INTEGRATED REPORTING ON POLICIES AND MEASURES AND ON PROJECTIONS UNDER ARTICLE 18 OF REGULATION (EU) NO. 2018/1999 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

LATVIA

2025

DATA SHEET

Title

Integrated Reporting on Policies and Measures and Projections under Article 18 of Regulation (EU) No. 2018/1999 of the European Parliament and of the Council and Articles 36, 37 and 38 of Commission Implementing Regulation (EU) 2020/1208, Latvia, 2025

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ABBREVIATIONS

ALTUM – JSC "Development Finance Institution Altum"
AU – animal units
BAT – Best Available Techniques
CAP – Common Agricultural Policy
CHP – Combined Heat and Power
CNG – Compressed natural gas
CP Programme – Latvia's EU Cohesion Policy Programme for 2021-2027 EU Funds planning period
DH – District Heating
EAAI – Emission Allowances Auction Instrument
EC – European Commission
EMEP/EEA 2023 – EMEP/EEA air pollutant emission inventory guidebook 2023
EMS – Energy Management Systems
EPI – Energy performance indicator
ESR – Effort Sharing Regulation
EU ETS – European Union Emission Trading Scheme
EU – European Union
EV – Electric vehicle
FEC – Final Energy Consumption
FIT – Preferential Feed-in Tariffs
F-gases – Fluorinated gases
GPEC – Gross primary energy consumption
GDP – Gross Domestic Product
GFEC – Gross Final Energy Consumption
GHG – Greenhouse Gases
ICT – Information and communications technology
IPPU – Industrial Processes and Product Use
LBN – Latvian Construction Standard (Latvijas būvnormatīvs)
LEC – Large Electricity Consumers
LPG – Liquefied petroleum gas
LULUCF – Land Use, Land Use Change and Forestry
NZEB – Nearly-zero energy building
MoA – Ministry of Agriculture
MoCE – Ministry of Climate and Energy
MoE – Ministry of Economics
MoT – Ministry of Transport
NDP2027 – National Development Plan 2021-2027
NECP 2021-2030 – National Energy and Climate Plan 2021-2030
NFI – National Forest Inventory
PaM – Policies and Measures
PEC – Primary energy consumption
PV – Photovoltaic
PT – Public transport
ODS – Ozone depleting substances
RDP – Rural Development Programme
RES – Renewable energy source
RRF Plan – Latvia's Plan of EU Recovery and Resilience Facility
SO – Specific Objective
SWD – Solid waste disposal
ThO – Thematic Objective
Thous. – thousand
UNFCCC – United Nations Framework Convention on Climate Change
UWWTD – Urban Wastewater Directive
WAM – Scenario with additional measures
WEM – Scenario with existing measures

CHEMICAL FORMULAS

CH_4 – methane
CO_2 – carbon dioxide
CO – carbon monoxide
HFC – hydrofluorocarbons
NMVOC – non-methane volatile organic compounds
N_2O – nitrous oxide
NO_X – nitrogen oxides
SF_6 – sulphur hexafluoride
SO_2 – sulphur dioxide

EXECUTIVE SUMMARY

The Latvian Government in January 2020 approved the Strategy of Latvia for the Achievement of Climate Neutrality by 2050. The aim of Latvia's long-term strategy is to contribute to fulfilling the Union's and the Member States' commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement to reduce anthropogenic greenhouse gas (GHG) emissions and enhance removals by sinks and to promote increased carbon sequestration as is defined in the Governance Regulation[1] (Article 15). The European Climate Law establishes the objective of achieving climate neutrality by 2050, with an interim aim of reducing net GHG emissions by at least 55% by 2030 compared to 1990 levels. The 2030 target aligns with the European Union`s (EU) Nationally Determined Contribution (NDC). Latvia, as a Member State of the EU, contributes to achieving this goal.

The Latvian Government approved the updated National Energy and Climate Plan (NECP) 2021–2030 on 12th July 2024. Latvia's updated NECP 2021-2030 refers to the revised energy and climate targets agreed under the 'Fit for 55' package. The goals set for Latvia to reduce GHG emissions in the sectors of the economy that fall outside the scope of the EU Emission Trading System (non-ETS) by 17% compared to 2005. The Land Use, Land Use Change and Forestry (LULUCF) sector must ensure at least 0.644 million tons of carbon dioxide (CO_2) removals by 2030.

In 2022, Latvia's total GHG emissions including indirect CO_2, excluding LULUCF decreased by 61.1% compared to 1990. However, GHG emissions including indirect CO_2 and LULUCF increased by 10.3% over the same period.

The base year of projections is 2022. By 2030, total GHG emissions, including indirect CO_2 but excluding LULUCF, are projected to be 15.6% lower under the scenario with existing measures (WEM) and 18.0% lower under the scenario with additional measures (WAM), compared to 2022. Similarly, total GHG emissions, including indirect CO_2 and LULUCF, are expected to decrease by 12.7% in the WEM scenario and by 14.3% in the WAM scenario by 2030, compared to 2022.

By 2050, total GHG emissions, including indirect CO_2 but excluding LULUCF, are projected to be 53.4% lower in the WEM scenario and 56.7% lower in the WAM scenario, compared to 2022. Total GHG emissions, including indirect CO_2 and LULUCF, are expected to decrease by 26.4% in the WEM scenario and by 28.6% in the WAM scenario, compared to 2022.

[1] European Parliament and of the Council Regulation (EU) No. 2018/1999 of 11th 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

By 2030, GHG emissions in the non-ETS sector (ESR) are projected to decrease by 15.2% under the WEM scenario and by 18.2% under the WAM scenario, compared to 2005[2].

This report, along with the submitted data in the Reportnet 3.0 platform, addresses the reporting obligations under Article 18, Annexes VI and VII of Governance Regulation as well as Articles 36, 37 and 38 of Commission Implementing Regulation (EU) 2020/1208.

[2] According to Annex I to Commission Implementing Decision (EU) 2020/2126 of 16th December 2020 on setting out the annual emission allocations of the Member States for the period from 2021 to 2030 pursuant to Regulation (EU) 2018/842 of the European Parliament and of the Council (Decision 2020/2126), the value of Latvia's 2005 greenhouse gas emissions pursuant to Article 4(3) of Regulation (EU) 2018/842 is 8 598 kt CO_2 eq.

INTRODUCTION

As a member of the EU, Latvia is obliged to report to the European Commission (EC) according to Article 18 of the Governance Regulation as well as Articles 36, 37 and 38 of Commission Implementing Regulation (EU) 2020/1208.

In accordance with the Governance Regulation, each Member State shall report to the EC information on its national policies and measures or groups of measures and their national projections of anthropogenic GHG emissions by sources and removals by sinks, organised by gas or group of gases pursuant to Article 18. Projections are prepared under two scenarios: WEM and WAM, with 2022 as the base year.

Latvia's 2025 submission contains the following data and information, submitted through the EC's online tool in the Reportnet 3.0 portal:

- Report on GHG projections and policies and measures (PaMs);
- GHG Projections;
- Information of indicators, parameters, models and sensitivity analysis;
- Information on implemented, adopted and planned PaMs;
- Description of the National System for PaMs and GHG projections.

Latvia's 2025 integrated report on PaMs and GHG projections comprises eight chapters. Chapter 1 presents information on Latvia's GHG emissions in the annual inventory which was submitted to the UNFCCC on 16th December 2024. The annual GHG inventory provides information on the trends in national GHG emissions and removals in the period from 1990 to 2022. Information on national systems for PaMs and projections is included in Chapter 2. Information on PaMs is presented in Chapter 3, and projected GHG emissions until 2050 can be found in Chapter 4. Information on projected GHG emissions per sector is included in Chapter 5, while Chapter 6 includes total projected GHG emissions and the Effort Sharing Regulation (ESR) target. Chapter 7 provides a sensitivity analysis, and Chapter 8 describes the methods used for emission projection calculations in sectors.

Latvia's 2025 report was compiled by the Latvian Environment, Geology, and Meteorology Centre (LEGMC) and supported by Institute of Physical Energetics (IPE), Latvian State Forest Research Institute "Silava", the Latvia University of Life Sciences and Technologies (LBTU) and Ministry of Climate and Energy (MoCE). Latvia's 2025 report has been coordinated with the sectoral ministries.

1. GREENHOUSE GAS EMISSIONS IN LATVIA

The GHG emission data presented in this chapter is based on Latvia's GHG inventory submitted to UNFCCC secretariat on 16th December 2024[3]. The annual GHG inventory provides information on the historical trends in national GHG emissions and removals since 1990. This information is essential for planning and monitoring climate policies, as well as for the development of GHG projections.

In 2022, Latvia's GHG emissions were 10131.01 kt CO_2 eq. including indirect CO_2, without LULUCF and 15075.18 kt CO_2 eq. including indirect CO_2, with LULUCF. Latvia's total GHG emissions including indirect CO_2, without LULUCF showed a decrease of 61.1% compared to 1990, but GHG emissions including indirect CO_2, with LULUCF have increased by 10.3% compared to 1990. GHG emissions by sectors are shown in Figure 1.1.

The main GHG emission source in Latvia in 2022 is Energy sector (63.4%) followed by Agriculture (22.2%), Industrial Processes and Product Use (IPPU) (8.5%) and Waste (5.8%).

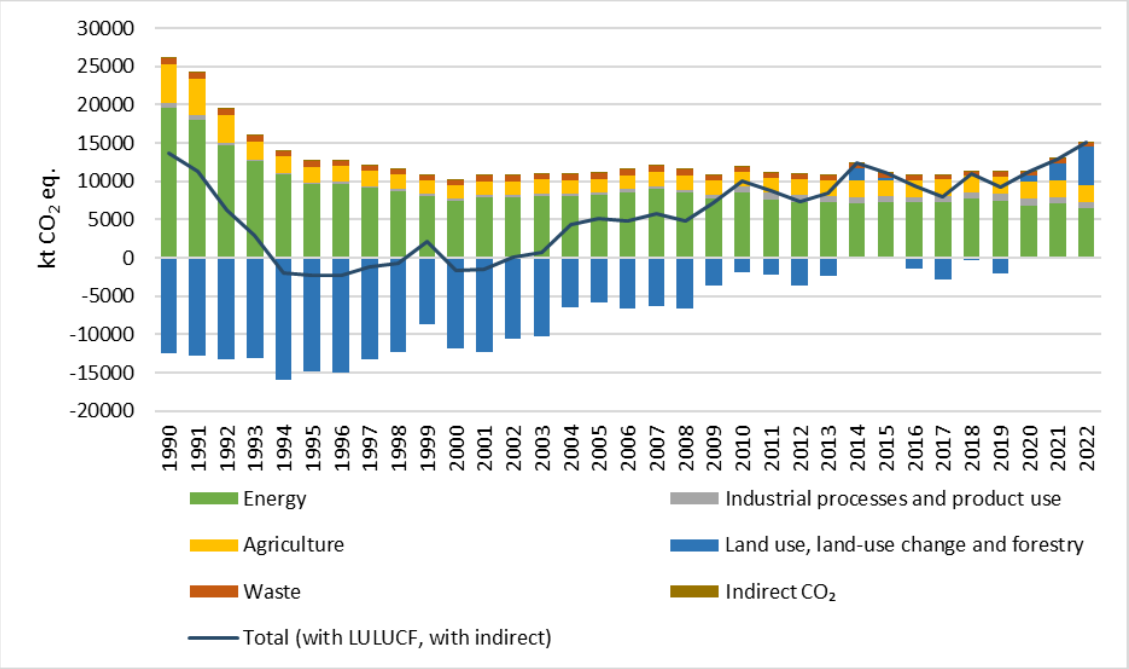

Figure 1.1 GHG emissions and removals in Latvia 1990 – 2022 by reporting sectors (emissions are positive and removals negative quantities)

Net GHG emissions from LULUCF in 2022 were 4944.16 kt CO_2 eq. compared to -12390.09 kt CO_2 eq. Aggregated net removals of the GHG were reduced by 139.9% in 2022 compared to 1990 mostly due to increase of harvest rate in mature 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. In 2022, the increased harvesting rate in forest land was related to Russia's aggression in Ukraine, disruption of the

[3] GHG inventory in Latvia 1990-2022. Available: https://unfccc.int/ghg-inventories-annex-i-parties/2024

existing wood supply chains, and timber market turbulences. Latvia's wood resources had to compensate for the previous wood supply from Russia and Belarus. Fluctuations in total GHG emissions during the last years (e.g. peak in 2014 and 2022) mostly are associated with the annual changes in CO_2 removals in living biomass in forest land caused by changes in forest characteristics and related management (gross annual increment of living biomass, natural mortality, harvesting rate, etc.). The most important impact factor is harvesting rate (e.g. peaks in 1999, 2014, 2022) that is also the main cause of net emission fluctuation between the last years.

The composition of Latvia`s GHG emissions by sector in 2022 is reflected in Figure 1.2.

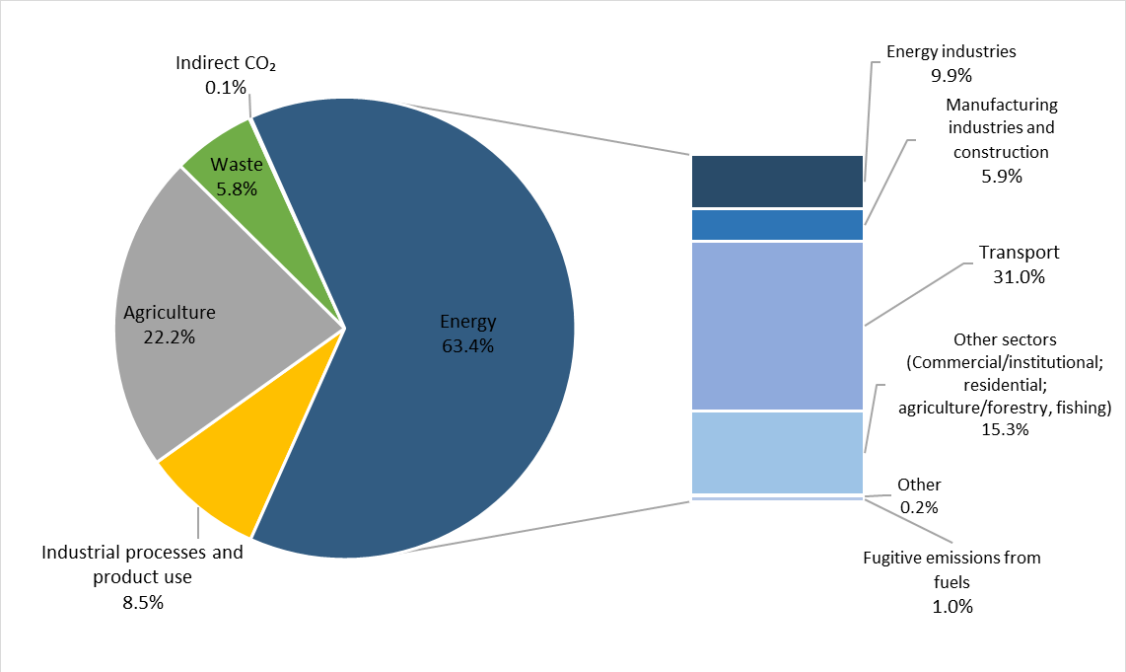

Figure 1.2 The composition of Latvia GHG emissions in 2022 (without LULUCF)

The ***Energy sector*** was the most significant source of GHG emissions in Latvia with 63.4% share of the total emissions in 2022. GHG emissions fluctuate in the latest years mainly due to economic trends, the energy supply structure and climate conditions as heat production is an essential part of Latvia's energy production. CO_2 emissions forms major part of Energy sector with contribution of 92.6%, then CH_4 emissions contributed 4.7% and N_2O emissions – 2.7%.

Agriculture was the second most significant source of GHG emissions in 2022, accounting for 22.2% of the total emissions. The GHG emissions from Agriculture sector include emissions of CO_2 from liming and urea application, CH_4 from enteric fermentation, manure management and emissions of N_2O from manure management and agricultural soils. N_2O emissions contributed 49.5%, but CH_4 emissions – 46.8%, and CO_2 emissions - 3.7% of total GHG emissions from Agriculture sector. 89.7% of total CH_4 emissions from Agriculture sector resulted from enteric fermentation and 10.3% from manure management. The major portion (94.0%) of Agriculture sector total N_2O emissions; only 6.0% of total N_2O emissions were contributed from manure management.

The emissions from ***IPPU*** were 8.5% of total GHG emissions in 2022. Emission fluctuations in IPPU sector are mainly linked with the economic situation in the country. CO_2 emissions are major part of IPPU sector with contribution of 69.0%, then F-gases contributed 29.2%, SF_6 – 1.4% and N_2O emissions – 0.4% of total IPPU sector. F-gases emissions from product uses as substitutes for ozone depleting substances (ODS) constituted 2.5% from total GHG emissions in 2022. Solvent Use sector was a significant non-methane volatile organic compound (NMVOC) emission source and covered 35.4% from the total Latvia's NMVOC emissions in 2022.

The ***Waste sector*** accounted for 5.8% of total Latvia's GHG emissions in 2022. CH_4 emissions contributed 91.4% and N_2O emissions contributed 8.6% of total GHG emissions from Waste sector. 75.2% of total CH_4 emissions from Waste sector resulted from solid waste disposal (SWD), 16.7% from wastewater treatment and discharge and 8.2% from biological treatment of solid waste.

2. INFORMATION ON NATIONAL SYSTEMS FOR POLICIES AND MEASURES AND PROJECTIONS

Under Article 39 of the Regulation (EU) No. 2018/1999 Member States shall operate and seek to continuously improve national systems respectively, for reporting on PaMs and for reporting on GHG projections. Those systems shall include the relevant institutional, legal and procedural arrangements established within a Member State.

In the Regulation of the Cabinet of Ministers (CoM) No. 675 "Procedures for Establishing and Maintaining the System for Greenhouse Gas Inventories, the Projection System, and the System for Reporting on the Adaptation to Climate Change" (Regulation No. 675)[4] requirements according to Governance Regulation and Implementation Regulation (EU) 2020/1208 are included to better reflect obligations and to make a reporting on PaMs and projections consistent with the national energy and climate progress reports.

Regulation No. 675 stipulates the determination of institutions that are responsible for preparation of GHG projections as well as includes the general information on Quality Assurance/Quality Control (QA/QC) procedures for GHG projections preparation.

In 2024, QA/QC programme was adopted by minister of MoCE. QA/QC programme outlines specific tasks and a timetable for the preparation of GHG projections.

MoCE is a single national entity with overall responsibility for the Latvian GHG projections and coordination of gathering information for reporting of PaMs.

The scheme of the institutional arrangements is shown in Figure 2.1. Institutions involved in the preparation of the projections are as follows:

MoCE ensures the submission of the GHG emission/removal projections to the relevant international institutions (EC, UNFCCC) and monitors the cooperation of the involved authorities. MoCE is responsible for preparation of legal basis for maintaining the National System, informing the inventory compilers about requirements of the national system overall coordination of GHG projection preparation process, final checking and approving of the GHG projections before official submission to the EC, and formal agreements with inventory experts and third part experts that evaluate quality assurance process.

Ministry of Economics (MoE) by 30th April prepares and once in two years submits the macroeconomic indicators. MoE in cooperation with the **IPE** prepares the primary data of the energy and construction and submits them by 1st June once in two years.

[4] Regulation of the CoM No. 675 (25th October 2022) "Procedures for Establishing and Maintaining the System for Greenhouse Gas Inventories, the Projection System, and the System for Reporting on the Adaptation to Climate Change". Available: https://m.likumi.lv/ta/id/336733-siltumnicefekta-gazu-inventarizacijas-sistemas-prognozu-sistemas-un-sistemas-zinosanai-par-pielagosanos-klimata-parmainam-izveidosanas-un-uzturesanas-kartiba *(in Latvian)*

LEGMC:

1) by 1st June once in two years prepares and submits:

- the primary data - projections of indicators of the waste and wastewater management sector;
- the secondary data and calculations of projections of GHG emissions;
- a description of GHG projections, PaMs for the activities of industrial processes.

2) prepares a draft report on the PaMs, and GHG emission projections (measures for the activities of Energy, Transport, Agriculture, IPPU, LULUCF and Waste activities).

3) in cooperation with other institution prepares a biennial transparency report under the UNFCCC.

MoA in cooperation with **LBTU** and **Latvian State Forest Research Institute "Silava"** prepares the primary data for Agriculture and Forestry sectors and, by 1st June, once in two years. **Latvian State Forest Research Institute "Silava"** in cooperation with the MoCE prepares the secondary data and calculations of GHG emission and CO_2 removal projections for LULUCF activities. **IPE** cooperation with the MoCE prepares the secondary data and calculations of GHG emission projections for the Energy and Transport sectors. **LBTU** in cooperation with MoCE prepares the secondary data and GHG emission calculations from agriculture activities.

Every second year, MoCE submits a report on PaMs and GHG projections to the EC (by 15th March) and to the UNFCCC (until 31st December).

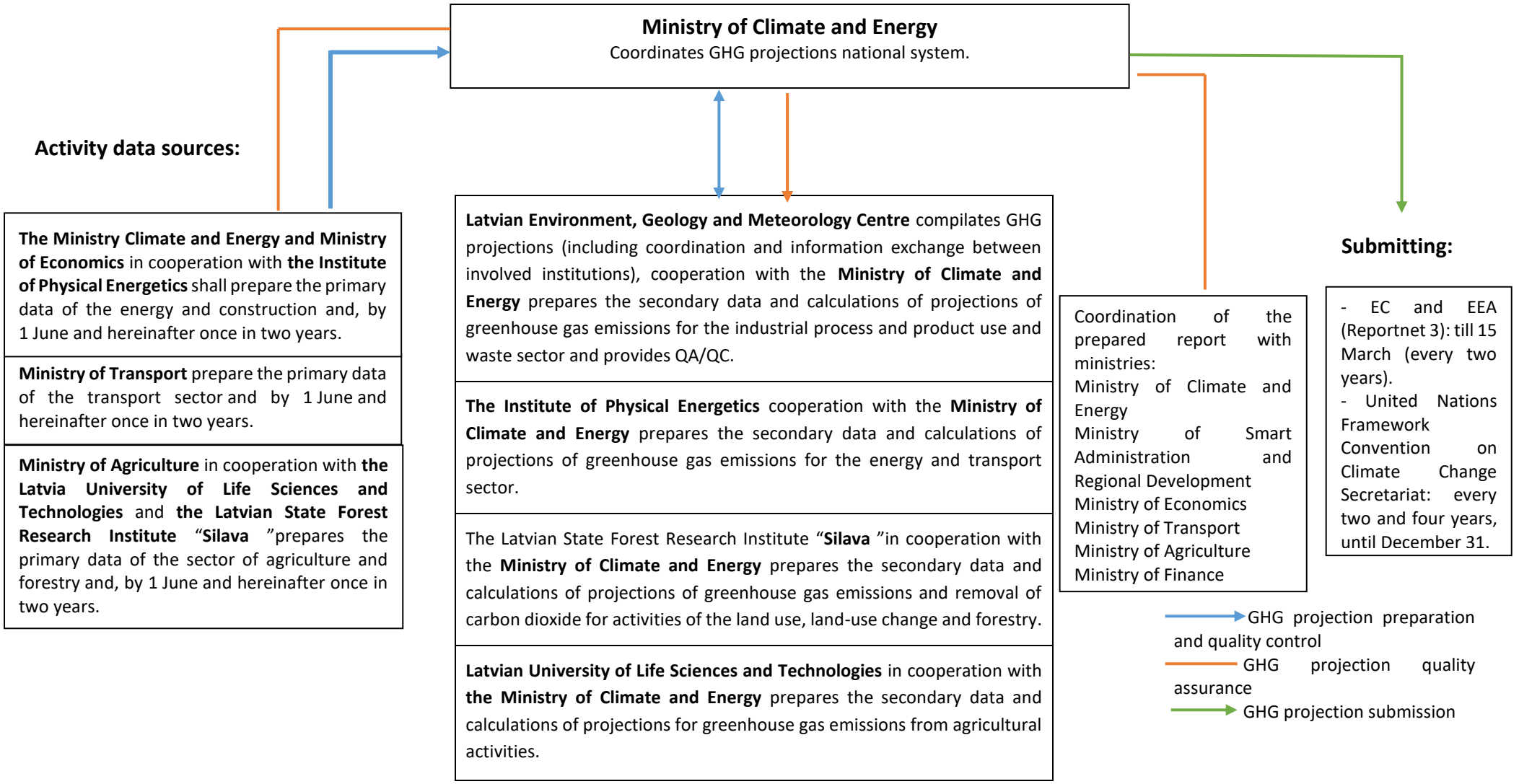

Figure 2.1 National system for the preparation of GHG projections and PaMs

3. INFORMATION ON POLICIES AND MEASURES

3.1 NATIONAL CLIMATE POLICY PLANNING

3.1.1 Policy planning strategies

The National Development Plan 2021–2027 (NDP2027)[5] has been developed in accordance with the Sustainable Development Strategy of Latvia until 2030 (Latvia2030) and the UN Sustainable Development Goals (SDGs) so that the quality of life improves for each individual, and society as a whole within 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, EU funds and other financial sources (including from foreign and national funds and programmes).

NDP2027 states to create a sustainable living environment for people and to 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.

On 30th August 2022 CoM adopted **Latvia's Environmental Policy Guidelines 2021-2027**. The Guidelines 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. 3 "Climate change" are defined as follows: (1) to ensure Latvia's progress towards achieving climate neutrality, and (2) to promote climate resilience and adaptation to climate change.

The following PaMs are defined by the Guidelines to mitigate climate change:

- To achieve the goal of reducing GHG emissions in 2030 and achieve climate neutrality by 2050;
- Improve adaptive capacity, strengthen resilience and reduce vulnerability to climate change;
- Ensure progress towards a regenerative growth model, decoupling economic growth from the use of natural resources and environmental degradation and accelerating the transition to a circular economy;
- Strive for zero pollution and an environment free of toxic substances, including air, water and soil, thus also protecting the health and well-being of Europeans;

[5]NDP2027. Available: https://www.pkc.gov.lv/sites/default/files/inline-files/NAP2027__ENG.pdf

- Protect, preserve and restore biodiversity and increase natural capital (especially the capital of air, water, soil and forest, freshwater, wetland and marine ecosystems);
- Promote environmental sustainability and reduce the environmental and climate burden associated with production and consumption (in the areas of energy, industrial development, buildings and infrastructure, mobility and food systems, etc.).

The Guidelines 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 (MoCE, MoA, MoE, MoT) and by involving local governments in the field of their competence.

Updated NECP 2021-2030 is a document for the long-term planning of energy and climate policy laying down the basic principles, targets 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.

Latvia's NECP 2021-2030 outline how Latvia intends to address the 5 dimensions of the energy union: decarbonisation, energy efficiency, energy security, internal energy market, research, innovation and competitiveness. NECP 2021-2030 "Target scenario" contains additional measures to WAM scenario to ensure that all targets related to these 5 dimensions are met.

This approach requires a coordination of purpose across all government departments, and it provides a level of planning that will ease public and private investment. Main targets are included in the updated NECP 2021-2030[6].

Strategy for Sustainable Use of Peat Resources 2020-2030 (adopted by CoM on 24th November 2020) covers main aspects of sustainability of the peat extraction and production. In order to ensure the sustainable development of the peat industry, the main directions of action have been identified:

- inventory of peat deposits and ensuring sustainable management and use of peat resources in the national economy;
- improvement of the legal framework for the use of bogs and building institutional capacity;

[6] Udpated NECP 2021-2030. Available: https://commission.europa.eu/publications/latvia-final-updated-necp-2021-2030-submitted-2024_en

- improvement of the availability of information and promoting scientific research and innovative solutions for peat extraction and development and GHG emission accounting.

For every direction of action responsible institutions are determined to perform specific measures and achieve results.

Member States had to publish the first version of **Long-term strategy for building renovation** by 30th April 2014 and update the strategy every three years by submitting each version to the EC as a part of the National Energy Efficiency Action Plans. On 11th November 2020 the CoM 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. In December 2021 the EC proposed to review the current framework within the revision of the Energy Performance of Buildings Directive (EPBD) and suggested to strengthen the long-term renovation strategies towards 'Building renovation plans'. These national plans should be submitted every 5 years, following the submission of a draft plan, and should have clear and specific chapters, based on a common template. The plans will include national targets (instead of indicative milestones) in a more unified and comparable approach, an outline of the investment needs for their implementation and an overview of PaMs.

Building renovation plans will be aligned with the Governance Regulation framework and will be better synchronised with the NECP 2021-2030.

The revised Energy Performance of Buildings Directive (EU/2024/1275) entered into force in all EU countries on 28th May 2024 and helps increase the rate of renovation in the EU, particularly for the worst-performing buildings in each country.

3.1.2 EU ETS allowances auctioning

In the first years of the EU ETS 4th period (2021-2024) Latvia has auctioned more than 4.3 million emission allowances (emission allowances and EU aviation allowance) in the primary market on the common auction platform and received 301.93 MEUR from these auctions. According to provisional estimates of MoCE, Latvia could gain approximately 700 MEUR from the auctioning of emission allowances in the EU ETS 4th period from 2021 to 2030. These projections are calculated by considering:

- 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 emission allowances (which in fact varies significantly depending on the actual market situation).

All auction revenues are channelled to the state budget program – Emission Allowances Auctioning Instrument (EAAI), which has been established in 2016. The EAAI is aimed to climate change mitigation and adaptation to climate change and operates in accordance with

the Law "On pollution" and also by taking into account determined directions of the use of revenues from the auctioning of emission allowances in the updated NECP 2021-2030 and operational strategy of the EAAI. The operational strategy of the EAAI will be renewed in 2025. Eight open tenders, two of them in two rounds, for projects has been organized since the establishment of the EAAI until the end of 2024 with total available co-funding amount of 225 MEUR. All undisbursed revenues from the auctioning of emission allowances are being accumulated in order to allocate them for the specified purposes in the following years.

3.1.3 Low-Carbon Development Strategy

"Strategy of Latvia for the Achievement of Climate Neutrality by 2050"[7] (Strategy) was approved by CoM in January 2020. It sets direction towards climate neutrality by setting climate change mitigation goals and outlining low carbon development principles in Latvia.

The strategy has been submitted to the EC according to the requirements of the EU Governance Regulation. In line with the Paris Agreement, the Strategy has been translated and submitted to the UNFCCC in 2020.

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 mention concrete measures, which will be identified by elaboration of shorter-term sectoral planning documents such as current NECP 2021-2030.

In 2025, the existing Strategy is set to be updated in line with developments in EU and national climate policy since 2019, as well as the provisions of Regulation (EU) No. 2018/1999.

3.2 ENERGY

3.2.1 Regulatory policies and measures

The **"Energy Efficiency Law"**[8], which contains legal norms arising from the Energy Efficiency Directive 2012/27/EU, is in force from 29th March 2016. The Amendments (14th July 2022) include the provisions of the amending Directive 2018/2002/EU, among others the *Energy efficiency first* principle.

The Law includes the framework for Energy Management Systems (EMS) and Energy Audits:

- **mandatory Energy Audits or EMS in Large Enterprises** (the transposition of the energy auditing framework defined by the Energy Efficiency Directive 2012/27/EU);
- **mandatory EMS or Energy Audits in Large Electricity Consumers (LEC)** (national measure, the electricity end-user is considered as a LEC if its own annual electricity consumption is above 500 MWh in two subsequent years).

[7] Strategy of Latvia for the Achievement of Climate Neutrality by 2050. Available: https://ec.europa.eu/clima/sites/lts/lts_lv_en.pdf
[8] Energy Efficiency Law. Available: http://likumi.lv/doc.php?id=280932

The large enterprises and the LECs shall submit an annual report to the state authority responsible for energy efficiency monitoring (State Construction Control Bureau of Latvia) on implemented energy efficiency improvement measures and energy saving reached. At least three energy efficiency improvement measures stated by the first and the following energy audit or EMS, which have the highest energy savings or the highest economic return, shall be implemented both by large enterprises (up to 1st April 2020 for 1st audit/EMS period) and by LECs (up to 1st April 2022 for 1st audit/EMS period).

The noted Amendments (14th July 2022) expand the coverage of public persons which are obliged to implement the EMS. The current regulation provides for:

- **mandatory EMS in those state direct administration institutions** which have in ownership or in possession the buildings with total heated area 10000 m^2 and above;
- **mandatory EMS in those derived public persons** which have in ownership or in possession the buildings with total heated area 10000 m^2 and above (new provision of 2022 Amendments);
- **mandatory EMS in all municipalities.** The new provision reflects the administrative territorial reform, in force from 1st July 2021. Until the Amendments of July 2022, only the largest nine cities and those municipalities which had both the territorial development index above the stated threshold and population above 10 thous. inhabitants had been obliged.

Annual report on implemented energy efficiency improvement measures and energy savings reached shall be submitted both by municipalities and specified state direct administration institutions and derived public persons.

The recast **Law on the Energy Performance of Buildings**[9] is in force from 9th January 2013. The Law, in accordance with the provisions of the EPB Directive 2010/31/EC[10], recasts the legal framework of setting the mandatory minimum energy performance requirements for buildings, the mandatory energy efficiency certification of buildings, verification of building`s heating systems and air conditioning systems, the functionality of automation and control systems of building's engineering systems, the installation of self-regulating devices for the microclimate regulation in premises, recording of the energy consumed in the building, etc. The Amendments (8th October 2020) include the provisions of the amending Directive 2018/844/EU. The regulation on the energy performance of buildings has impact on district heat consumption as high share of residential multi-apartment buildings and public and commerce buildings are connected to the DH systems.

Energy Performance Indicators (EPI) for buildings

The governmental regulations on the energy performance of buildings includes the following ones:

[9] Law on the Energy Performance of Buildings (recast). Available: http://likumi.lv/doc.php?id=253635
[10] Directive 2010/31/EC of the European Parliament and of the Council of 19th May 2010 on the energy performance of buildings

- the regulation on the energy certification of buildings (energy performance classes and related energy performance indicators, etc.);
- the regulation on the minimal energy efficiency requirements for existing, in exploitation, buildings (both residential and non-residential ones)[11];
- the national Construction Standard LBN 002-19 "Thermotechnics of Building Envelopes".

In 2013, six **energy performance classes** (A-F) for residential and non-residential buildings have been introduced[12]. On 16th April 2021 new Regulation[13] regarding energy certification of buildings has come into force. The 2021 Regulation introduces EPI for both: (1) energy consumption for heating, and (2) non-renewable primary energy consumption. The 2021 Regulation also adjusts the specific EPI 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 specific values in smaller buildings.

New Buildings. The nearly-zero energy building (NZEB) shall correspond to the A class (A+ is the voluntary one). The LBN 002-19 "Thermotechnics of Building Envelopes" (in force since 1st January 2020) has provided the transition period to the NZEB, as presented in the Table 3.1. The NZEB values need not be applied if application of the relevant requirements is either technically or functionally impossible and cost-benefit analysis on the useful lifetime of the relevant building indicates to losses.

Table 3.1 Minimum permissible level of energy performance of buildings: EPI for heating of new buildings (source: Latvian Construction Standard LBN 002-19)

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
From 1st January 2019 to 31st December 2020	≤ 50 kWh/m^2 per year	≤ 60 kWh/m^2 per year	NZEB ≤ 45 kWh/m^2 per year	≤ 65 kWh/m^2 per year

[11] CoM Regulation No 730 (10th December 2020) "Minimal Energy Efficiency Requirements for Existing, in Exploitation, Buildings". Available: https://likumi.lv/ta/id/319443

[12] CoM Regulation No. 383 (9th July 2013) "Regulations Regarding Energy Certification of Buildings": historical version, in force 19th July 2013 – 15th April 2021. Available: https://likumi.lv/doc.php?id=258322

[13] CoM Regulation No 222 (8th April 2021) „Regulations Regarding Energy Certification of Buildings and Energy Efficiency Calculation Method". Available: https://likumi.lv/ta/id/322436

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
From 1st January 2021	NZEB ≤ 40 kWh/m^2 per year	NZEB ≤ 40-60 kWh/m^2 per year (depending on the heated area)	NZEB≤ 45-50 kWh/m^2 per year (depending on the type of use and heated area)	
The presented values for 2021 and afterwards correspond to the re-casted values provided by the 2021 Regulation on energy certification of buildings.				

Reconstructed or renovated buildings. For the time periods of approval of a construction intension 21th November 2015 – 31th December 2020 and from the 1st January 2021 the EPI values for heating for the buildings to be reconstructed or renovated are directly included in the LBN 002-19 "Thermotechnics of Building Envelopes"[14]. They are as follows:

- for multi-apartment residential buildings – should not exceed 90 kWh per m^2 per year (21st November 2015 – 31st December 2020); from the 1st 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 (21st November 2015 – 31st December 2020); from the 1st January 2021 – should not exceed 90 kWh per m^2 per year;
- for public (state and municipal) buildings – should not exceed 110 kWh per m^2 per year (21st November 2015 – 31st December 2020), from the 1st 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 (21st November 2015 – 31st December 2020), from the 1st January 2021 – should not exceed 100 kWh per m^2 per year.

Minimum thermal insulation standards. The national Construction Standard LBN "Thermotechnics of Building Envelopes" systematically increases the requirements. The Amendments[15] (in force since 22nd April 2014) to the LBN 002-01 "Thermotechnics of Building Envelopes" had transposed the provisions of the recast EPB Directive 2010/31/EU. On 1st July

[14] Latvia Construction Standard LBN 002-19 "Thermotechnics of Building Envelopes", in force 1st January 2020. Available: https://likumi.lv/ta/id/307966

[15] The Amendments (8th April 2014) to the LBN 002-01 "Thermotechnics of Building Envelopes". Available: http://likumi.lv/doc.php?id=265703

2015 the LBN 002-15 "Thermotechnics of Building Envelopes"[16] had come into force. From 1st January 2020 the new LBN 002-19 "Thermotechnics of Building Envelopes" is in force. Due to the new Construction Standard incorporates directly the EPI for heating (in kWh per m^2 annually) for new buildings and buildings on-going reconstruction, there is no necessity to apply the normative values for particular construction elements. In its turn, the objective of the maximal U values is to eliminate the design of unsafe construction elements.

Mandatory individual heat energy metering. The individual heat energy metering by installing heat meters or heat cost allocators, if heating is supplied from a common heat source or a DH system, has become compulsory enabling residents to supervise their individual consumption and the energy costs thus encouraging users to save energy. The provision has been introduced in several steps:

- from 31st December 2016 - applies to new buildings and buildings to be converted or renovated, if funded by EU funds, State or municipal budgets (construction permit issued after 1st January 2016)[17];
- from 26th October 2020 – applies to all renovation projects of multi-apartment buildings, connected to DH system (remote readability shall be ensured)[18];
- from 1st January 2021 – applies to all existing buildings, on condition if the individual accounting is economically justified (a re-assement after a renovation of a heating system); installation of remotely readable metering devices required, for the devices, installed before 1st January 2021, a remote readability must be ensured by 1st January 2027[19].

Energy consumption management in buildings. By 1st January 2025, the existing non-residential buildings with an effective rated output for heating or air conditioning/ventilation system or combined system exceeding 290 kW shall be equipped with a building automation and control system. All new buildings, construction intentions of which are approved starting from 26th October 2020, shall have installed self-regulating equipment to control air temperature in each of premises or group of premises, on condition it is technically possible and economically justifiable.

The PaMs based on the Energy Efficiency Law, the Law on the Energy Performance of Buildings, governmental regulations issued pursuant to the Laws are included in the WEM scenario.

[16] Latvian Construction Standard LBN002-15 "Thermotechnics of Building Envelopes. Available: http://likumi.lv/ta/id/275015
[17] Amendments (3rd November 2015) to the CoM Regulation No. 876 (2008) "Heat Energy Supply and Consumption Regulations". Available: http://likumi.lv/doc.php?id=277661
[18] Amendments (16th June 2020) to the Latvia Construction Standard LBN 231-15 "Heat Supply and Ventilation (Conditioning) of Residential and Public Buildings". Available: https://likumi.lv/ta/id/315565
[19] CoM Regulation No 730 (10th December 2020) "Minimal Requirements for Existing, in Exploitation, Buildings": https://likumi.lv/ta/id/319443 // Amendments (4th October 2022) to the CoM Regulation No. 876 (2008) "Heat Energy Supply and Consumption Regulations". Available: http://likumi.lv/doc.php?id=336253

Two following planned measures, presented below, are included in the WAM scenario.

Impose an obligation on public authorities to monitor and reduce energy consumption. The updated NECP 2021-2030[20] states to set the mandatory target for public sector institutions - 1.9% energy consumption reduction annually. The energy coverage includes electricity, heat energy, natural gas and other fuels, transport energy. The obligation relates to energy consumed in the buildings owned or in possession by state and municipalities, energy consumed by state and municipal authorities and state and municipal capital companies. Thus, the target is set in accordance with the Article 5 of the new Energy Efficiency Directive 2023/1791/EU[21] - the total final energy consumption of all public bodies combined shall be reduced by at least 1.9% each year, when compared to 2021. To support the implementation of the given PaM, the updated NECP 2021-2030 states for the mandatory implementation of EMS in all public sector, including public capital companies.

Impose an Energy Management Obligation in Major Energy Consuming Entities. The given PaM expands the coverage of the enterprises for which the energy audit/EMS is mandatory. The updated NECP 2021-2030 states: companies with a total annual energy consumption of between 1.7 and 2.8 GWh will be obliged to carry out energy audits or introduce a certified EMS or complement the environmental management system and implement energy efficiency improvement measures[22]. Thus, the given PaM transposes the requirements of the new Energy Efficiency Directive's 2023/1791/EU Article 10.2.

Energy Efficiency Requirements for DH Systems. The measure is included in the WEM scenario. The CoM Regulation No 243 (2016)[23] defines the minimum efficiency requirements for DH technologies: (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 1st January 2019 – not higher than 17%).

3.2.2 Economic policies and measures

3.2.2.1 Programmes for DH Systems

The following planned measure, presented below, is included in the WAM scenario.

Electrification of DH systems. The updated NECP 2021-2030 provides to implement sufficiently extensive DH systems electrification: to electrify at least 100 MW heat production capacity up to 2030 and at least 200 MW heat production capacity up to 2040[24]. The support

[20] Updated NECP 2021-2030. Approved by the CoM Ordinance No 573, 12th July 2024: automatic machine translation. Available: https://commission.europa.eu/publications/latvia-final-updated-necp-2021-2030-submitted-2024_en , pages 73 & 75

[21] Directive (EU) 2023/1791 of the European Parliament and of the Council of 13th September 2023 on energy efficiency

[22] Updated NECP 2021-2030: automatic machine translation, page 71

[23] CoM Regulation No. 243 (19th April 2016) "Regulations Regarding the Energy Efficiency Requirements for District Heating Systems in the Possession of a Licensed or Registered Energy Supply Merchant and the Procedures for the Conformity Examination Thereof". Available: http://www.likumi.lv/doc.php?id=281914

[24] Updated NECP 2021- 2030: automatic machine translation, pages 50 & 52,53

would be provided to those DH systems, whose capacity allows for a partial or full transition to the electrification of heat generation, i.e. heat generation by large-scale heat pumps, by solar installations, electricity production in combination with energy storage facilities. It is envisaged that given PaM takes into account the necessity in long-term, particularly after 2030-2040, to reduce the use of solid biomass in energy production (particularly in heat production utilities above 7.5 MW capacity by switching them to zero emission technologies) and introduce the cascading principle in the circulation of timber.

3.2.2.2 Programmes for Household sector

Energy Efficiency Improvement in Apartment Buildings

In 2024-2029 period the EU Funds support for energy efficiency improvement of multi-apartment (three and more apartments) buildings continues. Beneficiaries – communities of apartment owners. The financing is provided by two funds: **Latvia's Plan of EU Recovery and Resilience Facility (RRF Plan**, the First Component "*Climate Change and Environmental Sustainability*" of the Plan) and **Latvia's EU Cohesion Policy Programme for 2021-2027 programming period (CP Programme). The described measure is included in the WEM scenario.** Within the funding of **RRF Plan** the submission of projects has been opened 8th December 2022, on 5th September 2024 all RRF Plan financing has been reserved for submitted projects. The projects shall be implemented up to 31st March 2026. The financial assistance is provided in the form of combined financial instrument: (1) subsidy (grant), up to 49 % of eligible cost of energy efficiency improvement project, (2) repayable low-interest loan, issued by the ALTUM, (3) guarantee for the loan, issued by the commercial financial institutions[25]. Eligible energy efficiency improvement activities relate to energy efficiency increase of building envelope, reconstruction of engineering systems (heat supply, hot water supply, installation of recuperation system), smart energy consumption control and management equipment installation. The renovation of multi-apartment building can be combined with the installation of renewable energy microgeneration technologies for self-consumption. In its turn, **CP Programme funding** (the measure No1 under the SO 2.1.1 "*Promotion of energy efficiency and reduction of GHG emissions*") will start after the contracting of the RRF Plan funding[26]. Investment in energy efficiency of multi-apartment buildings has an impact on district heat consumption as high share of multi-apartment buildings are connected to the DH systems.

[25] CoM Regulation No. 460 (14th July 2022) "Implementing Rules of the Latvia's Plan of the EU Recovery and Resilience Facility, the reform 1.2 "Energy Efficiency Improvement", the investment No 1.2.1.2.i "Energy Efficiency Improvement and transition to RES-utilizing technologies in multi-apartment buildings". Available: https://likumi.lv/ta/id/334084

[26] Latvia's EU Cohesion Policy Programme for the 2021-2027 planning period. Available: https://www.esfondi.lv/normativie-akti-un-dokumenti/2021-2027-planosanas-periods/eiropas-savienibas-kohezijas-politikas-programma-2021-2027-gadam

RES Technologies Implementation in Residential buildings

The national EAAI financed programme "GHG emissions reduction in households – support for utilisation of RES" has been approved on 1st March 2022[27]. The projects submission has been opened on 15th March 2022. The programme aims to reduce GHG emissions in residential buildings of different type. It supports the purchase of (1) RES-heat technology (heat boiler utilising wood pellets, heat pump, both up to 50 kW capacity, solar heat panels system with storage tank capacity up to 300 litres) to replace existing fossil fuel one, and (2) RES-electricity microgeneration technology (solar PV and wind energy technologies, including inverters and electricity storage equipment). Within the single project or step-by-step projects, the beneficiary can purchase several noted above technologies. The programme also supports the building's connection to DH system and establishment of related heating unit. The WEM scenario includes the programme's financial volume and total capacity of technologies installed up to 31st December 2024.

3.2.2.3 Programmes for Industrial and Commerce Buildings and Technologies

In 2024-2029 period the EU funds support for energy efficiency improvement and RES technologies implementation in manufacturing industry continues. The financing is provided by both **RRF Plan, CP Programme and Latvia's Territorial Just Transition Plan**. In 2024-2029 period the support is extended also to commerce sector. **These financing measures are included in the WEM scenario.**

RRF Plan funding provides aid for the wide range of activities. Beneficiaries are registered in Latvia enterprises operating in any economic sector, except specific ones. The measure is implemented in the form of combined financial instrument - loan with a capital rebate (grant). ALTUM issues both loans and parallel loans. The grant for the single beneficiary is provided for up to 30% of the project's total cost (not including (value added tax) VAT), but not more than 1.5 MEUR. The energy efficiency criteria to be met by the energy efficiency improvement projects: (i) at least 30% primary energy saving for building's energy efficiency improvement project, (ii) at least 30% primary energy savings for production processes' energy efficiency improvement project, (iii) in case of the combined energy efficiency improvement of building and production processes – at least 20% primary energy saving should be ensured for the building. For the RES technologies implementation projects, the minimum financial efficiency threshold is stated –at least 0.18 tons of annual CO_2 emission reduction per 1000 EUR of capital rebate (grant)[28]. The submission of the projects under the 1st Open Call was 4th November 2022 – 4th January 2023, afterwards following Open Calls have been announced in

[27] CoM Regulation No. 150 (1st March 2022) "Implementing Rules of the EAAI financed projects Open Call "GHG emission reduction in household – support for RES utilization": consolidated version. Available: https://likumi.lv/ta/id/330568

[28] CoM Regulation No. 594 (20th September 2022) "Implementing Rules of the Latvia's Plan of the EU Recovery and Resilience Facility, the reform No 1.2 "Energy Efficiency Improvement", the investment No 1.2.1.2.i, the Measure 1 "Energy efficiency improvement in business sector (including the transition to renewable technologies)". Available: https://likumi.lv/ta/id/336032

2023 and 2024. The decision on providing the aid may be adopted until 31st December 2025. The deadline for allocating the costs of the RRF Plan is 31st August 2026.

The **CP Programme funding,** the measure No2 under the SO 2.1.1 "*Promotion of energy efficiency and reduction of GHG emissions*", also provides investment aid for energy efficiency improvement and RES technologies implementation in industry and commerce sector. In its turn, **Latvia's Territorial Just Transition Plan**[29] includes the measure focused to greening the business sector by increasing energy efficiency of buildings and production technologies and implementation of RES technologies.

To promote the energy efficiency improvements and integration of renewable energy in the facilities' infrastructure, ALTUM provides the grants (85% of the total costs) for energy auditing and technical assistance. In July 2022, the ALTUM has signed the Second agreement "Energogrants" with the ELENA programme for the period 2022-2025[30]. The grant can be received by wide range of interested parties – individual merchants, enterprises, state and municipalities' institutions and capital companies. The beneficiary shall provide, up to end 2026, investments in energy efficiency of at least 20-fold of the amount of technical assistance received. The measure is included in the WEM scenario as the supplementing measure to investment support measures in industry and commerce sectors.

In 2024 and 2025 **the investments support to improve energy efficiency in food processing enterprises** continues, provided within the framework of the Measure 04.2 *"Investments"* of the national RDP of 2014-2022 programming period, co-financed by the Agriculture Fund for Rural Development (EAFRD). **The measure is included in the WEM scenario.** Energy efficiency improvement project shall provide the following results[31]: 1. Buildings: (1) at least 20% of energy savings shall be reached for existing building, (2) for new buildings the thresholds of heat penetrability specific values for particular elements of building envelope are defined. 2. In case of other energy efficiency improvement measures – improvement of lighting, production technologies as well as other technologies (e.g., heating & air conditioning equipment) – energy efficiency shall be increased by 20% as well compared to the replaced technology, or the alternative option is the implementation of the equipment corresponding to the two highest energy efficiency classes or whose high energy efficiency is certified by the manufacturer. Investment support intensity 40-50% depending on enterprise annual turnover.

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[29] Latvia's EU Cohesion Policy Programme for the 2021-2027 planning period. Information on the financing. The Specific measure 2.1.1.2 and the Specific measure 6.1.1.4 (Territorial Just Transition Plan). Available: https://www.esfondi.lv/normativie-akti-un-dokumenti/2021-2027-planosanas-periods/eiropas-savienibas-kohezijas-politikas-programma-2021-2027-gadam

[30] ELENA (European Local Energy Assistance) is a joint initiative by the European Investment Bank and the European Commission under the Horizon 2020 programme. ELENA project "Energogrants" factsheet (2nd stage 2022-2025). Available: https://www.eib.org/attachments/documents/143-project-factsheet-energogrants.pdf ; ALTUM. Grant for energy efficiency (*Grants energoefektivitātes projektu izstrādei*). Available: https://www.altum.lv/pakalpojumi/biznesam/aizdevumi-uznemumu-eneregoefektivitatei?tab=4

[31] CoM Regulation No. 778 (30th November 2021) "Regulations on the State and EU financial support for the Measure's "Investments" open call within the transition period, 2021 and 2022, of the 2014-2020 programming period": consolidated version. Available: https://likumi.lv/ta/id/328179

The following planned measure, presented below, is included in the WAM scenario.

Further increase of RES capacities and energy efficiency in industry and service sector. The given PaM, stated by the updated NECP 2021-2030[32], relates to industrial production entities, commercial services providers, municipal capital companies. The PaM further increases the financial support volume beyond the support provided by the WEM scenario's measures. The financial support is planned for installation of new capacities utilising RES and modernisation of existing ones with the focus on zero emission technologies, installation of energy efficient production technologies and auxiliary equipment, replacement of building's inner and outer engineering systems and networks. As a result, updated NECP 2021-2030 envisages to have significant renewable energy production capacity increase in the noted sectors.

3.2.2.4 Programmes for Public Sector

In 2024-2029 period the EU funds support for energy efficiency improvement and RES technologies implementation in public buildings continues. The financing is provided by two funds – **RRF Plan and CP Programme**, both **financing measures are included in the WEM scenario.** The support is provided for energy efficient renovation of buildings and their engineering systems, installation of smart energy consumption control and management equipment, installation of RES-utilising energy production (both heat and electricity) technologies for self-consumption.

Increasing Energy Efficiency in Municipal Buildings. The buildings coverage includes the buildings of municipalities, municipal capital companies and public-private capital companies providing public services. Within the **RRF Plan** funding the submission of projects under two Open Calls took place in 2023, the projects shall be implemented up to 31st December 2025, the RRF Plan provides the grant for 100% of the eligible costs of the project[33]. In its turn, within the **CP Programme** the intensity of aid is up to 85%. The eligible buildings and eligible activities of the CP Programme will be similar for the RRF Plan funding. The measure is included in the WEM scenario.

Increasing Energy Efficiency in State Public Buildings (restricted Calls). **The CP programme** provides the financing (aid intensity 85%), within the SO 2.1.1 "*Promotion of energy efficiency and reduction of GHG emissions*", for the buildings of: (1) state direct administration institutions, (2) state founded Latvian universities, (3) vocational education institutions and colleges, (4) buildings in which the culture sector functions are performed; the projects' implementation period - up to 31th December 2029. For the buildings in which the culture sector functions are performed, the support is provided also by the **RRF Plan** (the grant for

[32] Updated National Energy and Climate Plan 2021-2030: automatic machine translation, pages 50 & 53

[33] CoM Regulation No. 709 (8th November 2022) "Implementing Rules of the Latvia's Plan of the EU Recovery and Resilience Facility, the reform No 1.2 "Energy Efficiency Improvement", the investment No 1.2.1.3.i "Improvement of the municipal buildings and infrastructure by promoting the transition to the use of renewable energy technologies and improving energy efficiency)". Available: https://likumi.lv/ta/id/337385

100% of the eligible costs of the project, the projects' implementation up to 30th June 2026[34]). The measure is included in the WEM scenario.

National EAAI Investment Support Programme to reduce GHG emissions in buildings. The EAAI finances the energy efficiency improvement measures in public sector buildings, the supported projects have high demonstration value. The particular on-going EAAI programme, included **in WEM scenario**, is energy efficiency improvement of the public buildings having the status of protected architecture monuments of national importance[35]: five 2nd Call projects are on-going implementation in the period January 2023 - February 2028. Eligible investments include both energy efficiency improvement of the building and its engineering systems and implementation of RES-heat and RES-electricity technologies; the average EAAI support intensity is around 70% of project total cost[36].

The following planned measure, presented below, is included in the WAM scenario.

Financial and knowledge support to municipalities for the implementation of energy efficiency measures. The given PaM, stated by the updated NECP 2021-2030[37], further increases the financial support for municipalities, beyond the support provided by the PaM "Investment Support Programme to Increase Energy Efficiency in Municipal Buildings" of the WEM scenario. Activities relate to energy efficient renovation of buildings and their engineering systems, installation of smart energy control and management equipment, installation of RES utilising energy production technologies. The financial support is combined with the providing adequate knowledge support – energy managers in municipalities (partial covering of staff cost or outsourcing cost), aid in preparation of technical documentation of the projects, support in ICT solutions for energy consumption monitoring and demand management, etc.

Important, the investment support measures in 2024+ period facilities the fulfilment of the public buildings renovation obligation, defined by the Article 6.1 of the new Energy Efficiency Directive 2023/1791/EU - at least 3% of the total floor area of heated and/or cooled buildings that are owned by public bodies has to be renovated each year.

Investments in energy efficiency of public buildings have an impact on district heat consumption as a high share of municipal and state buildings are connected to the DH systems.

The national EAAI supports also the implementation of smart urban technologies, particularly efficient public areas lighting. The particular on-going EAAI programme, included **in WEM**

[34] CoM Regulation No. 443 (8th August 2023) "Implementing Rules of the Latvia's Plan of the EU Recovery and Resilience Facility, the reform 1.2 "Energy Efficiency Improvement", the investment No 1.2.1.4.i "Improvement of Energy Efficiency in State Sector Buildings, including Historical Ones". Available: https://likumi.lv/ta/id/344285

[35] CoM Regulation No. 35 (12th January 2016) "Regulations of the Open Call "GHG Emission Reduction in Buildings which are Architectural Monuments of State Significance" for the Projects Financed by the EAAI": Recasted 14th July 2022 by inclusion of the second Open Call. Consolidated version. Available: https://likumi.lv/ta/id/279830

[36] LEIF. Implementation of the projects. Available: https://ekii.lv/index.php?page=projekti_lv&konkursid=7 , accessed 16th December 2024

[37] Updated NECP 2021-2030: automatic machine translation, pages 73 & 75

scenario, are **GHG emissions reduction in the municipal public areas lighting infrastructure**: twenty-nine projects are on-going implementation in the period April 2023 – April 2025. Eligible investments include both purchase and installation of new energy efficient lighting fixtures or their components, lighting level adjustment devices and support elements of the existing lighting system, as well as implementation of RES technologies, providing electricity for lighting infrastructure[38], the average EAAI support intensity is 60% of project total costs[39].

3.2.2.5 Programmes for Renewable Energy Production

The following planned measure, presented below, is included in the WAM scenario.

Promotion of the production of biomethane and its injection into the natural gas grid. The updated NECP 2021-2030 provides for the support programme, including such activities as the purchase and installation of biogas upgrade to biomethane equipment, construction of a biomethane injection connections to natural gas transmission system, purchase of biomethane-utilising vehicles for biomethane transportation. The measure to be implemented in the form of combined financial instrument: loan issued by ALTUM, guarantee for loan issued by another commercial institutions, capital rebate (grant). Updated NECP 2021-2030 envisages: (i) at least 7 new biomethane production facilities to be installed, (ii) at least 7 biomethane producers to be connected to natural gas grid, (iii) up to 210 GWh biomethane production in 2030[40]. The financing is envisaged by the **CP Programme's** SO 2.1.2.

3.2.3 Fiscal policies and measures

The following measures – fuel taxation and taxation applicable for electricity – are included in the WEM scenario. The WEM scenario considers the tax rates in force in 2024.

3.2.3.1 Fuel taxation[41]

Excise duty on natural gas. Natural gas is the dominating fossil fuel in energy production in Latvia. Excise duty is determined by the Sections 6^1 & 15^1 of the Law "**On Excise Duties**"[42]. Starting from 1st January 2014 the differentiated rates are applied, Table 3.2. The reduced rate promotes the industrial production and the particular activities of agriculture sector.

Table 3.2 Excise Tax rates for Natural Gas (NG) utilized for energy production

Aim of utilisation of natural gas	Rate, EUR	
	1st January 2014-31st March 2017	from 1st April 2017 - 2024
Utilised as heating fuel	17.07 EUR/1000 m^3	1.65 EUR/1 MWh gross calorific value (GCF)

[38] CoM Regulation No. 454 (14th July 2022) "Regulations of the Open Tender "GHG Emission Reduction and Energy Efficiency Improvement in the Public Areas Lighting Infrastructure of Municipalities". Available: https://likumi.lv/ta/id/334008
[39] LEIF. Implementation of the projects. Available: https://ekii.lv/index.php?page=projekti_lv&konkursid=10 , accessed 16th December 2024
[40] Updated National Energy and Climate Plan 2021-2030: automatic machine translation, pages 50 & 51, 54.
[41] For transport fuel taxation see below, in Transport section
[42] Law "On Excise Duties". Available: http://likumi.lv/doc.php?id=81066

Aim of utilisation of natural gas	Rate, EUR	
	1st January 2014-31st March 2017	from 1st April 2017 - 2024
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 sited in industrial parks**	5.65 EUR/1000 m^3	0.55 EUR/1 MWh, GCF
Utilised to provide heating of greenhouses, industrial scale poultry holdings (poultry house) and incubators (see note 2)	Exempted	Exempted till 30th April 2020 From 1st May 2020 - 0.55 EUR/1 MWh, GCF
Used for purposes (other than fuel or heating fuel), dual used (including processes of chemical reduction, electrolytic and metallurgy processes) and used for mineralogical 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	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. The 2024 rates are: (i) residual fuel oil – 15.65 EUR/ton, (ii) kerosene, diesel (gas oil) – 60 EUR/1000 litres. Tax rate for petroleum gases and other gaseous hydrocarbons if supplied for utilisation as heating fuel or in gas furnaces and other equipment, not as fuel, is 0 EUR per ton. The exemption is applied for the oil products utilised for electricity production and for production in CHP mode.

Duty on coal, coke and lignite (brown coal). The procedure of taxation is prescribed by the **Natural Resources Tax Law**[43]. From 1st January 2020 tax rate has been doubled and in 2024 is 0.76 EUR/GJ, or 21.3 EUR/ton if information of specific heating value of coal is not available.

3.2.3.2 Taxation applicable for electricity

The procedure is prescribed by the **Electricity Tax Law**[44]. The rate is 1.01 EUR/MWh. 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

[43] Natural Resources Tax Law. Available: https://likumi.lv/doc.php?id=124707
[44] Electricity Tax Law. Available: http://www.likumi.lv/doc.php?id=150692

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 or coal taxable with the natural resource tax are used for the generation of the electricity. Related to other end-uses, the exemptions/zero rate is applied to (i) household users, (ii) street lighting services. From 1st January 2023, the exemption for the electricity used for the electricity generation is re-enacted.

3.2.4 Information and Education policies and measures

The measures below are included in the WEM scenario.

Informing Energy Consumers of Residential Sector

The given PaM motivates to renovate buildings, particularly in the frame of the EU funds co-financed measure of increasing energy efficiency in multi-apartment buildings. The programme *"Let's live warmer!''* has started in EU Funds 2007-2013 planning period, in 2010, and is continued for the following programming periods. Wide scope of methods is applied to reach and to inform and consult communities of the apartments' owners (housing societies) regarding the benefits of energy efficiency increase and the best practices of it, to present the typical faults during energy efficient renovation process, to inform regarding available financial support as well as to consult on the best practice of maintaining the apartment building after renovation. In recent years the "*Let's live warmer!*" has extended the activities to the target group of single-family and two-apartment buildings as well. The implementation of the programme is based on wide stakeholders' cooperation. The first Stakeholders Memorandum was signed in February 2010, at the initiative of the MoE. The Renewed Memorandum (opened in October 2024) in September 2024 is signed by more than 40 stakeholders[45].

Labelling of appliances

The national legislative framework by transposition of the Ecodesign Directive 2009/125/EC and of the Directive on Labelling and Standard Product Information of Energy Related Products (2010/30/EU) has been implemented in Latvia in due time[46]. The provisions, stated by the Energy Labelling Regulation 2017/1369/EU, new Ecodesign Regulation 2024/1781/EU and

[45] The stakeholders include the ministries, state administration institutions, state capital companies, experts Non-governmental organizations (NGOs), Association for the protection of consumers interest, Latvian Union of District Heating utilities, Latvian Union of Local Municipalities, Latvian Union of Cities, Riga city and Zemgale region energy agencies, Vidzeme planning region, Riga Technical university, etc.

[46] (1) CoM Regulation No. 941 (in force from 15th December 2011) "Regulations regarding Ecodesign Requirements for Energy-related Goods (Products)": http://likumi.lv/doc.php?id=241282 ; (2) CoM Regulation No. 480 (in force 20th July 2011-19th May 2020) "Regulation regarding Labelling of Energy and Other Resources Consumption Related Products as well as Their Advertisment and Supervision", historical 20th July 2011 – 18th May 2020. Available: http://likumi.lv/doc.php?id=232553

particular Commission Regulations on eco-design and labelling for particular appliances, are implemented directly by the responsible parties.

3.3 TRANSPORT

3.3.1 Regulatory policies and measures

3.3.1.1 Biofuel Blend Obligation

The given PaM is included in the WEM scenario. It ensures growth of the renewable energy share in transport sector. The Obligation has been introduced on 1st October 2009[47]. Blended biofuels shall correspond to the sustainability criteria. The Obligation applies to fuels offered on the Latvian market for the operation of spark-ignition and compression-ignition engines for road transport vehicles, all-terrain vehicles, agricultural and forestry tractors, inland waterway vessels, as well as recreational craft when not sailing at sea, considering the technical requirements of these engines in relation to health and environment protection. Exemptions are made for:

- diesels utilised: (i) in case of winter climate, namely, in the period 1st November - 1st April, (ii) in sea and avio transport engines; (iii) in specialized military vehicles;
- gasoline utilised: (i) in cars participating in sport competitions, (ii) in avio engines.

Table 3.3 presents the requirements in force from 2018. From 1st January 2020 the mandatory volumes of blend are increased. In the period 1st July 2022 - 31st December 2023 the biofuel blend was voluntary to mitigate sharp increase in transport fuel price.

Table 3.3 Biofuel Blend Obligation in Latvia

	1st April 2018 - 31st December 2019	from 1st 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, blended	At least 6.5% (volume) of total volume
	(b) at least 4.5% (volume) of total volume, if the paraffinic diesel, produced from biomass, blended	

3.3.1.2 GHG emission intensity reduction obligation for road transport fuels suppliers

The given PaM is included in the WAM scenario. Updated NECP 2021-2030 states to impose on fuel suppliers the GHG emission intensity reduction target of 15% by 2030 compared to the

[47] CoM Regulation No. 332 (2000, with amendments) "Requirements for Conformity Assessment of Petrol and Diesel Fuel": consolidated version. Available: https://likumi.lv/ta/id/11217

baseline[48]. The annual GHG emission intensity reduction targets for 2026-2030 are included in the new Draft Transport Energy Law, adopted by the CoM 25th June 2024 and in Autumn 2024 under the adoption procedure in the Parliament. The given PaM is in line with the Article 25 of the Amended (by 2023/2413/EU) Directive 2018/2001/EU on the promotion of the use of energy from RES.

3.3.1.3 Mandatory annual systematic inspection of technical conditions of motor vehicles

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[49]. Mandatory systematic inspection of technical conditions relates also to tractors. **The measure is included in the WEM scenario.**

In general, the inspection of road vehicles is annual. To reduce administrative burden for owners of new cars, which have not been registered either in Latvia or abroad before, from the 1st January 2018 it is introduced by the Road Traffic Law the provision that first two inspections are performed bi-annually (the first of the periodic inspections not later than 24 months after the relevant new car has been registered in Latvia for the first time, the second periodic inspection - not later than 24 months after the first one). In its turn, subsequent periodic technical inspections shall be performed on an annual basis[50].

3.3.1.4 Public Procurement: Promotion of clean and energy efficient road transport

The detailed description of this PaM is included below in the Cross-Sectorial section, in the PaM "Green Public Procurement". The measure is included in the WEM scenario.

3.3.2 Economic policies and measures

3.3.2.1 Electromobility Development

Electric Vehicles (EV) charging Infrastructure Development

Well-developed EV charging infrastructure is the key-condition for the long-term promotion of EV market and rapid growth of the number of EV.

In Latvia two largest EV charging networks are: (1) *E-mobi*, operated by the State SC "Road Traffic Safety Directorate"[51] - 141 fast charging stations, each with two charging points (DC and AC) with capacity up to 50 kW, and (2) the charging network of the largest private investor *Electrum Drive* - in middle of 2024 consists of more than 100 public charging locations (stations) with more than 350 charging points, of which more than 50 ones have the capacity

[48] Updated National Energy and Climate Plan 2021-2030: automatic machine translation, page 37
[49] CoM Regulation No. 295 (30th May 2017) „Regulations on motor vehicles state technical inspection and technical roadside inspection". Available: https://likumi.lv/doc.php?id=292396
[50] Note. The vehicles which have been registered abroad before shall be subject to the first-time periodic technical inspection not later than five days after the relevant vehicle has been registered in Latvia.
[51] Established in 2014-2020 EU funds programming period, construction finished end of 2021

50+ kW[52]. In November 2022 the cooperation agreement has been concluded between *E-mobi* and *Electrum Drive* charging networks, it makes easier for EV users to receive a charging service, regardless of whether they are charging in the *E-mobi* or *Elektrum Drive* network. This cooperation improves both the quality of service and availability of charging infrastructure.

EV Charging Infrastructure Development in Public Areas is supported by the RRF Plan funding. Power distribution system operator SJSC "Sadales tīkls" in cooperation with the customers are installing (up to 31st May 2026) 2060 grid connection points for installation of new publicly available EV charging points and/or solar PV micro-generation equipment throughout Latvia. The infrastructure from the power distribution network to the metering substation is designed and built by DSO "Sadales tīkls" (RRF Plan funding), the customers - municipality, state or municipal institution (authority), state or municipal capital company, public-private company, EV charging point operator – are financing the installation of charging point and related equipment and connection from the substation. The charging point is up to 22 kW [32 A, 0,4 kV][53]. **The measure is included in the WEM scenario.**

Development of large capacity EV charging stations on TEN-T network, 2024-2029 period. Financing is allocated by (i) CP Programme[54] (implementer – state capital company holded by the MoT), and (ii) Connecting Europe Facility (implementer *Electrum Drive).*

EV purchase support

Two target groups are supported[55]: natural persons (national EAAI) and merchants (RRF Plan). **Both measures are included in the WEM scenario.**

National EAAI programme for Natural persons (households) provides support for M1 and N1 category EV which are (i) new and exploited zero emission battery-EV (BEV) and (ii) new plug-in hybrid EV (PHEV), having specific GHG emissions up to 50 grams CO_2 per km. The mileage, to be reached by supported EV, is stated 52000 km for 5 years (10400 km annually in average). The general grant varies in the range 3350-4500 EUR per EV, differentiated depending on whether EV is new BEV or exploited BEV and new PHEV[56]. Two additional bonuses are: (1) support (2000 EUR) for the scrapping of an existing vehicle by handing it over to a treatment company, if purchasing a new BEV or PHEV, (2) the trader merchant - BEV and PHEV seller - shall offer the customer an additional incentive effect (discount, attractive leasing conditions, maintenance, etc.) of 1000 or 500 EUR respectively for new EV and exploited EV[57]. **The WEM**

[52] The Electrum Drive is the EV charging service which is offered within the overall energy services provided by the "Electrum" (the trademark of the SC "Latvenergo") – one of the largest electricity traders in Latvia. Electrum Drive charging network. Available: https://elektrumveikals.lv/lv/majai/e-auto-uzlade/publiska-uzlade Accessed 29th June 2024.

[53] CoM Regulation No. 726 (15th November 2022) "Implementation Rules of the Latvia's Recovery and Resilience Facility Plan's measure "Modernisation of Power Transmission and Distribution Networks"". Available: https://likumi.lv/ta/id/337225

[54] Latvia's EU Cohesion Policy Programme for the 2021-2027 planning period. Information on measures financing, the measure 2.4.4.1. Available: https://www.esfondi.lv/pieejamais-atbalsts/planotas-atlases/es-fondu-planotas-projektu-atlases

[55] For the EV support in public sector – see below, the PAM *"Development of zero emission public and municipal transport".*

[56] Increased support applies for large families, varying 5000-9000 EUR per EV, also differentiated depending on number of seats.

[57] CoM Regulation No. 896 (21st December 2021) "Regulations of the Open Tender "GHG Emissions Reduction in Transport Sector – Support for the Purchase of Zero and Low Emission Vehicles" for the Projects Financed by the EAAI". Available: http://likumi.lv/ta/id/328761

scenario includes the programme's financial volume and purchased number of EVs up to 31st December 2024.

Merchants (Businesses): RRF Plan funding[58] facilitates the purchase of new M1 and N1[59] category BEV. The combined financial instrument, administrated by the ALTUM, consists of the loan guarantee and the capital rebate (grant) for a full or partial reduction of the principal amount of the lease from another financier. The beneficiaries are registered in Latvia enterprises operating in any economic sector, except specific ones. The aid is granted as *de minimis* aid. The decision on providing the aid may be adopted by the ALTUM up to 31st December 2025; the deadline for allocating the costs of the RRF is 31st August 2026. The maximum grant for the purchase of one M1 and N1 category BEV is respectively 5000 EUR and 10000 EUR[60]. The grant shall not exceed the 30% of the eligible costs of the project. The beneficiary provides at least one year from the moment the purchased BEV is registered in Latvia the annual mileage of at least 20 thous. km.

The following planned measure, presented below, is included in the WAM scenario.

Further increase of the number of battery electric cars. The given PaM supports the increase of the number of BEVs beyond the WEM scenario's above measure "EV purchase support". The increase relates to all users – natural persons, merchants, state and municipal institutions. Updated NECP 2021-2030 provides to use diverse funding to support the EV purchasing – EU funds, EAAI, national Modernisation Fund[61]. **Modernisation Fund** envisages support for both the public sector (municipalities, municipal authorities and state direct administration institutions) and the private sector (including municipal capital companies). The Modernisation Fund support is envisaged for complex set of activities, such as purchase of new industrially produced EV, establishment of necessary new EV charging infrastructure as well as establishment of new engineering systems and equipment that produce and store renewable electricity from solar or wind. Updated NECP 2021-2030 states, as part of the action, also new financing instruments, e.g., soft loan and loan guarantee programme for natural persons, should be established.

3.3.2.2 Development of zero emission public and municipal transport

In 2024-2029 the support to purchase electric buses for public and municipal transport is provided by both **RRF Plan and Latvia's Territorial Just Transition Plan.** The support is

[58] CoM Regulation No. 594 (20th September 2022) "Implementing Rules of the Latvia's Plan of the EU Recovery and Resilience Facility, the reform No 1.2, investment No 1.2.1.2.i, the Measure 1 "Energy efficiency improvement in business sector (including the transition to renewable technologies)". Available: https://likumi.lv/ta/id/336032

[59] in case of N1 category vehicle, five years from the moment the purchased BEV is registered in Latvia, the vehicle is both not used for commercial cargo transportation and is not rented out to others for commercial cargo.

[60] For the single beneficiary for the purchase of all BEV within the whole project the maximum grant is 180 thous. EUR.

[61] Updated National Energy and Climate Plan 2021-2030: automatic machine translation, pages 34 & 39

provided for the purchase of more than 70 new electric buses (incl. replacing previously used fossil fuel utilizing ones)[62]:

- **The RRF Plan,** within the Third Component "*Reducing inequalities*"[63] provides the support for municipalities for the purchase of electric school buses[64]. The selection of beneficiaries (eligible - all Latvia municipalities, except capital city Rīga) has been done in Open Calls in 2023. At least 15 electric buses (M2 and M3) and related charging equipment will be purchased up to 31st December 2025;
- **Latvia's Territorial Just Transition Plan** provides the support for municipalities for the purchase of electric buses (M2 and M3), as well as M1 specialized zero-emission vehicles which are intended for transporting people in wheelchairs and people with special needs, to ensure municipal services in the education, social services, healthcare and culture sector[65]. The selection of beneficiaries (eligible – all Latvia municipalities, except Rīga region) has been done in Open Calls in 2024. At least 38 electric buses and related charging infrastructure will be purchased up to 31st December 2029;
- **RRF Plan funding** (within the first component "*Climate Change and Environmental Sustainability"),* provides wide complex investment for greening transport in the Rīga metropolitan area. One of the activities is purchase, up 30th June 2026, of at least 17 electric buses and related 7 charging infrastructure units[66] for Rīga city public transport system.

The following planned measure, presented below, is included in the WAM scenario.

Electrifying of public transport and improving its electricity infrastructure. The given PaM includes the further increase of the number of user convenient EV in public transport, beyond the WEM scenario's above measure "Development of zero emission public and municipal transport". Updated NECP 2021-2030 provides to use EU funding and municipalities' budgets to purchase new zero emission vehicles of public transport and their charging infrastructure and envisages to have in 2030 265 new electric buses in Latvia as well as 100 new trolleybuses and 24 new low-floor trams in Rīga city[67]. The infrastructure of Rīga city tram and trolleybuses depots will be reconstructed for the use of increased number of modern vehicles.

[62] On 1st January 2024 there were 112 electric buses registered in Latvia; thus, the implementation of the measure will significantly increase the number of electric buses.
[63] with focus on the consequences of 2021 administrative territorial reform
[64] CoM Regulation No. 673 (25th October 2022) "Implementing Rules of the Latvia's Plan of the EU Recovery and Resilience Facility, the Third Component "Reducing inequalities", the reform No 3.1 "Regional policy", the investment No 3.1.1.6.i "Purchase of zero-emission vehicles for implementation of municipal functions and provision of municipal services". Available: https://likumi.lv/ta/id/336738 (in Latvian)
[65] CoM Regulation No. 65 (23rd January 2024) "Implementing Rules of the Latvia's EU Cohesion Policy Programme for 2021-2027 planning period: the specific objective 6.1.1 ""Mitigating the economic, social and environmental consequences of the transition to climate neutrality in the most affected regions", the measure 6.1.1.6 "Promoting zero emission vehicles in municipalities". Available: https://likumi.lv/ta/id/349316 (in Latvian)
[66] CoM Regulation No. 237 (9th May 2023) "Implementing Rules of the Latvia's Plan of the EU Recovery and Resilience Facility, the reform and investment direction No 1.1 "Emission reduction in transport sector", reform No 1.1.1.r "Greening of Riga metropolitan area transport system", the investment 1.1.1.2.i "Environmental friendly improvements in Riga public transport system"". Available: https://likumi.lv/ta/id/341828 (in Latvian)
[67] Updated National Energy and Climate Plan 2021-2030: automatic machine translation, page 36

3.3.2.3 Modernisation and greening of the Latvia's railway infrastructure

The given measure is included in the WAM scenario. The policy of zero-emission multi-modal public transport, having railway as the central element, is stated by both the NDP2027 and updated NECP 2021-2030. It is envisaged the financial support for modernisation of 230 kilometres railway lines[68], modernisation of railway stations, particularly making them convenient for passengers. Thus, the infrastructure allows for the efficient operation of the new modern EMU trains. In total, 32 new EMU trains are put in operation during 2024, financing for EMUs purchase provided by EU funding. They replace worn-out previous-generation EMUs and allows for more frequent traffic schedule performed by user-convenient vehicles. The modernisation of railway is combined with the construction of multi-modality points and *Park&Ride* infrastructure. Thus, the public transport system is being optimised – the number of regional bus routes parallel to railway routes is being reduced. As a result of the measure, a significant increase in public transport passengers is projected.

3.3.2.4 Promotion of multi-modality of public transport

The given measure facilitates the passenger-convenient connecting points between rail and buses transport modes, as well as private electric mobility (including public EV charging points) and micromobility modes. In total, construction of at least 33 multi-modality points is considered. (1) **The CP Programme** (within the SO "*To promote the sustainable and diverse mobility in cities/towns*") provides the investment for the construction, up to 31st December 2029, of at least 25 multi-modal connection points and *Park&Ride* infrastructure, project submitter & financial beneficiary – municipality or municipal capital company. (2) **RRF Plan** provides investment for improving public transport access infrastructure of particular railway stations in Rīga area by creating eight smart digitalized multi-modal points[69] up to 31st May 2026[70] . **The measure is included in the WEM scenario.**

3.3.3 Fiscal policies and measures

The WEM scenario considers the tax rates in force in 2024.

The following fiscal PaMs are included in the WEM scenario:

- Excise duty – Transport sector;
- Annual taxation of vehicles;
- Exemption from electricity tax for the electricity used for carriage of goods and public carriage of passengers including on rail transport and public transport in towns[71].

[68] Modernisation of 100 km railway lines will be provided by RRF Plan funding, of 130 km – by CP Programme

[69] 6 – in Riga city, 2 – in Riga metropolitan area

[70] CoM Regulation No. 51 (16th January 2024) "Implementing Rules of the Latvia's Plan of the EU Recovery and Resilience Facility, the reform and investment direction No 1.1 "Emission reduction in transport sector" ,reform No 1.1.1.r "Greening of Riga metropolitan area transport system", the investment 1.1.1.2.i "Environmental friendly improvements in Riga public transport system", the measures 1.1.1.2.i.3 and 1.1.1.2.i.3" (multi-modality points). Available: https://likumi.lv/ta/id/349171

[71] Electricity Tax Law, Article 6.(2)

3.3.3.1 Excise Duty – Transport sector

Law "On Excise Duties" establishes procedure by which duty shall be imposed. The Law's Section 5 determines the rates of duty for gasoline and diesel oil. The Sections 6^1 & 15^1 determine the rate for natural gas. To promote natural gas utilising vehicles, the reduced rate for natural gas is stated for the period 1st January 2021 – 31st December 2025. From the 1st January 2026 basic tax rate applies.

Table 3.4 Excise duties for fuels utilised in transport sector

	Duties, EUR per 1000 litres		
	2018-2019	1st January 2020 – 1st February 2021	From 1st February 2021 - 2024
Unleaded gasoline	476	509	509
Unleaded gasoline with 70-85% (volume) of bioethanol (produced from agriculture origin raw materials in Latvia or imported from EU member state) mix	30% of the base rate (if mixed in Latvia or imported from EU member state)		360
Leaded gasoline	594	594	594
Diesel oil (including diesel oil with any mix of biodiesel)	372	414	414
Marked diesel oil utilised in agriculture sector (definated amount per ha depending on sector)	15% of the base rate		
Pure rapeseed biodiesel (produced in Latvia or imported from EU member state)	0 (if produced in Latvia or imported from EU member state)		330
Another pure biodiesel and paraffinic diesel produced from biomass	372	414	330
Petroleum gasses and other gaseous hydrocarbons (per 1000 kg)	244	285	285
Natural gas (per 1 MWh, gross calorific value)	9.64	9.64	1.91 (01.01.2021-31.12.2025) 10 (from 01.01.2026)

3.3.3.2 Annual taxation of vehicles

The vehicle annual operation tax, based on the specific CO_2 emissions of the vehicle, grams per km (plus fixed supplement for those engines capacity of which exceeds 3500 cm^3), is being calculated for the cars firstly registered from 1st January 2009 and for the light duty vehicles (LDV) firstly registered from 1st January 2012. Particularly, vehicle annual operation tax,

depending on CO_2 emissions, is applied considering emision testing procedure: (1) NEDC[72] for vehicles first registered up to 31st December 2020, and (2) WLTP[73] for vehicles first registered from 1st January 2021. For the cars and LDV with the specific CO_2 emissions not more than 50 grams per km zero tax rate is applied[74]. 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. Additionally for passenger cars and LDV with the first registration up to 31st December 2004 tax is based only on the gross weight of the vehicle. In its turn, for buses and heavy duty vehicles with gross weight above 3500 kg the annual operational tax is based on EURO class. For light buses (≤3500 kg) annual operational tax continues to base on the gross weight.

3.3.4 Information and Education

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). In July 2004 CoM Regulation No. 608[75] came into force transposing the requirements of the Directive 2003/73/EC. The measure is included in the WEM scenario.

3.4 CROSS-SECTORIAL

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 implementation of the EU ETS, applying of fiscal instruments on CO_2 emissions, green procurement.

The cross-sectorial measures described below are included in the WEM scenario.

EU emission allowances trading system

The EU ETS, established by the Directive 2003/87/EC, is operating since 1st January 2005. The fourth trading period, which covers 2021-2030, is divided into two consecutive periods. The first sub-period of 2021-2025 is under implementation according to the Directive 2018/410/EU of the European Parliament and of the Council of 14th March 2018 amending the Directive 2003/87/EC which established a scheme for GHG emission allowance trading within the Community.

The general framework for the stationary installations, by transposing the provisions of the Directive 2003/87/EC, is stated by the CoM Regulation No 769 (2012) "Regulations regarding Participation of Stationary Technological Installations in the Emission Allowance Trading

[72] The New European Driving Cycle
[73] Worldwide Harmonised Light Vehicles Test Procedure
[74] Law „On the Vehicle Operation Tax and Company Car Tax". Available: https://likumi.lv/ta/id/223536
[75] CoM Regulation No. 608 (20th July 2004) „Regulations Regarding Consumer Information to be Provided in Labelling and Promotional Publications on Fuel Consumption and CO_2 Emissions of New Passenger Cars". Available: http://likumi.lv/doc.php?id=91538

Scheme of the EU"[76]. The national regulation is regularly updated in line with EU ETS policy current conditions.

The Latvia's National Emissions Allowances Allocation Plan for 2021-2025 has been approved by the Ordinance of the CoM No 335 (18th May 2021, amended 18th April 2023) "On Emissions Allowances Allocation for 2021-2025: List of installations and allowances"[77]. Actual amendments in the Allocation Plan have been included by the MoCE Decisions on Allocation of Emission Allowances to Operators of EU ETS 2021-2025 sub-period. In 2022, 53 stationary installations and 2 avio operators participated in EU ETS.

The Latvia's National Emissions Allowances Allocation Plan for 2026-2030 is approved by the new Ordinance of the CoM No 776, 24th September 2024 "On Emissions Allowances Allocation for 2026-2030: List of installations and allowances"[78]. The List includes 46 stationary operators, the total amounts of emission allowances are: 673.3 (2026), 659.3 (2027), 634.4 (2028), 578.8 (2029) and 466.9 (2030) thous. t CO_2 eq.

The new ETS (ETS2), covering buildings, road transport and additional sectors, is included in the WAM scenario. The scope of ETS2 corresponds to the Chapter IVa and Annex III of amended (by 2023/959/EU) ETS Directive 2003/87/EC.

Emissions taxation

The procedure of emissions taxation is prescribed by the **Natural Resources Tax Law[79].** The policy is to promote the internalization of external costs. As the general principle, the household sector are not taxpayers of emission taxes.

The CO_2 emissions taxation has been introduced from 1st July 2005 and has been gradually raised. From 1st January 2023 and onwards tax rate is 15 EUR per ton of CO_2 emissions. The subject of CO_2 emission taxation is such CO_2 emitting activities (installations) which corresponds to existing EU ETS activities however the amount of the activity (installation) is below the threshold defined for inclusion in the existing EU ETS. The tax shall not be paid for the emissions of CO_2 which emerges (i) while using RES, and (ii) from the installations participating in existing EU ETS.

Taxation on noxious air polluting emissions creates synergy with CO_2 taxation. The taxable are emissions of PM (135 EUR/ton), CO (7.83 EUR/ton), NH_3, H_2S and other non-organic compounds (90 EUR/ton), SO_2 and NO_x (160 EUR/ton), VOC, C_nH_m (85.37 EUR/ton), metals (Cd, Ni, Sn, Hg, Pb, Zn, Cr, As, Se, Cu) and their compounds recalculated for the relevant metal, V_2O_5 recalculated to vanadium (1138.30 EUR /ton). In the brackets the rates from 1st January 2023 and onwards are indicated. The subject of air polluting emissions taxation is person who has a duty to receive a polluting activity permit or certificate.

[76] CoM Regulation No. 769 (13th November 2012): consolidated version. Available: https://likumi.lv/ta/id/253119
[77] CoM Ordinance No. 335 (18th May 2021). Available: https://likumi.lv/ta/id/323330
[78] CoM Ordinance No. 776 (24th September 2024). Available: https://likumi.lv/ta/id/355162
[79] Natural Resources Tax Law. Available: http://likumi.lv/doc.php?id=124707

Green Public Procurement (GPP)

Public Procurement Law[80] states the special rules with respect to energy efficiency (Section 55). Technical specifications shall additionally contain technical descriptions which include, among others, such requirements of the contracting authority in relation to the product or service as the energy efficiency, the requirements regarding reduction of GHG emissions and adaptation to climate change, other environmental protection requirements (Section 20.4).

Pursuant to the Public Procurement Law, the minimum energy efficiency requirements for goods procured by state central administration institutions are stated: (1) correspondence to one of the highest two energy efficiency classes, available in the market (if EU labelling regulation applies); (2) correspondence to eco-design requirements (if EU eco-design regulation applies)[81].

The Section 19 of the Public Procurement Law states the general framework for green public procurement (GPP) detailed by the CoM Regulation No. 353 (2017)[82]. Regarding energy consumption, the noted GPP Regulation states mandatory GPP criteria for: (i) imaging (printing) equipment; (ii) computer engineering (hardware), ICT infrastructure, services of data centers; (iii) in-door lighting; (iv) street lighting; (v) traffic lights; (vi) construction of new buildings or renovation of existing ones, applies for, so called, the third group of buildings (included by the Amendments of July 2023); (vii) purchase of cars and light duty vehicles (included by the Amendments of July 2023).

The third group of buildings includes**:** (1) buildings with more than six above-ground floors; (2) buildings with more than one underground floor; (3) public buildings with total area above 1000 m^2, as well as certain types of other buildings. Energy efficiency related mandatory GPP criteria are stated for such particular types of buildings, if they fit into the third group of buildings, as museum, library, audience hall, sport building, office building, education and science building, hotel, health care building, public catering building, commercial trade building, residential building. For these buildings, the GPP Regulation provides for higher energy efficiency class as required by the Regulation on the energy certification of buildings[83].

In its turn, the Section 54 of the Public Procurement Law states the special rules for procurement in the field of road transport.

In September 2021 the provisions of the Directive (EU) 2019/1161 of the European Parliament and of the Council of 20th June 2019 amending Directive 2009/33/EC on the promotion of

[80] Public Procurement Law. Available: https://likumi.lv/doc.php?id=287760

[81] CoM Regulation No. 180 (28th March 2017) "Requirements regarding Energy Efficiency to be Applied in the Goods' and Services' Public Procurements of State Direct Administration Institutions". Available: https://likumi.lv/doc.php?id=289757

[82] CoM Regulation No 353 (20th June 2017) "Requirements of Green Public Procurement and the Procedures They shall be Applied". Available: https://likumi.lv/ta/id/291867

[83] CoM Regulation No. 222 (8th April 2021) „Regulations Regarding Energy Certification of Buildings and Energy Efficiency Calculation Method". Available: https://likumi.lv/ta/id/322436

clean[84] and energy-efficient road transport vehicles have been transposed regarding the procurement targets for the share of clean vehicles[85].

Table 3.5 The minimum (at least) share of clean vehicles in the total number of particular vehicles covered by the public procurement contracts in Latvia

	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[86]	35%	50%

Pursuant to the Public Procurement Law, the minimum energy efficiency requirements for tyres procured by state central administration institutions are stated: (1) the tyre shall correspond to the highest fuel efficiency class, or (2) the tyre shall correspond to the highest class regarding noise or road adherence, if grounded by safety or public health considerations.

3.5 INDUSTRIAL PROCESSES AND PRODUCT USE

3.5.1. Industrial processes

Implementation of Best Available Techniques (BAT) is the PaM which is particularly important one for GHG emissions reduction in Industrial Processes and Product Use (IPPU). Requirements set in Directive 2010/75/EU of the European Parliament and of the Council of 24th November 2010 on industrial emissions (integrated pollution prevention and control) are overtaken with national Law "On Pollution"[87]. Law "On Pollution" states principal framework for the implementation of BAT. Namely, conclusions on the BAT 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:

[84] The Directive defines a "clean vehicle" as follows:
- Clean light-duty vehicle: any car or van meeting the following emission thresholds:
  - until 31st 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 1st 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, liquefied petroleum gas (LNG).

[85] Amendments to the Public Procurement Law (https://likumi.lv/ta/id/326070) and Amendments to the Law on the Procurement of Public Service Providers (https://m.likumi.lv/ta/id/326072), both Amendments adopted 2nd September and in force 14th September 2022.

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

[87] Law "On Pollution". Available: https://likumi.lv/doc.php?id=6075

- BAT is 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;
- the concept "techniques" shall include the technology used and the way in which the installation is designed, built, maintained, operated or decommissioned;
- 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;
- 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.

3.5.2. F-gases

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

- The Regulation (EU) 2024/573 of the European Parliament and of the Council of 7 February 2024 on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014 (Regulation (EU) 2024/573). This Regulation clarifies and strengthens rules on F-gas production, use, recovery, recycling and destruction as well as certification and training. Similarly, it strengthens conditions on the import, export and placing on the market of F-gases, and equipment containing F-gases;
- 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.

At national level the Regulation No. 704[88] of the CoM of Latvia "Requirements for operations with ozone-depleting substances and fluorinated greenhouse gases" was adopted on 1st November 2021. CoM Regulation No. 704 was developed with the aim of improving the accuracy and quality of F-gases data. National regulation No. 704 is 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

[88]CoM Regulation No.704 (19th October 2021) "Requirements for Activities Involving Ozone-depleting Substances and Fluorinated Greenhouse Gases". Available: https://likumi.lv/ta/id/327117-prasibas-darbibam-ar-ozona-slani-noardosam-vielam-un-fluoretam-siltumnicefekta-gazem

of information, to prohibitions on commercialisation, as well as to the training and certification of personnel and enterprises.

3.5.3. Solvent use

Law "On Pollution" laying down the procedures by which emission of non-methane 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 24th November 2010 on industrial emissions (integrated pollution prevention and control);
- Directive 2004/42/EC of the European Parliament and of the Council of 21st 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;
- Regulations of the CoM No 186[89] adopted on 2nd 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 CoM 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.

3.6. AGRICULTURE

All PaMs are included in WEM scenario.

3.6.1. Regulatory policies and 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. Legal norms arising from Council Directive 91/676/EEC concerning the protection of water against pollution caused by nitrates from agricultural sources have been included in Law "On Pollution"[90] (15th March 2001) 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 CoM 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

[89]CoM Regulation No.186 (2nd April 2013) "Regulations to limit emission of volatile organic compounds from installations, in which organic solvents are used". Available: https://likumi.lv/doc.php?id=256096
[90] Law "On Pollution". Available: https://likumi.lv/ta/en/en/id/6075

places for production pigs with weight over 30 kg (with more than 750 places for sows). These farms shall apply the BAT to prevent pollution.

The purpose of Law "On Environmental Impact Assessment" (1998)[91] 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 85 000 places for broilers; 60 000 places for hens; 3 000 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 CoM No. 834[92] adopted on 23rd December 2014 "Requirements Regarding the Protection of Water, Soil and Air from Pollution Caused by Agricultural Activity" and Regulations of the CoM No. 829 adopted on 23rd December 2014 "Special Requirements for the Performance of Polluting Activities in Animal Housing"[93].

3.6.1.1. Management of nitrate vulnerable territories

Management of nitrates in highly vulnerable zones 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 digestate per hectare in a year or 1.7 animal units (AU). If farm produces more than 170 kg of nitrogen per hectare of managed agricultural land in a year, proof of the transfer of manure or fermentation residuals to other farm or alternative use need to be documented.

3.6.1.2. Requirements for the protection of soil and water from agricultural pollution caused by nitrates

According to CoM Regulation No. 834 (23rd December 2014) "Regarding to Protection of Water and Soil from Pollution with Nitrates Caused by Agricultural Activity" to ensure the protection of water and soil from pollution with nitrates caused by agricultural activity, the several requirements are set for fertilisers spread, storing and using livestock manure and fermentation residues. Sewage sludge and the compost shall be used in accordance with the laws and regulations regarding the use, monitoring and control of sewage sludge and the compost. Regarding to the amount of nitrogen in one hectare of agricultural land, the amount of livestock manure and fermentation residues permitted for application shall be calculated based on the amount of nitrogen in livestock manure and fermentation residues. When building a new reservoir or re-building one for the storage of fermentation residues, it shall

[91] Law "On Environmental Impact Assessment": https://likumi.lv/doc.php?id=51522
[92] CoM Regulation No. 834 (23rd December 2014) "Requirements Regarding the Protection of Water, Soil and Air from Pollution Caused by Agricultural Activity". Available: https://likumi.lv/doc.php?id=271376
[93] CoM Regulation No. 829 (23rd December 2014) "Special Requirements for the Performance of Polluting Activities in Animal Housing". Available: https://likumi.lv/ta/en/en/id/271374

be intended that the capacity thereof provides for accumulation of the fermentation residues for at least eight months. At sites where the groundwater level rises to the surface of the ground, mineral fertilisers shall be used only after the subsidence of the groundwater level and the drying up of the field. Nitrogenous mineral fertiliser shall be used in basic fertiliser shortly before sowing or planting.

3.6.1.3. Crop fertilisation plans

According CoM Regulation No. 834 (23rd December 2014) "Regarding to Protection of Water and Soil from Pollution with Nitrates Caused by Agricultural Activity" in highly vulnerable zones farmers who manage the agricultural land with an area of 20 hectares and more, and grow 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 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. According to CoM Regulation No. 1056 (15th September 2009) "Requirements for Integrated Cultivation, Storage and Labelling of Agricultural Products and the Procedures for Control Thereof" crop fertilisation plans must use professional users of plant protection products who use plant protection products of the second registration class, and to persons who, for using plant protection products of the second registration class, use services provided by professional users of plant protection products in all territory.[94]

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 nitrogen (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.

3.6.1.4. Requirements for manure storage and spreading

The main target of the measure is to increase nutrient uptake efficiency and decrease nutrient run-off and N_2O emissions. Injections or sub-surface application of manure decrease direct and indirect N_2O emissions. Basic requirements are to incorporate solid manure within 24 hours and slurry – within 12 hours if it is used as a basic fertilizer. It is assumed for Latvia that slurry injection may increase manure N use efficiency compared to broadcast systems.

An appropriate manure management system allows storing manure in an environment friendly way, avoiding and reducing N_2O emissions. The measure consists of

[94] CoM Regulation No. 1056 (15th September 2009) "Requirements for Integrated Cultivation, Storage and Labelling of Agricultural Products and the Procedures for Control Thereof". Available: https://likumi.lv/ta/en/en/id/197883-requirements-for-integrated-cultivation-storage-and-labelling-of-agricultural-products-and-the-procedures-for-control-thereof

renovating/improving an existing manure management system or constructing a new system. Requirements refer to farms with more than 10 AU, and 5 AU in vulnerable territories depending on manure type and are stated in CoM Regulation No. 829 adopted on 23rd December 2014 "Special Requirements for the Performance of Polluting Activities in Animal Housing". This Regulation prescribes special requirements for the performance of polluting activities in animal housing. Several requirements are determined for the collection, drainage and storage of livestock manure, including the manure storage facilities. Specific requirements are determined for the storage of liquid manure, semi-liquid manure and urine.

3.6.2. Economic measures driven by Common Agricultural Policy

CAP is contributing to the reduction of GHG emissions.[95] In the planning period 2014–2022, CAP They included greening payment with crop diversification, maintaining maintenance of permanent grasslands and introduction of ecological focus areas. 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 leads to the fertility improvement of the farm's agro system by fixing atmospheric nitrogen.

The latest reform of the CAP from 2023 introduces enhanced conditionality and a new instrument - the Eco-scheme: covering climate, environment, and animal welfare schemes. CAP also maintains Agri-environment schemes that covering environment, climate, and other management obligations, as well as profitable and unprofitable Investment schemes for GHG and ammonia reduction measures and climate change mitigation and adaptation measures implementation on farms. The measures that directly or indirectly promote biodiversity, reduce GHG and ammonia emissions, improve the welfare of farm animals.

Eco-schemes and are designed differently in each Member State based on its environmental needs. Eco-schemes are voluntary applicable for the farmers. In Latvia, eco-schemes are designed to ensure enhanced crop diversification and introduction of ecological focus areas including legumes, green fallow and catch crops, promoting farmers' adaptation to climate change, improving water and soil quality and fertility, reducing disease and pest risks. Land that is considered as Ecological Focus Area may include: nitrogen fixing crops, and other. Introduction of leguminous plants on arable land leads to the fertility improvement of the farm's agro system by fixing atmospheric nitrogen. CAP included the greening payment, to deal with the environmental impacts of agriculture. The greening measures include crop diversification, maintaining permanent grasslands and introduction of ecological focus areas. A mandatory condition for receiving CAP support is to comply with the Good Agricultural and Environmental Condition (GAEC).

[95] Documents relating to the approval of the CAP Strategic Plans (2023). Available: https://agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans/latvia_en

Available investment support increases the possibilities of farms to change farming practices associated with more expensive technologies (such as digitalization, such as precision agriculture) and construction (such as improvements in manure storage and use). They also include measures that promotes carbon farming and precision farming to reduce pesticide use needs, risks, and leakages. The use of precision technologies will help reduce ammonia emissions. These measures are in line with the emission reduction measures developed by researchers at the LBTU and with the objectives of Latvia's 'Air Pollution Reduction Action Plan 2020-2030' and the measures to reduce GHG emissions in agriculture included in the NECP 2021-2030.

The "Law on Agriculture and Rural Development"[96] (7th April 2004) provide a legal basis for agricultural development and to specify sustainable agricultural and rural development policy in accordance with the CAP of the EU. CoM Regulation[97] based on the "Law on Agriculture and Rural Development" sets procedures for awarding of payments to farmers. According to the "Law on Agriculture and Rural Development" and resulting regulations following mitigation measures are taking place in Latvia.

3.6.2.1. Promote inclusion of leguminous plants in crop rotation for nitrogen fixation.

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. 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. Measures that stimulate the cultivation of nitrogen-fixing crops, supported in accordance with CAP TM4.2. "Eco-scheme support for an ecological focus area", as well as TM U5.14. "Related Support on Protein Plants".

3.6.2.2. Promote organic dairy farming (low emission dairy farming)

This measure includes environmentally friendly farming methods, improved cropland management and reduction of synthetic fertiliser use. Benefits of this measure are decreased nitrate leaching, increased biodiversity and reduced N_2O emissions. The state ensures support to organic farmers through subsidies. The aim of the measure is also to promote transition of small and medium-sized conventional dairy farms to the organic farming system, thus facilitating low emission dairy farming. The measure is supported within the framework of CAP

[96] Law on Agriculture and Rural Development. Available: https://likumi.lv/ta/en/en/id/87480
[97] CoM Regulation No.198 (18th April 2023). Available: "Procedures for Granting Direct Payments to Farmers". Available: https://likumi.lv/ta/en/en/id/341260

II pillar agri-environmental intervention, LA11. "Organic agriculture". Among other things, they provide for the replacement of conventional cows with organic ones. Which reduces GHG emissions in many ways, as both breeds and the way cows are kept, as well as feeding and grazing are changed.

3.6.2.3. Maintenance and modernization of amelioration systems on agricultural land

The measure involves the renovation and maintenance of existing amelioration systems. 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. 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. Support according to CAP LA 4.3. "Support for investments in agricultural and forestry infrastructure in development" is provided for amelioration system of national significance and local government significance for common use and will contribute to the development of the rural economy, it will provide support for investments to improve drainage systems in agricultural land and forestland.

3.6.2.4. Promote the production of biogas

Promote the production of biogas. The purpose of measure is to use bioresources (mainly or only manure) to produce biogas which is burnt to generate electric and/or thermal energy. By implementing this measure, the manure is efficiently used, odour is reduced and high-quality fertilizer called digestate is obtained. The main aim of the measure is to ensure the installation of biogas production on farms that do not yet have biogas production. There are very strict restrictions on the development of biogas production. At the same time, the measure has been supported by LA4.1.4. “Support for investments to use renewable energy production or increase energy efficiency”.

3.6.2.5. Support for fertilisation planning and Precision fertiliser application

Fertilization planning, which determines the effectiveness of the measure, is a mandatory condition for the use of precise technologies. Precision fertiliser application is a set of activities that involve the use of the newest technologies (the Global Positioning System (GPS), the Geographic information system (GIS), sensors, software, applications, specially equipped fertiliser spreaders, etc.) in planning fertiliser application rates and in fertiliser spreading. This measure also provides fertilizer planning in the electronic system using common methodology. Fertiliser planning is intended to ensure optimal supply of plant nutrients to crops.

This measure is market driven and 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 measure is to expand arable land and increase number of farms were precision technologies for application of nitrogen fertilisers (Promote and support for precision application of inorganic nitrogen fertilisers) are used in the planning of fertiliser schemes and spreading. Also, direct incorporation of organic fertilisers into the soil (Promote and support for direct incorporation of organic fertilisers into the soil) reduces nitrogen and ammonia emissions and promote the accurate and efficient use of fertilisers (organic fertilisers and mineral fertilisers) to reduce the risks associated with the use of fertilisers in the long term and to reduce leakage. The measure is supported by CAP Interventions (TM4.5.) "Nitrogen and ammonia emission and pollution-reducing agriculture practice" and assuming that the farmer will ensure fertilization planning, the amount of nitrogen used on the farm did not exceed the amount specified in the fertilization plan and the application of fertilizer will be carried out with precise technologies, including direct application of organic fertilizer (liquid manure) to the soil using a tape spreader or injection method, also contribute to the achievement of the goals of the EU Green Deal.

3.6.2.6. Increased welfare requirements and emissions-reducing livestock farming

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, reproductive status and productivity goal. The quality of feed also plays a significant role. This measure reduces the negative impact on the environment, as a balanced diet and animal performance influence the production of N from manure, which, in its turn, affects N_2O emissions. 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 and to increase number of cows whose are fed with high digestible feed. The measure is supported within the framework of the CAP Intervention LA10.3 "Increased welfare requirements and emission-reducing livestock farming" and foresees an increase in the proportion of cattle units (LUs) with respect to which there are supported obligations (among them manure management).

3.6.2.7. Conservation farming practices

The purpose of the activity is to promote gentle soil cultivation methods, ensuring the improvement of the soil's natural fertility and health, air and moisture circulation, i.e. the soil is treated sparingly or not plowed. Such practices help to reduce the effects of wind erosion and nitrogen leaching. Conservation agricultural practices will increase the content and amount of organic matter accumulated in the topsoil and can also increase the amount of phosphorus in the soil. The activity will promote the use of minimum tillage methods, which

will also contribute to the reduction of GHG emissions and help achieve the goals of the EU initiative on carbon farming. The measure is supported within the framework of the CAP Intervention TM4.4 “Conservation farming practices" and farmers undertake to cultivate the soil in a certain way, without using herbicides more often than twice.

3.6.2.8. Promotion of grassland conservation

The aim of the activity is to preserve grassland areas suitable for animal husbandry. It also contributes to the mitigation of climate change, including the reduction of GHG emissions from agricultural practices and the maintenance of soil carbon stocks. The intervention to preserve grasslands (no plowing) will contribute to achieving the goals of the Green Deal by implementing the directions foreseen in the Biodiversity Strategy and EU initiatives on carbon agriculture, as it will allow address climate change issues (adaptation and mitigation), considering the ability of perennial grasslands to store and sequester carbon from the atmosphere. The measure is supported within the framework of the CAP Intervention TM4.6 “Promotion of grassland conservation” and the planned target area is 317 thous. ha.

3.6.2.9. Increase of land area under organic farming relative to total agricultural land

The organic farming support payment encourages farmers to use environmentally friendly farming methods and to meet high standards of animal welfare. To avoid the return of farmers to traditional farming, it is necessary to support both transition period and farms producing with organic farming methods. Farmers should be encouraged to change their usual production practices, at least in the first years by allowing parallel production - applying organic farming methods in a separate part of the farm. Simultaneously with the implementation of this intervention, it is necessary to promote the development of not only the field of crop farming, but also the field of livestock farming, stimulating both the dairy farming sector, which makes a significant contribution to reducing emissions (especially ammonia), as well as other livestock farming sectors. The measure is supported within the framework of the CAP Intervention LA11 “Organic farming”, and plans support for the lost profit in crop cultivation (for specific plants), as well as for the maintenance of grasslands used in animal husbandry.

3.7. LAND USE, LAND USE CHANGE AND FORESTRY

All PaMs are included in WEM scenario.

3.7.1. Regulatory policies and measures

CAP Strategic plan for 2023-2027 aims to provide significant financial support to promote sustainable farming practices and address climate and environmental issues. The CAP Strategic plan will include various interventions to mitigate climate change, improve water, soil, and air quality, preserve biodiversity, and promote sustainable forestry. Latvia has set

higher targets for environmental and climate action compared to the previous planning period. The program aims to support environmental and climate ambitions without compromising the competitiveness of the sector, while ensuring the support of farmers' incomes and promoting sustainability. The direct payment system will be differentiated to achieve more targeted, effective, and fair income support.

Latvia adopted the **Forest Policy**. The main goal defined in the Forest Policy is to ensure a sustainable management of Latvian forests and it is being accomplished in accordance with documents of policy planning and regulations: the Law on Forests, Forest-based Sector Development Guidelines and other forest related regulations. The aim of the policy is to set the general long-term goals of the development of the Latvian forest sector and determine a strategy for achieving these goals. The policy was written in 1998, and the Forest Law is based on it.

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 low-valued lands.

Law on Forests[98] 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.

The CoM 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[99] defines a procedure of calculation of compensation and criteria for negative effect caused by deforestation. It defines that the compensation to the government should be paid if the forest area, that is registered in National Real Estate Cadaster information system, is deforested. The compensation should be paid for:

- decrease of CO_2 removal potential;
- reduction of biological diversity;
- decrease of quality of the environmental and natural resource protection zones and sanitary protection zone functions.

[98] Law on Forests (2000, with changes till 1st July 2020). Available: https://likumi.lv/ta/id/2825-meza-likums
[99] CoM Regulation No. 889 (18th December 2012). Regulations on criteria, calculation and payment order of compensation for deforestation activities. Available: http://likumi.lv/doc.php?id=253624

The reduction in CO_2 sequestration potential caused by deforestation can be fully or partially offset by afforestation.

Forest-based Sector Development Guidelines[100] is a medium-term policy planning document. Guidelines consist of the forest-based sector development medium-term (2015-2020) strategic goals, policy development guidelines, directions for actions to achieve these goals, problems hindering achievement of these goals, and results in policies. Forest-based Sector Development Guidelines 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. Updated document version is under development.

Guidelines for sustainable use of peat in 2020-2030[101] have been prepared in order to provide scientifically based substantiation and recommendations for the use and protection of peat resources, to determine the areas to be protected, to be used for peat extraction and to be left in reserve, and to determine the most effective, economically sound and biodiversity - friendly restoration measures. According to the guidelines the area available for peat extraction should not decrease in comparison to 2017 using the existing degraded areas and peatlands from reserved areas, and the peat production rate should not increase above the level resulting in an increase of GHG emissions.

3.7.2. Economic policies and measures

The measures proposed for reaching the climate change mitigation targets in LULUCF sector are based on the CAP[102], as well as EU Cohesion Policy Programme 2021-2027.

3.7.2.1. Measures in cropland and grassland

3.7.2.1.1. Development and adaption of drainage systems in cropland and grassland

The measure is aimed at restoration of malfunctioning or outdated drainage systems in cropland. The measure has to be implemented in extensively managed croplands and grasslands with mineral soils, where high yields are not possible due to unfavourable conditions during springtime, which are caused by wearing of existing drainage systems or there is increased risk of floods or drainage systems soon will reach end of life. After reconstruction of drainage systems affected fields are returned to a conventional production system with considerable input of organic material in soil due to higher yields and crop rotations, or high yields are retained due to preventive reconstruction of drainage systems.

Drainage systems in cropland and grassland in Latvia are usually established to get rid of excess water in spring and to avoid flooding, so that the mechanical processing of soil can be

[100]MoA, Guidelines for the development of forest and related sectors. Available: https://likumi.lv/ta/id/276929-par-meza-un-saistito-nozaru-attistibas-pamatnostadnem-2015-2020-gadam

[101]Guidelines for sustainable use of peat in 2020-2030. Available: https://likumi.lv/ta/id/319013-par-kudras-ilgtspejigas-izmantosanas-pamatnostadnem-20202030-gadam

[103]Interventions of the Strategic Plan of the CAP for 2023-2027. Available: https://www.lad.gov.lv/lv/kopejas-lauksaimniecibas-politikas-strategiska-plana-2023-2027gadam-klp-intervences-atbalsta-pasakumi

started earlier, and to avoid floods during heavy rain and in spring. These conditions are usually associated with high CH_4 emissions.

The direct impact in cropland is associated with accumulation of CO_2 in soil carbon pool due to high productivity of the drained fields and application of more advanced and higher yields targeted management practices in agriculture.

Important indirect impact of the reconstruction of drainage systems in cropland is concentration of production – more fertile cropland will be available without land use changes, so the need and willingness to convert grassland or forest land to cropland to increase production will be reduced by economic drivers.

Considering the high uncertainty of impact on non-CO_2 emissions, only carbon stock changes (CO_2 emissions) in soil due to application of different management system are considered in the evaluation of the impact of reconstruction of drainage systems in cropland. Tier 1 method described in the IPCC guidelines for AFOLU sector[103] is applied to compare carbon stock changes in soil in case of maintenance of the drainage systems in the cropland in good conditions and carbon stock in soil is considered to be equal to the value characteristic for high activity clays (HAC soils) in temperate region – 95 tonnes ha^{-1} at 0-30 cm deep soil layer. situation – measure is not implemented – considers continuous tillage in long term cultivated cropland with moderate input of organic material in soil (carbon stock change factor for land use 0.69, for tillage 1.0 and for input of organic material 1.0). The resulting carbon stock in soil in case if the proposed measure is not implemented decreases to 65.6 tonnes C ha^{-1}.

The comparison of the situation when productivity is decreasing and the situation after reconstruction of the drainage ditches considers a higher input of organic material (carbon stock change factor due to the organics input 1.1) after the drainage due to higher productivity and application of more fertilizers. Respectively, no carbon stock changes in soil are considered, if the measure is implemented and decrease of the soil carbon stock is considered in case if the measure is not implemented. Summary of comparison of situation when the measure is implemented and not implemented is shown in Table 3.6; 20 years' transition period is considered in calculation. Implementation of the measure according to the Tier 1 method will contribute to the net CO_2 removals in soil –1.32 tonnes CO_2 ha^{-1} annually (26.4 tonnes CO_2 ha^{-1} in total) during 20 years' period after implementation of the measure. Summary of the initially proposed impact of the measure is provided in Table 3.19. The estimate includes activities implemented between 2014 and 2022.

Table 3.6 Summary of comparison of effect of reconstruction of drainage systems on cropland

Parameter	Measurement unit	Measure not implemented	Implementation of measure
Carbon stock change factor – input	-	1.00	1.11

[103] Eggleston, S., Buendia, L., Miwa, K., Ngara, T., & Kiyoto, T. (Eds.). (2006). 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, p. 678). Institute for Global Environmental Strategies (IGES)

Parameter	Measurement unit	Measure not implemented	Implementation of measure
Carbon stock in soil 0-30 cm at the end of transition period	tonnes C ha^{-1}	65.6	72.8
Total impact of the measure on soil carbon stock	tonnes C ha^{-1}	7.21	
Annual soil carbon stock changes	tonnes C ha^{-1} year	0.36	
Annual removals of CO_2 in soil	tonnes CO_2 ha^{-1} year	1.32	

3.7.2.1.2. Establishment of new orchards

The measure applies to the establishment of new or reconstruction of existing orchards on cropland. Implementation of the measure will affect carbon stock in living biomass and soil carbon pool; respectively, it will reduce CO_2 emissions or maintain continuously high carbon stock in already existing orchards by provision of economic benefits to their owners. Change of the land management system, particularly, establishment of continuous ground vegetation, or maintenance of the existing carbon rich vegetation, will affect N_2O and CH_4 emissions; however, existing methods are not sufficient to predict these emissions in diverse growth conditions.

The quantitative estimation of impact of the measure is done according to the Tier 1 method of the IPCC good practice guidelines for LULUCF sector[104]. Carbon stock in living biomass after the transition period is calculated according to the Table 3.3.2 of the guidelines "Default coefficients for aboveground woody biomass and harvest cycles in cropping systems containing perennial species" – 63 tonnes C ha^{-1} in above-ground biomass with the average accumulation rate of 2.1 tonnes C ha^{-1} annually. Transition period according to the guidelines is 30 years. Initial carbon stock in soil is considered 95 tonnes ha^{-1} (HAC soils in temperate region). Soil carbon stock change factors for land use, tillage and input are adopted from the recent guidelines (cropland – 0.69, regular tillage – 1.0, no tillage – 1.15 and moderate input – 1.00)[105]; respectively, before implementation of the measure average carbon stock in soil is 65.6 tonnes C ha^{-1}. It can be also applied in opposite way – support to orchards ensures that the carbon stock is not decreasing to a level characteristic for croplands or grasslands.

Implementation of the measure according to the Tier 1 method will contribute to the net CO_2 removals in soil –8.9 tonnes CO_2 ha^{-1} annually (267 tonnes CO_2 ha^{-1} in total) during 30 years' period (Table 3.7). The estimate includes activities implemented between 2014 and 2022.

Table 3.7 Summary of comparison of effect of establishment of new orchards

Parameter	Measurement unit	Measure not implemented	Implementation of measure
Carbon stock change factor – tillage	-	1.00	1.15

[104] Blain, D., Boer, R., Eggleston, S., Gonzalez, S., Hiraishi, T., Irving, W., Krug, T., Krusche, A., Mpeta, E. J., Penman, J., Pipatti, R., Sturgiss, R., Tanabe, K., & Towprayoon, S. (2013). 2013 Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement) (p. 339)

[105] Eggleston, S., Buendia, L., Miwa, K., Ngara, T., & Kiyoto, T. (Eds.). (2006). 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, p. 678). Institute for Global Environmental Strategies (IGES)

Parameter	Measurement unit	Measure not implemented	Implementation of measure
Carbon stock in soil 0-30 cm at the end of transition period	tonnes C ha^{-1}	65.6	75.4
Total impact of the measure on soil carbon stock	tonnes C ha^{-1}	9.83	
Annual soil carbon stock changes	tonnes C ha^{-1} year	0.49	
Annual removals of CO_2 in soil	tonnes CO_2 ha^{-1} year	1.80	
Carbon stock changes in living biomass			
Carbon stock at the end of transition period	tonnes C ha^{-1}	63	
Transition period	years	30	
Average annual carbon stock changes	tonnes C ha^{-1} year	2.1	
Average annual net CO_2 removals	tonnes CO_2 ha^{-1} year	7.7	
Carbon stock changes in living biomass and soil			
Average net CO_2 removals in 30 years period	tonnes CO_2 ha^{-1} year	8.9	
Total net CO_2 removals in 30 years period	tonnes CO_2 ha^{-1}	267	

No additional emissions due to establishment of the new orchards in existing cropland are considered, because other measures, like the reconstruction of drainage systems in cropland, will secure availability of land to maintain or even increase crop production. Between 2021 and 2024 the area of orchards increased by 1.66 kha, significantly overreaching initially proposed area (0.35 kha) of new orchards. Summary of the initially proposed impact of the measure is provided in Table 3.19.

3.7.2.1.3. Introduction of legumes into conventional crop rotations

The measure applies to the use of legumes in mixture with other crops in cropland, resulting in higher inputs of organic material into soil and partial replacement of mineral fertilizers with nitrogen fixing plants. It will be implemented in managed cropland with medium input of organic material (carbon stock change factor for input is equal to 1.0)[106]. According to the 2006 IPCC Guidelines, after application of the measure the management system in the affected fields will be changed to "High, without manure" due to increased input of organic materials and the carbon stock change factor for input will increase to 1.11.

Summary of comparison of both conventional cropping system and implementation of the measure is shown in Table 3.8; 20 years' transition period is considered in calculation of soil carbon stock changes. Implementation of the measure according to the Tier 1 method will contribute to the net CO_2 removals in soil –1.32 tons CO_2 ha^{-1} annually (26.4 tons CO_2 ha^{-1} in total) during 20 years' period. Summary of the initially proposed impact of the measure is

[106] Eggleston, S., Buendia, L., Miwa, K., Ngara, T., & Kiyoto, T. (Eds.). (2006). 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, p. 678). Institute for Global Environmental Strategies (IGES)

provided in Table 3.19. The area affected by the measure up to now is 64 kha. The estimate includes activities implemented between 2014 and 2022.

Table 3.8 Summary of comparison of effect of growing of legumes

Parameter	Measurement unit	Measure not implemented	Implementation of measure
Carbon stock change factor – input	-	1.00	1.11
Carbon stock in soil 0-30 cm at the end of transition period	tons C ha^{-1}	65.6	72.8
Total impact of the measure on soil carbon stock	tons C ha^{-1}	7.21	
Annual soil carbon stock changes	tons C ha^{-1} year	0.36	
Annual removals of CO_2 in soil	tons CO_2 ha^{-1} year	1.32	

3.7.2.1.4. Undergrowth plants sown with winter crops

Support to use undergrowth plants in crop rotation in winter crops. Measure is aimed to increase of carbon input into soil in the integrated production systems and to increase the soil carbon stock.

The measure will be implemented in cropland with medium input of organic material (carbon stock change factor for input is equal to 1.0)[107]. According to the 2006 IPCC Guidelines, after application of the measure the management system in the affected fields will be changed to "High, without manure" due to increased input of organic materials and the carbon stock change factor for input will increase to 1.11.

Summary of comparison of conventional cropping system and the system considering input with green manure is shown in Table 3.9; 20 years' transition period is considered in calculation of soil carbon stock changes. Implementation of the measure according to the Tier 1 method will contribute to the net CO_2 removals in soil –1.32 tons CO_2 ha^{-1} annually (26.4 tons CO_2 ha^{-1} in total) during 20 years' period. Summary of the initially proposed impact of the measure is provided in Table 3.19. The area affected by the measure up to now is 22.5 kha, excluding activities implemented between 2014 and 2022 and considered in the effect calculation.

Table 3.9 Summary of comparison of effect of undergrowth plants sown with winter crops

Parameter	Measurement unit	Alternate scenario	Implementation of measure
Carbon stock change factor – input	-	1.00	1.11
Carbon stock in soil 0-30 cm at the end of transition period	tons C ha^{-1}	65.6	72.8
Total impact of the measure on soil carbon stock	tons C ha^{-1}	7.21	

[107] Eggleston, S., Buendia, L., Miwa, K., Ngara, T., & Kiyoto, T. (Eds.). (2006). 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, p. 678). Institute for Global Environmental Strategies (IGES)

Parameter	Measurement unit	Alternate scenario	Implementation of measure
Annual soil carbon stock changes	tons C ha^{-1} $year^{-1}$	0.36	
Annual removals of CO_2 in soil	tons CO_2 ha^{-1} $year^{-1}$	1.32	

3.7.2.1.5. Green fallow before winter crops

Support to use green fallows in crop rotation in winter crops. Measure is aimed to increase of carbon input into soil in the integrated production systems and to increase the soil carbon stock.

The measure will be implemented in conventionally managed cropland with medium input of organic material (carbon stock change factor for input is equal to 1.0)[108]. According to the IPCC Guidelines, after application of the measure the management system in the affected fields will be changed to "High, without manure" due to increased input of organic materials and the carbon stock change factor for input will increase to 1.11.

Summary of comparison of conventional cropping system and the system considering input with green manure is shown in Table 3.10; 20 years' transition period is considered in calculation of soil carbon stock changes. Implementation of the measure according to the Tier 1 method will contribute to the net CO_2 removals in soil –1.32 tonnes CO_2 ha^{-1} annually (26.4 tonnes CO_2 ha^{-1} in total) during 20 years' period. Summary of the initially proposed impact of the measure is provided in Table 3.19. The area affected by the measure up to now is 10.8 kha, excluding activities implemented between 2014 and 2022 and considered in the effect calculation.

Table 3.10 Summary of comparison of effect of green fallow before winter crops

Parameter	Measurement unit	Measure not implemented	Implementation of measure
Carbon stock change factor – input	-	1.00	1.11
Carbon stock in soil 0-30 cm at the end of transition period	tonnes C ha^{-1}	65.6	72.8
Total impact of the measure on soil carbon stock	tonnes C ha^{-1}	7.21	
Annual soil carbon stock changes	tonnes C ha^{-1} $year^{-1}$	0.36	
Annual removals of CO_2 in soil	tonnes CO_2 ha^{-1} $year^{-1}$	1.32	

3.7.2.1.6. Cumulative effect of the productivity targeted measures

There are several measures implemented in agriculture sector indirectly affecting LULUCF sector, like breeding of new crops, improvement of crop rotations, more accurate use of fertilizers, better soil scarification technologies and others, which results in an increase of

[108] Eggleston, S., Buendia, L., Miwa, K., Ngara, T., & Kiyoto, T. (Eds.). (2006). 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, p. 678). Institute for Global Environmental Strategies (IGES)

productivity and bigger inputs of carbon into soil by increased biomass of plant residues. These measures create cumulative effect, which cannot be easily projected and expressed in monetary terms; however, they can be monitored as increase of production per area unit and verified by the national soil monitoring programs.

The substantiation of the cumulative effect of productivity targeted measures is based on increase of input of organic matter into soil with plant residues resulting in the increase of the soil carbon stock. It is assumed that the measure is implemented in croplands on mineral soils, while in organic soils management activities are reduced.

3.7.2.2. Measures in forest land

The climate change mitigation measures in forest lands are based on the fact that the average growing stock, and accumulated carbon stock as a result, is considerably smaller than the potential growing stock and the reasons for such deviation can be explained by differences in forest management.

The climate change mitigation actions are targeted on support of implementation of the management methods contributing to reduction of the gap between the average and the best forest stands.

3.7.2.2.1. Reconstruction of drainage systems in forest land

The measures of the activity aimed on climate change mitigation are reconstruction and improvement of existing drainage systems in forest land to maintain and increase economic value of land and productivity on drained lands. The measure has a direct and indirect impact on GHG emissions in short and in long term. Living and dead biomass carbon pool is highly affected (increased in short and long term prospective) and can be quantified following to existing forest management models.

The scope of the measure is to maintain existing forest drainage systems, particularly, to secure successful forest regeneration after final felling. Mature stands reaching final felling age and recently regenerated forest stands are prioritized in this activity to reach maximum economic and GHG emission reduction effect.

Most of the forest drainage systems in forest land in Latvia are established before 1990. Proposed lifetime of a drainage system is 30 years; consequently, most of the drainage systems are outdated. However, despite declining of technical conditions of the drainage systems, the drained generation of trees usually continues to grow following increment curves characteristic for naturally dry forest or even better due to the water regime self-regulating functions. The growth rate can be disturbed by natural ageing of forest stands, regenerative felling or intensive thinning, as well as due to severe changes in growth conditions like flooding of an area by beavers. The most common reason for “switching off” self-regulation of water regime in Latvia is regenerative felling. Therefore, it is important to prioritize reconstruction of drainage systems in mature stands before regenerative felling and recently regenerated

young stands to secure that growth of the second generation of trees on drained lands follows the growth curves characteristic for naturally dry and drained forests.

Drained forest in Latvia is classified according to the soil parent material – drained forests on peat soil and on mineral soil. Drainage ditches on peat soil usually transport water during the whole vegetation season due to groundwater outputs, drainage systems on mineral soils can be similar to those on peat soil, as well as similar to drainage systems on farmlands – temporarily filled with excess water in spring and during heavy rain falls; therefore, the structure of CH_4 emissions from ditches might differ, depending on the dominating parent material. Forests are normally drained with open drainage systems, which are regularly maintained, and a complete cleaning and restoration of the whole ditch network is usually done once every 30 years. However, additional increment after restoration of the drainage systems normally appears only in young stands.

Forest drainage is one of the most efficient solutions to increase CO_2 removals in living biomass and other carbon pools in forest lands. The research data on impact of organic soil drainage demonstrates controversial results; for instance, 51 years long monitoring of drainage impact and afforestation of a transitional bog in central part of Latvia demonstrates a significant increase of carbon stock in all carbon pools, including soil[109]. However, in accordance with the 2006 IPCC Guidelines, soil is the source of CO_2 emissions in all forests on organic soils, CO_2 emission factor is 0.68 tons C ha^{-1} annually[110]. In wetlands, CO_2 emissions in rich rewetted organic soils in temperate climatic zone are 0.5 tons C ha^{-1} annually[111]; respectively, difference between soil carbon stock changes in forest area with maintained drainage system and rewetted area on organic soil is 0.18 tons C ha^{-1} annually.

Drainage also affects N_2O emissions. In drained organic soil N_2O emissions increase by 0.60 kg N_2O-N ha^{-1} annually and in drained mineral forest soils emissions increase by 0.06 kg N_2O-N ha^{-1} annually[112]. The uncertainty of these factors is very high, comparing the source data and

[109] Lazdiņš, A., Butlers, A., & Lupiķis, A. (2014). Case study of soil carbon stock changes in drained and afforested transitional bog. Forest Ecosystems and Its Management: Towards Understanding the Complexity. 9th Baltic theriological conference, Ilgas

[110] Eggleston, S., Buendia, L., Miwa, K., Ngara, T., & Kiyoto, T. (Eds.). (2006). 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, p. 678). Institute for Global Environmental Strategies (IGES)

[111] Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Fukuda, M., Troxler, T., & Jamsranjav, B. (2013). 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (p. 354). IPCC. Available: http://www.ipcc-nggip.iges.or.jp/public/wetlands/pdf/Wetlands_Supplement_Entire_Report.pdf

[112] Penman, J. (Ed.). (2003). Good Practice Guidance for Land Use, Land-Use Change and Forestry. Institute for Global Environmental Strategies (IGES). Available: http://www.ipcc-nggip.iges.or.jp

other publications[113,114,115]. Drainage of forest causes reduction of CH_4 emissions[116,117,118,119] however, uncertainty of these estimates is very high and strongly depends on the initial conditions, which cannot be determined any more in most cases. No impact on N_2O and CH_4 emissions is used in calculation of the effect of the drainage system reconstruction in forest lands, considering high uncertainty of these estimates.

An example of two cases – in drained and wet organic soil is shown in Figure 3.1. It is considered, that in case of reconstruction of the forest drainage systems in pine stands, the development of the second rotation of trees will follow the blue columns and in case of rewetting – orange columns in Figure 3.1.

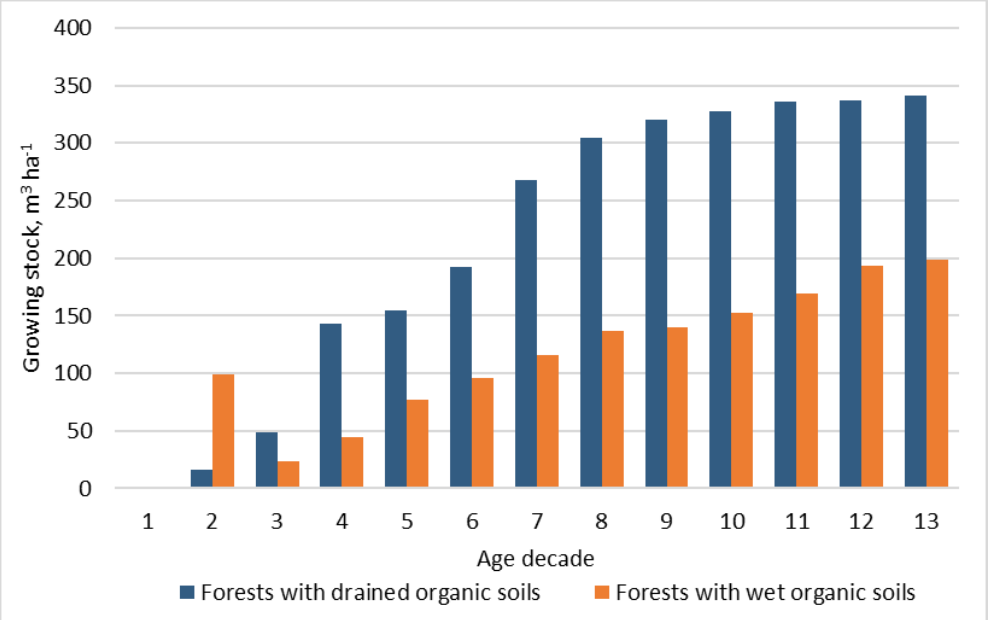

Figure 3.1 Growing stock in drained and naturally wet pine stands

The carbon stock change in dead wood and litter carbon pools is not considered in the calculation due to high uncertainty of the research data. Considerable increase of carbon stock in these pools is found in long term studies in Latvia however, these removals strongly depend on the initial conditions in the drained area, which usually cannot be identified.

[113]Maljanen, M., Liikanen, A., Silvola, J., & Martikainen, P. J. (2003). Nitrous oxide emissions from boreal organic soil under different land-use. Soil Biology and Biochemistry, 35(5), 689–700. Available: https://doi.org/16/S0038-0717(03)00085-3

[114] Mander, Ü., Uuemaa, E., Kull, A., Kanal, A., Maddison, M., Soosaar, K., Salm, J.-O., Lesta, M., Hansen, R., Kuller, R., Harding, A., & Augustin, J. (2010). Assessment of methane and nitrous oxide fluxes in rural landscapes. Landscape and Urban Planning, 98(3–4), 172–181. Available: https://doi.org/16/j.landurbplan.2010.08.021

[115]Ojanen, P., Minkkinen, K., & Penttilä, T. (2013). The current greenhouse gas impact of forestry-drained boreal peatlands. Forest Ecology and Management, 289, 201–208. Available: https://doi.org/10.1016/j.foreco.2012.10.008

[116]von Arnold, K., Nilsson, M., Hånell, B., Weslien, P., & Klemedtsson, L. (2005). Fluxes of CO_2, CH_4 and N_2O from drained organic soils in deciduous forests. Soil Biology and Biochemistry, 37(6), 1059–1071. Available: https://doi.org/10.1016/j.soilbio.2004.11.004

[117] Mander, Ü., Maddison, M., Soosaar, K., Koger, H., Teemusk, A., Truu, J., Well, R., & Sebilo, M. (2015). The impact of a pulsing water table on wastewater purification and greenhouse gas emission in a horizontal subsurface flow constructed wetland. Ecological Engineering, 80(Supplement C), 69–78. Available: https://doi.org/10.1016/j.ecoleng.2014.09.075

[118]Matson, A., Pennock, D., & Bedard-Haughn, A. (2009). Methane and nitrous oxide emissions from mature forest stands in the boreal forest, Saskatchewan, Canada. Forest Ecology and Management, 258(7), 1073–1083. Available: https://doi.org/10.1016/j.foreco.2009.05.034

[119]Arnold, K. V., Weslien, P., Nilsson, M., Svensson, B. H., & Klemedtsson, L. (2005). Fluxes of CO_2, CH_4 and N_2O from drained coniferous forests on organic soils. Forest Ecology and Management, 210(1–3), 239–254. Available: https://doi.org/10.1016/j.foreco.2005.02.031

The difference between both cases is accounted as a difference between growing stock in a typical final felling age for the species, which are the most common in drained forests (pine, spruce, and birch, aspen). Summary of the impact resulting from the maintenance of drainage systems on growing stock is provided in Table 3.11. The duration of the impact is equal to an average rotation for different tree species – 101 years for pine, 81 years for spruce, 71 years for birch and 51 years for aspen. Biomass expansion factors and carbon content in biomass applied in the calculation are derived from the GHG inventory report according to Liepiņš et al. (2017)[120].

Table 3.11 Impact of maintenance of drainage systems on growing stock

Parameter	Pine	Spruce	Birch	Aspen
Drained organic soils				
Net changes in living biomass, tons CO_2 yearly	2.05	2.75	1.36	0.93
Emissions from soil, tons CO_2 yearly	0.66	0.66	0.66	0.66
Net changes, tons CO_2 yearly	1.39	2.09	0.70	0.27
Drained mineral soils				
Net changes, tons CO_2 yearly	1.50	1.11	1.60	1.63

CO_2 removals during the rotation period in case of maintenance of drainage systems reach values provided in Table 3.12. Additional removals can be considered in harvested wood products due to commercial thinning (about 30 % of the growing stock in mature stands).

Table 3.12 CO_2 removals due to maintenance of drainage systems, tons CO_2

Soil	Pine	Spruce	Birch	Aspen
Organic	140	169	50	14
Mineral	152	90	114	83

Area of drained organic soils affected by the measure is considered according to a share of drained organic forest soils in Latvia (41%); mineral soils, respectively, are 59% of the area of drained forests. Similar approach is used to estimate the share of spruce, pine, birch and aspen stands. For other species the values characteristic for aspen are applied (Table 3.13).

Table 3.13 Distribution of species in drained forests

Species	Mineral soils	Organic soils
Pine	18%	29%
Spruce	23%	16%
Birch	27%	38%
Aspen and others	32%	17%

[120]Liepiņš, J., Lazdiņš, A., & Liepiņš, K. (2017). Equations for estimating above- and belowground biomass of Norway spruce, Scots pine, birch spp. And European aspen in Latvia. Scandinavian Journal of Forest Research, 1–43. Available: https://doi.org/10.1080/02827581.2017.1337923

The average annual impact of the measure on CO_2 removals is 1.7 tons CO_2 ha^{-1} and the average impact during the rotation period is 99 164 tons CO_2 ha^{-1}. Summary of the impact of the measure according to initially proposed implementation rate is provided in Table 3.19. The progress of implementation of the measure is not yet summarized. Approximate area of forest stands with reconstructed drainage systems is 14.2 kha, a bit more than 10% of the intially proposed area according to Table 3.19. The GHG projections includes effect of the previously implemented measures.

3.7.2.2.2. Afforestation of nutrient-poor soils in grassland and cropland

The scope of afforestation is economically and environmentally efficient utilization of former farmlands (mainly land with low fertility), which are not any more used for food of fodder production.

Afforestation secures accumulation of CO_2 in living and dead biomass, litter and soil. The growth conditions in afforested lands usually are similar to fertile forest stand types on drained or naturally dry mineral soils; therefore, the calculation of impact of afforestation on carbon stock in living and dead biomass is done on the basis of average values in *Hylocomiosa* stand type (Table 3.14), estimating the carbon stock in these pools at the end of rotation period (101 years for pine, 81 – spruce, 71 – birch and 51 years for aspen). Carbon stock changes in litter are 0.37 tons CO_2 ha^{-1} annually for 150 years period, according to the calculation method applied in the GHG inventory.

Reduction of CO_2 and N_2O emissions from soil due to land use change from cropland or grassland to forest land is not accounted, considering that there are no benefits pro-posed in the RDP for afforestation of organic soil.

Table 3.14 Average annual net CO_2 removal in living and dead biomass in *Hylocomiosa* stand type

Dominant species	Average annual net removal of CO_2 in living biomass, tons of CO_2	Average annual net removal of CO_2 in dead biomass, tons of CO_2
Aspen	5.78	0.42
Birch	7.53	0.77
Spruce	5.87	0.53
Pine	5.29	0.47

The distribution of tree species in afforested areas in the impact calculation is adopted according to the average historical values published by the State Forest Service (Figure 3.2).

In average, afforestation of 1 ha will contribute to removal of 596 tons of CO_2 during the rotation or 7.4 tons of CO_2 annually.

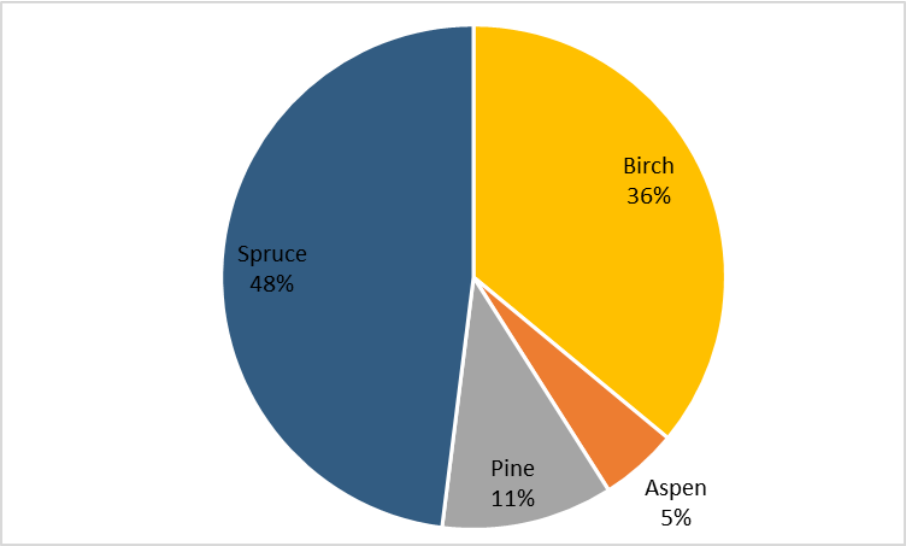

Figure 3.2 Dominant species in afforested lands

Summary of the initially proposed impact of the measure is provided in Table 3.19. The area affected by the measure up to now is 1.1 kha. The projections includes the effect of previously implemented measures.

3.7.2.2.3. Regeneration of forest stands suffered by natural disturbances

The measure supports regeneration of forests after natural disturbances, like forest fires and strong storms, as well as reconstruction of diseased low value forest stands. The measure will affect carbon stock in living biomass, dead wood, litter and soil carbon pools; respectively, it is aimed to increase CO_2 removals. The impact on dead biomass and soil carbon pools strongly depends on initial conditions; therefore, it is complicated to project the impact of the measure on these pools leading to increased uncertainty of the mitigation potential of this measure. In evaluation of carbon stock changes in living biomass two cases is compared – natural regeneration and planting of trees, considering that planted trees will grow faster according to recent research results[121,122,123]. Use of improved genetic material in the planting production is assessed according to expert judgement on a real situation in the market (Table 3.15). Average growing stock in the case of in natural regeneration is considered as the average growing stock values of the most common species in these stand types at the final felling age. Distribution of the stand types affected by the measure is equal to the average distribution of forest stands damaged in forest fires (Figure 3.3).

According to the given assumptions, average additional increment of stem wood per rotation due to utilization of improved planting material in the forest regeneration is 43 m^3 ha^{-1} (0.47 m^3 ha^{-1} annually) or 60 tons CO_2 ha^{-1} (0.59 tons CO_2 ha^{-1} annually).

[121]Jansons, Ā., & Baumanis, I. (2008). Parastās priedes (Pinus sylvestris L.) klonu atlase Kurzemes zonas 2. Kārtas sēklu plantācijas izveidei un sagaidāmais ģenētiskais ieguvums. Mežzinātne, Forest Science, 17(50), 88–116.
[122]Lazdiņš, A., Donis, J., & Strūve, L. (2012). Latvijas meža apsaimniekošanas radītās ogļskābās gāzes (CO_2) piesaistes un siltumnīcefekta gāzu (SEG) emisiju references līmeņa aprēķina modeļa izstrāde (5.5-9.1-0070-101-12–91; p. 104).
[123]Lazdiņš, A., Liepiņš, K., Lazdiņa, D., Jansons, Ā., & Bārdule, A. (2012). Mežsaimniecisko darbību ietekmes uz siltumnīcefekta gāzu emisijām un CO_2 piesaisti novērtējums (pārskats par 2012. Gada darba uzdevumu izpildi) (5.5-5.1/001Y/110/08/8; p. 74).

Table 3.15 Assumptions for estimation of breeding effect on additional increment

Species	Impact of breeding on growing stock before final felling	Share of improved seed material in planting production
Birch	15%	100%
Spruce	20%	60%
Pine	15%	100%

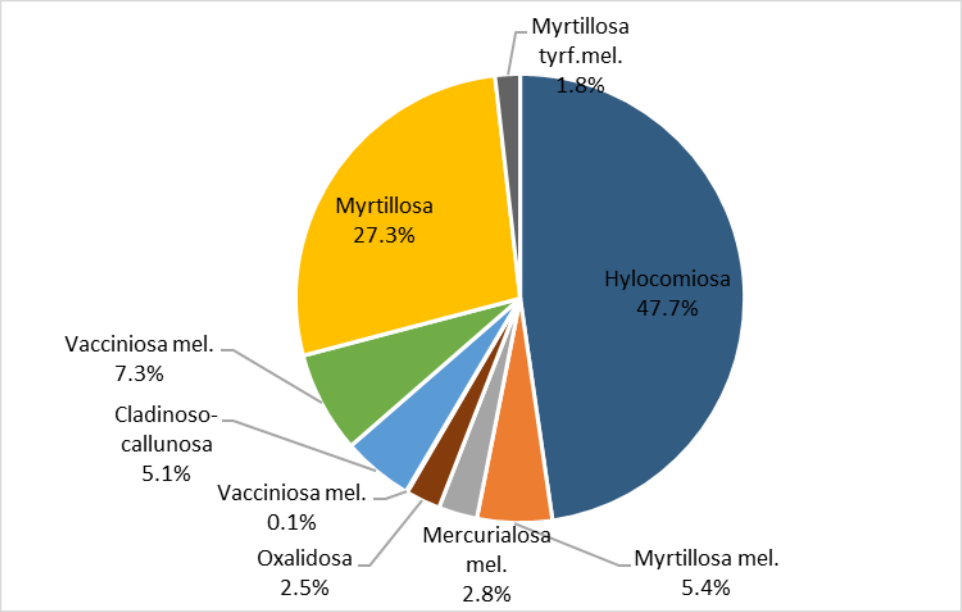

Figure 3.3 Distribution of the forest stand types in recent forest fire statistics

Summary of the initially proposed impact of the measure is provided in Table 3.19. The area affected by the measure up to now is 0.5 kha. Duration of the impact of the activity is 100 years; however, most of the impact will be reached during the first 50 years. The projections of GHG emissions includes the effect ofpreviously implemented measures.

3.7.2.2.4. Improvement of ecological value and sustainability of forest ecosystems

The scope of the measure is to support pre-commercial thinning of young stands and agrotechnical maintenance after stand establishment in private forests to ensure sustainable forest management practices[124,125,126,127] aimed to increase economic and ecological value of forests in long term. The principles of the thinning of young forest stands are proposed in the national legislation on forest management[128,129]. The basic for these principles is more intensive pre-commercial thinning to boost increment in following decades and to reduce the

[124]AS 'Latvijas valsts meži'. (2012). Kvalitātes prasības jaunaudžu kopšanas ciršu izpildei (Apstiprināts ar AS „Latvijas valsts meži" 20th April 2012. Rīkojumu Nr. 3.1-2.1_001a_200_12_12). AS 'Latvijas valsts meži'. Available: http://www.lvm.lv/files/text/Jaunaudzu%20kopsanas%20kvalitates%20prasibas.doc

[125] Jansons, J., & Zālītis, P. (1998). Dabiski atjaunojamo lapu koku apmežojumu struktūra un kopšanas iespējas. Meža Dzīve, Nr.4, 12–15.

[126] Zālītis, P. (2004). Sastāva kopšanas cirtes. LVMI Silava.

[127] Zālītis, P., & Lībiete, Z. (2008). Kopšanas ciršu režīms egļu jaunaudzēs. LLU Raksti, 20 (315), 38–45.

[128]Noteikumi par koku ciršanu mežā (Regulations on felling trees in forest) (18th December 2012). Available: https://likumi.lv/doc.php?id=253760

[129]Law on Forests (24th February 2000). Available: https://likumi.lv/doc.php?id=2825

need for additional commercial thinning before the final felling. The activity is not mandatory; hence the forest owners usually avoid it to save money and wait until trees reach the threshold dimensions for economically feasible commercial thinning, thus losing potential additional increment and providing favourable conditions for spreading of forests pests and diseases in weakened stands.

Pre-commercial thinning has short- and long-term impact. The short impact is a transfer of certain portion of the carbon from living biomass to the dead biomass pool with following conversion into CO_2 for 20 years period according to Tier 1 approach. The long-term effect is increase of growing rate (in average by 15% annually, according to an expert judgement used in several growth models). Contribution to the dead wood stock is not evaluated yet due to lack of research data, therefore, only living biomass is considered in the impact assessment.

Emission mitigation effect of the pre-commercial thinning is calculated as a difference between growing stock at the end of the rotation period and the difference in timber stock extracted in the commercial thinning. The growth models are derived from recent research data[130,131,132]. The biomass expansion factors are harmonized with the GHG inventory report.

The net impact of the intensified pre-commercial thinning in comparison to standard forest management practice in private forests is summarized in Table 3.16. It is considered in the impact assessment, that the distribution of the dominant species (pine, spruce and birch)[133] in stands, where the measure will be implemented, is equal to distribution of these species in the previously thinned stands in private forests (Figure 3.4). The largest mitigation potential of the pre-commercial thinning can be observed in spruce stands.

Table 3.16 Net impact of the pre-commercial thinning on growing stock in pine, spruce and birch forests

Parameter	Pine	Spruce	Birch
Additional increment, m^3 ha^{-1} annually	1.52	2.88	0.7
Additional CO_2 removals, tons ha^{-1} annually	1.94	3.5	1.0
Additional CO_2 removals, tons ha^{-1} per rotation	194	280	72

[130] Zālītis, P. (2006). Mežkopības priekšnosacījumi. et cetera.
[131] Zālītis, P., Donis, J., Ruņģis, D., Gaitnieks, T., & Jansons, J. (2014). Četri mežzinātņu motīvi. Daugavpils Universitātes Akadēmiskais apgāds 'Saule'.
[132] Zālītis, P., & Jansons, J. (2009). Mērķtiecīgi izveidoto kokaudžu struktūra. LVMI Silava.
[133] No quantitative data are available for other species and they are not considered in calculation.

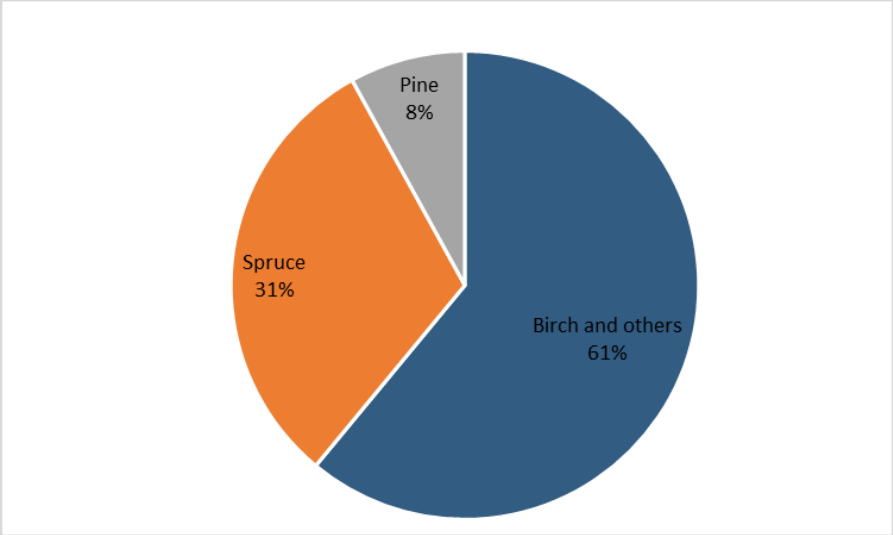

Figure 3.4 Dominant species in thinned lands in private forest

The average impact of the measure is additional increment of 1.4 m^3 ha^{-1} stem wood or additional removals of 1.9 tons CO_2 ha^{-1} annually resulting in net additional removals of 146 tons CO_2 ha^{-1} per rotation. The total area affected by the measure up to now is partly summarized. The total area where the measure is implemented since 2021 is 32.9 kha. Precommercial thinning is usually supported twice in the same area, therefore the actual area affected by the measure is 17.5 kha. Summary of the initially proposed impact of the measure is provided in Table 3.19. The projections of GHG emissions includes the effect ofpreviously implemented measures.

Table 3.17 Summary of the impact of the measure

Parameter	Measurement unit	Value
Implementation of the measure	kha	17.5
Total GHG reduction potential in 2030	kt CO_2 eq.	337
Average annual GHG reduction potential per area unit	kt CO_2 eq. $year^{-1}$	22
	tons CO_2 eq. $year^{-1}$ ha^{-1}	1.3

3.7.2.2.5. Preventive measures of forest damages

The scope of the measure is to maintain forest fire prevention system, including reconstruction of existing and building of new fire observation towers. The potential impact of the measure on GHG emissions is not evaluated yet; however, it is well known that the towers are very efficient in early identification and localization of the forest fire, hence the area of the forest fires is considerably smaller than it would be if the fire prevention system did not exist. Therefore, the cases with and without fire prevention system are compared to evaluate climate change mitigation effect of this measure.

The measure decreases CO_2, CO, CH_4, N_2O and NO_x emissions. GHG emissions due to forest fires in Latvia are 133 tons CO_2 eq. ha^{-1}. Total annual GHG emissions in forests due to forest fires in Latvia are very fluctuating; average annual GHG emissions since 1990 are 147 kt CO_2 eq.

3.7.2.2.6. Restoration of peat extraction sites

Abandoned peat extraction sites are considerable source of GHG emissions. Restoration of peat extraction sites including afforestation aimed at restoration of biologically valuable forest habitats and productive forests, 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.

The measure is implemented according to Just Transition Territorial Plan (Order of CoM No. 531 (14th July 2022), Just Transition Fund specific aid objective 6.1.1. measures 6.1.1.1 and 6.1.1.7. According to the assumptions in the projections the area, which will be affected by this measure for 7 year-period between 2023 and end of 2029, is 13.6 kha including 4.5 kha of afforested areas. The emission reduction is calculated for afforested areas.

The emission reduction potential is ensured by accumulation of CO_2 in living and dead biomass and reduction of GHG emissions from soil. The projection of the GHG emission reduction is based on the results of the LIFE REstore project[134], assuming that GHG emissions in afforested areas reduce to values characteristic for drained nutrient-poor coniferous forests. No GHG reduction is considered in flooded lands, because of lack of scientific evidence of the emission reduction in rewetted areas[135]. According to LIFE REstore project results additional CH_4 and N_2O emissions from rewetted areas compensates CO_2 removals, transferring rewetted areas into significant sources of GHG emissions.

Soil GHG emission factors applied in the calculation are provided in Table 3.18. Average annual GHG reduction potential is 4.9 tons CO_2 eq. ha^{-1} in 35 years period. Net GHG emissions reduction in afforested lands in this period is 11.3 tons CO_2 eq. ha^{-1}.

Table 3.18 Soil GHG emission factors, summarized according to LIFE REStore project results[136]

GHG, t CO_2 ha^{-1} yr^{-1}	Forest with optimal water regime	Bare ground abandoned peat extraction field	Overgrown abandoned peat extraction field	Peat extraction field
CO_2	3.51	6.78	4.8	3.99
DOC	1.14	1.14	0.88	1.14
CH_4	0.55	0.67	3.33	0.26
CH_4 from ditches	0.14	0.27	0	0.68
N_2O	-0.02	0.02	0.1	0.21
Total emissions	5.3	8.88	9.11	6.27

[134] LIFE Restore. Available: https://restore.daba.gov.lv/public/lat/optimizacijas_modelis1/
[135] Butlers, A., & Lazdins, A. (2022). Case study on greenhouse gas (GHG) fluxes from flooded former peat extraction fields in central part of Latvia. Research for rural development, 44–49. Available: https://doi.org/10.22616/rrd.28.2022.006
[136] Priede, A., & Gancone, A. (Eds.). (2019). Sustainable and responsible after-use of peat extraction areas. Baltijas Krasti.

In practice afforestation of degraded peatlands requires significant investments in regulation of water regime. Insufficient funding in modernization of drainage systems may result in significantly smaller GHG mitigation effect. Summary of the initially proposed impact of the measure is provided in Table 3.19.

3.7.2.3. Summary of effect of existing measures according to proposed implementation rate

The measures, which are proposed for implementation between 2023 and 2027 will result in reduction of GHG emissions by 13 million tons of CO_2 eq. until 2050 (Table 3.19); however, some of the measures are not yet quantified with sufficient accuracy or they will be implemented on demand, e.g., reconstruction of forests after natural disturbances. The projected GHG emissions' reduction in 2023-2030 due to implementation of the existing measures will reach 3.0 mill. tons of CO_2 eq. Implementation of the measures will increase forest area by 7.7 kha in 2027. It is also assumed that the measures aimed at increase of soil carbon stock in cropland and grassland will be continued to avoid release of the stored CO_2. Avoided emissions according to initial projections are 11475 kt CO_2 eq. yr^{-1} and additional CO_2 removals – 1992 kt CO_2 eq. yr^{-1} in 2050 (Table 3.19).

Table 3.19 Projected cumulative GHG emission reduction

Measures	Type of impact	Land use category	Initially proposed implementation rate, kha	Projection of GHG emission reduction, kt CO_2 eq.					
				2025	2030	2035	2040	2045	2050
Establishment of orchards	Reduces emissions	Cropland	0.35	1.6	9.6	22.7	36.0	49.4	62.7
Green fallow before winter crops	Reduces emissions	Cropland	16.7	8.0	48.0	113.3	180.0	238.7	265.3
Introduction of legumes into conventional crop rotations	Avoids emissions	Cropland	42.0	26.4	158.4	374.0	594.0	787.7	875.7
Undergrowth plants sown with winter crops	Reduces emissions	Cropland	23.9	13.9	83.3	196.6	312.3	414.1	460.4
Reconstruction of drainage systems in cropland and grassland	Avoids emissions	Cropland	200	318.0	1 590.1	2 915.2	4 240.4	5 247.4	5 300.4
Afforestation of nutrient-poor soils in grassland and cropland	Reduces emissions	Forest land	10.2	20.6	123.5	291.5	463.0	634.4	760.8
Forest thinning	Avoids emissions	Forest land	53.3	96.5	578.7	1 366.5	2 170.3	2 783.0	3 266.3

Measures	Type of impact	Land use category	Initially proposed implementation rate, kha	Projection of GHG emission reduction, kt CO_2 eq.					
				2025	2030	2035	2040	2045	2050
Regeneration of stands affected by natural disturbances	Avoids emissions	Forest land	2.7	3.3	19.6	46.2	73.3	100.5	120.6
Reconstruction of drainage systems in forest lands	Avoids emissions	Forest land	Not set	30.8	186.3	442.4	690.6	912.7	1 123.4
Restoration of peat extraction sites	Reduces emissions	Forest land / Wetlands	4.5	10.3	205.2	461.7	718.2	974.7	1 231.2
Total GHG emission reduction				529.3	3 002.7	6 230.2	9 478.1	12 142.5	13 466.9

The effect of the existing mitigation measures will reach maximum in 2032 and will reduce starting from 2042, according to the projection; however, due to the measures implemented in forest lands the effect will be long lasting and will continue also after 2050 (Figure 3.5). It is also considered in the assessment that the measures contributing to increase or retaining high soil carbon stock in agricultural soils are continued also after 2030 ensuring that the achieved effect is not lost.

The most significant effect is ensured by reconstruction of drainage systems in and farmlands; however, in case of farmlands it is associated with significant uncertainty due to different starting point in the soil carbon stock and unpredictable management decisions. The measures with the highest accuracy of projections – afforestation, pre-commercial thinning and reconstruction of drainage systems in forest lands contributes to 38% of the proposed mitigation effect (Figure 3.6). The effect of other measures is certainly positive but needs more accurate assessment methods.

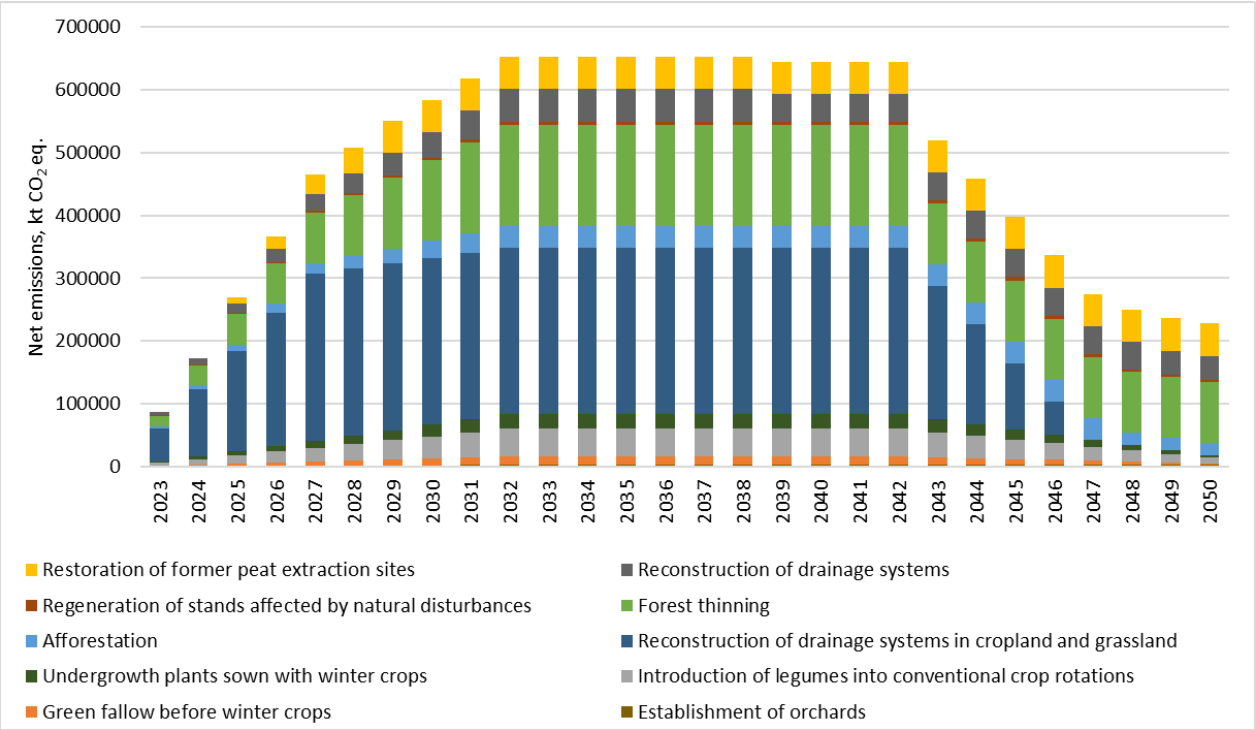

Figure 3.5 Mitigation of the effect of proposed measures

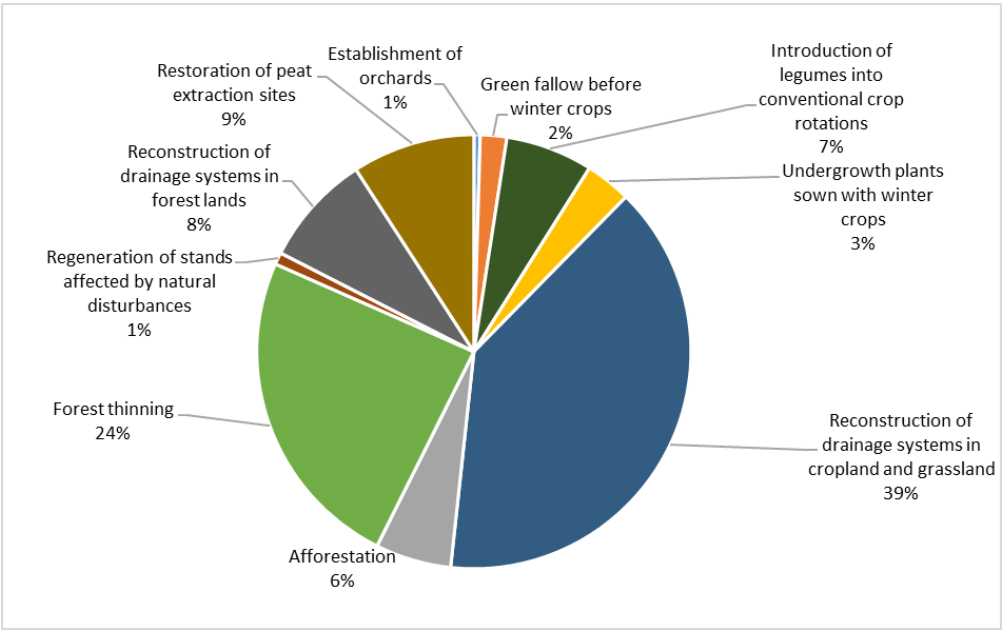

Figure 3.6 Summary of effect of the measures in 2050

3.8. WASTE

The most important document that describes the Latvian progress and planned policies on waste is **"Waste management plan 2021 - 2028"**[137], approved by the CoM with Order No 45 22nd January 2021. The waste management system is one of the most important directions of

[137] Waste management plan 2021 – 2028. Available: https://likumi.lv/ta/id/320476-par-atkritumu-apsaimniekosanas-valsts-planu-20212028-gadam

the EU and Latvian legislation on environmental protection. In Latvia, this is governed by 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 CoM, which influence on GHG emissions within the waste sector:

- Regulations of the CoM No. 1032 adopted on 27th December 2011 "Regulations Regarding the Construction of Landfill Sites, the Management, Closure and Re-cultivation of Landfill Sites and Waste Dumps";
- Regulations of the CoM No. 712 adopted on 26th October 2021 “Regulations Regarding Separate Waste Collection, Preparation for Re-use, Recycling and Material Recovery”;
- Regulations of the CoM No. 401 adopted on 24th May 2011 "Requirements for Incineration of Waste and Operation of Waste Incineration Plants".

In order to promote recycling and reuse of natural resources tax law sets the rate for waste disposal (Table 3.20).

Table 3.20 The tax rates for waste disposal from 1st January 2020

No.	Waste type	Unit	2020	2021	2022	2023	2024	2025	2026
1.	Municipal and industrial waste, which are not hazardous	EUR/t	50.00	65.00	80.00	95.00	110	120	130
2.	Hazardous waste (also industrial hazardous waste)	EUR/t	60.00	70.00	85.00	100.00	115	125	135

Main PaMs, regulating **wastewater handling sector**, are listed below:

- Urban Wastewater Directive 271/91/EEC (UWWTD)[138] requires implementing at least secondary treatment (which means “well managed biological treatment” in the terms of 2006 IPCC Guidelines) in all agglomerations, larger than 2000 population equivalents (p.e.) not later than 31st December 2015. Although there is no requirement for 100% connection rate for population, living within the border of agglomeration, total number of population living in these agglomerations constitutes a major proportion of national population. Full implementation of UWWTD means that up to 75% or even more of national population will be served by well managed biological treatment of urban wastewater and thus be very small or even not at all sources of CH_4 emissions. However, UWWTD requires as well, that all agglomerations, larger than 10 000 p.e.,

[138] The projections are based on the PaMs up to 30th September 2024, therefore Directive (EU) 2024/3019 of the European Parliament and of the Council of 27th November 2024 is not considered in this report.

must be served by more stringent treatment (significantly decreasing in the effluent content of total nitrogen and/or total phosphorus as well) not later than 31st December 2011. This requirement, while aimed at protection of water environment from eutrophication, in accordance with 2006 IPCC Guidelines leads to increase of N_2O emissions from modern, centralized treatment plants. Revised requirements of Directive are on their way to be implemented until 2035, but they are not expected to give a significant impact on GHG emissions from the sector;

- "Investment Plan of Wastewater Management for period 2021 – 2027", adopted in 2020 defines most important directions of development of sector, including renovation and coverage increase of sewage collection networks, increase of treatment quality in urban wastewater treatment plants, modernization of management of sewage sludge, measures to improve energy effectiveness in the wastewater treatment sector and management of decentralized collecting systems;
- "Sewage Sludge Management Plan 2024-2027", approved by a CoM, requires implementation of sustainable management of sewage sludge, according to circular economy, until end of 2027. In accordance with this plan, sewage sludge processing centres should be established in the 27 largest urban wastewater treatment plants, in order to ensure dewatering of sewage sludge and encouraging its use in agriculture or to produce a biogas.

4. PROJECTED GREENHOUSE GAS EMISSIONS UNTIL 2050

The scenarios underlying the emission projections in the 2025 submission have incorporated new insights regarding economic and demographic developments, sector developments, fossil fuel prices, the CO_2 price and policies compared to projections of 2024 submission[139]. In 2024, Latvia submitted updated GHG projections based on updated NECP 2021-2030. In 2024 submission, the initial data (projections of macroeconomic, activity data) were not changed. The year 2022 (base year) and the inventory report submitted to the UNFCCC on 16th December 2024 has been used as a starting point for the projections.

GHG emissions in Latvia have been projected for the years 2025, 2030, 2035, 2040, 2045 and 2050. GHG emission projections of Latvia up to 2050 are based upon the long-term macroeconomic projection developed by the MoE.

The projections are based on the PaMs approved by the Latvian parliament and government up to 30th September 2024, which means that it is a WEM projection. In addition to this scenario, there are also projected emissions with planned PaMs. This is WAM scenario. Measures in WAM scenario are principally announced by the high-level strategic development documents but still the implementation of these measures has not been elaborated in details and legal regulations have not been adopted but are expected to be adopted and implemented from a specific future year onwards.

In addition to the projections, four sensitivity analysis have been assessed for the Energy, Agriculture, Waste (including wastewater) to evaluate the impact of GDP and population growth rate as well as changes in sectorial assumptions and for LULUCF sector to evaluate the impact of harvest rate in regenerative felling compared to current forest management intensity. More information is provided in Chapter 7.

Based on macroeconomic projection, it is expected that GDP will increase during 2022-2050. The number of population in Latvia is expected to continue to decrease by 7.3% from 1.879 to 1.743 million in 2022-2050 (Table 4.1).

Table 4.1 The main macroeconomic parameters applied for projecting GHG emissions

	2022	2025	2030	2035	2040	2045	2050
Number of inhabitants, thsd.	1879.38	1847.83	1788.17	1753.51	1739.04	1737.79	1742.59
		2023 – 2025	**2026 – 2030**	**2031 - 2035**	**2036- 2040**	**2041- 2045**	**2046- 2050**
GDP growth, annual changes per period, %		1.9	2.5	2.2	2.0	1.7	1.3
agriculture		-1.2	2.1	1.9	1.7	1.2	0.8
service		1.8	2.4	2.2	2.0	1.7	1.3
construction		10.0	3.6	2.3	2.1	1.7	1.4

[139] 2024 submission on Integrating reporting on policies and measures and on projections: https://reportnet.europa.eu/public/dataflow/1057

Total GHG emissions (including indirect CO_2 and excluding LULUCF) under the WEM scenario decrease by 15.6% in 2030 and by 53.4% in 2050 compared to 2022 (Table 4.2 and Figure 4.1).

Table 4.2 Actual and projected GHG emissions per sector under WEM scenario, kt CO_2 eq.

	2022	2025	2030	2035	2040	2045	2050
Energy (excluding Transport)	3277.17	2681.84	2360.91	1941.57	1431.21	1318.57	1266.10
Transport	3141.70	3119.16	2737.89	1963.69	1400.22	501.40	201.70
IPPU	858.47	858.50	822.25	764.76	738.75	730.13	735.86
Agriculture	2253.83	2168.94	2223.17	2234.55	2214.51	2207.21	2199.90
Waste	588.61	505.83	405.05	358.98	338.74	333.52	311.20
Indirect CO_2	11.24	6.69	5.14	5.14	2.82	1.99	1.87
Total excluding LULUCF, including indirect CO_2	10131.01	9340.95	8554.40	7268.70	6126.25	5092.83	4716.63
Total including LULUCF and indirect CO_2	15075.18	12466.44	13163.54	12844.24	12452.14	11439.16	11099.15
LULUCF	4944.16	3125.49	4609.14	5575.54	6325.89	6346.34	6382.52

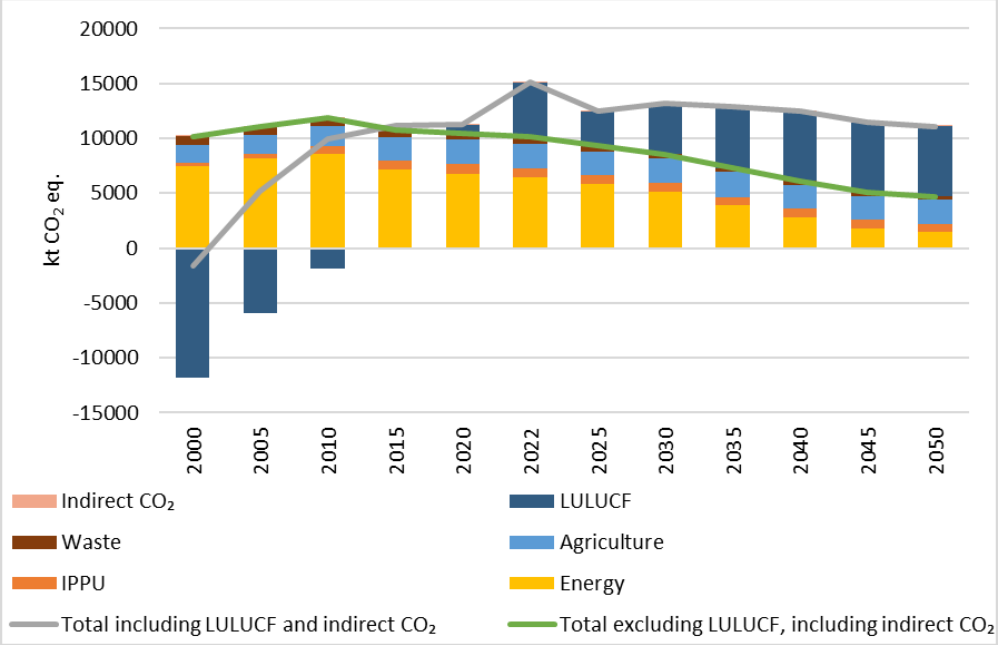

Figure 4.1 Total GHG emission projections in WEM scenario, kt CO_2 eq.

Energy sector (including Transport) will account for the largest share (59.6%) of the total projected GHG emissions in 2030, followed by Agriculture sector with its share amounting to 26.0%, IPPU with 9.6% and Waste sector with 4.7%.

In 2050, the share of Agriculture, IPPU sector and Waste increases, constituting 46.6%, 15.6% and 6.6% respectively. At the same time the contribution of the Energy sector to total emissions decreases to 31.1%.

CO_2 accounted for 65.4% of the total GHG emissions in 2022 and it is projected that CO_2 share of total emissions will decrease by 1.7% in 2030 compared to 2022. CH_4 and N_2O accounted for 18.7% and 13.3% of the total GHG emissions in 2022 and it is projected that CH_4 share of total emissions will decrease by 0.2% and the N_2O share of total emissions will increase by 2.3 percent point in 2030 compared to 2022.

The planned additional GHG emission mitigation measures under the WAM scenario allow a reduction of the projected emissions (Table 4.3 and Figure 4.2). Thus, in 2030 and 2050 under the WAM scenario total GHG emissions (including indirect CO_2 and excluding LULUCF) are 2.5% and 3.3% lower than in the respective years under the WEM scenario.

Table 4.3 Actual and projected GHG emissions per sector under WAM scenario, kt CO_2 eq.

	2022	2025	2030	2035	2040	2050	2050
Energy excluding transport	3277.17	2677.52	2369.08	1926.28	1209.52	1066.41	1107.82
Transport	3141.70	2640.43	2481.42	1612.91	733.18	277.86	99.45
IPPU	858.47	858.50	822.25	764.76	738.75	730.13	735.86
Agriculture	2253.83	2168.94	2223.17	2234.55	2214.51	2207.21	2199.90
Waste	588.61	505.83	403.00	333.82	279.21	252.43	241.20
Indirect CO_2	11.24	7.07	5.63	5.02	2.34	1.52	1.63
Total excluding LULUCF, including indirect CO_2	10131.01	8858.29	8304.55	6877.34	5177.52	4535.56	4385.86
Total including LULUCF and indirect CO_2	15075.18	11983.78	12913.68	12452.89	11503.41	10881.90	10768.38
LULUCF	4944.16	3125.49	4609.14	5575.54	6325.89	6346.34	6382.52

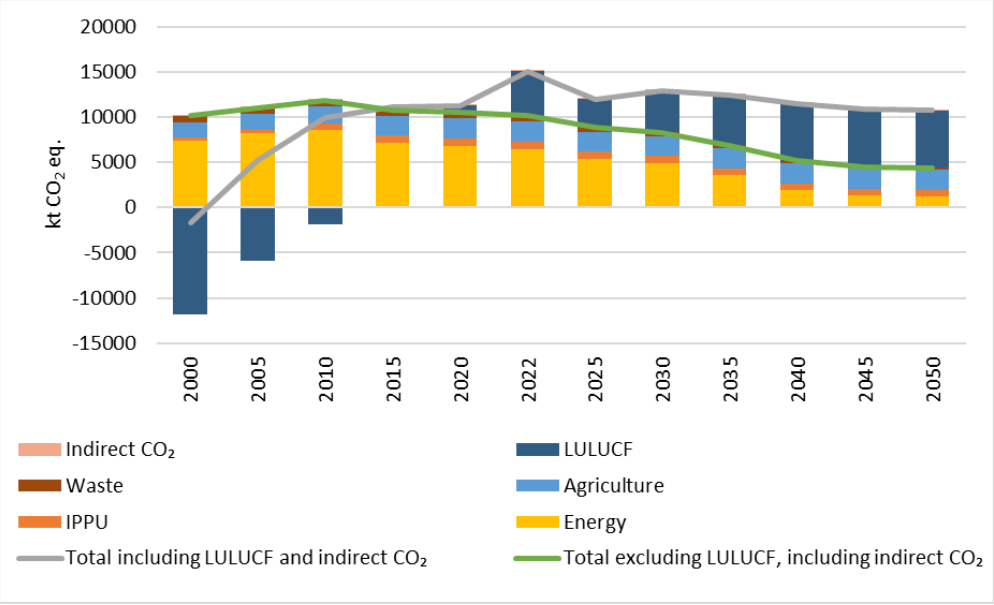

Figure 4.2 Total GHG emission projections in WAM scenario, kt CO_2 eq.

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. The matter is discussed in detail in the following sections on emission analysis.

5. PROJECTED EMISSIONS PER SECTOR

5.1 ENERGY

GHG emission projections are estimated in WEM and WAM scenario for the Energy sector. The basic parameters determining GHG emission amount in the Energy sector are changes in final energy consumption (FEC) and Gross primary energy supply (GPES) over certain time period and carbon intensity of the fuel mix in energy production. FEC has been calculated based on the projections of macroeconomic indicators (GDP, VA by branches, private consumption, the number of population, etc.). Parameters, characterizing each separate sector of FEC, are used additionally to calculate FEC in the relevant sector, e.g., the total floor area of dwellings in residential sector, the number of households, number of vehicles, number of vehicle kilometres travelled, etc.

The MoE has prepared a base scenario for economic growth and a corresponding macroeconomic forecast. The scenario was developed in line with the settings of the structural policy of Latvia, as set out in the policy documents – "Sustainable Development Strategy of Latvia until 2030", NDP2027 and "National Industrial Policy Guidelines 2021-2027". It also analyzes the processes that drive the development of the global economy.

With Russia invading Ukraine on 24th February 2022, the geopolitical situation has deteriorated causing great uncertainty regarding how the war in Ukraine and related imposed sanctions will affect economic development.

According to demographic projections, the population of Latvia will continue to decline in both the medium and long term. The projection of the number of households, dwellings and residential floor areas is based on demographic projections, and projections of specific parameters of the sector (average number of persons per household, average floor area per dwelling).

In the medium term (2024-2030), the baseline scenario projects GDP growth of an average of 2.6% annually, a prerequisite for which is the benefits of economic competitiveness based on technological improvements, production efficiency and innovation. In the long term (2031 - 2050), the annual growth rates of the economy will be slower and limited up to 1.2% - 2.2%.

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 technological processes, digitalisation, process optimisation, etc.

In both the above scenarios (WEM and WAM) the same indicators of macroeconomic projection are used for calculation of GHG emissions. In addition to macroeconomic parameters, assumptions on fossil fuel price projections and CO_2 price projections (ETS) were used to calculate projections in energy sector scenarios (WEM and WAM).

The EC price projections (for oil, coal and gas) have been used as the basis for calculating fuel price projections. These projections have been adjusted considering the Latvia's current fuel prices and the interrelationships between the prices of different fuels.

The uncertainty on the international energy markets will also affect the market ETS price in the coming years. Both WEM and WAM scenarios modelling use the EC[140] harmonised trajectory of the carbon price of the existing ETS and planned ETS II for WEM and WAM scenario.

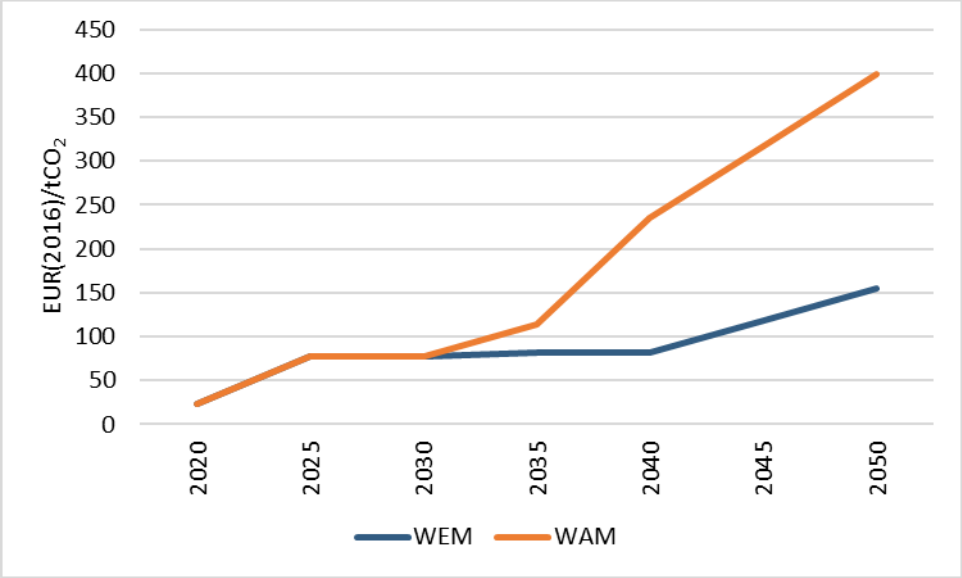

Figure 5.1 Projection of carbon price (ETS I) for WEM and WAM scenario, EUR (2016)/t CO_2

Energy sector development is strongly influenced by the measures to reduce GHG emissions aimed at improving energy efficiency and increasing RES share in energy production. The measures and related 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 FEC is determined not only by the planned energy efficiency measures, but also by the projected economic 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 energy efficient renovation financial support programmes in residential and commercial sector in particular, the public buildings, and higher energy efficiency requirements for the construction of new buildings.

[140] EC "Recommended parameters for reporting on GHG projections in 2025", June 2024

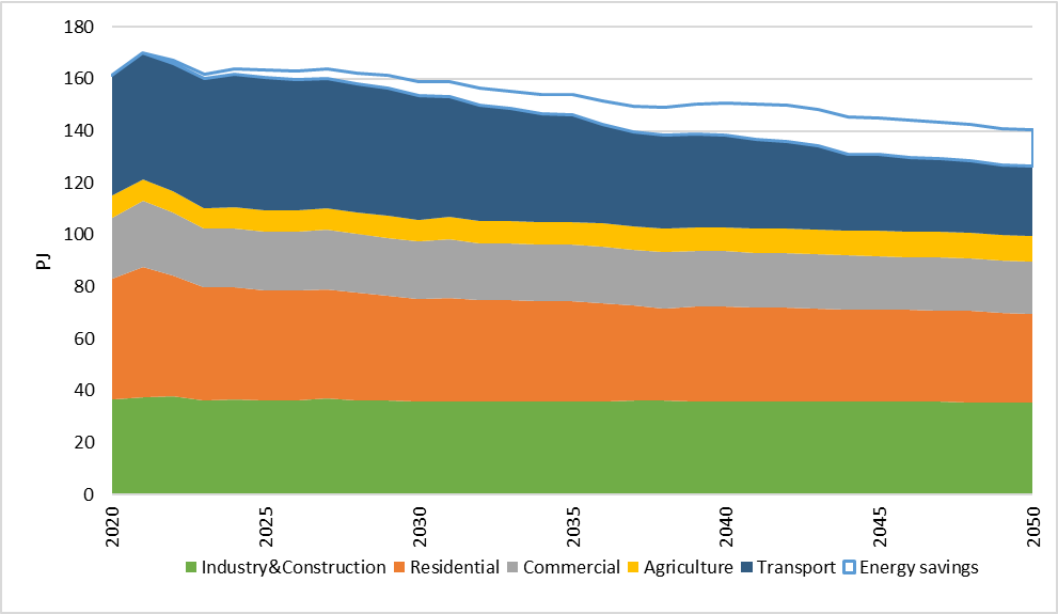

Figure 5.2 FEC development in sectors under the WEM scenario, PJ

The calculated FEC projections anticipate that in 2030 Transport (including international aviation) and Residential sector will be the main FEC sectors consuming respectively 31.0% and 25.5% of total FEC. In its turn, Industry will consume 23.4% and Commercial&Public Service sector 14.4% of total FEC. The rest will be consumed in Agriculture sector needs.

The assumption about the economic growth rate and change in population number and PaMs included in the WEM scenario result the FEC in 2030 will be per 7.4% lower, compared to 2022. As it can be seen in Figure 5.2, the implemented energy efficiency policy allows to save about 5.25 PJ in energy end-use in 2030 (meaning that without implementation of energy efficiency measures the FEC in 2030 will be per 5.25 PJ higher). Energy efficiency measures mainly focus on energy efficiency improvements in buildings (both residential and public buildings), but energy efficiency in industry is also improved.

WEM scenario envisages transition to more energy efficient vehicles and widened use of alternative fuels (electricity (BEV, PHEV), CNG and LNG) in the road transport.

The main characteristics of gross primary energy consumption (GPEC) in the WEM scenario (Figure 5.3) are as follows:

- calculated GPEC in 2030 is about 9.2% lower, compared to 2022. This GPEC decrease is caused by final energy consumption decrease in residential, services and commercial sector and industry sectors, as well as by fossil fuels substitution with RES (wind and solar) for electricity generation, as well as decrease in energy losses in energy transmission and distribution system;
- the share of RES is rising from 43.3% in 2022 to 51.2% in 2030;
- WEM scenario results in the significant change of the primary energy resources structure. The most significant change is the replacement of natural gas in electricity production (CHP) with renewables (wind and solar). As a result, the share of natural

gas will decrease by about 7.4 percent points, in turn, consumption of renewables (wind and solar) will increase by about 5.8 percent points.

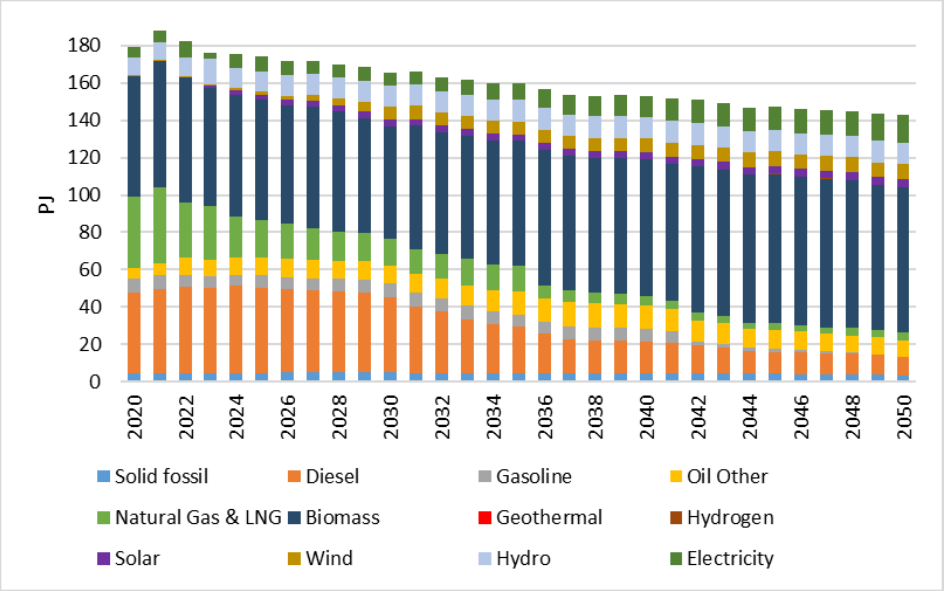

Figure 5.3 PEC by fuels under the WEM scenario, PJ

The total GHG emissions caused by energy production and use (Energy) will decrease by the year 2030 under the WEM scenario. Calculated GHG emission projections in 2030 are per 20.6% and in 2050 – per 77.1% lower compared to 2022 (Figure 5.4 and Table 5.1).

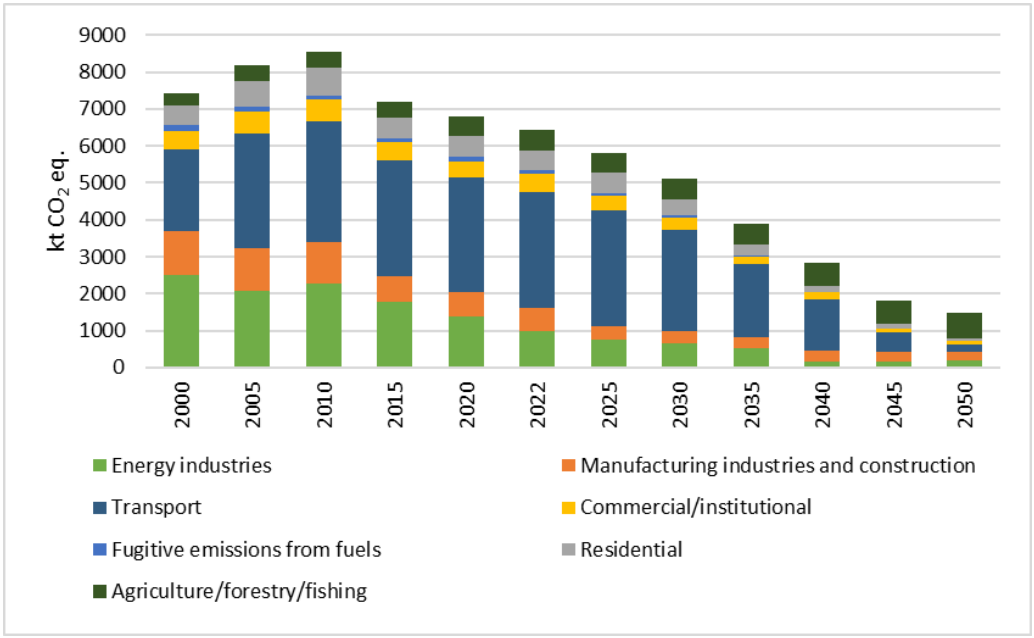

Figure 5.4 GHG emission projections under the WEM scenario, kt CO_2 eq.

Table 5.1 Projected GHG emissions under the WEM scenario, kt CO_2 eq.

Sector, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
Energy industries[141]	999.03	744.63	644.76	512.39	154.69	162.39	198.23
Manufacturing industries and construction	601.93	381.31	329.00	313.39	290.81	274.88	230.68
Transport	3141.70	3119.16	2737.89	1963.69	1400.22	501.40	201.70
Other sectors[142]	1577.75	1502.35	1349.20	1079.01	971.78	871.76	825.77
Fugitive emissions	98.45	53.54	37.95	36.78	13.93	9.54	11.42

In the WAM scenario, by 2030 the most significant GHG emission reduction PAMs are planned in the road transport. In energy sector, the WAM scenario plans additional energy efficiency improvement measures both in the services sector for public bodies (state and local government institutions) and in industry. After 2030, the main difference between the WAM and WEM scenarios is the WAM scenario comprises higher carbon price in both ETS and ETS2. This market instrument is expected to facilitate a faster transition from fossil fuels, including oil products utilised in transportation sector, to renewable energy sources, as well as to accelerate the implementation of energy efficiency measures in all sectors. Calculated GHG emission projections in 2030 are by 24.4% and in 2050 – by 81.2% lower compared to 2022 (Figure 5.5). Comparing the WAM and WEM scenarios, in the WAM scenario emissions in 2030 and 2050 are lower by 4.9% and 17.1%, respectively.

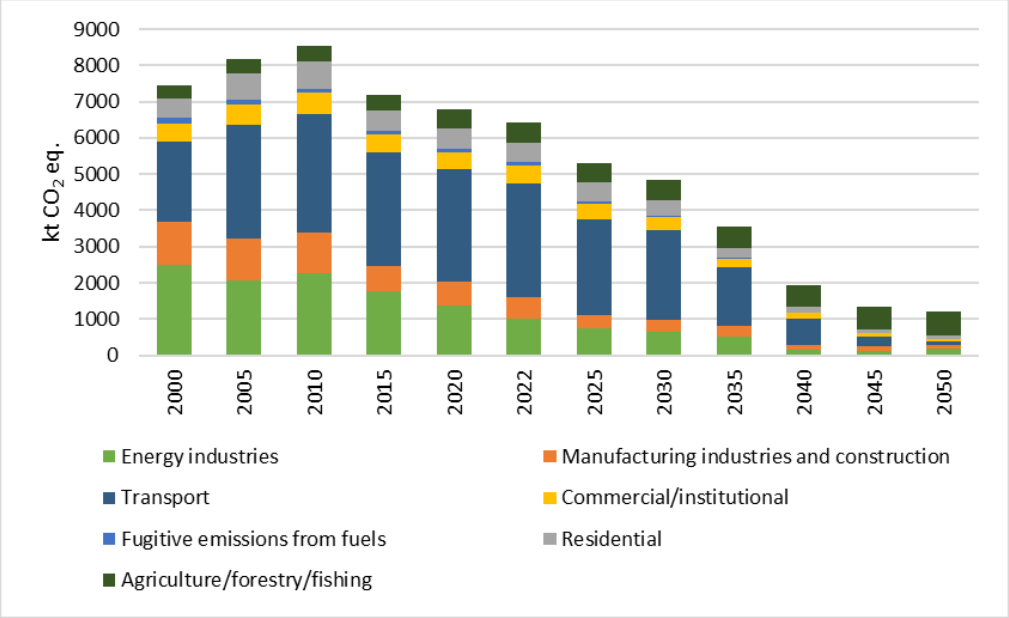

Figure 5.5 GHG emission projections under the WAM scenario, kt CO_2 eq.

[141] GHG emissions (historical and projected) of the categories "Manufacture of solid fuels and other energy industries" (1.A.1.c.) in the reporting format (Table 1) are marked with "IE". These emissions have been reported in the "Public electricity and heat production" (1.A.1.a.) category.

[142] GHG emissions (historical and projected) of the categories "1.A.5. Other" in the reporting format (Table 1) are marked with "IE". These emissions have been reported in the "1.A.4.a. Commercial/Institutional" category.

Energy sector (excluding transport) total emissions in the WEM scenario decrease by about 28% by 2030 and continues to fall by 2040, in 2050 they are about 61% less than in 2022.

On the one hand, the WEM scenario comprises electricity consumption increase, by 2030 and beyond, due to the substitution of fuels by electricity (mainly in transport and residential sectors) as well as due to the increase of electricity consumption in industrial production. Electricity consumption in 2030 is by 21.4% higher and in 2050 – by 65.4% higher, compared to 2022. On the other hand, the electricity consumption demand is being met by new RES plants, mainly wind and solar ones, gradually phasing-out natural gas. At the same time, thanks to the implementation of energy efficiency measures in buildings (commercial and residential sectors), the consumption of DHS decreases by approximately 11% by 2030, compared to 2022. In addition, the use of natural gas in DHS boiler houses and CHPs is gradually being replaced by biomass. As a result, GHG emissions in the energy industries in the WEM scenario are by 44.8% lower in 2030 and by 83.0% lower in 2050, compared to 2022.

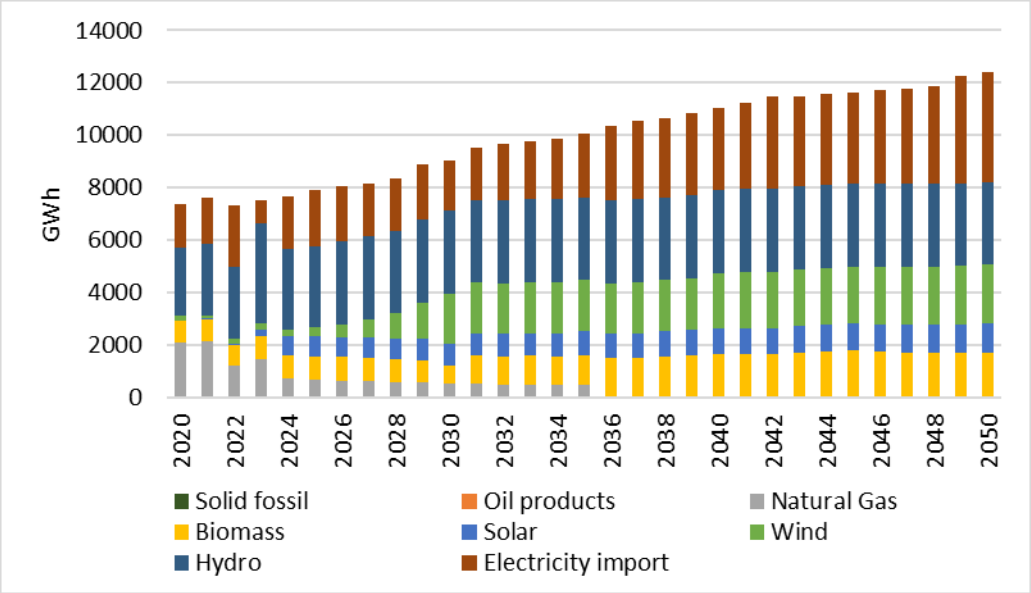

Figure 5.6 Electricity production by fuels in the WEM scenario, GWh

Since the WAM scenario for energy industry sector differs from the WEM scenario only with higher carbon price in ETS I after 2030, the reduction of GHG emissions in the WAM scenario against the WEM scenario is gradually increasing until the end of the period – 2050. The reduction in GHG emissions in the WAM scenario compared to the WEM scenario in2030, 2040 and 2050 is 1.3%, 7.6% and 9.8% respectively.

Table 5.2 Energy sector (with Transport) emissions according to WEM and WAM scenarios projections

Energy (including Transport), kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
WEM scenario	6418.86	5800.99	5098.81	3905.26	2831.43	1819.97	1467.80
WAM scenario	6418.86	5317.95	4850.50	3539.19	1942.71	1344.26	1207.27

Energy (including Transport), kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
Difference WAM vs WEM, %		-8.3%	-4.9%	-9.4%	-31.4%	-26.1%	-17.1%

Manufacturing industries and construction sector

On average, manufacturing industry maintains a faster growth rate both in the medium and long term compared with the average of national economy. The growth will be synchronously linked to the penetration 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 (Table 5.3) in the manufacturing industry sector in 2030 are about 45.3% lower compared to 2022. The main reason for this is the replacement of fossil fuels with RES, mainly biomass.

The WAM scenario foresees additional energy efficiency measures until 2030 and a higher carbon price in ETS and ETS2 after 2030 than in the WEM scenario. The higher carbon price has a significant impact on the reduction of GHG emissions (replacement of fossil fuels by RES and electricity and implementation of energy efficiency improvement measures) after 2035. The additionally planned energy efficiency measures until 2030 reduce energy consumption by 2.1% compared to the WEM scenario. However, since these measures are mainly implemented in enterprises already using biomass, they do not have a significant positive impact on the reduction of GHG emissions.

Table 5.3 Manufacturing industries and construction emissions according to WEM and WAM scenarios projections

Manufacturing industries and construction, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
WEM scenario	601.93	381.31	329.00	313.39	290.81	274.88	230.68
WAM scenario	601.93	378.97	329.05	311.54	151.89	121.69	103.12
Difference WAM vs WEM, %		-0.6%	0%	-0.6%	-47.8%	-55.7%	-55.3%

Residential and commercial sector

The emissions from individual heating of residential and commercial buildings will decrease in 2030 by 21.2% and in 2050 by 83.9% compared to 2022 under the WEM scenario. On the one hand, heated area of buildings 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 partly to offset the increase in energy consumption.

Correspondingly, the total FEC in residential and commercial sectors will decrease in 2030 by 11.0% and in 2050 by 23.0% compared to 2022 under the WEM scenario.

The WAM scenario comprises (i) the implementation of additional energy efficiency measures by 2030 for public bodies and (ii) a higher carbon price in ETS2 after 2030 than in the WEM scenario.

The implementation of additional energy efficiency measures provides reducing energy consumption in the commercial sector by 1.1% in 2030 compared to the WEM scenario. Due to the TIMES optimization model use for the calculation of emission projections (least cost optimisation), in the WAM scenario these measures are mainly proposed to be implemented in those enterprises that already use biomass. Since the carbon price in ETS2 is relatively low until 2030, the WAM scenario results in a biomass consumption decrease in the commercial sector, however there is no decrease in fossil fuel consumption and, thus, no decrease in total GHG emissions compared to the WEM scenario.

In contrast, after 2040, higher carbon price in ETS2 has a significant impact on GHG emission reduction (replacement of fossil fuels by RES and electricity and implementation of energy efficiency measures) in both the commercial and residential sectors.

Table 5.4 Commercial/Institutional; Residental; Agriculture/Forestry/Fishing and other sector emissions according to WEM and WAM scenarios projections

Commercial/Institutional; Residental; Agriculture/Forestry/Fishing and other, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
WEM scenario	1577.75	1502.35	1349.20	1079.01	971.78	871.76	825.77
WAM scenario	1577.75	1507.08	1365.65	1067.22	901.40	809.73	817.64
Difference WAM vs WEM, %		0.3%	1.2%	-1.1%	-7.2%	-7.1%	-1.0%

5.2 TRANSPORT

Since the number of passenger cars per 1000 inhabitants in Latvia is still lower than the EU average, then, considering the projected increase in private consumption and GDP growth, in the period 2023-2050 the growth of total passenger-kilometres by 19.6% and total freight tonne-kilometres by 20.0% are predicted.

The WEM scenario envisages the further development of EVs charging network both by public support programmes and private investment. The scenario includes the support measures for the purchase of EVs in municipalities (fulfilment of municipal functions), in public transport as well as in private sector. In the long-term, a transition from private transport to public transport (railway) is also expected to be promoted by the planned support programmes for railway development and the wider use of EMU trains in passenger transport.

Table 5.5 Transport emissions according to WEM and WAM scenarios projections

Transport, without International bunkers, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
WEM scenario	3141.70	3119.16	2737.89	1963.69	1400.22	501.40	201.70
WAM scenario	3141.70	2640.43	2481.42	1612.91	733.18	277.86	99.45
Difference WAM vs WEM, %		-15.3%	-9.4%	-17.9%	-47.6%	-44.6%	-50.7%
International bunkers, kt CO_2 eq.	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
WEM scenario, total	815.17	1029.16	1063.70	1087.98	1108.93	1119.98	1127.87
Aviation	437.90	441.85	463.83	477.05	487.94	491.96	496.19
Navigation	377.27	587.30	599.87	610.93	620.99	628.02	631.68

The total projected GHG emissions under WEM scenario of the inland transportation will decrease by 12.9% in 2030 and will decrease by 93.6% in 2050 against the 2022 level respectively (Table 5.5). Inland transportation GHG emissions comprise road transport, railway, domestic navigation and domestic aviation. GHG emissions of international aviation and navigation have been reported under International bunkers.

Most of GHG emissions in the transport sector are caused by road transport, which accounts for 96.5% of the total emissions in 2030. The key long-term trend in road transport is the replacement of fossil fuels with electricity and modern biofuel. The share of electricity in road transport FEC increases from 0.2% in 2020 up to 4.9% in 2030 and 50% in 2050. This trend not only reduces GHG emissions but also increases energy efficiency. In addition to electrification, the use of alternative fuels – CNG and H_2 – is increasing in certain road transport segments, such as trucks.

GHG emissions in the railway transport account for about 2.8% of the total projected emissions in the Transport sector in 2030.

The WAM scenario foresees two main additional measures compared to the WEM scenario. First, the WAM scenario comprises the imposition on fuel suppliers the GHG emission intensity reduction target of 15% by 2030 compared to the baseline, this measure significantly affects change in GHG emissions by 2030. Secondly, the WAM scenario assumes a higher carbon price after 2030 in ETS II (which includes road transport) compared to the WEM scenario. Both of these measures, in combination, determine that in the WAM scenario the use of BEVs increases more rapidly and in 2030 the share of electricity in total road transport consumption is 5.9%. In addition, the WAM scenario also comprises an increase in the use of H_2 in certain road transport vehicle groups (buses and trucks) already by 2030, as well as an increase in the consumption of advanced biofuels. As a result, GHG emissions in the WAM scenario in 2030 and 2050 are by respectively, 9.4% and 50.7% lower than in the WEM scenario.

GHG emission projections in International bunkers in the WEM scenario foresee an increasing trend. In 2023, International aviation already fully recovered from the COVID-19 pandemic caused crisis which manifested itself in a sharp decrease in the number of passengers and

flights. It is also expected that the number of cargo handled and ships serviced in international navigation in Latvian ports will increase.

5.3 INDUSTRIAL PROCESSES AND PRODUCT USE

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. The macroeconomic projections envisage growth of the manufacturing sector by 2030. As the largest part of emissions from IPPU appear in the mineral industry (cement production), these are the main driving forces for GHG emission projection. In cement production emissions will increase by 7.9% in 2030 and by 23.0% in 2050 compared to 2022.

The total projected GHG emissions under WEM scenario in IPPU will decrease by 4.2% in 2030 and by 14.3% in 2050 compared to 2022 (Table 5.6).

Table 5.6 IPPU emissions according to WEM and WAM scenarios projections, kt CO_2 eq.

IPPU, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
WEM scenario	858.47	858.50	822.25	764.76	738.75	730.13	735.86
WAM scenario	858.47	858.50	822.25	764.76	738.75	730.13	735.86

As it can be seen in Table 5.6. WEM and WAM scenario is the same. The distribution of IPPU emission projections by sectors is represented in Figure 5.7 and Table 5.7.

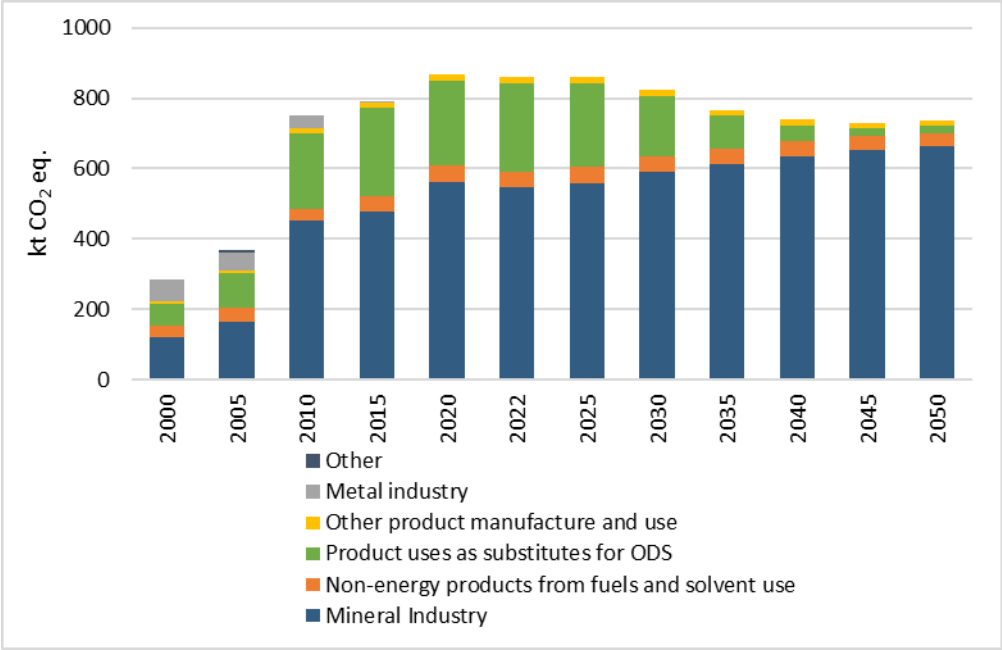

Figure 5.7 GHG emission projections by IPPU sector under the WEM and WAM scenario, kt CO_2 eq.

Table 5.7 The total emissions in IPPU sector under the WEM and WAM scenario, kt CO_2 eq.

IPPU, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
Mineral Industry	547.49	559.58	589.40	613.19	634.64	651.41	664.10

IPPU, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
Chemical industry	NO	NO	NO	NO	NO	NO	NO
Metal industry	NO	NO	NO	NO	NO	NO	NO
Non-energy products from fuels and solvent use	44.77	44.81	44.44	43.39	41.81	39.48	36.71
Electronics industry	NO	NO	NO	NO	NO	NO	NO
Product uses as substitutes for ODS	250.30	238.26	172.69	92.54	46.71	23.66	19.48
Other product manufacture and use	15.91	15.86	15.72	15.64	15.60	15.58	15.58
Other	NO	NO	NO	NO	NO	NO	NO
Total:	858.47	858.50	822.25	764.76	738.75	730.13	735.86

GHG emissions in IPPU under the WEM scenario are projected considering 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.

5.3.1. F-gases

Currently emissions from refrigeration and air conditioning equipment constitute the mayor part of total F-gas emissions (97.3% in 2022) 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 can be observed because of floating F-gas amounts used in the 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 (2024/573) as well as according to prohibition to use mobile air-conditioning systems designed to contain F-gases with a Global Warming Potential (GWP) higher than 150 from a certain date.

5.3.2. Solvent Use

The projection of CO_2 emissions in the solvent use sector is derived based on the forecasted population size, year-over-year changes in private consumption (%), and the assumed elasticity coefficient, the annual GDP growth rate.

The total projected CO_2 emissions under the WEM and WAM scenario are projected to increase by 4.0% in 2030 and by 2.5% in 2050 compared to 2022 (Table 5.8).

Table 5.8 Emissions in Solvent use sector per WEM and WAM scenario, kt CO_2 eq.

Solvent use, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
WEM scenario	25.07	25.74	26.07	26.08	26.00	25.86	25.70
WAM scenario	25.07	25.74	26.07	26.08	26.00	25.86	25.70

5.4. AGRICULTURE

GHG emission projections from Agriculture sector in WEM and WAM scenario are based on projected livestock population, main harvested crops yield, and area harvested, as well as amounts of lime, inorganic and organic N fertilizers use (Chapter 8.3).

It is projected that there will be a decreasing trend of total GHG emissions in the agriculture sector during the period 2022-2050. The total Agriculture GHG emissions will decrease by 1.4% in 2030 and by 2.4% in 2050 compared to 2022. The most rapid decrease of emissions is related to animal husbadry, including enteric fermentation and manure management. As it can see in Table 5.9 WEM and WAM scenario is the same.

Table 5.9 Agriculture emissions according to WEM and WAM scenarios projections, kt CO_2 eq.

Agriculture, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
WEM scenario	2253.83	2168.94	2223.17	2234.55	2214.51	2207.21	2199.90
WAM scenario	2253.83	2168.94	2223.17	2234.55	2214.51	2207.21	2199.90

It is expected that enteric fermentation emission will decrease by 4.2% in 2030 and by 11.68% in 2050 compared to 2022, however manure management emission will decrease by 3.2% in 2030 and by 10.3% in 2050 compared to 2022. Projections show an increase of GHG emissions from soil management sector by 3.0% and from liming and urea application by 53.2% during 2020-2050. All emissions from the agriculture sector projected under WEM scenario are represented in Table 5.10 and Figure 5.8.

Table 5.10 Projected GHG emissions from Agriculture sector in WEM and WAM scenario, kt CO_2 eq.

Subcategory, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
Enteric fermentation	946.57	874.33	907.78	906.63	875.41	855.27	835.13
Manure management	175.25	165.66	169.28	168.51	163.68	160.42	157.16
Agricultural soils	1048.60	1047.95	1053.01	1056.27	1063.25	1071.55	1079.86
Liming and urea application	83.40	81.00	93.10	103.14	112.17	119.96	127.75
Total:	**2253.83**	**2168.94**	**2223.17**	**2234.55**	**2214.51**	**2207.21**	**2199.90**

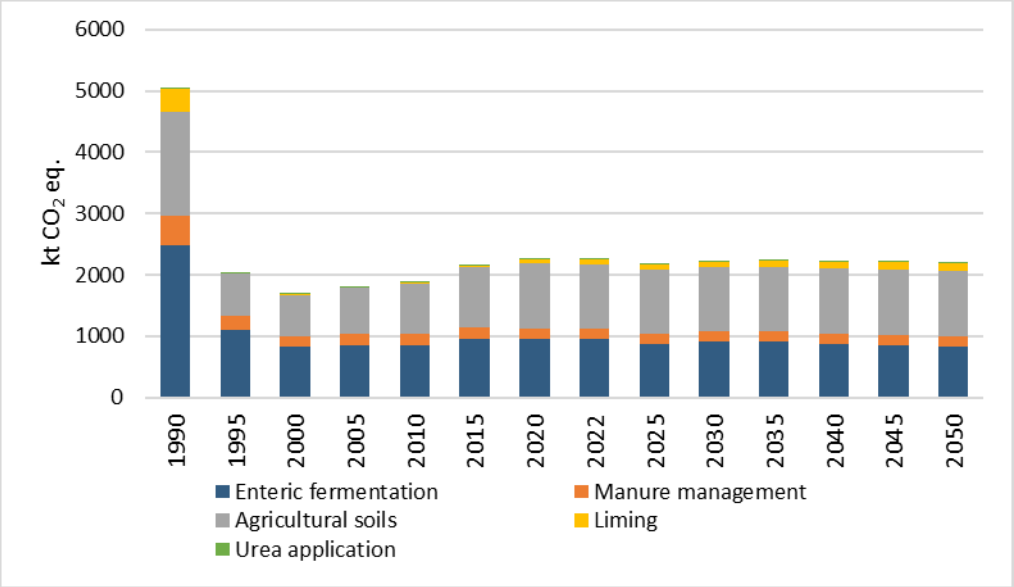

Figure 5.8 GHG emission projections by Agriculture sector under the WEM scenario, kt CO_2 eq.

Historical and projected CH_4 emissions from enteric fermentation are included in Table 5.11. Projection results show the decrease of enteric fermentation emissions by 4.1% till 2030, compared to 2022. Enteric fermentation emissions will decrease by 11.8% till 2050, compared to 2022. The decrease is strongly related to the projected number of livestock. It is projected that there will be decrease of animal numbers in all animal husbandry branches, except poultry farming.

Table 5.11 Projected CH_4 emission from enteric fermentation, kt

Subcategory, kt	2022	2025	2030	2035	2040	2045	2050
CH_4 emission from enteric fermentation	33.81	31.23	32.42	32.38	31.26	30.55	29.83

An important parameter that causes the large amount of enteric fermentation CH_4 emissions is the population of ruminant livestock. More than 90% of CH_4 emissions by enteric fermentation come from the cattle. It is projected that population of dairy cows will decrease by 8.1% in 2030 compared to 2022 and by 17.0% in 2050 comparing to 2022. However, projections show that in 2030 the average annual milk yield per dairy cow will increase by +17.3% and by 335% in 2050 compared to milk yield level in 2022.

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 GHG inventory and projections, GE for dairy cattle is calculated based on milk yields; therefore, average milk yield per cow is one of key indicators for calculation of CH_4 emissions.

Detailed information of projected livestock numbers and dairy cow productivity is included in Table 5.12.

Table 5.12 Projections of the livestock number, thsd. and milk yield per dairy cow, kg

Type of livestock	2022	2025	2030	2035	2040	2045	2050
Dairy Cattle	127.80	115.90	117.40	115.90	112.10	109.10	106.10
Milk yield	7492	8104	8790	9322	9701	9850.5	10000
Cattle	263.60	241.50	242.80	239.80	234.80	231.60	228.40
Sheep	87.3	74.10	66.70	61.70	57.80	54.90	52.00
Goats	11.70	10.20	10.00	9.80	9.60	9.45	9.30
Horses	8.7	9.00	9.00	9.00	9.00	9.00	9.00
Swine	307.90	301.90	297.60	297.20	296.30	295.40	294.50
Poultry	5744.3	5936.50	5946.60	5954.70	5961.50	5966.95	5972.40

Historical and projected CH_4 emissions from manure management are included in Table 5.13. Projections show that manure management CH_4 emission will decrease by 2.8% in 2030, and 10.0% in 2050, compared to 2022.

Table 5.13 Projected CH_4 emissions from manure management, kt

Subcategory, kt	2022	2025	2030	2035	2040	2045	2050
CH_4 emission from manure management	3.89	3.67	3.78	3.79	3.67	3.59	3.50

The main activity data for calculation of CH_4 emission from manure management is livestock population, mainly cattle, swine and poultry, and animal manure management systems (MMS) 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 5.14). 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 5.14 Projections of MMS distribution (share) for dairy cattle and swine

MMS	2022	2025	2030	2035	2040	2045	2050
Dairy cattle							
Liquid	0.429	0.533	0.588	0.637	0.637	0.637	0.637
Solid	0.348	0.312	0.261	0.217	0.217	0.217	0.217
Pasture	0.048	0.043	0.037	0.030	0.030	0.030	0.030
Anaerobic digesters	0.175	0.112	0.114	0.116	0.116	0.116	0.116
Swine							
Liquid	0.463	0.471	0.471	0.471	0.471	0.471	0.471
Solid	0.038	0.030	0.030	0.030	0.030	0.030	0.030
Pasture	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Anaerobic digesters	0.499	0.499	0.499	0.499	0.499	0.499	0.499

Historical and projected N_2O emissions from manure management are represented in Table 5.15. Fluctuations of projected N_2O emissions from manure management are related to relatively small emission factors for Latvia's typical manure management systems. The largest

decrease of N_2O emission from manure management is referred to 2050, when emission from subcategory is projected to decrease by 10.8% compared to 2022. In 2030, N_2O emissions from manure management will decrease by 4.5% compared to 2022.

Table 5.15 Projected N_2O emissions from manure management, kt

Subcategory, kt	2022	2025	2030	2035	2040	2045	2050
N_2O emissions from manure management	0.25	0.24	0.24	0.24	0.23	0.23	0.22

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 GHG inventory purposes Latvia uses country specific nitrogen excretion values, these values are also used for projections. Data on MMS are calculated based on results of agricultural census data, national research projects result 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 type 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 5.16.

Table 5.16 Projected N_2O emissions from soils, kt

Subcategory, kt	2022	2025	2030	2035	2040	2045	2050
N_2O emissions from soils	3.96	3.95	3.97	3.99	4.01	4.04	4.07

Emissions in this category will increase by 0.4% till 2030 and 3.0% till 2050, compared to 2022. Projections show that this synthetic fertilizers and organic soils will stay important as the main source of GHG emissions from soils.

The main activity data for calculation of projected N_2O emission from agricultural soils are the used amount of synthetics and organic nitrogen fertilizers, an area of harvested crops and the yield. 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 5.17.

Table 5.17 Projected activity data for estimation of GHG emissions from agricultural soils

Activity data	2022	2025	2030	2035	2040	2045	2050
Used N with synthetic fertilizers, kt	82.30	85.30	85.30	85.40	86.20	86.90	87.60
Used N with manure, kt	16.72	15.54	15.60	15.42	14.95	14.69	14.42
Organic soils, ha	168.59	169.96	169.96	169.96	169.96	169.96	169.96
Wheat total yield, thsd. t	2539.40	2416.60	2501.50	2590.00	2722.50	2854.60	2986.70
Barley total yield, thsd. t	281.70	254.90	244.00	235.50	228.70	223.55	218.40
Rye total yield, thsd. t	129.00	120.90	124.20	127.60	131.10	134.75	138.40

Activity data	2022	2025	2030	2035	2040	2045	2050
Oats total yield, thsd. t	224.50	209.70	214.00	218.30	222.80	227.40	232.00
Legumes total yield, thsd. t	145.80	209.20	217.40	224.20	229.80	234.45	239.10
Rape total yield, thsd. t	354.90	376.60	387.00	397.80	408.80	420.20	431.60
Total sown area, thsd. ha	1302.40	1304.80	1308.10	1303.80	1302.10	1301.90	1301.70

5.5. LAND USE, LAND USE CHANGE AND FORESTRY

The net GHG emissions in LULUCF sector based on WEM scenario are shown in Table 5.18 and Figure 5.9. As can be seen in Table 5.18. WEM and WAM scenario is the same. Total GHG emissions in LULUCF sector will increase in 2030 and 2050, compared to 2022.

The GHG emission projections for the LULUCF sector indicate varying trends across different land use categories. The projections, grounded in data from the National Forest Inventory and supplemented by additional data sources, highlight the key drivers of emission increases and decreases across the main subsectors.

Forest land remains the most significant carbon sink within the LULUCF sector. However, emissions and removals fluctuate based on harvesting rates, forest age structure, and management practices. An increase in harvesting intensity leads to higher emissions, while appropriate forest management practices on these areas contribute to enhanced carbon sequestration. In the current projections, net removals are expected to decrease due to aging forest stands and periodic increases in harvest rates, particularly during high-demand periods; however, average annual harvest rate is not increasing in the projections.

Emissions from croplands are primarily influenced by soil carbon stock changes in organic soils and due to conversion of forest land and grassland to cropland. The projections indicate stable cropland areas, with minor fluctuations in emissions driven by variations in crop types, which are harmonized with crop areas projected in agriculture sector.

GHG emissions from grasslands are relatively stable but depending on land use changes. The projections assume no significant changes in grassland area but highlight that improved management could reduce emissions over time. The largest source of emissions in grasslands and croplands are organic soils.

Wetlands, particularly peat extraction sites, are a notable source of GHG emissions. The projections maintain a constant peat extraction rate, resulting in continuously high emissions in this sector. Without active restoration measures, these areas will continue contributing to national emissions. Although restoration could offer significant mitigation potential, it is not accounted for in the projections because of high uncertainty, except the restoration measures in former peat extraction sites proposed for WEM scenario.

Emissions from land converted to settlements are driven by the permanent loss of carbon stocks in soil and biomass. Urban expansion and infrastructure development, as well as returning to agricultural production lands afforested earlier continue to contribute to GHG increases in this category. As settlements do not offer significant carbon sequestration potential, these emissions are not decreasing in projections.

Harvested Wood Products (HWP) play a significant role in the carbon dynamics of the LULUCF sector, acting as temporary carbon reservoirs that delay the release of carbon dioxide into the atmosphere. The projections for HWP in Latvia are based on national statistics regarding wood production, exports, and the distribution of wood among different product categories, such as sawnwood, panels, and paper. The carbon storage potential of HWP varies depending on product longevity—long-lived products like construction materials continue to sequester carbon over several decades, while short-lived products, such as paper, release carbon relatively quickly.

The overall contribution of HWP to carbon removals is expected to decline gradually due to changes in harvesting rates. Historically removals in HWP increased due to increase of harvest rate and efficiency of utilization of roundwood. In the projections continuous net removals in HWP category are mainly associated with more efficient utilization of roundwood. The increased demand for bioenergy and short-lived wood products reduces the share of long-term carbon storage, leading to a faster turnover of carbon back into the atmosphere. However, policies that promote the use of wood in long-lasting applications, such as construction and furniture, could help enhance the role of HWP as a carbon sink.

Additionally, improved tracking of the carbon flows in the wood product supply chain and promoting circular economy practices—such as recycling and reusing wood materials—can further extend the carbon storage period. In Latvia's projections, the impact of HWP remains very significant, partially offsetting emissions from forest harvesting, but its effectiveness depends on both market trends and policy incentives aimed at maximizing the use of wood in durable applications.

Key factors influencing emission changes:

- Increases in emissions are primarily associated with:
    - Deforestation for settlements and agricultural land use.
    - Higher forest harvest rates.
    - Ageing of forests leading to reduced removals and increased carbon losses due to natural mortality and salvage logging
    - Increase peat extraction rate for horticultural use.
- Reductions in emissions are linked to:
    - Afforestation of agricultural lands.
    - More efficient utilization of extracted roundwood logs.

These subsectoral dynamics emphasize the importance of targeted mitigation measures, including afforestation, soil carbon enhancement practices in agricultural lands, and intensification of forest management to increase carbon sequestration potential of forest lands.

Table 5.18 Summary of GHG emissions' projections in LULUCF sector in WEM scenario

Net emissions / Year	2022	2025	2030	2035	2040	2045	2050
CO_2 emissions, kt CO_2, excluding harvested wood products	6517.8	4247.4	5312.6	5931.0	6478.8	6406.2	6307.8
CO_2 in harvested wood products, kt CO_2	-3001.5	-2472.8	-2038.4	-1667.7	-1435.3	-1323.0	-1188.0
N_2O emissions, kt CO_2 eq.	570.6	630.0	622.1	601.2	573.2	553.7	553.6
CH_4 emissions, kt CO_2 eq.	854.4	720.9	712.8	711.1	709.3	709.4	709.1
Net GHG emissions, kt CO_2 eq.	4941.3	3125.5	4609.1	5575.5	6325.9	6346.3	6382.5

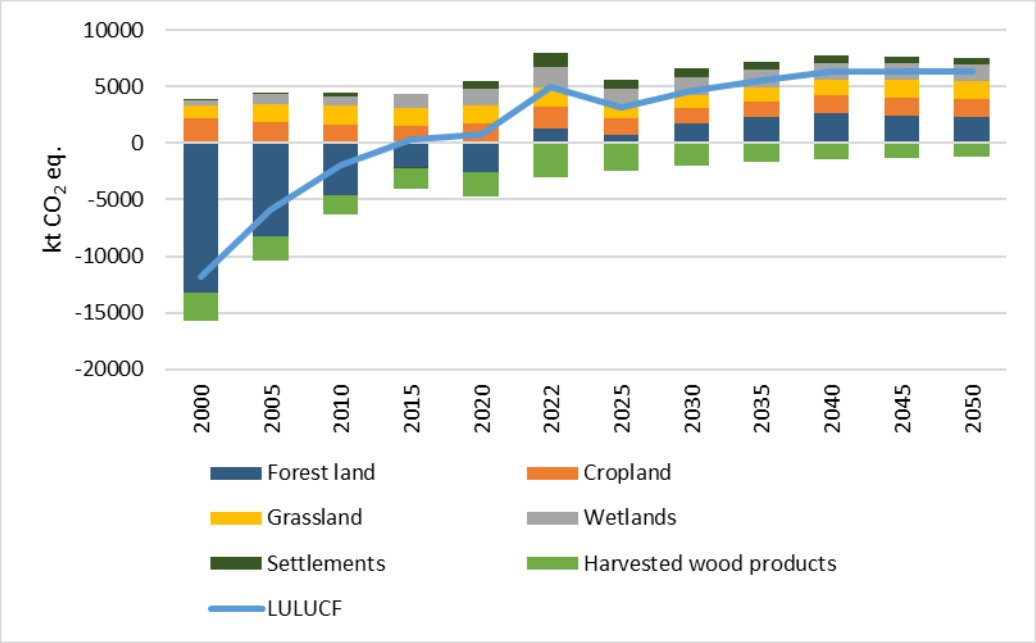

Figure 5.9 GHG emission projections of LULUCF sector in the WEM scenario, kt CO_2 eq.

5.6. WASTE

5.6.1. Main assumptions in the activity data projection

The calculation of the projected activity data and emissions was done based on the following 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, waste biological treatment and other recycling activities will increase. Latvia is developing separate waste collection system and waste recovery. Treatment of biodegradable waste is one of priorities set in Waste management plan.

To project activity data for wastewater handling sector, following assumptions were used and existing policies included:

- Projections of national population and historical trends;
- **Urban Wastewater Directive 271/91/EEC (UWWTD)**[143], implemented in the Latvian legislation in 2002 with Regulations of the CoM No. 34 adopted on 22nd January 2002 "Regulations Regarding Discharge of Polluting Substances into Water". According to conditions of accession EU in 2004, there were 3 deadlines designated for Latvia to implemented UWWTD – 31st December of 2008 for agglomerations larger than 100 000 of population equivalent (p.e.), 31st December of 2011 for agglomerations 10 000 – 100 000 p.e. and 31st December for agglomerations 2 000 – 10 000 p.e. At the moment UWWTD is fully implemented. Revised requirements of Directive are on their way to be implemented until 2035, but they are not expected to give a significant impact on GHG emissions from the sector;
- Sewage Sludge Management Plan for 2024-2027, approved with CoM decree No. 237[144] (28th March 2024) on measures to ensure sustainable and effective sewage sludge handling to be implemented until end of 2027.

5.6.2. Projections of GHG emissions by subsectors

GHG emission projections are estimated in WEM and WAM scenario for the Waste sector.

5.6.2.1. Solid waste disposal

SWD is the most essential GHG emission source in the waste sector (68.7% from total in 2022). Within SWD CH_4 is the most important GHG, other GHG emissions (CO_2, N_2O) are not calculated.

Under the WEM scenario the decrease of the volume of biodegradable waste within the total volume of disposed waste is projected. Projected amounts of biodegradable waste are indicated in the Waste Management State 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.

Under WAM scenario a decrease of disposed municipal waste amounts till 10% in year 2035 is projected. Achievement of a decrease is implemented in Waste Management plan 2021-2028. Private initiatives to build waste incineration plants are under discussions. Estimated Latvia's municipal waste amount usable for incineration are 150 000 – 200 000 tons per year.

[143] The projections are based on the PaMs up to 30th September 2024, therefore Directive (EU) 2024/3019 of the European Parliament and of the Council of 27th November 2024 is not considered in this report
[144] Sewage Sludge Management Plan for 2024-2027. Available: https://likumi.lv/ta/id/350822

Biological processing of solid waste

Biological waste treatment will increase in Latvia till 206 500 tons (projected capacity of biological waste treatment plants). According to project plans constructions will end in 2024. These plants will reach maximum capacity in 2028, depending on the successful implementation of separate collection of biowaste.

Composting corresponds to biological processing of solid waste. According to 2006 IPCC Guidelines emissions of CH_4 and 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 as decrease due to higher capacity of biological waste treatment plants.

Incineration and Open Burning of Waste

Incineration and Open Burning of Waste is small subsector of Waste sector, accounting for emissions of CO_2 and N_2O. Since year 2022 estimated and projected emissions are reported as NO – not occurring. Waste incineration without energy recovery does not occur since 2022 and will not occur in Latvia.

5.6.2.2. Wastewater handling

In Wastewater handling sector WEM and WAM scenario is the same. Wastewater Handling subsector is source of CH_4 and N_2O emissions. According to calculated projections, GHG emissions from Wastewater Handling will consequently decrease from 121.9 in 2022 to 99.0 kt CO_2 eq. in 2050. Contribution of this subsector in the Waste sector is projected to increase from 20.7% in 2022 to 31.8% in 2050 in WEM scenario.

In the projection period, significant driving force is decrease of national population, however share of national population, served by well managed biological treatment of wastewater, is not expected to exceed threshold of 85% from national population (especially taking into account that UWWTD requirements with passed deadlines already have been fully implemented in Latvia before 31st December 2015 and won't give significant direct effect on decrease of GHG emissions); nearly 15% of national population is expected to remain being served by septic tanks or latrines (in rural areas, where centralized collection of domestic wastewater is not justified economically). Emissions from sewage sludge is expected to keep its role as significant source of emissions, however rate of sludge treated anaerobically is expected to decrease, while leakage emissions from recovery of CH_4 from digestion of sewage sludge are expected to become more significant due to increase of amount of sewage sludge used to produce biogas. CH_4 and N_2O emissions from handling of industrial wastewater are expected to decrease over the entire projected period, accordingly to historical trends.

5.6.3. Projections of GHG emissions with existing measures

WEM scenario from Waste sector divided by subsectors are included in the following Table 5.19 and Figure 5.10.

Table 5.19 Projected GHG emissions from Waste sector in WEM scenario, kt CO_2 eq.

Subsector, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
Solid Waste Disposal	404.53	328.32	240.15	205.23	186.96	182.06	159.60
Biological Treatment of Solid Waste	62.17	57.90	54.39	52.63	52.63	52.63	52.63
Incineration and Open Burning of the Waste	NO	NO	NO	NO	NO	NO	NO
Wastewater Treatment and Discharge	121.91	119.61	110.51	101.12	99.14	98.83	98.97
Total:	**588.61**	**505.83**	**405.05**	**358.98**	**338.73**	**333.52**	**311.20**

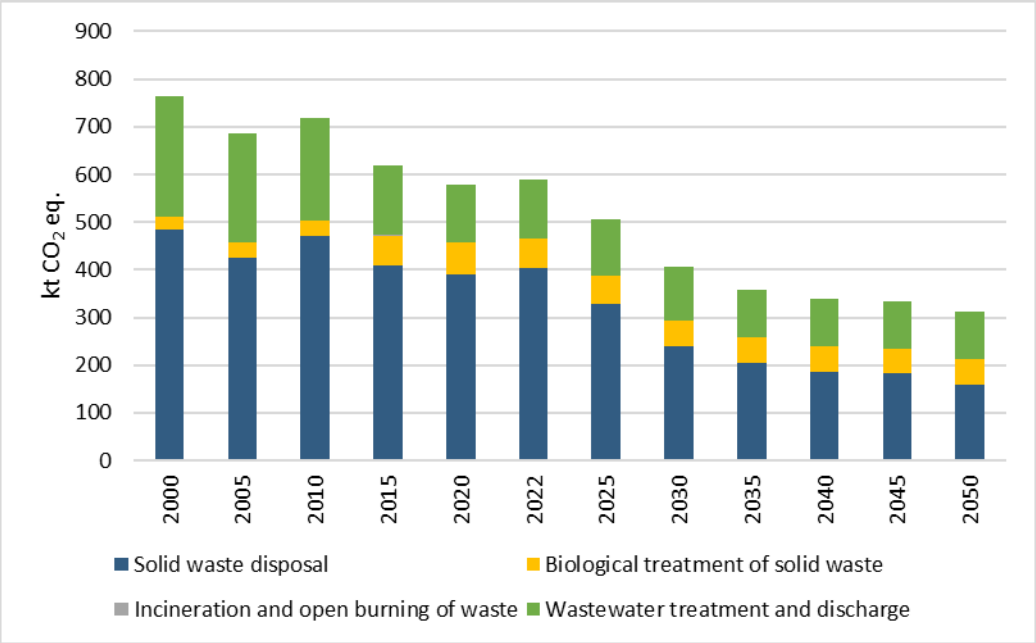

Figure 5.10 GHG emission projections by Waste sector under the WEM scenario, kt CO_2 eq.

The total projected GHG emissions under WEM scenario in Waste sector will decrease by 31.2% in 2030 and decrease by 47.1% in 2050, compared to 2022. The largest contributing subsectors are solid waste disposal (SWD) and wastewater treatment and discharge. SWD emissions are projected consider approved waste disposal reducing projects capacities.

5.6.4. Projections of GHG emissions with additional measures

WAM scenario is based on assumption that waste disposal will be 10% from generated Municipal solid waste in year 2035 (Requirements in Waste Framework Directive, which implementation is set in Waste Management plan 2021-2028) and it shows even more decrease of GHG emissions in the Waste sector. To reach this goal private initiatives to build

waste incineration plants are under discussion. WAM scenario emissions are shown Table 5.20 and Figure 5.11.

Table 5.20 Projected GHG emissions from Waste sector in WAM scenario, kt CO_2 eq.

Subsector, kt CO_2 eq.	2022	2025	2030	2035	2040	2045	2050
Solid Waste Disposal	404.53	328.32	238.10	180.07	127.44	100.97	89.60
Biological Treatment of Solid Waste	62.17	57.90	54.39	52.63	52.63	52.63	52.63
Incineration and Open Burning of the Waste	NO	NO	NO	NO	NO	NO	NO
Wastewater Treatment and Discharge	121.91	119.61	110.51	101.12	99.14	98.83	98.97
Total:	**588.61**	**505.83**	**403.00**	**333.82**	**279.21**	**252.43**	**241.20**

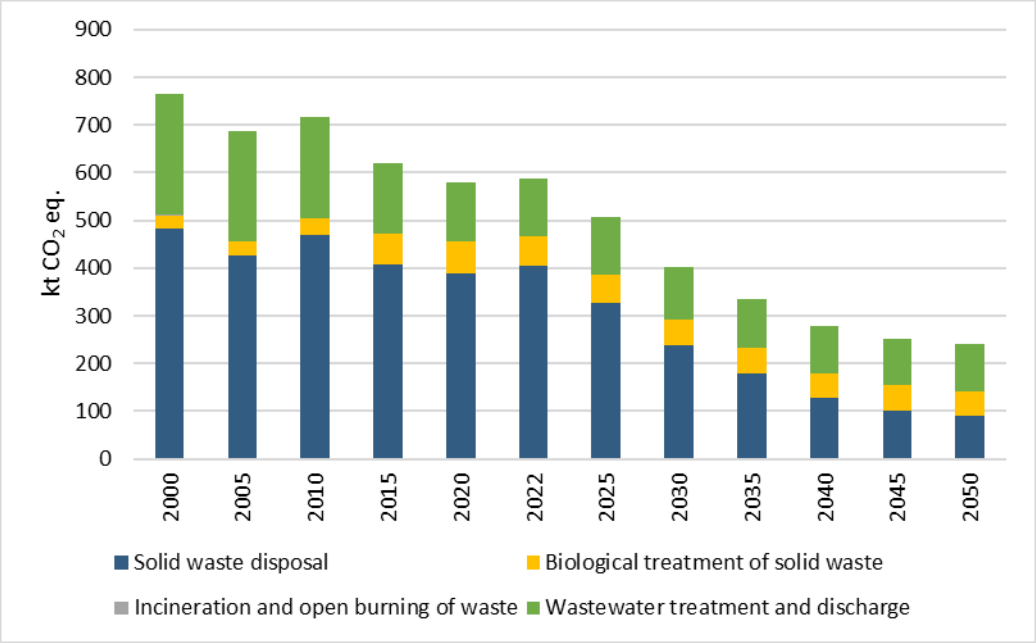

Figure 5.11 GHG emission projections by Waste sector under the WAM scenario, kt CO_2 eq.

The total projected GHG emissions under WAM scenario in Waste sector will decrease by 31.5% in 2030 and by 59.0% in 2050, compared to 2022. Projections of WAM scenario show significant decrease of emissions from SWD subsector during period of projections, however this subsector will remain the main source of GHG emissions in the Waste sector, contributing 62.9% from total GHG emissions from Waste sector in 2030.

6. TOTAL PROJECTED GHG EMISSIONS AND THE PROGRESS TOWARDS TARGETS

Total GHG emissions (excluding LULUCF, including indirect CO_2) under the WEM scenario will decrease in 2030 by 15.6% and by 53.4% in 2050 compared to 2022. In 2030, under the WAM scenario emissions will be 2.9% and 7.0% lower in 2050 than in the respective years under the WEM scenario (Figure 6.1).

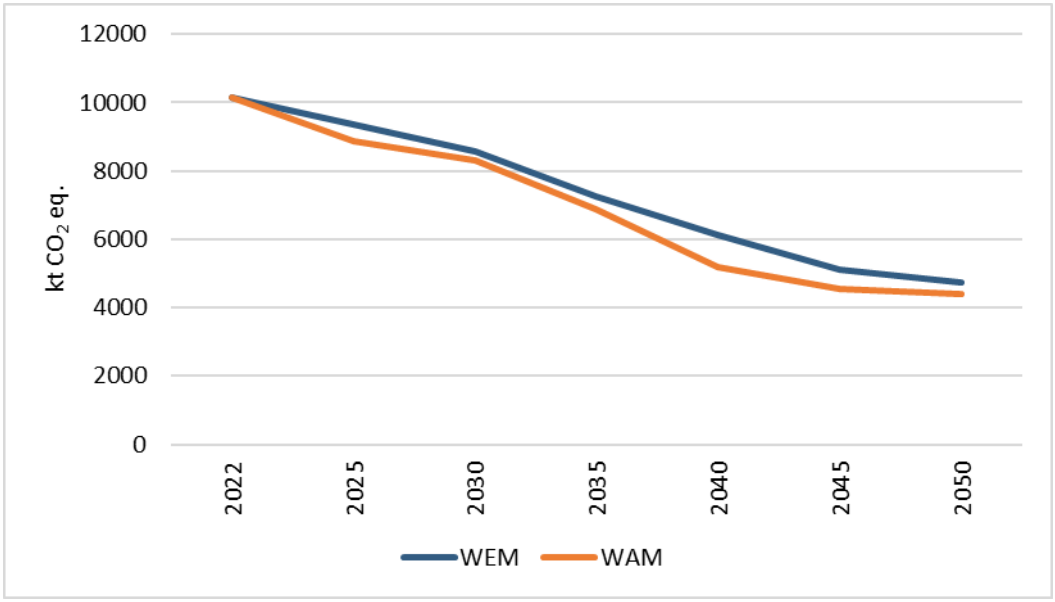

Figure 6.1 Total GHG emissions (excluding LULUCF, including indirect CO_2) under the WEM and WAM scenario, kt CO_2 eq.[145]

In 2022, 83.3% from total GHG emissions originated in the sectors outside the EU Emissions Trading Scheme (non-ETS sector) (such as Transport, Agriculture and Waste), but remaining 16.7% comes from EU ETS (installations in power generation and manufacturing industry sectors). WEM scenario projections show that in 2030 85.2% from total GHG emissions will be non-ETS sector but remaining 14.8% is EU ETS.

6.1 EFFORT SHARING REGULATION

Latvia's commitment for the non-ETS (ESR) according to the EC Implementing Decision (EU) 2020/2126 on determining Member States' annual emission allocations for the period from 2021 to 2030 is to reduce emissions in 2030 by 17%[146] compared to 2005 (ESR target).

[145] According to Commission Implementing Decision (EU) 2020/2126 of 16th December 2020 on setting out the annual emission allocations of the Member States for the period from 2021 to 2030 pursuant to Regulation (EU) 2018/842 of the European Parliament and of the Council (Decision 2020/2126), the value of Latvia's 2021-2025, 2030, based on Consolidated text of Commission Implementing Decision (EU) 2020/2126, 2026-2029 – based on indicative estimates by LEGMC

[146] Consolidated text: Regulation (EU) 2018/842 of the European Parliament and of the Council of 30th 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 and amending Regulation (EU) No 525/2013. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R0842-20230516

Projected non-ETS GHG emissions under the WAM are 3.4% lower in 2030 than the projected emissions under the WEM. Emission reduction under the WAM scenario for 2030 is due to additional measures in Energy, Transport and Waste sectors.

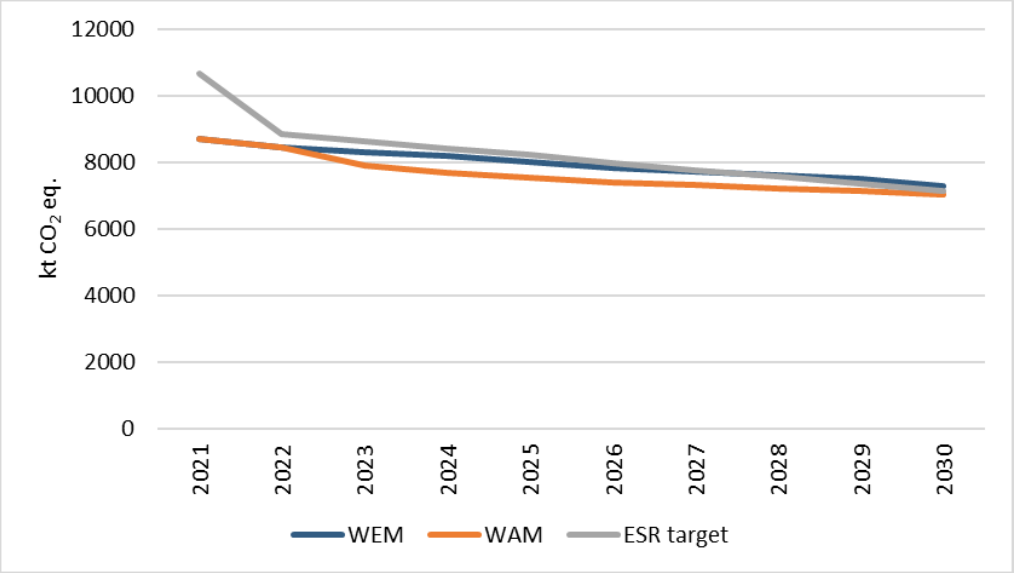

Figure 6.2 Actual and projected GHG emissions under the WEM and WAM scenarios in the non-ETS sector against ESR target, kt CO_2 eq.

It is projected that under the WEM scenario in 2030 GHG emissions in the non-ETS sector will decrease by 15.2% compared to 2005. GHG emissions will exceed the annual emission allocation in 2028-2030 in WEM scenario. In turn, GHG emissions will not exceed the annual emission allocation in WAM scenario for all period 2021-2030 (Figure 6.2).

Sectors, that have the largest share of non-ETS (ESR) emissions, are Energy, Transport and Agriculture sector, therefore the reduction of GHG emissions and PaMs implementation in these sectors are crucial to achieve ESR target.

6.2 LULUCF TARGET

Latvia's LULUCF sector plays a crucial role in the country's overall GHG balance, serving both as a carbon sink and a significant source of emissions. According to regulation (EU) 2018/841[147] binding targets for LULUCF sector in Latvia are to ensure balance of emissions and removals in acounting categories 2021 – 2025 and indicativly to reach 644 kt CO_2 eq. removals by 2030. However, the WEM scenario points out that Latvia will not achieve its LULUCF targets as established under Regulation (EU) 2018/841. The primary reason for this shortfall is the persistent and substantial emissions from organic soils, which continue to undermine net removals within the sector.

[147] Consolidated text: 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, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R0841-20230511

The WEM scenario predicts a continuous increase in net GHG emissions from the LULUCF sector through 2050. In 2030, Latvia's LULUCF net emissions are expected to reach 4609 kt CO_2 eq., significantly exceeding the 2030 target of 644 kt CO_2 eq. removals. The main driver of these emissions is the continued emissions from organic soils, particularly in croplands, grasslands and forest lands. These soils release substantial amounts of CO_2 and N_2O emissions, that are challenging to mitigate.

Organic soils, particularly in agricultural use, remain a constant emission source under the WEM scenario. Despite policy efforts to improve land management and promote sustainable agricultural practices, the projections assume that the total area of organic soils remains unchanged throughout the forecast period to ensure that conservative approach is applied, and no potential emissions are omitted. Additionally, the constant peat extraction rate, as outlined in Latvia's peat strategy, further exacerbates emissions from wetlands, contributing to the overall negative balance in the LULUCF sector.

In forest land, while the sector serves as a carbon sink, its capacity is constrained by harvest rates and the aging forest structure. Although reduced harvesting intensity could potentially increase removals in the short term, in the long term it would lead to even quicker reduction of the net removals due to ageing of forests, salvage logging and carbon losses in HWP pool. It would also have a direct negative effect on the energy sector, where biomass is a major source of renewable energy.

Another factor impacting Latvia's ability to meet its LULUCF targets is the limited potential of harvested wood products (HWP) to offset increasing emissions. While HWP continues to sequester carbon, its contribution is gradually declining as older stocks reach the end of their lifespan and newer materials cannot compensate for carbon losses in HWP pool if harvest rate is not increased, since efficiency measures have limited potential.

Despite the outlined challenges, mitigation options exist that could improve Latvia's progress towards its LULUCF targets. These include afforestation and restoration of organic soils, promoting afforestation on low valued farmlands, and incentivizing the use of long-lived wood products.

The elaborated projections highlight significant challenges for Latvia in meeting its LULUCF targets, primarily due to persistent emissions from organic soils and the limited scope of current mitigation measures. To bridge this gap, more ambitious policies focusing on soil carbon preservation, forest management optimization, and afforestation including agroforestry related measures will be essential in the coming years.

The updated NECP 2021-2030 includes multiple measures (NECP target scenario) aimed at increasing carbon sequestration in the LULUCF sector. These measures are essential for achieving emission targets in LULUCF sector. They are not included in the WAM scenario because funding has not been allocated for measure implementation.

6.3 CLIMATE NEUTRALITY

In 2050, total emissions with LULUCF and including indirect CO_2 are projected to be 11099.15 kt CO_2 eq. in WEM scenario, in turn, in WAM scenario emissions are projected to be 10768.38 kt CO_2 eq. It indicates that Latvia is not on a track to reach climate neutrality by 2050.

6.4 INFORMATION ON LEGAL, INSTITUTIONAL, ADMINISTRATIVE AND PROCEDURAL ARRANGEMENTS FOR DOMESTIC IMPLEMENTATION

Law "On Pollution" (*currently Climate Law is under development to take over the requirements set in this law*) is the defining Climate Change policy document in Latvia. According to the Law "On Pollution", the MoCE in cooperation with MoA, MoT, MoE and other ministries each year prepare and submit by 31st December a progress Report to the CoM on achievement of the commitments regarding GHG emission reduction and CO_2 removals. The following information shall be included in the above-mentioned progress report:

- Evaluation of the fulfilment of the commitments related to reduction of GHG and CO_2 removals;
- The projections to track progress on the main targets. Action is undertaken by parties (involved ministries) when progress falls behind expectations;
- If necessary, proposals regarding additional measures for the fulfilment of the commitments related to 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 the socio – economic point of view.

Emissions under the EU ETS are monitored by the MoCE (in cooperation with the State Environmental Service and LEGMC) through annual reporting in accordance with EU ETS requirements.

Non-ETS emissions are reported annually to the EC, as regulated in Governance Regulation, Regulation (EU) 2018/842[148] and Commission Implementation Regulation (EU) 2020/1208[149].

[148] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30th 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 and amending Regulation (EU) No 525/2013. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018R0842

[149] COMMISSION IMPLEMENTING REGULATION (EU) 2020/1208 of 7th August 2020 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) No. 2018/1999 of the European Parliament and of the Council and repealing Commission Implementing Regulation (EU) No. 749/2014. Available: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32020R1208

7. SENSITIVITY ANALYSIS

7.1. ENERGY

As underlined above, assumptions on the future change of macroeconomic's indices are one of the most important factors when projecting GHG emissions. To evaluate the impact of macroeconomic's indices on GHG emission 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.

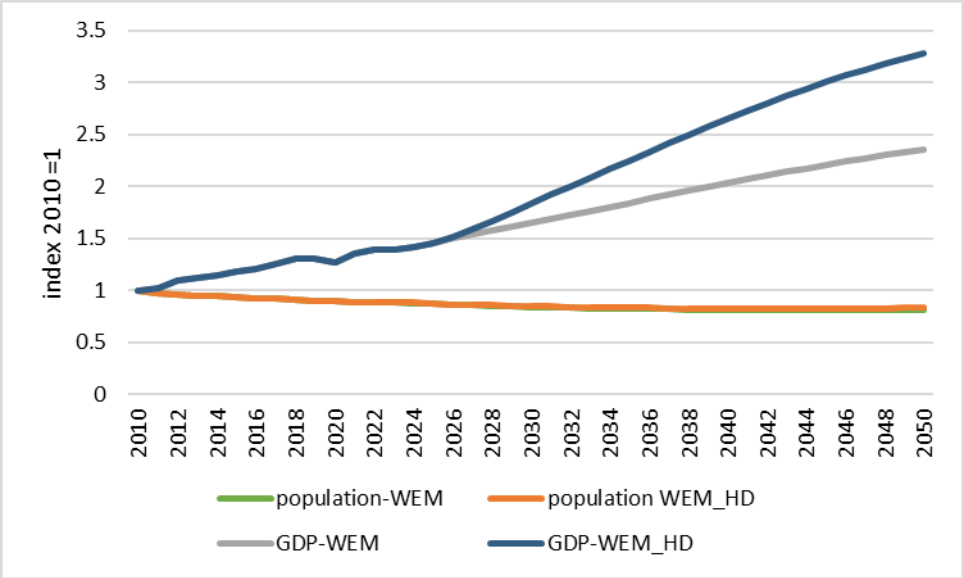

Figure 7.1 Comparison of macroeconomic's indices used in the modelled WEM and alternative (WEM_HD) scenarios

The alternative scenario (WEM_HD) assumes in 2030 the higher GDP per about 11% and higher number of population (per about 0.7%) against the WEM scenario level in 2030. At the end of the period (2050), this gap in the WEM_HD scenario against the WEM scenario increases, respectively GDP by 39% and population by 1.8%. 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, VA in manufacturing and other parameters.

As shown by the figure below, the assumptions on more rapid GDP growth rate and slower population decline result in 2030 in the increase of calculated FEC per 4.1% against the WEM scenario level in 2030. This increase of FEC varies in different sectors, being in 2030 in the range 3-5% against WEM scenario levels. The greatest impact can be found in the transport sector, where in an alternative scenario higher population and higher private consumption lead to higher mobility rates (pkm) and causes per 4.9% higher FEC in 2030 against the WEM

scenario level. High impact is seen also in residential, commercial and manufacturing sector in which in 2030 FEC in the alternative WEM_HD scenario increases per 4.4%, 3.6% and 3.2% respectively against the WEM scenario level.

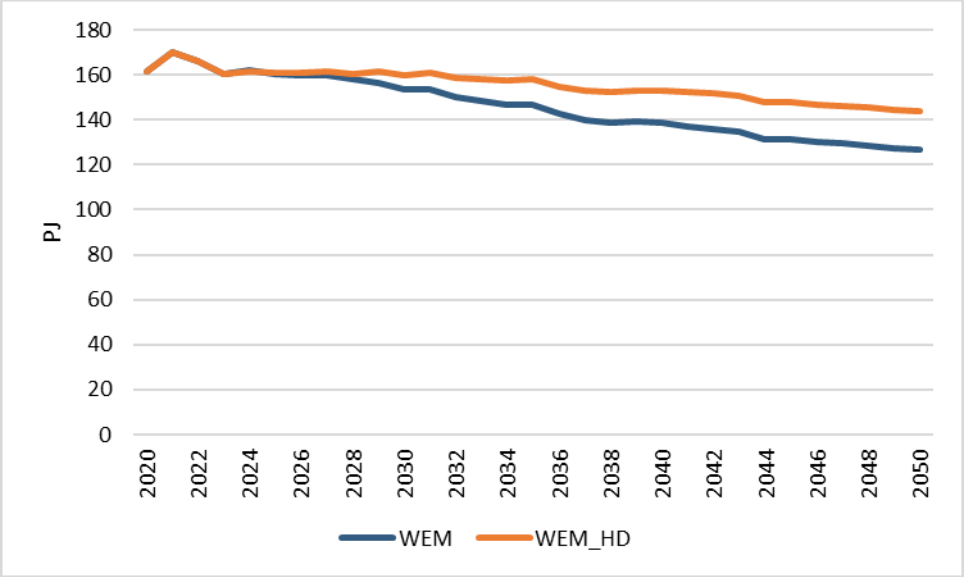

Figure 7.2 Comparison of calculated final energy consumption projections in the modelled WEM and alternative (WEM_HD) scenario, PJ

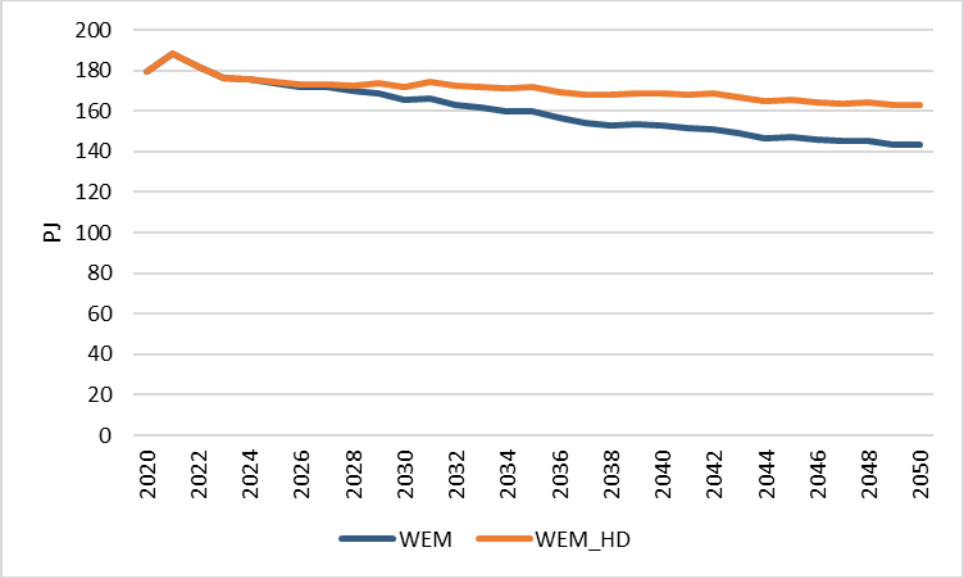

Figure 7.3 Comparison of calculated primary energy consumption projections in the modelled WEM and alternative (WEM_HD) scenario, PJ

In its turn, higher energy end-use volume results in higher GHG emissions in the case the additional PaMs aimed to decrease GHG emissions are not implemented. Calculated GHG emission projections in 2030 in the alternative (WEM_HD) scenario is per about 3.9% or per 201 kt CO_2 eq. higher, compared to WEM scenario. The highest impacts on GHG emission increase in the WEM_HD scenario are provided by commercial sector (5.3%), energy industries transport (4.5%) energy industries (4.3%) and manufacturing industry (1.8%). in 2050, in the

alternative scenario (WEM_HD), GHG emissions are already 14.7% higher than in the WEM scenario.

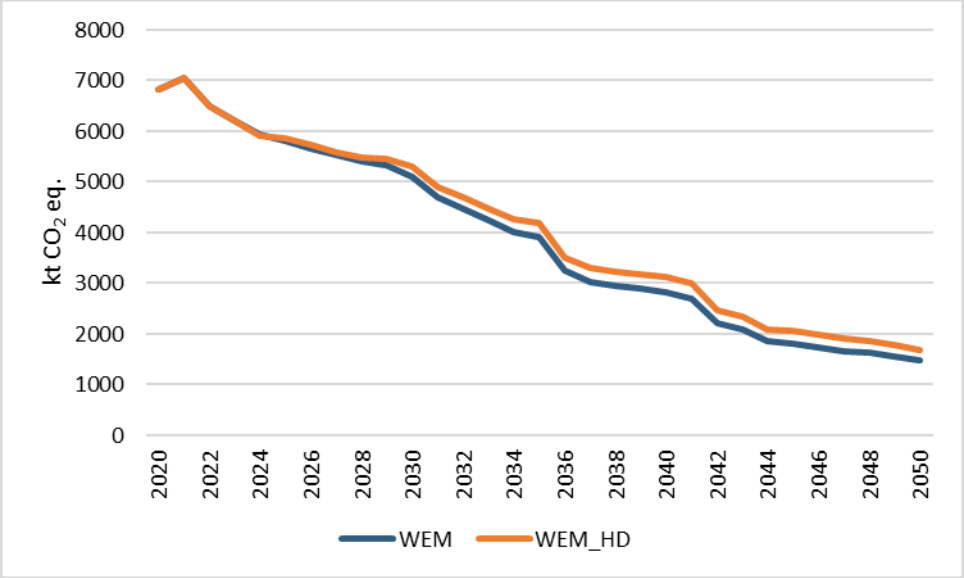

Figure 7.4 Comparison of calculated GHG emissions projections in the modelled WEM and alternative (WEM_HD) scenarios, kt CO_2 eq.

7.2. 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 7.5 which shows that Agriculture emissions will be 2125.6 kt CO_2 eq. in 2030. Total emissions could be by 2.0% lower than in the WEM scenario.

All other parameters of projections for both scenarios are similar to inputs for the WEM scenario projections.

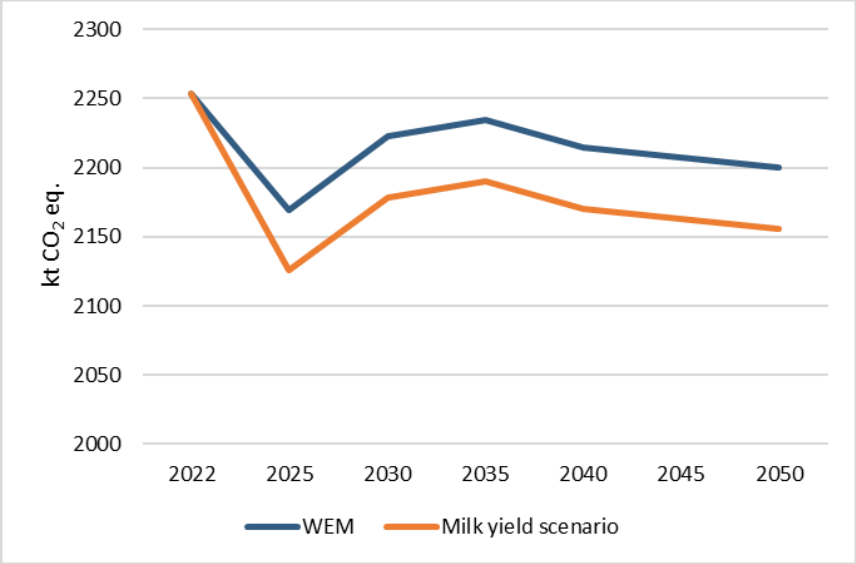

Figure 7.5 Sensitivity analysis of GHG emission projections for Agriculture sector, kt CO_2 eq.

7.3. LAND USE, LAND USE CHANGE AND FORESTRY

Results of sensitivity analysis considering different harvest rate in regenerative felling compared to current forest management intensity (regenerative felling reduced by 30%, 20% and 10% compared to WEM scenario). Summary of modelling results representing projections of the GHG emissions in LULUCF sector until 2050 provided in Figure 7.6Figure . According to this estimate the reduced harvest rate leads to proportionally reduced GHG emissions in the LULUCF sector; however, the sector is still a significant source of emissions, mainly due to GHG emissions from organic soils, use of peat in horticulture and carbon losses in HWP pool.

The net GHG emissions in LULUCF sector steadily increase until 2050, hence reduction of the regenerative felling rate by 20% and 30% ensures reduction of GHG emissions compared to 2022.

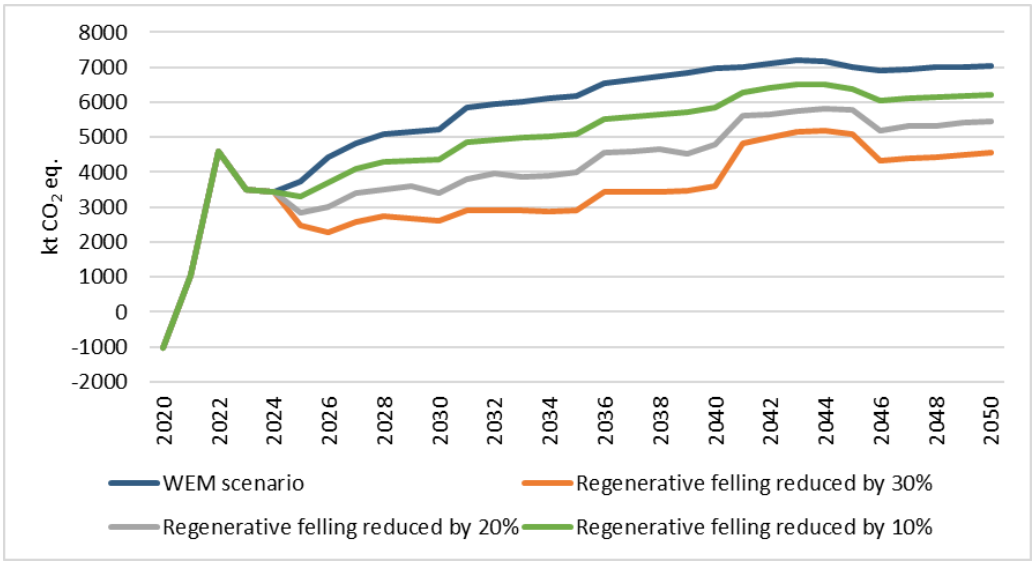

Figure 7.6 Sensitivity analysis in LULUCF sector depending on intensity of forest management, net GHG emissions compared to WEM scenario

The projection period between 2025 and 2050 is too short to demonstrate long term trends in forest growth. After 2070 the effect of the reduction of forest management intensity turns opposite – net GHG emissions rapidly increases with the decrease of harvest rate in regenerative felling, while in WEM scenario GHG emissions remains steady. All scenarios associated with reduction of the harvest rate in regenerative felling creates more emissions in the second half of the 21st century compared to the WEM scenario. It is associated with continuous carbon losses in HWP pool, as well as the ageing of forests leading to reduction of the net increment and carbon losses due to natural disturbances.

7.4. WASTE

Solid waste disposal

One of the main parameters to determining GHG emissions in SWD sector is biological waste content in disposal waste. For sensitivity analysis assumption that biological content is decreasing faster by 10% for each 5 years in disposed waste has been used.

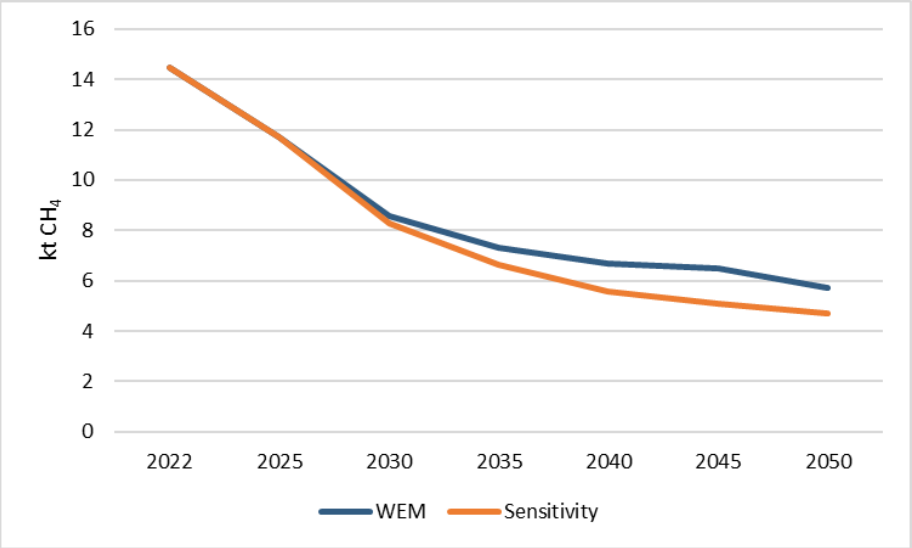

Figure 7.7 Results of SWD sensitivity analysis WEM scenario compared to sensitivity scenario, kt

Results of analysis (Figure 7.7) show that in 2035, considering the different biological content in disposal waste, the total fluctuations in the SWD sector will be almost 19.36 kt CO_2 eq. by WEM scenario.

Wastewater handling

Emissions of N_2O from domestic wastewater handling, being produced mainly from the protein consumption by a national population, is considerable source of GHG emissions in the Wastewater Handling sector, contributing around 25-30% from the GHG emissions of the sector.

Protein consumption was rather high in Latvia in last years, and corresponding values were used for WEM scenario. Lower values, closer to average ones in longer term, were used for sensitivity analysis.

Results of sensitivity analysis are shown in Figure 7.8.

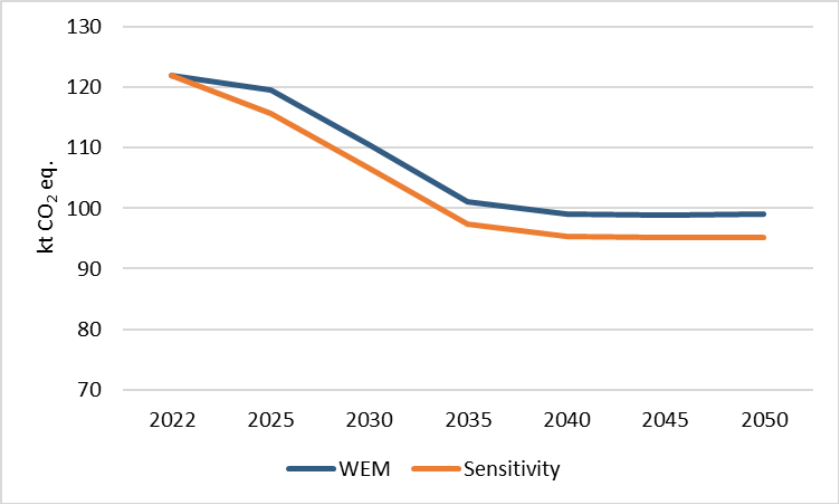

Figure 7.8 Comparison of calculated GHG emissions projections in the WEM and sensitivity scenario for Wastewater Handling sector, kt CO_2 eq.

The results of analysis (Figure 7.8) show that lower consumption of protein by national population, compared to WEM scenario, cause a decrease from 99.0 to 95.2 kt CO_2 eq. in 2050 in Wastewater Handling sector.

8. METHODOLOGY

8.1. ENERGY

To model the complex development of the Latvian energy system and perform calculation of GHG projections there is used internationally widely-applied partial equilibrium, bottom-up, dynamic, linear programming optimisation model TIMES code for the energy-environmental system optimisation which we have been adapted to Latvia's circumstances since 2022 by creating the TIMES-Latvia country model and applying it for the national level studies. Previously (before 2022) GHG emission projections for Energy were calculated using MARKAL-Latvia model, which is also of the MARKAL/TIMES model platform.

The TIMES-Latvia 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 time horizon 2000 to 2060, inclusive.

In the TIMES-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 projections are 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, VA, private consumption, population). In 2000, 2005, 2010, 2015 and 2020, 2022 the actual installed capacities and activity levels of technologies are imposed, thus providing that the model results exactly represent the real system being modelled.

TIMES-Latvia model 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 TIMES-Latvia 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 2050 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 EC ("Recommended parameters for reporting on GHG projections in 2025"). These projections have been adjusted considering the Latvia's current fuel prices and the interrelationships between the prices of different fuels. Prices of local energy resources depend on the geographic location of usage; therefore, the price may differ. Projection of average prices of these fuels have been developed based upon available statistics, various studies, considering the projection price trends of imported energy resources. Solid biomass (wood) is split to four price groups with different available amounts of sources. Actual prices of energy resources are projected without considering taxes. All implemented taxes in Latvia are further added in the model.

8.2. INDUSTRIAL PROCESSES AND PRODUCT USE

8.2.1. Industrial processes

GHG emission projections in the industrial processes 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 (VA or industrial production index).

8.2.2. F-gases

F-gas projections calculation is based on MS Excel top-down model. The structure and emission calculation are performed according to 2006 IPCC Guidelines and adjusted for projection estimation.

The use of F-gases is projected considering:

- 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 vehicles in road transport which determines 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 Regulation (EU) 2024/573 and the EC directive on emissions from air conditioning systems in motor vehicles (2006/40/EC) (MAC Directive).

8.2.3. Solvent use

CO_2 emission projections in the solvent use sector are based on numbers of inhabitant development scenario as well as based on GDP growth development scenario compared to the previous year and changes in private consumption development scenario compared to the previous year. The structure and emission calculation are performed according to EMEP/EEA 2023 and 2006 IPCC Guidelines.

8.3. AGRICULTURE

Emission projections under WEM scenario are based on primary activity data provided by MoA in collaboration with LBTU. 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 area (UAA) and the structure of UAA, 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 Farm Accountancy Data Network (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 LBTU. 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 LBTU 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 the scientific literature[150]. Projections of managed organic soils are provided by Latvian State Forest Research Institute “*Silava*”.

Projections of GHG emissions from Agriculture sector in Latvia are estimated according to the 2006 IPCC Guidelines.

[150]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

8.4. LAND USE, LAND USE CHANGE AND FORESTRY

The main data source for land use and carbon stock changes is National Forest inventory (NFI). Other data sources and research data are used as supplementary information, for quality assurance purposes, as well as to provide activity data for those sources which are not covered by the NFI programme and other sources of statistical data.

Area of organic soils in cropland and grassland is reported according to the results of research project implemented by Lazdiņš et al. in 2016[151]. Methodologies for calculating GHG emission projections for LULUCF are based on the Latvia's 2024 GHG inventory, e.g., emission factors for organic soils, carbon stocks at steady stage if forest floor vegetation and living biomass in cropland and grassland is harmonized with GHG 2024 GHG inventory. The potential effect of land use changes after 2022 is not considered in the calculation except land use changes associated with implementation of the measures.

The calculation to GHG emissions and carbon stock changes is done in EPIM model, which primary function is to integrate data from different land uses and conversion of the NFI data to carbon stock changes.

Forest land

Forest growth projections due to implementation of thinning, reconstruction of drainage system or afforestation measures are calculated using AGM model[152]. Similarly, forest growth projections under WEM scenario are calculated using AGM model assuming continuation of existing forestry practices (average during previous 5 years) and availability driven harvesting projections assuming constant intensity of harvests, i.e., proportion of extracted and legally available wood is not changing with time.

Cropland

The GHG projections are integral to Latvia`GHG inventory. The estimation process involves a combination of data collection, application of established calculation methodologies, and adherence to specific assumptions.

The primary data for GHG projections in croplands are sourced from the NFI and Rural support service. This includes detailed statistics on land use and crop types. Additionally, data on soil types and conditions are obtained from national soil surveys and databases. No land use and management changes are considered in the projection period, except those, derived from projections of growing of farm crops. Similarly, no changes of the total area of organc soils in

[151]Lazdiņš, A., Bārdule, A., Butlers, A., Lupiķis, A., Okmanis, M., Bebre, I., Sarkanābols, T., & Petaja, G. (2016). Aramzemes un ilggadīgo zālāju apsaimniekošanas radīto siltumnīcefekta gāzu (SEG) emisiju un oglekļa dioksīda (CO_2) piesaistes uzskaites sistēmas pilnveidošana un atbilstošu metodisko risinājumu izstrādāšana (2016. Gada starpziņojums) (101115/S109; p. 33). Available: https://www.researchgate.net/publication/389129776_Aramzemes_un_ilggadigo_zalaju_apsaimniekosanas_radito_siltumnicefekta_gazu_SEG_emisiju_un_oglekla_dioksida_CO2_piesaistes_uzskaites_sistemas_pilnveidosana_un_atbilstosu_metodisko_risinajumu_izstradasa

[152] 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. Rural Development, 289–294. Available: https://doi.org/10.15544/RD.2019.065

cropland are considered. Collaborations with institutions such as LEGMC further enrich the data pool, ensuring comprehensive coverage of factors influencing GHG emissions.

LSFRI Silava employs methodologies consistent with the IPCC guidelines, particularly the 2006 IPCC Guidelines.

Several assumptions underpin the GHG projection models. It is assumed that mineral soils under croplands are not a significant source of CO_2 emissions, based on modeling exercises using the Yasso07 model. However, loss of productivity due to depreciation of drainage systems or other factors or switching toless intensive (in terms of carbon input into soil) management may lead to loss of soil carbon. The models assume no significant changes in land use patterns, such as large-scale conversion of croplands to other uses, ensuring that projections reflect a continuation of existing practices.

Grassland

GHG projections for grasslands in Latvia are developed through a systematic approach that integrates data collection, standardized calculation methodologies, and defined assumptions. The primary data for these projections are sourced from the NFI, which provides detailed statistics on land use, and Rural support service providing information on the extent and management practices of grasslands. No land use and management changes are considered in the projection periods. Similarly, no changes of the total area of organc soils in cropland are considered. Additional information is obtained from the MoA and LEGMC, offering insights into agricultural activities and environmental conditions affecting grasslands. Soil characteristics and classifications are derived from national soil surveys and databases, ensuring accurate representation of soil types prevalent in grassland areas.

The estimation of GHG emissions and removals from grasslands adheres to the 2006 IPCC Guidelines. Thain main source of emissions - organic soils - are assessed using country specific calculation methods.

Several assumptions are integral to the projection models. It is assumed that grasslands are with mineral soils are not a source of GHG emissions. However, loss of productivity due to depreciation of drainage systems or other factors or switching toless intensive (in terms of carbon input into soil) management may lead to loss of soil carbon. Conversely, poorly managed or degraded grasslands may become net sources of CO_2 emissions. The projections consider average management practices, assuming consistent grazing patterns, mowing frequencies, and fertilization rates over the reporting period. The models operate under the assumption that there are no significant changes in land use, such as large-scale conversion of grasslands to croplands or urban areas, ensuring that projections reflect a continuation of existing land-use practices.

Settlements

GHG projections for settlements in Latvia are developed through a comprehensive approach that encompasses data collection, standardized calculation methodologies, and specific

assumptions. The primary data source for settlements is NFI. The NFI provides detailed information on land use and land-use changes, including the conversion of land to settlements and carbon stock changes in living and dead biomass.

The estimation of GHG emissions and removals associated with settlements follows the 2006 IPCC Guidelines. Default emission factors for croplands are used for organic soils.

It is assumed that the rate of land conversion to settlements remains consistent with historical trends, barring significant policy changes or economic developments that could accelerate urbanization. The models assume that converting forests or agricultural land to settlements results in a decrease in carbon stocks due to vegetation removal and soil disturbance. However, no further land use changes are considered in the projections. While urban areas typically lead to net emissions, the presence of parks, gardens, and other green spaces within settlements is considered. These areas are sequesterating carbon.

Wetlands

GHG emissions and removals in wetlands are calculated following the 2006 IPCC Guidelines. These guidelines provide a standardized approach to estimating emissions across different land-use categories, including wetlands. GHG projections for wetlands in Latvia are developed through a comprehensive approach based on thorough data collection, standardized calculation methods, and specific assumptions. Main data sources are NFI providing detailed information on land use types, including managed wetlands. Data on peat extraction is obtained from the CSB, which compiles statistics on peat extraction volumes. Update of areas used for peat extraction are taken from NFI; however, no significant changes of managed areas, except restoration of peatlands considered in projections. Country specific emission factors are used for most of the emission categories.

The projections assume that the rate of peat extraction remains constant, based on historical data and industry trends. It is assumed that managed wetland areas and their usage will not significantly change.

8.5. WASTE

8.5.1. Solid waste disposal

Two separate calculations from IPCC Waste Model according the 2006 IPCC Guidelines were used. One for unmanaged sites (closed dumpsites) and other for managed (landfills since 2002). For unmanaged sites calculation method for bulk waste was used. According to Ltd Virsma research 2011 – degradable organic carbon (DOC) factor 0.17 for these calculations was used. Other factors are default from 2006 IPCC Guidelines.

For managed sites method “waste by composition” in 2006 IPCC Waste Model was used. DOC and k values and other factors are taken from 2006 IPCC Guidelines. Waste composition is taken from Ltd Virsma research 2011 (Table 8.1). This waste composition is applied till year 2015.

Direct information from operators about collected CH_4 in waste polygons is used for emission projections.

Table 8.1 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

In 2016, bioreactor starts to operate in SIA Getlini Eko waste polygon. In bioreactor waste are stored after mechanical sorting. Biological part of stored waste in bioreactor is approximately 75%. Bioreactor operates till 2022. Data about waste composition are reported in annual waste polygon reports. These reports are provided to state institutions each year. Waste composition for 2016-2021 disposed waste was estimated. From year 2022 composition of disposed waste are estimated for a specific year.

8.5.2. 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 as decrease due to higher capacity of biological waste treatment plants.

8.5.3. Wastewater handling

Projected CH_4 and N_2O emissions from Domestic Wastewater handling were calculated according to 2006 IPCC Guidelines, using following activity data and assumptions:

- For CH_4 emissions from domestic/commercial wastewater 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, including its recent revision;
  - Projections of sewage sludge production based on its correlation with average annual amount of sewage sludge produced by a person and historical trend of share of anaerobic sludge, as well as expected impact of Sewage Sludge Management Plan 2024-2027.
- For N_2O emissions from domestic/commercial wastewater handling subsector:
  - Projections of national population;
  - Expected rate of national population served by modern centralized treatment plants, based on historical trends and requirements of UWWTD;
  - Constant consumption of protein by average person was assumed.

For CH_4 and N_2O emissions from industrial wastewater handling subsector projections of emissions were extrapolated from the historical emission trends of this subsector using MS Excel trendline function.

Country-specific emission factors were used to calculate CH_4 emissions, but for emissions of N_2O default IPCC emission factors were used. Emissions factors used for projections are the same as in 2024 GHG inventory.