. Biodiversity has a direct link to human welfare. As a result of destruction of species, habitats and ecosystems people will lose the opportunity to use their qualities and thus lose essential ecosystem services (e.g., bogs, besides biodiversity, are not only moisture regulators but also organic carbon sinks). The reduction of biodiversity and ecosystem services as a result of climate change and anthropogenic impacts interactions can threaten the maintenance and sustainable development of the natural capital of Latvia. The impact of climate change on biodiversity in Latvia is currently difficult to assess due to lack of data, although the process of mapping and evaluating the quality of biotopes of EU importance in whole of Latvia is completed. It is necessary to intensify research on new species in Latvia, to monitor invasive and aggressive alien species, as well as those species that are on the border of the distribution area in Latvia. It is also important to intensify the monitoring of plant pests, which are characteristic of warmer climate regions, as they can have a direct impact on biodiversity. The decline of biodiversity and ecosystem services as a result of climate change and anthropogenic interactions poses a threat to the preservation and sustainable development of Latvia's natural capital.

Biodiversity is also affected by landscape simplification (monocultures - continuous forest plantations with one type of species, agricultural lands with large areas of continuous crops). Ecosystems become less stable, contributing to the spread of invasive or alien species and pests. The more diverse the ecosystem, the more stable it is and the ability to adapt more quickly to climate change and can provide a wider range of ecosystem services.

6.3.5 Agriculture and forestry

According to risk and vulnerability assessments (LSFRI "Silava" and Latvia University of Agriculture, 2016), agriculture is exposed to different **climate change impacts**: changing temperature, heat waves, drought, heavy precipitation, flood, changing participation patterns, extreme weather events.

More specifically, according to risk and vulnerability assessments, agriculture is more exposed to:

- Increase in average air temperature in winters and decrease in the duration of the meteorological winter, increase in average air temperature in summers and an increase in the duration of meteorological summer, an increase in the probability of more frequent and longer periods of drought in the summers; increase in number of days with very high temperatures in summers;
- Increase in total annual precipitation, changes in the amount of precipitation in the summer months, increase in the probability of sudden and severe thunderstorms in summer;
- Greater uncertainty of snow cover thickness, decrease in the number of days with frozen soil, formation of air mass contact bands, creating suitable conditions for freezing rain; increase in wind gusts in some regions of Latvia.

Likelihood of key hazards (especially related to air temperature and changing precipitation patterns), is high. Most significant changes are related to extreme values of climate variables, indicating that in the future Latvia will more often face weather conditions uncharacteristic and extreme for its territory. Exposure of agriculture and food production to key hazards is likely to increase.

The most significant identified **risks** in agriculture are the risk of freezing of crops and plantations, the risk of crop and animal diseases and pests, the risk of crop and crop loss due to rainfall at harvest, the risk of faster soil drying and prolonged heat waves (see Figure 6.1).

The risks are mainly of economic impact. The social impact arises indirectly from the economic risks: as the yield of certain crops decreases, the well-being of farm owners decreases, as does the farm's ability to employ workers, thus leaving a socio-economic impact on the region in which the farm is located. The impact of these risks is particularly significant in cases where several farms in the same region are affected (for example, herds affected by animal diseases).

Climate change in forestry can cause potential losses on average from 25% to 50% for tree growth or for wood stock and / or timber assortment value. Besides, in agriculture, climate change can lead to an average of 10-20% loss of the yield. The research (LSFRI "Silava" and Latvia University of Agriculture, 2016) also identifies the potential benefits in the context of climate change, such as increased productivity of crops, the possibility of choosing serotinous, but more efficient and / or higher quality varieties, the possibility to start growing crops, which demand a little longer vegetation period, the possibility to cut perennial grasslands several times, thus increasing the availability of fresh fodder, the possibility to grow high-quality seedlings in shorter period of time, practised so far in covered areas, and others.

6.3.6 Tourism and landscape planning

According to risk and vulnerability assessments (Ltd. "Baltkonsults", 2016), tourism in Latvia is exposed to different **climate change impacts**, especially related to temperature, wind and water.

Climate change can influence the development of tourism in Latvia both as a deterrent and as a developing factor. Climate change can impact the visual quality, aesthetic, ecological, economic, scientific, historical and recreational value of landscapes, which in turn can change tourist behaviour and habits and affect the economy of a particular place, region or country.
Impacts of climate change, which in Latvia can significantly affect the tourism industry and landscape planning, are the following:

- Increase in the annual average air temperature, increase in the average air temperature in the winter season, increase in the minimum value of the daily maximum temperature, increase in the average air temperature in the summer months;
- Decrease in the number of frost days, increase in the number of days without thaws, decrease in the average number of days with snow cover, decrease in the average snow cover thickness in the winter months, shortening of the ice period, increase in the number of summer days, increase in the number of tropical nights;
- Increase in the number of days of the vegetation period;
- Increase in the annual precipitation, continuous increase in the duration of the precipitation period, increase in the number of days with heavy and very heavy precipitation, increase in the maximum daily precipitation;
- Increase in maximum wind gusts on the sea coast, increase in the number of days with the maximum wind speed.

Risk and vulnerability assessments (Ltd. "Baltkonsults", 2016) have shown that the **risks** posed by climate change for tourism in Latvia are: the risk of changing the length and characteristics of the winter tourism season; flood risk (rising water levels in rivers and lakes); risk of flooding and coastal erosion of the Baltic Sea and the Gulf of Riga, risk of changes of the length of the summer tourist season (see Figure 6.1).

The identified risks for the tourism industry have the following consequences: shortening of the visibility period of winter landscapes; reduction of winter tourism (activities, events); increase in the cost for providing artificial snow; decrease in the number of winter tourists; losses for Latvian tourism entrepreneurs; degradation or destruction of forestry, agricultural, natural objects and urban landscape elements; degradation or destruction of natural and cultural-historical values; changes in the visual quality and value of the landscape; degradation or destruction of tourism infrastructure; a decrease or increase in the flow of tourists in the affected areas.

The research also identifies potential benefits in the context of climate change, such as the longer period of the visibility of the summer landscape and the diversification and increase in summer tourism offerings (activities, events); the benefits of outbound winter tourism offerings to companies.

6.3.7 The economic impact of climate change

Table 6.2 Assessment of ex-post economic costs of climate change

Climate change impact	Ex-post economic costs
Annual compensations paid by Latvian insurers for property damage (incl. natural disasters, 2017-2020	Annual claims vary around 30 million EUR (2017 and 2018) to 78 million EUR (2019) and 80 million EUR in 2020[24]
Compensations paid to Latvian farmers for damage caused by the adverse weather conditions (including compensation for damage caused by floods and droughts, combating infectious diseases, compensation for animals fallen from midges bites, etc.), 2004-2016	~ 32,5 million EUR, total in the period, The biggest support of 20 million EUR was provided in 2018, amounts paid in other years were significantly lower.

[24] https://www.laa.lv/market-data/

Climate change impact	Ex-post economic costs
Funds from the State budget for unforeseen events, allocated to municipalities 2018-2021	
Flood damage compensations	2 549 EUR, total in the period
Heavy rainfall damage compensations	9 211 EUR, total in the period
Storm damage compensations	6 784 EUR, total in the period

Table 6.3 Sectoral estimates of the economic impacts of climate change related most relevant risks in Latvia (net impact, including losses and benefits

Sector	Economic Impact
Civil protection and emergency assistance	Losses Currently: ~ 11 million EUR/year In 2100: ~ 20 million EUR/year
Tourism and landscape	By 2100, losses due to flood risk 29 -52 million EUR/year; due to changes in winter tourism season-3.4 million EUR and 15-20 million EUR due to coastal flooding and erosion risk.
Health and welfare	Losses In 2016-2100: ~26 million EUR/year
Built environment, costs due to floods	Losses From 2040 to 2070: about 1.5 million EUR/year, 2070-2100: up to 3 -3.2 million EUR/year
Agriculture	Potential average loss of 10-20% of the yield
Forestry	Direct damage caused by storms to forest owners About 164 million EUR, total in the last decade Damage caused by dendrophagous insects to forest owners About 36 million EUR, total in the last decade
Biodiversity and ecosystem services	Benefit of ~295 million EUR in 2100

6.4 National adaptation plan

To address climate change risks on 17 July 2019 Cabinet of Ministers adopted Latvian National Plan for Adaptation to Climate Change until 2030 (NAP) setting out adaptation priority – to reduce vulnerability of people, economy, infrastructure, construction and environment to the impacts of climate change and to promote the use of opportunities created by climate change. To meet this aim, the NAP has more than 80 concrete adaptation measures and 5 Strategic goals/objectives (SO) to address climate change risks:

1. Human life, health and welfare, regardless of gender, age and social background, are protected from the adverse effects of climate change;
2. National economy has the capacity to adapt to the adverse effects of climate change and seize the opportunities derived from climate change;
3. Infrastructure and construction are climate-resilient and planned according to possible climate risks;
4. Nature, cultural and historical values of Latvia have been preserved and the negative impact of climate change thereupon has been reduced;
5. Information based on scientific argumentation is provided, including monitoring and projections that promote integration of the aspects of adaptation to climate change in sectoral policy and territorial development planning documents, and also public awareness.

The NAP defines the following principles for the development and implementation of Latvia's climate change adaptation policy:

- Principle of scientific justification – the latest scientific achievements in climate change impact assessment, vulnerability and risk assessment, adaptation policies are used and regularly reviewed. This principle implies that the strategy is based on the latest scientific research and evidence-based results on the expected climate change in Latvia and its potential impact in specific areas and creates the basis where the Latvia's climate change adapting policy facilitates further development of the scientific capacity in Latvia. The principle of scientific justification must be respected in ensuring the qualitative and representative climate and adaptation monitoring, forecasting, modelling and assessment to be used for decision making in Latvia;
- Principle of preventive action – prevention of existing impacts, vulnerabilities and risks related to climate change is aimed at preventing potential future losses, taking into account that today's investments can offset much greater losses in the event of a future risk, as well as allows to use the potential benefits. The development of the strategy takes into account potential scenarios for future climate development and the associated risks and benefits;
- Principle of cross-sectoral efficiency – priority for adaptation strategy is based on current programmes and a wide range of policy instruments and provides additional benefits for mitigating climate change and achieving sustainable development objectives. Planned actions and measures in different sectors and fields are coordinated with each other, ensuring synergies in funding and providing other resources for the implementation of priority measures;
- Integration in policy planning and decision making – an assessment of climate change impacts, risks, vulnerabilities and appropriate adaptation measures become an integral part of the planning and decision-making process in all relevant areas and levels of activity. Emphasis is placed on actions aimed at integration of adapting aspects of climate change, such as territorial development, spatial and policy planning;
- Principle of the protection of the most vulnerable groups – adaptation measures are developed to meet the individual needs of people, including the most vulnerable groups of the society. One of the strategic goals is to protect human life and health from the negative consequences of climate change.

To achieve the overarching goal, 5 strategic objectives (SO) are followed by directions of action (DA), see Figure 6.2. For each direction of action, priority measures have been developed.

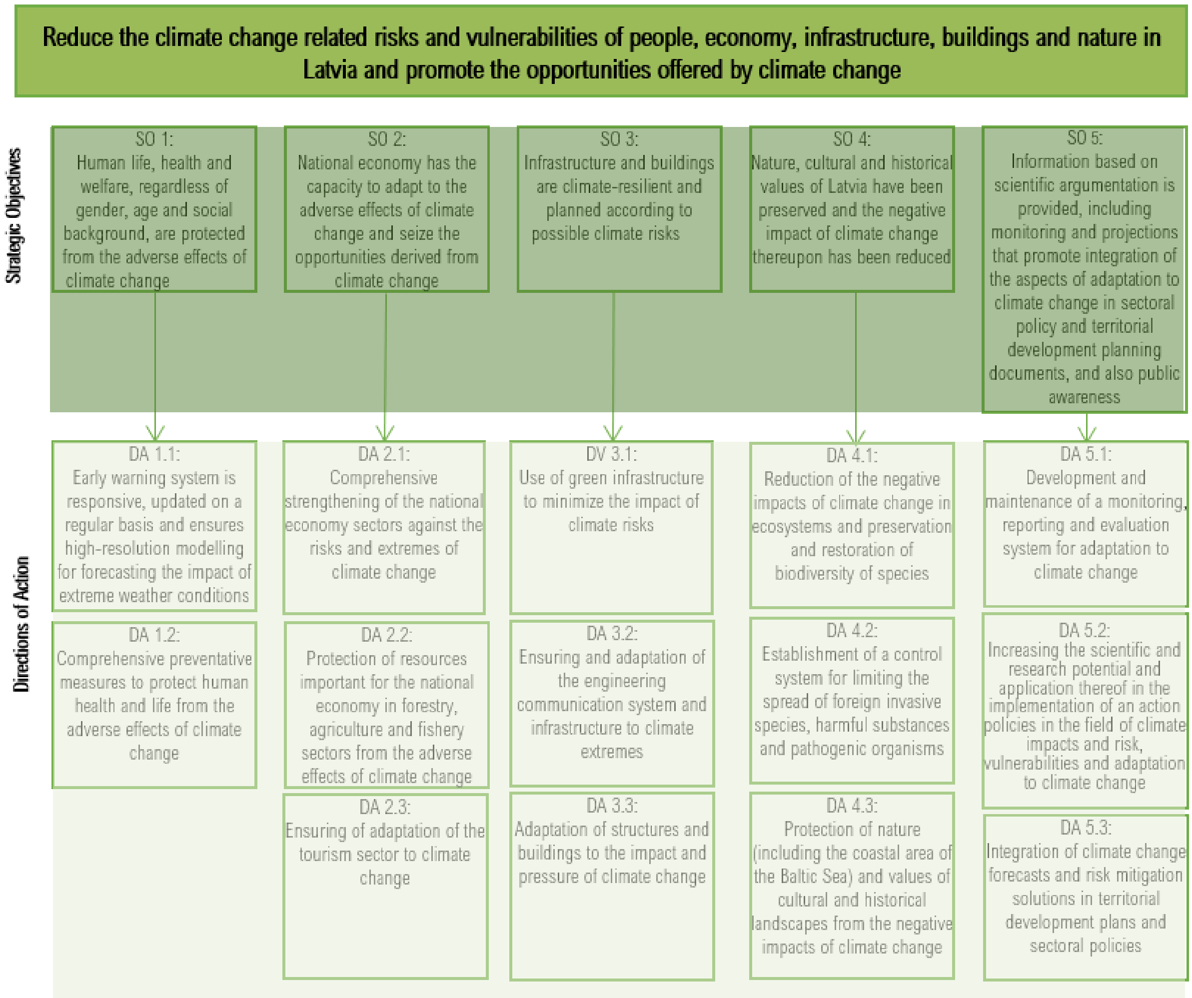


Figure 6.2 Layout of overarching goal, strategic objectives and directions of actions of the Latvian National Plan for Adaptation to Climate Change until 2030

Strategic objective SO1 "Human life, health and welfare, regardless of gender, age and social background, are protected from the adverse effects of climate change" is achieved by actions in two areas:

- In the area of health and welfare, additional assistance should be provided to vulnerable groups of society (elderly people, children, people needing social care etc.) and to reduce the load on the health care system. The implementation of various preventive measures will reduce the load on the health care system that can be caused by extreme climatic events or factors;
- The task of the Civil Protection and Early Warning System is to protect people's health, life and safety in Latvia, in this case, by timely forecasting, warning and response to extreme climate events. It should be emphasized that the risk assessment of the hydrometeorological phenomena is based on the results of a high-resolution numerical model adapted to the territory of Latvia.

Strategic objective SO2 "National economy has the capacity to adapt to the adverse effects of climate change and seize the opportunities derived from climate change" is aimed at preserving economic resources and promoting competitiveness as a result of the negative impacts of climate change and increasing the benefits from opportunities that climate change can bring to the Latvian economy (warmer and wetter climate, longer vegetation period, etc.). The directions of action are focused on preservation of resources and promotion of competitiveness in sectors important for the Latvian economy – agriculture, forestry and tourism. The creation of effective financial instruments for compensation of losses, as well as the development and introduction of new products and technologies for the promotion of the provided opportunities relates to the economy as a whole.

Strategic objective SO3 "Infrastructure and buildings are climate-resilient and planned according to possible climate risks" is aimed at ensuring climate-resilient conditions in a changing climate, especially extreme. The directions of action are directed towards the use of the green infrastructure, timely and regular review of construction standards, and providing the climate-proofing of buildings, constructions and engineering communications.

Strategic objective SO4 "Nature, cultural and historical values of Latvia have been preserved and the negative impact of climate change thereupon has been reduced" aims to preserve as much as possible the biological diversity of species that is threatened by various risks due to climate change, including invasive alien species and various pathogens, and to preserve as much as possible or at least not undermine the state of the ecosystems. The strategic objective also includes safeguarding cultural and historical values from the negative impacts of climate change. Directions of action are aimed at preserving biodiversity, protecting ecosystems, protecting nature and cultural heritage, protecting the Baltic Sea coast as a unique natural and cultural heritage site, and introducing and maintaining control systems for invasive alien species, pests and pathogens.

Strategic objective SO5 "Information based on scientific argumentation is provided, including monitoring and projections that promote integration of the aspects of adaptation to climate change in sectoral policy and territorial development planning documents, and also public awareness" is a horizontal objective related both to all six areas, described above in chapters 6.2.1 and 6.2.2, and the strategic objectives above. A policy must be built on knowledge, information and awareness. This, in turn, requires investments in science and research, climate change and adaptation monitoring, data collection and processing, forecasting and modelling tools and instruments. The public needs to be aware of the impact and risks of climate change, including specific target groups such as entrepreneurs, travellers, etc., while emphasizing the responsibility of each person for the adaptation needs to climate change. This objective includes directions of action for strengthening the science and research capacity, developing a monitoring system, forecasting and modelling, making the necessary changes to spatial planning and other development planning documents and regulatory acts, as well as drafting national legislation for provision of hydrometeorological and climatic information as well as climate change data and adaptation indicators, effective adaptation measures application in all areas of national economy.

The List of Priority Measures is structured around measures in line with the five strategic objectives and the eighteen directions of action that were prioritized in the process of multicriteria analysis according to the following criteria: (1) the technical feasibility of a measure, (2) the compatibility of the cost of a measure with budgetary possibilities, (3) the organizational feasibility of the measure, (4) the multiplier effect of the measure, positive synergy with possible solutions of other problems. Below is an overview of measures with high and/or moderate priorities (Table 6.4).

Table 6.4 Overview of measures with high and/or moderate priorities

SO 1: - " Human life, health and welfare, regardless of gender, age and social background, are protected from the adverse effects of climate change "
DA 1.1: - Early warning system is responsive, updated on a regular basis and ensures high-resolution modelling for forecasting the impact of extreme weather conditions
Measures: 1. Improve forecasting and early warning systems to warn of extreme weather events (2024) 2. Improve the national early warning system by launching and maintaining the cell broadcast service (i.e., mobile communications network) or another notification solution in order to ensure that the population is promptly informed of natural disasters and also, to the extent possible, of extreme weather events (2024)
DA 1.2: - Comprehensive preventative measures to protect human health and life from the adverse effects of climate change
Measures: 1. Promote accessibility of drinking water in public places for free (stations, bus terminals, bathing sites, parks, stores) and also State and local government institutions (2024)

2. Provide the public with information on the effects of heat on human health and recommendations for protecting health during heat waves (2021)
3. Ensure additional prevention and awareness-raising measures on the impacts of and adaptation to climate change at educational institutions, social care institutions, and also organise the training of the providers of childcare services and employees at children's camps, library employees (2021)
4. Conduct studies on correlation between the spread and activity of infectious disease carriers, infection status and population morbidity rates and changes in climate parameters (2027)
5. Upon informing the public, provide information on possible changes in infectious disease carriers caused by climate change in Latvia, symptoms of new diseases and preventive measures, particularly in high-risk areas (2024)
6. Prepare educational information on climate change, the impact thereof (including risks, potential losses) and adaptation thereto (2021)
7. Review the legal framework and improve the implementation thereof with regard to the necessity to install and maintain air cooling systems in public spaces, as a priority – in health care institutions, social care and social rehabilitation institutions, kindergartens, trains stations (where relevant) (2024)
8. Promote the formation of green spaces in order to create shadow areas in the urban environment (2030)
9. Improve the civil protection training course by including climate change issues and possible actions to adapt to the adverse effects of climate change (2021
10. Inform the public, especially chronic disease patients, of preventive healthcare measures before and during heat waves (2030)
11. Ensure drawing up of recommendations for social care institutions and social workers on preventive healthcare measures during heat waves (2030)
12. Perform periodic analyses of the total number of deaths, hospitalised people and people who received emergency medical aid throughout the year, split up over the days, seeking a link to the registered air temperature (2030)

SO2: - " National economy has the capacity to adapt to the adverse effects of climate change and seize the opportunities derived from climate change "

DA 2.1. Comprehensive strengthening of the national economy sectors against the risks and extremes of climate change

Measures:

1. Coordinate the improvement of the legal framework to reinforce the insurance market and expansion of services in order to reduce losses caused by climate change in all potentially affected sectors of national economy (2024)
2. Organise training for insurance companies on risks related to climate change (2021)
3. Improve the legal framework in order to promote investments, taking into account climate change risks and the necessity for the reduction of GHG emissions and preservation and increase of carbon dioxide removals (2022)
4. Organise training for the banking sector on green investments (including investments that ensure climate resilience), advantages thereof (2021)
5. Attract financing and assess the possibility of building and maintaining an information system (including integrated information on climate change indexes, satellite data on topography and precipitation, soil maps, mapping of EU protected habitats and distribution of specially protected nature territories, flood zones, provision of ecosystem services, etc.) that would help to take a decision on the type of land use, including taking into account the climate change scenarios of Latvia (2030)

DA 2.2: Protection of resources important for the national economy in forestry, agriculture and fishery sectors from the adverse effects of climate change

Measures:

Agriculture

1. Promote in practice the diversity of species and varieties of cultivated crops in order to reduce the risks caused by climate change (2027)
2. Implement the supervision and monitoring of harmful organisms and develop the supervision and monitoring of zoonotic agents and carriers of animal diseases, taking into account the risks of climate change (2027)
3. Restore and adapt land amelioration systems, including in populated areas, in order to prevent floods caused by climate change (increase in extreme rainfalls). If necessary, restore the natural sections crossing of watercourses to reduce the consequences of floods and stabilise ecosystems (2027)
4. Ensure that farmers are informed of insurance possibilities and advantages to receive compensation for losses caused by extreme weather events (also due to climate change) (2024)
5. Conduct studies on the role of the variable fauna of insects affected by climate change in the transmission of zoonoses and exotic diseases of animals and the dynamics of the risk of prevalence thereof in Latvia (2021)
6. Conduct studies on the carriers of infectious diseases facilitated by climate change and their tendency to spread in order to better understand the epidemiology, emergence, prevalence and burden of infectious diseases, and also to

further investigate how resistance develops and spreads, to improve early detection of infectious diseases and resistance development in the field of animal health (2027)
7. Conduct studies on the preservation of the existing constructed wetlands and creation of new constructed wetlands, and also promote the creation and maintenance of constructed wetlands, particularly in areas where agricultural land dominates (2024)

Forestry

1. Improve the legal framework in order to promote the breeding of high-quality planting stock for the creation of lower density young stands (restoration of a forest with planting or seeding), thus increasing the resistance of the forest to climate change impacts and increasing its productivity (2024)
2. Improve the legal framework in order to promote the afforestation of unused, productive agricultural land (ensuring that EU protected habitats are not subject to afforestation) with species compliant with soil and growing type, creating wind-resistant stands (2025)
3. Consider the necessity of introducing specific conditions to promote the care for young stands (tree height 4–6 m) in order to ensure stability against various risks caused by climate change (2025)
4. Promote the development of the network of forest roads in order to ensure effective management of forest lands and management of other types of land under unfavourable climate conditions and also prompt response in emergency situations (fire, including peat fire). Create additional forest fire-fighting infrastructure in high-risk areas by carrying out a thorough assessment of the necessity thereof (2027)
5. Restore and adapt forest amelioration systems to prevent the negative impacts of climate change as much as possible (2027)
6. Promote the use of access equipment with lower pressure on soil to protect soil in forests during winters under frost-free conditions (2027)
7. Develop scientifically valid guidelines for forest management to promote the climate resilience thereof (2028)
8. Ensure the harmonisation of measures provided for in the new policy planning document for the forestry sector and the necessity to adapt to climate changes (2022)
9. Conduct studies on the impact of risks caused by climate change on ecological, social and economic functions of forests (2024)

Fishery

1. Identify natural water fish species and fish species reared in aquaculture in Latvia that are endangered due to climate change (2024)
2. Review the Guidelines for Artificial Reproduction of Fish Resources and determine therein larger reproduction volumes for natural water species affected by climate change, if necessary (2024)
3. Inform the involved parties of the possible climate risks and possibilities of adaptation in the fishery sector (2024)
4. Elaborate a list of invasive water biological resources species that have entered Latvia as a result of the impacts of climate change (2020)

DA 2.3: Ensuring of adaptation of the tourism sector to climate change

Measures:

1. Promote adaptation of cultural monuments and natural monuments of national significance to the impacts of climate change (2024)
2. Provide educational information to tourism companies on climate, climate change and possibilities of entrepreneurship adaptation (2020)
3. Provide warning and safety measures of coastline visitors at potential mud slide, landslide and flooding risk locations (2024)
4. Ensure adjustment of tourism infrastructure to changes in sea dunes and bluffs caused by erosion and ensure appropriate access to the beach (2024)
5. Supplement the official tourism portal of Latvia http://www.latvia.travel with information useful for tourists on the climate of Latvia, for example, information on the water level in rivers used for water tourism, more complete information on the climate of Latvia in all seasons (2021)

SO 3: Infrastructure and buildings are climate-resilient and planned according to possible climate risks

DA 3.1: Use of green infrastructure to minimise the impact of climate risks

Measures:

1. Identify primarily important places in cities and other densely populated areas where green infrastructure can provide the greatest benefit and promote adaptation to climate change (2024)
2. Upon developing or recovering urban areas, devise and implement solutions of green infrastructure that promote adaptation to climate change (independently)

DA 3.2. Ensuring and adaptation of the engineering communication system and infrastructure to climate extremes

Measures:

1. Assess and plan the necessity for additional capacity for the collection of rainwater in cities, including the performance of maximum precipitation estimates for various probabilities under the impact of climate change in order to protect buildings and structures from rainwater load (foundation wash-out, etc.) (2024)
2. Improve rainwater systems and culverts in cities by supplementing them with the elements of green infrastructure, defining the necessary capacity in advance, taking into account climate change, and also promote sustainable water management and use of rainwater in places where water is not required in the quality of drinking water (2030)
3. Develop guidelines for the integration of changes in rainwater run-off due to climate change in the planning and design of road construction, and also adaptation of existing road structures (2024)
4. Develop guidelines for ports and berths on adaptation to potential floods from the sea and other hazard caused by climate change according to the latest scenarios of climate change (2024)
5. Identify the most sensitive electronic communications infrastructure that requires adaptation to climate change and risks related thereto (2022)
6. Ensure adaptation of the current transport (roads, railways, airports, ports) and electronic communications infrastructure to climate change (2024)
7. Review laws and regulations governing the field of transport (roads, railways, airports, ports) and electronic communications infrastructure according to climate change forecasts (2021)
8. Restore the values of meteorological and hydrological characteristics included in the design calculations of land amelioration systems and hydrotechnical structures (run-off layers typical for seasons with a certain likelihood of recurrence, drainage modules, annual average run-off layer, etc.) (2025)

DA 3.3: Adaptation of structures and buildings to the impact and pressure of climate change

Measures:

1. Promote the use of materials and technologies, including introduction of green infrastructure solutions, in the buildings of the public sector and largest companies that prevent heat accumulation at the buildings in order to reduce the necessity to install and use conditioning systems (2024)
2. Clarify the values of precipitation loads in the construction standards for the types of existing buildings in order to improve the accuracy of planning and reduce potential hazard (2021)
3. Identify the most sensitive State and local government buildings that require adaptation to climate change and risks related thereto (2020)
4. Develop guidelines for the improvement of existing building structures in order to reduce threats related to climate change, including extremes (2021)
5. When changing Latvian construction standards, their requirements are to be adjusted to the current climate change scenarios and regulatory framework reducing the risks caused by climate change must be included therein (2023)

SO 4: Nature, cultural and historical values of Latvia have been preserved and the negative impact of climate change thereupon has been reduced

DA 4.1: Reduction of the negative impacts of climate change in ecosystems and preservation and restoration of biodiversity of species

Measures:

1. Integrate the aspects of adaptation of climate change into all appropriate natural and environmental protection campaigns/projects (2030)
2. Integrate climate change impacts, scenarios and adaptation measures into the Habitat Management Guidelines (2020)
3. Develop a study on climate-sensitive wild species for the survival of which certain micro-climatic conditions are required in Latvia (2030)
4. In improving laws and regulations which provide for SPNT management, it is necessary to include there the norms regarding compliance with adaptation to climate change, including to maintain habitats and species which are sensitive to climate change and are characteristic to Latvia in an optimal condition (2024)
5. Develop a study on the dismantling of mechanical obstacles in rivers (where possible) to increase the current natural flow of rivers in order to reduce the negative impacts of climate change (2022)
6. Adjust the quality assessment of surface water bodies (including the monitoring of cyanobacteria and chlorophyll) by increasing the monitoring frequency during the summer season, taking into account increase in water temperature due to climate change (2024)
7. Develop a study by providing proposals for the implementation of measures to maintain biodiversity at the level of landscapes, taking into account the impacts of climate change. (2030)

DA 4.2: Establishment of a control system for limiting the spread of foreign invasive species, harmful substances and pathogenic organisms

Measures:

1. Consider climate change impacts when updating the list of invasive species (2024)
2. Improve control and preventive measures for invasive species, taking into account climate change (2024)

DA 4.3: Protection of nature (including the coastal area of the Baltic Sea) and values of cultural and historical landscapes from the negative impacts of climate change

Measures:

1. Integrate the aspects of adaptation to climate change in SPNT nature conservation plans and also national, regional and local development planning documents focused on sustainable use and management of coastal areas (2027)
2. Promote the implementation of measures for maintaining the stability of the grey infrastructure against risks caused by climate change (flood, flood from the sea, bathing sites of the sea and the Gulf of Riga, inland bathing sites endangered by coastal erosion) (2024)
3. Assess what measures to reduce the coastal erosion of the Baltic Sea and to reinforce the coastal areas are valid and ensure the implementation of such measures to reinforce the coastal areas where this is of priority importance and valid, taking into account climate change scenarios (2030)
4. Develop a methodology for the detailed study of landscapes, to conduct research and to determine landscape areas and places that are sensitive to climate change (2024)
5. Develop guidelines for maintaining and preserving landscape territories that are sensitive to climate change (2026)

SO5: Information based on scientific argumentation is provided, including monitoring and projections that promote integration of the aspects of adaptation to climate change in sectoral policy and territorial development planning documents, and also public awareness

DA 5.1: Development and maintenance of a monitoring, reporting and evaluation system for adaptation to climate change

Measures:

1. Improve and maintain the database of climate change analysis and forecasting, ensure public access thereto (2030)
2. Create and maintain a single database on losses caused by disasters, including weather conditions facilitated by climate change (2030)
3. Assess the methods for monitoring coastal erosion and develop a permanent monitoring methodology suitable for Latvia (2024)
4. Resume and ensure continuous monitoring, assessment of geological processes of coast areas and modelling of coastal erosion (2030
5. Assess the existing legal framework, and improve it, if necessary, for cooperation between authorities in order to ensure the operation of the climate change monitoring system, including the collection of data necessary for the operation of the system (2021)

DA 5.2 Increasing the scientific and research potential and application thereof in the implementation of an action policies in the field of climate impacts and risk, vulnerabilities and adaptation to climate change

Measures:

1. Ensure the implementation of research work that aims at studying the vulnerabilities of the population, national economy, infrastructure, buildings and nature of Latvia to climate change impacts, developing adaptation to climate change solutions and climate-resilient development, and also promoting the use of opportunities derived from climate change (continuously)
2. Strengthen international cooperation in science and research on climate change impacts, risks and vulnerabilities, adaptation to climate change (continuously)
3. Update and publish future climate change scenarios developed by Latvia, supplementing the scenarios developed so far with indicators that have not been reviewed up to now and updating the data used, taking into account the latest IPCC reports (including action direction 6) (2024)

DA 5.3.: Integration of climate change forecasts and risk mitigation solutions in territorial development plans and sectoral policies

Measures:

1. Integrate the aspects of climate change, issues related to reducing the impacts thereof and adjustment to climate change in the development and updating of territorial development planning and sectoral policy documents of all levels (2025)
2. In developing local government development programmes, ensure the inclusion of detailed actions and necessary measures for adaptation to climate change (2025)
3. Develop forecasts of floods from the sea for all cities, the administrative territories of which are bordering the sea (2024)
4. Develop or update flood risk management plans for coastal cities of Latvia by previously assessing for which cities such plans are necessary (2024)
5. Organise training for local governments on climate change risks and inclusion of their impacts in territorial planning, taking of decisions by local governments (2022)

6. Ensure that climate-resilient development aspects are taken into account when developing urban spatial plans (street/zone level) (2027)
7. Carry out expert training on integrated aspects of climate change mitigation and adaptation to climate change in sectoral and regional policies and activities (2024)

MEPRD has the overall responsibility of the development of NAP. Responsible authorities for implementing adaptation measures also include: MoA, MoW, MoE, MoI, MoF, MES, and other ministries. The task of each responsible ministry is to coordinate the activities of the NAP which belong to their area of responsibility. In implementing NAP adaptation measures, local governments and research institutions are involved.

Evaluation of implementation of adaptation measures of NAP is planned in the midterm and at the end:

The midterm evaluation report of implementation is to be prepared and submitted to Cabinet of Ministers by 31 December 2026 (information about period 2020-2025). The final report – by 31 December 2031 (information about period 2026-2030).

Funding for identified priority measures is to be provided within the framework of state, local government and external funding, depending on the content of the measure. NAP recommends that municipalities, when preparing and updating development programmes and other development planning documents, including spatial planning documents, take into account the need for adaptation to climate change and develop and incorporate appropriate targeted measures, as well as further assess climate risk and adaptation aspects in the already planned measures also, generally considering adaptation as one of the horizontal actions. No additional funding for adaptation to climate change is planned in the current budget framework and using EU funding. Adaptation measures are largely related to the activities already underway (e.g., civil protection, flood control, building climatology, construction standards, etc.), and NAP provides a common view, coordination and effective operation.

Cooperation to enhance adaptation action at the sub-national, national, macro-regional and international level, including the area, scale and types of cooperation.

To enhance adaptation action to implement Article 4, paragraph 1(e), of the Convention with regard to adaptation an international cooperation is mostly related to international initiatives, programmes and projects, such as “Integration of climate change adaptation into the work of local authorities”/ LIFE LOCAL ADAPT (LIFE15 CCA/DE/000133), “Common methodology for the development of Sustainable Energy and Climate Action Plans”/LIFE Adaptate (LIFE16 CCA/ES/000049). Norwegian Financial Instrument (NFI) pre-defined project (PDP) “Integration of climate change policy into sectoral and regional policies” is under implementation, where climate change adaption related activities are included.

Currently, Latvian municipalities are being active taking part in the initiative “Covenant of Mayors Europe” activities. Twenty-five Latvian municipalities as members should be talking on a forefront action and develop their Sustainable energy and climate change strategies (SECAP), which would be preconditional action to fulfil requirements in order to develop their climate change action plans in 2021. At the moment, seven municipalities have developed the adaption plans for 2030.

References

- Biedrība "Zaļā brīvība" (foundation "Green Liberty"), 2017. Risk and vulnerability assessment and identification of adaptation measures in the area of construction and infrastructure. Final report, Riga, 208 pages, in Latvian, available at http://petijumi.mk.gov.lv/sites/default/files/title_file/petijums_varam_2016_2017_risk_un_ievain_novert_un_pielag_pasak_identif_buvniec_un_infrastr_joma.pdf
- EEA, 2017. Climate change, impacts and vulnerability in Europe 2016: an indicator-based report. European Environment Agency Report No.01/2017, available at http://www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016.
- Latvian National Plan for Adaptation to Climate Change until 2030, http://polsis.mk.gov.lv/documents/6507
- Ltd. "Baltkonsults", 2016. Risk and vulnerability assessment and identification of adaptation measures in the area of landscape planning and tourism. Report, Riga, 142 pages, in Latvian, available at http://petijumi.mk.gov.lv/sites/default/files/title_file/petijums_2016_varam_risku_un_ievaonoj_novertej_un_pielag_pasak_identif_ainavu_planosa_un_turisma_joma.pdf
- Ltd. "Estonian. Latvian & Lithuanian Environment" (2016) Risk and vulnerability assessment and identification of adaptation measures in the area of health and welfare. Final report , Riga, 123 pages, in Latvian, available at http://petijumi.mk.gov.lv/sites/default/files/title_file/petijums_2016_varam_risku_un_ievain_novertej_pielagos_pasak_identific_veselibas_un_labklaj_joma.pdf
- Process analysis researh centre (Procesu analīzes izpētes centrs) (2017. Risk and vulnerability assessment and identification of adaptation measures in the area of civil protection and emergency assistance. Final report, Riga, 165 pages, in Latvian, available at http://petijumi.mk.gov.lv/sites/default/files/title_file/petijums_varam_2016_2017_risk_un_ievain_novert_un_pielag_pasak_identific_civilas_aizsardz_arkart_palidz_joma.pdf
- State Forest Science Institute "Silava" and Latvia University of Agriculture (2016). Risk and vulnerability assessment and identification of adaptation measures in the area of agriculture and forestry. Final report, 172 pages, in Latvian, available at http://petijumi.mk.gov.lv/sites/default/files/title_file/petijums_2016_varam_risku_un_ievan_noverte_un_pielag_pasak_identif_lauksaimniec_un_mesaimniec_joma.pdf

FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

7. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

This chapter includes information on financial capacity-building and technological transfer support to developing countries on the provision of Latvia.

Support to developing countries plays an important role in reaching the agreed goal of limiting the global average temperature increase to below 2°C above pre-industrial levels, achieving the transformation to low GHG emissions economies, and supporting climate-resilient sustainable development. At the same time, it should be emphasized that Latvia, as well as some of the other EU Member States due to strict budgetary constraints have limited opportunities to provide remarkable scale of financial and technological support to developing countries.

Latvia is not an Annex II Party therefore the provisions of UNFCCC Article 4.3, 4.4 and 4.5 are not applicable, but it was decided to report provision of financial support according to EU Regulation No.525/2013 of the European Parliament and of the Council on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No.280/2004/EC.

In Latvia's situation the climate finance is defined as voluntary action as Latvia is Annex I country with economy in transition (EIT) according to UNFCCC classification, which does not oblige to allocate financial support to developing countries according to Paris Agreement Article 9.

In 2019, the total contributions through bilateral channel were made in amount of 88 528,38 EUR (99 105,26 USD) as a capacity-building activities in Georgia, Kyrgyzstan and Uzbekistan, and cross-cutting project in Moldova.

In 2020, climate finance contributions were made through bilateral channel in total amount of 93 761,00 EUR (107 093 USD) as grant bilateral projects implemented in Uzbekistan, Moldova, Ghana and Vietnam. The applied financial instrument is an established national level annual grant mechanism for development cooperation based on the set goals of the national development cooperation policy 2016-2020.

Due to the restrictions of financial resources and global COVID-19 situation in years 2019-2020 the technology support and transfer were under reconsideration process.

Latvia is evaluating opportunities to contribute achieving the common climate finance goal of annual 100 BUSD by 2025 to support developing countries by diversifying ways for national financial contribution and expanding targeted prioritized regions and recipient countries covering climate change mitigation and adaptation trends.

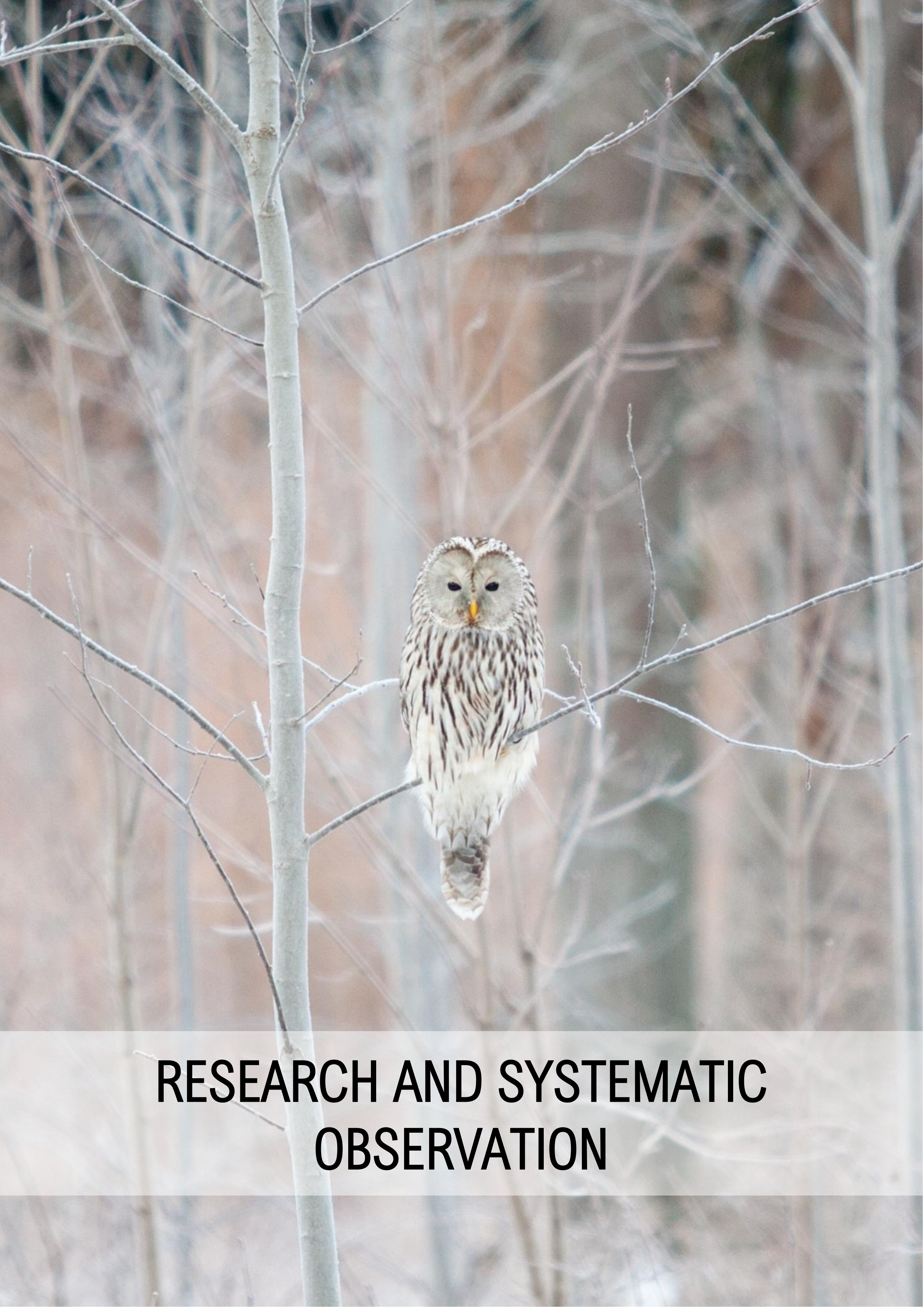
The significant improvements are made in the national legislation concerning reporting in the field of the climate change. Consequently, reporting will be enhanced across all related sectors from year 2023, including compiled data specifically on climate finance, capacity building, technology transfer and private mobilized financing targeted to developing countries.

Currently, responding to the announced ambitious climate targets and climate finance commitments both at UNFCCC and EU levels, Latvia intensively works on the progress of climate finance concept to contribute in most efficient and optimal ways to support common goals, climate change mitigation and adaptation to climate change, and to fulfil Paris Agreement conditions, providing support through bilateral and multilateral channels provisionally starting from 2023.

Main activities to support will be identified, considering the Paris Agreement Articles on financial, capacity-building, technology transfer actions.

As Latvia emphasizes the importance to mobilize both public sector and private sector financing to increase the climate finance support to developing countries, Latvia foresees actions on leveraging Latvian business society, to diversify channels of provision of climate support, as well as identifying a balance for financing between climate change mitigation and adaptation actions, as well as capacity-building and technology transfer opportunities in developing countries.

Summarized information on the financial and of capacity-building support can be found in the CTF Tables 7, 7(a), 7(b) and 9 included in the Common tabular format workbook for the BR5. The technology support and transfer were not provisioned, therefore the CTF Table 8 is not presented.



RESEARCH AND SYSTEMATIC OBSERVATION

8. RESEARCH AND SYSTEMATIC OBSERVATION

8.1 General Policy on and Funding of Research and Systematic Observation

8.1.1 General Policy on Research

Science and innovation are one of the key resources to achieve the national development aims. The legislative framework is established by the Law on Scientific Activity. Research policy is being developed in accordance with the national Guidelines for Science, Technology Development and Innovation (hereinafter- GSTDI) and the national Research and Innovation Strategy for Smart Specialisation (hereinafter – RIS3). The research policy aims to promote the development of a smart, technologically advanced and innovative society by creating a Latvia's science, technology and innovation system that develops excellent and competitive international research, increases innovation capacity and international cooperation and stimulates social and economic transformation towards higher added value and resource-efficiency. A particular focus is placed on transforming the economy to support knowledge- and technology-driven growth and catching up on the development of knowledge-based skills. The Latvia's research system is developed in line with European Research Area (ERA), in 2014 Latvia has joined the EC Smart Specialization Platform (S3 Platform).

National Development Plans for 2014-2020 (NDP2020) and for 2021-2027 (NDP2027)

The NDP2020 in the strategic objective "Advanced Research and Innovation and Higher Education" set the following goals:

- Goal 1: Increase investment in R&D with targeted efforts to attract human resources, develop innovative ideas, improve the research infrastructure, facilitate cooperation between higher education, science and the private sector, as well as the transfer of research and innovation to business;
- Goal 2: Through the commercialisation of knowledge, promote the creation of innovative and internationally competitive products with high added value as well as their introduction into production, increasing the share of output of such products in the national economy.

The NDP2027 in the strategic objective "Knowledge and Skills for Personal and National Growth" includes the Direction of Actions "Science for the development of society, the economy and security" having the following actions: (i) attracting human resources to research and the capacity building, (ii) effective implementation of a three pillar funding model with performance and innovation incentives (see the chapter 8.1.2), establishment of public research programmes for sectoral long-term strategic development and market-oriented research programmes for public and private R&D cooperation, especially in RIS3 areas, (iii) effective coordination and management of research and innovation investments, strengthening the R&D governance capacity; (iv) strengthening scientific excellence to address societal challenges, (v) strengthening the R&D strategic planning of state and municipal institutions and public enterprises, (vi) knowledge transfer, including through promoting the availability and use of open databases. NDP2027 underlines that climate change, geopolitical shifts, inequalities, rapid technological development and increased migration are new challenges to Latvian society and national security,

Latvian Research and Innovation Strategy for Smart Specialisation (RIS3), established in 2014, articulates and promotes economic transformation towards higher added value and greater resource efficiency, through the continued identification of competitive advantages, the choice of strategic priorities and the development of policy instruments that strategically prioritise public investments in research and innovation to promote knowledge-intensive socio-economic development. Latvia's RIS3 pursues a 'hybrid strategy' as it emphasises both general investments in the knowledge base and specific research activities in the five smart specialisation areas with the greatest research and innovation potential: 1) Knowledge-intensive bio-economy; 2) Biomedicine, medical technologies and bio-pharmacy; 3) Smart materials, technologies and engineering systems; 4) Smart energy; 5) Information and communication technologies. Social sciences and humanities are developed as an area with horizontal impact on RIS3. Research on climate change issues particularly relates to the noted (3) and (4) smart specialisation areas. RIS3 is the background for targeted use of EU Funds. The necessary development of R&D human capital, transfer of knowledge, skills, competences and technologies will be ensured. RIS3 areas of specialization are/will be developed within the RIS3 Research and Innovation Centres of Excellence. It emphasises the role of universities as “knowledge hubs” to provide modern education and knowledge base for the economy.

Guidelines STDI is a medium-term policy planning document that defines the national science and technology development policy, setting out the basic principles, objectives, priorities, directions of action and tasks to be performed, coordination of the innovation system and ensures the continuity of policies. GSTDI complement and are thematically aligned with the sectoral development activities envisaged in other thematically related national policy planning documents. GSTDI for 2014-2020 had been elaborated based on RIS3. In turn, GSTDI for 2021-2027 have been developed taking into account the RIS3 monitoring reports in 2018 and 2020. Within the GSTDI for 2014-2020 six sub-goals and, respectively, strategic directions for action had been set: (i) develop human capital in the field of STDI, (ii) promote international competitiveness of Latvian science, (iii) modernize and integrate the research and education sector by increasing their ability to respond to future challenges in STDI; (iv) develop a more effective knowledge transfer environment and strengthen the absorption and innovation capacity of companies, (v) optimize management of the STDI field ensuring effective coordination and R&D investment growth, (vi) create demand for science and innovation, communicating science achievements to the public and promoting innovative activities and technological development. The GSTDI for 2021-2027 underline it is still primarily necessary to increase the intensity of R&D. Priority will be given to developing research excellence, digital transformation of the R&D system and improvement of institutional governance to increase the social and economic value of the research. National universities and public sector research institutes will be further developed as centres of knowledge and innovation, concentrating research capacity, strengthening research infrastructure and resource sharing, and proactively developing new knowledge flows with industry and the ERA. It will be developed an open science culture ensuring the wide availability and usability of research data and results.

Priority Directions in Science focus scientific activity on issues of strategic importance for the sustainability and development of Latvia, providing funding from the state budget. The determination of them started in 2001, the Cabinet of Ministers approved the priority directions in science once every four years according to the national policy for the development of science and technology. In 13 December 2017, it had been approved nine priority directions in science for the period 2018-2021:

1. Technologies, materials and engineering systems for increasing the added value of products and processes and enhancing cybersecurity;
2. Energy supply security strengthening, energy sector development, energy efficiency, sustainable transport;
3. Climate change, nature protection and environment;
4. Local natural resources and their sustainable use for development of knowledge-based bioeconomy;
5. Statehood of Latvian language and values, culture and art;
6. Public health;
7. Knowledge society and innovations for economic sustainability;
8. Demography, sport, open and inclusive society, welfare and social securitability;
9. State defence challenges and social security.

Climate change related issues are dealt within the several priority directions and are financed by a range of research programmes (see the chapter 8.1.4).

Scientific Institutions and Staff

The Law on Scientific Activity defines scientific institutions are scientific institutes, higher education institutions, commercial companies and other institutions in the articles of which scientific activity and participation in the process of acquiring and improving scientific qualification is provided for and which are registered in the Register of scientific institutions. A scientific institution shall have at least five persons with a doctoral degree in the field of research that conforms to the activities of the scientific institution. The scientific institute in achieving scientific goals shall be free from the influence of by the founder or establisher. The legal form of a scientific institute may be: 1) a public agency; 2) a derived public person; 3) a structural unit of a higher education institute; or 4) a private law legal person or a structural unit thereof. A State scientific institute may be established as a State agency or a derived public person and shall be under supervision of the Minister for Education and Science or the relevant sectoral minister. A scientific institute of a State-founded university may be established as a derived public person under the supervision of the relevant university.

On the beginning 2022, 61 research institutions are registered in Latvia Register of Scientific Institutions, 22 of them are public sector scientific institutions founded by the government. In its turn, also 462 business sector entities had been engaged in the R&D activities in 2020.

In 2020, 6559 employees have worked in research in Latvia (re-calculated to the full time equivalent), of which 5178 – in universities/higher education sector and public sector scientific institutions, and 1381 – in the business sector. Of this number, 4072 were scientific personnel – researchers and 2487 were scientific technicians and other supporting staff.

8.1.2 Research funding

Total research financing over the last few years has been rising from 0.51% in 2017 up to 0.71% (share of GDP) in 2020 (Figure 8.1).

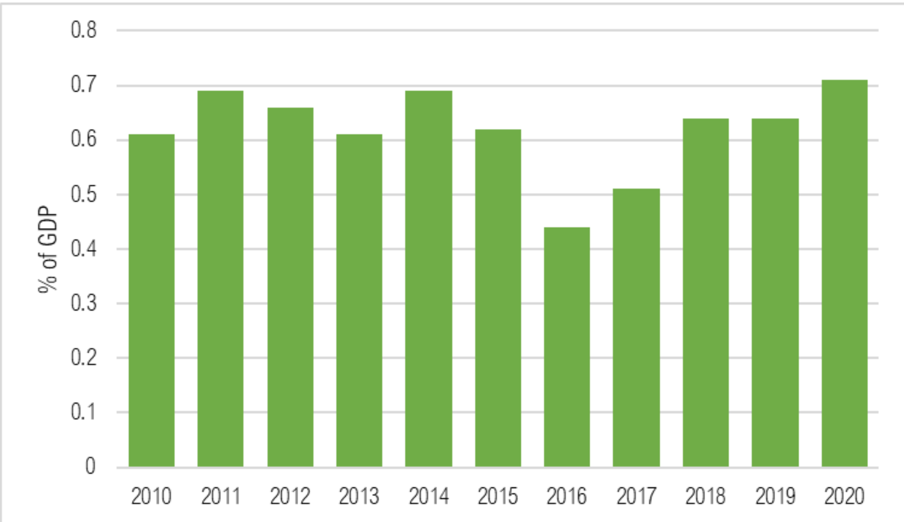


Figure 8.1 R&D expenditure as percentage of GDP

The total R&D funding has growing trend (Figure 8.2). In 2020, the total R&D funding was ~ 208 MEUR and it has increased by around 28% compared to 2014 and by around 34% compared to 2017. The total volume of the R&D financing over the last 4 years period (2017-2020) constituted around 727 MEUR. (around 182 MEUR annual average). State and university financing was around 39.3%, financing from enterprises – around 24.5%, foreign financing – around 36.2% of the total R&D financing in the last 4 years (2017-2020) period.

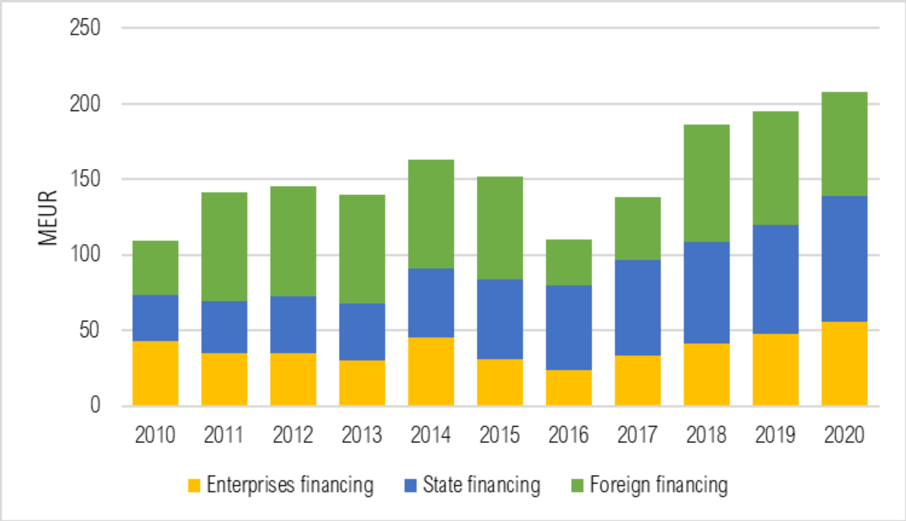


Figure 8.2 Breakdown of R&D financing by sector

The expenditures for the basic research in 2017-2020 period was around 33% of the total research expenditures, the rest was expenditures for applied research and experimental development (Figure 8.3).

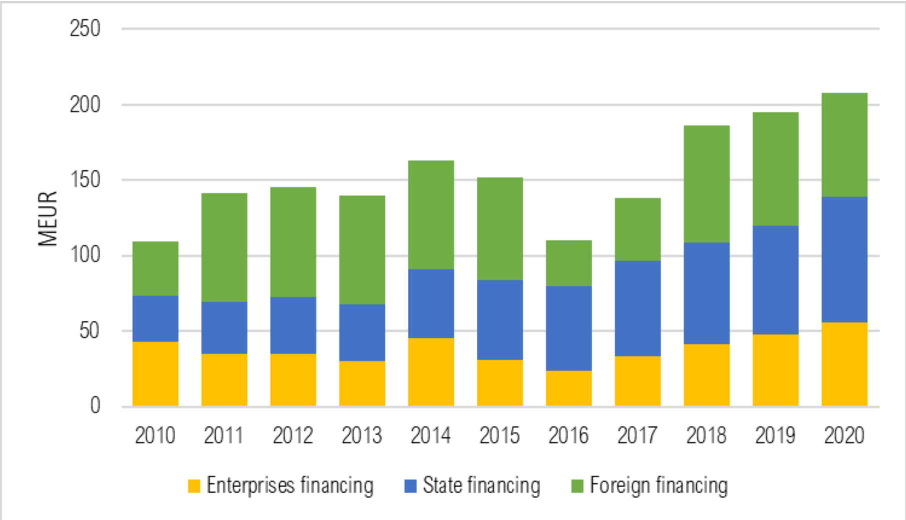


Figure 8.3 Breakdown of R&D expenditure by R&D type

For the development of research and innovation system, the MES provides funding from the State budget, attracts funding from EU funds and assists in attracting funding from international research programmes and financial instruments. Funding is granted both institutionally (basic funding of research) and on a competitive basis.

Institutional funding. Since 2015 a **three pillar funding model** has been step-by-step introduced in Latvia to stimulate research and innovation in the public sector research institutions. The three pillars are:

- base funding – institutional funding to ensure the development of studies and basic research;
- performance-based funding that is allocated based on study outcomes and research results;
- innovation funding – development-oriented financing that promotes the specialisation of institutions and their profile development.

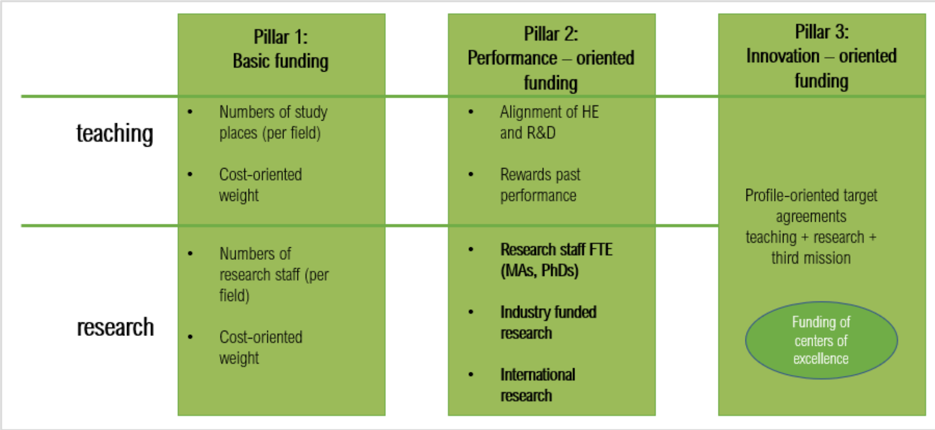


Figure 8.4 Three pillar funding model (source: MES website)

In the 2017-2021 period 22 Latvian scientific institutions received base funding of research: a total of 118.56 MEUR was granted (annual average 23.7 MEUR). Important, base research funding serves to raise funding on a competitive basis. In April 2022 the government has approved re-casted regulation on allocating financial reference amount to public scientific institutions. The re-casted regulation provides increasing the stability and predictability of institutional funding and promotes better performance of scientific activities.

Funding on Competitive Basis

National Research Programmes (NRPs), initiated by the sectorial ministries, are funded from the state budget resources. The NRP system in Latvia was launched in 2005. NRPs are State commissions for the performance of scientific research in a specific economic, educational, cultural, or other sector of priority to the State with the purpose of promoting the development of such sector. The scientific institutions – implementers of NRP are determined based on open Call procedure. In the period of 2018-2021 a total of nine NRPs are implemented in different sectors, the total financing constituted ~ 16.5 MEUR. Among them, two NRPs have direct focus on climate change mitigation – (1) NRP "Energy" (~ 4.8 MEUR) and (2) NRP "Sustainable Spatial Development and Rational Use of Land Resources" (~0.377 MEUR, more details see in the chapter 8.2.2). In 2022 the new period for NRP has started.

Within the **National Fundamental and Applied Research Programme (NFARP)** national financing (grants) is allocated to the specific projects in accordance with the results of open Calls. The NFARP is aimed to create new knowledge and technological know-how in all fields of science. Within 2018-2021 period, a total of 374 projects were supported for the total amount of grants around 86 MEUR.

Research commissioned by a State administrative authorities is a procurement (according the competition procedures) for State needs the purpose of which is to promote the development of a sector with the help of scientific research and to promote the solving of concrete problems within the field of competence of the relevant State administrative authority.

Programmes financed by EU ERDF: planning period for 2014-2020. Use of EU ERDF funding are in line with the NOP "Growth and Employment". The NOP sets out the priority axis "Research, Technological Development and Innovation", which includes 2 investment priorities:

1. Improve research and innovation infrastructure and ability to develop excellence in research and innovation, as well as promote the creation of a centres of excellence, in particular centres of European interest (total allocated public funding around 344.6 MEUR[25], of that ERDF funding 291.7 MEUR, Figure 8.5);

[25] Financing of BBCE (Baltic Biomaterials Centre of Excellence) not included in this financial volume. For this centre it is allocated total funding of around 49,3 MEUR, of that ERDF financing 41.1 MEUR

2. Promote business investments in R&D and create links and synergies between businesses, R&D centres and the higher education sector (total allocated ERDF funding around 177 MEUR, including the development of new products and technologies and their commercialization within competence centres[26], technology transfer, promotion of implementation of new innovative products, innovation promotion, training incentives in the SMEs, etc.).

Thus, thanks to the EU funds, there is a growing portfolio of research funding instruments. Practical research programme supports industry-oriented research projects in the areas of Latvia's RIS3 strategy, programme provides open competition for the project proposals, to develop new technologies and products. Another activity – support for R&D infrastructure and institutional capacity building – focuses to support smart specialization areas/smart technology centres in Latvia's universities and scientific institutes having high competence. Postdoctoral research grants and Innovation grants to students provide an opportunity for young researchers to develop their research capacity and career while contributing to the goals of Latvia's RIS3 strategy. More than 350 postdoctoral research projects are being supported. These programmes will be continued in the following EU Funds planning period for 2021-2027 as well.

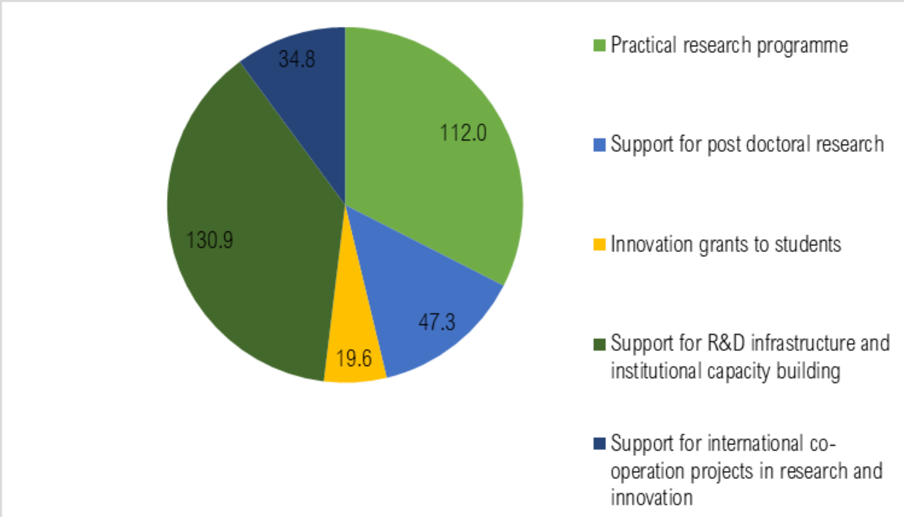


Figure 8.5 Financing of the measures of the Specific Objective "Strengthening research and innovation capacity and implementation of advanced technologies in R&D system" of the NOP "Growth and Employment" for 2014-2020", MEUR

In the EU Funds planning period for 2021-2027 the financial support will be continued for both the research infrastructure and skills development and the development of new products and technologies as one of the policies to support entrepreneurship. Particularly, around 320 MEUR is planned by the Latvia's EU Cohesion Policy Programme of 2021-2027 planning period the for research and skills development, of that 85% -ERDF financing and 15% -national financing. In turn, around 150 MEUR co-financing (total, by the Latvia's EU Cohesion Policy Programme 2021-2027 and Latvia's Plan of Recovery and Resilience Facility) will be granted for the development of new products. Important measure of the following planning period is the digitalisation of research.

Internationalisation of research is promoted through a number of bi- and multi-lateral arrangements, including the EU Research and Innovation Funding Programme Horizon 2020. It is evaluated that up to 31 January 2022, Latvia institutions implement 433 Horizon2020 funded projects (538 participations of Latvia's organizations) and thus have attracted around 116 MEUR financing, of which universities/HEI and science institutions – around 55%, business sector organisations – around 28%, public (state and municipal) bodies – around 11%, other institutions – around 6%.

[26] the financial support for the eight competence centres is provided, see more in the Chapter 8.1.4 below

To promote **research cooperation in the Baltic Sea region** important role has EEA and Norwegian Financial Mechanism programmes, joint Baltic – Nordic Energy Research Programme as well as the joint Baltic Sea research and development programme BONUS 2020.

8.1.3 International activity

Latvia participates in several European and worldwide research and environmental monitoring programmes, which are important for fulfilling the commitments made in international treaties and for the development of open science.

Latvia is a member of IPCC, WMO, EUMETSAT, NORDMET, ECMWF, HELCOM. Latvia cooperates with Union Member States, international cooperation, and with regional and international organisations to share information and to strengthen science, institutions and adaptive knowledge though participation in scientific organizations and projects. In addition, Representatives from Latvia participate as project partners in EU Horizon 2020 projects, LIFE 2014-2020 programme sub-programme Action Climate and Interreg programmes projects where both environmental quality and climate change are tackled from aspects of environmental and urban environmental quality as well as climate change adaptation.

As a member of WMO (World Meteorological Organization) LEGMC provides representative observational network with systematic and qualitative meteorological observations in the whole territory of Latvia. Within the framework of climate change monitoring, information is obtained from meteorological observation stations located in Latvia. Permanent weather observations are needed for climate change trends characterization and assessment. Systematic maintenance, development and data collection of observation system reduces uncertainty of climate change adverse effects. Long-term climate monitoring and climate change detection at the national level is ensured by collection of meteorological and climate information with its further systematization and storage in data bases.

Meteorological observations in Latvia are collected in accordance with national meteorological observation program. The methodology of meteorological observations is based on the WMO guidelines.

Regarding climate modelling, projections and climate change scenarios, LEGMC has performed a detailed analysis of long-term historical climate data and, in collaboration with the Finnish Meteorological Institute, developed future change scenarios (until year 2100)[27]. Climate change scenarios correspond to the projected values of either average or high amounts of greenhouse gas emissions based on the IPCC 5th (Fifth Assessment Report of the United Nations Intergovernmental Panel on Climate Change) assessment report. Multiple climate models are adapted to territory of Latvia by bias correction and statistical downscaling methods. Results are extensively analysed by team of analysts and climatologists, and improved by comparing them to the latest climate change monitoring results.

For wider public the visualization of the climate change scenarios is available online in the Climate Change Analysis Tool[28]. Climate Change Analysis Tool allows to explore current and projected future climate scenarios in Latvia in the form of maps and graphs. Maps display 30-year average values of the selected climate indices. A summary report of these results is available as well as all the data is freely downloadable for further scientific research.

As soon as new IPCC scenarios are approved Latvia will start to work on update of climate models and projections under the pre-defined project "Integration of climate change policy in sectoral and regional policies" funded under the Norwegian Financial Mechanism 2014-2021 Programme "Climate Change Mitigation, Adaptation and Environment".

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[27] http://www4.meteo.lv/klimatariks/zinojums.pdf
[28] http://www4.meteo.lv/klimatariks/

On 24 June 2020, the European Space Agency (ESA) Council approved Latvia's accession as an associated Member State of ESA. It opens up new opportunities for Latvian scientists and entrepreneurs to cooperate with the European space industry in the field of human capital in the field of high technology, as well as to promote the development of the research and study base of universities, thereby contributing to the development of a higher value-added economy in Latvia.

The ESA Convention provides that the funding invested by Latvia as an associated Member State will return to Latvia at least 85% per year and will come to the disposal of Latvian high-tech companies and scientific institutions in order to further develop space technologies, innovation, services and their commercialisation on the global market.

In 2020, Latvia's space strategy for 2021-2027 has been developed, with the aim of structuring and coordinating issues related to the space policy in Latvia. The strategy also contributes to the achievement of the objectives, priorities and actions defined in the Latvian National Development Plan for 2021-2027, the National Industrial Policy Guidelines for 2021-2027 and the Science, Technological Development and Innovation Guidelines for 2021-2027.

The Ministry of Education and Science, in cooperation with the Latvian Space Industry Association, has created a portal for the Latvian space sector, https://latviaspace.gov.lv/, which aims to increase the international visibility of the Latvian space industry, promote the establishment of contacts and support the development of national and international networks.

The new portal provides a database with companies and scientific institutions registered in Latvia that are an active part of the space ecosystem or have direct potential to apply their technologies to the space sector. The portal can familiarise itself with the success stories of the Latvian space industry and obtain information on Latvian space technologies and competencies, cooperation, financial support and training opportunities for the Latvian space industry and students - at national, European and global levels.

8.1.4 Research management

The general framework of the research management is established by the Law on Scientific Activity.

Cabinet of Ministers determines the state policy for the development of science and technology, as well as innovation, approves the priority directions in science, approves NRPs, approves the governmental regulations related to the financing of research and development and procedures thereof.

MES develops the state policy for the development of science and technology and ensures its coordinated implementation and monitoring, organizes the financing and evaluation of scientific institutions; co-ordinates international research cooperation at the national level, ensures support for participation in such programmes, represents Latvia in the research management institutions of the EU. MES maintains and updates the National Information System of Scientific Activity (NISSA) as well as performs other activities. MES co-operates with other sectoral ministries, and, where necessary, consults with sectoral and social partners. MES is responsible for the implementation of RIS3 in higher education and science.

MoE is responsible for developing and implementation of RIS3 in relation to the development of entrepreneurial competitiveness.

MEPRD is involved in the implementation of RIS3 with regard to the promotion of balanced regional development and regional specialization within regional innovation and knowledge platforms and the implementation of digital transformation. According to the provisions of Environmental Protection Law, the MEPRD is responsible, in co-operation with the MES, for performing the necessary measures for development of environmental science.

MoA is involved in the implementation of RIS3 related to the implementation of the Bioeconomy Strategy. Other ministries are also involved in the implementation of RIS3 in accordance with their competence in the areas of RIS3 specialization.

Latvian Academy of Science participates in the development of science policy and in scientific expertise, takes care for the involvement of young researchers, fosters ethics of scientific research, discussion principles and traditions, promotes international contacts and provides science communication.

LCS is an institution of direct administration subordinated to the MES and fulfilling the following functions: strategic implementation and communication of science policy, planning and implementation of scientific research programmes, including open Calls of NRPs and NFARP[29], ensuring of scientific expert-examination for the needs of public and private sector; promotion and coordination of international scientific cooperation. LCS has a Scientific Advisory Board in the field of science and technology development policy, including the development of legislation.

State Education Development Agency (SEDA) is the institution of direct administration subordinated to MES. Up to 31 December 2021, SEDA provided information and advice on the implementation of national science and innovation policy, ensured the implementation of EU policy initiatives in Latvia, among them was Horizon2020 National Contact Point, ensured Latvia's participation in EU joint programmes and joint technology initiatives, as well as COST, ERA-NET and ERA-NET+ projects, ensured monitoring of EEA and Norwegian Financial Mechanism programmes and coordination of bilateral co-operation programmes, etc. SEDA provided management of postdoctoral research grants as well. **As of 1 January 2022, SEDA is reorganized and these functions are taken over by LCS.**

The role of National Research Centres is the thematic concentration of research resources in RIS3 areas and in sectors of high horizontal importance.

Access to research results

NISSA[30] is a state information system, which collects information on the scientific activities of scientific institutions. It includes a register of scientific institutions, the databases of: persons elected to academic positions; LCS experts; research projects; research results; reports on the scientific activities of scientific institutions and an international evaluation database. NISSA also provides centralized information on national and international research programmes' open calls.

The NRP implementer is obliged to publish relevant information (including on the project implementation, scientific group, activities and achieved results) on the implementer's website and to maintain it for at least five years after the end of the project. In turn, in the website of the LCS, mid-term and final reports on the implementation of the NRPs are published. The same applies to the projects financed by NFARP.

Research projects commissioned (as well as planned) by State administrative authorities are collected in the "Research and Publications Database", specially developed for this purpose by the CSCC. It assists policy planners and promotes evidence-based policy planning in Latvia as well as provide an overview to a wider public on public investments in development of activities in specific fields and sectors. In addition, sectoral ministries maintain their websites which includes section on funded research projects and their results as well.

Scientific institutions and organizations participating in the implementation of internationally funded projects provide access to results in their websites.

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[29] Up to 30th June 2020, ensuring administrative and financial monitoring of research programmes and projects funded from the state budget was the competence of the Study and Science Administration (SSA) that had been direct administration institution subordinated to MES. As of July 1, 2020, the SSA was abolished and these functions are transferred to the LCS.

[30] In Latvian - Nacionālā zinātniskās darbības informācijas sistēma (NZDIS)

On 1 March 2022 the Cabinet of Ministers has supported the "Latvia's Open Science Strategy for 2021-2027". The three pillars of the strategy are: (1) freely available scientific publications (all new scientific publications on public budget funded research results shall be available in "green" or "gold" open access without embargo period), (2) research data shall be open on default; the research data, intended for long-term retention and re-use, their metadata and e-infrastructure shall maximally correspond to the FAIR (Findable, Accessible, Interoperable, Reusable) principles, and (3) promotion of the citizens science based on co-creation.

8.1.5 Climate and energy research in the Latvian research system

NDP2027 underlines that **climate change** is one of key-challenges to Latvian society and national security that require R&D investment. **RIS3 strategy** established in 2014, articulates and promotes economic transformation towards higher added value and greater resource efficiency. The RIS3 provides targeted focusing of research and innovation resources in areas of knowledge where Latvia has comparative advantages or has basis for creating such advantages. Five smart specialization areas are defined. Climate change mitigation, meeting the decarbonisation and climate neutrality goals is most closely linked with smart energy as well as knowledge-intensive bio-economy and smart materials, technologies and engineering systems specialisations.

Climate change mitigation and adaptation research covers a wide range of research from fundamental research to applied research and experimental development and is financed within different programmes, both national and international ones.

National Research Programmes (NRP) system was launched in 2005. These programmes aim to create new knowledge, expertise and innovations, develop new solutions to contribute to the development of the specific field and strategic national development goals. NRPs in energy and environmental science had been launched in 2006.

Energy efficiency, renewable energy resources, climate mitigation and adaptation issues, including assessment of socio-economic impacts are addressed in the **national thematic research projects**. They are financed within the framework of the National Fundamental and Applied Research Programme (NFARP). The NFARP is aimed to create new knowledge and technological know-how in all fields of science. Financing is assigned to the specific projects in the form of grants in accordance with the results of open competition (open Calls), organized by the LCS. The topics, purposes and tasks of the research are formulated by the scientists themselves. The main criterion for the allocation of a grant is the scientific merit of a project.

An important contribution to climate change mitigation and adaptation related research is provided by the sectoral **studies commissioned by responsible state authorities.** The goal of these studies is to provide the analytical knowledge basis for the following development of national policies and measures as well as for improvement of the monitoring of GHG emissions (e.g., better substantiation of GHG emission specific factors). These studies also address promotion of the climate friendly governance and management practices. Such studies are elaborated not only by science institutions, but also by other actors, such as NGO, foundations and private sector companies, which have strong expert staff capacity in the particular field.

Within the framework of the EU Funds 2014-2020 planning period, the projects of the **Practical research programme** are co-financed by the EU ERDF. Lead partners of the projects are both science institutions as well as private companies active in the particular branch and willing to develop new technologies. Another activity, supported by the ERDF, is promoting the commercialization of research results within the competence centres. The competence centres, most linked to climate change mitigation, are Forest Sector Competence Centre; Smart Engineering Systems, Transport and Energy Competence Centre; Centre for Smart Materials and Technologies; Machine Engineering Centre.

Important contribution both in research on climate change impact and adaptation and in support of the national GHG inventory are provided by the **EEA and Norwegian Financial Mechanism** for both 2009-2014 and 2014-2021 periods. Particularly, within the EEA and Norway Mechanism of 2014-2021 the financial support is provided by: (1) **Norwegian Financial Mechanism Programme "Climate Change Mitigation, Adaptation and Environment"** as well as by (2) **Baltic Research Programme.** The aim of the Baltic Research Programme is to promote in-depth, research-based knowledge development by improving the research performance of the Baltic States at the international level. This is done by research organizations from Latvia, donor countries, Estonia and Lithuania cooperating in the field of basic research and industrial research. An open tender was held in each of the Baltic States and the implementation of approved projects is currently underway.

In its turn, in October 2018 all three Baltic countries entered into the Baltic-Nordic energy research cooperation (**Joint Baltic-Nordic Energy Research Programme**) initiated by Nordic Energy Research. This cooperation is built upon the success of the Baltic Energy Technology Scenarios project that is a scenario-based energy system analysis that explores the changes in the Baltic countries' energy systems. The overall aim of the programme is to promote energy research and analysis in the Baltic States and inspire intra-Baltic and Baltic-Nordic collaboration. This aim translates into three central actions: (1) promotion of intra-Baltic and Baltic-Nordic research projects with participation of Baltic researchers, (2) a Baltic-Nordic PhD collaboration, (3) exchange of energy researchers between the Baltic and Nordic countries.

Latvian research institutions and organizations are active participants in the project consortiums of EU horizontal programmes:

- EU Framework Programme for Research and Innovation **Horizon2020**;
- EU's Funding Instrument for the Environment and Climate Action (**LIFE programme),** that for 2014-2020 period is divided into two sub-actions: environment and climate ones.

The thematic information regarding the projects implemented within the scope of noted above programmes that relate to climate change adaptation and mitigation issues are provided below in the chapters 8.2.1 and 8.2.2 respectively.

Projects within ERA-NET/ERA-NET COFUND networks. ERA-Net projects co-finance activities that promote the internationally coordinated implementation of national research programmes and projects. One of the most important activities of ERA-Net projects is the organization of joint research project competitions. The ERA-Net project country provides funding for the participation of its scientific institutions and companies in the most successful research projects and part of the research project costs (up to 30%) is co-financed by the EC. ERA-Net COFUND projects combine the operating principles above: several research and technology development project tenders are organized within the particular COFUND project and one of them is co-financed by the EC. It is provided the financing ensuring Latvia's institutions participation in such ERA-NET networks' project calls and activities as:

- EXPERA (ERA-Net Smart Energy Systems), particularly the Focus Initiatives Smart Grid Plus and ENERDIGIT (Digitalisation of Energy Systems and Networks);
- Urban sustainable development: EN-SUF (Smart Urban Futures); ENSUGI (Sustainable Urbanisation Global Initiative); T2S (Transformation to (urban) Sustainability); EN-UAC (Urban Accessibility and Connectivity, the network addresses the challenges of sustainable urban mobility and connectivity as integral part of sustainable urban development); ENUTC (2021 initiative to promote urban transformation capacities);
- M-ERA.Net 2 (ERA-NET for materials research and innovation) supporting research and innovation related to materials and battery technologies supporting the European Green Deal;
- Forest value (ForestValue – Innovating forest-based bioeconomy) supports research to promote increased innovation and competitiveness of the forest-based sector in Europe and its transformation from a resource-intensive to a knowledge-intensive, productive, resource-efficient and resilient sector;

- ERA GAS (ERA-NET for Monitoring & Mitigation of Greenhouse Gases from Agri- and Silvi-cultures);
- ERA-NET SusAn (European Research Area on Sustainable Animal Production Systems).

Research infrastructure of European Interest are developed in such projects as:

- SeaDataCloud/Sea DataNet, Latvian Institute of Aquatic Ecology;
- European Long-Term Ecosystem, critical zone and socio-ecological Research Infrastructure (eLTER, Advance eLTER and eLTER PLUS), The Institute of Biology of the University of Latvia;
- Research Infrastructure for Circular Forest Bioeconomy (ERIFORE), Latvian State Institute of Wood Chemistry).

Main institutions participating in climate change mitigation and adaptation related research

Leading research institutions in **RIS3 specialization area "Smart Energy"** are Riga Technical University; the Institute of Solid State Physics of University of Latvia; the Institute of Numerical Modelling of Faculty of Physics, Mathematics and Optometry of University of Latvia. Important players in the area are the Institute of Physical Energetics; Latvia University of Life Sciences and Technologies and Latvian State Institute of Wood Chemistry. In is turn, leading research institutions in **RIS3 specialization area "Smart materials, technologies and engineering systems"** are the Institute of Solid State Physics; Riga Technical University; University of Latvia; Latvian State Institute of Wood Chemistry and Latvian Institute of Organic Synthesis.

Riga Technical University conducts the research in all aspects of the smart energy system, e.g., smart solutions for nearly-zero energy building, smart energy storage, hybrid energy systems, biomass conversion and synthesis of modern biofuels, smart industrial production processes, smart grids and other challenges. Research includes both technologies and their implementation and management policies.

Institute of Solid State Physics of University of Latvia is the only scientific institution in Latvia, where the Hydrogen Energy Laboratory has been operating since 2007 that carries out research on materials and technologies in all hydrogen energy sectors – hydrogen production, storage, use for vehicles and stationary generation of electricity. Research of energy storage technologies – batteries – are performed. Another field of the institute competence is new materials for fuel cells and for solar PV. The Institute runs the Excellence Centre of Advanced Material Research and Technology Transfer (CAMART2) supported within the Horizon 2020 programme.

The Institute of Physical Energetics (IPE) conducts active and diversified research activities in the field of energy and related engineering sciences that promotes the development and implementation of innovative technologies and solutions in the Latvia's energy sector. The research directions cover the entire energy supply-demand system to promote its sustainability: energy and environment technological and economic research, energy system infrastructure research and development planning, with particular attention to smart grids and demand management, research into new materials and technologies for energy sector and efficient use of energy resources. Climate change mitigation is directly related to the Institute's research activities, such as energy–climate policy analysis, modelling energy-environment system, GHG and air pollutant emissions calculation and projecting for the energy and transport sectors.

The Institute of Numerical Modelling (the Faculty of Physics, Mathematics and Optometry of the University of Latvia) conducts research in several areas related to the field. Regarding climate change mitigation, important research area is energy efficient buildings (diagnostics, design of insulation units and HVAC systems, smart building monitoring solutions, etc.) and assessment of how well the building and its individual components are suitable for the local climate. Regarding climate change related data, the institute has many years of experience in meteorological observation processing and climate data analysis using regional and global climate models and has developed downscaling techniques for projecting climate forecasts to a specific area (e.g., Latvia as a whole, Riga).

Latvian State Institute of Wood Chemistry is lead institute in the developing of wood biomass containing composite materials and their use.

Latvia University of Life Sciences and Technologies is the leading research institution in the GHG mitigation in agriculture and land-use sector. The faculties and research institutes conduct research in knowledge intensive bio-economy, engineering as well as social sciences. The following specific research areas have to be underlined in the context of climate change impact: research on soil and land-use as basic agricultural resource, plant and animal productivity studies, hydrological and agricultural runoff research, and others. The university staff work on the assessment of the emission reduction potential and costs-benefits analysis in the agricultural sector as one of the most important sectors of GHG emissions in Latvia. Also, the active research on forest ecology and forestry studies (including forest resource economics and forest management planning) is done. Important research direction is the economics of sustainable development of the bio-resources industries and reduction and rational use of production by-products and residues.

LSFRI "Silava" is the leading research institution in the LULUCF sector. The institute is the Latvian national forest research centre. The aim of LSFRI "Silava" is to acquire new knowledge and develop innovative technologies using scientific methods in order to promote the sustainable development and competitiveness of the forestry sector. As such, the institute promotes the development of knowledge based bio-economy. The Institute is responsible for the national monitoring of forests. The Institute conducts forestry research in the context of climate change and performs GHG emission and CO_2 capture assessments in the LULUCF sector. Within the research programmes since the Latvia's NC7 report the further investigation of forestry sector has been commenced.

Research in the climate sector, provided by the staff of the **Faculty of Geography and Earth Sciences of the University of Latvia** relates to the change of climatic parameters in Latvia, impacts of climate change on aquatic ecosystems, biodiversity, soils, developing adaptation strategies and actions. High attention is paid to study climate change impact on soils.

Ecosystem research is crucial in the context of climate change impact. The **Faculty of Biology of the University of Latvia, the Institute of Biology of the University of Latvia and Daugavpils University** are the leading Latvian research institutions in this field. Daugavpils University has a long-term experience in the research of freshwater ecosystems, both at species and habitat level, as well as in research on the spread of alien species. The research activities of the Institute of Biology of the University of Latvia relate to (i) natural resources of Latvia, their rational use, environmental and ecological problems, nature protection, and (ii) plant and animal life processes and biological productivity. The Institute for Food Safety, Animal Health and Environment (BIOR) has a long history of working with commercially important fish stocks. **The Latvian Institute of Aquatic Ecology** is the agency of the Daugavpils University that studies fundamental and practical problems related to the Baltic Sea environment and ecology.

8.2 Research on climate processes, climate change impacts and adaptation, climate change mitigation

8.2.1 Research on climate processes, climate change impacts and adaptation

Data analysis and research on climate change related risks and vulnerability assessments are actively on-going resulting in the identification of relevant adaptation measures.

The national **Air Monitoring and Climate Change Monitoring Programmes for 2015-2020** had been carried out continued for the next, **2021-2027** period. The state integrated control and information system for fishery is on place, supervised by the MoA.

Remote sensing and derived products are becoming increasingly important in analysing climate change and in monitoring of extreme hydro-meteorological phenomena. LEGMC has used remote sensing, reanalysis and derived products in recent years in the monitoring of meteorological parameters, product development and a number of studies.

One of the most important sources of monitoring data on climate change is the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT). LEGMC has developed the digital climatic atlases based on the use of EUMETSAT satellite observation data for climate data monitoring data sets. For example, the data set used in the Solar Radiation Atlas (developed in cooperation with meteorology authorities of Lithuania, Estonia and Poland) and Satellite Climate Atlas. EUMETSAT data have been also used for monitoring of sunshine duration and solar radiation and for the update of the Latvian national construction standard "Building Climatology" recalculating direct and diffused solar radiation.

Membership in the European Medium-Term Weather Forecast (ECMWF) provides a unique opportunity for observational data sets and model data to be used in climate studies. ECMWF data together with data from European Union's Earth observation programme Copernicus are used in LEGMC Marine data portal, where one can learn about hydrological and meteorological forecasts for central part of the Baltic Sea. LEGMC has used ECMWF reanalysis in a number of studies, for example, data are currently used in the sea surface temperature analysis for characterisation of past climate change. ECMWF data have also been used in the study for updating Latvia national construction standard "Building Climatology", recalculating snow loads for the entire territory of Latvia.

Currently LEGMC is also carrying out coastal erosion analysis using European Space Agency (ESA) Sentinel-2 satellite measurements. Within its climate portal LEGMC also provides translated version of Global temperature change monitoring tool, which in turn is developed by Copernicus using remote sensing satellite mission data.

Important contribution had been provided by the project **"Development of Proposals for National Adaptation Strategy, including Identification of Scientific Data, Measures for Adapting to Changing Climate, Impact and Cost Evaluation"** supported by the EEA 2009-2014 Financial Mechanism programme "National Climate Policy". Within the project, in 2017, LEGMC had prepared a study on historical manifestations (1961 -2010) and the future projections and climate change scenarios in Latvia. Particularly it is analysed the scenarios for heat waves change, snow cover thickness change, standardised precipitation index change, wind gusts change as well as climate change impact on tourism sector (tourism climate index). LEGM has developed the Climate Change Analysis Tool which allows to model possible climate change scenarios in Latvia up to 2100. The Tool includes options for:

- climate element (air temperature, atmospheric precipitation, wind speed, snow cover), climate index (mean, minimum, maximum air temperature; minimum and maximum of daily mean, minimum and maximum temperature; number of frost days, summer days, ice days, tropical nights; growing seasonal length; warm spell duration index);
- observing station (22 stations available);
- future time period (3 options available: 2011-2040; 2041-2070 and 2071-2100);
- scenarios of moderate climate change (IPCC RCP4.5 scenario) and of significant climate change (IPCC RCP 8.5 scenario) investigated.

In 2021 LEGMC calculated climate standard 230lans230 for the period 1991-2020 for 18 meteorological parameters and indices, which provides a comprehensive description of the current climatic conditions of Latvia.

Within the **NRP "The values and dynamic of Latvia's ecosystems under changing climate"** (**EVIDEnT,** 2014-2018) it had been adapted/elaborated models for wind fields, wave and streams dynamic, developed wave and streams measurement sensor prototypes and performed field measurements. The climatic scenarios, including extreme events, had been developed.

The project **"Integration of climate change policy in sectoral and regional policies"** (April 2021 – April 2024, budget – 2.182 MEUR), initiated by the MEPRD and funded by the Norwegian Financial Mechanism's for 2014-2021 Programme "Climate Change Mitigation, Adaptation and Environment" is on-going. Partnership involves the CSB, LEGMC and the Norwegian Environment Agency. The aim is to improve the consistency and relevance of climate change policy planning at the national level as well as to increase its integration into sectoral and regional policies. The project develops new additional climate change policy planning tools, including a framework for the collection and provision of regional data to facilitate and improve the planning and implementation of climate change policy at the regional level. As one of key activity, **the project performs updating of Latvian climate change scenarios for 2100**. As a result, renewed and improved Latvian climate change scenarios up to 2100 will be elaborated considering the Sixth Assessment Report of the IPCC (AR6) in order to ensure policy planning in accordance with the latest forecasts.

The first climate change risk assessment In particular sectors affected by climate change and sectorial recommendations on the adaptation to them was provided at the end of 2012 in the study "Analysis and elaboration of proposals for the development of an Informative report on adaptation to climate change under the Report on the implementation of the national Environmental Policy Guidelines for 2009-2015" (Bruņeniece I.) done within the framework of the BaltClim project.

The Baltic Sea Region Climate Change Adaptation Strategy and Action Plan (BALTADAPT, 2013-2015) sought to provide joint transnational solutions to address the sustainable management of the Baltic Sea in the context of climate change. It analysed the scenarios of how climate change affects the society and the potentials for the active action. The study also covered the issue of ever more severe rainfalls, important for the urban environment and the issue of urban planning, as well as practical solutions and recommendations for action, and had set out a set of indicators to measure the effectiveness of implemented adaptation measures. Among the strategy developers there were researchers from the University of Latvia as Latvian partner. In line with the EU Strategy "EU Adapting to Climate Change", the Action Plan set out actions and guidelines for each objective and emphasized the importance of international co-operation for successful adaptation to climate change. The strategy particularly underlined the systematic work and the implementation of measures that use monitoring and data modelling are important.

The climate action is the horizontal measure of the EU Strategy for the Baltic Sea Region, which, approved in 2009, is the first macro-regional strategy in the Europe. The Action Plan of the Strategy is regularly updated. In February 2021 the Revised Action Plan (replacing the Action Plan of 17th March 2017) has been published.

An important contribution to the further analysis of the impacts, risks and vulnerabilities of climate change in Latvia, identification of appropriate adaptation measures, long-term analysis of their benefits and costs, monitoring system and indicators had been provided by the research conducted under the framework of the noted above EEA Financial Mechanism 2009-2014 programme "National Climate Policy". Six major studies in the field of (i) landscape planning and tourism, (ii) biodiversity and ecosystem services, (iii) health and welfare, (iv) agriculture and forestry, (v) construction and infrastructure, and (vi) civil protection and emergency planning had been done in 2016 and 2017.

In its turn, the noted above NRP "EVIDEnT" had performed studies of biodiversity on all levels, including studies of food chain functioning in the lake-river-sea system, provided biotopes/habitats simulations and estimated monetary value of selected ecosystem services. Also, it had been investigated introduced species in freshwater ecosystem (hydro power plant reservoir), port and adjacent to them areas, and in the sea.

Below the research and studies on climate change related risks and adaptation in the 2018-2021 is characterised.

Research on climate change related impacts and risks is performed in a range of national Thematic Research Projects funded by the NFARP. It can be noted such themes as: change of material properties, particularly durability and stability, under climate and environmental factors; spatial and temporal predictions of groundwater drought for multilayer sedimentary basin under climate change; research on pond aquaculture production and ecosystem services and climate impact modelling; carry-over effects, energetic fitness and population dynamics of migratory birds under global change; condition and health status of Baltic cod in the changing ecosystem of the Eastern Baltic. Attention is also paid to the historical change of climate, e.g., influence of tidal regime and climate on the Middle-Late Devonian biota in the epeiric Baltic paleobasin. In its turn, the establishing reference data set of pollen and non-pollen palynomorphs for Latvia (obtaining a total of 78 lake surface sediment samples) provides a basis for validation of climate models and thus will serve as a fundamental ground for climate, landscape, vegetation and water quality reconstructions and modelling.

Important attention is paid to involvement of young researchers. For example, there are PhD theses defended in the University of Latvia like "Characteristics and long-term changes of extreme climate events and hazardous hydrometeorological phenomena in Latvia" (2018), "Wind flows at the Kurzeme coast of the Baltic proper" (2018), "Forecasting the Geospatial and Temporal Patterns of Pollen Season in Europe Using Statistical and Deterministic Modelling" (2017). Several postdoctoral research are also devoted to climate change impacts and adaptation, e.g., Plasticity of development and xylogenesis of native and introduced tree species in changing climate conditions; Opportunities to increase the resilience of spruce forests to the effects of climate change; Mathematical modelling of weather conditions – development and application of methodology in Latvia; Impact of climate change on phytophenological phases and related risks in the Baltic region; Impact of climate change on groundwater and soil water regime; Assessment of the potential impact of climate change on carbon sequestration through litter and small roots in forests with drained and naturally moist organic soils; A values-led planning approach for sustainable land use and development.

The noted above project "**Integration of climate change policy in sectoral and regional policies**" provides, as ones of the activities:

- updated Latvian coastal erosion assessment considering the climate change scenarios. Activity provides obtaining the latest data on coastal erosion in Latvia in order to adjust coastal planning, and a set of the most appropriate solutions to prevent coastal erosion developed, taking the current climate change scenarios into account;
- assessment of current practices and development of recommendations to integrate climate change mitigation and adaptation aspects in sectors such as finance, insurance, construction of buildings, roads and railways, land use planning/re-planning. Activity envisages development of new regulatory recommendations in order to integrate climate change adaptation aspects into at least 6 sectoral and regional policies.

An important contribution to the climate change adaptation related studies is provided by sectoral studies commissioned by responsible state authorities.

Studies commissioned by **MEPRD** relate to the development of long-term (up to 2100) climate change impact and adaptation scenarios for Latvia. Also, MEPRD in 2020 has commissioned the study focused to prioritising climate change adaptation at municipal level – development of criteria for setting priority measures and criteria for evaluating the priority of the financing of the measures. As the studies to be commissioned it is envisaged, e.g., Assessment of current practices and development of recommendations for regular and more substantial involvement of insurance services to mitigate climate change risks and losses; Assessment of current practices and development of recommendations for improvement of national construction regulation, taking into account the effects and risks of climate change, as well as the need to reduce GHG emissions;

Assessment of current practices and development of recommendations for assessing the impact of major projects on GHG emissions and resilience to climate change.

MoA has commissioned such studies as : Assessment of land reclamation impact to reduce climate change related flood risk; Evaluation of resistance of cereal varieties to diseases in Latvian agroclimatic conditions, evaluation the economic characteristics of varieties; Assessment of tree species mixture types and optimal mixture establishment and management methods and their effect as one of the options for increasing stand stability and resilience by reducing the long-term impact of climate change related to changes in the natural disturbance regime.

LSFRI "Silava" develops and implements the decision support tools for risk assessment of storm caused damage for the stand on peatland soils and for birch and aspen forest stands

Latvia's State Fire and Rescue Service (SFRS) in 2021 has commissioned the research on a creation of a database of losses caused by natural disasters in Latvia.

It is envisaged the study on the Impact of climate change on the sustainability of road infrastructure (by State Ltd. "Latvian State Roads"/MoT).

Improvement of the national warning system is also one of the activities of the noted project "Integration of climate change policy in sectoral and regional policies". This activity envisages updated existing warnings and at least five new warnings developed on hydro-meteorological phenomena. In its turn, several studies have been commissioned in 2021 by SFRS as well, the results of them help to better prepare Latvian society for climate extreme situations: it have to be noted a quantitative study "Latvian Public Awareness of Preparedness and Action in Emergencies and Disaster or Threat Situations"; "Website and mobile applications for emergency information, research on content and information support provision, preparation of technical specifications and calculation of indicative costs"; Feasibility study on the improvement of the national early warning system using the services of mobile operators, mobile applications and websites.

8.2.2 Research on Climate Change Mitigation

This section includes the following sub-sections:

- research in energy and transport sectors to mitigate GHG emissions;
- research on sustainable use of soil resources;
- (other) research in agriculture and forestry sector to mitigate GHG emissions.

Finally, in this section the development of up-to-date modelling methods, approaches and tools to assess GHG emissions developments and related impacts in national economy is presented.

Research in Energy and Transport sectors to mitigate GHG emissions

Within the energy sector, GHG emissions are in practice reduced in two ways:

- the primary energy consumption is reduced by increasing energy efficiency in different sectors of energy end-uses or by increasing the conversion efficiency of energy production and the efficiency of energy storage, transmission and distribution systems;
- fuels and energy use are shifted to renewable energy sources.

In its turn, in the Transport Sector the following policies are key ones promoting:

- the use of RES within the transport sector;
- the energy efficient and clean vehicles;
- the energy-efficiency of transport system by the choices of more environmentally friendly modes of transport.

Both these areas are important focus of research on climate change mitigation in Latvia. The research includes both the new materials and technologies development to improve energy efficiency and RES utilisation, studies of RES-based smart larger/large scale systems, the socio-economic factors of their implementation, promotion of behavioural change.

National Research Programmes (NRPs)

In **2014-2017/2018**[31] the particular NRP "Energy-efficient and low carbon solutions for a secure, sustainable and climate variability reducing energy supply (LATENERGI)" had been implemented. The NRP carried out the research on such issues as: energy and climate policies impact assessment; sustainable climate policy and innovative, energy-efficient technological solutions; innovative technologies for the production and use of RES (biogas production in the waste treatment industry; production of hydrogen and biofuels); innovative energy electronics technologies for increasing energy efficiency in the Latvian economy; future energy supply networks and the use of RES. In its turn, the particular project "Environmental Diversity and Sustainable Use" of the NRP "Innovation and Sustainable Development: Latvia's Post-crisis Processes in a Global Context (SUSTINNO)" had studied the society's value-behaviour-environmental loads change parameters.

In the period **December 2018-December 2021 the NRP "Energy"** (total financing 4.809 MEUR) had been implemented. This NRP was split into four independent Open Calls (OC), which have been implemented in the form of particular research projects:

- within the OC "Energy Efficiency" four projects were implemented: (1) "Energy Path: Guide to Energy Efficient Latvia's Future"; (2) "Development of heating and cooling systems in Latvia"; (3) "Improvement of Technological Solutions for Buildings Energy Efficiency" and (4) "Energy Efficiency Policy's Evaluation and Analysis";
- within the OC "Renewable and Local Energy Resources´ three projects were implemented: (1) "Evaluation of Economical Potential of Production and Utilization of Latvia's RES and Related Policy Recommendations"; (2) "Sustainable and Renewable Transport Policy Development in Latvia" and (3) "Innovative solutions and recommendations for increasing the acquisition of local and renewable energy resources in Latvia";
- the single project "Energy and Climate Modelling towards Net Zero Emissions" was implemented within the OC "Analytical framework for state long-term energy policy planning";
- in its turn, the OC "Sustainable Energy: Infrastructure and Market" dealt with the innovative smart grid technologies, natural gas infrastructure development, Latvia's energy system integration in European systems.

All the projects had been led by the particular science institutes of Riga Technical University[32].

National Thematic Research Projects. NFARP is organized as annual OC. Within six OC, announced in the period 2018-2021, it is approved almost 50 research projects related to climate change mitigation and adaptation with total financing around 10.7 MEUR (constitute around one eight of the total financial volume of the calls). Both technologies and their enabling framework and socio-economic challenges are addressed in the approved thematic research projects. E.g., they focus on (i) new materials for fuel cells, solar PV, new photocatalytics materials to improve electrolysis process, topological semi-metals for energy-efficient electronics, (ii) novel composite materials and their use, including biomass-derived hybrid carbon materials and wood-mimic biocomposites, (iii) new resources, e.g., extraction of renewable hydrocarbons in hydrotreating from alternative raw materials; ecologically friendly thermal insulation materials from the residues of sustainable renewable industrial crops, (iv) improvement of biogas and biodiesel production processes, e.g., catalytic agents for synthesis of modern biofuels, (v) development of novel batteries technologies for power storage, (vi) smart windows; smart building envelope with solar energy storage; use of smart control for heat storage systems, (vii) analysis of heat conduction processes, e.g., to improve

[31] Information on the NRPs in the energy sector, implemented in 2006-2013, are provided in NC7, pages 177-178.

[32] Institute of Energy Systems and Environment, Institute of Power Engineering, Institute of Industrial Electronics and Electrical Engineering, both the Faculty of Electrical and Environmental Engineering. Depending on the project other science institutes and units of Riga Technical University as well as of University of Latvia, Institute of Solid State Physics of University of Latvia, Latvia University of Life Sciences and Technologies, Ventspils University of Applied Sciences had been involved.

insulation materials like PU foam, as well as other technological challenges. Particular attention is paid to policies to implement smart energy systems and provide their effective management, e.g., tools for sustainable governance of urban (district) heating systems. High attention is paid to develop solutions of circular economy; to study socio economic challenges of sustainable long-term management of natural resources; to ensure sustainable urban environment. Economic valuation of bioresources; integrated decarbonisation solutions for efficient CO_2 valorisation in the regions are studied. Social innovation and public participation in energy transition processes to carbon neutrality, particularly development of energy communities; possibilities to improve the interaction between political narrative and public perception in Latvia in order to implement changes in climate policy are studied as well.

EU ERDF supported research. Within the framework of the EU Funds 2014-2020 planning period, the Practical research programme of the NOP's "Growth and Employment" co-financed by the ERDF, the projects related to energy efficiency and RES technologies are supported as well. Lead partners of the projects are both science institutions as well as private companies active in the particular branch and willing to develop new technologies. Attention is paid to such themes as: (i) near-zero energy building smart solutions, including research into the sustainability of smart solutions in a real climate, (ii) sustainable construction based on ecological construction materials, (iii) hybrid energy systems, (iv) novel nano materials, particularly polyurethane/polyisocyanurate thermal insulation materials filled with nano/micro cellulose; thermoelectric nanomaterials/topological dielectrics for efficient conversion of heat losses into useful energy, (v) technological challenges in the development of electrical transport, particularly electric bus development technology based on a traditional diesel engine bus, (vi) challenges of modern biodiesel synthesis as well as of biogas production, (vii) efficient biomass combustion processes, (viii) energy from waste, (ix) efficient lighting system (street lighting; industrial lighting; greenhouse plant lighting; etc)., (x) improvement of efficiency of cooling technologies, (xi) new generation electric motors and low power generators, as well as other themes.

Research co-operation in Baltic/Nordic area

EEA and Norwegian Financial Mechanism of 2009-2014 period. The contribution in applied research had been provided by pilot projects of open calls, particularly implementation of 5 low energy building construction projects as the demo sites had been finished in 2016.

EEA and Norwegian Financial Mechanism of 2014-2021 period. Energy related research is provided within the framework of the Baltic Research Programme funded by this mechanism. Within this programme the following projects relates to climate change mitigation:

- Development of Semi-Transparent Bifacial Thin Film Solar Cells for Innovative Applications (January 2021 – December 2023, lead – Kaunas University of Technology, partnership – Institute of Solid States Physics of University of Latvia, Tallinn University of Technology, Institute for Energy Technologies (Norway);
- Optimised Residential Battery Energy Storage Systems (January 2020 – December 2023, lead – Tallinn University of Technology, partnership – Riga Technical University, Kaunas University of Technology, Norwegian University of Science and Technology);
- Industrial Internet methods for electrical energy conversion systems monitoring and diagnostics (January 2021 – December 2023, lead – Vilnius Gediminas Technical University, partnership – Riga Technical University, Tallinn University of Technology, University of Agder (Norway);
- Aluminium in circle economy – from waste through hydrogen energy to alumina" (May 2021- April 2024, lead – Institute of Solid States Physics of University of Latvia, partnership – Lithuania Energy Institute, University of Iceland, Innovation Centre Iceland).

Joint Baltic – Nordic Energy Research Programme. The overall aim of the programme is to promote energy research and analysis in the Baltic States and inspire intra-Baltic and Baltic-Nordic collaboration. The programme supports the research projects for up to 2 years, three projects are selected within each of the open Calls.

The first Call (announced 2019) supported the following projects:

- "Fast, flexible and secure decarbonisation of the Baltic States – possible progress in the next ten years" (FasTen, Latvian partner – Riga Technical University);
- "Integrating energy sufficiency into modelling of sustainable energy scenarios" (Latvian partner – NGO "Green Liberty), develops modified energy scenarios for the cases of Denmark, Latvia and Lithuania, thus emphasize the combination of sufficiency, efficiency, and renewable energy and enables a policy dialogue;
- "Knowledge sharing on NZEB Buildings in the Nordic-Baltic region" (Latvian partner – Riga Technical University).

The second Call (announced 2020) supported the following projects:

- "the Amber (Impacts of ambitious energy policy pathways)" analyses decarbonization pathways for the Baltic countries until 2050 and is built on modelling and collaboration started in previos FasTen project;
- the Interconnecting Baltic Sea countries via offshore energy hubs (BaltHub);
- "Techno-economic performance and feasibility study of the 5th generation district heating and cooling (5GDHC) technology using agent based modelling and GIS" (Latvian partners – Riga Technical University and Latvian District Heating Association).

The third Call (announced 2021) supported the following projects, they will run until January 2024:

- "Waste heat in smart energy systems (WasteHeaySES, Latvian partner – Riga Technical University, lead);
- "Guidelines for next generation buildings as future scalable virtual management of microGrids (Next-uGrid, Latvian partner – Riga Technical University, lead);
- "The role of hard to reach energy users in reaching Baltics+Nordics Climate Targets – a multidisciplinary analysis (NUANCE, Latvian partners – Riga Technical University, lead).

In addition, in 2021- 2020 it has been elaborated "The Baltic-Nordic Roadmap for Cooperation on Clean Energy Technologies" to determine which clean energy technologies are most relevant for Baltic-Nordic research cooperation. A roadmap guides Baltic and Nordic energy authorities, researchers, and industry in developing the next generation of clean energy technologies. Final Report has been published in the first half of 2022.

EU Research and Innovation programme Horizon 2020. On 31 January 2022, in the area of Secure, clean and efficient energy the approved projects (both research and innovation action projects and coordination and support action projects) with Latvian partnership[33] have attracted total H2020 financing 11.452 MEUR, in the area of Smart, green and integrated transport – 3.470 MEUR, in the area of Climate action, environment, resource efficiency and raw materials – 4.654 MEUR. Total number of supported projects with Latvian partnership, which relates to these thematic areas is around 120 ones. Several particular projects, financed in other areas, also relates to climate change mitigation and adaptation issues. Significant share of Horizon 2020 projects, in which Latvia institutions and organizations are involved, relates to nearly-zero energy smart buildings, energy efficient refurbishment of buildings as well as DH systems retrofit and development of 4+ generation DH systems, recycling of waste heat. The research relates both technologies, innovative design tools, new financing instruments, management, including building certification, challenges. Decision support tools are developed based on life cycle approach. The studies relate multi-apartment buildings as well as single family buildings. The research is performed at different spatial levels – building, district, whole town/city. Closely related to this issue is energy efficiency and energy savings governance at different

[33] both the research carried out by Latvian science institutions within the international research consortiums and the research carried out by Latvian SMEs under the Horizon 2020 SME support programme. Information provided by LCS.

administrative levels (state, municipal), energy savings in public authorities, implementation of green procurement, new label driving supply and demand of energy efficient products. Also, a big data application for holistic energy services in buildings as well as for future generation energy in general are studied. Another high importance issue is development of RES technologies and their deployment, particularly fuel cells, hydrogen technologies, sun coupled innovative heat pumps, biogas production meeting sustainability criteria. Storage technologies, for instance, liquid-processed solid state Li-metal battery, are studied as well. Particular attention is paid to implement hydrogen technologies in Riga city public transport. Latvia's science institutes and organizations carry out and participate also in the international research related to novel electric vehicles' charging technologies, to novel dual fuel system for diesel locomotives, intelligent control systems in railway to save electricity. Transferability of cycling innovations is assessed as well. Social acceptance of wind power technologies, development of energy communities, combating energy poverty are studied also.

Innovative heat insulation materials have been developed also within the LIFE Climate Action project "Alternative Recycling of Waste Paper and Hemp Fibre into Innovative Heat Insulation Materials with Improved Thermal Conductivity" (September 2018 – August 2021) coordinated by the Balticfloc ltd (Latvia).

An important contribution to the climate change mitigation related research is provided by **sectoral studies commissioned by responsible state authorities (MEPRD, MoE, MoT).**

Research on sustainable use of soils

The Baltic Research programme of the EEA and Norwegian Financial Mechanism of 2014-2021 period funds the project **"Sustainable use of soil resources in the changing climate (SUCC)"** (01.01.2020-31.12.2023, partnership – Institute of Ecology and Earth Sciences of University of Tartu (lead), LSFRI "Silava", Lithuanian Agriculture and Forestry Sciences Centre, Arctic University of Norway as well as University of Copenhagen and Natural Resources Institute Finland (LUKE)). The project aims to (1) develop novel molecular methods for rapid abundance assessment of various microbial groups and their potential of organic degradation and carbon release, (2) determine shifts in carbon allocation in plants and carbon sequestration in soil along the latitudinal gradient in response to climate change, (3) evaluate the economic costs and benefits of changing climate on various aspects of forestry and soil carbon balance, (4) determine ecological sustainability of afforestation of former agricultural land, (5) to develop sustainable forestry and other land use practices to mitigate the negative effects of climate change on one hand and securing forest productivity on the other hand).

The project **"Enhancement of sustainable soil resource management in agriculture (E2SOILAGRI)"** (April 2021 – April 2024, budget 1.835 MEUR) is initiated by the MoA and funded by Norwegian Financial Mechanism's for 2014-2021 Programme "Climate Change Mitigation, Adaptation and Environment". Partnership involves University of Latvia, LSFRI "Silava", State Plant Protection Service of Latvia and Norwegian Institute of Bioeconomy Research. The implementation of the E2SOILAGRI improves climate-related information on agricultural soils, as well as the capacity and expertise of public authorities in sustainable soil management. The project is aimed at updating national soil data in order to develop sustainable soil management solutions in the future (e.g., how to use fertilizers more efficiently, etc.). The new knowledge, new spatial data, as well as data on soil carbon change will be a new step in providing land managers with additional information on how to manage smartly and modern, by implementing sustainable agricultural management practices. The updating the soil data to be used in the development of climate change mitigation policy will help to achieve international and European climate change targets and reporting requirements. The project includes three key activities: (1) improving of reliable, country-specific soil information on agricultural land; (2) developing of a national soil carbon monitoring system; (3) developing of GHG emission factors and elaboration of proposals for inclusion of the obtained emission factors in the national GHG inventory report.

24 European countries have joined the research forces in the joint European research programme "**EJP Soil"** (February 2020 – January 2025) financed by the Horizon2020, in which Latvia is represented by the Faculty

of Geography and Earth Sciences of the University of Latvia. Its overall objective is to ensure enabling environment for climate-wise sustainable agriculture soil management that contributes to mitigate climate change, provide long-term food for society, maintains soil biodiversity and other soil functions that preserve and enhance soil ecosystem services. EJP Soil develops the knowledge, tools and integrated research community. The harmonised and easily accessible soil information between countries will be collected. Farmers, landowners, land managers and the agriculture sector as a whole will have access to region-specific contextual guidelines on sustainable soil management practices, carbon accounting technologies and tools. The development of the roadmap will assess current models for soil quality and soil carbon accounting in project partner countries. In addition, it will enable soil management options to be implemented, taking into account the potential impact on soil organic carbon stocks and GHG emissions. At policy level, the programme aims to identify data gaps and priority needs for new knowledge and to develop science-based recommendations for sustainable soil policy-making at European and regional level.

A range of another Horizon2020 funded projects are on-going in Latvia or had been implemented in the last years, for example:

- Increased drainage effects on soil properties and water quality (IDESoWam, July 2019-November 2021, Latvia partner -University of Latvia);
- Optimal strategies to retain and reuse water and nutrients in small agricultural catchments across different soil-climate regions in Europe (OPTAIN, September 2020-August 2025, Daugavpils university);
- Sino-EU Soil observatory for intelligent land use management (SIEUSOIL, June 2019 – May 2022, Baltic Open Solution Centre).

An important role is played by EU's Funding Instrument for the Environment and Climate Action LIFE, whose supported projects develop and test innovative practical solutions. These projects provide contribution to Latvia-specific GHG emission factors **development as well.**

LIFE OrgBalt: Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland (August 2019-August 2023). The overall aim of the project is implementation of innovative climate change mitigation measures in cool & TCM climate region. Specific objectives are: (1) to improve the GHG accounting methods and activity data for nutrient-rich organic soils under conventional management conditions, (2) to identify and demonstrate sustainable, resilient and cost-effective climate change mitigation measures applicable in nutrient rich organic soils, (3) to provide tools and guidance for elaboration, implementation and verification of results of climate change mitigation policies. Partnership involves organizations from 5 countries (Latvia, Estonia, Lithuania, Finland, Germany), co-ordinated by LSFRI "Silava". Other participants from Latvia are MoA, Latvia University of Life Sciences and Technologies; NGO association "Baltic Coasts".

LIFE Peat Restore "Reduction of CO_2 emissions by restoring degraded peatlands in Northern European Lowland" (July 2016 – June 2021). The project aimed to rewet degraded peatlands to restore the natural function as carbon sinks. The emissions and removal of GHG, the water level as well as the wildlife (flora and fauna) had been documented, analysed and compared. This helped to prove rewetting measures and gave the chance to regulate aberrations quickly. Also, the potential climate effects of the rewetting can be calculated. The project's experience as well as the best practice scenarios to reduce GHG emissions are summarized in a guide of rewetting peatlands. Adapted management plans and restoration concepts for each of the project sites had been elaborated to ensure the achievements in the long term. Partnership included nine partners from Poland, Germany and the Baltic states (Estonia, Lithuania and Latvia) coordinated by the Nature and Biodiversity Conservation Union (NABU, Germany). In Latvia, the project actions had been implemented within three protected nature areas, the restoration area In total covers 248 hectares.

LIFE Restore "Sustainable and responsible management and re-use of degraded peatlands in Latvia" (September 2015 – August 2019). The main goal of the project was the establishment of a decision support system for responsible and sustainable degraded peatland re-use and management. The project (i) performed an inventory and developed a database of the degraded peatlands; (ii) approbated a field measurement based methodology for accounting of the GHG emissions from managed wetlands in accordance with the supplement to the IPCC guidelines; (iii) developed a decision support tool for land re-use planning of degraded peatland areas, providing the most optimal balance of the aspects of ecological restoration for biodiversity, benefits for economic growth and GHG emission reduction for long-term mitigation of negative climate change impacts; (iv) supported policy-makers by providing a strategic framework for implementation of the developed approaches of sustainable re-use of degraded peatlands for integration into the National Peat Strategy. The implementation of the project had been coordinated by the Nature Conservation Agency in cooperation with the NGO association "Baltic Coasts", LSFRI "Silava" and Latvian Peat Association.

Also, **MEPRD** has commissioned several studies related to evaluation and development of recommendation on best practice for responsible and sustainable use of peatland areas, in which peat excavation has/had taken place. Remote sensing also is in the focus – in 2020 the LEPF supported the study on development of remote sensing based GHG monitoring method for bogs.

MoA has commissioned the study on the Assessment of the contribution of organic soils to Latvian agriculture, using multifactor impact assessment in the offer of efficient land use solutions

LSFRI "Silava" implements a range of research projects related to soils, for instance, on: Relationships between microbiological diversity, CH_4 emissions and mercury methylation in organic soils; Investigation of the impact of land use type, soil and meteorological factors on GHG emissions from amelioration ditches; Assessment of carbon uptake with litter and small roots in forests with ameliorated and naturally moist organic soils; The development of innovative white willow – perennial grassland agroforestry systems with mixtures of wood ash and less demanded peat fractions in improved marginal mineral soils. LSFRI "Silava" developed the tools for the management of degraded peatlands after peat extraction.

Research in agriculture and forestry sector to mitigate GHG emissions

Within the NRP "The values and dynamic of Latvia's ecosystems under changing climate" (EVIDEnT, 2014-2018) it had been performed survey of farms and developed a tool to estimate GHG and air emissions in agriculture sector as well as estimated integral impact from forestry.

The single project **"Sustainable Use of Land Resources and Landscape Management: challenge assessment, methodological solutions and proposals (LandLat4Pol)"** of the NRP "Sustainable Spatial Development and Rational Use of Land Resources" (December 2020 – November 2022, funding 0.337 MEUR) aims to develop knowledge-based solutions and proposals for sustainable use of land resources and sustainable landscape management by assessing land use efficiency, determining the drivers, as well as to prepare methodological solutions for Latvian landscape mapping, including the mapping in the context of on-shore wind development. The project implementation is based on multi-partners consortium: the Institute of Agriculture Resources and Economics (lead), Latvia University of Life Sciences and Technologies; LSFRI "Silava"; Vidzeme University of Applied Sciences and Riga Technical University.

A significant number of agriculture sector related projects' consortiums of EU Horizon 2020 programme include Latvian science institutions and organisations. E.g., the project related to the sustainable integrated management for the nexus of water-land-food-energy-climate for a resource efficient Europe (SIM4NEXUS, June 2016-May 2020) included the Baltic Environmental Forum Latvia as the project's consortium partner. These projects provide synergy with GHG mitigation measures. The studies within Horizon 2020 funded projects relate to the development and implementation of particular farming practices which can contribute in GHG emissions reduction, circular bio-based strategies for rural development, sustainability of agro-ecological farming systems. In the forestry sector, the innovative solutions for increasing efficiency and reducing environmental impacts of future wood supply is studied. Enhancing ecosystem services mapping for policy and decision making is also performed.

The ecosystem services are studied also in the several national Thematic Research projects.

LIFE CRAFT: Climate Responsible Agriculture for Latvia (April 2018 – June 2023). The objective of the project is to implement, test, evaluate, promote and provide guidance on effective and economically feasible means for the reduction of agricultural GHG emissions while preserving stable income for farmers by taking an ecosystem-based approach. The specific objectives are: increase farmers and decision-maker awareness about available GHG emission reducing agricultural practices by developing a guidebook that lists all the relevant climate responsible agricultural practices applicable in the Baltic Sea region; implement, test and demonstrate three different GHG emission reducing agricultural management practices, hitherto unexploited in Latvia, at farm level (no-till farming, biochar incorporation into the soils and controlled amelioration) and compile practical recommendations for their application; adapt remote sensing based monitoring instruments for improved evaluation of national policy efficiency targeting agricultural GHG emissions reduction. Partnership includes Latvian Nature Fund (lead), Institute for Environmental Solutions (Latvia), Latvian Rural Advisory and Training Centre, Czech Centre for Science and Society.

As the projects providing synergy with climate action, the following ones might be noted.

- LIFE VIVA GRASS "Integrated planning tool to ensure viability of grasslands" (June 2014 – April 2019);
- Grass LIFE "Restoring EU priority grasslands and promoting their multiple use" (September 2017 – March 2023, restoration activities are/will be carried out within 14 Natura 2000 network sites in Latvia);
- LIFE Wetlands "Conservation and Management of Priority Wetlands in Latvia" (2014-2017);
- LIFE Ecosystem Services "Assessment of ecosystems and their services for nature biodiversity conservation and management" (2014-2020);
- LIFE GRASSERVICE "Alternative use of biomass for grassland biodiversity and ecosystem services" (2013-2017).

Development of grasslands and wetlands management practice has high importance in Latvia. LIFE VIVA GRASS developed the models of economically viable management of grasslands to provide the conservation of them. The project had been aimed to prevent loss of high nature value grasslands and increase effectiveness of semi-natural grasslands management by developing integrated planning tool based on ecosystem services approach. The opportunities for multifunctional use of grasslands' ecosystem services as basis for sustainable development of rural areas had been demonstrated in 9 demo sites in three Baltic states (Latvia, Lithuania, Estonia). The project had been coordinated by the foundation "Baltic Environmental Forum". Partners in Latvia – Baltic Environmental Forum Latvia, University of Latvia, Cēsis local municipality, Institute for Environmental Solutions, the farm "Kalnāju ferma".

MoA commissions the studies to evaluate the possibilities and results of implementation of agro-environmental measures. The results of studies are applicable in policy making. It is commissioned studies related to the CO_2 sequestration in arable land and grassland. It has to be noted also such assessments that provides the synergy with climate change mitigation in the agriculture sector: Assessment of the impact of minimal tillage on the maintenance of soil fertility; Development and spread of pests, yield and its quality in unchanged crops; Assessment and justification of NH_3 emission control measures; Development of marginal abatement cost curves of NH_3 emissions; Evaluation of agriculture biomass sustainability.

LSFRI "Silava" actively develops decision support tools and carries out studies providing information for a more accurate assessment of the carbon balance. For instance, such tools are developed for old semi-natural forest stands; new forest stand stock assessment technology is developed based on satellite data. It is performed the modelling to evaluate carbon cycle and GHG emissions in the damaged by stem rot deciduous stands; research of factors influencing GHG emissions from the surface of tree trunks in deciduous stands with drained and wet soils, and other studies. LSFRI "Silava" has implemented the project on the improvement of the accounting system for GHG emissions and CO_2 sequestration caused by the use (management) of arable land and perennial grassland and development of appropriate methodological solutions as well. Thus, these studies are closely related to the inventory of GHG emissions and contributes in developing of Latvia-specific GHG emissions factors.

Development of up-to-date modelling methods, approaches and tools

Since 2006 Latvia's NRPs on energy and environment include as one of the key tasks the development of up-to-date modelling methods, approaches and tools, assessment of GHG emissions developments and related impacts in national economy as well as sectorial development scenarios, analysis of emissions' mitigation policies and measures.

Within the NC7 period (2014-2017) significant efforts had been paid to further develop and apply advanced research approaches, methods and models that by means of analysing and forecasting the correlations between the parameters, characterising the development of different economic sectors, and related emissions, contributed to the national climate change mitigation policy that is compatible with the EU 2030 framework for climate and energy policies and promoted sustainable development of Latvian economy[34].

The modelling tool and integrated development scenarios particularly had been developed for the national sectors in assessing GHG emissions within the NRP "EVIDEnT", 2014-/2018.

The modelling is provided by the Institute of Physical Energetics by applying the MARKAL-LV model. By its nature, this model is a detailed bottom-up optimisation modelling platform that covers primary energy supply, transformation, and the consumption of by demand sectors allowing an integrated evaluation of energy demand-consumption development in situations, when both – demand and consumption – are supplemented with the new factors (new available resources, new customers, new environment & climate objectives to be achieved, etc.). This specified modelling tool is used for analysing the energy sector complex development scenarios and influencing factors in general and its' individual components and links between them, in particular. In order to connect energy sector with agricultural and waste, the MARKAL-LV model has been augmented by biofuel and biogas modules. By applying MARKAL-Latvia model national implementation of EU energy-climate framework strategy are examined. The assessment of overall impact of GHG emissions reduction policies and measures, both implemented and planned in Latvia, identification and evaluation of the critical points for Latvia's situation, interpreting the sectoral targets set by the GHG emissions mitigation policies are carried out within elaborated, defined on the basis of reasoned macroeconomic development, scenarios of national economy and its sectoral development.

In 2021, with the support of the MoE and based on the experience of the IPE with the MARKAL-Latvia model, the development of a new successor energy environment system TIMES-Latvia optimization model was launched. In addition to assessing the impact of different energy and climate policies on the economy, researchers at the University of Latvia are developing an economic model (Computable General Equilibrium (CGE) model) for Latvia. It is planned to link these two models into a single economic – energy and environmental modelling system. The establishment and use of that modelling system is enshrined in the CoM Regulation No. 737[35] (12.12.2017).

Since NC7, in the 2018-2021 the further developing of modelling studies have taken place:

- **MoE,** as the national authority responsible for development of Latvia's NECP2030, had commissioned modelling studies related to the elaboration of this plan;

[34] The modelling efforts within the period of 2014-2017 are described in details in NC7, in pages 185 &186.
[35] Since 25 October 2022 CoM Regulation No.737 is replaced by CoM Regulation No.675

- studies commissioned by **MEPRD** relate to the development and analysis of GHG emissions medium term (up to 2030) projections and long term (2050 and beyond) pathways and socio-economically justified GHG emission reduction policies and measures. In 2021 the MEPRD has commissioned the study on the elaboration of Latvia's economics development scenarios and evaluation of their socio-economic impact in the context of the proposed new GHG emission reduction targets in the EU Effort Sharing Regulation's covered sectors (EC "Fit for 55" Package);
- **MoT** commissioned study on the scenarios for implementation of alternative fuel infrastructure;
- **MoA** commissions studies related to the long-term (up to 2050) development scenarios of Latvia's agriculture sector, including projections of emissions; marginal abatement cost curves (MACC) for GHG and NH_3 emissions studied and linked with the CO_2 removal in arable land, permanent grasslands and wetlands, recommendations for use of MACC in agriculture, environmental and climate policy have been elaborated;
- **MoA** commissions the modelling of GHG emissions and CO_2 removal in LULUCF sector, improvement of modelling methodologies and tools in particular for arable land, permanent grasslands, forest land. Modelling in LULUCF sector is performed by LSFRI "Silava" and Latvia University of Life Sciences and Technologies, including their close cooperation in particular areas;
- Long-term (up to 2050) scenarios for state of Latvia forests/ forestry are elaborated and further development of modelling methodology and tools by the LSFRI "Silava" has been performed;
- The project "Energy and Climate Modelling towards Net Zero Emissions" was implemented within the NRP "Energy" in 2018-2021 by Riga Technical University.

8.2.3 Research in Support of the National Greenhouse Gas Inventory

This section provides the information on main developments since NC7. The project **"Integration of climate change policy in sectoral and regional policies" (September 2020 – September 2023**, funded by Norwegian Financial Mechanism 2014-2021 Programme "Climate Change Mitigation, Adaptation and Environment") provides several activities to improve the preparation of National GHG Inventory. As one of the activities, the development of an electronic database on ozone depleting substances and F-gases is to ensure the collection of complete and high-quality data, data selection and analysis, which is necessary to ensure the calculation of GHG emissions for the national inventory report. The project activity's aim in upgrading the integrated database MESAP is to improve the calculation of historical GHG emissions, inaccuracies and source categories, taking into account the IPCC 2019 supplement to the 2006 IPCC guidelines.

Under the project **MEPRD** commissioned the following studies to implement the IPCC 2019 supplement to the 2006 IPCC guidelines**:**

- the studies in the agricultural sector, particularly focused on the definition of the new groups of livestock according to their productivity and the definition of manure management systems and new parameters related to emissions from biogas production;
- the studies in the energy sector on development of the calculation methodology for leakage emissions from fuel conversion.

The studies in the LULUCF sector on the improvement of GHG emission and CO_2 removal accounting, upgrading of the GHG accounting system for managed wetlands and development of the improvement plan for GHG inventory system improvement, including incorporating accounting of GHG emissions and CO_2 removal from managed wetlands. **MEPRD commissioned the following studies:**

- evaluation of fluorine-GHG amount in the devices and systems containing them;
- substantiation of GHG emission specific factors for most utilised in Latvia fuels;
- the studies in waste management sector, particularly focused to better evaluation of waste content and organic waste amount (e.g., in 2019 the guidelines for evaluation of food waste in households and private commerce sector were elaborated) contribute in better inventory in Waste sector;

- the study on national GHG emissions factors for wetlands.

LIFE Restore "Sustainable and responsible management and re-use of degraded peatlands in Latvia" (September 2015 – August 2019). Approbated a field measurement based methodology for accounting of the GHG emissions from managed wetlands in accordance with the supplement to the IPCC guidelines; the country-specific GHG emission factors have been determined.

Establishment of a national soil carbon monitoring system; the development of GHG emission factors and the elaboration of proposals for inclusion of the obtained emission factors in the national **GHG inventory report is on-going within the E2SOILAGRI** project (April 2021 – April 2024) funded by Norwegian Financial Mechanism's for 2014-2021 Programme "Climate Change Mitigation, Adaptation and Environment".

LSFRI "Silava" performed several studies to provide a more accurate assessment of the carbon balance in LULUCF sector. Such assessments are carried out for areas like:

- degraded peatlands after peat extraction;
- old semi-natural forest stands;
- a new forest stand stock assessment technology based on satellite data is being developed;
- GHG emissions from land reclamation ditches;
- white alder and black alder forests;
- relationships between microbiological diversity, CH_4 emissions and Hg methylation in organic soils;
- modelling to evaluate carbon cycle and GHG emissions in the damaged, by heart rot, deciduous stands;
- factors influencing GHG emissions from the surface of tree trunks in deciduous stands with drained and wet soils.

8.3 Systematic Observations

Since 2009 LEGMC is responsible for systematic observation in Latvia according to Cabinet of Ministers Order No. 448 from 1 July 2009 "On the State agency "Latvian Environment, Geology and Meteorology Agency" and the State Hazardous Waste Management Agency liquidation and the limited liability company" Latvian Environment, Geology and Meteorology Agency" foundation".

In the climate change field LEGMC collects, stores and analyses long-term observation results. It prepares reports, providing information to the public and to the state and local governments and international organizations, as well as maintains a GHG emission trading registry.

Main activities of LEGMC:

- Development of environmental monitoring system in line with national and European policy needs, international recommendations and guidelines;
- Assessment of environmental quality and natural resources;
- Report on environment quality, meteorological, hydrological phenomena, warnings of dangerous and natural disasters, weather and hydrological forecasting;
- Environment laboratory testing;
- Management of environmental data, maintenance of databases on water resources and inland water quality, air emissions, air quality, chemicals, waste management and polluted areas;
- Maintenance of GHG emissions trading national scheme;
- Supervision of subsoil resources and insurance of rational subsoil use.

The Centre represents the Republic of Latvia within the World Meteorological Organization (WMO), performs executive functions in Latvia implementing international conventions related to meteorology, hydrology and environment. LEGMC is a member of EUMETNET, EUMETSAT, NORDMET and EurogeoSuvey as well as represents Latvia at ECMWF, European Chemicals Agency (ECHA) and acts as the National Focal Point of the European Environment Agency (EEA) within the European environment information and observation network (EIONET).

Environmental monitoring guidelines and program. Environmental monitoring is a tool for environmental policy planning and assessing the effectiveness of the environmental protection measures. It includes the Early Warning System for dangerous change in quality of the environment, which is the basis for emergency actions for the recovery or mitigation. Environmental monitoring program sets parameters, frequency and methods for Latvia's environmental monitoring network organized by environmental authorities.

The Environmental Monitoring Program 2015-2020 was developed on the basis of" Environmental Policy Guidelines 2014-2020", approved by the Cabinet of Ministers Order No.130 of March 26, 2014 "On Environmental Policy Guidance for 2014-2020".

The main task of Environmental monitoring program is to create a structure for monitoring information system, which ensures:

- Requirements of legislative acts of Republic of Latvia;
- Requirements of EU directives;
- Requirements of International conventions Latvia are involved.

Environmental monitoring program consists of Air monitoring program, Water monitoring program, Earth monitoring program and Biodiversity monitoring program.

Each of the programs is divided into sections according the structure required by Environmental Monitoring program guidelines 2014-2020.

Atmospheric and climate observation systems

LEGMC carry out meteorological observations in 31 observation stations, spread over the entire territory of Latvia. The location of meteorological stations in the territory is optimal to accurately describe the weather conditions and climate variables in Latvia. In 24 weather stations automatic meteorological sensors are used allowing continuous observations of the main meteorological parameters as air temperature, relative humidity, atmospheric pressure, wind speed/direction, precipitation amount and intensity, snow depth, visibility and atmospheric phenomena over 24 hours, and in 7 additional stations – only precipitation amount and intensity and snow depth. The observation results of these stations have been entered into the Integrated Meteorological System and MetMan system, which processes the measurements, prepares reports and transmits to a database via the Telecommunication Centre or via the mobile internet. Since the 2020 all observation data (with time resolution one minute) from weather stations is sent to new Observation Network Management System NM10 via mobile internet, where data is automatically aggregated, generated and encoded of hourly BUFR messages for international information exchange, as also exported to Climatological database CLIDATA with time resolution 10 minutes. Observation data series from meteorological stations are available for more than 50 years. 50% of all observation series cover at least 80 years, but several stations have been operating for more than 100 years. The weather station Rīga-University operates on an on-going basis since 1795.

With the financial support of European Cohesion fund (CF) during 2013-2019 was modernized 24 meteorological stations in Latvia. There were installed 10 new MAWS301 and 14 new AWS310 automatic weather stations and new sensors for a visibility, atmospheric phenomena, cloud height, base and amount above sensor, precipitation, sun duration, global radiation, ultraviolet radiation and snow depth measurements.

LEGMC operates one upper air station, which makes sounding every second day. The observations of the upper air in the territory of Latvia have been taking place for 72 years.

There is one automatic lightning detection station in the western part of Latvia, since October 2017. Station is a part of the Nordic Lightning Information System (NORDLIS) of the Finnish Meteorological Institute. Second station will be installed in eastern part until the end of 2021.

Doppler's meteorological radar METEOR 500C was installed in 2005, providing precise and regularly updated information on physical characteristics and processes in the atmosphere including also the higher atmospheric layers. The meteorological radar observation data are stored in the digital database and can be extensively used for climate system research in the future.

Since 2006 Latvia is a member of EUMETSAT, which promotes the use of satellite technologies for atmospheric monitoring above the territory of Latvia. Latvia receives and processes the data from geostationary satellite MGS and polar orbit satellite NOAA. Since 2020 LEGMC is ongoing to prepare for MTG (Meteosat Third Generation) satellites system. Currently LEGMC uses only EUMETSAT EUMETCast system, while starting MTG there will be put into operation new EUMETSAT Terrestrial data gathering system.

The long-term metrological observation data from weather stations are widely used for climate change research in Latvia, Baltic countries, Europe and the world. Data from the Latvian meteorological stations are reported through the WMO international data exchange and are sent to the World Data Centre according to standard procedures:

- meteorological observation data from Liepāja weather station – to the World Data Centre for Meteorology, Asheville, USA as part of GCOS program „Implementation of the Global Climate Observation System Surface Network";
- data of hourly and daily global solar radiation from 3 stations – to the World Radiation Data Centre, St. Petersburg, Russian Federation;
- on a regular basis Latvia sends reports „Latvia's report of activities under the implementation plan for the evolution of the surface and space-based sub-systems of the GOS" to WMO EGOS-IP (Implementation Plan for the Evolution of Global Observing Systems);
- Each month meteorological data from all meteorological stations are sent to Global Precipitation Climatology Project (GPCP) and European Centre for Medium-Range Weather Forecasts (ECMWF);
- Each month global radiation data from 6 stations are sent to Copernicus organization.

Real time data are exchanged internationally within the framework of GTS – Global Telecommunication System:

- meteorological observation data for main and additional terms from 24 weather stations and intermediate terms from 7 weather stations, upper air observations from Skrīveri station – to Regional Basic Synoptic Network (RBSN);
- from 4 weather stations – to Regional Basic Climatic Network (RBCN);
- meteorological radar real time data – within the international projects NORDRAD, OPERA and BALTRAD.

Latvia sends the information from 18 weather stations to the Climatology Centre Deutscher Wetterdienst, Offenback, Germany under the WMO World Climate Research Program (WCRP) Global Energy and Water Cycle Experiment (GEWEX) Global Precipitation Climatology Project (GPCP), but starting from 2020 daily data for multiple parameters are provided only to ECA&D (European Climate Assessment & Dataset) each month.

Latvia has also contributed to the World Weather Records (WWR) data series (2014-2016) by sending the data from 7 weather stations to this database, which has been widely employed in operational climate monitoring, international climate assessments, and numerous other applications.

Latvia sends the annual information for the WMO issue "Annual Statement on the Status of the Global Climate" as well as information about annual extreme weather conditions to the Annual Bulletin on the Climate in RA VI (RA VI Bulletin).

LEGMC provides environmental quality observations in Latvia, including atmospheric air quality monitoring, which are managed in 4 cities – Rīga, Ventspils, Liepāja, Rēzekne (in 7 observation stations) as well as in rural stations Rucava and Zosēni. 30 air and precipitation pollutant parameter analyses are carried out at observation stations.

Air quality monitoring data and information are presented according to prescribed format and forwarded to the EC, the European Environment Agency and uploaded in EIONET databases store.

Latvia provides assessment of the impact of air quality on ecosystems and monitoring of the impacts of trans-boundary air pollution on ecosystems within the scope of several international programme:

- EMEP (Cooperative Programme for the Monitoring and Evaluation of Long-Range Air Pollutants in Europe) – in monitoring stations Rucava and Zosēni;
- Regional GAW (Global Atmosphere Watch) – atmospheric air quality monitoring in Rucava and Zosēni and precipitation quality in 4 monitoring stations (Alūksne, Dobele, Rīga and Skrīveri);
- ICP Waters (International Cooperative Programme on Assessment and Monitoring Effects of Air Pollution on Rivers and Lakes) in 5 monitoring stations;
- ICP Vegetation (ICP Vegetation – The International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops) – heavy metal content in mosses are observed in 101 monitoring points.

Monitoring data and information are regularly sent to the WMO, to The World Data Centre for Reactive Gases, to the World Data Centre for Aerosols, to the World Data Centre for Precipitation Chemistry, to the Chemical Co-ordinating Centre of EMEP, to the European Environment Agency included in the EIONET database, to the Institutional Programme Centre for ICP Waters.

Oceanographic observations

Baltic Sea observations are performed by the LEGMC. LEGMC provides regular measurements and data on sea water level, water temperature, water salinity, sea ice conditions and waves from 9 coastal observation stations. 4 coastal observation stations have been collecting observation data series for more than 100 years; observations at other stations cover period of nearly 80 years. Coastal observation monitoring data and information are regularly sent to the international institutions through GTS (Global Telecommunication System) and Regional Basic Synoptic Network (RBSN).

Two coastal observation stations regularly provide data and information exchange within Baltic Operational Oceanographic System (BOOS).

Terrestrial observations

Land Cover monitoring. In accordance with CORINE Land Cover program Latvian Geospatial Information Agency (LGIA) was the responsible institution for land cover monitoring in Latvia for year 2012. Next revision has been provided in year 2018, coordinated by the European Environment Agency as one of the Corine Land Cover (CLC) datasets produced within the frame the Copernicus Land Monitoring Service referring to land cover / land use status of year 2018.

Modern monitoring of geological processes. In 2009 modern monitoring of geological processes was carried out in 100 monitoring places with the funding of the Latvian Environmental Protection Fund Administration. Risk areas on the shores were identified, coastal erosion places were observed and the extent of erosion risk was evaluated making use of the monitoring data. Modern monitoring of geological processes has not been carried out since 2010 due to reduced public funding.

Monitoring the coastal dynamics in the hydroelectric power station affected territory of river Daugava. The coastal dynamics monitoring in the hydroelectric power station affected territories of river Daugava has started in 1999. Since 2014 coastal dynamic monitoring in the hydroelectric power station affected territories has been responsibility of LEGMC. In annual monitoring affected coastal areas by Rīga, Ķegums and Pļaviņas hydroelectric power stations are included.

Seismic monitoring. The main objective of seismic monitoring is to control seismic processes. The monitoring covers possible regional earthquakes and explosions localization and evaluation of their parameters, control of regional seismic regime and collection of statistical information about seismic events. Information on seismic monitoring can be used to identify seismically active regions, to evaluate their parameters and also to evaluate seismic risk at these regions. Seismic monitoring in Latvia is carried out at two seismic stations – Skuja (SKJA) that is located in Burtnieku district Rencēnu area (NE part of Latvia) and Slītere (SLIT) that is located in Dundaga district, Slītere (W part of Latvia). The station Slītere was set up in 2006 in Dundaga district at Slītere lighthouse territory broadband, equipped by automatic sensors. The station Skuja was set up in 1994 and provided observations until 2014, when was closed. The Slītere station is included in international seismic GEOFON network with its centre at GFZ Potsdam, Germany. If requested, seismic information (bulletin) is sent to European-Mediterranean Seismological Centre (EMSC) and also to regional partners (Geological Survey of Estonia and Lithuanian Geological Survey). There is a periodical information exchange with regional partners to specify hypocentre localization.

Hydrogeological monitoring. Hydrogeological observations in the territory of Latvia are ensured by State groundwater observation network which provides groundwater level measurements in 305 wells of 60 observation stations and water quality observation in 206 wells of 51 stations and 30 springs. Network covers whole territory of Latvia and provides observations of all active water exchange zone horizons, focusing on the horizons which are mainly used for water supply. The largest density of network is in Rīga, Jūrmala and Liepāja cities where the largest rate of groundwater extraction is observed and most potential sources of groundwater contamination are identified. 198 wells of 40 observation stations are equipped with automatic level loggers which take measurements every day. In other observation wells the level measurements are taken manually and number of measurements differs from once a month to four times a year depending on aim of the observation station. The annual report about groundwater condition is reported to European Environment Agency and included in the EIONET database.

Surface water observations. LEGMC provides surface hydrological observations. Hydrological observations are carried out in 70 stationary observation stations located near rivers, lakes and reservoirs of Latvia. Water level, flow, water temperature, ice phenomena, ice and snow thickness are monitored. In 2013, 2 new observation stations were opened, as well 5 historical observation stations were restored, stationary acoustic doppler current profile (ADCP) were installed at three observation stations. From 2013, observation stations are started to equip with web cameras for remote observation of ice phenomena in rivers. Modern technical equipment, automatic observation sensors and mobile communication devices provide the possibility to receive water level and temperature data in real time regime and perform operative information follow-up and correction of possible inaccuracies. Two of the terrestrial hydrological observation stations currently operating have been operating for more than 100 years. More than a half of the stations have covered observations of data series for more than 80 years. 4 terrestrial hydrological stations daily runoff data is sent to Global Runoff Data Centre, Germany.

Surface water quality observation are carried out in 4 River Basin Districts, 225 river and 263 lake stations in the actual state network. Water samples are taken manually with lowest intensity according to monitoring programme 1 year in a 6-year observation cycle; 4 water samples in a year. Under the HELCOM and ICP-Waters international programme, drinking water, cross-border pollution monitoring is performed every year in a 6-year cycle; 12 water samples in a year. Automatic hydrochemical observation station Piedrūja was operated on Latvian – Belarus border for period 2014-2016 when lansensory provided dissolved oxygen, pH, chlorides, nitrate and ammonium nitrogen registration.

The annual data report about surface water condition is reported to European Environment Agency and included in the EIONET database.

Large part of the long-term meteorological and hydrological data is digitized and together with current systematic observation data are stored in the data base CLIDATA. This database contains data of more than 500 meteorological and hydrological parameters from the beginning of the 19th century. The quality of operative observation data and the homogeneity of historical measurement data series is controlled and analysed on a regular basis. In 2012 and secondly in 2018 the database CLIDATA has been updated with the new version containing „Clidata Java", which allows completing, analysing, and quality control of large data array as well as distributing the information via Internet.

All observation data are kept in LEGMC archives – part in digital, part in a paper form. The latest systematic observation data are stored in observation databases. The quality of the operative observation data and the quality and homogeneity of historical measurement data series is controlled and analysed on a regular basis. Observation data are available without restrictions to all parties of concern. Online information on meteorological, hydrological air pollution as well as monthly analysis are available on the LEGMC's web page. All historical observation data are available from LEGMC data archives, including digitized data – on the LEGMC's web page.

Hydro meteorological information and data are regularly exchanged among appropriate services in the neighbouring countries – Lithuania, Estonia, Belarus and Russian Federation, and for cooperation within the framework in international projects and programs (with WMO, ECMWF, ECOMET, EUMETSAT) is taking place.

Databases

Until 2020 LEGMC maintained 14 databases and registers of which 7 were publicly available. In the data bases data and information on meteorology, terrestrial and marine hydrology, environmental quality, emissions, natural resources, chemicals are entered, controlled and revised (see Table 8.1), including summary tables and thematic maps on human-induced environmental load.

Table 8.1 LEGMC databases

Data bases	Information stored
On state of environment and natural resources	Mineral Deposit Register
On environmental load	Register of polluted and potentially polluted sites Database of environmental damage Europe Union GHG Emission trading registry system Annual Governmental statistical report "2-Air" Annual Governmental statistical report "3 – Waste" Annual Governmental statistical report "2 – Water" EUROPEAN POLLUTANT RELEASE AND TRANSFER REGISTER (E-PRTR) Waste transport registration system Register of chemical substances and mixture
Observation data	Air and water quality information processing system (AGŪNS) Laboratory Test Result Processing System (STARLIM)

Data bases	Information stored
	Climatological database (CLIDATA) Hydrometric data processing system (HYMER)

Summarizing and processing the collected information held in databases, various public reports are developed: “National Report on the State of Environment”, “Report on Environmental and Surface Water Quality in Latvia”; “Air quality annual report” as well as reports to the EC and international organizations.

8.4 Action taken to support related capacity-building in developing countries

This section includes information on the provision of capacity-building support to developing countries by Latvia.

Besides indicated financial contributions mentioned in chapter 7 of the NC8, there were four projects carried out through bilateral/regional channel that were related also with capacity-building issues:

- “Latvian-Georgian training seminar in Tbilisi (Georgia) on implementation of measures for low-carbon development in the EU Eastern Partnership or Central Asia country” in 2019 providing co-funding of 3291.40 EUR. The training seminar was focused on basic elements of the GHG forecasting and GHG inventory preparation of the Latvian national system, including information regarding the time schedules for submission of reports; development of future climate change scenarios at national level. Experience with the use of the COPERT model in the calculation of GHG emissions from the transport sector was also shared;
- “Promoting the initiative and strengthening the capacity to promote entrepreneurship in the fisheries in Georgia” in 2019 providing co-funding of 39,284.79 EUR. The aim was to support the Ministry of Agriculture of the Autonomous Republic of Adjara and the LEPL Laboratory Research Centre for the development of small and medium-sized enterprises in the fisheries by improving the quality assessment and standardization system in the fisheries, strengthening coordination of common standardization processes and exchanging experience ensuring the monitoring of the sector and access to information and development perspectives, as well as promoting the participation of stakeholders and the development of competencies in the development of the fisheries;
- “Promoting co-operation between municipalities and the government and improving public administration in Kyrgyzstan” in 2019 providing co-funding of 36,287.18 EUR. The project aimed to promote good governance in Kyrgyzstan by building the institutional capacity of the public administration. The project will also develop recommendations for improving the performance of local governments and promoting cooperation, environmental protection and waste management;
- “Assessing the applicability of open source technologies in the administrative management of the Republic of Uzbekistan” in 2019 providing co-funding of 7,542.01 EUR. The aim of the project was to identify the needs of GIS technologies used in the administrative system of the Republic of Uzbekistan, to analyse the existing systems and data structure in order to develop proposals for the implementation of open technology GIS solutions in the administrative management of Uzbekistan.

No barriers have been identified to the free and open international exchange of data.

References

- Air and Climate Change Monitoring Programme for 2015-2020 https://videscentrs.lvgmc.lv/lapas/vides-monitoringa-pamatnostadnes-un-programmas
- Air and Climate Change Monitoring Programme for 2021-2027 Annex 1 (Part 1) of the national Environmental Policy Guidelines 2021-2027
- Baltic Energy Technology Scenarios Project (2018): https://www.nordicenergy.org/project/bente/
- Baltic Research Programme (EEA/Norwegian Financial Mechanism 2014-2021): https://eeagrants.lv/en/research-and-education/about-program/
- Climate Change Scenarios for Latvia: Report summary: https://www4.meteo.lv/klimatariks/files/summary.pdf. Full Report in Latvian "Klimata pārmaiņu scenāriji Latvijai", by Avotniece Z., Aņiskeviča S., Maļinovskis E.: https://www4.meteo.lv/klimatariks/files/zinojums.pdf
- Daugavpils University: https://du.lv/en/home/
- "EJP Soil" (joint European research programme): https://cordis.europa.eu/project/id/862695 ; https://ejpsoil.eu/
- Institute of Physical Energetics: https://fei-web.lv/en/
- Institute of Solid State Physics of University of Latvia: https://www.cfi.lu.lv/en/
- Joint Baltic-Nordic Energy Research Programme: https://www.nordicenergy.org/programme/the-joint-baltic-nordic-energy-research-programme/ .
- Latvia University of Life Sciences and Technologies: https://www.llu.lv/en
- Latvian Institute of Aquatic Ecology https://www.lhei.lv/en/
- Latvian State Forest Research Institute "Silava": http://www.silava.lv/mainen/aboutus.aspx
- Latvian State Institute of Wood Chemistry.: http://www.kki.lv/en
- LCS (Latvian Council of Science). Stastistics on Latvia's participation in the EU Horizon2020 programme (Apvārsnis2020. Atbalstītie projekti. Latvijas dalība Apvārsnis2020): https://lzp.gov.lv/starptautiskas-sadarbibas-programmas/apvarsnis-eiropa/apvarsnis-2020/atbalstitie-projekti/
- LIFE Programme projects in Latvia: https://www.lifeprogramma.lv/en/home
- National Development Plan of Latvia for 2021-2027 (NDP2027, Nacionālais Attīstības 250lans 2021.-2027.gadam): approved by the Parliament (Saeima), 2 July 2020: https://likumi.lv/ta/id/315879-par-latvijas-nacionalo-attistibas-planu-20212027-gadam-nap2027; https://pkc.gov.lv/sites/default/files/inline-files/NAP2027__ENG.pdf
- National Research Programmes (Valsts pētījumu programmas): Latvian Council of Science: https://lzp.gov.lv/programmas/valsts-petijumu-programmas/
- National Thematic Research Projects (Fundamentālo un lietišķo pētījumu projekti): Latvian Council of Science: https://lzp.gov.lv/programmas/fundamentalo-un-lietisko-petijumu-projekti-programma-flpp/
- Norwegian Financial Mechanism 2014-2021 Programme "Climate Change Mitigation, Adaptation and Environment": https://www.varam.gov.lv/en/projects/norwegian-financial-mechanism-programme-climate-change-mitigation-adaptation-and-environment, https://eeagrants.lv/en/climate-and-environment/about-program/
- Practical Research Programme: National Operational Programme (NOP) "Growth and Employment" for 2014-2020, the specific objective 1.1.1 "Improve research and innovation capacity and the ability of Latvian research institutions to attract external funding, by investing in human capital and infrastructure": https://www.esfondi.lv/planosanas-dokumenti
- Riga Technical University: https://www.rtu.lv/en
- Research and Innovation Strategy for Smart Specialisation (RIS3, Viedās Specializācijas Stratēģija): https://www.izm.gov.lv/en/smart-specialisation-strategy-ris3,
- Research and Publications Database (Pētījumu un publikāciju datu bāze, research projects commissioned by a State authorities): http://petijumi.mk.gov.lv/ .

- State Development Education Agency Republic of Latvia. EEA and Norway grants: Climate and Environment: https://eeagrants.lv/en/climate-and-environment/about-program/
- University of Latvia: https://www.lu.lv/en/
- Central Statistical Bureau of Latvia (CSB): https://stat.gov.lv/en/statistics-themes/education/science-and-research
- Guidelines for Science and Technology Development and Innovation for 2014-2020 (Zinātnes un tehnoloģijas attīstības un inovācijas pamatnostādnes 2014-2020 gadam), the Cabinet of Ministers Ordinance No 685, 28th December 2013: http://polsis.mk.gov.lv/documents/4608
- Guidelines for Science, Technology Development and Innovation for 2021-2027 (Zinātnes, tehnoloģijas attīstības un inovācijas pamatnostādnes 2021-2027. Gadam), the Cabinet of Ministers Ordinance No 246, 14th April 2021: http://polsis.mk.gov.lv/documents/7053
- Latvia's Open Science Strategy for 2021-2027 (Latvijas atvērtās zinātnes stratēģija 2021. – 2027. Gadam), viewed by the Cabinet of Ministers 1 March 2022: http://polsis.mk.gov.lv/documents/7327
- Likumi (Legal Acts of the Republic of Latvia): https://likumi.lv/
- Ministry of Education and Science. Sectoral policy: Science: https://www.izm.gov.lv/en/science-1 ; https://www.izm.gov.lv/lv/zinatne-0
- Nacionālā Zinātniskās Darbības Informācijas Sistēma (National Information System of Scientific Activity): https://sciencelatvia.lv/#/pub/home
- National Development Plan oF Latvia for 2014-2020 (NDP2020, Nacionālais Attīstības Plāns 2014-2020.gadam), approved by the Parliament (Saeima), 20th December 2012: https://www.pkc.gov.lv/images/NAP2020%20dokumenti/NDP2020_English_Final.pdf
- On the Implementation of the European Research Area Roadmap 2016-2020 in Latvia (informatīvais ziņojums "Par Eiropas Pētniecības telpas ceļveža 2016.-2020.gadam īstenošanu Latvijā"): http://polsis.mk.gov.lv/documents/5695

EDUCATION, TRAINING AND PUBLIC AWARENESS

9. EDUCATION, TRAINING AND PUBLIC AWARENESS

9.1 General Policy Toward Education, Training and Public Awareness

The education system is administered at three levels – national, municipal and institutional. The Parliament (Saeima), the government (Cabinet of Ministers) and the Ministry of Education and Science (MES) are the main decision-making bodies at national level. The MES is the leading state administration institution of education policy development and implementation that oversees the national network of education institutions, sets educational standards, determines teacher training content and other procedures.

Education Law is a framework law that contains definitions of all types and levels of education, states general principles and determines competences of governing bodies. Particular laws are: General Education Law, Vocational Education Law and Law on Higher Education Institutions.

Education system consists of both formal and non-formal education. The following levels of formal education are specified: pre-school education (PSE), basic education (BE), secondary education (SE) and higher education (HE); the types of education are as follows: general education, vocational education and academic education. Preparation of children from the age of five for the acquisition of BE and the acquisition of BE, or the continuation of the acquisition of BE until attaining 18 years of age are compulsory. After the basic school, SE has two types of programmes: general SE programmes and vocational SE programmes. The right to work as the teacher has a person who has higher pedagogical education or who is acquiring it conforming to the professional qualification requirements specified by the government (these requirements do not apply to non-formal adult education). Non-formal education includes organized interest and demand-oriented educational activities.

There are also inclusive education and special needs education programmes and support measures. Special education is the specific type of general education for children with special needs provided both by special schools or special education classes within general education schools. The structure of the special education is very similar to that of the mainstream education and is focused to attain general knowledge and skills with strong emphasis on their applicability, thereby facilitating social inclusion. From September 2012, the assistant service in education institutions to support mobility and self-care for persons with disabilities is introduced. In its turn, the special education development centres provide consultative and methodological support to parents, children and teachers.

Each local government has an obligation to ensure that the children whose declared place of residence is in its administrative territory have the opportunity to acquire PSE and BE at the educational institution closest to the place of residence of the child, to ensure that young persons have the opportunity to acquire SE, as well as to ensure the opportunity to implement interest-related education and to support extra-curricular activities, also children's camps.

The tuition fee for PSE, BE and SE in a state or municipality founded educational establishment is funded from the national or municipal budget, a private educational institution may set a tuition fee. In HE programmes the state covers tuition fees for a certain number of students' places and the respective students receive state grants. Each HE institution may set a tuition fee for the other students' places. Any student is entitled to a state guaranteed loan for his/her studies in HE programmes.

The aim of adult education Is to ensure access to lifelong learning by providing a quality educational offer. Adult education is not linked to a specific age stage, but to a person' s motivation to return to education process, including after completing or termination of BE, in order to acquire new or improve existing knowledge, skills and competences (including attitudes) for the competitiveness in the labour market and/or self-development and civic participation.

Education Development Guidelines for 2014-2020 set the overarching goal – qualitative and inclusive education for the development of a personality, human well-being and sustainable development of the state. The sub-goals had been set in line with both the problems identified in the analysis of the previous programming period and the future challenges: 1. To improve the quality of the educational environment by improving the content and developing the appropriate infrastructure; 2. To promote the development of the individual's professional and social skills based on value for the life and competitiveness in the labour market and work environment; 3. To ensure effective governance: improve the efficiency of resource management by developing institutional excellence in educational institutions.

The NOP "Growth and Employment" of EU Funds planning period for 2014-2020 includes the Priority Axis 8 "Education, skills and lifelong learning" that provides investment co-financing, by ERDF and European Social fund, to achieve such goals as: to increase number of modernized study programmes of STEM, to reduce the fragmentation of HE study programmes, provide sharing of their resources and strengthening of academic staff strategic specialization; to improve study environment of general education institutions, to develop the content of general education based on the competence approach and support for the development of individual competences of learners; to increase number of fully modernised vocational education and training institutions, to develop work environment based education, provide career support for learners in general education and vocational training institutions; to involve and develop the skills among young NEET[36] people, to reduce the early school leaving; to improve the professional competence of the employed persons. Improving governance at all levels of the education system and a system for monitoring education quality is a top priority. The implementation of NOP activities will continue up to 2023 including.

In June 2021 the **Education Development Guidelines for 2021-2027** have been approved, having the title "Future skills for future society" thus emphasizing the importance of the usability of knowledge and skills as an outcome of education as well as referring to actual EU and global initiatives – OECD National Skills Strategies project and EC European Skills Agenda 2025. The overarching goal of the Guidelines is to provide quality education opportunities for all residents of Latvia in order to promote the development and realization of their potential throughout their lives and to develop their ability to change and responsibly manage the change in society and the economy. The essential characteristics of the Latvia's education system in future are: individualised learning approach; acquisition of balanced and future needs appropriate skills: functional transformation of education institutions to "learning organisations" (offering diverse learning opportunities, learning environments and approaches for diverse audiences based on active collaboration both with each other and with other stakeholders); an improved education governance system in which the activities of the sector are strategically planned with the involvement of stakeholders. Four interrelated goals have been set:

- Highly qualified, competent and excellence-oriented teachers and academic staff;
- Modern, high-quality and focused on the development of highly valued skills in the labour market educational offer. Both the content and the process of education, the resources and infrastructure of the education environment will be developed and the partnerships important for the development of education will be created;
- Supporting the growth of each individual – children, young people and adults, by implementing institutional solutions that will promote high-quality specialised education, development of individual competences and also an inclusive education approach as well as developing cooperation with the local community and particularly developing adult education;
- Creating a sustainable and efficient governance of the education system and education institutions.

[36] NEET - not involved in employment, education or training

9.2 Primary, Secondary and Higher Education, Vocational Education

9.2.1 General education

The general educational system is divided into four levels:

- pre-school is the first educational level;
- basic education (grades 1-9) can be acquired in: primary schools (grades 1–6, primary education) and basic schools (grades 1(7) –9, lower secondary education);
- upper secondary education (grades 10–12).

9.2.1.1 Pre-school education

Pre-school education (PSE, UNESCO ISCED-P-2011 level 0) is a comprehensive first stage of general education. Children are involved in pre-school preparation from the moment they start attending kindergartens of pre-primary education institutions. PSE programmes are acquired from the age of 1.5 up to the age of 7. Preparation of five and six-year-old children, which do not attend PSE institutions, for the acquisition of basic education is compulsory. The objective of the PSE content is a curious, creative and joyful child who leads a healthy, safe, and active life, acts independently, learns with interest and joy, gaining experience about himself/herself, others, the surrounding world and the interaction therein. Thus, PSE curriculum ensures multi-faceted development of a child's personality. PSE provide also the acquisition of basic language skills in Latvian as the state language. PSE can be delivered at various pre-primary education institutions (kindergartens) or at the pre-primary classes of general education institutions. Children with special needs attend special pre-school institutions or special classes within general education schools. There are public and private PSE institutions. The institution has to be registered in the Register of Education Institutions and licensed for running the PSE programmes. The government adopts the State Guidelines for PSE and Model PSE Programmes. In the beginning of 2020/2021 school year (on 1 September 2020) there were 100.3 thsd enrolment in the PSE institutions, in the beginning of 2021/2022 school year – 99.4 thsd enrolment.

9.2.1.2 Basic education

9-year single structure basic education (BE; primary and lower secondary education, ISCED-P-2011 level 1 and 2) is compulsory for all children from the age of 7 and is generally completed till the age of 16, but may continue till the age of 18. The objective of the BE content is a comprehensively developed and competent pupil who is interested in his/her intellectual, socio-emotional, and physical development, is living healthily and safely, learns with pleasure and interest, participates in public events in a socially responsible manner and undertakes initiative, is a patriot of Latvia. The State BE Standard determines the objectives and tasks, compulsory curriculum and the principles and procedures for the assessment of BE. Natural sciences, mathematics and technologies are ones of the fields of the BE. Full BE programmes are provided in basic schools. Partial acquisition of BE – educational programmes of the first six grades – can be provided by primary schools. Secondary schools may also provide a full programme of BE[37]. At the end of basic school pupils take centralized national examinations. In the beginning of 2020/2021 (on 1 September 2020) school year the total enrolment in the BE (grades 1-9) were 180 thousand pupils, in the beginning of 2021/2022 school year – 181.6 thousand pupils. The State BE Standard determines also the model special BE programmes for pupils with special needs. The BE programmes are developed also for inclusion of minority pupils.

[37] basic education can also be provided by vocational school, special education institution, evening (shift) school, boarding school, educational institution of social or pedagogical correction, or in any other educational institutions providing BE programmes.

9.2.1.3 General Secondary Education

There are two types of programmes at the secondary education (SE) level: academic SE programmes and vocational SE and training programmes. The main task of academic upper SE programmes (ISCED-P-2011 level 3) is to prepare for further studies at university. Academic secondary education programmes are provided in gymnasiums, secondary schools and evening (shift) schools. Enrolment in SE programmes (10^{th}-12^{th} grades) in the beginning of 2020/2021 school year (on 1 September 2020) were around 36 thousand students, in the beginning of 2021/2022 school year – 35.6 thousand students. The State General SE Standard determines the compulsory curriculum of academic SE programmes. When completing academic SE programmes, students shall take centralized national examinations. The content and procedure of these examinations is determined by the MES and is approved by the government. The new 2019 Standard (see in the paragraph below) determines following State examinations: (1) in the Latvian language; (2) in a foreign language (English, German, or French), (3) in mathematics, all three examinations at the least at the optimal level of acquisition of the study content, and (4) not less than two examinations in advanced courses at the advanced level, including also the examinations referred above. An academic SE may be combined with a national minority educational programme, by inclusion of the minority language and other contents related to the minority's cultural identity and integration into Latvian society. The State General SE Standard provides also for the general secondary special education programme for visually impaired students, for hearing-impaired students, for students with physical development impairments.

The State General SE Standard, adopted in 2013, required that content of SE programmes should include the following fields of education: (1) languages, (2) mathematics and computing, (3) sports and health, (4) natural sciences, (5) social sciences and (6) art. The SE programmes had been available in the following profiles: (1) a general education profile without specifically emphasized subjects; (2) a humanities and social sciences profile, (3) a mathematics, natural science and technical profile, and (4) a vocational preparation profile with special emphasis on specific vocational/ professional areas (for example, in arts, music, business, and sports). Each profile had contained 14-15 subjects, including 2-3 profile-specific subjects. The particular content of the profile had been formed by the SE institution based on the sample education programmes.

On 3 September 2019 the government adopted new State General SE Standard, which has come into force on 1 September 2020 (the provisions in relation to the implementation of a general SE programme at grade 12 will enter into force on 1 September 2022). The new standard is directly aimed at the development of competence education. The objective of the general SE content is a competent student who is aware of his/her own personal capacities and interests for the purposeful creation of personal and professional future, who respects himself/ herself and others, deepens knowledge, understanding, skills and continues to strengthen values and virtues according to his/her own future objectives, acts responsibly, innovatively, and productively in the creation of himself/herself, family, welfare, and sustainable State of Latvia and the world. The following fields of studies are stated: (1) languages, (2) social and civic studies, (3) understanding in culture and self-expression in art, (4) natural sciences, (5) mathematics, (6) technologies, (7) health, security and physical activity. Three levels of the acquisition of course content are determined – general, optimal and advanced ones. The new Standard no longer explicitly defines SE program profiles, allowing students to choose the subjects' set that suits their interests. At the same the new Standard makes it possible for an educational institution to create a specific profile for an SE programme[38]. The new Standard strengthens the role of natural science subjects: the mathematics shall be implemented in the optimal level for all students; the courses in chemistry, physics, geography, and biology shall be offered and according to the choice of students implemented at the optimal level. The implementation of the inter-disciplinary course "Project work"

[38] namely, it shall be offered at least four advanced courses of which the student acquires three ones according to his/her interests. The educational institution shall implement at least two sets of advanced courses, each set shall consist of at least three advanced courses with at least one different advanced course in each set. The education institution may implement specialized courses corresponding to the interests of students.

provides the study environment in which students conducts and defends research, creative or social work in relation to one or several advanced courses.

9.2.2 Vocational Education and Training

Vocational education and training after acquiring of the basic education (BE) can be acquired in:

1. vocational BE and training programmes, obtaining Vocational Qualification Level 2 (corresponds to Latvian level 3) as well as partial vocational SE, the studies last 2.5- 3 years in general;
2. vocational secondary education (SE) programmes, obtaining vocational SE and Vocational Qualification Level 3 (corresponds to Latvian level 4); the studies last 3.5- 4 years in general. In its turn, students with already previously acquired vocational education can obtain a vocational SE within 1 – 1.5 years if they continue to acquire a consecutive higher level vocational qualification by joining the vocational SE programme which is implemented for 3.5-4 years (the independent vocational SE programme lasting 1-1.5 years cannot be implemented). Upon completion of a vocational SE programme, a person may start working or continue studies at a higher education institution.

In 2020, new State Vocational Secondary Education and Vocational Education Standard has been adopted.

In 2021, the vocational BE and training programmes and vocational SE programmes were offered by 55 educational institutions, having the total enrolment on the beginning of school year (1 September 2021) 28 thousand students.

The content of both vocational SE programme and vocational education and training programme includes main part (70%) and variable part (30%):

- the main part includes: (i) subjects or modules of professional competences, (ii) general courses of general SE according the State General SE Standard if the studies are commenced after the acquisition of BE, and (iii) lifelong learning competence module "Society (public) and Human Security";
- the variable part may include: (i) general or advanced courses of general SE subjects, (ii) lifelong learning competence modules (except the one noted above), (iii) specialised courses of vocational education and training, and (iv) modules of professional competences or professional subjects in accordance with the specialization or related professions as it is included in the sectoral qualification descriptions.

The vocational education institution shall offer at least 2 advanced courses and shall provide the possibility to take centralized national examinations in them as provided by the State General SE Standard.

Table 9.1 Vocational Schools: split of enrolment (on the beginning of 2021/2022 teaching year), new entrants in 2021 and graduates in 2021, by field of education

Education Thematic Groups	Number of students		
	Enrolment	New entrants	Graduates
Engineering, manufacturing and construction	9480	3621	2164
Services	5994	2169	1465
Humanities and art	4464	1360	804
Social sciences, business and law	3039	1086	703
Natural sciences, mathematics and information technologies	2827	1026	407
Agriculture	1406	723	273
Health and welfare	780	622	501
Total	27990	10607	6317

Post secondary education (ISCED-P-2011 level 4). Several vocational education institutions offer young people to acquire professional qualification after graduating the secondary school and qualification can be acquired in 1.5 -3 years long vocational education programmes. In its turn, up-skilling professional development programmes, duration not less than 160 study hours, may be considered as a partial qualification. These programmes are focused towards mastering purely professional skills and knowledge in line with the requirements of the respective vocational qualification level.

Work-based learning is on-going the development in Latvia. The MES has approved the Guidelines for the organization and implementation of studies based on the Work Environment. In the EU Funds planning period of 2014-2020, Employers' Confederation of Latvia in cooperation with the vocational education institutions, business companies, associations and foundations implements (January 2017 – August 2023) the European Social Fund co-financed project on work-based learning by involving more than 3 thousand students in work-based learning and more than 11 thousand students in practical training and learning practices in companies.

9.2.3 Higher education

Law on Higher Education Institutions applies to all existing higher education institutions (HEIs) and colleges in Latvia irrespective of the procedures for the founding and financing and the specialisation thereof.

A college is an educational institution that provides programmes of the first level of professional higher education (ISCED-P-2011 level 5) which can be acquired after the completion of secondary education. Duration of study programme is 2-3 years. These programmes are developed taking into account provisions of both Law on Higher Education Institutions and Vocational Education Law.

HEIs are higher education and science institutions in which academic and professional study programmes are implemented, and also which are engaged in science and artistic creation. The Amendments to the Law on Higher Education Institutions, adopted on 8 June 2021, state four types of HEIs: (1) science universities, (2) arts and culture universities, (3) applied sciences universities and (4) applied sciences HEIs. The founder of HEI determines the strategic specialisation – in the selected fields of science (in the study and research activities) the internationally recognized excellence and compliance with the needs and requirements of society should be achieved. Science universities, to provide cross-disciplinary and multi-sectoral research, shall specialise in at least three fields of science. The government determines the strategic specialisations for state founded HEIs.

All HEIs provide bachelor's (ISCED-P-2011 level 6) and master's (ISCED-P-2011 level 7) degree programmes. In its turn, doctoral (ISCED-P-2011 level 8) degree programmes should be provided by science universities. Other HEIs might provide doctoral degree programmes only in case if they present in the particular study direction the research results that meet international level requirements or develop joint doctoral study programmes with another partner institution.

The system of higher education in Latvia is binary – there is set a difference between academic and professional higher education, but it is not strictly institutionalised. Universities and HEIs run both academic and professional study programmes.

There are 27 accredited HEIs in Latvia, of which – 4 science universities[39], 3 arts and culture universities, 5 applied sciences universities and 15 applied sciences HEIs (in addition, the 2 subsidiaries of the Pontifical Lateran University are accredited as well). The high variety of legal forms are presented – derived public persons (15, state founded HEIs), state institution (1), commercial companies (10), foundation (1). There are also 24 accredited colleges (including 8 colleges joined with the universities), of which 8 are commercial companies. The network of HEIs and colleges covers the whole country. Important role has the regional applied sciences universities and HEIs: Daugavpils University, Rēzekne Academy of Technologies, Liepāja University, Vidzeme University of Applied sciences, Ventspils University of Applied Sciences. Including the regional affiliates of the HEIs and colleges, total number of accredited institutions is 93 ones (the data provided by the State Education Information System and Higher Education Quality Agency).

[39] University of Latvia, Riga Technical University, Latvia University of Life Sciences and Technologies and Riga Stradiņš University.

Total enrolment of higher education students at the beginning of the academic year 2021/2022 was 77.4 thousand (full-time studies – 55.7 thousand and part-time studies – 21.7 thousand students). Due to negative demographic trends, compared to 2010/2011 academic year, the enrolment has decreased by around 25%. In its turn, the total number of academic staff (main work place) at the beginning of the academic year 2021/2022 was 5.2 thousand persons, this number has increased per around 9.5% compared to 2010/2011 academic year.

The structural reforms are progressively put into practice to ensure development of effective and sustainable higher education system. The new financing model, comprising three pillars, has been step-by-step put into practice from 2015 to stimulate research and innovation in the universities/higher education institutions as well as public research institutions (see more details in the chapter 8.1.2 above).

Table 9.2 Higher education: split of enrolment (on the beginning of 2021/2022 academic year), new entrants in 2021 and graduates in 2021, by field of education level

Education level	ISCED level	number of students		
		Enrolment	New entrants	Graduates
first level higher education (college)	5	14344	6327	3063
bachelor's degree (including professional) and second level professional higher education with length of studies 3-4 years	6	43556	15157	7150
master's degree (including professional) and second level professional higher education with length of studies 5 years	7	17444	6958	4345
doctoral degree	8	2032	595	149
Total higher education	5-8	77376	29037	14707

Table 9.3 Higher education (total all levels): Split of enrolment (on the beginning of 2021/2022 academic year), new entrants in 2021 and graduates in 2021, by field of education.

Education Thematic Groups	number of students		
	Enrolment	New entrants	Graduates
Social sciences, business and law	26106	10495	5284
Health and welfare	13493	4753	2719
Engineering, manufacturing and construction	11112	4209	1668
Natural sciences, mathematics and information technologies	7840	3201	1067
Services	6229	2047	1358
Humanities and art	6128	2263	1131
Education	5129	1619	1295
Agriculture	1339	450	185
Total	77376	29037	14707

9.3 Environmental Education/Education for Sustainable Development

9.3.1 General Policy

MEPRD, in cooperation with other public authorities, academic sector, NGO and other organizations, promotes the environmental education and education for sustainable development by implementing the Sustainable Development Strategy of Latvia until 2030 (the section "Promotion of Sustainable Lifestyle" of the Strategy), Environmental Policy Guidelines as the medium-term sectoral planning document, as well as by incorporating environmental education priorities in regulatory enactments and policy planning documents of other sectors. The co-operation between MES and MEPRD establishes the basis for implementing of environmental education.

Environmental Protection Law defines:

- education for sustainable development – education which promotes the possibilities of each individual to obtain knowledge, values and skills necessary for the participation in the taking of decision regarding individual or collective activities at the local and world level in order to improve the quality of life at present without causing threats to the needs of the future generations;
- environmental education – education within the framework of which the knowledge and awareness of the environment and problems of environmental protection are obtained, the abilities and skills required for the solving of environmental protection problems are cultivated, as well as the responsible attitude and motivation for the taking of justified decisions is developed.

The Environmental Policy Guidelines for 2014-2020 paid high attention to education, training and awareness issues. Improving the environmental education system at all levels, including public education, providing high quality environmental information and communication was highlighted as one of the priority horizontal issues. The Guidelines indicated that climate change mitigation and adaptation information did not correspond to the specific interests and needs of different groups of society, therefore one of the priority measures is to inform and educate the public, as well as provide public involvement in policy development and implementation, as a result of which society would be able to contribute to climate change mitigation and adapt to their effects well in time and use them in their favour. New **Environmental Policy Guidelines for 2021-2027** further develop the approaches of the Guidelines for 2014-2020. New Guidelines state five sub-objectives to increase the efficiency of environmental policy. Among them there are:

- raising public awareness and understanding of environmental issues, for that the work of environmental public authorities is essential (directly targeted campaigns and information and education activities; regular dissemination of information to the public on the most important trends and the state of the environment; regular communication on the activities of public authorities and institutions and reached results);
- developing professional competence in environmental issues (increasing the number of study places financed from the state budget, in the thematic area of environmental protection; information provision for professional users of different sectors; developing training programme for civil servants and officials);
- further developing of environmental education and research on environmental issues.

The Latvian Council of Environmental Science and Education, as a coordinating and advisory intersectoral institution, has been established in May 2004, in accordance with the section 41 of the Environmental Protection Law. The Council consists of the representatives from Latvia's universities and higher education institutions, Latvian Academy of Sciences, the MEPRD and the MES. The Council promotes the co-operation between the institutions related to the development of environmental science and education in order to identify and effectively address the problems in the sector, promote implementation of sustainable environmental policy and improvement of the policy instruments. One of the main activities of the Council is the regular Environmental Science Awards and organization of international conference "Environmental Science and Education in Latvia and Europe".

The NGO sector provides a highly valuable contribution to both the environmental education and awareness raising and to the education for sustainable development. LEPF organizes the open calls for co-financing the projects in the field focused to NGOs as the beneficiaries.

Latvia's NECP2030 provides that one of the measures of the action direction "Public involvement, education and awareness raising" is to ensure the availability of teaching materials on environmentally and climate friendly lifestyles to educational institutions of various levels (pre-schools, primary schools, secondary schools). New teaching materials, including digital ones, shall be developed or adapted for the Latvia's situation. Schools shall be provided with the opportunity to introduce climate, energy efficiency calculators allowing to teach to minimise the scores on a benchmark basis and compare school achievements. Several CO_2 footprint calculators are already developed, presented in the chapter 9.7.

9.3.2 Environmental Education/Education for Sustainable Development in General and professional Education National curricula

The Environmental Protection Law includes the section VIII "Environmental Science, Environmental Education and Education for Sustainable Development". The section 42.1 of this chapter states the matters regarding environmental education and education for sustainable development shall be included in the mandatory curriculum of the subject or course standard in accordance with the specific character of each subject by agreeing thereupon and ensuring succession on different education levels. Thus, environmental studies at school are part of many subjects, i.e., nature science, geography, biology, chemistry and physics.

Special provisions relate to vocation education. The State Vocational Secondary Education and Vocational Education Standard, adopted in 2000, stated that the themes of (1) health education, (2) environmental education, (3) education in the field of safety in the working environment, (4) education in the field of national defence shall be included in the relevant study courses of all vocational education programmes. From September 2016 these themes have been united in the common study module "Public and human security". This requirement is continued also in the new Standard, adopted in 2020. The section 5 of the current Standard states the lifelong learning competence module "Society (public) and Human Security" is included in the main part of all vocational secondary education and vocational education programmes.

In 2016, with the support of the EEA Financial Mechanism's for 2009-2014 programme "National climate policy", the project "Klimata valoda" ("Language of the Climate") was implemented by the NGO "Latvian 4H club" in partnership with Norwegian Institute for Agricultural and Environmental Research "Bioforsk", University of Latvia and Latvian Fund for Nature. Project included elaboration of school programmes of interdisciplinary practical work in lessons of geography and science considering climate change as well as inclusion of these materials in the professional education programmes for teachers. The book "Climate education at school. Practical advice" (Kalvāne G. et al.) and range of related additional educational materials were developed.

At both pre-school, primary and secondary school level, the "Environmental Education Fund" (EEF) under the programme of "Eco-schools" of the international organisation Foundation for Environmental Education works in Latvia. The memorandum of co-operation between the MEPRD and the EEF on "Implementation of the International Environmental Education Fund Programmes in Latvia" was signed on January 22 2016. The Eco-schools Programme is financially supported by the LEPF.

The Eco-Schools aim to raise students' awareness of sustainable development issues through classroom study as well as school and community action. This programme does not compete with other environmental education initiatives, but provides a framework for coordinated and successful long-term work with environmental education issues in schools. In Latvia, Eco-Schools can choose from the following topics: Waste, Energy, Water, Transport, Environment and Healthy Lifestyle, School Environment and Neighbourhood, Climate change**,** Forests, Food, Biodiversity. On the web-site of the EEF a number of methodological materials is available, among them the materials - "Climate change", "Energy", "Transport: sustainable mobility and eco-shools", "Food". A range of materials directly focuses to climate change, for instance, such ones as "Climate Change and Energy: Advice for Eco-shool"; "Climate Change: Good Practices of Eco-schools", "Crazy Things about Climate Change", "Environmental Initiatives for Sustainable Community", and others. In the 2021/2022 school year 174 education institutions are involved in the Eco-shools movement at different stages[40]: the International Green Flag are awarded to 102 education institutions,

[40] Thus, around 10% of pre-school education institutions, around 20% of basic education institutions and around 15% of general seconday education institutions are involved in the Eco-Schools programmes

the Certificate of Eco-school is awarded to 44 educational institutions, Thanks are expressed to 28 education institutions.

Besides, „Young Environmental Reporters" co-ordinated by EEF also should be noted. This is the environmental education programme for young people with the aim of exploring environmental problems, promoting their solutions and mastering modern media tools for public information. In the annual national contest of "The Young Environmental Reporters" the works (both individual and group ones), which describe a specific environmental problem, study into the causes and possible solutions of it and present this information in a way that is easily understood by the general public, can be submitted. The contest includes three nominations (articles, photo and video) and three age groups (11-14, 15-18, 19-25).

In its turn, "Young Innovators" is the programme of European Knowledge and Innovation Community Climate-KIC of the European Institute of Innovation & Technology. Riga Technical University, EIT Climate-KIC Hub Latvia and Environmental Education Fund cooperates to implement the programme in Latvia. This is the programme based on the system thinking and focused to age 12-18, as well as to teachers, to promote the necessary skills to mitigate climate change, reduce environmental problems together with the improvement of life quality. The important part of the programme is the hackathons.

The Baltic Sea Project is the first regional project within the UNESCO Associated Schools Network. The objectives are to increase students' awareness of the environmental problems of the Baltic Sea area and to give them an understanding of the scientific, social and cultural aspects of the interdependence between man and nature, to develop the ability of the students to study changes in the environment, and to encourage students to participate in developing a sustainable future. 15 Latvian schools participate in the Baltic Sea Project – 13 secondary schools and gymnasiums and 2 basic schools.

As a good example it has to be noted education activities implemented by Vidzeme planning region.

In 2017-2018 the Vidzeme planning region (regional planning authority) had created the "Energy Groups" to learn good practice in the use of energy/energy resources. This had been a pilot project in three schools in the region. The Energy Groups explored the importance and benefits of an energy-efficient lifestyle through practical examples and activities, studying of everyday relationships related to energy use and performing particular focused experiments. The participants of the activity were schoolchildren, teachers and their family members. Schools were equipped with particular energy efficiency equipment, which allowed school staff and children to draw conclusions about the consumption of energy for lighting, heating as well as other purposes. Exploratory tours have been organized as well as video competition for schoolchildren and their families; teachers took part in training on energy efficiency. A modern and professional material with worksheets on energy for schoolchildren was created to guide the work of the Energy Groups. The qualified experts from energy efficiency and innovation centres were involved in the project activities.

In 2019, the Vidzeme planning region had implemented the programme "Effective energy consumption in education institutions". More than 20 schools of 8 municipalities committed themselves to reduce school's energy consumption by changing habits and introducing regular energy saving measures. Within the framework of the competition at least 10% energy savings should be reached compared to the selected base year. To promote the rational use of energy in schools and to encourage students to become knowledgeable and responsible energy users, the educational material has been prepared, which includes 10 topics: Energy Consumption in Buildings, Heating, Electricity, Types of Energy Resources, Climate Change, Lighting, Ventilation, Water, Energy Planning, Waste, providing both the content and the methodological support to teachers. The practical tasks are intended for use in the basic school stage, but they can also be adapted for learners of other ages.

With the regard to Development education, the NGO Education Development Centre offers continuing education programmes for young people and teachers, particularly value-creating programmes. The mission of the Centre is to promote further development of an educated, democratic society in Latvia by promoting the professional capacity, competitiveness, cooperation and civic participation skills of each individual.

9.3.3 Environmental Studies in Higher Education

The Environmental Protection Law states (section 42) a course in environmental protection shall be included in the mandatory part of all study programmes of HE institutions and colleges. In its turn, a course in sustainable development shall be included in all study programmes for teachers, run by HE institutions and colleges. The Law provides that matters regarding environmental education and education for sustainable development shall be included in the mandatory curriculum of the course standard in accordance with the specific character of each subject meaning that environmental science should be run also as an interdisciplinary theme.

There are defined 32 study fields in higher education, including the study field “Environmental protection” that is accredited in six higher education institutions. Climate change related issues are integral part of these programmes:

- University of Latvia runs the programme “Environmental Science” both at bachelor study, master study and doctoral study level;
- Riga Technical University runs the programme “Environmental Engineering” both at bachelor study, master study and doctoral study level (besides, the “Environmental Science” programmes at these three levels had been accredited up to 30 March 2022);
- Technology College of Olaine (agency of Riga Technical University) runs the first level professional higher education programme “Environmental Protection Technology”;
- Latvia University of Life Sciences and Technologies runs the professional bachelor study programme “Environment and Water Management”, the master study programme “Environment, Water and Earth Engineering Sciences” and the doctoral study programme “Environmental Engineering”;
- Daugavpils University runs the bachelor study programme “Environmental Science” and professional master study programme “Environmental Planning”;
- Liepāja University runs the professional bachelor study programme “Environmental Innovation Technologies” (replacing the previous programme “Management and Engineering of the Environment and Renewable Energy Resources” run until summer 2021) and the professional master study programme “Ecotechnologies”.

The total number of study places, financed from the state budget, in the thematic area of environmental protection in 2020 were 510 ones (all study levels, including colleges)[41].

It has to be noted also several programmes closely related to climate change mitigation and adaptation issues, however accredited within another study fields, particularly

- Rēzekne Academy of Technologies runs the first level professional higher education programme “Environmental Design” (study field – Arts), the professional bachelor study programme “Environmental Engineer”, the professional master study programme “Environmental Protection” and the doctoral study programme “Environmental Engineering” (study field – Mechanics and metal processing, heat power engineering, heat technology and mechanical engineering);
- Latvia University of Life Sciences and Technologies runs the several programmes on sustainable agriculture and sustainable forestry;
- Daugavpils university runs the master study programme “Natural Recreation” (joint programme with Siauliai University in Lithuania, study field – Wildlife sciences).

[41] data presented in the Environmental Policy Guidelines for 2021-2027

Climate change related issues are also integrated within the study programmes of natural sciences, engineering and construction, smart economics, run by several universities.

9.4 Public Information Campaigns

9.4.1 Media

The climate change mitigation policy, in particular the policies and measures to meet EU and Latvia long-term climate neutrality target 2050 and related Latvia national mid-term target 2030 are kept high on the general agenda of mass media. E.g., discussions related to national climate policy are actively performed within the framework of such TV regular broadcast programmes as "National Interests Club (Nacionālo interešu klubs)" (Rīga TV24); "Latvian Benefit (Latvijas labums)" (Rīga TV24, the broadcast discusses challenges of Latvia economics and politics); "De facto" (LTV1); "The 4th Studio (Ceturtā Studija, LTV, the broadcasts deal with the topical socially important issues) and others. Among regular radio broadcasts it might be noted "In the Crosspoint (Krustpunktā)" (Radio 1, the broadcast analyses current events in Latvia and abroad, provides discussions on economic and social challenges) and "Known in the Unknown (Zināmais nezināmajā)" (Radio1, popular science radio magazine, covering different fields of science) as well as others. In its turn, the 4th programme of Latvia radio (Latvijas radio 4) provides the information on topical policy issues in minority (Russian) language.

At second, there are range of environmental regular thematic sections, including climate change related issues, in mass media and thematic broadcasts in TV and radio. Among them it has to be noted:

- "Environmental facts" (Vides fakti, LTV1): during its sixteen years of existence, this weekly thematic broadcast has become the leading one dedicated to the environment and nature in Latvia, which shapes and influences public opinion;
- TV regular broadcast "My environment" (Mana Vide, ReTV) actualizes and updates the environmental issues in a modern, engaging way;
- "Nature Tops" ("Dabas Tops", RīgaTV24): a weekly TV broadcast that explains the diversity of Latvia's natural values and the need to preserve them, focuses on the responsible use of the environment and resources and the necessity of the participation of each individual in limiting climate change;
- The broadcast cycle "Environmental Workshop" (Darbnīca, radio SWH) informs and educates listeners in an engaging and dynamic form of discussion on different environmental issues, including responsible lifestyle, sustainable use of resources, need to preserve natural values;
- "Green Wave" (Radio 1): nature related stories, green with tips and information on environmental issues;
- the major Latvian newspaper "Diena" publishes the weekly thematic supplements "Vides Diena" ("The Environmental Day") and "Dabas Diena" ("The Nature Day");
- another major "Latvijas Avīze (Latvian Newspaper)" and related news portal la.lv has the environment related weekly thematic supplement/key-word "Zaļā Latvija (Green Latvia)";
- The weekly magazine "Kas Jauns Avīze" (What a New Magazine) and related news portal jauns.lv has the thematic section "Green Lifestyle ABC" (Zaļās Dzīves ABC);
- the popular journal "Ieva" has the special editions "Ieva dzīvo zaļi" ("Ieva lives green");
- popular science magazines "Ilustrētā Zinātne" („Illustrated Science") and "Terra 2.0" (e-magazine) provide a science-based view of global problems, including thematic articles on climate change issues;
- magazine "Iepirkums (Procurement)" publishes articles on the green procurement. The Waste management and Environment and Energy are ones of the particular sections of the magazine;
- magazine "Vides Vēstis (Environmental Messages)" is the magazine for the Green Lifestyle;
- several regional media have regular environmental related page / broadcast as well.

9.4.2 Portals

- official portal lvportals.lv (Man.State.Law, Cilvēks.Valsts.Likums) has the particular sections (themes) "Environment" and "Energy resources";
- the high role in public information has the single portal of public media lsm.lv;
- environmental content information is actively provided by such well-recognized in society portals as Delfi.lv and portals of Tvnet group. The Delfi portal has a rich experience in visual storytelling and reaching a wide and diverse audience;
- one of the most popular social portals, draugiem.lv has an environmental section as well;
- Videsportals.lv is the specialised environmental portal;
- the portal Uzladets.lv (charged) has to be noted considering the role of zero-emission transport in climate change mitigation;
- urda.lv is the portal of the Nature of Technology Park "URDA" of the North Vidzeme region waste management company "ZAAO" providing sustainable waste management materials targeted to different audiences.

9.4.3 Campaigns

European Mobility Week is celebrated yearly to raise public awareness of the need to take action against the air pollution and climate change caused by the increase in the number of cars in the urban environment. Already traditionally the campaign "Bike to Work" and "A Day without a Car" is organized in capital city Riga and elsewhere in Latvia.

Since April 22, 1990, the International Earth Day has been celebrated in Latvia. During the Earth Day the public attention is drawn to the significance of the Paris Agreement and the urgency of climate change mitigation.

The Earth Hour is organized every year on March 23, at 20:30 local time. The Earth Hour activities are actively promoted by the foundation "Pasaules Dabas Fonds" as the WWF associated partner in Latvia. Latvia municipalities, including capital city Riga, actively participate in the Earth Hour. While waiting for the Earth Hour, the annual contest "The Climate Ambassador" is organized by the WWF in cooperation with the company "Tetra Pak". Any Latvia's citizen who pursues an environmentally friendly lifestyle or who has made a significant progress in the implementation of initiatives, involving people all over the country, the municipality, the workplace, the school or elsewhere, can apply or can be applied for the contest.

The annual national contest "Most Energy Efficient Building in Latvia" is organized in five nominations – (1) renovated multi-apartment building, (2) new multi-apartment building, (3) single family building, (4) public building, (5) industrial building. The contest promotes the good practice and raise public awareness in the field of energy efficiency and sustainability of buildings and create a high-quality architecturally expressive living space. Annually around 30 buildings in total are submitted for the contest, most of them - in the nomination of renovated multi-apartment building. In its turn, International Passive House Open Days in Latvia are taking place since 2012. In 2019 twelve passive houses opened their doors for the public. The event in Latvia is organized by the Smart City Cluster of Latvia and the association "Passive House Latvia".

Events under the framework of the World Water Day are being organized in Latvia in March 22. The next data, March 23, is the World Meteorological Day in which the climate change is emphasised. A number of Latvian NGOs and research institutes organize events in these days. In 2020 both days had been merged into a single climate & water theme, in which LEGMC/ MEPRD took an active part.

Every year, since 2006 the Latvia's Great Cleanup (Latvijas Lielā Talka) has taken place in April. The goal is to invite Latvia's people to pay attention and participate in the cleanup, rehabilitation and improvement of the environment, creating a sense of people unity, positivism and a well done job. In the second decade of its existence, starting from 2019, the Great Cleanup calls not only to fight the consequences, but also the causes.

The “My Sea” (“Mana jūra”) campaign is organized annually by the Environmental Education Fund. Expeditions along the Baltic Sea coastline are organized, aiming to promote unique natural values of the Latvia’s coast and to draw attention to the problem of marine polluting waste. In July 2021, the “My Sea” campaign took place in Latvia for the tenth time.

NGO association “Pēdas” (“Footprints”) organises annual events popularising the environmental protection aspects, sustainable way of living and consumption, etc. Activities include actions, events and campaigns, including waste collection bees, aimed at explaining environmental and human relationships, causes and consequences, promoting public education and information.

Since 2006 The Nature Concert hall („Dabas koncertzāle”) is practiced in Latvia to raise public awareness on EU protected habitats and their proper governance/management. Ambient music concert is created in the close communication between the science and the art – scientists, musicians, poets, photographers and filmmakers together create a show whos main hero is nature. Audience meets annually in two previously unpublished or little-known places, each year the theme is selected in a way that it ensures that places, emotions and knowledge are different. The Nature Concert Hall is not just a concert – these are nature schools giving scientists the opportunity to communicate complex ideas about the environment to the public.

National Environmental Education and Information Centres. By the co-financing of Cohesion Fund of the EU Funds planning period of 2014-2020 (implementation until 2023), the infrastructure development is being carried out in three environmental education and information centres of national significance - Riga National Zoo, National Botanic Garden of Latvia and Latvian National Museum of Natural History. In its turn, in the frame of EEA and Norwegian Financial Mechanism for 2014-2021 programme’s "Research and Education” activity “Innovation centres”, the innovation centre in the field of environmental education and sciences is established in Liepaja city.

Public information policies and measures envisaged by Latvia’s NECP 2030

NECP2030 pays high attention to the measures aimed at improving public knowledge, awareness and understanding of climate change mitigation, low carbon development, RES use, resource efficiency, innovative technologies.

At least once a year, information campaigns are envisaged on how to reduce the use of various everyday resources; on the need for RES and the benefits of their socially responsible utilization to the economy, society, nature and climate. At least four information and education campaigns per year on low carbon development and innovative technologies are envisaged.

Public information and education measures are envisaged to encourage a change in behaviour towards energy efficiency, including informing the public on the energy efficiency of products. Measures to promote the knowledge and understanding of energy efficiency requirements of business sector operators (both producers and traders) as well as of professional users are also envisaged. A data base is envisaged to be set up containing the information on all available support for energy efficiency improvements.

To promote the use of zero and low emissions vehicles. NECP2030 envisages to improve public awareness of the car’s fuel consumption and CO_2 emissions, to inform about the labelling of new cars. It is envisaged to set up a single information platform that will provide information on the transition to a zero or low emission transport system and provide information support to the public, including the information on specific support instruments (leasing, lending) and on advantages of using alternative fuels. Information centres, different printed materials, direct consultations, information days, seminars are envisaged. The campaign “A day without auto” is envisaged to be organized at least four times a year, in a certain areas of capital city Riga.

As a specific measure, it is planned to provide information on F-gasses by implementing information campaigns for both the professionals and the general public and by conducting public consultations on F-gasses issues.

When implementing public information measures, the authorities will cooperate with the official publisher of the Republic of Latvia "Latvijas Vēstnesis" to ensure public information on the portal "Cilvēks.Valsts.Likums" (´Man.State.Law", https://lvportals.lv/) by publishing press releases, explanations, events agendas, developments and other materials.

9.5 Local Activities

Up to 30 June 2021 there were 119 local municipalities in Latvia – 9 republic cities (republikas pilsētas) and 110 local municipalities (novadi). In the 1 July 2021 new division of administrative territories have come into force, which have decreased the number of local municipalities due to joining a most part of municipalities in larger local units. From the 1 July 2021, Latvia's administrative division consists of 43 municipalities: (i) territories of 7 state cities (valstpilsētas) and (ii) 36 territories of local municipalities (novadi). Territories of local municipalities consists from rural territories (divided in parishes, pagasti) and towns, as well as three of local municipalities include also territory of state cities. At the moment there are no regional (second level) municipalities in Latvia.

Local governments play a highly important role in involving the local people, as they are closest to the population and the aim of the local government is to increase the well-being of the people in the area. The Municipal Council shall adopt the by-law, which, among other issues, determines the rights and duties of residents in local governance, the procedure for holding public consultations, the procedure by which private individuals can get acquainted with the decisions made by the Municipal Council, concluded agreements, etc., the procedure for receiving visitors and examining applications in municipal authorities, etc. Municipal Council meetings are open to the public. When starting municipal development planning in a policy area, sector or territory, it is required to identify and involve the target groups of society that will be directly affected and choose appropriate forms of public involvement and participation. In the local government website, the section "Public participation", information and announcements about on-going planning and related changes as well as other information are published. In its turn, establishment of larger local municipalities could give also new impulse for better action planning at municipal level for climate change mitigation and adaptation.

Important incentives for public participation at local level decision making are provided by the new Law on Local Governments that has been adopted in 20th October (in force 1 January 2023):

- the Citizen's Council is envisaged as the consultative council that can be elected with the aim to ensure the representation of the interests of the inhabitants of the local communities, promote the local co-operation for the common good and development. The Citizens' Council examines issues within the competence of the local government that affect the interests of the inhabitants of the given area. The activity area of the particular Citizens Council is stated by the municipal Council;
- Important, the cities and municipalities already establish their own forms of cooperation with the population. For instance, already existing cooperation between Riga city Council and Riga city Neighbourhoods Alliance (umbrella organization of Riga neighbourhoods' associations) can be noted;
- In order to involve the public in the performance of particular municipal functions or tasks, it is underlined the role of consultative councils as well as commissions, that might include representatives of residents and local stakeholders;
- a public consultation on the issues which are autonomous competence of the municipalities shall be organized by the local government on the initiative of the residents (the submission shall be signed by the certain threshold of population) as well as the Citizens Council (public consultation should not be held on issues related to the municipal budget, services fees, tax and fee rates);
- another form of public participation envisaged is the collective submission, which also shall be signed by the certain threshold of citizens depending on the total number of residents of the municipality (100-300 signatories in local municipalities, in capital city Riga – 2000 signatories);

- the participatory budget will be introduced from 2025 that shall be used for the territorial development projects proposed by the residents and decided in the residents voting procedure. Important, a range of municipalities has already introduced the participatory budget in their budget planning.

On 17 March 2022 the Parliament (Saeima) has adopted the new Local Government Referendum Law, which will come into force from 1 January 2024. One of the issues for which the local referendum can be hold is the municipal sustainable development strategy or amendments thereto. The referendum shall be initiated within two months after the adoption of the strategy by the Municipal Council, at least 15% of the number of population (in capital city Riga -10%), who were included in the electoral roll of the last municipal council election, shall sign the submission for the local referendum.

Voluntary EMS in municipalities. Certain municipalities are obliged to implement EMS (see in the section 4.3.2 above). At the same time, the municipalities may implement the EMS on a voluntary basis. Six municipalities have reported the voluntary implementation of EMS to the state authority, responsible for energy efficiency system administrating and monitoring - State Construction Control Bureau of Latvia.

Municipal Sustainable Energy Action Plans and Sustainable Energy and Climate Action Plans. Development of SEAPs and SECAPs is a voluntary action performed by a range of municipalities. It had been estimated (by Ekodoma ltd.) that in Spring 2021 the SECAPs and SEAPs as well as the Energy Action Plans having equivalent, as required by the Covenant of Mayors for Climate and Energy, CO_2 emissions reduction target (at least 20% in 2020) had been adopted by 43 Latvia local municipalities, including capital city Riga and 6 cities, this information corresponds to the administrative territorial division which had been in force up to 30 June 2021 (119 local municipalities in total).

In 2019-2021 active elaboration of SECAPs for the period up to 2030 has started in Latvia. The new SECAPs are adopted by more than 20 Latvian local municipalities, including capital city Riga and several largest cities. Most of these municipalities had also elaborated previously SEAPs. In addition, several municipalities had elaborated the SEAP until 2025 and due to administrative territorial reform now is re-considering the elaboration of SECAP. Development of SECAPs have been supported by a range of EU international co-operation projects. Important, the objectives of these projects are much broader than just SECAPs development.

The C-Track50 (“Putting regions on track for carbon neutrality by 2050”, partner in Latvia – Riga planning region, March 2018 - August 2021) aimed to mobilize and guide public authorities in defining long-term energy policy priorities, promote multi-level governance and support regional and local authorities in developing, financing and implementing ambitious SECAPs in order to achieve climate resilience and carbon neutrality by 2050. The project had supported the development of SECAPs in 9 municipalities of Riga Planning Region.

COMPETE4SECAP (“Energy management competition for local authorities for uptake and enhance of SECAP”, lead – Ltd. ”Ekodoma”, October 2017 – December 2020) delivered a systematic approach to energy savings in local authorities using EMS according to ISO 50001 or European Energy Award with dedicated online monitoring tool and energy saving competitions. EMS and competitions when combined can trigger significant benefits by providing innovative and efficient way to involve municipalities that have already their SEAPs but do not act in order to foster their integrated SECAPs development.

PentaHelix (“Multi-stakeholder and governance approach for SECAP development and implementation”, partners in Latvia – “Zemgale Regional Energy Agency and Jēkabpils municipality, March 2018 - September 2021) focused on developing and testing a new approach for integrating multi-governance planning for sustainable energy, both horizontal and vertical, together with a close interaction with key stakeholders such as the industry and business, building sector, NGO's, academia and individual citizens or relevant associations. The project aimed at developing a peer-to-peer online platform for SECAP development that can be used for multiple public authorities in joint planning and implementation. The project supported SECAPs development in municipalities of Zemgale Region.

Central Eastern European Sustainable Energy Union (partner in Latvia – Vidzeme planning region, November 2020 – October 2023) helps to build the capacity of public administrators in CEE countries to promote increased energy efficiency, sustainable energy, reduced carbon emissions and improved climate change adaptability. Specifically, the project develops training materials for public administrators, engages stakeholders and guides municipalities and other actors to implement SECAP, particularly in Latvia - in Cēsis and Valmiera municipalities.

The specific goals of LIFE LOCAL ADAPT "Integration of climate change adaptation (CCA) into the work of local authorities" (July 2016-June 2021) were to improve the data on climate change risks and vulnerabilities and provide climate indices; to enhance municipalities' knowledge on CCA; to integrate CCA into local authorities' administrative practices; to implement specific CCA pilot measures. The project encouraged municipalities to start implementing CCA measures in key vulnerable sectors. The partnership included six organisations from 4 countries (Germany, Austria, Czech Republic and Latvia), among the municipal partners was Valka municipality in Latvia for which CCA strategy had been developed.

LIFE ADAPTATE (September 2017-September 2021) aimed to increase the commitment of European municipalities with the Covenant of Mayors by the development of local adaptation plans which is integrated in the previous mitigation objectives of six municipalities in three different countries (among them Smiltene municipality and Gulbene municipality in Latvia, supported by the ltd. "Ekodoma") giving a comprehensive approach to the fight against climate change. Local authorities and support entities had reinforced mechanism to develop effective measures to CCA. The project developed demonstrative pilot actions and approaches, widening the knowledge database of adaptation actions.

Within the ActNow ("Actions for Energy Efficiency in Baltic Cities, October 2017-March 2021) nine municipalities, each from a different country, among them Gulbene municipality, supported by Riga Technical University, in Latvia, succeeded in setting up local energy efficiency groups by involving representatives of municipalities, public organisations like schools, transport agencies as well as business, homeowners and residents to coordinate and streamline knowledge scattered across different municipal departments and other organizations. The manual – from the sustainable energy action plan to investments – was elaborated.

PowerPoor (Empowering Energy Poor Citizens through Joint Energy Initiatives, September 2020-August 2023, partner in Latvia - Zemgale region Energy Agency) aims to develop support programmes/schemes for energy poor citizens and encourage the use of alternative financing schemes, e.g., establishing energy communities/cooperatives, crew funding. It will encourage the exchange of experience and knowledge, the realisation of small scale energy efficiency interventions and installation of RES technologies. Pilot support projects are planned in eight EU countries under the direction of trained/certified voluntary energy supporters and mentors.

Energy communities: the first pilot projects. The promotion of the energy communities have been done within the framework of the "Co2mmunity: co-producing and co-financing renewable community energy projects" and its follow-up extension "Energize Co2mmunity: real-life implementation of renewable community energy projects" which are the projects within the framework of EU Interreg Baltic Sea region programme. Riga region planning authority had been the project partner in Latvia, self-government of Mārupe municipality – the associated partner. The activities of the Co2mmunity project in Mārupe municipality had started in 2018. In Autumn 2018 a local survey was conducted and a discussion on the development of community energy projects was organized. In September 2019 Mārupe municipality Council held a discussion on community renewable energy project ideas. Roof-top solar technologies in both pilot projects sites (the multi-apartment building and the row-house building) had been installed in 2020. Green Energy Weeks were organized in the municipality in September 2020 and 2021 as well as Green Festival in April 2022, demonstrating, among others, the benefits of the concept of energy communities.

The provision of training for local self-governments

Latvia's NECP2030 envisages the training for municipalities on low-carbon development, innovative technologies, adaptation to climate change, including how to integrate these issues in municipal development planning. It is envisaged to provide educational activities on the principles of socially responsible use of RES, to support pilot and demonstration projects to be implemented by municipalities. NECP2030 envisages the integration of low-carbon development aspects in the spatial planning of towns/cities and their agglomerations, including wide promotion of green infrastructure, providing wide information and education campaigns for the public, business sector, NGOs, state and local authorities on the existence and benefits of green solutions in particular cases; implementation of pilot projects assessing long-term and short-term costs-benefits and serving as a demonstration and inspiration to others as well as envisages to improve/develop the regulations on construction and city utilities that support and motivate the choice of green infrastructure solutions.

In line with the Latvia NECP2030, the project "**Integration of climate change policy in sectoral and regional policies**" funded by Norwegian Financial Mechanism for 2014-2021 Programme "Climate Change Mitigation, Adaptation and Environment" provides for:

- development and implementation of a study course for Latvian local governments as well as regional planning authorities on climate change mitigation and adaptation issues, as a result of the open tender, the contract with the "Estonian, Latvian & Lithuanian Environment Ltd" had been signed in November 2021 providing for the e-learning course content development within 8 months (July 2022);
- at least 100 experts trained on integrated aspects of climate change mitigation and adaptation in sectoral and regional policies and activities;
- integration of climate change policy into sectoral and regional policies and activities: development of framework for the collection and provision of regional data to facilitate the planning and implementation of regional climate change policy.

9.6 Projects and Training Programmes

In the period 2010-2016 two large scale public information and training programmes had been implemented. At first, CCFI co-financed programme "Promotion of public understanding on the role and possibilities of GHG emissions reduction" (implemented 2010-2013) had supported development of the thematic programmes for electronic broadcasters, development and publication of materials in printed periodicals and on websites, organization of educational activities for pupils of primary schools, students of secondary schools and vocational education institutions, development of content materials and organization of workshops, trainings, other informative and educational events for professional audiences and local governments. In addition, two other projects supported by CCFI were: (i) Ltd Belss had developed the database for low energy consumption services to promote energy efficient materials and technologies in private housing, an energy calculator close to the energy audit was developed, and (ii) national power supply company "AS Latvenergo" had implemented the pilot project "Promoting energy efficiency in households using smart technologies" by involving of 500 households. Secondly, in 2014-2016 significant contribution was made by the projects implemented within the framework of the programme "National Climate Policy" of the EEA Financial Mechanism for 2009-2014: (i) within Small-scale grants scheme's area "Organizing of educational projects and informative campaigns" in total 13 education and information campaigns were organized; within the area "Capacity building through applied research on mitigation of climate change" six projects had been implemented having important public information component as well; also study programmes' modules and study courses on relevant climate change issues had been developed in Latvia universities; (ii) within the Open Call "Development of Sustainable Buildings, Renewable Energy Technologies and Innovative Emission Reducing Technologies", five demonstration projects of low energy buildings (specific energy consumption below 15 kWh/m^2/year) were implemented. Thus, solid basis for further development of training programmes had been provided.

In the Eighth National Communication period (2018-2021) two main directions of activities are:

1. information, education, public awareness raising in the frame of the projects supported by the LEPF;
2. demonstration of nearly-zero energy public building: the projects co-financed by the national green investment scheme (EAAI).

Information, education, public awareness raising supported by the LEPF

Substantial financial support for targeted public information had been and are annually provided by the LEPF. In 2018-2021, LEPF has announced open project calls for projects in such directions of activities as:

- public informing about an environmentally friendly and responsible lifestyle, promoting environmental awareness – in all types of media (printed, web portals, TV and radio), including the support for regular thematic environmental sections/broadcasts of media as well as the support for specialized environmental broadcasts and publications, with the support given to both national wide and regional media;
- promoting young people's environmental awareness and educating them about environmentally friendly lifestyles;
- organizing environmentally friendly and responsible lifestyle promotions and campaigns;
- supporting the co-operation projects for the development and implementation of environmental policy: the aim of this particular LEPF programme is to create and strengthen co-operation between the state authority and university, research institution or NGO, the supported projects jointly address specific topical issues and challenges of environmental sector;
- strengthening the capacity of environmental NGOs and promoting co-operation among them;
- support for the specific activities of national environmental education centres (for instance, the digital exhibition "Human and Nature" of the National Museum of Natural History);
- supporting local practices and initiatives aimed to improve the state of environment or prevent risks to environment, the areas include management of public waters, the improvement of habitats and state of species, restoration of biologically valuable grasslands as well as other ones.

An important activity of the LEPF is the support of international activities performed by Latvia's environmental organizations. For instance, LEPF supports the Environmental Education Fund for the implementation of the International Foundation for Environmental Education programme in Latvia – Eco-schools, Young Environmental Reporters (see above in the chapter 9.3.2), Blue Flag, Green Key, Explore the Forest as well as other sub-fields of the international programme.

LEPF supports the thematic broadcasts and media publications - "Environmental Facts", "Environmental Messages", "Green Latvia", "Nature Tops", "My Environment", "Environmental Workshop" - presented in the chapter 9.4. above. Below, as the examples of LEPF support for national-wide media, more detailed insights are provided for several recently approved projects.

The project "I do that" ("Es daru tā", by Environmental Film Studio) provides a comprehensive campaign for environmentally friendly behaviour encouraging behavioural changes in Latvia's society. The project includes the development of 50 compact video portraits for digital, audio and printed media. The audience to be reached is 500 thousand people in the first round (from January till April 2021). The second round takes place throughout the year from May 2021 to May 2022.

The project "**Environmental Facts – promotion of public environmental awareness on Latvian TV, the single portal of public media lsm.lv and social networks**" (implemented by Finger Film Production) continues existing successful work in creating public environmental awareness.

The project **"Green awareness"** ("Zaļā apziņa", by portals of TVNET group) tells qualitatively, analytically and in compelling manner about various aspects of sustainability and environmental protection.

The project **"Go Greener"** ("Opā Zaļāk", April 2021 – April 2023) will cover more than 3 different media platforms – websites, social networks, national wide press – reaching a total of 700 thousand audience. During the project, 48 to 54 original articles will be published in the various press, published by Santa Magazine Publishing House. The special edition "**Ieva lives green**" ("Ieva dzīvo zaļi") will be published 4 times a year, each with a volume of at least 16 articles.

Series of broadcasts, articles and podcasts about nature and city are under publication in the web-journal Satori.lv and Latvia TV in 2021 and 2022. They educate the public, especially young people, in an exciting and modern way on the sustainable use of environmental and nature resources, the various ecosystems and their interactions, as well as on other environmental issues in order to promote individual responsibility and change in behaviour.

Within the project **"Responsible in the nature"** ("Atbildīgi dabā") the leading Latvia's news portal Delfi continues the previous successful multimedia content project – a series of articles on current environmental policy issues, on development of circular economy, on importance and value of biodiversity, and other themes, inspiring the public to change everyday habits. Interactive solutions (competition, test and voting) will also be implemented to increase audience involvement.

The project **"Green Life ABC"** ("Zaļās Dzīves ABC", publisher "Rīgas Viļņi") developed educational and informative publications and video materials on the progress towards a circular economy, on natural capital and provide communication on topical environmental policy issues.

Demonstration of nearly-zero energy public building. The on-going national green investment scheme (EAAI) pays high attention to the demonstration of construction practice of nearly-zero energy public buildings. The implementation of awarded projects includes the specific requirements to be met by the beneficiary regarding public information and good practice demonstration. The beneficiary shall provide that during the project implementation at least three events are carried out at different stages of construction which demonstrate technologies, methods or solutions used for the construction of the building. In its turn, during the project results monitoring period at least two events shall be carried out that promote public awareness of construction of energy self-sufficient buildings and provides information on reduction of CO_2 emissions and specific heat energy consumption for heating (kWh/m^2 per year) achieved. The beneficiary shall ensure the installed technologies are visible from a publicly accessible point and the technology and its operation demonstrating panel or exposition with technological data (display of the produced or saved energy in electronic, video or other form) is placed in the publicly accessible place at the implementation site.

9.7 Resource or Information Centres

Climate Change portal[42]. The Portal and related Climate Change analysis Tool had been elaborated by the support of EEA Financial Mechanism for 2009-2014 programme "National Climate Policy". The portal provides up-to-date information elaborated to various target groups - households, municipalities, businesses, pupils and researchers. The main sections of the Portal are:

- News: three sub-sections - News, Calendar of Events and Polls;

[42] https://klimatam.lv/en/

- Climate Change: three sub-sections - Climate Change, Climate Change Mitigation and Adapting to Climate Change;
- For You, containing sections for five principal target groups noted above;
- Climate Change Tool;
- Opportunities;
- Information Repository: Research studies, Policy and legislative documents, Annual GHG emissions inventory data, Abstracts of relevant projects, Climate Change Analysis Tool, another online Tools and Games developed by other organisations, Video and Terms;
- Frequently asked questions (FAQ);
- Information on the on-going project "Integration of climate change policy in sectoral and regional policies" funded under the Norwegian Financial Mechanism 2014-2021 Programme "Climate Change Mitigation, Adaptation and Environment".

Climate Change Tool allows to look at the current and future climate in Latvia in the visual form of maps and graphs. The maps show average values for selected climatic parameters, on the left-side map – the values observed in the past, 1961-1990; on the right-side map – the values of future climatic parameters that can be changed according to the future period selected and climatic change scenario (RCP 4.5 and RCP 8.5 scenarios). In its turn, the graph shows the values of the climatic parameters at the selected observation station. The blue line shows the observed annual averages of the climatic parameter, while the yellow and red lines represent the annual averages of the climate change scenario. A Handbook on Climate Change Tool has been elaborated. Section of **Opportunities** contains the following sub-sections: (1) GHG emissions calculation: both emission inventory methodology and calculator for approximate emission calculation are provided, the calculator contains the sectors of emissions and various different cases in them ; (2) information on investment projects and other projects implementation opportunities in Latvia; (3) advices for implementers of GHG emissions reduction and climate change adaptation projects; (4) information on EU ETS and (5) development of the project abroad.

Climate Portal[43] run by LEGMC, provides the information to a wide range of audiences. The Portal includes the following main sections:

- Latvian climate section;
- Visual materials: infographics;
- Atlases: (1) graph of global air temperature trend (prepared in Latvian based on Copernicus Climate Data Store), (2) Satellite Climate Atlas, and (3) Solar Radiation Atlas (more details on Atlases see in the section 8.2.1 above);
- Weather characteristics: monthly, seasonal and yearly;
- Drought and moisture indicator for insurance in agriculture sector;
- Hydrological conditions characterization;
- the section "Climate and tourism";
- the section "Climate and health";
- The link to previously presented Climate Change Tool is included.

The Latvian Climate Section includes: (1) the general information on Latvian climate such as: climate standard for annual and monthly average air temperature and precipitation in the period 1991-2020; deviation of the average annual temperature from the standard; average annual air temperature for the period 1961-2020; average annual precipitation for the period 1961-2020 as well as other data. The information on monthly (January-December) climate parameters is provided. The particular section provides the overviews of the weather conditions on Latvian holidays, days of remembrance and commemoration.

[43] https://klimats.meteo.lv/klimats/latvijas_klimats/

Climate change and agriculture website[44] run by the MoA, provides the information on climate change impact on agriculture and forestry and climate change mitigation and adaptation policies in the noted sectors, the links to other relevant websites are provided.

In addition, the Latvia specific section is provided on international portals as well, e.g., Climate Change Knowledge Portal for Development Practitioners and Policy Makers[45] run by World Bank:

Reports of the projects. Reports of research projects commissioned by State authorities are collected in the "Research and Publications Database", http://petijumi.mk.gov.lv/. Reports of the projects, supported by the LEPF, are collected in the LEPF Administration database "Studies, evaluations and other materials" ("Pētījumi, izvērtējumi un citi materiāli")[46].

Public Awareness Raising: CO_2 footprint calculators

CO_2 footprint calculator for private person (features of food, transport, housing, lifestyle), including the lifestyle advices, is provided by the WWF Latvia in co-operation with WWF[47].

Two new calculators have been recently developed by WWF Latvia supported by the LEPF[48]:

- highly interactive **CO_2 footprint calculator focused to individual schoolchild;**
- The **CO_2 footprint calculator for the organizers of events.**

In its turn, the website http://co2.videsfonds.lv/, by Environmental Education Fund, provides how to measure **CO_2 footprint of the school**.

Websites of NGOs

Association "Green Liberty". The current main working directions of the association are sustainable development, environmentally friendly consumption and production, climate and energy, chemical substances, development cooperation and fair trade, human rights and freedoms. The association has joined the Climate Action Network-Europe, European Environmental Bureau, European EcoForum, Bankwatch Network. The Association actively follows the EU policy developments and provides the relevant information in the website. The Association actively participates in various national and international research projects, among them the projects, focused towards EU climate neutrality by 2050.

Association "Baltic Environmental Forum Latvia" (BEF Latvija). The BEF was established in 1995 as a technical assistance project of the three Baltic Ministries of Environment, Germany and the EC. It aimed at strengthening co-operation and information among the authorities of the Baltic States in the field of environmental protection. In 2004, after the entry into the EU, technical assistance projects have been completed. In 2003, BEF staff created NGOs in Latvia, Estonia, Lithuania and Germany to maintain the existing expert networks and implement new projects in the Baltic region. Currently, the association implements projects, both international partnership and national ones, in different environmental areas: climate change, energy efficiency and RES, sustainable mobility, waste management, water resources protection, chemical control, reduction of industrial pollution, nature protection, coastal planning, etc. Association actively participates in such on-going or recently finished projects as, e.g.,Dynamic Information Management Approach for the Implementation of Climate Resilient Adaptation Packages in European Regions (IMPETUS, 2021-2025), Climate Adaptation and Mitigation Synergies in Energy Efficiency Project (CAMS Platform); Sustainable Urban Mobility and Commuting in Practice (SUMBA and SUMBA+); EU Copernicus programme's Climate Change Service project on Sectoral Information System to Support Biodiversity Sector; Agro-Ecological Knowledge HUB (UNISECO).

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44 https://www.zm.gov.lv/lauksaimnieciba/statiskas-lapas/klimata-parmainas-un-lauksaimnieciba?nid=1129#jump
45 https://climateknowledgeportal.worldbank.org/country/latvia
46 https://lvafa.vraa.gov.lv/projektu-materiali/petijumi-izvertejumi-un-citi-dokumenti
47 http://www.pdf.lv/klimats
48 https://www.nacgavilet.lv/klimata-draugs/klimata-kalkulators/:

Foundation "Pasaules Dabas Fonds" (World Wildlife Fund in Latvia) is a public organization registered in Latvia, operating since 1991. In 2005, the organization was registered as a foundation. In 2005, The Pasaules Dabas Fonds signed a co-operation agreement with the world's most influential nature conservation organization – WWF. To achieve common goals, organizations implement joint campaigns and projects. The Fund regularly implements public information, education and awareness raising activities. The Fund's website has a particular section "Climate" that provides advice on how to reduce individual's impact on the climate, information on the Latvian carbon foot, the current events related to climate change, and other information.

The "Environmental Education Fund" works in the field of environmental education, eco-certification and environmental public initiatives, representing the international organization – Foundation for Environmental Education – in Latvia. The Fund implements the Eco-School Programme and its Climate Campaign and several other significant education programmes, the methodological materials of which are available on the Fund's website.

"Waste Management Association of Latvia" addresses issues of efficient waste management system, including reduction of GHG emissions.

The "Latvian Fund for Nature" works in five directions: nature conservation policy, society and nature education, biodiversity and ecosystems, protected species and habitats, specially protected nature territories. The Fund maintains and develops the portal of nature observation data Dabasdati.lv.

Zero Emission Mobility Support Society promotes the development of sustainable, emission-free transport. The association informs the public on the advantages and limitations of sustainable transport; promotes zero-emission mobility solutions; promotes the production of energy-efficient zero emission vehicles in Latvia; co-operates with the state, local governments and NGOs, companies and other institutions in Latvia and abroad to support the availability of new mobility opportunities for the residents of Latvia; as well as performs other activities. The Association is highly active in both information and communication for public (e.g., annual electric car rally) and providing inputs for national policy planning documents.

The Civic Alliance Latvia provides wide information on how to realize public participation rights both by individual natural persons and NGOs,

9.8 Involvement of the Public and Non-governmental Organizations

In February 2022, more than 25 thousand public organizations - the associations, societies and foundations- have been registered in Latvia. In June 2021 more than 40% of NGOs had been registered in capital city Riga. It is rather hard to evaluate the precise number of NGOs working in the field of environmental protection due to registration of the field of activity is not a mandatory requirement. At the end of 2020, 230 NGOs had registered the environmental sector as their field of activity. At the same time, several fields of NGOs activity, such as community and neighbourhood development, public health and youth activities, are also linked to climate change issues, particularly adaptation to climate change. It might be assumed that around 4% of NGOs work in the fields related to environmental protection.

Latvian legislation incorporates a strong foundation for civil society participation in the decision-making process at all levels and for participation in public administration procedures. The Constitution (Satversme) of the Republic of Latvia determines the right of the people to participate in the work of the state and local governments, the right of association, the right to receive information, and other issues. The right to apply to public authorities and receive answer is specified in such laws as Administrative Procedure Law, Law on Submissions, Freedom of Information Law, Cabinet of Ministers Structure Law. Public participation in public administration and the methods of it (working groups and consultative advisory councils, public consultations, discussion groups, forums, public opinion polls, etc., providing written opinions, proposals and objections in the process of drafting legal acts and planning documents drafted both by state direct administration authorities and local governments, both before its adoption and during the adoption procedure, participation in the implementation of policies, entrust/delegation of the implementation of certain public administration tasks to private persons, including NGOs) are specified in such laws as State Administration Structure Law, Rules of Procedures of the Cabinet of Ministers, Rules of Order of the Saeima (Parliament), Law on Local Governments, Cabinet of Ministers regulation on the procedures for concluding participation Agreements. The right to implement voluntary initiatives is a general clause.

Governmental regulation provides procedure that all websites of public authorities shall have the section “Public participation”, which includes the information on: (i) co-operation of the authority with the NGOs, (ii) consultative institutions established in the areas of responsibility of the authority, (iii) draft development planning documents and legal acts which are in the process of development and harmonisation. In its turn, the developer of the draft legal act is obliged to observe the requirements specified in the regulatory enactments on public participation and to provide the information on public participation and its results in the initial impact assessment report or annotation of the particular draft legal act.

On 9 September 2021, with the entry into force of the new Rules of the Procedures of the Cabinet of Ministers, the approach to how drafts of legal acts are developed and coordinated/harmonized in the state administration was significantly changed. Namely, the new Unified portal for the development and coordination/harmonization of draft legislation (TAP portal) was created which ensures both a more transparent, modern and faster circulation of documents and a wider opportunity for creative public participation in the process of legislation. Every public representative has the opportunity to follow the decision-making process, starting from the first preliminary draft to the final decision in the Cabinet of Ministers, in a single portal. The functionality of the portal will provide an opportunity to select both individual legislation and the policy of interest in order to receive news about the progress of the legislation. The technical solutions envisage various forms of public participation: surveys, discussions, advisory councils and working groups, opinions.

The Environmental Policy Guidelines for 2014-2020 had highlighted increasing of public involvement in solving environmental issues at both national and local municipality levels as one of the priority horizontal issues. The Guidelines stated the need to provide high quality environmental communication and to ensure public involvement in policy development and implementation. New **Environmental Policy Guidelines for 2021-2027** further develop the approaches of the Guidelines for 2014-2020. The implementation of an environmental, natural resources’ sustainable management and energy policies shall be based on justice and mutual trust, public support, clear and open models of cooperation between the state and the people, and public involvement in decision making. It shall be promoted the environmental sustainability and reduced the load on environment and climate associated with both production and consumption. These are the horizontal objectives of new Guidelines.

Advisory Councils is one of the effective tools for public participation and NGO representation. The governmental regulation on the procedures for the public participation provides that representatives of the public are selected through an open procedure, publishing the information on the establishment of a working group or advisory council and the possibility to apply for it on the website of the particular public authority, the section “Public participation”, as well as, if possible, disseminating this information in other ways available to the public. Important, the public authority shall ensure that also that representatives of the public, who have expressed an interest in participating in the working group or advisory council but are not included in it, are also heard.

The objective of t**he National Energy and Climate Board** is to provide contribution in coordinated, integrated and sustainable national policy for energy and climate, including the NECP2030 and long-term climate neutrality strategy for 2050. The Board includes representatives of the relevant ministries, energy transmission and distribution companies and relevant climate policy stakeholders. The following NGOs participates in the Board: Zero emission mobility support society; Baltic Environmental Forum; “Green Liberty”;

Latvian Wind Energy Association; Latvian Renewable Energy Federation. The national economics and its branches are presented by such associations as: Latvian Chamber of Commerce and Industry; Employers' Confederation of Latvia; Latvian Forest Industry Federation; Latvian Union of Timber Harvesting Enterprises; Latvian Agriculture Organisation Cooperation Council; NGO "Farmers Parliament" ("Zemnieku saeima"); Latvian Association of Agriculture Cooperatives; Finance Latvia Association; Latvian Fuel Traders Association; Latvian Authorised Automobile Dealers Association; Latvian Association of Heating Utilities. Interests of municipalities are presented by the Latvian Association of Local Governments. Interests of employees are presented by the Free Trade Union Confederation of Latvia. The interests of consumers are represented by the national Public Utilities Commission. Rīga Stradiņš University participates as well. The work of the secretariat of the Board is provided by the MoE.

The **Environmental Consultative Council of the MEPRD** (Vides konsultatīvā padome) is a consultative coordinating body that aims to promote public participation in the development and implementation of environmental policy. It`s statute is determined by the governmental regulation. The functions and tasks of the Council are to facilitate, in line with the public interests, the development of normative acts and policy planning documents, promote co-operation and exchange of environmental information between individuals and public as a whole, as well as state institutions and local governments, to inform the public about current environmental issues and promote the integration of environmental issues into sectoral policies. Rights of the Council include to request information from the MEPRD and its subordinate institutions as well as from other institutions for the work of the council, to establish working groups, to invite officials of the MEPRD and other institutions, sectoral experts and representatives of the public to the meetings of the Council, etc. **20 NGOs works in the Council.** Annual elections of the Council are held yearly.

The **Consultative Council of national green investment schemes (joint council for CCFI and EAAI**) promotes the economic efficiency and transparency of use of the financial resources and the efficiency of climate change mitigation provided by the CCFI and EAAI, as well as promotes co-operation and the exchange of information among state administrative institutions, individuals and the society on issues related to implementation of the CCFI and EAAI. The chairman of the Council is the minister of environmental protection and regional development. The composition of the council is stated by the Law on Pollution. Council includes one representative from the following ministries - MEPRD, MoE, MoA, MoT and MES, two representatives delegated by the noted above Environmental Consultative Council and two representatives delegated by the NGOs (associations and foundations, delegation is done on a rotating basis, for one year).

Due to the interdisciplinary nature of climate change, specific climate change adaptation issues are necessarily included in the agenda of a range of other advisory councils of the MEPRD: River Basins Advisory Councils, Marine Environment Council, Water Resources and Technology Council, Council for Coordination of Management Measures in Particularly Vulnerable Areas, Advisory Councils for Particularly Protected Nature Areas. Climate change issues are also linked to the work of the Packaging Management Board and the Information Society Council.

National Economics Council (Tautsaimniecības padome) is the consultative institution to promote the development and implementation of business-friendly policies and sustainable economic principles in Latvia. Thus, the Council necessarily also focuses on Latvia's climate policy challenges. The Council involves the representatives of the MoE, Investment and Development Agency of Latvia, Latvian Chamber of Commerce and Industry, the associations of essential sectors of the national economy, Latvian Union of Local Governments, Employers Confederation of Latvia, Free Trade Union Confederation of Latvia, trade union "Energy" as well as chairmen of the committees established by the Council. In the context of climate policy, **Latvian Construction Council** (Latvijas Būvniecības padome) is important consultative coordinating institution as well. **Latvian Tourism Consultative Council** (Latvijas Tūrisma konsultatīvā padome) as a consultative institution promotes a coordinated tourism policy in all stages – development, implementation and evaluation, thus relates to climate change challenges as well. Both councils operate under the MoE.

Also, the MoT actively cooperates with the sectorial associations by using different formats.

Considering the contribution of agriculture and LULUCF sector, the involvement of the NGOs, representing the stakeholders of these sectors, in climate policy development and implementation is very essential. Nine largest NGOs representing the interests of Latvian farmers, rural residents and food producers -Latvian Agriculture Organisation Cooperation Council, NGO "Farmers Parliament" ("Zemnieku saeima"), The Association of Agriculture Statutory Companies, http://www.losp.lv/node/15The Association of Latvian Organic Agriculture, Latvian Young Farmers' Club, Latvian Farmers' Federation, Latvian Federation of Food Companies, Farmers Association and Latvian Association of Agriculture Cooperatives - are participants of the **Advisory Council of Agriculture Sector NGOs**. In the **Forestry Consultative Council** the representatives of public (JSC "Latvia's State Forests" and Ltd. "Rīga Forests") and private forest owners and managers, wood industry, non-timber forest value managers and forest management service providers have the voting rights. In turn, in an advisory capacity the representatives of state authorities (MoA, MEPRD, the State Forest Service, the Nature Conservation Agency), relevant universities and research institutes, forestry vocational education and training centres, Latvian Union of Local Governments participate.

9.9 International Cooperation on Education, Training and Public Awareness

Within the period from the last National Communication, Latvia has participated in several international cooperation measures. They are listed in Annex 1 (BR5 to the UNFCCC) of this report (Table 7(b) Provision of public financial support: contribution through bilateral, regional and other channels in 2019a) as well as information is provided in chapter 7 "Financial resources and transfer of technology".

9.10 Monitoring, review and evaluation of the implementation of Article 6 of the Convention

In Latvia, there is no formal monitoring, review and evaluation process in place for assessing the implementation of Article 6 of the UNFCCC. However, implementation of Article 6 is taken into account as part of other commitments related to mitigation, adaptation and international cooperation.

References

- ActNow (EU Interreg Baltic Sea region programme project): https://interreg-baltic.eu/project/act-now/
- “Baltic Environmental Forum Latvia” (BEF Latvija), http://www.bef.lv/
- Baltic Sea Project. BSP schools in Latvia: http://www.b-s-p.org/home/schools/3134-latvia.html
- Central Eastern European Sustainable Energy Union (Horizon2020 programme project): , https://cordis.europa.eu/project/id/892270; https://ceesen.org
- Central Statistical Bureau of Latvia (CSB): https://stat.gov.lv/en/statistics-themes/education
- Civic Alliance Latvia: https://nvo.lv/lv/portfelis/jurista_padomi
- Civic Aliance Latvia and Public Policy Think Tank “Providus”(2021). “Research on the civil society organisations in Latvia 2020-2024: Problems and solutions for classification of Latvian associations and foundations, 2021”, authors Kažoka I., Frīdenberga A., Stafecka L., Tarasova S.: https://nvo.lv/uploads/research_on_the_sector_of_civil_society_organizations_in_latvia_2020202456.pdf
- COMPETE4SECAP (Horizon2020 programme project): https://cordis.europa.eu/project/id/754162; https://compete4secap.eu/
- C-Track50 (Horizon2020 programme project): https://cordis.europa.eu/project/id/784974 ; https://www.c-track50.eu/
- Darbības programma “Izaugsme un nodarbinātība”, ES fondu 2014.-2020.plānošanas periods (national Operational Programme “Growth and Employment” of the EU Funds planning period of 2014-2020, consolidated version in Latvian): https://www.esfondi.lv/upload/EK%20programmas/dp-30.06.2021.pdf
- Education Development Centre (Izglītības attīstības centrs): http://www.iac.edu.lv/home-en ;
- Education Development Guidelines for 2014-2020 (Izglītibas attīstības pamatnostādnes 2014.-2020.gadam): https://likumi.lv/ta/id/266406
- Education Development Guidelines for 2021-2027 (Izglītibas attīstības pamatnostādnes 2021.-2027.gadam): http://polsis.mk.gov.lv/documents/7122
- Energy communities: the first pilot projects in Latvia. COME RES (Horizon2020 programme project): https://come-res.eu/fileadmin/user_upload/Resources/Deliverables/Del_5.2__Good_Practice_Portfolio.pdf.
- Environmental Education Fund (Foundation for Environmental Education (FEE) – Latvia) : http://www.videsfonds.lv/lv/s-kums
- Environmental Policy Guidelines for 2014-2020 (Vides politikas pamatnostādnes 2014.-2020.gadam): http://polsis.mk.gov.lv/documents/4711
- Environmental Policy Guidelines for 2021-2027 (Vides politikas pamatnostādnes 2014.-2020.gadam)
- “Green Liberty” (association): http://www.zalabriviba.lv/
- “Integration of climate change policy in sectoral and regional policies” (the project): https://klimatam.lv/en/norway-grants-project/par-projektu/
- Kalvāne Gunta, Andris Ģērmanis, Zaiga Tenisone, Kristīne Auziņa, Karina Šcastnaja, Anita Vaivode, Vita Ozola. “Climate language. Climate education at schools: practical recommendations” (Klimata valoda. Klimata izglītība skolā: praktiski ieteikumi, in Latvian), Riga, organization “Latvijas mazpulki”, printed in SIA Masterprint, 2016, 100 lpp: http://ldf.lv/sites/default/files/faili/Publikacijas/Gramatas/gramata_klimatavaloda.pdf ; https://languageofclimate.wordpress.com/about-the-project/
- Latvian Environmental Protection Fund (LEPF). Information on the supported projects: https://lvafa.vraa.gov.lv/
- Latvian Fund for Nature: http://ldf.lv

- Latvia's National Energy and Climate Plan 2021-2030 (NECP2030): https://energy.ec.europa.eu/system/files/2020-04/lv_final_necp_main_en_0.pdf
- LIFE ADAPTATE: https://lifeadaptate.eu/en
- LIFE LOCAL ADAPT: https://life-local-adapt.eu/en
- Likumi (Legal Acts of the Republic of Latvia): https://likumi.lv/
- Ministry of Education and Science. Sectoral policy: Education: https://www.izm.gov.lv/en/education-0 ; https://www.izm.gov.lv/lv/izglitiba
- National Energy and Climate Board. Cabinet of Ministers Ordinance No 609 (2019): https://likumi.lv/ta/id/311155
- OECD Skills Strategy Latvia: Assessment and Recomendations, published December 2019: https://www.oecd.org/latvia/oecd-skills-strategy-latvia-74fe3bf8-en.htm
- Pasaules Dabas Fonds (World Wildlife Fund in Latvia), https://lv-pdf.panda.org/
- PentaHelix (Horizon2020 programme project): https://cordis.europa.eu/project/id/784994 ; https://pentahelix.eu
- PowerPoor (Horizon2020 programme project) https://cordis.europa.eu/project/id/890437 ; https://powerpoor.eu/
- State Education Information System (Valsts Izglītības informācijas sistēma): https://is.viis.gov.lv/.
- Sustainable Development Strategy of Latvia until 2030: https://pkc.gov.lv/sites/default/files/inline-files/LIAS_2030_en_1.pdf
- Vidzeme Planning Region. Projects: http://www.vidzeme.lv/en/projects
- Waste Management Association of Latvia: http://www.lasa.lv/
- Zero Emission Mobility Support Society: http://www.bimab.lv/

ABBREVIATIONS

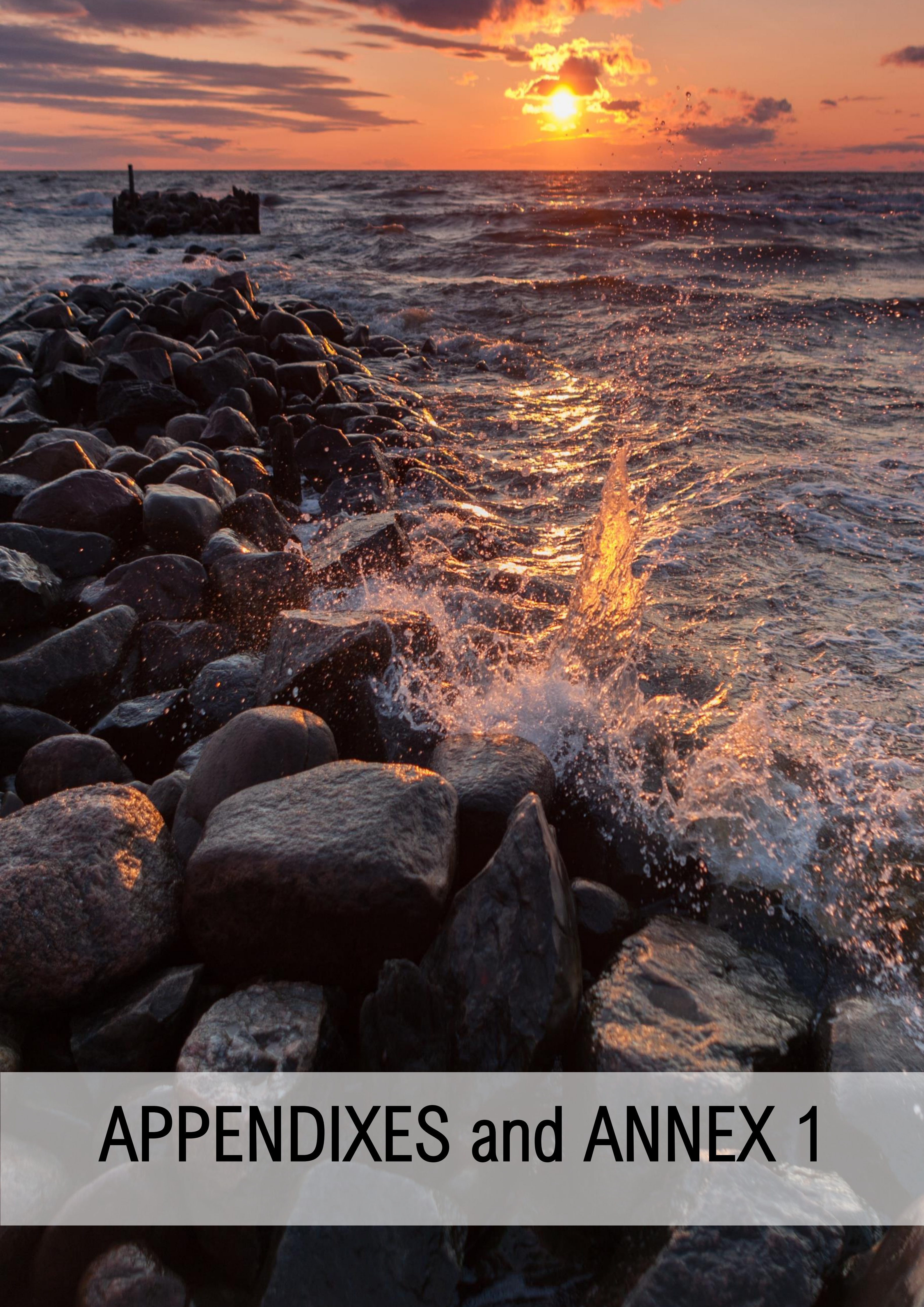
AAU	Assigned amount unit
AEAs	Annual Emission Allocations
AWMS	Animal waste management systems
AU	Animal units
BR4	Fourth biennial report
BR5	Fifth biennial report
BAT	Best available techniques
BAU	Business as usual
BE	Basic education
CAP	Common Agricultural Policy
CCFI	Climate Change Financial Instrument
CDM	Clean Development Mechanism
CEE countries	Central and Eastern European countries
CF	Cohesion Fund
CoM Regulation No. 737 (12.12.2017)	Regulations of the Cabinet of Ministers No. 737 adopted on 12 December 2017 “Development and management of national system for greenhouse gas inventory and projections”
CoM Regulation No. 675 (25.10.2022)	Regulations of the Cabinet of Ministers No. 675 adopted on 25 October 2022 “GHG inventory, projections and adaptation to climate change reporting systems”
CHP	Combined heat and power plants
CM	Covenant of Mayors
CNG	Compressed natural gas
CRF	Common Reporting Format
CSB	Central Statistical Bureau of the Republic of Latvia
CSCC	Cross-Sectoral Coordination Centre
COP	Conference of the Parties
CTF	Common Tabular Format
CVS	Cardiovascular diseases
DA	Direction of action
DES	Data Exchange Standards
DH	District heating
DOC	Degradable organic carbon
EAAI	Emissions Allowances Auctioning Instrument
EAU	Carbon Emissions Allowance
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
EEA	European Economic Area
EEF	Environmental Education Fund
EEOS	Energy Efficiency Obligation Scheme
EMS	Energy Management Systems
EMEP/EEA 2016	EMEP/EEA air pollutant emission inventory guidebook 2016
EMEP/EEA 2019	EMEP/EEA air pollutant emission inventory guidebook 2019
EPI	Energy performance indicator
ERA	European Research Area
EU ESD	European Union Effort Sharing Decision
ERDF	European Union Regional Development Fund
ETR	Emission Trading Registry
ETS	Emissions Trading System
EU ETS	European Union Emissions Trading System
EU MMR	European Union Monitoring Mechanism Regulation
EUAA	Aviation Emissions Allowance
EV	Electric Vehicles
E5P	Eastern Europe Energy Efficiency and Environment partnership
FADN	Farm Accountancy Data Network
FEC	Final energy consumption

FIT	Feed-in Tariffs
EAFRD	European Agriculture Fund for Rural Development
ERA-NET	European Research Area Network
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FSC	Forest Stewardship Council
GDP	Gross domestic product
GFEC	Gross final energy consumption
GHG	Greenhouse gases
GPEC	Gross Primary Energy Consumption
GE	Gross energy
GES	General secondary education
H2020	EU Research and Innovation programme Horizon 2020
HAC	High activity clays
HE	Higher education
HEI	Higher education institution
HPP	Hydropower plants
HVAC	Heating, ventilation, air conditioning
IE	Included elsewhere
IEA	International Energy Agency
IET	International emissions trading
2006 IPCC Guidelines	Intergovernmental Panel on Climate Change 2006 IPCC Guidelines for National Greenhouse Gas Inventories
2013 IPCC Kyoto Protocol Supplement	IPCC Wetlands Supplement - 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol
IPE	Institute of Physical Energetics
IPPC	Integrated Pollution Prevention Control
IPPU	Industrial Processes and Product Use
IRR	Internal return rate
ITL	International Transaction Log
JI	Joint Implementation
KP	Kyoto Protocol
LASAM	Latvian Agricultural Sector Analysis Model
LEC	Large Electricity Consumers
LEGMC	Limited liability company "Latvian Environment, Geology and Meteorology Centre"
LSFRI	Latvian State Forest Research Institute
LULUCF	Land use, land use change and forestry
LVL	Latvian lats
MBT	Mechanical Biological treatment
MCF	Methane conversion factor
MEPRD	Ministry of Environmental Protection and Regional Development
MFA	Ministry of Foreign Affairs of the Republic of Latvia
MoA	Ministry of Agriculture
MoE	Ministry of Economics
ME	Minority education
MES	Ministry of Education and Science
MEUR	Million Euros
MMR	Monitoring Mechanism Regulation
MMS	Manure management systems
MoF	Ministry of Finance
Mo	Ministry of Transport
MS	Member state
NA	Not applicable
ND	Nitrates Directive
NE	Not estimated

NO	Not occurring
NCP	National Contact Point
NDP2020	National Development Plan 2014–2020
NDP2027	National Development Plan 2021-2027
NECP2030	National Energy and Climate Plan 2021-2030
NEEAP	Energy Efficiency Action Plan
NEET	Not involved in employment, education or training
NFARP	National Fundamental and Applied Research Programme
NFI	National Forest Inventory
NGO	Non-governmental organisations
NIR	National Inventory Report
NIS	National Inventory System
NISSA	National Information System of Scientific Activity
Non-ETS	Sectors outside of Emission Trading System
NOP	National Operational Programme
NP	Nord Pool
NREC IS	Information System of the National Real Estate Cadastre
NRC	National Research Centres
NRP	National Research Program
NZEB	Nearly-zero energy building
OD	Ozone depleting substances
OECD	The Organisation for Economic Co-operation and Development
PEFC	Programme for the Endorsement of Forest Certification
PaMs	Policies and Measures
PM	Particulate matter
PSE	Pre-school education
PT	Public transport
PV	Photovoltaic
RES	Renewable energy sources
RIS3	Research and Innovation Strategy for Smart Specialisation
R&D	Research and development
RDP	Rural Development Programme
QA	Quality Assurance
QC	Quality Control
QEWER	Quantified economy-wide emission reduction
RES	Renewable energy sources
RTU	Riga Technical University
SE	Secondary education
SEAP	Sustainable Energy Action Plan
SECAP	Sustainable Energy and Climate Action Plan
SEDA	State Education Development Agency
SEF	Standard Electronic Format
SME	Small and medium enterprises
SO	Strategic objective
SP	Study programme
SSA	Study and Science Administration
STDI	Science, technology development and innovation
STEM	Science, technology, engineering and mathematics
SWD	Solid waste disposal
UNFCCC	United Nations Framework Convention on Climate Change
UUA	Utilised agricultural area
UWWTD	Urban Waste Water Treatment Directive 91/271/EEC
URL	User access entry point
USD	United States Dollars
VA	Value added
WAM	Scenario with additional measures

WEO	World Energy Outlook
WEM	Scenario with existing measures
WFD	Water Framework Directive
WMO	World Meteorological Organization
WOM	Scenario without measures
WWF	World Wildlife Fund

Chemical formulas		Units of measurement	
CH_4	Methane	CO_2 eq	Carbon dioxide equivalent
CO	Carbon monoxide	ºC	Degree Celsius
CO_2	Carbon dioxide	GWh	Gigawatt hour
HFC	Hydrofluorocarbons	Ha	Hectare
N	Nitrogen	kg yr^{-1}	Kilograms per year
N_2O NMVOC	Nitrous oxide Non-methane volatile organic compounds	Kha	Kilo hectare
NO_x	Nitric oxide	kt	Kiloton
PFC	Perfluorocarbons	kWh	Kilowatt-hour
SF_6	Sulphur hexafluoride	MJ	Mega joule
NF_3	Nitrogen trifluoride	MW	Megawatt
		m/s	Meters per second
		Mm	Millimetre
		%	Per cent
		PJ	Peta joule
		km^2	Square kilometre
		m^2	Square metre
		Mill	Millions



APPENDIXES and ANNEX 1

APPENDIX 1 SUMMARY OF REPORTING OF THE SUPPLEMENTARY INFORMATION UNDER ARTICLE 7, PARAGRAPH 2, OF THE KYOTO PROTOCOL

National systems in accordance with Article 5, paragraph 1		Chapter 3.2.
National registries		Chapter 3.3.
Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17		Chapter 5.5.
Policies and measures in accordance with Article 2		Chapter 4.4.
Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures		Chapter 4.3
Information under Article 10		
	Art 10a	Chapter 3.2.
	Art 10b	Chapter 4.3., 6.
	Art 10c	NA
	Art 10d	Chapter 8.
	Art 10e	Chapter 9.
Financial resources		NA*
Minimization of adverse impacts in accordance with Article 3, paragraph 14		Chapter 4.4.11

*Reporting on financial resources under the Kyoto Protocol is relevant to Annex II Parties. As Latvia is not an Annex II Party, it does not have an obligation to provide information on financial resources under Article 11 of the Kyoto Protocol, including on “new and additional” resources.

APPENDIX 2 OVERVIEW TABLE OF RECOMMENDATIONS

Table below represents the review recommendations from the technical review of NC7 of the Latvia[49] and explains how these recommendations were addressed in the NC8.

Issue type/reference to Report on the technical review of NC7	Recommendation	Section in NC8
Transparency Table 4 Issue 1	The ERT reiterates the recommendation made in the previous review report that Latvia improve the transparency of its NC by providing further information on how national circumstances affect GHG emissions and removals, and how national circumstances and changes in national circumstances affect GHG emissions and removals over time, by further developing the examples provided to the ERT during the review.	More information added in Chapters 2.1., 2.3., 2.5., 2.6, 2.7., 2.8
Transparency Table 6 Issue 1	The ERT recommends that in the next NC Latvia include the name and contact information of the registry administrator designated by the Party to maintain the national registry.	Missing information included in Chapter 3.3, Table 3.9
Completeness Table 7 Issue 1	The ERT reiterates the recommendation made in the previous review report that Latvia report, in its next NC, information on any provisions to make information on legislative arrangements and enforcement and administrative procedures, established pursuant to the implementation of the Kyoto Protocol, publicly accessible by including the information provided to the ERT during the review.	Missing information included in Chapter 3.2.1
Completeness Table 7 Issue 2	The ERT reiterates the recommendation made in the previous review report that Latvia include in its next NC information on any national legislative arrangements and administrative procedures that seek to ensure that the implementation of activities under Article 3, paragraph 3, forest management under Article 3, paragraph 4, and any elected activities under Article 3, paragraph	Missing information included in Chapter 3.2.1

[49] https://unfccc.int/documents/181233

Issue type/reference to Report on the technical review of NC7	Recommendation	Section in NC8
	4, of the Kyoto Protocol also contributes to the conservation of biodiversity and sustainable use of natural resources, in line with the information provided during the review.	
Transparency Table 9 Issue 3	The ERT recommends that Latvia improve the transparency of the reporting in its next NC by organizing the reporting of PaMs by sector subdivided by gas.	Sectoral PaMs tables in Chapter 4.4 supplemented with column "GHGs affected"
Transparency Table 9 Issue 4	The ERT recommends that Latvia increase the transparency of the reporting on its PaMs by ensuring consistency between the information provided in the textual part of the NC and the associated tables.	Consistency between the information provided in the textual part of the NC8 Chapter 4.4 and the associated sectoral PaMs tables has been ensured
Transparency Table 9 Issue 6	The ERT recommends that Latvia improve the transparency of its presentation of PaMs by including the information provided during the review in its next NC or by referring to its BR in the NC.	In PaMs tables in Chapter 4.4 (4.4.2 Energy, 4.4.3 Transport, 4.4.5 Agriculture, 4.4.6 Waste, 4.4.7 IPPU, 4.4.8 LULUCF) added column "GHGs affected"
Completeness Table 9 Issue 10	The ERT reiterates the recommendation made in the previous review report that Latvia improve the completeness of its reporting by including information on the identification of the steps taken to promote and/or implement any decisions by ICAO and IMO to limit or reduce GHG emissions from aviation and marine bunker fuels, in line with the information provided during the review, in its next NC.	Added Chapter 4.4.4 International Bunkers
Transparency Table 9 Issue 11	The ERT recommends that Latvia increase the transparency of its reporting by providing coherent information in its NC on how it strives to implement PaMs under Article 2 of the Kyoto Protocol in such a way as to minimize adverse effects, or, where such information is provided in the NIR, by providing a relevant reference in its next NC.	Added Chapter 4.4.11 Information on minimization of adverse impacts

Issue type/reference to Report on the technical review of NC7	Recommendation	Section in NC8
Completeness Table 13 Issue 3	The ERT recommends that Latvia present the WEM scenario on a gas-by-gas basis in the next NC for all GHGs.	Information on a gas-by-gas basis presented in Chapter 5.1
Completeness Table 13 Issue 5	The ERT reiterates the recommendation made in the previous review report that Latvia, in its next NC, provide emission projections related to fuel sold to ships and aircraft engaged in international transport separately and not included in the totals, to the extent possible, in line with the information provided during the review.	Added information on "International Bunkers" under Chapter 5.1.2
Transparency Table 15 Issue 1	The ERT reiterates the recommendation made in the previous review report that Latvia include information on the total effect of PaMs, in accordance with the WEM scenario, compared with a situation without such PaMs, by gas.	Information on total effect of PaMs presented by gas, Chapter 5.3
Transparency Table 17 Issue 1	The ERT recommends that Latvia report in its next NC an outline of the action taken to implement Article 4, paragraph 1(e), of the Convention with regard to adaptation, or provide a relevant explanation should it not be possible to report such information owing to national circumstances.	Information provided at the end of Chapter 6.4
Completeness Table 18 Issue 1	The ERT reiterates the recommendation made in the previous review report that Latvia report, in its next NC, action taken to support systematic observation related to capacity-building, particularly in developing countries, or provide a relevant explanation should it not be possible to report such information owing to national circumstances.	Information provided at the end of Chapter 8.4

ANNEX 1 LATVIA'S FIFTH BIENNIAL REPORT TO THE UNFCCCC

CONTENTS

I INTRODUCTION

BR5, which has been prepared according to UNFCCC biennial reporting guidelines contained in the Decision 2/CP.17 (FCCC/CP/2011/9/Add.1) adopted by the Conference of the Parties at its 17th session and the Decision 6/CP.25 (FCCC/CP/2019/13/Add.1) adopted by the Conference of the Parties at its 25th session, is presented as a part of the NC8 of the Republic of Latvia. This report contains summary information on GHG inventory information for the time period 1990-2020, summary information on quantified economy-wide emission reduction target and Latvia's progress in achievement of it, as well as summary information on projections until year 2040.

Information provided on GHG emissions and trends is consistent with information in Latvia's GHG inventory submission in 2022[50].

In 2010, the EU submitted a pledge to reduce its GHG emissions by 2020 by 20% compared to 1990 levels.

The report also includes information on the provision of financial, technological and capacity-building support to Parties not included in Annex I to the Convention.

Common Tabular Format tables according to the Decision 19/CP.18 – Common tabular format for "UNFCCC biennial reporting guidelines for developed country Parties" (FCCC/CP/2012/8/Add.3) – are enclosed to Annex 1 – BR5 – and are submitted separately to the UNFCCC using the CTF software.

[50] Latvia's national inventory submission 2022, https://unfccc.int/ghg-inventories-annex-i-parties/2022

II GHG EMISSIONS AND TRENDS

This section presents summary information on the national GHG emissions since 1990. The information is consistent with the most recent – 2022 GHG inventory submission under the UNFCCC where detailed information on GHG emissions and their estimates can be found. Further information is reported in NC8 chapter 3 “Greenhouse Gas Inventory Information” and Table 1 included in Common tabular format workbook for the BR5.

II.I Summary information on GHG emissions and trends

Description of emission trends by sector

As a Party to the UNFCCC and the KP as well as being a Member State of the EU, Latvia has an obligation to prepare, publish and submit GHG inventories on an annual basis.

The annual submission (National inventory report and Common reporting format tables) contains emission estimates for the time series since 1990 till year prior to the previous year (x-2).

The GHG inventory is prepared according to the UNFCCC Decision 24/CP.19 Annex I reporting guidelines “Guidelines for the preparation of national communications by Parties included in Annex I of the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories on annual inventories”, the 2006 IPCC Guidelines for National Greenhouse Gas inventories, 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands and 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the KP.

The emission data presented in this chapter and in CTF table 1 are based on the Latvia’s national GHG inventory 1990-2020, submitted to the UNFCCC on 14 April 2022[51]. Table 1 and Figure 1 show a time series of CO_2 equivalent emissions by sectors without LULUCF, including indirect CO_2.

Table 1 Latvia GHG emissions by source sector, kt CO_2 eq.

	1990	1995	2000	2005	2010	2015	2020
1.Energy	19494.38	9578.59	7397.85	8137.43	8508.00	7178.05	6780.35
2.Industrial processes and product use	655.98	227.13	286.55	371.16	749.44	791.23	868.15
3.Agriculture	4985.80	2004.23	1678.46	1793.20	1878.76	2158.16	2250.88
4.Land Use, Land-Use Change and Forestry	-12300.85	-14745.99	-11754.19	-5830.39	-1879.51	189.49	646.57
5.Waste	732.09	638.53	696.91	626.08	665.73	575.91	547.25
Indirect CO_2	40.41	32.03	24.78	21.35	16.27	17.04	13.10
Total (without LULUCF, with indirect)	25908.66	12480.51	10084.56	10949.22	11818.20	10720.39	10459.72
Total (with LULUCF, with indirect)	13607.81	-2265.48	-1669.63	5118.83	9938.69	10909.89	11106.30

According to Table 1 in 2020, Latvia's GHG emissions composed 10459.72 kt CO_2 eq. excluding LULUCF, including indirect CO_2 emissions, showing in 2020 a decrease of 59.6%, compared to the base year 1990. The largest decrease is observed in Energy sector – 65.2% followed by the 54.9% decrease in Agriculture sector. In Waste sector GHG emissions have decreased by 25.2%.

[51]Latvia’s national inventory submission 2022, https://unfccc.int/ghg-inventories-annex-i-parties/2022

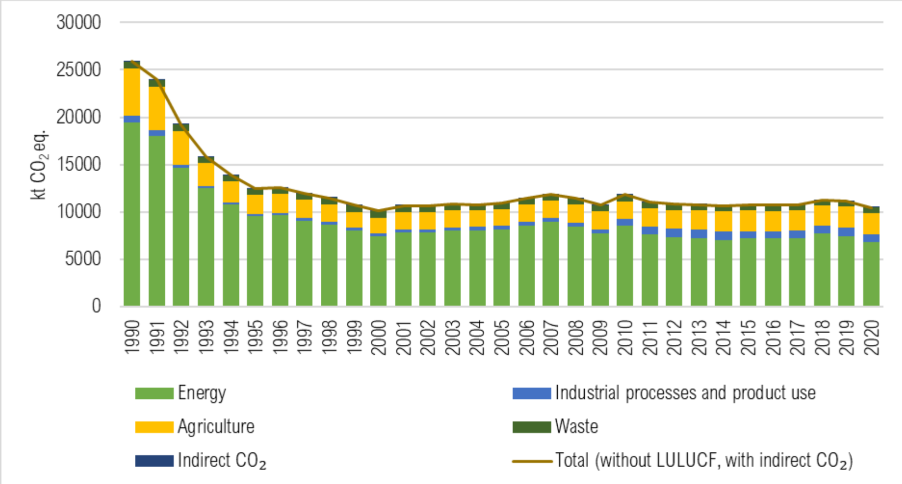


Figure 1 GHG emission time series for 1990–2020, kt CO_2 eq.

In 2020, Energy sector caused 64.8% from total GHG emissions (without LULUCF), Agriculture – 21.5%, Industrial processes and product use (IPPU) – 8.3% and Waste sector – 5.2%. Further information, particularly emissions trends analysis, can be found in Chapter 3.1.1 "Overall greenhouse gas emissions trends" of the NC8.

The following Figure 2 shows the total GHG emissions including LULUCF sector.

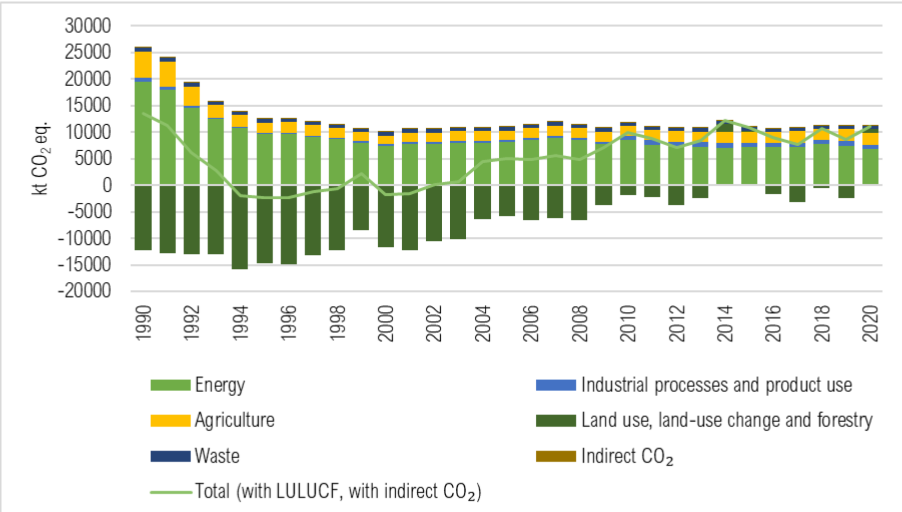


Figure 2 GHG emissions (with LULUCF) in Latvia by sector, kt CO_2 eq.

In 2020, total emissions in LULUCF sector were 646.57 kt CO_2 eq. Aggregated net removals of GHG were reduced by -105.3% in 2020, compared to 1990. Decrease of removals in LULUCF sector is associated with the increase of wood resources accessible to regenerative felling (significant increase of area of mature forests) leading to growth of harvest rate. Another driver leading to reduction of the CO_2 removals is increase of natural mortality and reduction of increment due to ageing of forest stands. Considerable role in the increase of GHG emissions had conversion of forest land to settlements, as well as returning of naturally afforested lands to farm crop production. Land use conversion to cropland is associated mostly with removal of woody vegetation from naturally afforested farmlands abandoned in 1980s and 1990s. Although the increment of living biomass in forest land remaining forest and afforested land is still larger than the carbon losses due to commercial felling, natural mortality and decomposition of soil organic matter in peat soils, the gap between gains and losses is decreasing, causing reduction of the net removals of CO_2 in forest land.

Description of emission trends by gas

Latvia's GHG emissions presented by gas are shown in the Table 2.

CO_2 is the main GHG causing climate change. In 2020, CO_2 emissions constituted 67.0% of Latvia's total GHG emissions (without indirect CO_2 emissions). In 2020, total CO_2 emissions without LULUCF and indirect CO_2 emissions decreased by 64.4%, compared to 1990. The most important source of CO_2 emissions (kt) in 2020 was fossil fuel combustion – 90.4%, including Energy Industries – 19.0%, Manufacturing Industries and Construction – 8.7%; Transport – 43.9% and Other sectors (Agriculture, Forestry, Residential, Commercial, etc.) – 18.6%. Other anthropogenic emission sources of CO_2 are IPPU – 8.6%, Agriculture 1.0% and Waste 0.0006%.

Main sources of CH_4 emissions in Latvia are Enteric Fermentation of Livestock, Solid Waste Disposal Sites and Energy sector. Other important sources of CH_4 emissions are leakage from natural gas pipeline systems and combustion of biomass. CH_4 emissions in 2020 contributed to 16.4% of total GHG emissions (excluding LULUCF, excluding indirect CO_2). CH_4 emissions (kt) decreased by 52.6% in 2020 since 1990.

Agricultural soils are the main source of N_2O emissions in Latvia generating 83.8% of all N_2O emissions (kt) in 2020. Other N_2O emission sources are from Transport sector and, biomass, liquid and other solid fuel combustion in other Energy sectors, also IPPU and Waste sectors. Since 1990 total N_2O emissions had decreased by 43.0% in 2020, mainly due to decrease in emissions from Agriculture.

Emissions from HFCs and SF_6 consumption are reported for the period 1995-2020. In 2020, F-gases constitute 2.4% form Latvia`s total GHG emissions. Total F-gases emissions (kt CO_2 eq.) increased in 2020, compared to 1995, by 1407.7%. SF_6 emissions from electrical equipment contribute 11.94 kt CO_2 eq. in 2020.

Emissions of the PFCs and NF_3 do not occur in Latvia for all time series. Further information, particularly emissions trends analysis, can be found in chapter 3.1.2 "Emission trends by gas" of the NC8.

Table 2 Latvia's GHG emissions (without LULUCF and indirect CO_2), kt CO_2 eq.

	1990	1995	2000	2005	2010	2015	2020
CO_2	19661.40	9133.78	7081.47	7810.47	8554.09	7262.10	6994.11
CH_4	3623.78	2179.95	1885.83	1870.14	1805.89	1772.69	1718.06
N_2O	2583.07	1117.44	1026.99	1138.28	1220.54	1403.93	1473.61
HFCs, SF_6	NO,NA	17.30	65.48	108.97	221.41	264.64	260.85
PFCs	NO	NO	NO	NO	NO	NO	NO
NF_3	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF, indirect CO_2)	25868.25	12448.48	10059.78	10927.87	11801.93	10703.36	10446.63

Precursor gases and SO_2

Emissions trends of nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOC) and sulphur oxide (SO_2) are presented in Table 3.

Table 3 Emissions of precursor gases and SO_2, kt

Year	NO_x	CO	NMVOC	SO_2
1990	95.98	469.90	89.24	100.45
1995	51.09	341.40	64.83	49.39
2000	42.03	282.92	55.02	17.75
2005	45.00	235.00	51.80	8.74
2010	40.41	164.72	40.74	4.31
2015	36.46	113.41	35.84	3.56
2020	31.95	102.71	33.56	3.51

In the period from 1990 to 2020 precursors have decreased: NO_x by 66.7%, CO by 78.1%, NMVOC by 62.4% and SO_2 by 96.5%.

Taking into account that amount of precursors, except NMVOC emissions, in a great extent are determined by the fuel combustion in Energy sector, emissions have decreased in the period of 1990-1995 was mainly caused by the rapid decrease of fuel consumption in this sector. However, in the subsequent years there were different causes for the reduction of precursors. SO_2 emissions have decreased mainly due to implementation of more stringent regulations regarding maximum sulphur content in the liquid fuels utilized in both Energy sector stationary sources and transport (mobile sources). The decrease of NO_x emissions was mainly caused by the wider penetration of new state-of-art technologies in Energy sector (in stationary sources as well as in transport vehicles due to the implementation of catalytic converters), this penetration was favoured by the implementation of regulations regarding NO_x emissions specific values from large combustion plants and all types of road transport (passenger cars, HDV and LDV). The biggest part of CO emission reduction is resulting from increased amount of cars with catalytic converters.

In 2020, the most important sector producing precursors (including LULUCF) was Energy sector (including fugitive emissions). Fuel combustion in Energy sector causes the largest part of NO_x emissions (79.4% from total NO_x emissions in 2020), but IPPU and Agriculture sectors make 6.1% and 14.1%, accordingly. Small part of NO_x emissions is produced in LULUCF sector (0.3% from total NO_x emissions). Almost all CO emissions (91.5%) appear in Energy sector, mainly from fuel combustion in residential and commercial/institutional subsectors (72.9% from all CO emissions). The remaining part of CO emissions come from LULUCF sector (5.8%), IPPU sector (2.7%) and Waste sector (0.0006%). The major part of SO_2 emissions (94.2%) comes from Energy sector (fuel combustion), then 5.7% SO_2 emissions are from IPPU (cement production), and a negligible part of SO_2 comes also from Waste sector (waste incineration). The largest amounts of NMVOC emissions are produced in Energy sector (39.8%; fuel combustion mainly in Residential sector) and 37.0% from total NMVOC emissions in 2020 are produced in IPPU sector, mainly from solvent use. In addition, 22.5% of NMVOC emissions are produced in Agriculture sector, but the remaining 0.8% in Waste sector.

Description on recalculation results for 2022 GHG inventory

The information about recalculations is provided in Latvia's National Inventory Report 1990-2020 which was submitted to the UNFCCC secretariat on 14 April 2022, Chapter 10 Recalculations and improvements and in NC8 Chapter 3.1.5.

II.II National Inventory Arrangements

Institutional arrangements

This section provides a summary of National System for preparing Latvia's GHG inventory. Detailed information of institutional arrangements can be found in Latvia's inventory 2022 submitted under the UNFCCC. Further information can be found in chapter 3.2.1 "Institutional Arrangements" of the NC8.

Latvia's national GHG inventory system is designed and operated according to the guidelines for national system under article 5, paragraph 1, of the KP and Decision 19/CMP.1 to ensure the transparency, consistency, comparability, completeness and accuracy of the inventory.

Latvia's GHG inventory submitted in 2022 is compiled according to Regulations of the Cabinet of Ministers No. 737 adopted on 12 December 2017 "Development and management of national system for greenhouse gas inventory and projections" (CoM Regulation No. 737). On 25 October 2022 CoM Regulation No. 737 was replaced with the new CoM Regulation No.675 "GHG inventory, projections and adaptation to climate change reporting systems". The new CoM Regulation No.675 were developed with the aim to improve the monitoring and reporting system GHG emissions and CO_2 removals within the framework of the Paris Agreement, which will contain data to be submitted for 2021 and beyond. The CoM Regulation No.675 establish certain procedures for reporting on national adaptation measures, the use of proceeds from auctions of emission allowances, financial and technological support provided to developing countries, information on approximate and annual GHG inventory, policies, measures and GHG projections reporting.

The schematic model for the national system is shown in chapter 3.2.1 of the NC8.

Climate Change Department of MEPRD[52] is responsible for the implementation and development of climate change mitigation and adaptation (and related) policies and measures. MEPRD is responsible for the actions (coordination, implementation and development) to meet the international and EU emission reduction targets. MEPRD also coordinates the monitoring and reporting of GHG emission data as well as is designated as the single national entity with overall responsibility for the Latvian GHG inventory.

Beside MEPRD the main institutions involved in the compilation of the Latvia's GHG inventory:

- LEGMC is a governmental limited liability company and is responsible for collecting of activity data and calculation of emissions for Energy, Industrial processes and product use and Waste sectors;
- Calculations of removals and emissions for the LULUCF, KP-LULUCF sector are done by LSFRI "Silava" in collaboration with Ministry of Agriculture. LSFRI "Silava" is responsible for collecting of activity data, preparation of the removals/emission estimates;
- Institute of Physical Energetic calculates emissions for Transport sector. IPE is responsible for collecting of activity data and preparation of the emission estimate;
- Emission calculation from Agriculture sector was done by Latvia University of Life Sciences and Technologies in collaboration with MoA. LULST is responsible for collecting of necessary activity data cooperating with Central Statistical Bureau and preparation of the emission estimates.

For ensuring the continuity of the functions of the national system, the delegation contracts are signed between the MEPRD and the above mentioned institutions.

According to the above mentioned Cabinet of Ministers Regulation No.737[53] (12.12.2017) all institutions involved in inventory process are responsible for implementing quality control procedures

[52] Since January 1, 2023 new ministry - Ministry of Climate and Energy (MoCE) - is established and therefore MEPRD is replaced by MoCE as a single national entity with overall responsibility for the Latvian GHG inventory. The contact person at MoCE is Agita Gancone, address: Maskavas street 165, Riga, LV – 1019, Latvia, E-mail: Agita.Gancone@kem.gov.lv.

[53] Since 25 October 2022 CoM Regulation No.737 is replaced by CoM Regulation No.675

The main data supplier for the Latvian GHG inventory is the Central Statistical Bureau.

For ensuring the continuity of the functions of the national system, the delegation agreement is signed between the MEPRD and LEGMC. The delegation agreement ensures the accomplishing of emission estimations and information preparation in the Energy, Industrial processes and product use and Waste sectors for the inventory, as well as GHG inventory compilation and activities related to the EU ETS.

Additionally, there are agreements with LSFRI "Silava", IPE and Latvia University of Life Sciences and Technologies for emission estimations and information preparation accordingly for LULUCF, Transport and Agriculture sectors.

Before final GHG inventory is submitted to the EC and to the UNFCCC secretariat it is forwarded to the involved ministries for review and approval. Based on received comments inventory is corrected appropriately.

Several meetings (related to Energy, LULUCF, Agriculture, Industrial processes and product use, Waste) were held before and during the preparation of inventory to discuss and agree on the methodological issues, problems that have risen and improvements that need to be implemented. There was discussion on the different problems that came up during the last inventory preparation to find solutions on how to improve the overall system.

Further information, including description of responsibilities of involved in the system institutions, can be found in chapter 3.2.1 "Institutional Arrangements" of the NC8.

Inventory process and quality management

The organizations responsible for the preparation and reporting of Latvia's GHG inventory and their duties are described above.

The preparation of the annual inventory based on schedule of the reporting under EU MMR and UNFCCC.

Figure 3 shows the annual inventory process how the inventory is prepared within the national system.

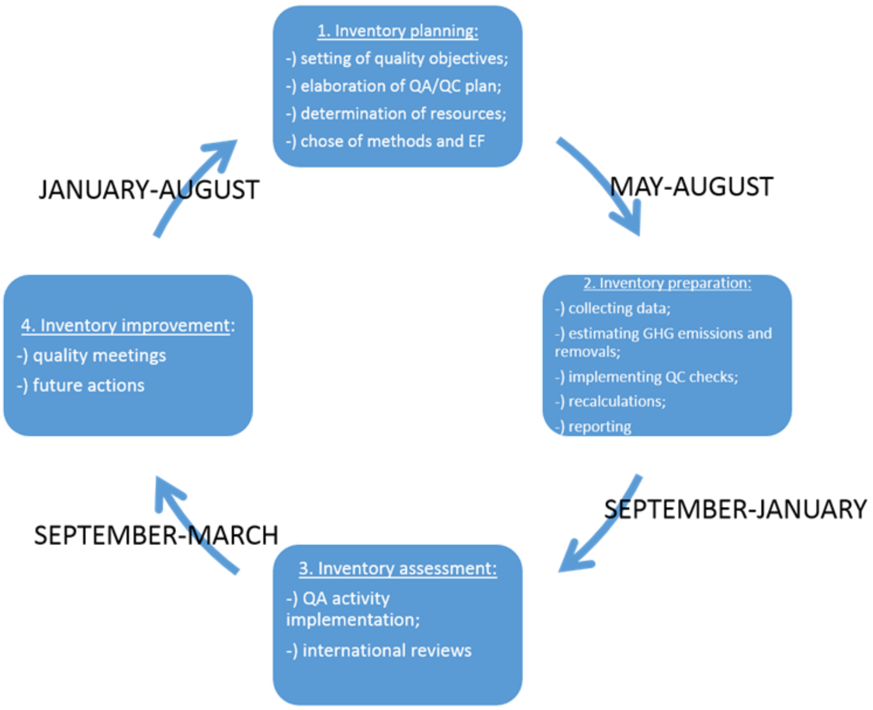


Figure 3 Inventory process

During the preparation of 2022 submission, all processes relevant to the GHG inventory have been restructured according to the 2006 IPCC Guidelines and the revised CRF tables. Detailed descriptions of the activity data and methodologies used can be found in the sectoral chapters of the National Inventory Report 2022.

Tier 1 is used to identify key categories for time period 1990-2020. Key categories that have been identified are used for improving the GHG inventory as well results of key category analysis are included annually in the National Inventory Report.

According to Cabinet of Ministers Regulation No.737[54] (12.12.2017) all institutions involved in the inventory process are responsible for implementing QC procedures.

The inventory planning stage includes the setting of quality objectives and elaboration of the QA/QC plan for the coming inventory preparation, compilation and reporting work. The quality requirements set for the annual inventories – transparency, consistency, comparability, completeness, accuracy, improvements and timelines.

The setting of quality objectives is based on the inventory principles taking into account the available resources.

The QA reviews are performed after the implementation of QC procedures to the finalised inventory. The inventory QA system comprises reviews to assess the quality of the inventory.

A basic review of the draft GHG emission and removal estimates and the draft report takes place before the final submissions to the EU and UNFCCC (January to March) by the involved institutions on GHG inventory preparation process.

The draft of National inventory report was sent to CSB, MoA, and MoT for checking and approving.

UNFCCC review reports indicate the issues where inventory need improvements and elaboration. The improvement plan for GHG inventory is compiled based on the findings of the UNFCCC, EC, internal reviews and recommendations from third part experts.

Quality Assurance activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. Periodically all sectors are revised by third part experts.

All institutions involved in GHG inventory preparation process are responsible for archiving the collected data and estimated emissions. Latvia has a centralized archiving system – all information (including corresponding letters, internal documentation on QA/QC procedures, external and internal reviews, documentation on annual key sources and key source identification, planned inventory improvements) used for inventory compilation are collected on the special server and the backup of data are made periodically. All information is archived at LEGMC. Common, password protected FTP folder is used for information storage and exchange.

Process and quality management of projections

Regulations of the Cabinet of Ministers No. 737[54] "Development and management of national system for greenhouse gas inventory and projections" was adopted in 2017.

MEPRD ensures the submission of the GHG emission/removals projections to the relevant international institutions (EC, UNFCCC) and monitor the co-operation of the authorities involved.

MoE by 30 April 2018 prepares and hereinafter once in two years submits the macroeconomic indicators. MoE in cooperation with the Institute of Physical Energetics prepares the primary data of the energy and construction and, by 1 June 2018 and hereinafter once in two years.

LEGMC:

[54] Since 25 October 2022 CoM Regulation No.737 is replaced by CoM Regulation No.675

1) by 1 June 2018 prepares and hereinafter once in two years:
   - submits the primary data - projections of indicators of the waste management and wastewater management sector;
   - prepares the secondary data and calculations of projections of GHG emissions;
   - submits a description of GHG projections, policy and measures for the activities of industrial processes;
   - maintains and administers the part of GHG projections of the integrated database.
2) prepares a draft report on the policy, measures, and GHG projections (measures for the activities of Energy, Transport, Agriculture, Industrial processes use of hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride and solvents and different chemical substances, LULUCF and Waste management activities);
3) in cooperation with other institution prepares a biennial report.

MoA in cooperation with the Latvia University of Life Sciences and Technologies and LSFRI "Silava" prepares the primary data of the sector of Agriculture and Forestry and, by 1 June 2018 and hereinafter once in two years.

LSFRI "Silava" in cooperation with the MEPRD prepares the secondary data and calculations of projections of GHG emissions and removal of carbon dioxide for activities of Land use, land-use change and forestry.

Institution of Physical Energetics cooperation with the MEPRD prepares the secondary data and calculations of projections of GHG emissions for the Energy and Transport sector.

LULST in cooperation with MEPRD prepares the secondary data and calculations of projections for GHG emissions from Agriculture activities.

Every second year MEPRD submits to the EC (until 15 March) and the UNFCCC Secretariat (until 31 December) Report on Policies and Measures and GHG projections.

II.III Changes in National Inventory Arrangements Since Fourth Biennial Report

Changes in GHG inventory arrangements since BR4

Since the Fourth biennial report (BR4)[55] under the UNFCCC, CoM Regulation No. 737 (12.12.2017) was amended by CoM Regulation No. 490 (06.07.2021) in order to improve the preparation of projections by improving system for long term modelling (including the establishment and maintenance of energy-climate modelling and economic modelling systems). Other agreements regarding responsibilities are maintained and continue to be in force according to the national legislation (CoM Regulation No. 737 (12.12.2017)). Since 25 October 2022 CoM Regulation No.737 is replaced by CoM Regulation No.675. No changes in institutional, legal, administrative and procedural arrangements used for domestic compliance, monitoring, reporting, archiving of information and evaluation of the progress towards its economy-wide emission reduction target have been made.

[55]Latvia`s BR4, https://unfccc.int/BRs

III QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGET

This section explains Latvia's emission reduction target as a Member State of the European Union under the UNFCCC and the target compliance architecture set up within the country in order to meet that target.

III.I The EU target under the Convention

Under the UNFCCC, the EU and its Member States committed to achieving a joint quantified economy-wide GHG emission reduction target of 20 per cent below the 1990 level by 2020 ("the Cancun pledge"). It is therefore a joint pledge with no separate targets for Member States under the Convention.

Table 4 Key facts of the Convention target of the EU-27+UK[56]

Parameters	Target
Base Year	1990
Target Year	2020
Emission Reduction target	-20% in 2020 compared to 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3
Global Warming Potential	AR4
Sectors Covered	All IPCC sources and sectors with the exception of LULUCF, as measured by the full annual inventory including international aviation (outgoing flights)
Land Use, Land-Use Change, and Forests (LULUCF)	LULUCF sector is excluded from the target under Convention. LULUCF is accounted under the Kyoto Protocol[2]
Use of international credits (JI and CDM)	Possible subject to quantitative and qualitative limits
Other	Conditional offer to move to a 30% reduction by 2020 compared to 1990 levels as part of a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities

III.II EU target compliance architecture

The EU has jointly committed to its UNFCCC target and implemented it internally through EU legislation in the 2020 EU Climate and Energy Package. In this package, the EU introduced a clear approach to achieving the 20% reduction in total GHG emissions from 1990 levels, by dividing the effort between the sectors covered by the EU ETS and the sectors under the ESD. Binding national targets were set for Member States under the ESD. The achievement of EU internal compliance under the 2020 Climate and Energy Package including the national targets under the ESD is not subject to the UNFCCC assessment of the EU's joint commitment under the Convention.

In 2009 under the EU 2020 Climate and Energy Package, the EU has set internal rules to achieve the 20% reduction of total GHG emissions from 1990 levels, which is equivalent to a 14% reduction compared to 2005 levels. This 14% reduction objective is divided between ETS and non-ETS sectors. The two sub-targets are:

- a 21% reduction target compared to 2005 for emissions covered by the ETS (including domestic and international aviation);
- a 10% reduction target compared to 2005 for ESD sectors, shared between the 28 MSs through individual national GHG targets.

[56] Source: EC

The EU ETS target is to be achieved by the EU as a whole, under the revised EU ETS Directive[57], a single ETS cap covers EU MSs and the three participating non-EU countries (Norway, Iceland and Liechtenstein) and there are no further individual caps by country. For allowances allocated to the EU ETS sectors, annual caps have been set for the period from 2013 to 2020; these decrease by 1.74% annually, starting from the average level of allowances issued by MS for the second trading period (2008-2012). The annual caps imply interim targets for emission reductions in sectors covered by the EU ETS for each year until 2020. For further information on the EU ETS and for information on the use of flexible mechanisms in the EU ETS see the BR4 of the European Union.

The vast majority of emissions within the EU which fall outside the scope of the EU ETS are addressed under the ESD (Decision No. 406/2009/EC). The ESD covers emissions from all sources outside the EU ETS, except for emissions from domestic and international aviation (which were included in the EU ETS from 1 January 2012), international maritime emissions, and emissions and removals from LULUCF. It thus includes a diverse range of small-scale emitters in a wide range of sectors: transport (cars, trucks), buildings (in particular heating), services, small industrial installations, fugitive emissions from the Energy sector, emissions of fluorinated gases from appliances and other sources, Agriculture and Waste.

The monitoring and review process under ESD are harmonized for all EU MS by the Monitoring Mechanism Regulation[58]. The use of flexible mechanisms is possible under the ESD.

While the EU ETS target is to be achieved by the EU as a whole, the ESD target was divided into national targets, expressed as percentage changes from 2005 levels, to be achieved individually by each MS. The target levels have been set on the basis of MSs' relative GDP per capita. In addition, different levels of development in the EU-28 are taken into account by the provision of several flexibility options.

Latvia's emission reduction target for 2020 includes the positive limit +17% compared to 2005 established for ESD sector in line with ESD. By 2013 EC Decisions (EC 2013)[59,60], these percentage changes have been transferred into binding quantified annual reduction targets for the period from 2013 to 2020, denominated in Annual Emission Allocations.

III.III Other emission reduction targets

In addition to the EU target under the Convention, Latvia as the member of the EU also committed to a legally binding quantified emission limitation reduction commitment for the second commitment period of the KP (2013-2020) and phase-down of hydrofluorocarbon use under Montreal Protocol on Substances that Deplete the Ozone Layer. Latvia's target and progress towards the achievement of the target for the second

[57] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community (OJ L 140, 05.06.2009, p. 63), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32009L0029

[58] Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC

[59] Commission decision of 26 March 2013 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No. 406/2009/EC of the European Parliament and of the Council (2013/162/EU), http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013D0162&from=EN

[60] Commission Implementing Decision of 31 October 2013 on the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No. 406/2009/ EC of the European Parliament and of the Council (2013/634/EU), http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013D0634&from=EN

commitment period of the KP has been reported annually in the national inventory report and included in Latvia's 8NC.

The Paris Agreement was adopted in December 2015 and entered into force in November 2016. Latvia ratified the agreement in February 2017. The EU's joint nationally determined contribution (NDC)[61] under the Paris Agreement is to reduce the GHG emissions by at least 55 per cent by 2030 from the 1990.

According to the EU Climate and Energy Package 2030 for the period 2021 to 2030, the emission reduction targets for each EU Member State have been set according to Regulation (EU) 2018/842[62] Article 4 and in addition, according to the Regulation (EU) 2018/841[63] the LULUCF sector is part of the Member State level obligations. The reduction target from the 2005 levels in the EU ETS is 43 % and in the ESD 30 %. In the Effort Sharing Regulation, Latvia's target for emission reductions in 2030 compared to the 2005 level is 6%.

Since the EU submitted its last BR to the UNFCCC secretariat in 2019, the European Green Deal was introduced which included a target of carbon neutrality by 2050.

The Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 (hereinafter - European Climate Law) includes the goal of achieving EU climate neutrality by 2050. The European Climate Law also includes a binding EU target for the reduction of net GHG emissions (including CO_2 removals) by 2030 of at least a 55% reduction in emissions compared to 1990 levels. Therefore, the EC on 14 July 2021 released the "Fit for 55" package, which includes proposals for amendments, including Regulation (EU) 2018/842, which includes the reduction of GHG emissions determined by Latvia until 2030 in accordance with Regulation (EU) 2018/842 amendment to Article 4, for non-ETS (ESD) activities compared to 2005 is -17%.

MEPRD is currently developing a national Climate Law, that will set up the national framework for climate policy in Latvia. Taking into account international and European obligations on climate change, the Climate Law will allow for policy instrument development, as well as monitoring and review of progress.

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[61] Update of the NDC of the European Union and its Member States (December 2020) https://unfccc.int/sites/default/files/NDC/2022-06/EU_NDC_Submission_December%202020.pdf

[62] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement

[63] Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework

IV PROGRESS IN ACHIEVEMENT OF QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGET

For the quantification of the progress to 2020 targets, the development of GHG emissions is the key indicator.

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

Latvia's institutional, legal, administrative and procedural arrangements used for domestic compliance, monitoring, reporting, archiving of information and evaluation of the progress towards economy – wide emission reduction target is shown in Figure 4.

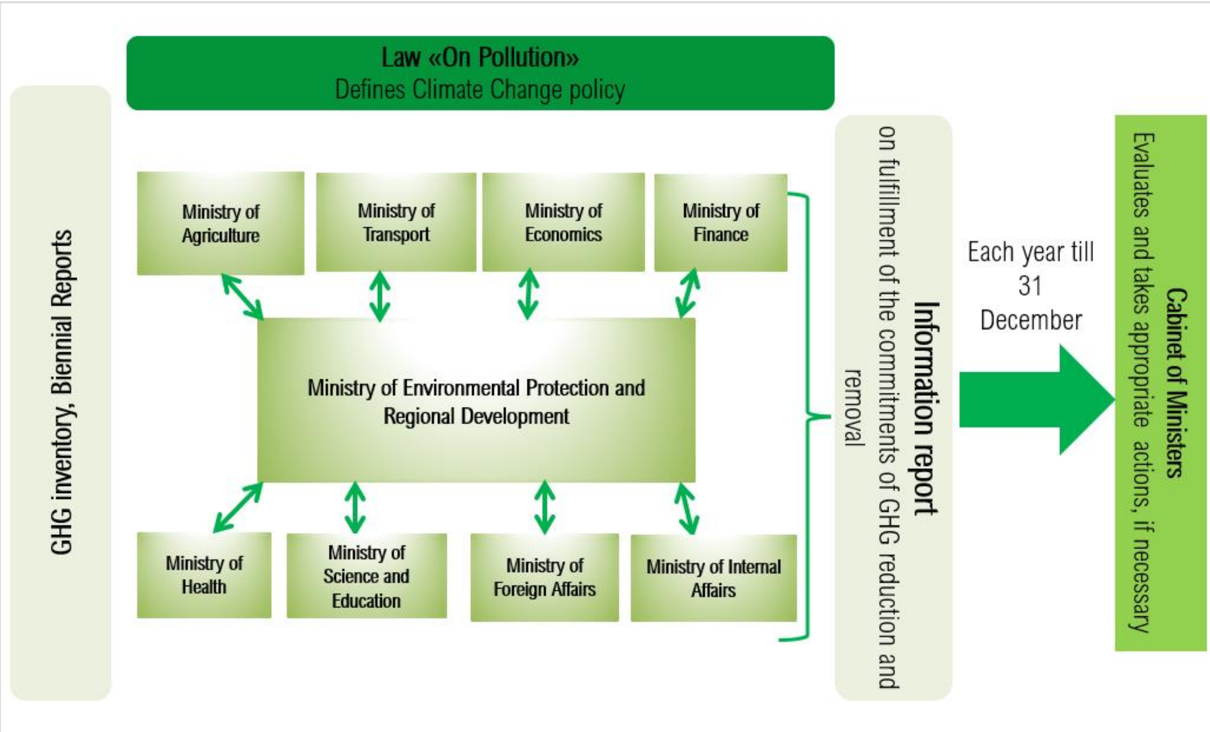

Figure 4 Institutional framework for domestic compliance

Law on Pollution is the defining Climate Change policy document in Latvia. According to the amendment of Law on Pollution (2018), the Ministry of Environmental Protection and Regional Development of Latvia in cooperation with Ministry of Agriculture, Ministry of Transport, Ministry of Economics, and other ministries each year prepare and submit by 31 December an Informative Report to the Cabinet of Ministers (The Government of Latvia) on achievement of the commitments regarding GHG emission reduction and CO_2 removals. The following information is included in the Informative Report:

- the summary information regarding historical GHG emissions from GHG inventory as well as GHG projections, policies and measures;
- an evaluation of the achievement of the commitments related to reduction of GHG emissions and CO_2 removals;
- if necessary, proposals regarding additional measures for the reduction of GHG emissions and CO_2 removals, corresponding to the sectoral policy planning documents for the relevant period.

In 2018, amendments to the **Law on Pollution** were approved with the following goals:

- to determine the conditions for fulfilment of the commitments on climate change mitigation (GHGs reduction and CO_2 removals) under the UNFCCC as well as the EU regulation up until 2030 for sectors not included in the EU ETS, include giving delegation to develop necessary policies;
- to adapt Latvian legislation to the EU regulation regarding the participation of aviation activities in the EU ETS;
- to remedy possible shortcomings in the failure to transpose the provisions of the EU regulation that were indicated for Latvia;
- to determine the conditions for using financial resources obtained by the EU ETS operators and aircraft operators;
- to prepare and submit, by 31 December each year, an informative report to the Cabinet of Ministers on fulfilment of the commitments for reduction of GHG emissions and CO_2 removals;
- to set obligatory conditions for sea ships (regulation 2015/757[64]) and requirements for fuel suppliers regarding GHG emission reduction for fuels;
- to include provisions from the Fuel Quality Directive which set an obligation for fuel suppliers to reduce life cycle GHG emissions unit of energy from fuel and energy supplied by 6% in 2020.

According to the EU's regulation No 2018/1999[65], every two years Latvia will submit the integrated National energy and climate progress report to the EC. It is planned that the Report will include the information on the progress accomplished towards reaching the objectives, targets and contributions settled out in the integrated Latvia's National Energy and Climate Plan, and towards financing and implementing the policies and measures necessary to meet them, including a review of actual investment against initial investment assumptions.

In addition, every two years Latvia will be obliged to report national policies and measures (or group of measures) and national GHG projections emissions by sources and removals by sinks to the EC and the UNFCCC.

Furthermore, Latvia is currently working on a national Climate Law that in the period after 2020 will determine institutional and procedural arrangements for monitoring and evaluating progress towards targets for period 2021 – 2030 and beyond.

Target under the UNFCCC of a reduction of emissions by 20% from 1990 to 2020 only refers to the emissions of the EU-27+UK as a whole. GHG emissions of EU-27+UK are calculated as the sum of MSs emissions. With this, GHG emissions of Latvia are part of EU-27+UK (+ Iceland) emissions with 0.3% from total EU emissions in 2020.

Latvia's emission trends 1990–2020 are reported in detail in CTF Table 1. The development of GHG emissions is reported in CTF Table 4.

Emissions in the LULUCF sector are not included under the Convention target, therefore they are not included in CTF Tables 4 and 4(a).

The use of flexible mechanisms takes place on the one hand by operators in the EU ETS, on the other hand by governments for the achievement of ESD targets. For information on the use of flexible mechanisms under the EU ETS please see the 5th BR under the UNFCCC of the European Union.

[64] Regulation (EU) No. 2015/757 of the European Parliament and of the Council of 29 April 2015 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, and amending Directive 2009/16/EC, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015R0757

[65] Regulation (EU) No. 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

Latvia met ESD target with national measures in 2013-2020 (see Table 5).

Table 5 Latvia's annual emission allocation, ESD verified emissions and emission surplus for the years 2013 to 2020, Mt CO_2 eq.

Year	2013[1]	2014[2]	2015[3]	2016[4]	2017[5]	2018[6]	2019[7]	2020[8]	Total
ESD target[9]	9,260	9,351	9,442	9,534	9,729	9,817	9,904	9,992	**77,030**
ESD verified emissions	8,777	9,018	9,005	9,107	9,243	9,127	8,650	8,436	**71,363**
ESD target fulfilment (surplus)	+0,483	+0,334	+0,437	+0,426	+0,486	+0,690	+1,254	+1,556	**+5,667**

[1] actual surplus in accordance with actual emissions approved by Commission Implementing Decision (EU) 2016/2132 of 5 December 2016 on greenhouse gas emissions for each Member State for the year 2013 covered by Decision No. 406/2009/EC of the European Parliament and of the Council;
[2] actual surplus in accordance with actual emissions approved by Commission Implementing Decision (EU) 2017/1015 of 15 June 2017 on greenhouse gas emissions covered by Decision No. 406/2009/EC of the European Parliament and of the Council for the year 2014 for each Member State;
[3] actual surplus in accordance with actual emissions approved by Commission Implementing Decision (EU) 2017/2377 of 15 December 2017 on greenhouse gas emissions covered by Decision No. 406/2009/EC of the European Parliament and of the Council for the year 2015 for each Member State;
[4] actual surplus in accordance with actual emissions approved by Commission Implementing Decision (EU) 2018/1855 of 27 November 2018 on greenhouse gas emissions covered by Decision No. 406/2009/EC of the European Parliament and of the Council for the year 2016 for each Member State;
[5] actual surplus in accordance with actual emissions approved by Commission Implementing Decision (EU) 2019/2005 of 29 November 2019 on greenhouse gas emissions covered by Decision No. 406/2009/EC of the European Parliament and of the Council for the year 2017 for each Member State;
[6] actual surplus in accordance with actual emissions approved by Commission Implementing Decision (EU) 2020/1834 of 3 December 2020 on greenhouse gas emissions covered by Decision No. 406/2009/EC of the European Parliament and of the Council for the year 2018 for each Member State;
[7] actual surplus in accordance with actual emissions approved by Commission Implementing Decision (EU) 2021/1876 of 20 October 2021 on greenhouse gas emissions covered by Decision No. 406/2009/EC of the European Parliament and of the Council for the year 2019 for each Member State;
[8] according to Latvia`s 2022 GHG inventory submitted to UNFCCC (14.04.2022) https://unfccc.int/ghg-inventories-annex-i-parties/2022;
[9] Latvia's annual ESD targets for the period from 2013 to 2020 are set by the EC's decisions: Commission Decision of 26 March 2013 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No. 406/2009/EC of the European Parliament and of the Council (2013/162/EU); Commission Decision (EU) 2017/1471 of 10 August 2017 amending Decision 2013/162/EU to revise Member States' annual emission allocations for the period from 2017 to 2020; Commission implementing decision 31 October 2013 on the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No. 406/2009/EC of the European Parliament and of the Council (2013/634/EU).

Taking into account that Latvia has met its targets and has not transferred any ESD units to another EU Member State - Latvia used only one flexible mechanism (banking) under the ESD compliance cycles for the years 2013 till 2019 and transferred all the surplus of AEAs to 2020 ESD Compliance Account. In 2018, Latvia started to identify potential opportunities and partners regarding the trading of AEAs. Negotiations with potential partners continued in the following years.

Assessment of the economic and social consequences of response measures

To ensure that all relevant possible impacts are taken into account, Latvia has established processes that assess the economic and social consequences of climate policy measures.

For the development of new policy initiatives through legislative proposals by the EC, an impact assessment system has been established in which all proposals are examined before any legislation is passed. It is based on an integrated approach which analyses both benefits and costs, and addresses all significant economic, social and environmental impacts of possible new initiatives (for details please refer to chapter 15 of the Latvia`s National Inventory Report 2022).

Regarding economical and social consequences of response measures to other countries, Latvia strive to implement its climate policies and measures in such a way that the social, environmental and economic impacts on other countries, and on developing countries in particular, do not appear at all or the impacts are very minimised and are negligible. Latvia takes into account up-to-date knowledge on and understanding of the possible impacts of PaMs based on available actual scientific studies and R&D information.

Latvia takes measures aiming to reduce GHG emissions through energy savings and increase of using renewable energy sources.

Biofuel production

All biofuels on the market in Europe and the Latvia must comply with the sustainability criteria laid down in the Renewable Energy Directive (2009/28/EC) and its revision (2018/2001/EU). Only sustainable biofuels are allowed to be used for fulfilling the blending target. Compliance with these criteria must be demonstrated through one of the adopted certification systems defined in The Cabinet of Ministers Regulation No.545 (Amendments 2019). Biofuels and bioliquids, which are produced in the Latvia, imported into the Latvia from another European Union Member State or imported from third countries and which may be used to achieve the national objective - to ensure that the share of energy from renewable energy sources in the gross final energy consumption of transport energy in Latvia in 2020 is at least 10 per cent, whether the reduction in GHG emissions during the transport life cycle as defined in the Law on Pollution should be consistent with sustainability criteria.

Biomass production

The Latvian Government considers important that business sector promotes sustainable development in its field, respecting the best practices and obligations of corporate social responsibility. Therefore, particular focus is placed on responsible private sector engagement and mobilizing private sector finance and expertise.

Latvian pellets production companies provide a transition from fossil fuels to renewable resources, thereby reducing GHG emissions, not only in Latvia, but also supplying products to other countries, mainly in Europe. Most of them are engaged in a voluntary Sustainable Biomass Programme. The Sustainable Biomass Program (SBP) is a certification system designed for woody biomass, mostly in the form of wood pellets and woodchips, used in industrial, large-scale energy production. SBP has developed a certification system to provide assurance that woody biomass is sourced from legal and sustainable sources. Companies annually prepare Supply Base Reports for this certification system.

Mitigation actions and their effects

Latvia has made efforts to improve the information on the effects of the policies and measures, however still for some individual measures Latvia has not been able to provide quantified estimates on the impacts on the national emissions. These measures are marked with NE (not estimated) in the CTF Table 3. There are various reasons why it has not been possible to make the estimates, such as the complexity and overlaps with other measures and where measurement of the effect is difficult (for example, measures providing advice and information). To avoid overlapping of estimates, the several individual measures are considered as the single package and thus the impact of the whole package is evaluated. This approach is applied for particular cases if such combination of measures is applicable and rational, e.g., the typical case of such package comprises the information measures and economic measures (investment support programmes). Further information on mitigation actions and their effects is provided in the chapter 1.4. “Projections” and in the chapter 5.3 “Total effect of policies and measures” of the NC8.

V POLICIES AND MEASURES

The following section describes in short those GHG emissions reduction policies and measures (PaMs) which were not included in the Latvia's BR4, namely, they were started in 2020 and after.

In the last years Latvia national climate policy had undergone more integration with the planning and decision making processes in energy production and consumption, transport, agriculture, waste management, forestry and land-use sectors. Further information on the actual sectorial policy planning key documents which have synergy to meet national climate policy objectives see in the chapter 4.4. "Policies and measures and their effects" of the NC8.

At the same time, the impact of expired (implemented) investment-related measures, focused to technology change and energy efficiency, will last up to 2025-2030, thus having significant impact on GHG emissions projections.

Individual mitigation impacts could not be assessed for several PaMs owing to the complexity of interactions between measures and the consequential difficulty of determining an impact as specific to an individual policy or measure.

Furthermore, in estimating the mitigation impact of some educational and behavioural measures, it can be hard to quantify precisely how such measures directly result in changes in activity and emissions.

Further information on the actual sectorial PaMs, including their detailed description, is seen in the chapter 4.4. "Policies and measures and their effects" of the NC8. The full list of GHG PaMs is available in the Common tabular format workbook for the BR5, see CTF Table 3.

In the period since Latvia's BR4 changes in policies and measures are described lower:

V.I Energy

WEM scenario

The main changes relate to the following:

- there is insignificant change in the financial volumes allocated for the investment co-financing measures, due to re-allocation and adjustment of resources among different specific measures of the National Operational Programme "Growth and Employment" of EU Funds 2014-2020 planning period;
- the BR4 include the investment co-financing measure to promote production of renewable energy in the agriculture sector in EU funds 2014-2020 planning period. During the implementation of the national Rural Development Programme for 2014-2020 period the objective of this measure has been changed and now is focused to the improvement of manure management systems (CH_4 reduction) thus this measure is not more included in the WEM projection of Energy sector.
- Change in the measures' implementation final year. The implementation of the investment co-measures of the National Operational Programme "Growth and Employment" are extended up to 2023 including, that is slower implementation as reported in the BR4.

CO_2 taxation. The tax rate is raised. In the period 1 January 2017 – 31 December 2019 the tax rate was 4.5 EUR per ton of CO_2 emissions. From the 1 January 2020 tax rate per ton of CO_2 emission was 9 EUR. This rate is raised up to 12 EUR (in 2021) and 15 EUR (from the 1 January 2022) per ton of CO_2 emissions. In turn, taxation on noxious air polluting emissions creates synergy with CO_2 taxation. Amendments, adopted in 2020, have increased the rate for the following emissions: PM_{10}, SO_2, NO_x, NH_3, H_2S and other non-organic compounds which is considered as non-GHG mitigation benefit.

The several policies and measures have been adjusted from 2020. The indicated below adjustments relate to the quantitative values of legislative provisions and not change the content of the measures. Changes concerning fuel taxation:

- the rate for kerosene and diesel (gas oil), if used for heat energy production from the 1 July 2021 is slightly increased, up to 60 EUR per 1000 litres (before that data it was 56.91 EUR per 1000 litres);
- the rate for coal, coke and lignite (brown coal) is increased. The current rate, in force from the 1 January 2020, is 0.76 EUR/GJ or 21.3 EUR/ ton if information of specific heating value of coal is not available (in 2019 respectively 0.38 EUR/GJ or 10.65 EUR/ton). From 1 January 2020 application of zero tax rate is cancelled in case of utilisation for electricity production and in CHP mode.

WAM scenario

In the BR4, the WAM projection's several measures have been only indicated as their content elaboration in that time only started. Currently the specific information on WAM measures is provided.

Investment Support Programme to Increase Energy Efficiency in municipal public buildings: 2021-2027 EU Funds programming period. The measure will support energy efficiency improvement of the existing municipal buildings, including smart energy management systems as well as building-scale RES technologies.

Investment Support Programme for Solar (PV) Energy: 2021-2027 EU Funds programming period. This particular measure is planned as the complex financial instrument with the grant part. The wide range of target groups is planned as the beneficiaries – commercial sector, municipal sector as well as energy communities.

Investment Support in Manufacturing Industry sector to promote energy efficiency: 2021-2027 EU Funds programming period. The financial instrument with the grant part for energy efficiency improvement and RES utilizing technologies in manufacturing industry sector is planned. The measure will support the upgrade of production capacities by purchase and installation of energy efficient both production and auxiliary technologies; improvement of energy efficiency of industrial buildings and related engineering systems.

V.II Transport

WEM scenario

The quantitative **requirements for biofuel mix obligation** have been increased from the 1 January 2020. The new provisions are as follows:

- Bioethanol mix, mandatory for the gasoline of "95" trademark - at least 9.5% (volume) of total volume,
- Biodiesel mix – at least 6.5% (volume) of total volume.

The system of vehicles' annual taxation based on the specific CO_2 emissions has been expanded by including also light duty (gross weight up to 3500 kg) vehicles, registered after 2011, the particular provisions came into force since 1 January 2021 (previously only cars registered after 2008 have been taxed).

The natural gas vehicles are temporarily promoted by the reduced excise duty rate for natural gas - 1.91 EUR per MWh - stated for the period 1 January 2021 - 31 December 2025. From the 1 January 2026 tax rate of 10 EUR per MWh will be applied.

There is insignificant change in the financial volumes allocated for the investment co-financing measures, due to re-allocation and adjustment of resources among different specific measures of the National Operational Programme "Growth and Employment" of EU Funds 2014-2020 planning period.

WAM scenario

Information on the measure is specified.

Electrification of Latvian railway network. Railway electrification is stated as one of the indicative investment projects of the NDP2027. The Specific Objective "To develop a sustainable, climate-resilient, smart, secure and diverse TEN-T infrastructure" plans the measure, objectives of that are construction, reconstruction and renewal of railway infrastructure and improvement of energy efficiency in railway passenger transport.

Latvia's NECP2030 provides to promote the creation of multimodal public transport points to combine the diversity of public transport (road, rail and bicycle). NDP2027 plans the establishment of the multi-modal public transport system having the rail transport as the central element; integration of planned "Rail Baltica" line in the existing transport network of state and municipalities, creating multi-modal passenger centres which will promote reachability of regions, mobility of population and will ensure accessibility.

Promotion of Biomethane production and utilisation in transport sector. As planned by the NDP2027, in EU Funds planning period of 2021-2027 the target groups of this particular measure are both biomethane producers (particularly upgrade to biomethane quality of biogas produced by processing agriculture sector raw materials) and biomethane consumers. The NDP2027 plans to support investment for the biogas upgrade equipment and the infrastructure to ensure utilisation of biomethane in transportation sector[66]. The financial support is planned to be provided as the financial instrument with the grant part.

V.III Agriculture

WEM scenario

The main changes relate to the following:

Agricultural activity data for projections are recalculated every year. The proposed drivers of agricultural development are different from the previous report.

In accordance with the impact of agricultural policy, the intensity of emission reduction measures has been recalculated.

WAM scenario

Promote organic dairy farming and extended grazing (low emission dairy farming)

The main aim of the measure is to promote transition of small and medium-sized conventional dairy farms to the organic farming system and extend grazing season thus facilitating low emission dairy farming.

Support for fertilisation planning

The main aim of the measure is to expand arable land and increase number of medium-sized crop and livestock farms were fertilisation planning and practical implementation that is based on knowledge about agrochemical properties of soil have not been done previously.

Promote inclusion of leguminous plants in crop rotation for nitrogen fixation

The main aim of the measure is to expand arable land and increase number of farms where leguminous plants are included in crop rotation thus contributing to atmospheric nitrogen fixation and reduction of application of inorganic nitrogen fertilizers.

[66]Latvia National Development Plan 2021-2027. The list of indicative investment projects, the project No.87, https://www.pkc.gov.lv/lv/nap2027.

Promote and support for precision application of inorganic nitrogen fertilisers

The main aim of the measure is to expand arable land and increase number of farms were precision technologies for application of inorganic nitrogen fertilisers are used in the planning of fertiliser schemes and spreading.

Promote and support for direct incorporation of organic fertilisers into the soil

The main aim of measure is to expand arable land where organic fertilisers are directly incorporated into the soil thus promoting more efficient use of organic fertilisers.

Promote feed ration planning and improvement of feed quality

The main aim of measure is to increase number of cows whose feed rations are balanced for reduced crude protein level without loss in milk production. As wee as to increase number of cows whose are fed with feed with high digestible energy.

Maintenance and modernization of amelioration systems on agricultural land

The main aim of the measure is to increase arable land area with improved and maintained amelioration systems, thereby reducing N leaching and run-off from agriculture.

Promote the production of biogas and biomethane and the use of biomethane

The main aim of the measure is to ensure the installation of biogas production and biogas purification (biomethane production) facilities on farms that do not yet have biogas production and purification facilities.

V.IV LULUCF

WEM scenario

The main changes relate to the following:

Methodological improvements in GHG emissions calculation from organic soils in cropland, grassland and forest land, including more accurate activity data and verified and CH_4 and CO_2 emission factors. Minor changes are associated with continuous improvement of the National Forest inventory data, more specifically – recalculation of land use changes following to the methodology published by Krumšteds et al. (2019)[67]. Changes of area of organic soils in cropland and grassland is calculated according to Petaja et al. (2018)[68]. No changes are introduced in the evaluation of the effect of the existing measures.

WAM scenario

Restoration of former peat extraction sites

Former and actively employed peat extraction sites are considerable source of GHG emissions. Afforestation or rewetting following to extraction of remaining peat layer, if possible. Rewetting may be selected in areas where tree cultivation is not possible or potentially biologically areas. According to recent studies afforestation under natural conditions (restored groundwater level) would be natural succession in about 50% of degraded peatlands, while flooding would take place in about 20% of area and continuous water layer would not occur in the remaining 30% of degraded peatlands.

The climate change mitigation effect is calculated assuming that the most of degraded areas are afforested. The emission reduction potential consists of accumulation of CO_2 in living and dead biomass and reduction

[67] Krumšteds, L. L., Ivanovs, J., Jansons, J., & Lazdiņš, A. (2019). Development of Latvian land use and land use change matrix using geospatial data of National forest inventory. Agronomy Research, 17, https://doi.org/10.15159/AR.19.195

[68] Petaja, G., Okmanis, M., Polmanis, K., Stola, J., Spalva, G., & Jansons, J. (2018). Evaluation of greenhouse gas emissions and area of organic soils in cropland and grassland in Latvia – integrated National forest inventory data and soil maps approach. Agronomy Research, 16(4), 1809–1823, https://doi.org/10.15159/ar.18.183

of GHG emissions from soil. The assumptions are based on the results of the LIFE REstore project, assuming that GHG emissions in afforested areas reduce to values characteristic for drained nutrient-poor coniferous forests. No GHG reduction is considered in in flooded or rewetted lands, because of lack of scientific evidence of the emission reduction in rewetted areas.

In spite it is considered that at least half of the degraded peatlands can be afforested, in practice this measure may need significant investments in regulation of water regime to avoid risk of temporal floods. Insufficient funding in modernization of drainage systems may result in significantly smaller GHG mitigation effect.

Restoration and modernization of amelioration systems in cropland

Primary functions of amelioration systems in cropland are increase of technical accessibility of farmlands in spring and reduction of flood risks, including temporal flooding resulting in disease or significant damages of farm crops. Amelioration systems is mandatory precondition for efficient and competitive farming in the flat landscape of Latvia, and in many cases amelioration systems belongs to critical infrastructure retaining living conditions suitable for human beings. More than 90% of cropland in Latvia is covered by drainage network. The total area that could be affected by the measure until 2030 is 50000 ha (5000 ha per year). This is indicative value and will be updated during adaptation of the measure in the policy documents.

V.V Waste

WEM scenario

The main changes relate to the following:

To reach requirement about 10% of Municipal solid waste disposal from generated amount in year 2035 is a main point of reference for WEM scenario.

WAM scenario

Increase biological waste preparation for treatment to 210 000 t per year

One Biological waste treatment facility operates in Latvia. Expected capacity is 125 000 tons per year. Till 2028 it is planned to open 6 new facilities for biological waste treatment. Planned capacity for 6 new facilities is 100 000 tons. Operation of these facilities will increase biological waste preparation for treatment.

Increase preparation of Refused derived fuel to 130 000 t per year

For previous period 30 000 tons/year of Refused derived fuel (RDF) were prepared and combusted in cement kiln factory. In plans are new RDF incineration facility with 15 000 tons capacity. The estimation of PaM mitigation impact is included in PaM - *Increase biological waste preparation for treatment to 210 000 t per year.*

Increase biological waste treatment to 110 000 t per year

Together with composting biological waste treatment increases over 110 000 tons per year. The estimation of PaM mitigation impact is included in PaM - *Increase biological waste preparation for treatment to 210 000 t per year.*

VI PROJECTIONS

The scenarios underlying emissions projections in the 2022 submission have incorporated new insights with regard to economic and demographic developments, sector developments, fossil fuel prices, the CO_2 price and policies when compared with the projection of BR4[69] (2019).

Last historical year for GHG emissions is 2020 from Latvia`s 2022 GHG inventory but GHG emissions are projected for years 2025, 2030, 2035 and 2040 in Latvia. Emission projections include and provide information about the implementation of policies and measures which are defined in policy documents developed by the government of Latvia until the year 2020. These projections correspond to the "scenario with existing measures". In addition to WEM scenario, emissions projections with planned additional measures are only described in the approved government documents, but legal regulations and implementation mechanisms have not yet been elaborated. This is the scenario "with additional measures" (WAM). In addition to the projections, sensitivity scenarios have been assessed for the Energy, Agriculture, Waste (including wastewater) and LULUCF sectors to evaluate the impact of GDP and population growth rate as well as changes in sectorial assumptions.

Latvia has not reported projections of "without measures" scenario, because it is not mandatory and may concern additional cost to prepare.

Total GHG emissions (excluding LULUCF) under the WEM scenario will decrease in 2030 against 2020 by 2.6% and in 2040 by 20.0% (Figure 5).

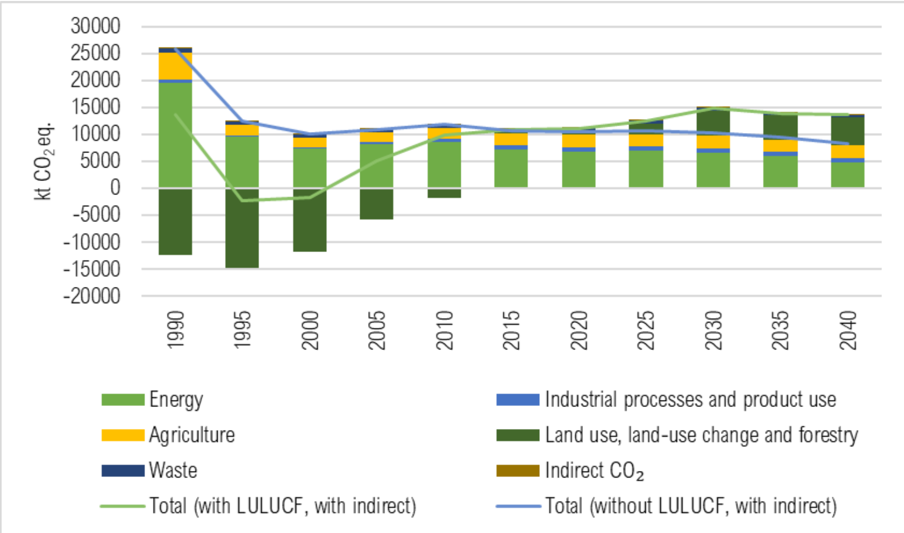

Figure 5 GHG emission projections in WEM scenario, kt CO_2 eq.

In WEM scenario Energy sector (including Transport) will account for the biggest share amounting to 65.0% of total projected GHG emissions in 2030, followed by the Agriculture sector with its share amounting to 22.4%, IPPU with 8.2% share and Waste sector with 4.4%. The projected emissions change trends differ across different sectors.

The planned additional GHG emission mitigation measures under the WAM scenario allow a reduction of projected emissions (Figure 6). Thus, in 2030 and 2040, under the WAM scenario emissions are by 4.2% and 6.7% lower than in the respective years under the WEM scenario.

[69] BR4, https://unfccc.int/BRs

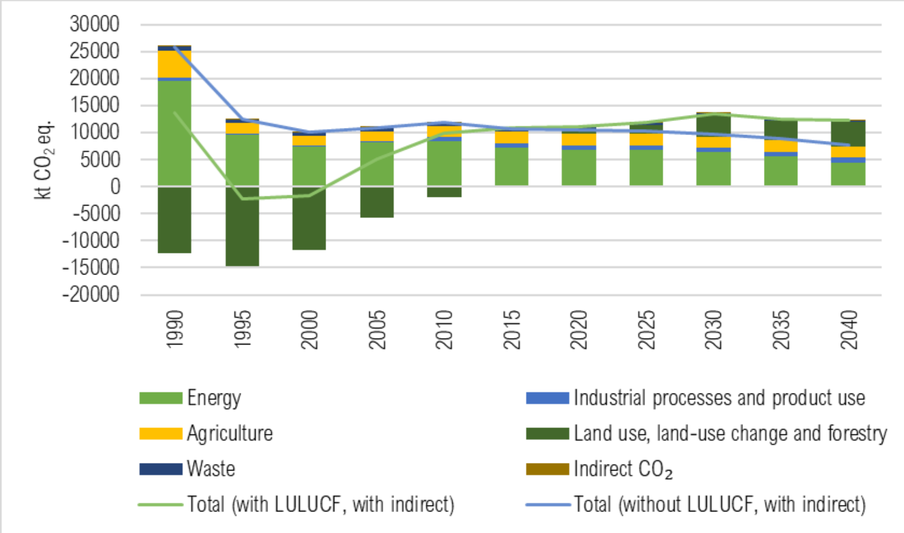

Figure 6 GHG emission projections in WAM scenario, kt CO_2 eq.

Further detailed information on projections is reported in the chapter 5 "Projections and the total effects of policies and measures" of the NC8.

Precursor gases and SO_2

Emissions for 2020 are taken from Latvia's national GHG inventory 1990-2020, submitted to the UNFCCC on 14 April 2022 but projections for air pollutants are from 2021 submission of projections under CLRTAP[70]. CO emissions are not mandatory to report under CLRTAP, therefore in BR5 projected CO emissions are also not reported. Some inconsistencies with the projections for GHG may therefore occur.

Table 6 Projections of NO_x, NMVOC and SO_2 emissions by sector (kt)

	2020	2025	2030	2040
Total NO_x	**31.95**	**29.53**	**28.42**	**24.77**
- Energy	25.39	22.36	20.92	16.99
- IPPU	1.96	2.33	2.44	2.62
- Agriculture	4.52	4.81	5.02	5.15
- LULUCF	0.09	0.03	0.03	NE
- Waste	0.004	0.01	0.01	0.01
Total NMVOC	**33.56**	**38.19**	**38.17**	37.91
- Energy	13.35	16.78	16.15	15.02
- IPPU	12.42	13.40	14.00	15.18
- Agriculture	7.54	7.78	7.83	7.54
- LULUCF	NA	NA	NA	NA
- Waste	0.26	0.23	0.20	0.18
Total SO_2	**3.51**	**3.10**	**2.98**	**3.05**
- Energy	3.31	2.98	2.85	2.92
- IPPU	0.20	0.12	0.12	0.13
- Agriculture	NA	NA	NA	NA
- LULUCF	NA	NA	NA	NA
- Waste	0.0005	0.001	0.001	0.001

Sensitivity analysis

Performing GHG emissions calculations in different sectors, it was taken into account that there are sector-specific key drivers which influence emissions projected amount as well as uncertainties regarding the future trends of parameters, used for GHG emissions projecting, exist. Therefore, the availability of sensitivity

[70] 2021 submission of projections under CLRTAP, https://cdr.eionet.europa.eu/lv/un/clrtap/projected/envyhql2q/

analysis around the chosen baseline (WEM scenario) was particularly useful to show how changes in key drivers would affect emissions. Four sensitivity analysis regarding GHG emissions projections have been carried out. GDP and population assumptions impacts on projected GHG emissions have been analysed in Energy and Waste sector. In Energy sector the projected higher GDP growth rates and higher population in the alternative scenario affect parameters such as floor area in residential sector, passenger kilometres and freight transportation (tkm) in transport, value added in manufacturing and others parameters. In Agriculture sector the sensitivity analysis is used to determine how different projection approaches of milk yield can impact the total emissions under a given set of assumptions. In sensitivity analysis of LULUCF is considered the implementation of the proposed changes in forest management regulations affecting threshold values for the tree diameters sufficient for regenerative felling and forest regeneration requirements. The scenario of sensitivity considers increased intensity of early tending and pre-commercial thinning and reduced intensity of thinning in pre-mature forest stands. For this report sensitivity analysis is not made for IPPU sector because it is not mandatory however it is planned in the next reporting cycle. Further detailed information on sensitivity analysis is reported in the chapter 5 “Projections and the total effects of policies and measures” of the NC8 (see chapter 5.2 “Sensitivity analysis”).

Models and methodology

There are no changes to implemented Models or Methodologies compared to BR4. Further detailed information on models and methodology is reported in the chapter 5 “Projections and the total effects of policies and measures” of the NC8 (see chapter 5.4 “Methodology”). Summarized information on the implemented Models and Methodologies can be found in Table 7 of BR5 (section VI PROJECTIONS).

Table 7 Description of implemented models for GHG projections

Model	Gases and/sector	Type of model/approach and characteristics	Original purpose and changes to climate change purposes	Strengths and weaknesses of the model/approach	Overlap or synergies with PAM
MARKAL-Latvia	All GHG and air pollution emissions Energy and Transport	Partial equilibrium, bottom-up, optimization model. It is used Elastic demand approach. Additional information can be found at: http://www.iea-etsap.org/web/Markal.asp	Original purpose is to describe development of the Latvian energy system over a period of 50 years on the national level. The model structure is adapted, so that emissions can be calculated and reported not only by the type of fuel, but also by sector and corresponding type of technologies. Model is developed to investigate impact of specific policies (energy efficiency and RES) to GHG emissions.	Strength: Well understood least-cost modelling paradigm (efficient markets); Provides a framework to evaluate technologies on the basis of cost assumptions, to check the consistency of results and explore sensitivities to key data and assumptions; Transparent framework; open assumptions on data, technology pathways, constraints etc; Interactions within entire energy system (e.g. resource supply curves, competing use for infrastructures and fuels, sectoral technology diffusion); Ability to track emissions and energy consumption across the energy system, and model the impact of constraints on both; Weaknesses: Model is highly data intensive (characterization of technologies and RES);	Considering that MARKAL model is optimisation model, the impact assessment of defined PaMs might be done without overlapping. The MARKAL model chooses the PaMs according the least cost order (e.g., at first it is chosen the energy efficiency measures having lower costs which are followed by the higher costs' RES measures). Thus as the result, the integrated evaluation of energy system is performed. To minimise the risk of overlapping the GHG savings from PaMs a package approach has been adopted when accounting for the impact of policies on emissions.

Model	Gases and/sector	Type of model/approach and characteristics	Original purpose and changes to climate change purposes	Strengths and weaknesses of the model/approach	Overlap or synergies with PAM
				Limited ability to model consumers' behaviour;	
F-gases Excel based accounting model	HFC and SF_6 CRF 2.F Product uses as substitutes for ODS; CRF 2.G Other product manufacture and use.	Accounting model: Top-down accounting model is based on 2006 IPCC guidelines and adjusted for projection estimation incorporating parameters according to macroeconomic projections.	The F-gases accounting model originally was designed for F-gases emission calculation in annual GHG inventory.	Strength: As the one model is used for F-gases emission calculation in both GHG inventory and for estimation of projections hence the consistency is ensured Weakness: Susceptible to trivial human errors.	In purpose to avoid the overlapping that may exist between different PaMs the analyse of PaMs is carried out before including them into WEM or WAM scenario. Afterwards measures are grouped and combined by the type of their effect.
IPCC Waste model and Excel based estimation of activity data	All GHG and air pollution emissions CRF 5 Waste	IPCC Waste model: bottom up approach. Emission projection estimations based on IPCC methodology. Estimations of activity data are based on macroeconomic projections, existing trends and existing/planned PaMs in the sector.	IPCC Waste model was originally designed for estimation of CH_4 emission from solid waste disposal.	Strength: IPCC Waste model: Comparability with calculations from other countries. Excel based estimations: simplicity and flexibility. Weakness: IPCC Waste model: Low flexibility if parameters are changing due to time series. Excel based estimations: Susceptible to trivial human errors in interpretation of existing or projected trends in the sector.	Existing and planned PaMs are taken into account in order to estimate relevant activity data for emission projections.

Model	Gases and/sector	Type of model/approach and characteristics	Original purpose and changes to climate change purposes	Strengths and weaknesses of the model/approach	Overlap or synergies with PAM
IPCC AFOLU model and Excel or R based estimation of activity data	All GHG and air pollution emissions CRF 3 Agriculture.	IPCC AFOLU model: bottom up approach. Emission projection estimations are based on IPCC methodology. Estimations of activity data are based on projection of milk and grain price; as well as on existing trends of agricultural sector activity data.	IPCC AFOLU model was originally designed for estimation of CH_4 and N_2O emissions from enteric fermentation, manure and soil management.	Strength: IPCC AFOLU model: Comparability of calculations for inventory and providing of calculation consistency. Weakness: Regression based estimation of activity data is done by using different sources of macroeconomic indicators, low flexibility in relation to existing PaMs.	Existing PaMs are evaluated in order to estimate relevant emission projections by using IPCC methodology.
LULUCF	Primarily CO_2	AGM model for calculation of forest growth considering probabilities of different forest management measures. Predicts increment, natural mortality and harvesting, as well as forest structure (species composition, age structure, dimensions of trees). The model is working with National forest inventory data extrapolated of national scale.	Originally developed to predict forest resources, additions implemented – special forms to calculate GHG fluxes using national GHG inventory model.	Strengths: The model is verified using historical data and provides data necessary for modelling of all carbon pools. Weakness: Cumulative effect of ageing of forests and depletion of drainage systems is not considering potentially underestimating carbon losses due to natural disturbances.	The model is used to evaluate PaMs in forest lands.

Comparison of projections between BR4 and BR5

In BR4 reference year was 2017 and projections were calculated up to 2035. Some of the main assumptions and results of the BR4 and BR5 projections are presented in Table 8.

Table 8 Comparison of projections between BR4 and BR5

	2025	2030	2035
BR4 Population, thousand people	1751.41	1634.37	1567.22
BR5 Population, thousand people	1849.68	1799.00	1760.97
Difference between BR4 and BR5	98.27	164.63	193.75
BR4 Annual GDP growth rates, per cent	2.5	2.0	1.9
BR5 Annual GDP growth rates, per cent	3.8	2.4	2.2
Difference between BR4 and BR5	1.3	0.4	0.3
BR4 WEM total emissions (without LULUCF, indirect CO_2), kt CO_2 eq.	11219	10408	9240
BR5 WEM total emissions (without LULUCF, indirect CO_2), kt CO_2 eq.	10578	10174	9484
Difference between BR4 and BR5	-641	-234	244
BR4 WAM total emissions (without LULUCF, indirect CO_2), kt CO_2 eq.	10970	10262	9068
BR5 WAM total emissions (without LULUCF, indirect CO_2), kt CO_2 eq.	10323	9752	8927
Difference between BR4 and BR5	-647	-510	-141

The difference in GHG projections in the WEM scenario between the BR4 and BR5 report is due to three main reasons. First of all, historical GHG emissions in the agriculture sector have been significantly recalculated in 2021 GHG inventory, as a result, GHG emissions decreased in the base year and, accordingly, also for projections in 2025 and subsequent years. Secondly, as can be seen in Table 8, GHG emission projections in the BR5 report are calculated based on projections of macroeconomic indicators (GDP growth, population, private consumption, projections for fossil fuel). If the number of inhabitants in the last calculated projections is a bit higher, then the GDP growth is a bit lower. It balances the impact of changes in macroeconomic parameters. Thirdly, as can be seen in chapter V “Policies and Measures” have been clarified and slightly changed in certain sectors.

The differences between the results of the WAM scenario, in addition to the factors already listed, are caused by the clarification of policies and measures in the BR5 report. Differences in current projections and previous submissions scenarios are shown in Figure 7.

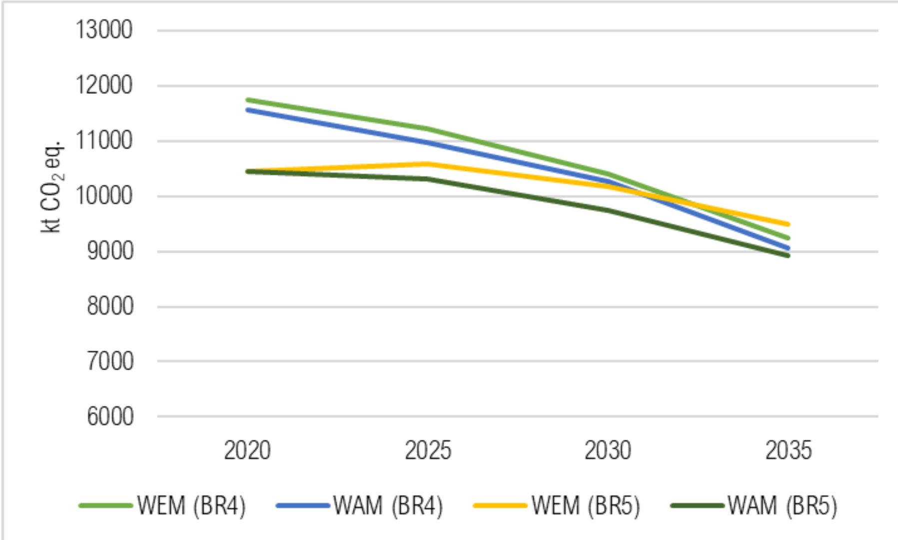

Figure 7 Comparison of submitted GHG projections for BR4 and BR5

VII PROVISION OF FINANCIAL, TECHNOLOGICAL AND CAPACITY- BUILDING SUPPORT TO DEVELOPING COUNTRY PARTIES

This section includes information on the provision of financial, technological and capacity-building support to developing countries by Latvia. Further information, can be found in chapter 7 “Financial resources and transfer of technology” of the NC8.

It should be emphasized that Latvia due to strict budgetary constraints have limited opportunities to participate in the financing of climate change and to support developing countries. As regards of scaling up climate finance, Latvia would like to acknowledge that an essential factor is the leverage of private finance. Private finance and investment will be pivotal to achieving long-term transformation of developing countries into low-carbon, sustainable, and climate-resilient economies.

Latvia is not an Annex II Party therefore the provisions of United Nations Framework Convention on Climate Change Article 4.3, 4.4 and 4.5 are not applicable, but it was decided to report provision of financial support according to Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council.

Regarding capacity-building Latvia has engaged in bilateral cooperation with Georgia, Kyrgyzstan and Uzbekistan in 2019.

In Georgia Latvian-Georgian training seminar in Tbilisi on implementation of measures for low-carbon development in the EU Eastern Partnership or Central Asia country was organized, with funding of 3 291.40 EUR. The seminar focused on basic elements of the GHG forecasting and GHG inventory preparation of the Latvian national system, including information regarding the time schedules for submission of reports, development of future climate change scenarios at national level and experience with the use of the COPERT model in the calculation of GHG emissions from the transport sector.

University of Daugavpils implemented the project in Georgia “Promoting the initiative and strengthening the capacity to promote entrepreneurship in the fisheries” with funding of 39 284.79 EUR. The aim of the project was to support the Ministry of Agriculture of the Autonomous Republic of Adjara and the LEPL Laboratory Research Centre for the development of small and medium-sized enterprises in the fisheries by improving the quality assessment and standardization system in the fisheries, strengthening coordination of common standardization processes and exchanging experience ensuring the monitoring of the sector and access to information and development perspectives, as well as promoting the participation of stakeholders and the development of competencies in the development of the fisheries.

The Latvian Association of Local Governments supported the project in Kyrgyzstan “Promoting co-operation between municipalities and the government and improving public administration in Kyrgyzstan” with funding of 36 287.18 EUR with aim to promote good governance in Kyrgyzstan by building the institutional capacity of the public administration. The project also developed recommendations for improving the performance of local governments and promoting cooperation, environmental protection and waste management.

In 2019 there was also a capacity-building project implemented in Uzbekistan by “SunGIS” with aim to identify the needs of GIS technologies used in the administrative system of the Republic of Uzbekistan, to analyse the existing systems and data structure in order to develop proposals for the implementation of open technology GIS solutions in the administrative management of Uzbekistan – “Assessing the applicability of open source technologies in the administrative management of the Republic of Uzbekistan” with funding of 7 542.01 EUR.

Latvia intends to continue the work on the support to developing countries in the future including bilateral channels.

Summarized information on the financial and provision of capacity – building support can be found in the CTF Tables 7 and 9 included also in BR5. The technology support and transfer were not provisioned, therefore in the BR5 the CTF Table 8 is not presented.

COMMON TABULAR FORMAT WORKBOOK FOR THE BR5

Contents

CTF Table 1: Emission trends

Table 1
Emission trends: summary
(Sheet 1 of 3)

LVA_BR5_v2.0

GREENHOUSE GAS EMISSIONS	Base year[a]	1990	1991	1992	1993	1994	1995	1996	1997	1998
	kt CO_2 eq									
CO_2 emissions without net CO_2 from LULUCF	19,661.40	19,661.40	17,919.40	14,193.36	11,921.50	10,370.01	9,133.78	9,211.50	8,679.76	8,305.88
CO_2 emissions with net CO_2 from LULUCF	6,259.44	6,259.44	4,082.91	-91.57	-2,182.98	-6,633.71	-6,741.08	-6,822.43	-5,591.25	-5,018.54
CH_4 emissions without CH_4 from LULUCF	3,623.78	3,623.78	3,576.29	3,083.89	2,362.71	2,190.97	2,179.95	2,143.20	2,108.40	2,021.60
CH_4 emissions with CH_4 from LULUCF	4,178.85	4,178.85	4,127.02	3,711.65	2,915.09	2,739.82	2,736.88	2,699.75	2,665.40	2,577.07
N_2O emissions without N_2O from LULUCF	2,583.07	2,583.07	2,476.84	1,922.64	1,498.76	1,270.50	1,117.44	1,118.76	1,121.88	1,075.44
N_2O emissions with N_2O from LULUCF	3,129.12	3,129.12	3,044.80	2,500.51	2,068.84	1,840.82	1,689.38	1,692.51	1,696.66	1,652.10
HFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	17.13	29.43	38.94	47.59
PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Unspecified mix of HFCs and PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
SF_6	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.17	0.18	0.37	0.52
NF3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Total (without LULUCF)	25,868.25	25,868.25	23,972.53	19,199.88	15,782.96	13,831.49	12,448.48	12,503.06	11,949.36	11,451.02
Total (with LULUCF)	13,567.40	13,567.40	11,254.72	6,120.58	2,800.95	-2,053.07	-2,297.51	-2,400.56	-1,189.87	-741.26
Total (without LULUCF, with indirect)	25,908.66	25,908.66	24,010.92	19,235.41	15,816.57	13,864.48	12,480.51	12,533.83	11,978.23	11,478.43
Total (with LULUCF, with indirect)	13,607.81	13,607.81	11,293.11	6,156.11	2,834.55	-2,020.07	-2,265.48	-2,369.79	-1,161.00	-713.85

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a]	1990	1991	1992	1993	1994	1995	1996	1997	1998
	kt CO_2 eq									
1. Energy	19,494.38	19,494.38	18,026.42	14,634.96	12,528.91	10,835.39	9,578.59	9,647.87	9,071.94	8,654.98
2. Industrial processes and product use	655.98	655.98	588.36	308.08	149.62	196.95	227.13	250.18	275.14	288.23
3. Agriculture	4,985.80	4,985.80	4,596.48	3,535.52	2,458.86	2,168.24	2,004.23	1,963.60	1,946.00	1,841.74
4. Land Use, Land-Use Change and Forestry[b]	-12,300.85	-12,300.85	-12,717.81	-13,079.30	-12,982.01	-15,884.56	-14,745.99	-14,903.62	-13,139.23	-12,192.28
5. Waste	732.09	732.09	761.27	721.33	645.56	630.91	638.53	641.40	656.29	666.07
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)	13,567.40	13,567.40	11,254.72	6,120.58	2,800.95	-2,053.07	-2,297.51	-2,400.56	-1,189.87	-741.26

Notes: All footnotes for this table are given on sheet 3 of table 1

Table 1
Emission trends: summary
(Sheet 2 of 3)

GREENHOUSE GAS EMISSIONS	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
CO_2 emissions without net CO_2 from LULUCF	7,717.71	7,081.47	7,496.32	7,520.25	7,725.86	7,730.93	7,810.47	8,309.83	8,637.10	8,197.89	7,456.01
CO_2 emissions with net CO_2 from LULUCF	-1,956.26	-5,815.80	-5,833.33	-4,114.63	-3,485.72	234.09	892.17	583.19	1,357.88	530.74	2,692.01
CH_4 emissions without CH_4 from LULUCF	1,887.59	1,885.83	1,971.51	1,944.97	1,856.57	1,823.93	1,870.14	1,823.41	1,868.53	1,855.33	1,872.33
CH_4 emissions with CH_4 from LULUCF	2,469.77	2,449.24	2,501.12	2,501.83	2,393.61	2,356.90	2,379.40	2,374.80	2,378.51	2,365.16	2,397.18
N_2O emissions without N_2O from LULUCF	1,012.63	1,026.99	1,104.85	1,068.65	1,115.61	1,100.81	1,138.28	1,139.44	1,189.91	1,166.62	1,191.00
N_2O emissions with N_2O from LULUCF	1,593.30	1,606.67	1,681.79	1,650.37	1,696.23	1,681.69	1,716.94	1,726.06	1,770.74	1,748.12	1,774.03
HFCs	55.93	64.60	72.86	80.68	88.46	96.69	105.20	132.80	154.49	178.32	188.60
PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Unspecified mix of HFCs and PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
SF_6	0.71	0.88	1.39	2.62	2.76	3.25	3.78	4.07	4.55	5.23	7.33
NF3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Total (without LULUCF)	10,674.57	10,059.78	10,646.93	10,617.17	10,789.25	10,755.60	10,927.87	11,409.54	11,854.58	11,403.40	10,715.26
Total (with LULUCF)	2,163.44	-1,694.41	-1,576.17	120.87	695.34	4,372.62	5,097.49	4,820.91	5,666.17	4,827.58	7,059.14
Total (without LULUCF, with indirect)	10,701.26	10,084.56	10,671.11	10,642.18	10,809.14	10,775.07	10,949.22	11,426.12	11,872.88	11,421.27	10,732.18
Total (with LULUCF, with indirect)	2,190.12	-1,669.63	-1,551.99	145.88	715.22	4,392.08	5,118.83	4,837.49	5,684.47	4,845.45	7,076.07

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1. Energy	8,017.89	7,397.85	7,827.63	7,827.23	7,998.19	8,024.71	8,137.43	8,571.57	8,905.96	8,444.76	7,733.32
2. Industrial processes and product use	329.24	286.55	316.63	335.17	356.84	383.02	371.16	423.70	445.50	457.00	455.93
3. Agriculture	1,653.28	1,678.46	1,789.53	1,760.69	1,804.26	1,730.06	1,793.20	1,792.71	1,874.63	1,837.59	1,859.29
4. Land Use, Land-Use Change and Forestry[b]	-8,511.14	-11,754.19	-12,223.10	-10,496.30	-10,093.92	-6,382.99	-5,830.39	-6,588.63	-6,188.41	-6,575.82	-3,656.12
5. Waste	674.18	696.91	713.14	694.08	629.97	617.82	626.08	621.56	628.49	664.04	666.71
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)	2,163.44	-1,694.41	-1,576.17	120.87	695.34	4,372.62	5,097.49	4,820.91	5,666.17	4,827.58	7,059.14

Notes: All footnotes for this table are given on sheet 3 of table 1.

Table 1

Emission trends: summary

(Sheet 3 of 3)

GREENHOUSE GAS EMISSIONS	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
												(%)
CO_2 emissions without net CO_2 from LULUCF	8,554.09	7,810.79	7,519.41	7,368.44	7,171.96	7,262.10	7,210.32	7,214.95	7,859.36	7,648.67	6,994.11	-64.43
CO_2 emissions with net CO_2 from LULUCF	5,557.43	4,401.83	2,731.58	3,830.10	7,436.04	6,216.77	4,280.56	2,784.86	5,864.89	3,844.95	6,235.31	-0.39
CH_4 emissions without CH_4 from LULUCF	1,805.89	1,755.17	1,798.84	1,821.78	1,868.48	1,772.69	1,795.90	1,826.73	1,742.30	1,743.03	1,718.06	-52.59
CH_4 emissions with CH_4 from LULUCF	2,335.87	2,294.52	2,349.71	2,386.75	2,473.92	2,412.01	2,472.15	2,541.12	2,532.84	2,518.54	2,500.35	-40.17
N_2O emissions without N_2O from LULUCF	1,220.54	1,221.39	1,288.45	1,314.00	1,355.13	1,403.93	1,402.18	1,413.41	1,359.75	1,443.00	1,473.61	-42.95
N_2O emissions with N_2O from LULUCF	1,807.71	1,806.83	1,878.84	1,909.59	1,942.07	1,999.44	2,006.64	2,026.92	1,986.78	2,065.33	2,096.69	-32.99
HFCs	214.05	215.86	216.01	229.53	243.65	254.52	275.02	267.87	263.09	255.11	248.91	100.00
PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
Unspecified mix of HFCs and PFCs	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
SF_6	7.35	7.47	7.78	8.50	8.58	10.12	9.89	10.32	10.54	13.82	11.94	100.00
NF3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
Total (without LULUCF)	11,801.93	11,010.68	10,830.48	10,742.25	10,647.80	10,703.36	10,693.31	10,733.28	11,235.04	11,103.63	10,446.63	-59.62
Total (with LULUCF)	9,922.42	8,726.50	7,183.91	8,364.47	12,104.26	10,892.85	9,044.26	7,631.09	10,658.15	8,697.75	11,093.20	-18.24
Total (without LULUCF, with indirect)	11,818.20	11,021.60	10,843.10	10,757.75	10,668.38	10,720.39	10,711.08	10,752.40	11,246.84	11,116.30	10,459.72	-59.63
Total (with LULUCF, with indirect)	9,938.69	8,737.42	7,196.52	8,379.97	12,124.84	10,909.89	9,062.02	7,650.22	10,669.95	8,710.42	11,106.30	-18.38

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
												(%)
1. Energy	8,508.00	7,638.44	7,322.10	7,244.12	7,066.82	7,178.05	7,249.80	7,234.47	7,686.97	7,458.18	6,780.35	-65.22
2. Industrial processes and product use	749.44	846.92	905.11	848.75	863.37	791.23	690.99	768.38	893.97	891.77	868.15	32.34
3. Agriculture	1,878.76	1,890.81	1,974.19	2,032.98	2,109.78	2,158.16	2,166.93	2,179.77	2,096.21	2,201.39	2,250.88	-54.85
4. Land Use, Land-Use Change and Forestry[b]	-1,879.51	-2,284.18	-3,646.58	-2,377.78	1,456.45	189.49	-1,649.05	-3,102.18	-576.89	-2,405.88	646.57	-105.26
5. Waste	665.73	634.51	629.07	616.41	607.84	575.91	585.60	550.66	557.90	552.29	547.25	-25.25
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total (including LULUCF)	9,922.42	8,726.50	7,183.91	8,364.47	12,104.26	10,892.85	9,044.26	7,631.09	10,658.15	8,697.75	11,093.20	-18.24

Further detailed information could be found in the common reporting format tables of the Party's greenhouse gas inventory, namely "Emission trends (CO_2)", "Emission trends (CH_4)", "Emission trends (N_2O)" and "Emission trends (HFCs, PFCs and SF_6)", which is included in an annex to this biennial report.

1 kt CO_2 eq. equals 1 Gg CO_2 eq.

Abbreviation: LULUCF = land use, land-use change and forestry.

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

Table 1(a)

Emission trends (CO_2)

(Sheet 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a]	1990	1991	1992	1993	1994	1995	1996	1997	1998
	kt									
1. Energy	18,644.91	18,644.91	17,105.65	13,853.26	11,772.03	10,174.62	8,925.94	8,993.26	8,446.40	8,066.18
A. Fuel combustion (sectoral approach)	18,644.90	18,644.90	17,105.64	13,853.25	11,772.02	10,174.61	8,925.94	8,993.25	8,446.39	8,066.17
1. Energy industries	6,301.72	6,301.72	5,790.01	4,924.64	4,019.95	3,743.31	3,417.27	3,542.01	3,301.80	3,363.37
2. Manufacturing industries and construction	3,909.78	3,909.78	2,944.09	2,493.86	2,159.66	1,951.22	1,905.58	1,862.21	1,802.86	1,572.09
3. Transport	2,939.95	2,939.95	2,754.14	2,456.85	2,265.65	2,149.58	2,047.77	2,013.42	2,005.57	1,981.03
4. Other sectors	5,493.45	5,493.45	5,617.39	3,977.91	3,326.77	2,330.50	1,549.14	1,572.32	1,323.72	1,146.40
5. Other	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	6.18	3.28	12.45	3.28
B. Fugitive emissions from fuels	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial processes	651.07	651.07	583.50	303.25	144.90	192.30	205.26	216.06	231.33	235.67
A. Mineral industry	537.24	537.24	493.54	226.26	61.17	108.06	126.57	138.83	139.53	139.70
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	69.56	69.56	54.30	43.26	47.98	50.04	45.38	44.16	60.14	62.66
D. Non-energy products from fuels and solvent use	44.28	44.28	35.66	33.73	35.75	34.21	33.30	33.08	31.66	33.31
E. Electronic industry										
F. Product uses as ODS substitutes										
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
3. Agriculture	364.84	364.84	229.66	36.23	3.93	2.43	1.91	1.49	1.32	3.30
A. Enteric fermentation										
B. Manure management										
C. Rice cultivation										
D. Agricultural soils										
E. Prescribed burning of savannas										
F. Field burning of agricultural residues										
G. Liming	357.13	357.13	223.07	32.36	1.60	0.73	1.24	0.64	0.18	2.15
H. Urea application	7.71	7.71	6.59	3.87	2.33	1.70	0.67	0.85	1.14	1.15
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	-13,401.95	-13,401.95	-13,836.49	-14,284.93	-14,104.48	-17,003.72	-15,874.86	-16,033.93	-14,271.01	-13,324.41
A. Forest land	-17,561.03	-17,561.03	-18,342.77	-17,975.56	-17,837.32	-20,313.78	-18,779.61	-18,749.00	-16,103.06	-14,629.27
B. Cropland	2,370.48	2,370.48	2,335.70	2,301.15	2,266.84	2,231.93	2,198.09	2,159.96	2,122.22	2,084.88
C. Grassland	942.81	942.81	941.15	937.80	936.03	933.86	931.94	990.18	984.61	979.46
D. Wetlands	986.75	986.75	1,428.45	433.09	167.55	277.37	283.18	267.62	307.30	220.27
E. Settlements	25.15	25.15	-36.33	-36.57	-34.09	-34.45	-33.04	-19.65	-19.25	-15.97
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

G. Harvested wood products	-166.11	-166.11	-162.69	55.16	396.51	-98.65	-475.42	-683.04	-1,562.83	-1,963.78
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	0.57	0.57	0.59	0.61	0.63	0.65	0.67	0.69	0.71	0.73
A. Solid waste disposal	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
B. Biological treatment of solid waste										
C. Incineration and open burning of waste	0.57	0.57	0.59	0.61	0.63	0.65	0.67	0.69	0.71	0.73
D. Waste water treatment and discharge										
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items:										
International bunkers	1,736.63	1,736.63	752.16	659.67	763.98	972.68	559.54	411.51	326.60	137.90
Aviation	221.15	221.15	299.01	84.10	84.10	77.87	77.87	99.67	99.67	90.33
Navigation	1,515.49	1,515.49	453.15	575.57	679.88	894.81	481.67	311.84	226.93	47.57
Multilateral operations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CO_2 emissions from biomass	3,024.52	3,024.52	3,547.13	3,537.13	3,941.14	4,085.70	4,631.32	4,841.42	4,852.61	4,789.29
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indirect N_2O										
Indirect CO_2 (3)	40.41	40.41	38.39	35.53	33.60	33.00	32.03	30.77	28.87	27.41
Total CO_2 equivalent emissions without land use, land-use change and forestry	19,661.40	19,661.40	17,919.40	14,193.36	11,921.50	10,370.01	9,133.78	9,211.50	8,679.76	8,305.88
Total CO_2 equivalent emissions with land use, land-use change and forestry	6,259.44	6,259.44	4,082.91	-91.57	-2,182.98	-6,633.71	-6,741.08	-6,822.43	-5,591.25	-5,018.54
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry	19,701.81	19,701.81	17,957.79	14,228.89	11,955.10	10,403.01	9,165.82	9,242.27	8,708.63	8,333.29
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry	6,299.85	6,299.85	4,121.29	-56.04	-2,149.38	-6,600.71	-6,709.04	-6,791.66	-5,562.38	-4,991.12

Notes:
All footnotes for this table are given on sheet 3 of table 1(a).

Table 1(a)
Emission trends (CO_2)
(Sheet 2 of 3)

LVA_BR5_v2.0

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1. Energy	7,445.41	6,857.56	7,253.74	7,252.81	7,438.02	7,449.18	7,549.05	8,022.78	8,347.18	7,921.89	7,191.77
A. Fuel combustion (sectoral approach)	7,445.41	6,857.55	7,253.73	7,252.80	7,438.02	7,449.17	7,549.04	8,022.77	8,347.18	7,921.88	7,191.77
1. Energy industries	2,940.28	2,491.00	2,435.86	2,331.21	2,259.75	2,068.30	2,058.13	2,084.68	1,954.74	1,927.07	1,877.07
2. Manufacturing industries and construction	1,422.61	1,156.55	1,055.20	1,104.56	1,123.71	1,137.17	1,143.59	1,214.75	1,209.45	1,102.38	875.57
3. Transport	1,949.13	2,160.40	2,556.06	2,634.27	2,779.35	2,919.70	3,047.03	3,362.65	3,805.14	3,593.70	3,151.11
4. Other sectors	1,123.97	1,049.47	1,206.44	1,175.99	1,268.86	1,312.49	1,292.67	1,351.78	1,375.00	1,295.32	1,282.68
5. Other	9.42	0.14	0.17	6.78	6.35	11.51	7.62	8.91	2.84	3.41	5.34
B. Fugitive emissions from fuels	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00

1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
C. CO2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial processes	268.19	216.70	238.05	247.59	261.39	278.88	258.04	282.72	282.39	269.58	255.56
A. Mineral industry	173.67	122.68	145.16	154.93	163.39	174.50	165.38	193.11	199.63	198.81	190.97
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	61.37	61.10	60.27	60.33	64.63	68.52	49.98	48.36	44.41	37.73	39.01
D. Non-energy products from fuels and solvent use	33.15	32.91	32.61	32.33	33.37	35.85	37.84	36.53	38.35	33.04	25.58
E. Electronic industry											
F. Product uses as ODS substitutes											
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	4.85	4.73	NO, NA	NO, NA	NO, NA
3. Agriculture	3.36	6.02	2.17	19.54	26.08	2.43	2.94	2.80	6.33	5.92	8.34
A. Enteric fermentation											
B. Manure management											
C. Rice cultivation											
D. Agricultural soils											
E. Prescribed burning of savannas											
F. Field burning of agricultural residues											
G. Liming	2.25	4.68	0.32	15.08	24.66	1.01	1.51	1.38	4.90	2.75	3.99
H. Urea application	1.11	1.35	1.85	4.46	1.42	1.42	1.43	1.43	1.43	3.17	4.35
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	-9,673.97	-12,897.27	-13,329.66	-11,634.88	-11,211.58	-7,496.85	-6,918.30	-7,726.64	-7,279.22	-7,667.16	-4,763.99
A. Forest land	-10,983.45	-13,852.36	-14,834.13	-13,378.31	-12,842.88	-9,239.53	-8,787.64	-9,745.33	-9,525.62	-10,546.38	-7,605.86
B. Cropland	2,047.94	2,011.39	1,941.29	1,872.42	1,804.77	1,738.58	1,673.40	1,609.45	1,544.29	1,482.82	1,515.58
C. Grassland	973.41	968.62	1,261.70	1,291.69	1,330.24	1,367.92	1,405.68	1,441.86	1,440.94	1,475.84	1,428.09
D. Wetlands	601.69	408.14	476.87	781.20	660.73	667.01	855.62	1,061.05	500.07	823.44	805.43
E. Settlements	-13.54	-10.41	82.83	93.66	104.58	115.30	126.17	136.78	81.82	92.57	272.33
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products	-2,300.02	-2,422.65	-2,258.22	-2,295.53	-2,269.02	-2,146.12	-2,191.54	-2,230.45	-1,320.72	-995.45	-1,179.57
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	0.75	1.19	2.36	0.30	0.37	0.45	0.44	1.53	1.20	0.51	0.34
A. Solid waste disposal	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
B. Biological treatment of solid waste											
C. Incineration and open burning of waste	0.75	1.19	2.36	0.30	0.37	0.45	0.44	1.53	1.20	0.51	0.34
D. Waste water treatment and discharge											
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items:											
International bunkers	122.09	106.39	703.41	740.59	721.02	794.17	1,011.39	831.32	815.44	955.67	1,189.41
Aviation	90.33	80.98	80.98	84.10	121.50	147.44	178.76	200.64	244.67	294.24	310.61
Navigation	31.76	25.41	622.43	656.49	599.52	646.73	832.64	630.68	570.77	661.43	878.80

Multilateral operations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CO_2 emissions from biomass	4,703.02	4,370.82	4,881.00	4,850.62	5,150.40	5,430.50	5,439.32	5,479.37	5,355.38	5,074.24	5,799.93
CO_2 captured	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO
Long-term storage of C in waste disposal sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indirect N_2O											
Indirect CO_2 (3)	26.68	24.78	24.18	25.01	19.89	19.46	21.35	16.57	18.29	17.88	16.93
Total CO_2 equivalent emissions without land use, land-use change and forestry	7,717.71	7,081.47	7,496.32	7,520.25	7,725.86	7,730.93	7,810.47	8,309.83	8,637.10	8,197.89	7,456.01
Total CO_2 equivalent emissions with land use, land-use change and forestry	-1,956.26	-5,815.80	-5,833.33	-4,114.63	-3,485.72	234.09	892.17	583.19	1,357.88	530.74	2,692.01
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry	7,744.39	7,106.25	7,520.50	7,545.25	7,745.74	7,750.40	7,831.82	8,326.40	8,655.40	8,215.77	7,472.93
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry	-1,929.58	-5,791.02	-5,809.15	-4,089.63	-3,465.84	253.55	913.52	599.76	1,376.18	548.62	2,708.94

Notes:
All footnotes for this table are given on sheet 3 of table 1(a).

Table 1(a) LVA_BR5_v2.0

Emission trends (CO_2)
(Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
												%
1. Energy	8,024.14	7,179.38	6,826.70	6,744.54	6,541.09	6,713.66	6,777.82	6,694.98	7,198.59	6,975.18	6,319.43	-66.11
A. Fuel combustion (sectoral approach)	8,024.13	7,179.38	6,826.69	6,744.53	6,541.07	6,713.65	6,777.81	6,694.97	7,198.58	6,975.17	6,319.41	-66.11
1. Energy industries	2,260.90	2,081.80	1,864.41	1,929.18	1,670.10	1,746.42	1,821.90	1,510.68	1,893.32	1,783.09	1,328.81	-78.91
2. Manufacturing industries and construction	1,073.71	872.49	917.06	761.63	691.29	640.34	576.87	619.25	704.21	625.85	607.88	-84.45
3. Transport	3,223.64	2,861.15	2,757.88	2,794.50	2,917.77	3,097.24	3,119.66	3,271.92	3,297.96	3,282.32	3,068.59	4.38
4. Other sectors	1,458.02	1,356.71	1,280.01	1,252.77	1,252.47	1,220.09	1,247.99	1,279.94	1,283.23	1,260.20	1,299.41	-76.35
5. Other	7.87	7.22	7.33	6.45	9.44	9.57	11.39	13.17	19.85	23.70	14.72	100.00
B. Fugitive emissions from fuels	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	-3.50
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Oil and natural gas and other emissions from energy production	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	-3.50
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Industrial processes	523.64	618.84	676.70	606.15	606.65	522.11	401.80	485.77	615.89	618.59	603.67	-7.28
A. Mineral industry	452.96	569.00	586.96	553.79	571.51	479.57	356.11	447.25	561.62	570.83	560.56	4.34
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C. Metal industry	38.64	13.71	53.34	13.88	0.01	0.81	NO	NO	NO	NO	NO	

D. Non-energy products from fuels and solvent use	32.04	36.13	36.40	38.48	35.13	41.73	45.69	38.52	54.27	47.77	43.11	-2.64
E. Electronic industry												
F. Product uses as ODS substitutes												
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
H. Other	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
3. Agriculture	5.97	12.23	15.69	17.32	23.66	26.15	30.53	33.90	44.49	54.87	70.97	-80.55
A. Enteric fermentation												
B. Manure management												
C. Rice cultivation												
D. Agricultural soils												
E. Prescribed burning of savannas												
F. Field burning of agricultural residues												
G. Liming	1.97	7.98	9.90	13.25	18.93	19.94	22.60	24.43	34.38	44.63	61.87	-82.68
H. Urea application	4.00	4.25	5.79	4.08	4.73	6.21	7.93	9.48	10.11	10.24	9.10	18.08
I. Other carbon-containing fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land Use, Land-Use Change and Forestry	-2,996.67	-3,408.97	-4,787.83	-3,538.34	264.08	-1,045.33	-2,929.77	-4,430.08	-1,994.47	-3,803.72	-758.81	-94.34
A. Forest land	-5,126.65	-5,572.67	-6,145.88	-5,385.26	-1,106.55	-2,753.48	-3,974.73	-5,734.85	-4,727.73	-5,893.54	-3,490.77	-80.12
B. Cropland	1,500.02	1,484.72	1,404.14	1,389.12	1,368.65	1,357.94	1,348.27	1,398.01	1,428.88	1,442.09	1,409.20	-40.55
C. Grassland	1,418.52	1,409.27	1,370.14	1,359.58	1,079.30	1,066.54	1,054.73	930.82	1,136.67	1,155.22	1,168.56	23.94
D. Wetlands	672.56	924.93	774.38	1,272.20	953.93	1,274.40	876.18	1,041.13	1,702.55	1,376.16	1,394.97	41.37
E. Settlements	300.11	318.01	-354.79	-327.28	-205.88	-170.75	-133.47	429.46	761.84	448.96	485.38	1,830.18
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Harvested wood products	-1,761.23	-1,973.23	-1,835.82	-1,846.71	-1,825.39	-1,819.98	-2,100.74	-2,494.66	-2,296.69	-2,332.62	-1,726.14	939.14
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
5. Waste	0.34	0.34	0.32	0.43	0.56	0.18	0.17	0.29	0.40	0.03	0.04	-93.25
A. Solid waste disposal	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
B. Biological treatment of solid waste												
C. Incineration and open burning of waste	0.34	0.34	0.32	0.43	0.56	0.18	0.17	0.29	0.40	0.03	0.04	-93.25
D. Waste water treatment and discharge												
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Memo items:												
International bunkers	1,163.15	1,044.60	1,131.73	1,124.22	1,077.33	1,138.83	1,375.73	1,254.38	587.01	1,401.47	826.39	-52.41
Aviation	356.36	357.45	362.04	373.58	333.39	327.13	372.38	426.42	467.00	481.21	178.05	-19.49
Navigation	806.79	687.15	769.70	750.64	743.94	811.70	1,003.35	827.96	120.02	920.26	648.35	-57.22
Multilateral operations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
CO_2 emissions from biomass	5,155.07	5,390.02	6,048.82	6,123.24	6,476.57	6,140.55	6,265.60	6,611.87	6,994.26	6,943.91	6,624.02	119.01
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Long-term storage of C in waste disposal sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
Indirect N_2O												
Indirect CO_2 (3)	16.27	10.92	12.61	15.50	20.58	17.04	17.77	19.13	11.80	12.67	13.10	-67.58

Total CO_2 equivalent emissions without land use, land-use change and forestry	8,554.09	7,810.79	7,519.41	7,368.44	7,171.96	7,262.10	7,210.32	7,214.95	7,859.36	7,648.67	6,994.11	-64.43
Total CO_2 equivalent emissions with land use, land-use change and forestry	5,557.43	4,401.83	2,731.58	3,830.10	7,436.04	6,216.77	4,280.56	2,784.86	5,864.89	3,844.95	6,235.31	-0.39
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry	8,570.36	7,821.71	7,532.02	7,383.94	7,192.54	7,279.14	7,228.09	7,234.07	7,871.17	7,661.35	7,007.21	-64.43
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry	5,573.70	4,412.75	2,744.19	3,845.60	7,456.62	6,233.81	4,298.32	2,803.99	5,876.70	3,857.62	6,248.41	-0.82

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[b] Fill in net emissions/removals as reported in CRF table Summary 1.A of the latest reported inventory year. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

Table 1(b)

Emission trends (CH_4)

(Sheet 1 of 3)

LVA_BR5_v2.0

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a]	1990	1991	1992	1993	1994	1995	1996	1997	1998
	kt									
1. Energy	21.82	21.82	22.70	20.58	20.91	20.63	20.89	20.93	19.76	18.64
A. Fuel combustion (sectoral approach)	11.92	11.92	13.16	11.88	12.59	12.51	12.98	13.30	12.65	11.81
1. Energy industries	0.19	0.19	0.17	0.15	0.14	0.15	0.12	0.15	0.19	0.21
2. Manufacturing industries and construction	0.24	0.24	0.13	0.12	0.15	0.15	0.14	0.15	0.15	0.16
3. Transport	0.78	0.78	0.71	0.67	0.62	0.59	0.55	0.53	0.50	0.48
4. Other sectors	10.70	10.70	12.14	10.95	11.68	11.62	12.16	12.46	11.81	10.96
5. Other	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	0.00	0.00	0.00	0.00
B. Fugitive emissions from fuels	9.90	9.90	9.54	8.70	8.32	8.13	7.92	7.63	7.12	6.83
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	9.90	9.90	9.54	8.70	8.32	8.13	7.92	7.63	7.12	6.83
C. CO_2 transport and storage										
2. Industrial processes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A. Mineral industry										
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Non-energy products from fuels and solvent use	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
E. Electronic industry										
F. Product uses as ODS substitutes										
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
3. Agriculture	96.45	96.45	92.50	76.51	50.25	44.10	42.99	41.14	40.26	37.46
A. Enteric fermentation	88.86	88.86	85.25	70.62	46.23	40.42	39.16	37.67	36.83	34.18
B. Manure management	7.59	7.59	7.25	5.89	4.02	3.68	3.83	3.47	3.42	3.28
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

D. Agricultural soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming										
H. Urea application										
I. Other carbon-containing fertilizers										
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	22.20	22.20	22.03	25.11	22.10	21.95	22.28	22.26	22.28	22.22
A. Forest land	4.62	4.62	4.55	7.73	4.82	4.78	5.20	5.36	5.55	5.65
B. Cropland	7.87	7.87	7.76	7.64	7.53	7.41	7.30	7.18	7.05	6.93
C. Grassland	7.87	7.87	7.85	7.82	7.79	7.76	7.73	7.65	7.56	7.48
D. Wetlands	1.84	1.84	1.88	1.92	1.96	2.00	2.04	2.08	2.12	2.16
E. Settlements	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
F. Other land	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
G. Harvested wood products										
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	26.67	26.67	27.85	26.27	23.35	22.90	23.32	23.66	24.31	24.76
A. Solid waste disposal	12.59	12.59	13.02	13.47	13.92	14.38	14.84	15.32	15.79	16.28
B. Biological treatment of solid waste	0.67	0.67	0.67	0.66	0.65	0.64	0.63	0.62	0.62	0.62
C. Incineration and open burning of waste	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Waste water treatment and discharge	13.42	13.42	14.16	12.14	8.78	7.89	7.85	7.73	7.90	7.86
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CH_4 emissions without CH_4 from LULUCF	144.95	144.95	143.05	123.36	94.51	87.64	87.20	85.73	84.34	80.86
Total CH_4 emissions with CH_4 from LULUCF	167.15	167.15	165.08	148.47	116.60	109.59	109.48	107.99	106.62	103.08
Memo items:										
International bunkers	0.10	0.10	0.03	0.04	0.04	0.06	0.03	0.02	0.01	0.00
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navigation	0.09	0.09	0.03	0.04	0.04	0.06	0.03	0.02	0.01	0.00
Multilateral operations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CO_2 emissions from biomass										
CO_2 captured										
Long-term storage of C in waste disposal sites										
Indirect N_2O										
Indirect CO_2 (3)										

Notes:
All footnotes for this table are given on sheet 3 of table 1(b).

Table 1(b)
Emission trends (CH_4)
(Sheet 2 of 3)

LVA_BR5_v2.0

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1. Energy	18.09	16.90	17.87	17.84	16.92	17.19	17.70	15.82	15.81	14.90	15.56
A. Fuel combustion (sectoral approach)	11.58	10.87	12.03	11.74	12.16	12.47	12.37	12.00	11.89	10.88	11.75
1. Energy industries	0.19	0.15	0.17	0.18	0.20	0.20	0.17	0.19	0.19	0.18	0.18

2. Manufacturing industries and construction	0.15	0.12	0.16	0.16	0.15	0.19	0.23	0.25	0.22	0.24	0.30
3. Transport	0.47	0.49	0.54	0.52	0.49	0.48	0.45	0.45	0.45	0.38	0.31
4. Other sectors	10.78	10.10	11.15	10.88	11.31	11.60	11.52	11.10	11.04	10.08	10.96
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive emissions from fuels	6.51	6.03	5.84	6.10	4.76	4.71	5.33	3.82	3.92	4.03	3.81
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	6.51	6.03	5.84	6.10	4.76	4.71	5.33	3.82	3.92	4.03	3.81
C. CO_2 transport and storage											
2. Industrial processes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A. Mineral industry											
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Non-energy products from fuels and solvent use	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
E. Electronic industry											
F. Product uses as ODS substitutes											
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
3. Agriculture	32.29	32.47	34.31	33.99	33.99	32.89	33.91	34.19	35.77	34.75	34.66
A. Enteric fermentation	29.24	29.33	30.69	30.26	30.24	29.21	30.11	30.28	31.64	30.66	30.56
B. Manure management	3.05	3.14	3.62	3.73	3.75	3.68	3.80	3.92	4.13	4.09	4.10
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming											
H. Urea application											
I. Other carbon-containing fertilizers											
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	23.29	22.54	21.18	22.27	21.48	21.32	20.37	22.06	20.40	20.39	20.99
A. Forest land	6.88	6.30	4.95	6.03	5.23	5.11	4.18	5.78	4.20	4.20	4.95
B. Cropland	6.80	6.68	6.45	6.22	6.00	5.78	5.56	5.35	5.14	4.94	4.88
C. Grassland	7.40	7.32	7.50	7.71	7.89	8.04	8.19	8.45	8.54	8.69	8.57
D. Wetlands	2.20	2.24	2.28	2.32	2.36	2.40	2.44	2.48	2.52	2.56	2.60
E. Settlements	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
F. Other land	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
G. Harvested wood products											
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	25.12	26.06	26.68	25.96	23.35	22.87	23.19	22.92	23.15	24.56	24.67
A. Solid waste disposal	16.76	17.26	17.75	17.39	16.01	14.92	15.38	15.89	16.35	17.17	17.29
B. Biological treatment of solid waste	0.63	0.63	0.63	0.63	0.65	0.67	0.69	0.64	0.69	0.67	0.70
C. Incineration and open burning of waste	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Waste water treatment and discharge	7.72	8.18	8.29	7.94	6.69	7.28	7.13	6.39	6.12	6.71	6.68
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CH_4 emissions without CH_4 from LULUCF	75.50	75.43	78.86	77.80	74.26	72.96	74.81	72.94	74.74	74.21	74.89
Total CH_4 emissions with CH_4 from LULUCF	98.79	97.97	100.04	100.07	95.74	94.28	95.18	94.99	95.14	94.61	95.89

Memo items:											
International bunkers	0.00	0.00	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.06
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navigation	0.00	0.00	0.04	0.04	0.04	0.04	0.05	0.04	0.03	0.04	0.05
Multilateral operations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CO_2 emissions from biomass											
CO_2 captured											
Long-term storage of C in waste disposal sites											
Indirect N_2O											
Indirect CO_2 (3)											

Notes:
All footnotes for this table are given on sheet 3 of table 1(b).

Table 1(b)
Emission trends (CH_4)
(Sheet 3 of 3)

LVA_BR5_v2.0

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
												%
1. Energy	13.16	11.99	13.07	13.08	14.00	11.49	12.05	14.29	11.89	11.85	11.10	-49.14
A. Fuel combustion (sectoral approach)	9.50	9.47	9.89	9.04	8.58	7.38	7.38	8.19	8.25	7.93	7.08	-40.61
1. Energy industries	0.20	0.19	0.22	0.32	0.38	0.41	0.52	0.59	0.61	0.64	0.61	221.62
2. Manufacturing industries and construction	0.37	0.44	0.49	0.51	0.57	0.56	0.50	0.51	0.60	0.58	0.61	153.27
3. Transport	0.29	0.26	0.23	0.21	0.20	0.19	0.17	0.16	0.15	0.13	0.12	-84.26
4. Other sectors	8.63	8.59	8.95	8.00	7.44	6.22	6.20	6.93	6.89	6.57	5.74	-46.41
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
B. Fugitive emissions from fuels	3.66	2.52	3.18	4.04	5.41	4.11	4.66	6.11	3.64	3.92	4.02	-59.39
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Oil and natural gas and other emissions from energy production	3.66	2.52	3.18	4.04	5.41	4.11	4.66	6.11	3.64	3.92	4.02	-59.39
C. CO_2 transport and storage												
2. Industrial processes	0.00	0.00	0.00	0.00	0.00	0.00	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	
A. Mineral industry												
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C. Metal industry	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO	NO	NO	NO	
D. Non-energy products from fuels and solvent use	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
E. Electronic industry												
F. Product uses as ODS substitutes												
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
H. Other	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
3. Agriculture	34.42	34.81	35.59	36.95	38.33	38.37	38.53	38.82	37.60	37.78	37.79	-60.82
A. Enteric fermentation	30.52	30.90	31.91	33.28	34.46	34.33	34.47	34.75	34.00	34.00	34.24	-61.47
B. Manure management	3.90	3.91	3.68	3.67	3.86	4.05	4.06	4.07	3.60	3.78	3.55	-53.21
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00

D. Agricultural soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Liming												
H. Urea application												
I. Other carbon-containing fertilizers												
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry	21.20	21.57	22.03	22.60	24.22	25.57	27.05	28.58	31.62	31.02	31.29	40.94
A. Forest land	5.25	5.70	6.24	6.87	8.50	9.89	11.38	12.80	15.74	15.00	15.14	227.67
B. Cropland	4.83	4.77	4.72	4.66	4.63	4.59	4.55	4.56	4.58	4.59	4.60	-41.55
C. Grassland	8.43	8.31	8.19	8.07	8.00	7.90	7.83	7.82	7.82	7.85	7.87	-0.07
D. Wetlands	2.70	2.80	2.90	2.99	3.09	3.19	3.29	3.39	3.49	3.59	3.69	100.40
E. Settlements	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
F. Other land	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
G. Harvested wood products												
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
5. Waste	24.65	23.40	23.28	22.84	22.42	21.04	21.26	19.95	20.21	20.09	19.83	-25.66
A. Solid waste disposal	17.31	17.19	17.12	16.55	16.42	15.28	15.19	14.77	14.88	15.34	15.16	20.44
B. Biological treatment of solid waste	0.75	0.88	1.17	1.27	1.47	1.73	2.01	1.89	1.89	1.70	1.77	164.63
C. Incineration and open burning of waste	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	0.00
D. Waste water treatment and discharge	6.59	5.33	5.00	5.02	4.53	4.04	4.06	3.30	3.44	3.05	2.90	-78.40
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total CH_4 emissions without CH_4 from LULUCF	72.24	70.21	71.95	72.87	74.74	70.91	71.84	73.07	69.69	69.72	68.72	-52.59
Total CH_4 emissions with CH_4 from LULUCF	93.43	91.78	93.99	95.47	98.96	96.48	98.89	101.64	101.31	100.74	100.01	-40.17
Memo items:												
International bunkers	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.01	0.06	0.04	-60.90
Aviation	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	59.77
Navigation	0.05	0.04	0.05	0.05	0.05	0.05	0.06	0.05	0.01	0.05	0.03	-62.87
Multilateral operations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
CO_2 emissions from biomass												
CO_2 captured												
Long-term storage of C in waste disposal sites												
Indirect N_2O												
Indirect CO_2 (3)												

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

Table 1(c)

LVA_BR5_v2.0

Emission trends (N_2O)

(Sheet 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a]	1990	1991	1992	1993	1994	1995	1996	1997	1998

	kt									
1. Energy	1.02	1.02	1.19	0.90	0.79	0.49	0.44	0.44	0.44	0.41
A. Fuel combustion (sectoral approach)	1.02	1.02	1.19	0.90	0.79	0.49	0.44	0.44	0.44	0.41
1. Energy industries	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04
2. Manufacturing industries and construction	0.18	0.18	0.17	0.13	0.13	0.07	0.06	0.06	0.07	0.07
3. Transport	0.27	0.27	0.26	0.22	0.16	0.14	0.15	0.14	0.15	0.14
4. Other sectors	0.53	0.53	0.72	0.52	0.47	0.24	0.20	0.21	0.19	0.17
5. Other	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	0.00	0.00	0.00	0.00
B. Fugitive emissions from fuels	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
1. Solid fuels	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
2. Oil and natural gas and other emissions from energy production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. CO_2 transport and storage										
2. Industrial processes	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
A. Mineral industry										
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
E. Electronic industry										
F. Product uses as ODS substitutes										
G. Other product manufacture and use	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
H. Other	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
3. Agriculture	7.41	7.41	6.89	5.32	4.02	3.57	3.11	3.13	3.15	3.03
A. Enteric fermentation										
B. Manure management	0.95	0.95	0.91	0.75	0.51	0.46	0.46	0.44	0.42	0.39
C. Rice cultivation										
D. Agricultural soils	6.47	6.47	5.98	4.57	3.51	3.11	2.65	2.70	2.73	2.64
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming										
H. Urea application										
I. Other carbon containing fertlizers										
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	1.83	1.83	1.91	1.94	1.91	1.91	1.92	1.93	1.93	1.94
A. Forest land	1.79	1.79	1.84	1.87	1.85	1.85	1.85	1.86	1.86	1.86
B. Cropland	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C. Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Wetlands	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
E. Settlements	0.01	0.01	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
F. Other land	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
G. Harvested wood products										
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	0.22	0.22	0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16
A. Solid waste disposal										
B. Biological treatment of solid waste	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Waste water treatment and discharge	0.18	0.18	0.18	0.17	0.17	0.16	0.15	0.13	0.12	0.12

E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total direct N_2O emissions without N_2O from LULUCF	8.67	8.67	8.31	6.45	5.03	4.26	3.75	3.75	3.76	3.61
Total direct N_2O emissions with N_2O from LULUCF	10.50	10.50	10.22	8.39	6.94	6.18	5.67	5.68	5.69	5.54
Memo items:										
International bunkers	0.19	0.19	0.04	0.04	0.06	0.11	0.05	0.04	0.03	0.02
Aviation	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navigation	0.18	0.18	0.03	0.03	0.06	0.11	0.04	0.03	0.03	0.02
Multilateral operations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CO_2 emissions from biomass										
CO_2 captured										
Long-term storage of C in waste disposal sites										
Indirect N_2O	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA
Indirect CO_2 (3)										

Notes:
All footnotes for this table are given on sheet 3 of table 1(c).

Table 1(c) LVA_BR5_v2.0

Emission trends (N_2O)
(Sheet 2 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1. Energy	0.40	0.40	0.43	0.43	0.46	0.49	0.49	0.51	0.55	0.50	0.51
A. Fuel combustion (sectoral approach)	0.40	0.40	0.43	0.43	0.46	0.49	0.49	0.51	0.55	0.50	0.51
1. Energy industries	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02
2. Manufacturing industries and construction	0.06	0.06	0.06	0.06	0.05	0.06	0.07	0.08	0.08	0.08	0.08
3. Transport	0.13	0.14	0.15	0.16	0.17	0.18	0.18	0.18	0.19	0.19	0.16
4. Other sectors	0.18	0.18	0.19	0.19	0.20	0.22	0.21	0.24	0.25	0.22	0.25
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive emissions from fuels	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
1. Solid fuels	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
2. Oil and natural gas and other emissions from energy production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. CO_2 transport and storage											
2. Industrial processes	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
A. Mineral industry											
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
E. Electronic industry											
F. Product uses as ODS substitutes											
G. Other product manufacture and use	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
H. Other	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
3. Agriculture	2.83	2.89	3.12	2.99	3.12	3.04	3.16	3.14	3.27	3.23	3.30
A. Enteric fermentation											

B. Manure management	0.34	0.35	0.37	0.37	0.36	0.35	0.35	0.35	0.36	0.34	0.33
C. Rice cultivation											
D. Agricultural soils	2.48	2.54	2.75	2.62	2.75	2.69	2.81	2.79	2.91	2.89	2.97
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming											
H. Urea application											
I. Other carbon containing fertlizers											
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	1.95	1.95	1.94	1.95	1.95	1.95	1.94	1.97	1.95	1.95	1.96
A. Forest land	1.87	1.87	1.85	1.86	1.85	1.85	1.84	1.85	1.83	1.83	1.81
B. Cropland	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
C. Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
D. Wetlands	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
E. Settlements	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.10	0.12
F. Other land	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
G. Harvested wood products											
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Waste	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.16	0.17	0.17
A. Solid waste disposal											
B. Biological treatment of solid waste	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Waste water treatment and discharge	0.11	0.11	0.11	0.11	0.12	0.11	0.11	0.12	0.12	0.13	0.12
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total direct N_2O emissions without N_2O from LULUCF	3.40	3.45	3.71	3.59	3.74	3.69	3.82	3.82	3.99	3.91	4.00
Total direct N_2O emissions with N_2O from LULUCF	5.35	5.39	5.64	5.54	5.69	5.64	5.76	5.79	5.94	5.87	5.95
Memo items:											
International bunkers	0.02	0.01	0.14	0.12	0.11	0.11	0.13	0.10	0.09	0.08	0.11
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Navigation	0.01	0.01	0.14	0.12	0.10	0.11	0.13	0.09	0.09	0.07	0.10
Multilateral operations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CO_2 emissions from biomass											
CO_2 captured											
Long-term storage of C in waste disposal sites											
Indirect N_2O	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA
Indirect CO_2 (3)											

Notes:
All footnotes for this table are given on sheet 3 of table 1(c).

Table 1(c)
Emission trends (N_2O)
(Sheet 3 of 3)

LVA_BR5_v2.0

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
												%
1. Energy	0.52	0.53	0.57	0.58	0.59	0.59	0.57	0.61	0.64	0.63	0.62	-39.64
A. Fuel combustion (sectoral approach)	0.52	0.53	0.57	0.58	0.59	0.59	0.57	0.61	0.64	0.63	0.62	-39.64
1. Energy industries	0.03	0.02	0.03	0.04	0.05	0.05	0.07	0.08	0.08	0.09	0.08	114.03
2. Manufacturing industries and construction	0.09	0.11	0.12	0.12	0.12	0.12	0.11	0.11	0.13	0.12	0.13	-32.09
3. Transport	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.16	0.17	0.15	0.12	-54.32
4. Other sectors	0.25	0.24	0.25	0.25	0.25	0.26	0.24	0.26	0.27	0.27	0.29	-45.81
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
B. Fugitive emissions from fuels	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
1. Solid fuels	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
2. Oil and natural gas and other emissions from energy production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C. CO_2 transport and storage												
2. Industrial processes	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	-25.10
A. Mineral industry												
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
D. Non-energy products from fuels and solvent use	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
E. Electronic industry												
F. Product uses as ODS substitutes												
G. Other product manufacture and use	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	-25.10
H. Other	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
3. Agriculture	3.40	3.38	3.59	3.66	3.79	3.94	3.94	3.94	3.73	4.03	4.14	-44.11
A. Enteric fermentation												
B. Manure management	0.32	0.31	0.30	0.29	0.30	0.30	0.29	0.29	0.26	0.26	0.25	-73.76
C. Rice cultivation												
D. Agricultural soils	3.08	3.07	3.29	3.37	3.49	3.64	3.65	3.66	3.47	3.77	3.90	-39.75
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Liming												
H. Urea application												
I. Other carbon containing fertlizers												
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry	1.97	1.96	1.98	2.00	1.97	2.00	2.03	2.06	2.10	2.09	2.09	14.11
A. Forest land	1.80	1.80	1.80	1.79	1.73	1.73	1.72	1.72	1.73	1.70	1.68	-5.96
B. Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
C. Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	68.51
D. Wetlands	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-32.54
E. Settlements	0.14	0.14	0.16	0.18	0.21	0.24	0.27	0.31	0.34	0.36	0.37	4,884.04
F. Other land	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
G. Harvested wood products												
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00

5. Waste	0.16	0.16	0.16	0.15	0.16	0.17	0.18	0.17	0.18	0.17	0.17	-20.42
A. Solid waste disposal												
B. Biological treatment of solid waste	0.04	0.05	0.05	0.04	0.05	0.06	0.07	0.06	0.07	0.06	0.06	61.37
C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-92.95
D. Waste water treatment and discharge	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	-38.91
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total direct N_2O emissions without N_2O from LULUCF	4.10	4.10	4.32	4.41	4.55	4.71	4.71	4.74	4.56	4.84	4.94	-42.95
Total direct N_2O emissions with N_2O from LULUCF	6.07	6.06	6.30	6.41	6.52	6.71	6.73	6.80	6.67	6.93	7.04	-32.99
Memo items:												
International bunkers	0.12	0.12	0.14	0.12	0.11	0.18	0.23	0.20	0.06	0.34	0.26	41.05
Aviation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	-3.78
Navigation	0.10	0.11	0.12	0.11	0.10	0.17	0.22	0.18	0.05	0.32	0.26	42.58
Multilateral operations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
CO_2 emissions from biomass												
CO_2 captured												
Long-term storage of C in waste disposal sites												
Indirect N_2O	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	NO, IE, NA	0.00
Indirect CO_2 (3)												

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] The column “Base year” should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

Table 1(d)

Emission trends (HFCs, PFCs and SF_6)

(Sheet 1 of 3)

LVA_BR5_v2.0

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a]	1990	1991	1992	1993	1994	1995	1996	1997	1998
	kt									
Emissions of HFCs and PFCs - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	17.13	29.43	38.94	47.59
Emissions of HFCs - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	17.13	29.43	38.94	47.59
HFC-23	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-32	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00
HFC-41	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-43-10mee	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-125	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00
HFC-134	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-134a	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.01	0.01	0.01	0.01
HFC-143	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-143a	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00
HFC-152	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA

HFC-152a	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-161	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-227ea	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-236cb	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-236ea	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-236fa	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-245ca	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-245fa	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-365mfc	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Unspecified mix of HFCs(4) - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Emissions of PFCs - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
CF_4	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C_2F_6	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C_3F_8	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C_4F_{10}	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
$c\text{-}C_4F_8$	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C_5F_{12}	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C_6F_{14}	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
$C_{10}F_{18}$	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
$c\text{-}C_3F_6$	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Unspecified mix of PFCs(4) - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Emissions of SF_6 - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.17	0.18	0.37	0.52
SF_6	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00
Emissions of NF3 - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
NF_3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA

Notes:
All footnotes for this table are given on sheet 3 of table 1(d).

Table 1(d)
Emission trends (HFCs, PFCs and SF_6)
(Sheet 2 of 3)

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Emissions of HFCs and PFCs - (kt CO_2 equivalent)	55.93	64.60	72.86	80.68	88.46	96.69	105.20	132.80	154.49	178.32	188.60
Emissions of HFCs - (kt CO_2 equivalent)	55.93	64.60	72.86	80.68	88.46	96.69	105.20	132.80	154.49	178.32	188.60
HFC-23	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-41	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-43-10mee	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-125	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
HFC-134	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-134a	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.05	0.05	0.05
HFC-143	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA

HFC-143a	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HFC-152	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-152a	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00	0.00	0.00
HFC-161	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-227ea	NO, NA	NO, NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-236cb	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-236ea	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-236fa	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-245ca	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-245fa	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
HFC-365mfc	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00	0.00
Unspecified mix of HFCs(4) - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Emissions of PFCs - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
CF_4	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C_2F_6	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C_3F_8	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C_4F_{10}	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
$c-C_4F_8$	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C_5F_{12}	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
C_6F_{14}	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
$C_{10}F_{18}$	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
$c-C_3F_6$	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Unspecified mix of PFCs(4) - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
Emissions of SF_6 - (kt CO_2 equivalent)	0.71	0.88	1.39	2.62	2.76	3.25	3.78	4.07	4.55	5.23	7.33
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions of NF_3 - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
NF_3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA

Notes:

All footnotes for this table are given on sheet 3 of table 1(d).

Table 1(d)

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Emission trends (HFCs, PFCs and SF_6)

(Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
												%
Emissions of HFCs and PFCs - (kt CO2 equivalent)	214.05	215.86	216.01	229.53	243.65	254.52	275.02	267.87	263.09	255.11	248.91	100.00
Emissions of HFCs - (kt CO2 equivalent)	214.05	215.86	216.01	229.53	243.65	254.52	275.02	267.87	263.09	255.11	248.91	100.00
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-41	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-43-10mee	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-125	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	100.00

HFC-134	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-134a	0.06	0.06	0.06	0.06	0.07	0.07	0.08	0.08	0.08	0.09	0.09	100.00
HFC-143	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-143a	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	100.00
HFC-152	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-161	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-236cb	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-236ea	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-236fa	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-245ca	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
HFC-245fa	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-365mfc	0.00	0.00	0.00	0.00	0.00	0.00	NO, NA	NO, NA	NO, NA	0.00	0.00	100.00
Unspecified mix of HFCs(4) - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
Emissions of PFCs - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
CF_4	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
C_2F_6	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
C_3F_8	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
C_4F_{10}	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
$c\text{-}C_4F_8$	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
C_5F_{12}	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
C_6F_{14}	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
$C_{10}F_{18}$	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
$c\text{-}C_3F_6$	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
Unspecified mix of PFCs(4) - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NA, NO	NA, NO	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
Emissions of SF_6 - (kt CO_2 equivalent)	7.35	7.47	7.78	8.50	8.58	10.12	9.89	10.32	10.54	13.82	11.94	100.00
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Emissions of NF_3 - (kt CO_2 equivalent)	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
NF_3	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[c]Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equivalent emissions.

[d]In accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories", HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is kt of CO2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.)

CTF Table 2: Description of quantified economy-wide emission reduction target

Table 2(a) LVA_BR5_v2.0

Description of quantified economy-wide emission reduction target: base year[a]

Party	Latvia	
Base year /base period	1990	
Emission reduction target	% of base year/base period	% of 1990 [b]
	20.00%	20.00%
Period for reaching target	BY-2020	

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.
[b] Optional.

Table 2(b) LVA_BR5_v2.0

Description of quantified economy-wide emission reduction target: gases and sectors covered[a]

Gases covered		Base year for each gas (year):
CO_2		1990
CH_4		1990
N_2O		1990
HFCs		1990
PFCs		1990
SF_6		1990
NF_3		1990
Other Gases (specify)		
Sectors covered[b]	Energy	Yes
	Transport[f]	Yes
	Industrial processes[g]	Yes
	Agriculture	Yes
	LULUCF	No
	Waste	Yes
	Other Sectors (specify)	

Abbreviations: LULUCF = land use, land-use change and forestry.
[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.
[b] More than one selection will be allowed. If Parties use sectors other than those indicated above, the explanation of how these sectors relate to the sectors defined by the IPCC should be provided.
[f] Transport is reported as a subsector of the energy sector.
[g] Industrial processes refer to the industrial processes and solvent and other product use sectors.

Table 2(c) LVA_BR5_v2.0

Description of quantified economy-wide emission reduction target: global warming potential values (GWP)[a]

Gases	GWP values [b]
CO_2	4th AR
CH_4	4th AR
N_2O	4th AR
HFCs	4th AR
PFCs	4th AR
SF_6	4th AR
NF_3	4th AR
Other Gases (specify)	

Abbreviations: GWP = global warming potential

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.
[b] Please specify the reference for the GWP: Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) or the Fourth Assessment Report of the IPCC.

Table 2(d) LVA_BR5_v2.0

Description of quantified economy-wide emission reduction target: approach to counting emissions and removals from the LULUCF sector[a]

Role of LULUCF	LULUCF in base year level and target	Excluded
	Contribution of LULUCF is calculated using	

Abbreviation: LULUCF = land use, land-use change and forestry.
[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

Table 2(e)I LVA_BR5_v2.0

Description of quantified economy-wide emission reduction target: market-based mechanisms under the Convention[a]

Market-based mechanisms under the Convention	Possible scale of contributions (estimated kt CO_2 eq)
CERs	NA
ERUs	NA
AAUs[i]	NA
Carry-over units[j]	NA
Other mechanism units under the Convention (specify)[d]	

Abbreviations: AAU = assigned amount unit, CER = certified emission reduction, ERU = emission reduction unit.
[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.
[d] As indicated in paragraph 5(e) of the guidelines contained in annex I of decision 2/CP.17.
[i] AAUs issued to or purchased by a Party.
[j] Units carried over from the first to the second commitment periods of the Kyoto Protocol, as described in decision 13/CMP.1 and consistent with decision 1/CMP.8.

CTF Table 2(e)II: Description of quantified economy-wide emission reduction target: other market-based mechanisms

No information provided in Table 2(e)II, notation key - NA - are provided.

CTF Table 2(f): Description of quantified economy-wide emission reduction target: any other information

No information provided in Table 2(f), notation key - NA - is provided.

CTF Table 3: Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects

Table 3

LVA_BR5_v2.0

Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects

Name of mitigation action[a]	Sector(s) affected[b]	GHG(s) affected	Objective and/or activity affected	Type of instrument[c]	Status of implementation[d]	Brief description[e]	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2 eq)			
									2020	2025 [f]	2030 [f]	2040
Energy Efficiency Requirements for District Heating (DH) Systems*	Energy	CO_2	Reduction of losses (Energy Supply)	Regulatory	Implemented	The minimum energy efficiency requirements are defined for DH technologies: 1.heat production boilers; 2. combined heat-power production (CHP) units; 3. solar heat collectors; 4. heat pumps; 5.maximum heat losses in DH pipeline network.	2018	Ministry of Economics (National government)	NE	NE	NE	NE
Energy Performance of Buildings*	Energy	CO_2	Efficiency improvement of buildings (Energy consumption); the specific energy consumption per floor space (kWh/m2/year) reduction	Regulatory	Implemented	The Law on the Energy Performance of Buildings (recast in force 09.01.2013) provides the general legal framework. The Governmental Regulation (2013, latest recast in April 2021) states the energy efficiency classification system for both residential and non-residential buildings. The mandatory energy performance indicators (EPI) for new buildings are stated. If construction intention of new building is approved 1 January 2021 and hereinafter, the building shall be the nearly-zero energy building (NZEB) - shall be of the A class on condition the EPI reference level of NZEB is technically or functionally possible and	2013	Ministry of Economics (National government)	2.50	2.90	3.90	5.90

						benefit analysis of the useful lifetime of the building does not indicate to losses. New public buildings (state and municipal ones) shall correspond to NZEB starting from 1 January 2019 on the same condition. In turn, Latvia's Construction Standard LBN 002-19 provides the EPI reference levels for heating for renovated and reconstructed buildings. In addition, the particular Governmental Regulation (adopted December 2020) provides minimal requirements for existing, in exploitation, buildings: both residential and non-residential ones are compliant if correspond to at least "E" class building. The given PAM in Latvia case has impact on: district heat consumption especially in residential multi-flat buildings - a large number of Latvia district heating utilities participate in ETS sector. Thus given PAM has impact on both ETS and ESD sectors.						
Voluntary Agreements on Energy Efficiency with industrial sector and other sectors*	Energy	CO_2	Efficiency improvement in industrial and services/tertiary end-use sectors (Energy Consumption)	Voluntary Agreement	Implemented	The general framework is stated by the Energy Efficiency Law. In October 2016 the detailed procedures had been adopted by the Government Regulation, having the following main provisions - at least 10% of energy efficiency improvement, development of energy efficiency action plan, agreement duration at least 5 years, reporting of energy savings.	2016	Ministry of Economics (National government)	NE	NE	NE	NE
Informing Energy Consumers of Residential	Energy	CO_2	Efficiency improvements of buildings (Energy Consumption); Efficiency	Information	Implemented	It motivates to renovate buildings in the frame of the ERDF co-financed measure of	2010	Ministry of Economics (National government)	IE	IE	IE	IE

Sector (Multi-apartment buildings) (1) *			improvement of appliances (Energy Consumption).			Increasing energy efficiency in multi-apartment buildings (PAM No22). The programme "Let's live warmer!" has started in EU Funds 2007-2013 programming period, currently the implementation of the 2014-2020 programming period is on-going. Wide scope of methods are applied by "Let's live warmer!" to reach and to inform and consult communities of the flats' owners regarding conditions and benefits of energy efficiency increase and the best practices of it. Involved in 2016-2023 at least 19589 households (to be reached on 31 December 2023). The programme consults also on the good practice of maintaining the apartment building after renovation. The informing will be continued in the EU Funds programming period 2021-2027. In turn, energy audits of multi-apartment buildings provide reasoned quantitative information; the technical documentation cost is stated as the eligible cost for multi-apartment building renovation projects co-financed by the ERDF. The given PAM has impact on: district heat consumption especially in residential multi-flat buildings - a large number of Latvia district heating utilities participate in ETS sector. Thus given PAM has impact on both ETS and ESD sectors.						

Energy Labelling of Appliances*	Energy	CO_2	Efficiency improvement of appliances (Energy Consumption)	Regulatory	Implemented	The legislative framework by transposition of the provisions of the Ecodesign Directive 2009/125/EC and of the revised Directive on Labelling and standard product information of Energy Related Products (2010/30/EU) has been implemented in Latvia in due time . The provisions, stated by the Energy Labelling Regulation 2017/1369/EU and Commission Regulations on ecodesign and labelling for particular appliances, are implemented directly by the responsible parties. Emissions from electricity consumption is calculated and reported under 1.A.1.a. Public electricity and heat production which is part of ETS.	2011	Ministry of Economics (National government)	NE	NE	NE	NE
Biofuel Mix Obligation*	Transport	CO_2	Low carbon fuels (Transport); Increase in renewable energy (Transport). RES share of transport fuel (RES-F) 10% in 2020	Regulatory	Implemented	To ensure growth of the share of RES in transport sector, in 1 October 2009 Latvia has introduced the Biofuel Mix Obligation. Mixed biofuels shall correspond to the sustainability criteria. Until 31.12.2019 it was mandatory bioethanol mix, 4.5-5% (volume) of total volume for the gasoline of "95" trademark and biodiesel mix, at least 4.5% (volume) of total volume for the diesel fuel. From 1 January 2020 the mandatory volumes of mix are increased: (1) at least 9.5% (volume) bioethanol mix for the gasoline of „95" trademark, (2) at least 6.5% (volume) biodiesel mix for the diesel fuel. Exemption of the mix is done for diesels utilised in winter climate conditions, 1 November – 1 April.	2010	Ministry of Economics (National government)	136.00	145.00	137.00	230.00

Excise Tax – Transport sector*	Transport	CO_2	Efficiency improvements of vehicles (Transport); Low carbon fuels (Transport); Demand management/reduction (Transport)	Fiscal	Implemented	The procedure is established by the Law "On Excise Duties". The implementation has started 1993, afterwards was linked with EU policy.The duty is imposed on gasoline, diesel oil, LPG and natural gas. Currently the use of natural gas vehicles is promoted: in the period 01.01.2021-31.12.2026 the reduced rate (around 19% of the base rate) is applied for natural gas. Also unleaded gasoline with 70-85% (volume) of bioethanol mix and pure biodiesel has reduced rate of duty.	1993	Ministry of Finance (National government)	NE	NE	NE	NE
Annual taxation of vehicles based on specific CO_2 emissions*	Transport	CO_2	Efficiency improvements of vehicles (Transport); Modal shift to public transport or non-motorized transport (Transport)	Fiscal	Implemented	The annual taxation based on the specific CO_2 emissions is introduced in Latvia in several steps: (1) for new cars – in force from 01.01.2017; (2) for the cars firstly registered from 01.01.2009 – in force from 01.01.2019, (3) for light duty vehicles (gross weight up to 3500 kg) firstly registered from 01.01.2012 – in force from 01.01.2021. For the cars and LDV with the specific CO_2 emissions up to 50 grams per km zero tax rate is applied. For the older (as indicated above) cars and LDV the differentiated annual tax continues to base on engine capacity, maximal power of engine and the gross weight of the vehicle.	2017	Ministry of Transport (National government); Ministry of Finance (National Government).	NE	NE	NE	NE
New Passenger Cars Labelling on Fuel Economy Rating*	Transport	CO_2	Efficiency improvements of vehicles (Transport); Low carbon fuels (Transport)	Information, Regulatory	Implemented	The labelling of new cars regarding fuel consumption (litres per 100 km or km per litre) and CO_2 emissions (grams per km).	2003	Ministry of Economics (National government)	2.95	3.85	7.70	15.50

Taxation of Electricity*	Energy	CO_2	Efficiency improvement in the energy transformation sector (Energy Supply); Efficiency improvement in industrial and services/ tertiary end-use sectors (Energy Consumption)	Fiscal	Implemented	The procedure is prescribed by the Electricity Tax Law. The rate is 1.01 EUR/MWh. Tax shall apply to entities who are engaged in the generation, distribution, supply, selling of electricity as well as purchasing electricity in spot exchange. The following end-use exemptions are in force: (i) carriage of goods and public carriage of passengers, including on rail transport and public transport in towns, (ii) household users, (iii street lighting services. The exemption is made also for autonomous producers if they correspond to certain criteria. From 01.01.2023 the electricity that will be utilised for electricity production will be exempted as well.	2007	Ministry of Finance (National government)	NE	NE	NE	NE
Taxation of CO_2 emissions*	Energy	CO_2	Efficiency improvement in the energy transformation sector (Energy Supply); Increase in renewable energy (Energy Supply); Efficiency improvement in industrial and services/ tertiary end-use sectors (Other Energy Supply)	Fiscal	Implemented	The procedure is prescribed by the Natural Resources Tax Law.The implementation of the given PAM started in 2005 as the national policy to get environmental benefits and to start to internalise the external costs related to GHG emissions, afterwards this policy was linked with EU GHG policies. The subject of CO_2 taxation is CO_2 emitting activities (installations) which correspond to EU ETS activities however the amount of the activity (installation) is below the threshold defined for inclusion in EU ETS. The tax shall not be paid for the CO_2 emissions which emerges (i) from the installations participating in the EU ETS, and (ii) while using renewable energy sources. The tax rate	2005	Ministry of Finance (National government)	NE	NE	NE	NE

						per 1 ton of CO_2 emission is gradually raised up from the starting rate 0.142 EUR (July 2005) up to 4.50 EUR (in the period 01.01.2017-31.12.2019) and 9 EUR (in 2020). For year 2021 the rate is 12 EUR, from the 1 January 2022 - 15 EUR per ton of CO_2 emission.						
Taxation on Noxious Air Polluting Emissions*	Energy	CO_2	Efficiency improvement in the energy transformation sector (Energy Supply); Efficiency improvement in the industrial and services/tertiary end-use sectors (Other energy supply)	Fiscal	Implemented	The procedure is prescribed by the Natural Resources Tax Law. The emissions of PM10, CO, SO2, NO_x, NH_3, H_2S and other non-organic compounds, CnHm, VOC, metals (Cd, Ni, Sn, Hg, Pb, Zn, Cr, As, Se, Cu) and their compounds, V2O5 are taxable. Improvement of combustion processes as the technical measure to control noxious emissions results in reducing fuel consumption as well thus creating synergy with GHG emissions reduction. The tax shall be paid by entities which should have pollution permits of A,B,C categories. The given PAM relates to the enterpises both of ETS and ESD sectors, motivating the use of cleaner fuel, thus have impact in both sectors.The implementation of the given PAM started in 1991 as the national policy to get environmental benefits and to start to internalise external costs related to environmental pollution, afterwards this policy was linked with implementation of EU environmental legislation. Amendments, adopted in 2020, have increased the rate for the following emissions: PM10, SO2, NOx NH3, H2S	1991	Ministry of Finance (National government)	NE	NE	NE	NE

						and other non-organic compounds.						
Systematic inspection of the technical conditions of motor vehicles*	Transport	CO_2	Efficiency improvements of vehicles (Transport)	Regulatory	Implemented	Mandatory annual technical inspections of motor vehicles ensure that only those vehicles that comply with technical and environmental requirements are being allowed to take part in road transport. PAM has started as the national policy, afterwards has transposed EU Directive requirements.	1996	Ministry of Transport (National government)	3.00	3.00	3.50	3.50
Development of the infrastructure of environmentally friendly public transport (PT) in cities: 2014-2020 EU Funds Programming Period*	Transport	CO_2	Modal shift to public transport (Transport)	Economic	Implemented	Development of the infrastructure of PT is supported by Cohesion Fund within the framework of the national Operational Programme “Growth and Employment” (the Specific Objective 4.5.1). The increase of number of environmentally friendly vehicles of PT (trams and buses) and length of tram lines is on-going (planned values of new/reconstructed tram lines - 20 km; new/improved buses - 123 ones). Thus, more effective urban transport infrastructure will be developed promoting the use of PT. Investments are made in accordance with cities development plans.	2016	Ministry of Transport (National government)	2.50	2.50	3.90	5.80
Preferential Feed-in Tariffs for Renewable Electricity and Electricity Produced in Combined Heat-Power mode*	Energy	CO_2	Increase in renewable energy (Energy Supply)	Economic	Implemented	The implementation of the given PAM started in 1996 as the national policy to get both environmental benefits, socio-economic benefits by contributing in regional development and benefits in energy security and also in energy production efficiency (by CHP mode); afterwards this policy was linked with EU	1996	Ministry of Economics (National government)	230.00	227.00	192.91	113.48

						RES policies. Currently the legislative provisions are adopted to ensure a controlled closure of the FIT scheme. WEM scenario considers the long-term impact of FIT on the development of RES-electricity capacity - the total RES capacity developed under the FIT scheme is ~240 MW.						
Increased minimum thermal insulation standards of buildings (2) *	Energy	CO_2	Efficiency improvements of buildings (Energy Consumption)	Regulatory	Implemented	The Latvian Construction Standard (LCS) "Thermotechnics of Building Envelopes" systematically increases the requirements. In April 2014 the provisions of the re-cast Energy Performance of Buildings Directive (2010/31/EU) were transposed. In 1 January 2020 the new LCS LBN002-19 is in force that incorporates directly the energy performance indicators reference levels for heating (in kWh per m2 annually) for new buildings and buildings ongoing renovation/reconstruction. As district heating is supplied to large number of buildings and large number of Latvia's district heating utilities participate in EU ETS, the given PAM has impact in both ETS and ESD sectors.	2014	Ministry of Economics (National government)	IE	IE	IE	IE
Investment Support Programme for District Heating (DH) Systems: 2014-2020 EU Funds programming period*	Energy	CO_2	Increase in renewable energy in the heating and cooling sector (Energy Supply); Reduction of losses (Energy Supply); Efficiency improvement in the energy transformation sector (Energy Supply.) RES share in DH - 60%.	Economic	Implemented	The increasing overall efficiency and RES share in DH supply systems is supported within the framework of the national Operational Programme “Growth and Employment” (the Specific Objective 4.3.1). Activities supported: (i) new RES utilising heat production sources (both additional RES capacities to supply new DH	2017	Ministry of Economics (National government)	76.00	76.00	76.00	76.00

						consumers and replacement of existing fossil fuel capacities), (ii) reconstruction for increase of energy efficiency of existing heat production sources utilising RES (renovation of heat boilers, construction of heat accumulation units), (iii) construction (widening) and renovation of DH pipeline systems. RES-utilising technologies include both combustible (biomass) and solar heat.					
Investment Support Programme for Solar PV Energy: 2021-2027 EU Funds programming period	Energy	CO_2	Increase in renewable energy (Energy Supply)	Economic	Planned	This particular measure, planned by the National Development Plan 2021-2027, is planned as the complex financial instrument with the grant part. The wide range of target groups is planned as the beneficiaries – commercial sector, municipal sector as well as energy communities.	2023	Ministry of Economics(National government)	NA	10.00	15.00	15.00
Investment Support in Manufacturing Industry sector to promote efficient use of energy resources, reduction of energy consumption and transfer to RES: 2014-2020 EU Funds programming period*	Energy	CO_2	Increase in renewable energy (Energy Supply), Efficiency improvement in industrial end-use sectors (Energy Consumption).	Economic	Implemented	Investment for new, innovative energy-saving technology, measures increasing energy efficiency and share of RES is co-financed by Cohesion Fund within the framework of the national Operational Programme "Growth and Employment" (the Specific Objective 4.1.1). Type of support - the financial instrument with the grant part. Activities supported relate to improvement of energy efficiency of building's outer constructions and engineering systems, efficient heating system, efficient lighting, improvement of energy efficiency of both production and auxiliary technologies, replacement of non-efficient technologies, use of highly	2016	Ministry of Economics(National government)	4.40	5.30	5.30	5.30

						efficient RES equipment for production of heat and electricity for own consumption, use of RES-utilizing cooling technologies.						
Investment Support in Manufacturing Industry sector to promote energy efficiency and RES utilization: 2021-2027 EU Funds programming period	Energy	CO_2	Increase in renewable energy (Energy Supply); Efficiency improvement in industrial end-use sectors (Energy Consumption)	Economic	Planned	Continuation of the particular support programme in the manufacturing industry sector in the following EU Funds period is planned by the national Energy-Climate Plan 2030 and the National Development Plan 2021-2027. Type of support - financial instrument with a grant part.	2023	Ministry of Economics (National government)	NA	2.10	7.20	7.20
Investment Support to Improve Energy Efficiency in Food Processing Enterprises: 2014-2020 EU Funds programming period*	Energy	CO_2	Efficiency improvement in industrial end-use sectors (Energy Consumption)	Economic	Implemented	The support is provided within the framework of the national Rural Development Programme 2014-2020 co-financed by the EAFRD. The support can be used for implementation of both energy efficient building (both new buildings and reconstruction) and new energy efficient equipment (heating & conditioning, lighting, equipment for production processes). The support might be used also for implementation of RES utilising energy production technologies in the enterprise.	2015	Ministry of Agriculture (National government)	0.70	0.90	0.90	0.90
Investment Support Programme to Increase Energy Efficiency in Apartment Buildings: 2014-2020 EU Funds programming period*	Energy	CO_2	Efficiency improvements of buildings (Energy Consumption), number of renovated multi-dwelling buildings; renovated floor area - 2.5 million m2.	Economic	Implemented	Increasing of energy efficiency in multi-apartment buildings is co-financed by the ERDF within the framework of the national Operational Programme "Growth and Employment" (the Specific Objective 4.2.1.1). Activities supported relate to renovation of apartment building envelope for increase of	2016	Ministry of Economics (National government)	18.00	26.00	26.00	26.00

						energy efficiency, reconstruction of heat supply and hot water supply systems of building, installation of recuperation system, energy control and management equipment, including smart meters as well as installation of local heat energy production equipment and water boilers utilising RES. The financial assistance is provided in the following forms of subsidy (grant), repayable loan with low interest rate, guarantee for the loan issued by commercial institution. Specific condition of Latvia is the high relative share of buildings supplied by district heating systems. As large number of Latvia district heating utilities participate in EU ETS, the given PAM has impact in both ETS and ESD sectors.						
Investment Support Programme to Increase Energy Efficiency in Public (State and municipal) Buildings: 2014-2020 EU Funds programming period*	Energy	CO_2	Efficiency improvements of buildings (Energy Consumption), renovated floor area 1.09 million m2	Economic	Implemented	Increasing of energy efficiency in state and municipal buildings is supported within the framework of the national Operational Programme "Growth and Employment" (the Specific Objectives 4.2.1.2 and 4.2.2 respectively). Activities supported relate to renovation of buildings for the increase of energy efficiency, reconstruction, renovation or establishment of engineering systems of buildings, recuperation systems, smart energy control and management equipment as well as RES utilizing local energy production technologies and cooling technologies. Specific condition of Latvia is the high	2016	Ministry of Economics (National government); Ministry of Environmental Protection and Regional Development(National government)	8.00	10.00	10.00	10.00

						relative share of buildings supplied by district heating systems. As large number of Latvia district heating utilities participate in EU ETS, the given PAM has impact in both ETS and ESD sectors.						
Investment Support Programmes in public sector to reduce GHG emissions: national Emissions Allowances Auctioning Instrument (EAAI).*	Energy	CO_2	Efficiency improvements of buildings (Energy Consumption); Demand management/reduction (Energy Consumption)	Economic	Implemented	The revenues from the auctioning of Latvia's allocated EU ETS emission allowances are used for co-financing the energy efficiency measures which have high demonstration value. Application of smart technologies and smart energy management is in the focus of them. Currently several EAAI programmes are on-going implementation targeted to: (i) energy efficient renovation of the buildings having status of architectural monuments of state significance, (ii) nearly zero energy public buildings (construction of new ones as well as reconstruction of existing ones) comprising smart technologies, as well as (iii) the use of smart technologies for energy efficiency (efficient outdoor lighting) in urban environment.	2016	Ministry of Environment Protection and Regional Development (National government)	2.00	2.00	2.00	2.00
Implementation of the EU Emissions Trading Scheme*	Energy	CO_2	Increase in renewable energy (Energy Supply); Reduction of losses (Energy Supply); Efficiency improvement in the energy transformation sector (Energy Supply); Efficiency improvement in industrial end-use sectors	Regulatory, Economic	Implemented	Limitation of amount of emission allowances allocated for ETS operators	2005	Ministry of Environment Protection and Regional Development (National government)	NE	NE	NE	NE

Development of Latvian railway network	Transport	CO_2	Electric vehicles (Transport), Modal shift to public transport	Economic	Planned	Development of railway infrastructure including electrification is stated as one of the indicative investment projects of the National Development Plan for 2021-2027. The Specific Objective "To develop a sustainable, climate-resilient, smart, secure and diverse TEN-T infrastructure" of the NDP2027 plans the measure, objectives of that are construction, reconstruction and renewal of railway infrastructure and improvement of energy efficiency in railway passenger transport. Also creation of multimodal public transport points/centres to combine the diversity of public transport (road, rail, bicycle) having the rail transport as the central element is planned.	2023	Ministry of Transport (National government)	NA	9.00	14.00	17.00
Promotion of Biomethane production and utilisation in transport sector	Energy, Transport	CO_2, CH_4	Low carbon fuels (Transport); volume of 2nd generation biomethane used in transport: 0.3 PJ (2025); 1 PJ (2030)	Economic	Planned	The measure is planned by the National Energy-Climate Plan 2030 and the National Development Plan 2021-2027. It is planned the financial instrument with the grant part for biogas upgrade up to biomethane quality (equipment and its installation, particularly upgrade of biogas produced by processing agriculture sector raw materials) and establishment of necessary infrastructure for use of biomethane in Transport sector.	2022	Ministry of Economics (National government)	NA	22.00	74.00	74.00
Increasing energy efficiency in general and vocational education institutions: EU	Energy	CO_2	Efficiency improvements of buildings (Energy Consumption); Efficiency improvement of	Economic	Implemented	Complex measures, that include different eligible activities, to improve study environment is co-financed by the ERDF within the framework of national Operational	2016	Ministry of Education and Science (National government)	0.50	0.70	0.70	0.70

Funds Programming Period 2014-2020*			appliances (Energy Consumption)			Programme "Growth and Employment"(the Specific Objectives 8.1.2 and 8.1.3). These measures relate both to buildings (including dormitories) and their engineering and lighting systems and to learning environment (classrooms, laboratories, learning equipment, ICT technologies). Thus the support includes also energy efficiency, including appliances, and RES related measures.						
Promote organic dairy farming and extended grazing (low emission dairy farming)	Agriculture	CH_4, N_2O	Improved livestock management (Agriculture) Target number of organic dairy cows in 2030 - 33352 dairy cows	Economic, Voluntary Agreement	Planned	The main aim of the measure is to promote transition of small and medium-sized conventional dairy farms to the organic farming system, thus facilitating low emission dairy farming.	2022	Ministry of Agriculture (National government)	NA	NE	NE	NE
Support for fertilisation planning	Agriculture	N_2O	Reduction of fertilizer/manure use on cropland (Agriculture) Target arable land area in 2030 - 245675 ha	Economic, Voluntary Agreement	Planned	The main aim of measure is to expand arable land and increase number of medium-sized crop and livestock farms were fertilisation planning and practical implementation that is based on knowledge about agrochemical properties of soil have not been done previously.	2022	Ministry of Agriculture (National government)	NA	NE	NE	NE
Promote inclusion of leguminous plants in crop rotation for nitrogen fixation	Agriculture	N_2O	Other activities improving cropland management (Agriculture)Target arable land area in 2030 - 172331 ha	Economic, Voluntary Agreement	Planned	The main aim of the measure is to expand arable land and increase number of farms were leguminous plants are included in crop rotation thus contributing to atmospheric nitrogen fixation and reduction of application of inorganic nitrogen fertilizers.	2022	Ministry of Agriculture (National government)	NA	NE	NE	NE

Promote and support for precision application of inorganic nitrogen fertilisers	Agriculture	N_2O	Other activities improving cropland management (Agriculture) Target arable land area in 2030 - 65478 ha	Economic, Voluntary Agreement	Planned	The main aim of measure is to expand arable land and increase number of farms were precision technologies for application of inorganic nitrogen fertilisers are used in the planning of fertiliser schemes and spreading.	2022	Ministry of Agriculture (National government)	NA	NE	NE	NE
Restoration and modernization of amelioration systems in cropland	Forestry/LULUCF	CO_2	Retaining of high productivity in croplands (Other LULUCF)	Economic	Planned	Restoration and maintenance of drainage systems in cropland. The measure will be implemented in croplands, where high yields are possible due to drainage and wearing out of the drainage systems would lead to reduction of carbon input in soil with plant residues. After reconstruction of drainage systems fields will be maintained as a conventional production systems with considerable input of organic material in soil due to higher yields and crop rotations. Only CO_2 is considered due to the fact that country specific methods for accounting of reduction of CH_4 are not elaborated and use of the default IPCC values might lead to considerable overestimation of positive impact of the measure.	2022	Ministry of Agriculture (National government)	NA	99.14	363.53	694.01
Support for evolving of precision livestock feeding approach in cattle breeding farms to develop feeding plans and promote high quality feed use to increase the digestibility*	Agriculture	CH_4, N_2O	Improved livestock management (Agriculture)	Economic, Voluntary Agreement	Implemented	The main aim of measure is to promote high quality feed use for animals to increase the digestibility and reduce CH_4 emissions. Voluntary/negotiated agreements, because financial support for farmers is available, if a farmer develop precision livestock feeding technologies in the farm with	2015	Ministry of Agriculture (National government)	NE	NE	NE	NE

						the aim to reduce GHG emissions.						
Introduction of legumes into conventional crop rotations*	Agriculture	N_2O	Other activities improving cropland management (Agriculture)	Economic, Voluntary Agreement	Implemented	Measure is associated with establishing procedures for receiving payments for climate and environmentally friendly farming practices, including legumes in crop rotation. Financial support is defined in Regulations of the Cabinet of Ministers No. 126 (2015).	2015	Ministry of Agriculture (National government)	NE	NE	NE	NE
Management of nitrate vulnerable territories*	Agriculture	N_2O	Reduction of fertilizer/manure use on cropland (Agriculture)	Regulatory	Implemented	Restriction for nitrogen usage, reduction of nitrogen leaching. Water protection against pollution caused by nitrates from agricultural sources. Rules for management of vulnerable zones.	2014	Ministry of Agriculture (National government)	NE	NE	NE	NE
Requirements for the protection of soil and water from agricultural pollution caused by nitrates*	Agriculture	N_2O	Reduction of fertilizer/manure use on cropland (Agriculture)	Regulatory	Implemented	Restriction for nitrogen usage, reduction of nitrogen leaching. Reduction of non-direct N_2O emissions	2014	Ministry of Agriculture (National government)	NE	NE	NE	NE
Crop fertilization plans in vulnerable zones*	Agriculture	N_2O	Reduction of fertilizer/manure use on cropland (Agriculture); Other activities improving cropland management (Agriculture)	Regulatory	Implemented	According to Republic of Latvia Cabinet Regulation No. 834 (2014) "Regarding to Protection of Water and Soil from Pollution with Nitrates Caused by Agricultural Activity" in highly vulnerable zones farmers who managing the agricultural land with an area of 20 hectares and more, and grows vegetables, potatoes, fruit trees or fruit bushes in an area of three hectares and more, are required to document the field history for each field and shall keep field history documentation for at least three years and, if using fertilisers; shall prepare a crop	2012	Ministry of Agriculture (National government)	NE	NE	NE	NE

						fertilisation plan for each field not later than until the sowing or planting of a crop, for perennial sowings and plants - until the start of vegetation.					
Requirements for manure storage and spreading*	Agriculture	CH_4, N_2O	Improved animal waste management systems (Agriculture)	Regulatory	Implemented	Specify the requirements for storing of manure outside animal shed Requirements refer to farms with more than 10 AU (animal units), and 5 AU in vulnerable territories.	2014	Ministry of Agriculture (National government)	NE	NE	NE	NE
Maintenance of amelioration systems*	Agriculture	N_2O	Other activities improving cropland management (Agriculture)	Voluntary Agreement	Implemented	Financial support for reconstruction or renovation of a drainage system is defined in Regulations of the Cabinet of Ministers No. 600 (2014) , that establishing procedures for receiving payments for investments in the development of agricultural and forestry infrastructure. The measure is implemented in extensively managed croplands on mineral soils, where high yields are not possible due to unfavorable conditions during spring time, which are caused by wearing of existing drainage systems. This will reduce indirect N_2O emissions from N leaching and runoff from agricultural land.	2014	Ministry of Agriculture (National government)	NE	NE	NE	NE
Promote and support for direct incorporation of organic fertilisers into the soil	Agriculture	CH_4, N_2O	Improved animal waste management systems (Agriculture) Target arable land area in 2030 - 8868 ha	Economic, Voluntary Agreement	Planned	The main aim of measure is to expand arable land were organic fertilisers are directly incorporated into the soil thus promoting more efficient use of organic fertilisers.	2022	Ministry of Agriculture(National government)	NA	NE	NE	NE
Promote feed ration planning	Agriculture	CH_4, N_2O	Improved livestock management (Agriculture) Target	Economic, Voluntary Agreement	Planned	The main aim of measure is to increase number of cows whose feed rations are balanced for reduced crude	2022	Ministry of Agriculture(National government)	NA	NE	NE	NE

			number of dairy cows in 2030, 31408 dairy cows			protein level without loss in milk production.					
Promote improvement of feed quality	Agriculture	CH_4	Improved livestock management (Agriculture)Target number of dairy cows in 2030, 20300 dairy cows	Economic, Voluntary Agreement	Planned	The main aim of measure is to increase number of cows whose are fed with feed (in this measure special attention is paid on hay, hay silage, grass silage) with high digestible energy (i.e. DE is more than 68%).	2022	Ministry of Agriculture (National government)	NA	NE	NE	NE
Reduce emissions of fluorinated greenhouse gases*	Industry/industrial processes	HFCs, SF_6	Replacement of fluorinated gases by other substances (Industrial Processes)	Regulatory	Implemented	Prevent and minimise emissions of fluorinated GHG. Bans on the placing on the market, maintainance and service products and equipment containing HFCs with high GWPs.	2015	Ministry of Environment and Regional Development(National government)	NE	NE	NE	NE
Maintenance and modernization of amelioration systems on agricultural land	Agriculture	CH_4, N_2O	Other activities improving cropland management (Agriculture) Target arable land area in 2030, 639023 ha	Economic, Voluntary Agreement	Planned	The main aim of measure is to increase arable land area with improved and maintained amelioration systems, thereby reducing N leaching and run-off from agriculture	2022	Ministry of Agriculture(National government)	NA	NE	NE	NE
Cropland drainage*	Forestry/LULUCF	CO_2, CH_4	Other activities improving cropland management (Other LULUCF)	Economic	Implemented	Restoration of malfunctioning drainage systems in cropland. The measure has to be implemented in extensively managed croplands on mineral soils, where high yields are not possible due to unfavourable conditions during spring time, which are caused by wearing of existing drainage systems. After reconstruction of drainage systems fields are returned to a conventional production systems with considerable input of organic material in soil due to higher yields and crop rotations. Only CO_2 is considered due to the fact that country specific methods for accounting of reduction of CH_4	2015	Ministry of Agriculture(National government)	NE	6.10	6.10	NE

						are not elaborated and use of the default IPCC values might lead to considerable overestimation of positive impact of the measure.					
Production of legumes*	Forestry/LULUCF	CO_2	Increase of soil carbon stock (Other LULUCF)	Economic	Implemented	Support to use of legumes as green manure and fodder in crop rotation. Reduces GHG emissions in LULUCF and agriculture sector.	2015	Ministry of Agriculture (National government)	NE	66.00	66.00	NE
Extensified crop rotation*	Forestry/LULUCF	CO_2	Improved management of organic soils (Other LULUCF)	Economic	Implemented	Support to use green manure in crop rotation. Measure is aimed to increase carbon input into soil in conventional production systems and increase of soil carbon stock.	2015	Ministry of Agriculture (National government)	NE	33.00	33.00	NE
Drainage in forest*	Forestry/LULUCF	CO_2	Retaining high productivity in forests (Other LULUCF)	Economic	Implemented	Restoration of malfunctioning forest drainage systems. The measure avoids deterioration of the growth conditions and ensures continuously high growth rate in drained forests avoiding at the same time increase of CH_4 emissions.	2015	Ministry of Agriculture (National government)	NE	15.00	15.00	NE
Afforestation*	Forestry/LULUCF	CO_2	Afforestation and reforestation (Land use, land use change and forestry)	Economic	Implemented	Support to afforestation of low valued farmlands. The measure ensures increase of carbon stock in living and dead biomass, and HWP in long term. Soil carbon stock changes and GHG emissions from soil are not considered due to lack of scientific substantiation of the GHG emission reduction.	2016	Ministry of Agriculture (National government)	NE	48.00	48.00	NE
Forest thinning*	Forestry/LULUCF	CO_2	Improve forest management (Other LULUCF)	Economic	Implemented	Support to pre-commercial thinning of forest stands. According to the study results (the research programme on impact of forest management measures on GHG emissions and CO_2 removals 2011-2015) early thinning in coniferous	2016	Ministry of Agriculture (National government)	NE	28.00	28.00	NE

						stands, as it is done now according to national regulations, contributes to additional increment during 20 years period; respectively, growing stock in 40-60 years old coniferous stands and research trials is by 15-25% higher than in non-thinned stands. Private forest owners are not motivated to implement early thinning due to the fact that is is not resulting in direct incomes, therefore, this measure is oftenly avoided to save money. Support to forest thinning will result in rapid and significant increase of carbon stock.						
Forest regeneration*	Forestry/LULUCF	CO_2	Improving forest management (Other LULUCF)	Economic	Implemented	Support to reconstruction and regeneration of low valued and diseased forest stands after natural disturbances. The measure speeds up increase of living and dead biomass carbon pool, and increase the total potential increase of carbon pools by selection of tree species with high growth potential.	2016	Ministry of Agriculture (National government)	NE	18.00	18.00	NE
Promote the production of biogas and biomethane and the use of biomethane	Agriculture	CH_4	Improved animal waste management systems (Agriculture) Target amount of manure that are used for biogas production in 2030, 20427 m3	Economic, Voluntary Agreement	Planned	The main aim of the measure is to ensure the installation of biogas production and biogas purification (biomethane production) facilities on farms that do not yet have biogas production and purification facilities.	2022	Ministry of Agriculture (National government)	NA	NE	NE	NE
Fuel Taxation - fuels utilised for energy production *	Energy	CO_2	Efficiency improvement in the energy transformation sector (Energy Supply); Reduction of losses (Energy Supply); Increase in renewable	Fiscal	Implemented	(1) Natural gas - the procedure is established by the Law on Excise Duties (Articles 6.1 & 15.1), the reduced rate is applied for the natural gas utilized in the industrial production and	2010	Ministry of Finance (National government)	NE	NE	NE	NE

			energy (Energy Supply); Efficiency improvements of buildings (Energy Consumption); Efficiency improvement in industrial end-use sectors (Energy Consumption).			agriculture raw materials pre-treatment processes, as well as in greenhouses, industrial scale poultry holdings (poultry houses) and incubators to promote the development of these sectors. (2) Mineral oils - the procedure is established by the Law on Excise Duties (Articles 5 & 14), The exempt is made for (i) oil products utilised for electricity production and for production in CHP mode, (ii) oil gasses and other hydrocarbons, if supplied to persons who use them as heating fuel or in gas furnaces and other equipment (not in the transport); (3) Coal, coke and lignite (brown coal) - the procedure is established by the Natural Resources Tax Law (Article 23.1 and Annex 9).						
Green Public Procurement*	Energy, Transport	CO_2	Low carbon fuels/electric cars (Transport); Efficiency improvements of buildings (Energy Consumption); Efficiency improvement in services/ tertiary sector (Energy Consumption); Efficiency improvement of appliances (Energy Consumption)	Regulatory	Implemented	Public Procurement Law states special rules with respect to energy efficiency (Article 55) and in road transport (Article 54). The Governmental Regulation on Green Public Procurement includes also particular energy consuming goods and services. The minimum energy efficiency requirements for goods (including tyres) and services purchased by state central administration institutions are stated. Public Transport Service Provider when purchasing road transport vehicles shall take into account the effect of the putting into operation thereof on energy and the environment, including CO_2 and noxious air emissions.	2016	Ministry of Finance (National government); Ministry of Environmental Protection and Regional Development (National government); Ministry of Economics(National government)	2.00	10.50	35.10	35.10

Energy Efficiency Obligation Scheme (EEOS)*	Energy	CO_2	Efficiency improvement of appliances (Energy Consumption); Demand management/reduction (Energy Consumption)	Regulatory	Implemented	The measure results in energy efficiency improvement in electricity end use. The obliged parties for the EEOS start period and the 1 (till 31.12.2020) period are electricity retail sellers which had sold at least 10 GWh of electricity in 2016 or in any of years related to the 1 EEOS period.	2017	Ministry of Economics (National government)	46.00	46.00	42.00	42.00
Energy Management System in Commercial Sector*	Energy	CO_2	Demand management/reduction (Energy Consumption); Efficiency improvement in industrial and services/ tertiary end-use sectors (Energy Consumption)	Regulatory	Implemented	Mandatory (1) Energy Audit in Large Enterprises (transposition of EED 2012/27/EU). (2) Energy Management System for enterprises - Large Electricity Consumers (LEC) which have its own annual electricity consumption above 500 MWh in two subsequent years (national measure). The large enterprises and the LECs shall provide annual report on implemented measures and reached energy savings. At least three energy efficiency measures (or all, if only one or two measures stated) stated by the energy audit or EMS which have the highest energy savings or the highest economical return shall be implemented both by large enterprises (up to the 1 April 2020 for the 1 audit/EMS period) and by LECs (up to the 1 April 2022, for the 1 audit/EMS period).	2017	Ministry of Economics (National government)	62.00	64.80	56.00	56.00
Energy Management System (EMS) in Public Sector*	Energy	CO_2	Demand management/reduction (Energy Consumption); Efficiency improvements of buildings (Energy Consumption); Efficiency improvement in	Regulatory, Voluntary Agreement	Implemented	(1) Mandatory implementation of EMS in those state direct administration institutions which have buildings with total heating area 10000 m2 and above. (2) Mandatory implementation of EMS in	2017	Ministry of Economics (National government)	1.70	1.70	2.20	2.50

			municipal end-use sector (Energy consumption)			local municipalities based on such threshold criteria as number of population and territorial development index, at the end of 2020, 17 municipalities, including largest cities have the duty to implement EMS. Municipalities implement EMS also on voluntary base. Annual report on implemented energy efficiency measures and reached energy savings shall be submitted.						
Mandatory individual meters for consumers connected to District Heating Systems or supplied from a common heat source.*	Energy	CO_2	Demand management/reduction (Energy Consumption)	Regulatory, Information	Implemented	The individual heat energy metering enables residents to supervise their individual consumption and the energy costs thus encouraging to save energy. The provision to install heat meters or heat cost allocators in each apartment or set of premises that is invoiced separately in the multi-apartment and multi-purpose building has been introduced in several steps. From the 31 December 2016 it applies to new buildings and buildings to be converted or renovated, if funded by EU funds, State or municipal budgets. In turn, from the 1 January 2021 it applies to all existing, in exploitation, buildings, on condition if the individual accounting is economically justified (remotely readable devices shall be installed).	2016	Ministry of Economics (National government)	NE	NE	NE	NE
Investment Support Programme to Increase Energy Efficiency in Apartment Buildings: 2021-	Energy	CO_2	Efficiency improvements of buildings (Energy Consumption), renovated floor area - 2.22 Mm2	Economic	Planned	Continuation of the particular support programme in the apartment buildings sector (see PAM No22) in the following EU Funds period is planned by the National Energy-Climate Plan 2030 and	2023	Ministry of Economics (National government)	NA	22.00	22.00	22.00

2027 EU Funds Programming Period						the National Development Plan 2021-2027. The given PAM has impact on: district heat consumption especially in residential multi-flat buildings - a large number of Latvia district heating utilities participate in ETS sector. Thus given PAM has impact on both ETS and ESD sectors.						
Investment Support Programme to Increase Energy Efficiency in public (State and municipal) Buildings: 2021-2027 EU Funds programming period	Energy	CO_2	Efficiency improvements of buildings (Energy Consumption); Demand management/reduction (Energy Consumption); renovated floor area - 0.91 Mm2	Economic	Planned	Continuation of the particular support programmes in the state and municipal public buildings sector in the following EU Funds period is planned by the National Energy-Climate Plan 2030 and the National Development Plan 2021-2027. The energy efficiency improvement and implementation of RES utilizing technologies, including smart management systems, are planned. The given PAM has impact on: district heat consumption as large share of public buildings are connected to district heating system. As a large number of Latvia district heating utilities participate in ETS sector, the given PAM has impact on both ETS and ESD sectors.	2023	Ministry of Economics (National government); Ministry of Environmental Protection and Regional Development(National government)	NA	9.00	9.00	9.00
Electric Vehicles (EV) Charging Infrastructure Development: EU Funds Programming Period of 2014-2020*	Transport	CO_2	Electric cars (Transport)	Economic	Implemented	Development of a single national level fast charging infrastructure coverage (139 EV direct current fast charging points with capacity up to 50 kW) promotes the development of EV market and increase of number of EV in road transport, The measure is implemented within the framework of the national Operational Programme "Growth and Employment"	2016	Ministry of Transport (National government)	3.30	39.00	87.00	670.00

						(the Specific Objective 4.4.1) and is one of the measures of the Alternative Fuels Development Plan for 2017-2020.						
Alternative Fuels Infrastructure Development (3)*	Transport	CO_2	Low carbon fuels (Transport)	Information, Economic	Implemented	The Alternative Fuels Development Plan for 2017-2020 provided also for the development of LNG and CNG fuelling infrastructure, in addition to EV infrastructure described in the PAM above.	2017	Ministry of Transport (National government)	IE	IE	IE	IE
Establishment of new orchards	Forestry/LULUCF	CO_2	Increase of carbon stock in cropland (Other LULUCF)	Economic	Planned	The measure is aimed of maintenance of area of the orchards. Without financial support area of orchards would decrease resulting in reduction of carbon stock in affected areas.	2022	Ministry of Agriculture (National government)	NA	4.01	15.00	28.00
Undergrowth plants sown with winter crops	Forestry/LULUCF	CO_2	Increase of carbon stock in soils (Other LULUCF)	Economic	Planned	More efficient utilization of nutrients and increase of carbon input into soil due to prolongation of vegetation period and increased removals CO_2 in plants.	2022	Ministry of Agriculture (National government)	NA	34.65	127.00	243.00
Green fallow before winter crops	Forestry/LULUCF	CO_2	Increase of carbon stock in soils (Other LULUCF)	Economic	Planned	Increased carbon stock in soil due to increase of efficient vegetation period and bigger carbon input in soil. The measure is efficient in case if fallows are used before winter crops.	2022	Ministry of Agriculture (National government)	NA	199.99	733.30	1,399.93
Legumes in cereals dominant crop rotations	Forestry/LULUCF	CO_2	Increase of carbon stock in soils (Other LULUCF)	Economic	Planned	Increase of carbon stock in soils due to increase of carbon input into soil with biomass; reduction of N_2O emissions in agriculture sector.	2022	Ministry of Agriculture (National government)	NA	34.65	242.00	462.00
Restoration and modernization of amelioration	Forestry/LULUCF	CO_2	improving forest management (Other LULUCF)	Economic	Planned	Restoration of malfunctioning drainage systems and preventive maintenance of drainage ditches, which	2022	Ministry of Agriculture (National government)	NA	108.00	284.00	549.00

systems in forest land						secures continuously high removals of CO_2 in following forest generation.						
Afforestation of nutrient-poor soils in grassland and cropland	Forestry/LULUCF	CO_2	Improving forest management (Other LULUCF)	Economic	Planned	Increase of carbon stock in soil, living and dead biomass pools by afforestation of low valued croplands and grasslands.	2022	Ministry of Agriculture (National government)	NA	85.50	189.00	360.00
Pre-commercial thinning	Forestry/LULUCF	CO_2	Improving forest management (Other LULUCF)	Economic	Planned	Support to pre-commercial thinning of forest stands to contribute to additional increment during 20 years period; growing stock in 40-60 years old coniferous stands (thinned at 20-40 years age) and research trials is by 15-25% higher than in non-thinned stands. Support to forest thinning will result in rapid and significant increase of all carbon pools in thinned stands.	2022	Ministry of Agriculture (National government)	NA	252.00	884.00	1,688.00
Restoration of forests after natural disturbances	Forestry/LULUCF	CO_2	Improving forest management (Other LULUCF)	Economic	Planned	Support to reconstruction and regeneration of forest stands damaged by natural disasters like wind and fire. The measure will reduce forest regeneration period and quicker increase of all carbon pools including the total potential of CO_2 removals by proper selection of species.	2022	Ministry of Agriculture (National government)	NA	15.00	30.00	57.00
Increase of land area under organic farming relative to total agricultural land*	Agriculture	CH_4, N_2O	Other activities improving cropland management (Agriculture)	Economic	Implemented	Farming methods with environmentally friendly influence on nature, reduction of synthetic nitrate use and leaching, increased biodiversity. The state support for organic farmers through subsidies. National Development Plan of Latvia for 2014-2020 (NDP2020) set the plan to increase organic agriculture area to 15% by	2014	Ministry of Agriculture (National government)	NE	NE	NE	NE

						2030 in relation to total agricultural area. The National Development Plan 2014–2020 is hierarchically the highest national-level medium-term planning document.						
Extensified crop rotation*	Agriculture	N_2O	Other activities improving cropland management (Agriculture)	Economic	Implemented	Support to use green manure in crop rotation	2015	Ministry of Agriculture (National government)	NE	NE	NE	NE
Restoration of former peat extraction sites	Forestry/LULUCF	CO_2, CH_4, N_2O	Restoration of degraded lands (Land use, land use change and forestry)	Economic	Planned	Abandoned peat extraction sites is considerable source of GHG emissions. Afforestation, establishment of perennial energy crops or extraction of remaining peat layer with following flooding or rewetting of areas, where growing of perennial crops for biomass production is not possible, may lead to significant reduction of GHG emissions and increase of CO_2 removals.	2022	Ministry of Environmental Protection and Regional Development (National government)	NA	132.20	485.10	926.10
Increase biological waste preparation for treatment to 210 000 t per year	Waste management/waste	CH_4	Reduced landfilling (Waste management/waste) 210 000 t per year	Economic	Planned	Increase biological waste preparation for treatment. Implementation of separate collection of biological waste. Waste management plan period 2021-2028.	2022	Ministry of Environmental Protection and Regional Development (National government)	NA	NE	52.00	52.00
Increase preparation of Refused direved fuel to 130 000 t per year (4)	Waste management/waste	CH_4	Reduced landfilling (Waste management/waste) 130 000 t per year	Economic	Planned	Increase preparation of refused derived fuel (RDF). Develop installations for RDF productions. Waste management plan period 2021-2028.	2022	Ministry of Environment and Regional Development (National government)	NA	IE	IE	IE
Increase biological waste treatment to 110 000 t per year (5)	Waste management/waste	CH_4	Reduced landfilling (Waste management/waste) 110 000 t per year	Economic	Planned	Increase biological waste treatment capacity. Waste management plan period 2021-2028.	2022	Ministry of Environment and Regional Development (National government)	NA	IE	IE	IE

Support for evolving of precision agriculture technologies in crop growing farms to reduce nitrogen use*	Agriculture	N_2O	Other activities improving cropland management (Agriculture)	Economic, Voluntary Agreement	Implemented	Measure is associated with promoting of nitrogen fertilizer use reduction and consequently with reduction of nitrogen amount in the run-off. This will reduce N_2O emissions from use of synthetic fertilizers and indirect N_2O emissions from soils. Voluntary/negotiated agreements, because financial support for farmers is available, if a farmer develop precision agriculture technologies in the farm with the aim to reduce GHG emissions.	2014	Ministry of Agriculture (National government)	NE	NE	NE	NE

Custom Footnotes

(1) The estimation of PaM mitigation impact is included in the investment support programme "Increasing energy efficiency in multi-apartment buildings" (NC8 Chapter 4.4.2.1)

(2) The estimation of PaM mitigation impact is included in the evaluation of the impact of Requirements of energy efficiency performance in buildings (NC8 Chapter 4.4.2.1)

(3) The estimation of PaM mitigation impact is included in PaM - Electric Vehicles (EV) Charging Infrastructure Development: EU Funds Programming Period of 2014-2020 (NC8 Chapter 4.4.3.1)

(4) The estimation of PaM mitigation impact is included in PaM - Increase biological waste preparation for treatment to 210 000 t per year (NC8 Chapter 4.4.6)

(5) The estimation of PaM mitigation impact is included in PaM - Increase biological waste preparation for treatment to 210 000 t per year (NC8 Chapter 4.4.6)

CTF Table 4: Reporting on progress

Table 4 LVA_BR5_v2.0

Reporting on progress[a,b]

Year[c]	Total emissions excluding LULUCF (kt CO_2 eq)	Contribution from LULUCF[d] (1) (kt CO_2 eq)	Quantity of units from market based mechanisms under the Convention (number of units)	Quantity of units from market based mechanisms under the Convention (kt CO_2 eq)	Quantity of units from other market based mechanisms (number of units)	Quantity of units from other market based mechanisms (kt CO_2 eq)
Base year/period (1990)	25908.66	NA	NA	NA	NA	NA
1990	25908.66	NA	NA	NA	NA	NA
2010	11818.20	NA	NA	NA	NA	NA
2011	11021.60	NA	NA	NA	NA	NA
2012	10843.10	NA	NA	NA	NA	NA
2013	10757.75	NA	NA	NA	NA	NA
2014	10668.38	NA	NA	NA	NA	NA
2015	10720.39	NA	NA	NA	NA	NA
2016	10711.08	NA	NA	NA	NA	NA
2017	10752.40	NA	NA	NA	NA	NA
2018	11246.84	NA	NA	NA	NA	NA
2019	11116.30	NA	NA	NA	NA	NA
2020	10459.72	NA	NA	NA	NA	NA

Abbreviation: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For the base year, information reported on the emission reduction target shall include the following: (a) total GHG emissions, excluding emissions and removals from the LULUCF sector; (b) emissions and/or removals from the LULUCF sector based on the accounting approach applied taking into consideration any relevant decisions of the Conference of the Parties and the activities and/or land that will be accounted for; (c) total GHG emissions, including emissions and removals from the LULUCF sector. For each reported year, information reported on progress made towards the emission reduction targets shall include, in addition to the information noted in paragraphs 9(a–c) of the UNFCCC biennial reporting guidelines for developed country Parties, information on the use of units from market-based mechanisms.

[c] Parties may add additional rows for years other than those specified below.

[d] Information in this column should be consistent with the information reported in table 4(a)I or 4(a)II, as appropriate. The Parties for which all relevant information on the LULUCF contribution is reported in table 1 of this common tabular format can refer to table 1.

Custom Footnotes

(1) Numbers for LULUCF are not reported because this sector is not included under the Convention target

Progress in achieving the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the contribution of the land use, land-use change and forestry sector in 2019 [a,b]

	Net GHG emissions/removals from LULUCF categories [c]	Base year/period or reference level value [d]	Contribution from LULUCF for reported year	Cumulative contribution from LULUCF [e]	Accounting approach [f]
	(kt CO_2 eq)				
Total LULUCF	NA	NA	NA	NA	
A. Forest land	NA	NA	NA	NA	
1. Forest land remaining forest land	NA	NA	NA	NA	
2. Land converted to forest land	NA	NA	NA	NA	
3. Other [g]					
B. Cropland	NA	NA	NA	NA	
1. Cropland remaining cropland	NA	NA	NA	NA	
2. Land converted to cropland	NA	NA	NA	NA	
3. Other [g]					
C. Grassland	NA	NA	NA	NA	
1. Grassland remaining grassland	NA	NA	NA	NA	
2. Land converted to grassland	NA	NA	NA	NA	
3. Other [g]					
D. Wetlands	NA	NA	NA	NA	
1. Wetland remaining wetland	NA	NA	NA	NA	
2. Land converted to wetland	NA	NA	NA	NA	
3. Other [g]					
E. Settlements	NA	NA	NA	NA	
1. Settlements remaining settlements	NA	NA	NA	NA	
2. Land converted to settlements	NA	NA	NA	NA	
3. Other [g]					
F. Other land	NA	NA	NA	NA	
1. Other land remaining other land	NA	NA	NA	NA	
2. Land converted to other land	NA	NA	NA	NA	
3. Other [g]					
G. Other	NA	NA	NA	NA	
Harvested wood products	NA	NA	NA	NA	

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Parties that use the LULUCF approach that is based on table 1 do not need to complete this table, but should indicate the approach in table 2. Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[c] For each category, enter the net emissions or removals reported in the most recent inventory submission for the corresponding inventory year. If a category differs from that used for the reporting under the Convention or its Kyoto Protocol, explain in the biennial report how the value was derived.

[d] Enter one reference level or base year/period value for each category. Explain in the biennial report how these values have been calculated.

[e] If applicable to the accounting approach chosen. Explain in this biennial report to which years or period the cumulative contribution refers to.

[f] Label each accounting approach and indicate where additional information is provided within this biennial report explaining how it was implemented, including all relevant accounting parameters (i.e. natural disturbances, caps).

[g] Specify what was used for the category "other". Explain in this biennial report how each was defined and how it relates to the categories used for reporting under the Convention or its Kyoto Protocol.

Progress in achieving the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the contribution of the land use, land-use change and forestry sector in 2020 [a, b]

	Net GHG emissions/removals from LULUCF categories [c]	Base year/period or reference level value [d]	Contribution from LULUCF for reported year	Cumulative contribution from LULUCF [e]	Accounting approach [f]
	(kt CO_2 eq)				
Total LULUCF	NA	NA	NA	NA	
A. Forest land	NA	NA	NA	NA	
1. Forest land remaining forest land	NA	NA	NA	NA	
2. Land converted to forest land	NA	NA	NA	NA	
3. Other [g]					
B. Cropland	NA	NA	NA	NA	
1. Cropland remaining cropland	NA	NA	NA	NA	
2. Land converted to cropland	NA	NA	NA	NA	
3. Other [g]					
C. Grassland	NA	NA	NA	NA	
1. Grassland remaining grassland	NA	NA	NA	NA	
2. Land converted to grassland	NA	NA	NA	NA	
3. Other [g]					
D. Wetlands	NA	NA	NA	NA	
1. Wetland remaining wetland	NA	NA	NA	NA	
2. Land converted to wetland	NA	NA	NA	NA	
3. Other [g]					
E. Settlements	NA	NA	NA	NA	
1. Settlements remaining settlements	NA	NA	NA	NA	
2. Land converted to settlements	NA	NA	NA	NA	
3. Other [g]					
F. Other land	NA	NA	NA	NA	
1. Other land remaining other land	NA	NA	NA	NA	
2. Land converted to other land	NA	NA	NA	NA	
3. Other [g]					
G. Other	NA	NA	NA	NA	
Harvested wood products	NA	NA	NA	NA	

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Parties that use the LULUCF approach that is based on table 1 do not need to complete this table, but should indicate the approach in table 2. Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[c] For each category, enter the net emissions or removals reported in the most recent inventory submission for the corresponding inventory year. If a category differs from that used for the reporting under the Convention or its Kyoto Protocol, explain in the biennial report how the value was derived.

[d] Enter one reference level or base year/period value for each category. Explain in the biennial report how these values have been calculated.

[e] If applicable to the accounting approach chosen. Explain in this biennial report to which years or period the cumulative contribution refers to.

[f] Label each accounting approach and indicate where additional information is provided within this biennial report explaining how it was implemented, including all relevant accounting parameters (i.e. natural disturbances, caps).

[g] Specify what was used for the category “other”. Explain in this biennial report how each was defined and how it relates to the categories used for reporting under the Convention or its Kyoto Protocol.

CTF Table 4(a)II: Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

Table 4(a)II

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Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol[a,b, c]

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	Base year[d]	Net emissions/removals[e]									Accounting parameters[h]	Accounting quantity[i]
		2013	2014	2015	2016	2017	2018	2019	2020	Total[g]		
	(kt CO_2 eq)											
A. Article 3.3 activities												
A.1. Afforestation/reforestation		-179.80	-194.12	-208.55	-222.75	-240.68	-254.55	-273.17	-293.25	-1,866.87		-1866.87
Excluded emissions from natural disturbances (5)		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Excluded subsequent removals from land subject to natural disturbances (6)		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
A.2. Deforestation		1,066.40	820.24	850.57	880.85	911.24	941.29	1,118.63	1,150.67	7,739.90		7739.90
B. Article 3.4 activities												
B.1. Forest management										-22,100.42		-10317.30
Net emissions/removals		-6,624.96	-938.46	-2,723.06	-1,826.03	-3,064.03	-2,295.19	-3,069.94	-1,558.75	-22,100.42		
Excluded emissions from natural disturbances (5)												
Excluded subsequent removals from land subject to natural disturbances(6)		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Any debits from newly established forest (CEF-ne) (7),(8)		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
Forest management reference level (FMRL) (9)											-16302.00	
Technical corrections to FMRL(10)											14829.11	
Forest management cap											7394.54	-7394.54
B.2. Cropland management (if elected)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA

B.3. Grazing land management (if elected)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
B.4. Revegetation (if elected)	NO,NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA		NO,NA
B.5. Wetland drainage and rewetting (if elected)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA

Note: 1 kt CO_2 eq equals 1 Gg CO_2 eq.

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Developed country Parties with a quantified economy-wide emission reduction target as communicated to the secretariat and contained in document FCCC/SB/2011/INF.1/Rev.1 or any update to that document, that are Parties to the Kyoto Protocol, may use table 4(a)II for reporting of accounting quantities if LULUCF is contributing to the attainment of that target.

[c] Parties can include references to the relevant parts of the national inventory report, where accounting methodologies regarding LULUCF are further described in the documentation box or in the biennial reports.

[d] Net emissions and removals in the Party's base year, as established by decision 9/CP.2.

[e] All values are reported in the information table on accounting for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, of the CRF for the relevant inventory year as reported in the current submission and are automatically entered in this table.

[f] Additional columns for relevant years should be added, if applicable.

[g] Cumulative net emissions and removals for all years of the commitment period reported in the current submission.

[h] The values in the cells "3.3 offset" and "Forest management cap" are absolute values.

[i] The accounting quantity is the total quantity of units to be added to or subtracted from a Party's assigned amount for a particular activity in accordance with the provisions of Article 7, paragraph 4, of the Kyoto Protocol.

[j] In accordance with paragraph 4 of the annex to decision 16/CMP.1, debits resulting from harvesting during the first commitment period following afforestation and reforestation since 1990 shall not be greater than the credits accounted for on that unit of land.

[k] In accordance with paragraph 10 of the annex to decision 16/CMP.1, for the first commitment period a Party included in Annex I that incurs a net source of emissions under the provisions of Article 3 paragraph 3, may account for anthropogenic greenhouse gas emissions by sources and removals by sinks in areas under forest management under Article 3, paragraph 4, up to a level that is equal to the net source of emissions under the provisions of Article 3, paragraph 3, but not greater than 9.0 megatons of carbon times five, if the total anthropogenic greenhouse gas emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3, paragraph 3.

[l] In accordance with paragraph 11 of the annex to decision 16/CMP.1, for the first commitment period of the Kyoto Protocol only, additions to and subtractions from the assigned amount of a Party resulting from Forest management under Article 3, paragraph 4, after the application of paragraph 10 of the annex to decision 16/CMP.1 and resulting from forest management project activities undertaken under Article 6, shall not exceed the value inscribed in the appendix of the annex to decision 16/CMP.1, times five.

Custom footnotes

LULUCF is not part of the target

CTF Table 4(b): Reporting on progress

Table 4(b) LVA_BR5_v2.0

Reporting on progress[a, b, c]

Units of market based mechanisms			Year 2019	Year 2020
Kyoto Protocol units[d]	Kyoto Protocol units	(number of units)	NA	NA
		(kt CO_2 eq)	NA	NA
	AAUs	(number of units)	NA	NA
		(kt CO_2 eq)	NA	NA
	ERUs	(number of units)	NA	NA
		(kt CO_2 eq)	NA	NA
	CERs	(number of units)	NA	NA
		(kt CO_2 eq)	NA	NA
	tCERs	(number of units)	NA	NA
		(kt CO_2 eq)	NA	NA
	lCERs	(number of units)	NA	NA
		(kt CO_2 eq)	NA	NA
Other units[d,e]	Units from market-based mechanisms under the Convention	(number of units)		
		(kt CO_2 eq)		
	Units from other market-based mechanisms	(number of units)		
		(kt CO_2 eq)		
Total		(number of units)	NA	NA
		(kt CO_2 eq)	NA	NA

Abbreviations: AAUs = assigned amount units, CERs = certified emission reductions, ERUs = emission reduction units, lCERs = long-term certified emission reductions, tCERs = temporary certified emission reductions.

Note: 2011 is the latest reporting year.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For each reported year, information reported on progress made towards the emission reduction target shall include, in addition to the information noted in paragraphs 9(a-c) of the reporting guidelines, on the use of units from market-based mechanisms.

[c] Parties may include this information, as appropriate and if relevant to their target.

[d] Units surrendered by that Party for that year that have not been previously surrendered by that or any other Party.

[e] Additional rows for each market-based mechanism should be added, if applicable.

(1) NA for the quantity of units and kt CO_2 eq. from market-based mechanisms under the Convention
(2) NA for the quantity of units and kt CO_2 eq. from other market-based mechanisms
(3) NA for the quantity of units and kt CO_2 eq. from market-based mechanisms under the Convention
(4) NA for the quantity of units and kt CO_2 eq. from other market-based mechanisms

CTF Table 5: Summary of key variables and assumptions used in the projections analysis

LVA_BR5_v2.0

Table 5

Summary of key variables and assumptions used in the projections analysis[a]

Key underlying assumptions		Historical[b]											Projected			
Assumption	Unit	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
Population	thousands	2,668.14	2,500.58	2,381.72	2,249.72	2,120.50	1,986.10	1,968.96	1,950.12	1,934.38	1,919.97	1,907.68	1,849.68	1,799.00	1,760.97	1,738.07
Gross domestic product, constant prices	MEUR (2015)	NE	11,133.20	14,353.45	21,243.45	20,727.04	24,572.13	25,153.90	25,987.27	27,024.03	27,695.39	26,651.53	30,503.73	34,277.10	38,217.14	42,153.43
EU ETS carbon price	EUR(2015)/EUA	NA	NA	NA	32.50	11.27	7.60	5.24	5.58	14.74	22.74	24.94	27.94	29.93	39.91	52.88
Coal import price	EUR(2015)/GJ	NE	1.37	1.74	2.33	2.74	3.61	2.54	3.05	3.14	3.45	3.67	3.16	3.20	3.27	3.27
Crude oil import price	EUR(2015)/GJ	NE	2.71	5.53	6.55	8.49	6.08	4.83	5.90	7.18	7.57	7.57	8.58	9.32	10.17	10.91
Natural gas import price	EUR(2015)GJ	NE	2.41	3.51	2.81	7.27	7.50	5.40	5.18	6.46	6.92	7.32	8.05	8.05	8.46	8.95
Number of passenger-kilometres (all modes)	Mpkm	NE	10,894.60	14,829.70	16,169.20	15,495.34	16,496.58	16,793.33	17,868.75	18,163.80	18,462.52	16,532.00	19,934.28	20,682.05	21,379.04	21,973.38
Freight transport tonnes-kilometres (all modes)	Mtkm	86,033.00	44,650.00	18,106.00	28,357.00	27,787.00	33,605.00	30,111.00	29,999.00	32,871.00	30,002.00	21,695.00	34,486.18	35,993.14	37,396.05	38,651.45
Livestock - Dairy cattle	1000	535.10	291.90	204.50	185.20	164.10	162.40	154.00	150.40	144.50	138.40	136.00	127.50	125.40	121.60	119.40
Livestock - Non-dairy cattle	1000	904.20	245.20	162.20	200.00	215.40	256.70	258.30	255.40	250.90	256.90	263.00	247.20	244.10	239.50	237.55
Livestock - Sheep	1000	164.60	72.20	28.60	41.60	76.80	102.30	106.60	112.20	107.30	99.80	91.90	109.20	115.10	119.90	125.25
Livestock - Pig	1000	1,401.10	552.80	393.50	427.90	389.70	334.20	336.40	320.60	304.90	314.20	306.80	284.50	274.70	268.70	262.30
Livestock - Poultry	1000	10,321.10	4,198.30	3,104.60	4,092.30	4,948.70	4,532.00	4,711.70	4,943.80	5,403.10	5,690.40	5,837.90	5,349.10	5,319.30	5,295.80	5,270.90
Nitrogen input from application of synthetic fertilizers	kt N	131.40	11.50	23.00	40.90	59.50	75.80	78.29	77.40	74.50	80.70	84.30	86.60	91.10	94.00	97.60
Nitrogen input from application of manure	kt N	51.15	25.21	18.88	19.19	18.18	18.09	17.23	18.77	16.78	17.03	16.94	14.05	14.04	13.89	14.89
Nitrogen in crop residues returned to soils	kt N	32.56	13.74	12.41	18.02	19.79	32.20	30.74	30.05	25.10	33.91	36.35	28.27	31.21	34.46	35.00
Area of cultivated organic soils	ha	195.06	184.71	172.15	166.86	162.82	158.73	157.70	158.01	158.31	164.22	166.81	162.76	162.76	162.76	162.76
Municipal solid waste (MSW) generation	1000t	NE	657.00	713.00	716.00	680.10	798.06	802.47	798.19	785.07	840.41	908.96	904.39	912.75	921.19	900.00
Municipal solid waste (MSW) going to landfills	1000t	NE	456.79	627.66	516.00	615.55	494.00	515.71	518.00	462.36	481.63	480.07	406.00	400.00	400.00	400.00
Share of CH4 recovery in total CH4 generation from landfills	%	NO	NO	NO	23.36	26.29	33.89	33.41	34.74	33.62	30.72	30.91	33.65	37.04	38.41	38.98

Primary energy consumption - Coal	PJ	29.70	11.22	5.50	3.41	4.56	1.96	1.71	1.72	2.78	3.47	3.19	1.26	0.72	0.48	0.48
Primary energy consumption - petroleum products	PJ	143.92	78.72	53.13	59.68	58.77	57.71	57.18	59.53	60.19	58.11	55.65	56.89	51.48	46.05	35.55
Primary energy consumption - Natural gas	PJ	99.65	42.28	45.74	56.85	61.23	45.99	46.61	41.57	48.94	46.19	38.11	52.70	53.99	50.15	42.54
Primary energy consumption - Renewables	PJ	43.77	52.68	49.86	61.99	61.24	66.68	69.50	82.10	78.48	76.43	75.87	61.48	62.22	61.12	70.05
Primary energy consumption - Total	PJ	329.95	193.02	160.65	189.67	188.94	178.89	178.71	184.70	194.32	188.11	178.67	176.56	174.08	168.43	158.54

[a] Parties should include key underlying assumptions as appropriate.

[b] Parties should include historical data used to develop the greenhouse gas projections reported.

CTF Table 6(a): Information on updated greenhouse gas projections under a "with measures" scenario

Table 6(a) LVA_BR5_v2.0

Information on updated greenhouse gas projections under a "with measures" scenario[a]

	GHG emissions and removals[b] (kt CO_2 eq)								GHG emission projections (kt CO_2 eq)	
	Base year (1990)	1990	1995	2000	2005	2010	2015	2019	2020	2030
Sector[d,e]										
Energy	16,453.98	16,453.98	7,473.87	5,184.16	5,024.56	5,229.75	4,027.42	4,127.00	3,671.75	3,860.62
Transport	3,040.40	3,040.40	2,104.71	2,213.69	3,112.87	3,278.25	3,150.63	3,331.18	3,108.60	2,763.48
Industry/industrial processes	655.98	655.98	227.13	286.55	371.16	749.44	791.23	891.77	868.15	836.72
Agriculture	4,985.80	4,985.80	2,004.23	1,678.46	1,793.20	1,878.76	2,158.16	2,201.39	2,250.88	2,261.66
Forestry/LULUCF	-12,300.85	-12,300.85	-14,745.99	-11,754.19	-5,830.39	-1,879.51	189.49	-2,405.88	646.57	4,703.73
Waste management/waste	732.09	732.09	638.53	696.91	626.08	665.73	575.91	552.29	547.25	451.85
Other (specify)	40.41	40.41	32.03	24.78	21.35	16.27	17.04	12.67	13.10	11.84
Indirect CO2	40.41	40.41	32.03	24.78	21.35	16.27	17.04	12.67	13.10	11.84
Gas										
CO_2 emissions including net CO_2 from LULUCF	6,259.44	6,259.44	-6,741.08	-5,815.80	892.17	5,557.43	6,216.77	3,844.95	6,235.31	10,267.29
CO_2 emissions excluding net CO_2 from LULUCF	19,661.40	19,661.40	9,133.78	7,081.47	7,810.47	8,554.09	7,262.10	7,648.67	6,994.11	6,940.77
CH_4 emissions including CH_4 from LULUCF	4,178.85	4,178.85	2,736.88	2,449.24	2,379.40	2,335.87	2,412.01	2,518.54	2,500.35	2,410.07
CH_4 emissions excluding CH_4 from LULUCF	3,623.78	3,623.78	2,179.95	1,885.83	1,870.14	1,805.89	1,772.69	1,743.03	1,718.06	1,639.28
N_2O emissions including N_2O from LULUCF	3,129.12	3,129.12	1,689.38	1,606.67	1,716.94	1,807.71	1,999.44	2,065.33	2,096.69	2,027.69
N_2O emissions excluding N_2O from LULUCF	2,583.07	2,583.07	1,117.44	1,026.99	1,138.28	1,220.54	1,403.93	1,443.00	1,473.61	1,421.28
HFCs	NO	NO	17.13	64.60	105.20	214.05	254.52	255.11	248.91	162.65
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	0.17	0.88	3.78	7.35	10.12	13.82	11.94	10.36
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other (specify)										
Total with LULUCF[f]	13,567.41	13,567.41	-2,297.52	-1,694.41	5,097.49	9,922.41	10,892.86	8,697.75	11,093.20	14,878.06
Total without LULUCF	25,868.25	25,868.25	12,448.47	10,059.77	10,927.87	11,801.92	10,703.36	11,103.63	10,446.63	10,174.34

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", at a minimum Parties shall report a "with measures" scenario, and may report "without measures" and "with additional measures" scenarios. If a Party chooses to report "without measures" and/or "with additional measures" scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report "without measures" or "with additional measures" scenarios then it should not include tables 6(b) or 6(c) in the biennial report.

[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.

[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.
[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.
[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

Custom footnotes

Values of 2020 are historical emissions to make consistency with all other CTF tables.

CTF Table 6(c): Information on updated greenhouse gas projections under a "with additional measures" scenario

Table 6(c) LVA_BR5_v2.0

Information on updated greenhouse gas projections under a "with additional measures" scenario[a]

	GHG emissions and removals[b] (kt CO_2 eq)								GHG emission projections (kt CO_2 eq)	
	Base year (1990)	1990	1995	2000	2005	2010	2015	2019	2020	2030
Sector[d,e]										
Energy	16,453.98	16,453.98	7,473.87	5,184.16	5,024.56	5,229.75	4,027.42	4,127.00	3,671.75	3,765.42
Transport	3,040.40	3,040.40	2,104.71	2,213.69	3,112.87	3,278.25	3,150.63	3,331.18	3,108.60	2,578.26
Industry/industrial processes	655.98	655.98	227.13	286.55	371.16	749.44	791.23	891.77	868.15	836.72
Agriculture	4,985.80	4,985.80	2,004.23	1,678.46	1,793.20	1,878.76	2,158.16	2,201.39	2,250.88	2,136.90
Forestry/LULUCF	-12,300.85	-12,300.85	-14,745.99	-11,754.19	-5,830.39	-1,879.51	189.49	-2,405.88	646.57	3,838.22
Waste management/waste	732.09	732.09	638.53	696.91	626.08	665.73	575.91	552.29	547.25	434.94
Other (specify)	40.41	40.41	32.03	24.78	21.35	16.27	17.04	12.67	13.10	11.06
Indirect CO2	40.41	40.41	32.03	24.78	21.35	16.27	17.04	12.67	13.10	11.06
Gas										
CO_2 emissions including net CO_2 from LULUCF	6,259.44	6,259.44	-6,741.08	-5,815.80	892.17	5,557.43	6,216.77	3,844.95	6,235.31	9,138.60
CO_2 emissions excluding net CO_2 from LULUCF	19,661.40	19,661.40	9,133.78	7,081.47	7,810.47	8,554.09	7,262.10	7,648.67	6,994.11	6,677.59
CH_4 emissions including CH_4 from LULUCF	4,178.85	4,178.85	2,736.88	2,449.24	2,379.40	2,335.87	2,412.01	2,518.54	2,500.35	2,383.89
CH_4 emissions excluding CH_4 from LULUCF	3,623.78	3,623.78	2,179.95	1,885.83	1,870.14	1,805.89	1,772.69	1,743.03	1,718.06	1,613.10
N_2O emissions including N_2O from LULUCF	3,129.12	3,129.12	1,689.38	1,606.67	1,716.94	1,807.71	1,999.44	2,065.33	2,096.69	1,894.96
N_2O emissions excluding N_2O from LULUCF	2,583.07	2,583.07	1,117.44	1,026.99	1,138.28	1,220.54	1,403.93	1,443.00	1,473.61	1,288.55
HFCs	NO	NO	17.13	64.60	105.20	214.05	254.52	255.11	248.91	162.65
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	0.17	0.88	3.78	7.35	10.12	13.82	11.94	10.36
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other (specify)										
Total with LULUCF[f]	13,567.41	13,567.41	-2,297.52	-1,694.41	5,097.49	9,922.41	10,892.86	8,697.75	11,093.20	13,590.46
Total without LULUCF	25,868.25	25,868.25	12,448.47	10,059.77	10,927.87	11,801.92	10,703.36	11,103.63	10,446.63	9,752.25

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", at a minimum Parties shall report a "with measures" scenario, and may report "without measures" and "with additional measures" scenarios. If a Party chooses to report "without measures" and/or "with additional measures" scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report 'without measures' or "with additional measures" scenarios then it should not include tables 6(b) or 6(c) in the biennial report.

[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.

[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.
[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.
[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

Custom footnotes

Values of 2020 are historical emissions to make consistency with all other CTF tables.

CTF Table 7: Provision of public financial support: summary information

Table 7 LVA_BR5_v2.0

Provision of public financial support: summary information in 2019[a]

Allocation channels	Year									
	European euro - EUR					USD[b]				
	Core/ general[c, 1]	Climate-specific[d, 2]				Core/ general[c, 1]	Climate-specific[d, 2]			
		Mitigation	Adaptation	Cross-cutting[e]	Other[f]		Mitigation	Adaptation	Cross-cutting[e]	Other[f]
Total contributions through multilateral channels:										
Multilateral climate change funds[g]										
Other multilateral climate change funds[h]										
Multilateral financial institutions, including regional development banks										
Specialized United Nations bodies										
Total contributions through bilateral, regional and other channels				88,528.38					99,105.26	
Total				88,528.38					99,105.26	

Note: Explanation of numerical footnotes is provided in the documentation box after tables 7, 7(a) and 7(b).

Abbreviation: USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.

[b] Parties should provide an explanation of the methodology used for currency exchange for the information provided in tables 7, 7(a) and 7(b) in the documentation box.

[c] This refers to support to multilateral institutions that Parties cannot specify as being climate-specific.

[d] Parties should explain in their biennial reports how they define funds as being climate-specific.

[e] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

[f] Please specify.

[g] Multilateral climate change funds listed in paragraph 17(a) of the “UNFCCC biennial reporting guidelines for developed country Parties” in decision 2/CP.17.

[h] Other multilateral climate change funds as referred in paragraph 17(b) of the “UNFCCC biennial reporting guidelines for developed country Parties” in decision 2/CP.17.

Table 7

Provision of public financial support: summary information in 2020[a]

Allocation channels	Year									
	European euro - EUR					USD[b]				
	Core/ general[c, 1]	Climate-specific[d, 2]				Core/ general[c, 1]	Climate-specific[d, 2]			
		Mitigation	Adaptation	Cross-cutting[e]	Other[f]		Mitigation	Adaptation	Cross-cutting[e]	Other[f]
Total contributions through multilateral channels:										
Multilateral climate change funds[g]										
Other multilateral climate change funds[h]										
Multilateral financial institutions, including regional development banks										
Specialized United Nations bodies										
Total contributions through bilateral, regional and other channels		55,361.00		38,400.00			63,233.12		43,860.33	
Total		55,361.00		38,400.00			63,233.12		43,860.33	

Note: Explanation of numerical footnotes is provided in the documentation box after tables 7, 7(a) and 7(b).

Abbreviation: USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.

[b] Parties should provide an explanation of the methodology used for currency exchange for the information provided in tables 7, 7(a) and 7(b) in the documentation box.

[c] This refers to support to multilateral institutions that Parties cannot specify as being climate-specific.

[d] Parties should explain in their biennial reports how they define funds as being climate-specific.

[e] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

[f] Please specify.

[g] Multilateral climate change funds listed in paragraph 17(a) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

[h] Other multilateral climate change funds as referred in paragraph 17(b) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

CTF Table 7(a): Provision of public financial support: contribution through multilateral channels in 2019

No information provided in Table 7(a).

CTF Table 7(a): Provision of public financial support: contribution through multilateral channels in 2020

No information provided in Table 7(a).

CTF Table 7(b): Provision of public financial support: contribution through bilateral, regional and other channels

Table 7(b) LVA_BR5_v2.0

Provision of public financial support: contribution through bilateral, regional and other channels in 2019[a]

Recipient country/ region/project/programme[b]	Total amount Climate-specific[f, 2] European euro - EUR	USD	Status[c, 3]	Funding source[g, 4]	Financial instrument[g, 5]	Type of support[g, h, 6]	Sector[d, g, 7]	Additional information[e]
Total contributions through bilateral, regional and other channels	88,528.38	99,105.26						
Georgia / Georgia – Latvian-Georgian training seminar in Tbilisi (Georgia) on implementation of measures for low-carbon development in the EU Eastern Partnership or Central Asia country	3,291.40	3,684.64	Disbursed	Oda	Other	Cross-cutting	Cross-cutting	The seminar focused on basic elements of the greenhouse gas (GHG) forecasting and GHG inventory preparation of the Latvian national system, including information regarding the time schedules for submission of reports; development of future climate change scenarios at national level; experience with the use of the COPERT model in the calculation of GHG emissions from the transport sector. Latvia joined Eurozone 1 January, 2014. According to the Bank of Latvia, the average EUR / USD rate in 2019 was 1,11947451.(https://www.bank.lv/statistika/dati-statistika/valutu-kursi/ecb-kursu-videjavertiba?view=graph&layout=currencyconverter&tmpl=component&ecb=1&action=average&dateFrom=01.01.2019&dateTo=31.12.2019)
Georgia / Georgia – Promoting the initiative and strengthening the capacity to promote entrepreneurship in the fisheries	39,284.79	43,978.32	Disbursed	Oda	Other	Cross-cutting	Cross-cutting	The aim was to support the Ministry of Agriculture of the Autonomous Republic of Adjara and the LEPL Laboratory Research Center for the development of small and medium-sized enterprises in the fisheries by improving the quality assessment and standardization system in the fisheries, strengthening coordination of common standardization processes and exchanging experience ensuring the monitoring of the sector and access to information and development perspectives, as well as promoting the participation of stakeholders and the development of competencies in the development of the fisheries. Latvia joined Eurozone 1 January, 2014. According to the Bank of Latvia, the average EUR / USD rate in 2019 was 1,11947451.(https://www.bank.lv/statistika/dati-statistika/valutu-kursi/ecb-kursu-videjavertiba?view=graph&layout=currencyconverter&tmpl=component&ecb=1&action=average&dateFrom=01.01.2019&dateTo=31.12.2019)
Kyrgyzstan / Kyrgyzstan – Promoting co-operation between municipalities and the	36,287.18	40,622.57	Disbursed	Oda	Other	Cross-cutting	Cross-cutting	The project aimed promote good governance in Kyrgyzstan by building the institutional capacity of the

government and improving public administration in Kyrgyzstan								public administration. The project will also develop recommendations for improving the performance of local governments and promoting cooperation, environmental protection and waste management. The project will provide an in-depth analysis of current cooperation practices, and experts will develop recommendations for improving municipal performance and governance principles. The key components of good governance - credibility, knowledge, skills and leadership - will ensure the transparency, participatory, successful and efficient operation of local authorities by providing public services to their citizens, improving existing forms of inter-municipal cooperation and introducing new ones. Experts will provide methodological support and develop recommendations for improving the work and performance of local governments. Latvian experts will conduct in-depth expertise in the field of environmental protection and waste management and develop recommendations in accordance with the request of the partner country. Latvia joined Eurozone 1 January, 2014. According to the Bank of Latvia, the average EUR / USD rate in 2019 was 1,11947451.(https://www.bank.lv/statistika/dati-statistika/valutu-kursi/ecb-kursu-videjavertiba?view=graph&layout=currencyconverter&tmpl=component&ecb=1&action=average&dateFrom=01.01.2019&dateTo=31.12.2019)
Uzbekistan / Uzbekistan – Assessing the applicability of open source technologies in the administrative management of the Republic of Uzbekistan	7,542.01	8,443.09	Disbursed	Oda	Other	Cross-cutting	Cross-cutting	The aim of the project was to identify the needs of GIS technologies used in the administrative system of the Republic of Uzbekistan, to analyse the existing systems and data structure in order to develop proposals for the implementation of open technology GIS solutions in the administrative management of Uzbekistan. As a result of the project implementation, the necessary preconditions will be created for ensuring sustainable and environmentally friendly development. The implementation of the project activities will promote the wider availability of geospatial data, significantly speeding up the decision-making process, making decision-making more transparent and evidence-based. The introduction of open technologies and the promotion of the e-services system contribute to the implementation of the principles of sustainable development, creating the necessary preconditions for the preservation and sustainable use of natural and environmental resources. Latvia joined Eurozone 1 January, 2014. According to the Bank of Latvia, the average EUR / USD rate in 2019 was 1,11947451.(https://www.bank.lv/statistika/dati-

								statistika/valutu-kursi/ecb-kursu-videjavertiba?view=graph&layout=currencyconverter&tmpl=component&ecb=1&action=average&dateFrom=01.01.2019&dateTo=31.12.2019)
Republic Of Moldova / Moldova – Civil society engagement in improving the rural development processes and promotion of efficient models for sustainable local development	2,123.00	2,376.64	Disbursed	Oda	Other	Cross-cutting	Cross-cutting	The aim was to increase the role of civil society in improving rural development processes through participation, openness and the promotion of effective sustainable local development. Within the framework of the project, a policy analysis on the implementation of rural policies at the national level was performed. The analysis was carried out by the expert conducting interviews in Moldova with key target groups, as well as assessing available policy documents and other relevant information. Its results were discussed together with the reports of the thematic groups in the Rural Network Round Table discussion and formed the basis for the Opinion of the National Rural Network on the implementation of rural development policy and recommendations for further action. Latvia joined Eurozone 1 January, 2014. According to the Bank of Latvia, the average EUR / USD rate in 2019 was 1,11947451.(https://www.bank.lv/statistika/dati-statistika/valutu-kursi/ecb-kursu-videjavertiba?view=graph&layout=currencyconverter&tmpl=component&ecb=1&action=average&dateFrom=01.01.2019&dateTo=31.12.2019)

Abbreviations: ODA = official development assistance, OOF = other official flows; USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.

[b] Parties should report, to the extent possible, on details contained in this table.

[c] Parties should explain, in their biennial reports, the methodologies used to specify the funds as disbursed and committed. Parties will provide the information for as many status categories as appropriate in the following order of priority: disbursed and committed.

[d] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under "Other".

[e] Parties should report, as appropriate, on project details and the implementing agency.

[f] Parties should explain in their biennial reports how they define funds as being climate-specific.

[g] Please specify.

[h] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

Provision of public financial support: contribution through bilateral, regional and other channels in 2020[a]

Recipient country/ region/project/programme[b]	Total amount Climate-specific[f, 2] European euro - EUR	USD	Status[c, 3]	Funding source[g, 4]	Financial instrument[g, 5]	Type of support[g, h, 6]	Sector[d, g, 7]	Additional information[e]
Total contributions through bilateral, regional and other channels	93,761.00	107,093.45						
Uzbekistan / Uzbekistan – Modernization of municipal public services Support in strengthing the efficiency of the public services and modernisation of district heating	53,137.00	60,692.88	Disbursed	Oda	Grant	Mitigation	Energy	The main objective of the project was to build the capacity of the Bukhara Energo Markaz and ISSIKLIK MANBAI district heating companies to implement infrastructure reconstruction and modernization projects. Training was provided on various risks and aspects of future reconstruction and development projects, such as technology selection, equipment installation and maintenance, etc. It was also discussed how to create efficient charging, invoicing, various data accounting. The transfer of good practice and the education of people will encourage further modernization of infrastructure and the use of more sustainable solutions that will save resources, reduce air pollution and reduce greenhouse gas emissions. Latvia joined Eurozone 1 January, 2014. According to the Bank of Latvia, the average EUR / USD rate in 2020 was 1,14219611.(https://www.bank.lv/statistika/dati-statistika/valutu-kursi/ecb-kursu-videjavertiba?view=graph&layout=currencyconverter&tmpl=component&ecb=1&action=average&dateFrom=01.01.2020&dateTo=31.12.2020)
Republic Of Moldova / Moldova – Supporting the growth of Moldova's regions by enhancing their resilience to emergencies and mitigating the long-term consequences of COVID-19	38,400.00	43,860.33	Disbursed	Oda	Grant	Cross-cutting	Not Applicable	The aim of the project, by supporting Moldova in the aftermath of COVID-19, is directly related to the promotion of sustainability, as one of the key tasks of the project is to promote local short supply chains as a way of green and sustainable business, and also included in green public procurement conditions, reducing the distances from which products, especially food, are delivered. Latvia joined Eurozone 1 January, 2014. According to the Bank of Latvia, the average EUR / USD rate in 2020 was 1,14219611.(https://www.bank.lv/statistika/dati-statistika/valutu-kursi/ecb-kursu-videjavertiba?view=graph&layout=currencyconverter&tmpl=component&ecb=1&action=average&da
Ghana / Ghana, Vietnam – EU Aid Volunteers initiative - strengthening of local rain forest organisations	2,224.00	2,540.24	Disbursed	Oda	Grant	Mitigation	Forestry	The project is part of the EU Aid Volunteers initiative and aims to send volunteers to Cameroon, Guinea, Congo, Vietnam and Ghana to strengthen local organizations that support local communities to jointly protect rainforests and make their management more sustainable. Latvia joined Eurozone 1 January, 2014.

								According to the Bank of Latvia, the average EUR / USD rate in 2020 was 1,14219611.(https://www.bank.lv/statistika/dati-statistika/valutu-kursi/ecb-kursu-videjavertiba?view=graph&layout=currencyconverter&tmpl=component&ecb=1&action=average&dateFrom=01.01.2020&dateTo=31.12.2020)

Abbreviations: ODA = official development assistance, OOF = other official flows; USD = United States dollars.
[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.
[b] Parties should report, to the extent possible, on details contained in this table.
[c] Parties should explain, in their biennial reports, the methodologies used to specify the funds as disbursed and committed. Parties will provide the information for as many status categories as appropriate in the following order of priority: disbursed and committed.
[d] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under "Other".
[e] Parties should report, as appropriate, on project details and the implementing agency.
[f] Parties should explain in their biennial reports how they define funds as being climate-specific.
[g] Please specify.
[h] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

CTF Table 8: Provision of technology development and transfer support

No information provided in Table 8.

CTF Table 9: Provision of capacity-building support

Table 9 LVA_BR5_v2.0

Provision of capacity-building support[a]

Recipient country/region	Targeted area	Programme or project title	Description of programme or project [b,c]
Georgia	Multiple Areas	Latvian-Georgian training seminar in Tbilisi on implementation of measures for low-carbon development in the EU Eastern Partnership or Central Asia country	The seminar focused on basic elements of the greenhouse gas (GHG) projections and GHG inventory preparation of the Latvian national system, including information regarding the time schedules for submission of reports; development of future climate change scenarios at national level and experience with the use of the COPERT model in the calculation of GHG emissions from the transport sector.
Georgia	Multiple Areas	Promoting the initiative and strengthening the capacity to promote entrepreneurship in the fisheries	The aim is to support the Ministry of Agriculture of the Autonomous Republic of Adjara and the LEPL Laboratory Research Center for the development of small and medium-sized enterprises in the fisheries by improving the quality assessment and standardization system in the fisheries, strengthening coordination of common standardization processes and exchanging experience ensuring the monitoring of the sector and access to information and development perspectives, as well as promoting the participation of stakeholders and the development of competencies in the development of the fisheries.
Kyrgyzstan	Multiple Areas	Promoting co-operation between municipalities and the government and improving public administration	The project aims to promote good governance in Kyrgyzstan by building the institutional capacity of the public administration. The project will also develop recommendations for improving the performance of local governments and promoting cooperation, environmental protection and waste management.
Uzbekistan	Multiple Areas	Assessing the applicability of open source technologies in the administrative management of the Republic of Uzbekistan	The aim of the project is to identify the needs of GIS technologies used in the administrative system of the Republic of Uzbekistan, to analyse the existing systems and data structure in order to develop proposals for the implementation of open technology GIS solutions in the administrative management of Uzbekistan.

[a] To be reported to the extent possible.

[b] Each Party included in Annex II to the Convention shall provide information, to the extent possible, on how it has provided capacity-building support that responds to the existing and emerging capacity-building needs identified by Parties not included in Annex I to the Convention in the areas of mitigation, adaptation and technology development and transfer.

[c] Additional information may be provided on, for example, the measure or activity and co-financing arrangements.