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

# LATVIA

2023

# DATA SHEET

**Title**

Integrated Reporting on Policies and Measures and Projections under Article 18 of Regulation (EU) No. 2018/1999 of the European Parlament and of the Council and Articles 36, 37 and 38 of Commission Implementing Regulation (EU) 2020/1208, Latvia, 2023

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# Abbreviations

ALTUM – JSC “Development Finance Institution Altum”
AR5 - IPCC Fifth Assessment Report
BAT - Best Available Techniques
CAP – Common Agricultural Policy
CF - Cohesion Fund
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
EAFRD - Agriculture Fund for Rural Development
EC – European Commission
EEOS - Energy Efficiency Obligation Scheme
EMS - Energy Management Systems
EPI - Energy performance indicator
ERDF - EU Regional Development Fund
ESR – Effort Sharing Regulation
EU ETS – European Union Emission Trading Scheme
EU – European Union
EUA - Emission allowances
EUAA - European Union Aviation Allowance
EV – Electric vehicle
FADN - Farm Accountancy Data Network
FEC - Final Energy Consumption
FIT - Preferential Feed-in Tariffs
GPEC – Gross primary energy consumption
GDP - Gross Domestic Product
GFEC – Gross Final Energy Consumption
GHG – Greenhouse Gases
GIS - Geographic information system
GPES - Gross primary energy supply
GPS - Global Positioning System
GWP - Global Warming Potential
ICT - Information and communications technology
IPPU – Industrial Processes and Product Use
LBN – Latvian Construction Standard (Latvijas būvnormatīvs)
LEC - Large Electricity Consumers
LNRP – National Reform Programme of Latvia
LPG - Liquefied petroleum gas
LULUCF – Land Use, Land Use Change and Forestry
MEPRD – Ministry of Environmental Protection and Regional Development
MoA – Ministry of Agriculture
MoCE - Ministry of Climate and Energy

MoE – Ministry of Economics
MoT – Ministry of Transport
NDP – National Development Plan
NECP – National Energy and Climate Plan
NGO - Non-governmental organizations
NOP – National Operational Programme
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
SMEs - Small and medium-sized enterprises
SO – Specific Objective
SWD - Solid waste disposal
ThO – Thematic Objective
UNFCCC – United Nations Framework Convention on Climate Change
UWWTD – Urban Wastewater Directive
VAT - Value Added Tax
WAM – Scenario with additional measures
WEM – Scenario with existing measures

# Chemical formulas

$CH_4$ – methane
$CO_2$ – carbon dioxide
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 Latvia's 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 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 Latvia's Government approved the National Energy and Climate Plan 2021-2030 (NECP) in January 2020. NECP outlines policies and measures (PaMs) that will enable Latvia to attain the targets specified in the adopted Government documents and adopted in the EU for 2030, and to systematically set the course for achieving climate neutrality by 2050. NECP covers objectives of all the dimensions[2] of Governance Regulation as well as PaMs required to reach them.

The 2030 climate and energy framework of January 2014 contains the EC's proposals for climate and energy targets for the post-2020 period. In coherence with the 2030 climate and energy framework in summer 2018 the EC published its proposal for a new Effort Sharing Regulation 2021−2030. According to the EC's proposal, Latvia should achieve reduction of 6% in its emissions by 2030 compared to 2005.

In 2020, Latvia's total GHG emissions including indirect $CO_2$, without Land use, land use change and forestry (LULUCF) showed a decrease of 59.7% compared to 1990, but GHG emissions including indirect $CO_2$, with LULUCF have decreased by 18.9% compared to 1990. Emissions are recalculated in by using global warming potentials (GWP) provided in IPCC Fifth Assessment Report (AR5).

The base year of projections is 2020. According to the GHG projections Latvia in 2030 will reduce its total GHG emissions without LULUCF by 7.1% and 8.5% in scenario with existing measures (WEM) and scenario with additional measures (WAM) compared to 2020. Likewise, total GHG emissions with LULUCF in 2030 in WEM scenario will increase by 16.8% and by 8.9% in WAM scenario compared to 2020.

In 2050, Latvia will reduce its total GHG emissions without LULUCF by 39.5% and 40.8% in WEM and WAM scenarios compared to 2020. Total GHG emissions with LULUCF in 2050 in WEM scenario will increase by 5.3% and in WAM scenario will decrease by 0.8% compared to 2020.

[1] Governance Regulation: European Parliament and of the Council Regulation (EU) No. 2018/1999 of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council
[2] Article 1(2) of Directive 2018/1999

It is projected that under the WEM scenario in 2030 GHG emissions in the non-ETS sector will decrease by 6.6% and in WAM scenario by 8.4% compared to 2005.

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

# Introduction

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

In accordance with the Governance Regulation a Member State shall report to the EC information on their national policies and measures or group 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 in two scenarios: WEM and WAM. Base year for scenarios is 2020.

Latvia's 2023 submission contains following data and information submitted through the EC's online tool in the Reportnet 3.0 portal:

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

Latvia's 2023 report on policies and measures and projections comprises eight chapters. Chapter 1 presents information on Latvia`s GHG emissions in the annual inventory which has been submitted to the UNFCCC on 14$^{th}$ April 2022 but emissions are recalculated by using GWP provided in AR5. The annual GHG inventory provides information on the trends in national GHG emissions and removals since 1990. Information on national systems for policies and measures and projections are included in Chapter 2. Information on policies and measures are presented in Chapter 3 and projected GHG emissions until 2050 can be found in Chapter 4. Information on projected emissions per sector is included in Chapter 5, but Chapter 6 includes total projected GHG emissions and the Effort Sharing Regulation (ESR) target. Chapter 7 provides sensitivity analysis and Chapter 8 describes methods used for emissions projection calculations in sectors.

Latvia's 2023 report was compiled by Latvian Environment Geology and Meteorology Centre and supported by Institute of Physical Energetics, Latvian State Forest Research Institute "Silava", Latvia University of Life Sciences and Technologies and Ministry of Climate and Energy.  Latvia's 2023 report was coordinate with sectoral ministries for accordance.

# 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 14th April 2022[3] but emissions are recalculated by using GWP provided in AR5[4]. The annual GHG inventory contains information on the historical trends in national GHG emissions and removals since 1990. This information is essential for the planning and monitoring of climate policies and for the development of GHG projections.

In 2020, Latvia's GHG emissions were 10490.74 kt $CO_2$ eq. including indirect $CO_2$, without LULUCF and 11159.92 kt $CO_2$ eq. including indirect $CO_2$, with LULUCF based on GWP provided in AR5. Latvia's total GHG emissions including indirect $CO_2$, without LULUCF showed a decrease of 59.7% compared to 1990, but GHG emissions including indirect $CO_2$, with LULUCF have decreased by 18.9% compared to 1990. GHG emissions by sectors are shown in Figure 1.1.

The main GHG emission source in Latvia in 2020 is Energy sector (64.8%) followed by Agriculture (21.2%), IPPU (8.2%) and Waste (5.7%).

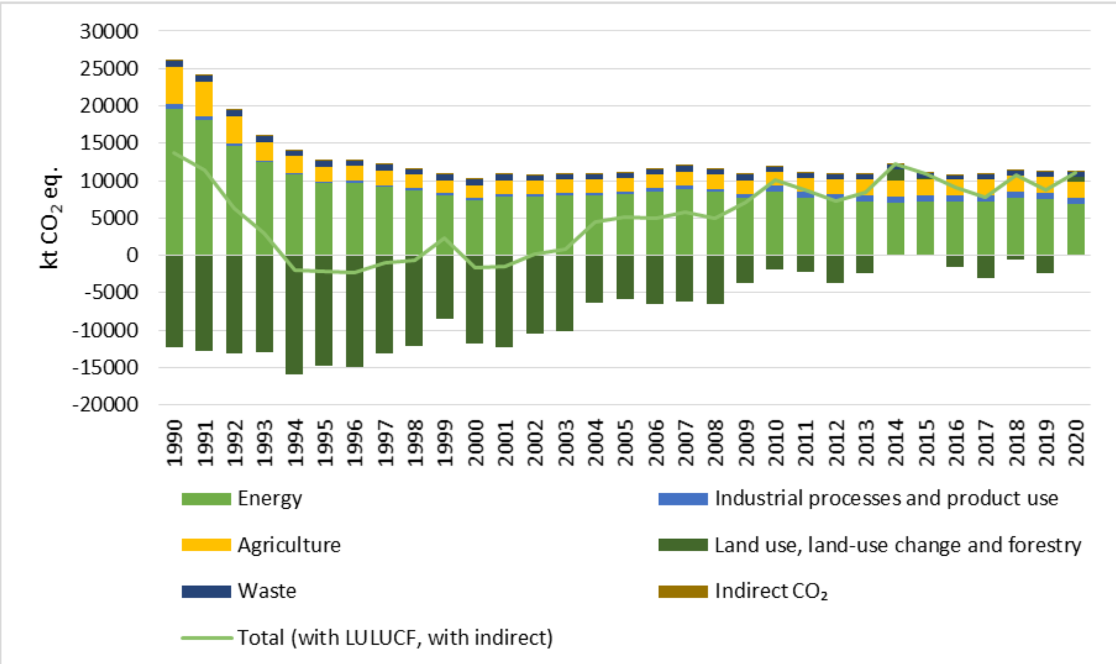


**Figure 1.1 GHG emissions and removals in Latvia 1990 – 2020 by reporting sectors (emissions are positive and removals negative quantities)**

Net GHG emissions from LULUCF in 2020 were 669.18 kt $CO_2$ eq. compared to -12294.71 kt $CO_2$ eq. in 1990. Change from base to latest reported year of emissions/removals from LULUCF constitutes -105%. This decrease of removals from LULUCF sector is associated with the decrease of net $CO_2$ removals in living biomass in forest lands due to significantly increased carbon losses as a result of commercial harvesting, natural mortality and ageing of forests.

[3] GHG inventory in Latvia 1990-2020: https://unfccc.int/ghg-inventories-annex-i-parties/2022
[4] Global worming potential according to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

Fluctuations in total GHG emissions during recent years (e.g., peak in 2014 and 2017) mostly are associated with annual changes in $CO_2$ removals in living biomass in forest land is mainly associated with changes of the commercial harvest rate determined by changing demand of roundwood in the market.

The composition of Latvia`s GHG emissions by sector in 2020 is reflected in Figure 1.2.

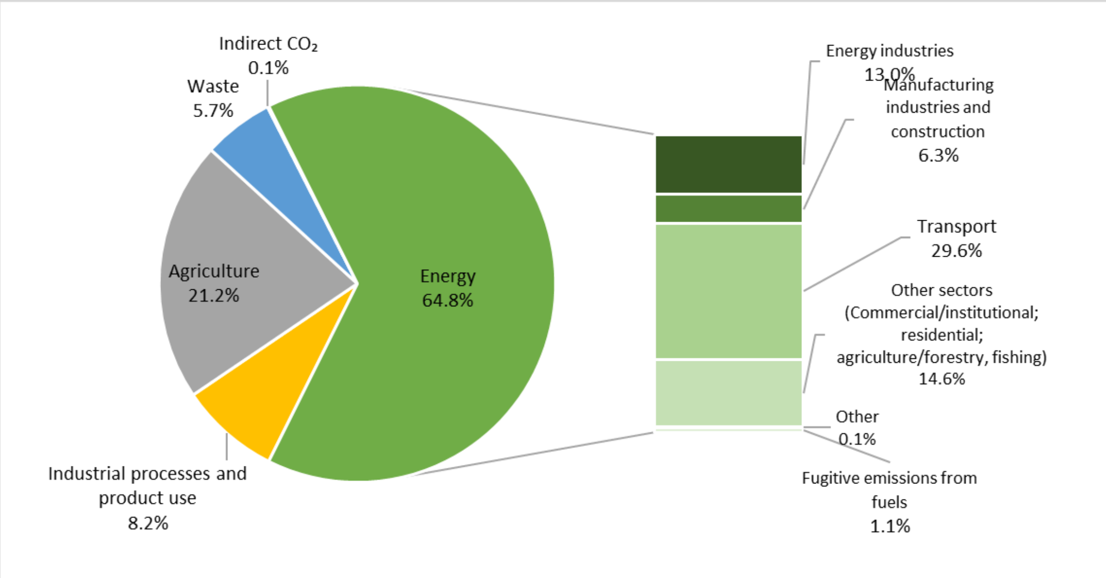


**Figure 1.2 The composition of Latvia GHG emissions in 2020 (without LULUCF)**

The ***Energy sector*** was the most significant source of GHG emissions in Latvia with 64.8% share of the total emissions in 2020. This reflects extensive consumption of fuel for a long heating period, as well as fuel consumption for transport. There are not many energy effective manufacturing branches in Latvia. Energy-related $CO_2$ emissions vary mainly according to the economic trend, the energy supply structure and climate conditions including the impact on hydro power production and electricity import. $CO_2$ emissions forms major part of Energy sector with contribution of 93.0%, then CH4 emissions contributed 4.6% and $N_2O$ emissions – 2.4%.

***Agriculture*** was the second most significant source of GHG emissions in 2020, accounting for 21.2% of the total emissions. The GHG 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 49.3%, but $CH_4$ emissions - 47.5%, and $CO_2$ emissions - 3.2% of total GHG emissions from Agriculture sector. 90.6% of total $CH_4$ emissions from Agriculture sector resulted from enteric fermentation and 9.4% from manure management. The major portion (94.0%) of Agriculture sector total $N_2O$ emissions resulted from direct-indirect emissions; only 6.0% of total $N_2O$ emissions were contributed from manure management.

The emissions from ***IPPU*** were 8.2% of total GHG emissions in 2020. Emission fluctuations in IPPU sectors are mainly linked with the economic situation in the country. $CO_2$ emissions are major part of IPPU sector with contribution of 70.5%, then F-gases contributed 27.6%, $SF_6$ –

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 2.3% from total GHG emissions in 2020. Solvent Use sector was a significant non-methane volatile organic compound (NMVOC) emission source and covered 33.0% from the total Latvia's NMVOC emissions in 2020.

The ***Waste sector*** accounted for 5.7% of total Latvia's GHG emissions in 2020. $CH_4$ emissions contributed 92.4%, $N_2O$ emissions contributed 7.6%, and $CO_2$ emissions contributed 0.01% of total GHG emissions from Waste sector. 76.5% of total $CH_4$ emissions from Waste sector resulted from solid waste disposal (SWD), 14.6% from waste water treatment and discharge and 8.9% 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 policies and measures and for reporting on projections of anthropogenic greenhouse gas emissions by sources and removals by sinks. Those systems shall include the relevant institutional, legal and procedural arrangements established within a Member State.

Regulation of the Cabinet of Ministers No. 675 "GHG inventory, projections and adaptation to climate change reporting systems" (Regulation No. 675)[5] was adopted in 2022 replacing Regulation of the Cabinet of Ministers No. 737 "Regulations Regarding the Establishment and Maintenance of the National System for the Greenhouse Gas Inventories and Preparation of Projections" (Regulation No. 737)[6]. In the new Regulation No. 675 requirements according to Regulation (EU) 2018/1999 and Implementation Regulation (EU) 2020/1208 are included to better reflect new obligations and to make reporting on PaMs and projections consistent with national energy and climate progress reports.

The Regulation No. 675 stipulate the determination of institutions that are responsible for preparation of GHG projections as well as includes the general information on Quality Assurance/Quality Control procedures for projections preparation.

In 2018, QA/QC programme was adopted. QA/QC programme determines specific tasks and timetable for preparation of GHG projections.

Since 1st January 2023 new ministry - Ministry of Climate and Energy (MoCE) - is created and therefore MEPRD is replaced by MoCE as a single national entity with overall responsibility for the Latvian GHG projections and coordination of gathering 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/removals projections to the relevant international institutions (EC, UNFCCC) and monitor the co-operation of the authorities involved. 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 preperation 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.

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[5] Regulation of the Cabinet of Ministers No. 675 "GHG inventory, projections and adaptation to climate change reporting systems" https://m.likumi.lv/ta/id/336733-siltumnicefekta-gazu-inventarizacijas-sistemas-prognozu-sistemas-un-sistemas-zinosanai-par-pielagosanos-klimata-parmainam-izveidosanas-un-uzturesanas-kartiba

[6] Regulation of the Cabinet of Ministers No. 737 "Regulations Regarding the Establishment and Maintenance of the National System for the Greenhouse Gas Inventories and Preparation of Projections" https://likumi.lv/ta/en/en/id/295801-regulations-regarding-the-establishment-and-maintenance-of-the-national-system-for-the-greenhouse-gas-inventories-and-preparation-of-projections

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

**LEGMC:**

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

- the primary data - projections of indicators of the waste management and wastewater management sector;
- the secondary data and calculations of projections of GHG emissions;
- a description of GHG projections, policy and measures 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, Industrial processes, use of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride, solvents and different chemical substances, LULUCF and Waste management activities).

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

**MoA** in cooperation with **the Latvia University of Life Sciences and Technologies** and **the 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. **Institution of Physical Energetics** cooperation with the MoCE prepares the secondary data and calculations of GHG emission projections for the Energy and Transport sectors. **Latvia University of Life Science and Technologies** in cooperation with MoCE prepares the secondary data and GHG emission calculations from agriculture activities.

Every second year MoCE submits to the EC (until 15 March) and the UNFCCC (until 31st December) Report on Policies and Measures and GHG projections.

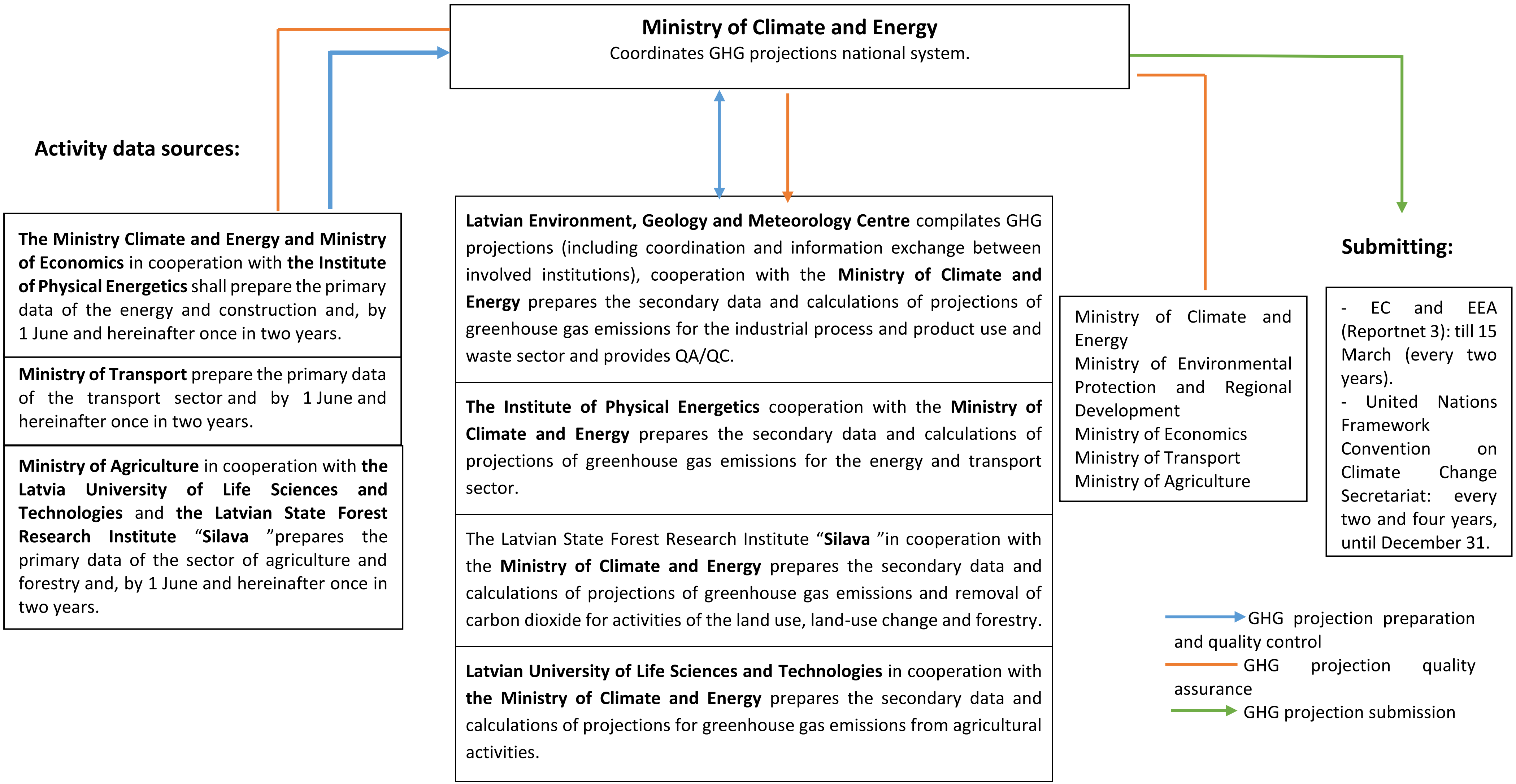


**Figure 2.1 National system for the preparation of GHG projections and PAMs**

# 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)**[7] 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 over the next seven years.

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

**National Reform Programme of Latvia for the Implementation of the "*Europe 2020*" Strategy** (approved 26$^{th}$ April 2011[8]) defines that, agreeably to the Effort Sharing Decision, GHG emission increase in Latvia non-ETS sector in total shall not increase +17% in year 2020, comparing to 2005. Total GHG emission in Latvia, including both European Union Emissions Trading System (EU ETS) and non-ETS sectors, according to the Programme, shall not exceed 12.19 Mt $CO_2$ eq. in 2020.

In April 2022 the Cabinet of Ministers approved the eleventh Progress Report on the Implementation of the National Reform Program of Latvia, which is prepared annually and submitted to the EC. The Progress Report contains an updated medium-term macroeconomic scenario, described in the National Reform Programme of Latvia (approved by the Cabinet of Ministers on 26$^{th}$ April 2011), evaluates the progress of Latvia in addressing the recommendations issued by the EU Council in 2018, gives a detailed description of policy directions, including national quantitative targets of Latvia in the context of the Europe 2020 strategy, reflects information on the investments of EU funds and Latvia's investment needs in the 2021-2027.

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[7] Latvia's The National Development Plan 2021–2027: https://www.pkc.gov.lv/sites/default/files/inline-files/NAP2027__ENG.pdf
[8] Latvia's National Reform Programme of Latvia for the Implementation of the "Europe 2020" Strategy. Approved by the Cabinet of Ministers, 26 April 2011: https://ec.europa.eu/info/sites/info/files/2019-european-semester-national-reform-programme-latvia_en.pdf

In 31st August 2022 Cabinet of Ministers adopted Latvia's **Environmental Policy Strategy 2021-2027**[9] which is a medium-term policy planning document for the environmental protection sector. It was developed in accordance with the priorities set in the Latvia2030 and NDP2027 and the strategic goals of the European Green Deal. The general climate policy objectives under the section No. 3 "Climate change" are defined as follows: 1) Ensure Latvia's progress towards achieving climate neutrality and 2) Promote climate resilience and adaptation to climate change.

Following targets have been defined to ensure achievement of objectives for 2027:

- Reduction of GHG emissions (compared to 1990), excluding LULUCF sector- 9 850.5[10] kt $CO_2$ eq.;
- Reduction of GHG emissions from non-ETS activities (compared to 2005) - 8 372 kt $CO_2$ eq.;
- Annually maintained forest reference level.

To reach the above quantitative targets, the Strategy sets the following concrete activities, such as to set quantitative sectoral climate targets, assess the impact of state budget planning on mitigating and adapting to climate change, prepare an assessment on the elimination of direct and indirect fossil subsidies, ensure the operation of the EU ETS, develop and implement risk assessment-based local government adaptation strategies to and other. These activities are implemented based on interministerial co-operation and depending on the competence of particular ministry (MoCE, MEPRD, MoA, MoE, MoT) and by involving local governments in the field of their competence.

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

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

Latvia2030 sets out indicators to be reached till 2030 (Table 3.1).

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[9] Environmental Policy Strategy 2021-2027 (Vides Politikas Pamatnostādnes 2021-2027.gadam)". Approved by the Cabinet of Ministers, 31 August 2022: https://likumi.lv/ta/id/335137-par-vides-politikas-pamatnostadnem-2021-2027-gadam, in Latvian

[10] The reduction is set according to a linear trajectory, moving from 2018 to the 2030 target.

**Table 3.1 Latvia2030 indicators**

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

**National Energy and Climate Plan 2021-2030 (NECP)**[11] is a document for the long-term planning of energy and climate policy laying down the basic principles, goals and action lines of Latvia's national energy and climate policy for the next ten years, as per the outlined long-term lines of development.

In order to implement the objective, it is necessary:

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

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

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

Main targets are shown in Table 3.2.

**Table 3.2 Policy outcomes and main performance indicators in Latvia**

| Policy outcome in each dimension of the Plan | Actual value | Target value | |
|---|---|---|---|
| | 2017 | 2020 | 2030 |
| 1.1. GHG emission reduction target (% compared to 1990) | -57 | - | -65 |
| 1.1.1. Non-ETS activities (% compared to 2005) | +7 | +17 | -6 |
| 1.1.2. LULUCF accounting categories (million t) | - | 0 | -3.1 |
| 1.1.3. Transport energy life-cycle GHG emission intensity reduction (%) | 0.8 | 6 | ≥6 |
| 1.2. Share of energy produced from RES in gross final energy consumption (%) | 39 | 40 | 50 |
| 1.3. Share of energy produced from RES in gross final energy consumption in transport (%) | 2.5 | 10 | 7[12] |
| 1.4. Share of advanced biofuels & biogas in gross final energy consumption in transport (%) | 0 | - | 3.5 |

[11] National Energy and Climate Plan 2021-2030: https://ec.europa.eu/energy/sites/ener/files/documents/lv_final_necp_main_en.pdf

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

| Policy outcome in each dimension of the Plan | Actual value | Target value | |
|---|---|---|---|
| | 2017 | 2020 | 2030 |
| 2.1. Mandatory national target — cumulative final energy savings (Mtoe) | 0.45 | 0.85 | 1.76 |
| 2.2. Building renovation target (total renovated $m^2$) | 398.707 | 678.460 | 500.000 |

According to Governance Regulation in 2023-2024 NECP will be revised and submitted to EC.

**Strategy for Sustainable Use of Peat Resources 2020-2030**[13] (adopted in Cabinet of Ministers on 24th November 2020) covers main aspects for sustainability of the peat extraction and production. It addresses assessment of GHG emissions from the use of peatlands as one of the main issues. Therefore, one of the main indicators for successful implementation of this strategy is to achieve a GHG emission zero increase compared to the average level of GHG emissions in 2005-2009 in LULUCF sector.

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

### 3.1.2 EU ETS allowances auctioning

In the first two years of the EU ETS 4th period Latvia has auctioned more than 2.21 million emission allowances (EUA and EUAA) in the primary market on the common auction platform and received near 146.69 MEUR from these auctions. According to provisional estimates of MEPRD Latvia could gain near 700 MEUR from the auctioning of emission allowances in the EU ETS 4th period from 2021 to 2030. These projections are calculated by taking into account:

- the approximate volume of allowances to be auctioned in the ETS 4th period on the common auction platform;
- the potential impact of the market stability reserve;
- the possible average yearly auction price of emission allowances (which in fact varies significantly depending on the actual market situation).

However, there will most likely be changes in the light of the EC's initiatives related to "*fit for 55 package"*, accordingly, it will be necessary to update the estimates after the final approval of the legislation.

All auction revenues are channelled to the state budget program – Emission Allowances Auctioning Instrument (EAAI), which has been established in 2016. In 2021, the MEPRD

[13] Strategy for Sustainable Use of Peat Resources 2020-2030 (Par Kūdras ilgtspējīgas izmantošanas pamatnostādnēm 2020.-2030. gadam). Approved by the Cabinet of Ministers, 24 November 2020: https://likumi.lv/ta/id/319013-par-kudras-ilgtspejigas-izmantosanas-pamatnostadnem-20202030-gadam

updated and published the operational strategy of the EAAI[14]. The EAAI is aimed at tackling global climate change, supporting adaptation to the consequences of climate change and reducing GHG emissions in accordance with national legislation "On pollution". Seven open tenders and one open tender in two rounds for projects has been organized since the establishment of the EAAI with total available co-funding in the amount of 135 MEUR. All unspent revenues from the auctioning of emission allowances are being accumulated and will be spent in the coming years.

### 3.1.3 Low-Carbon Development Strategy

***"Strategy of Latvia for the Achievement of Climate Neutrality by 2050"***[15] (Strategy) was approved by Cabinet of Ministers in January, 2020. It sets direction towards climate neutrality by setting climate change mitigation goals and outlining low carbon development principles in Latvia.

Strategy has been submitted to the EC according to the requirements of the Energy Union 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.

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

The implementation of the Strategy will be coordinated by MoCE[16]. MoCE, MEPRD, MoE, MoA, MoT, Ministry of Education and Science, Ministry of Welfare, Ministry of Finance, State Chancellery (as cross-sectoral coordinators) will be responsible authorities for the implementation of the Strategy. The targets of the climate neutrality will be considered and incorporated in the sectoral strategies, programmes of financial support, research programmes for the next period 2021-2027 and beyond. Climate neutrality of Latvia in 2050 will be reached/achieved in cost effective, integrated and smart way taking into account the priorities of each sector.

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

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[14] MEPRD. Order No. 265 (21 October 2016) "Strategy for the Use of Emissions Quota Auctioning Instrument": http://varam.gov.lv/lat/fondi/ekii/likumdosana/, in Latvian

[15] Strategy of Latvia for the Achievement of Climate Neutrality by 2050: https://ec.europa.eu/clima/sites/lts/lts_lv_en.pdf

[16] Since 1 January 2023, a new Ministry of Climate and Energy has been established and MoCE is the main coordination institution of "Strategy of Latvia for the Achievement of Climate Neutrality by 2050"

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

## 3.2 ENERGY

### 3.2.1 Regulatory policies and measures

#### 3.2.1.1 Increasing a deployment of renewable energy sources

Pursuant to Annex I(A) to the Directive 2009/28/EC of the European Parliament and of the Council of 23rd April 2009 on the promotion of the use of energy from renewable sources (RES Directive), Latvia's target is to increase the share of renewable energy from 32.6% of Gross Final Energy Consumption (GFEC) in 2005 up to 40% in 2020. Latvia had fulfilled this target by reaching the following shares of renewable energy in 2020: (i) in GFEC - 42.13%, (ii) in electricity - 53.36%, (iii) in heating & cooling - 57.09%, (iv) in transport - 6.73%[17].

**Preferential Feed-in Tariffs (FIT) for renewable electricity production** are prescribed by the **Electricity Market Law[18]** and the Cabinet of Ministers Regulations[19] issued pursuant to this Law. From 26th May 2011 the new RES electricity producers, as well as from 10th September 2012 the new Renewable energy resources Combined Heat and Power (RES-CHP) producers have no rights to qualify for the FIT. The legislative provisions are adopted to ensure a controlled closure of the FIT scheme. Thus, the preferential FIT is continuing in relation to the existing RES-electricity and RES-CHP plants only which had obtained the FIT rights before the date noted above, until their expire or waive by the producer.

#### 3.2.1.2 Increasing the energy efficiency

Based on the requirements of Article 7 "Energy Savings Obligation" of the Energy Efficiency Directive 2012/27/EU, the Latvia's total cumulative energy savings target 2020 is 0.85 Mtoe (9899 GWh). In its turn, the total cumulative energy savings target 2030 is 1.76 Mtoe (20472 GWh)[20], calculated according to the provisions of the amending Directive 2018/2002/EU.

The **"Energy Efficiency Law"[21]**, which contains legal norms arising from the Directive 2012/27/EU, is in force from 29th March 2016. The Amendments (14th July 2022) include the

[17]Central Statistical Bureau Republic of Latvia. The data base ENA020: https://data.stat.gov.lv/pxweb/en/OSP_PUB/START__NOZ__EN__ENA/ENA020/

[18] Electricity Market Law: http://likumi.lv/doc.php?id=108834

[19] (1) Cabinet of Ministers Regulation No. 560 (2020) "Regulations regarding the Production of Electricity Using Renewable Energy Sources, the Procedures for the Determination of the Price and the Supervision": http://likumi.lv/doc.php?id=317215 , (2) Cabinet of Ministers Regulation No. 561 (2020) "Regulations regarding Electricity Production, Supervision and Price Determination upon Production of Electricity in Cogeneration": http://likumi.lv/doc.php?id=317216

[20] Latvia's NECP 2021-2030, the Table 17 in page 83.

[21] Energy Efficiency Law: http://likumi.lv/doc.php?id=280932

provisions of the amending Directive 2018/2002/EU, among others the *Energy efficiency first* principle.

The Law includes the framework for the measures used for meeting the energy saving obligation set by Article 7 of the Energy Efficiency Directive:

- **Energy Efficiency Obligation Scheme (EEOS)**[22]. The obliged parties for the EEOS start period and the first period (up to 31th December 2020) had been electricity retail sellers which (1) had sold at least 10 GWh of electricity in 2016, or (2) had sold at least 10 GWh of electricity in any of years related to EEOS period. No annual obligation has been stated for 2021 and 2022. The noted electricity retail sellers will continue to perform the annual duty starting from 2023 and have the right to include documented energy savings, achieved in 2021 and 2022, in the savings to be achieved in 2023-2025 period;
- **mandatory Energy Audits and Energy Efficiency Improvement in Large Enterprises** (the transposition of the energy auditing framework defined by the Energy Efficiency Directive 2018/2002/EU);
- **mandatory Energy Management Systems (EMS) to be implemented by 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).

The large enterprises and the LECs shall provide an annual report on implemented energy saving measures and energy savings reached. At least three energy efficiency measures (or all, if only one or two measures are defined) 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 the 1st April 2020 for the 1st audit/EMS period) and by LECs (up to the 1st April 2022 for the 1st audit/EMS period).

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

- **mandatory EMS in state administration institutions,** to be implemented up to 31th August 2023[23]. Until these Amendments, mandatory implementation of EMS had been stated in those state direct administration institutions which have buildings with total heating area 10000 $m^2$ and above;
- **mandatory EMS in those derived public persons** which have buildings with total heating area 10000 $m^2$ and above, to be implemented up to 31th August 2023 or within a year from the date of entry into force of the said condition (new provision);

[22] Cabinet of Ministers Regulation No. 226 (2017) "Regulations on Energy Efficiency Obligation Scheme": https://likumi.lv/ta/id/290809

[23] In addition to the provisions of the Law, in 6th September 2022, the Cabinet of Ministers had approved the Decision which provides that by December 31, 2023, all ministries and the SJSC "State real estate" should implement EMS at the level of the ministries' resors, including in the EMS the subordinate institutions and capital companies of the ministries.

- **mandatory EMS in all municipalities.** The new provision reflects the administrative territorial reform, in force from the 1st July 2021. Until these Amendments, only the largest nine cities and those municipalities which had both the territorial development index above the stated threshold and population above 10 thousand inhabitants had been obliged.

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

The recast **Law on the Energy Performance of Buildings**[24] is in force from 9th January 2013. The Law, in accordance with the provisions of the Directive 2010/31/EC of the European Parliament and of the Council of 19th May 2010 on the energy performance of buildings (EPB Directive), recasts the general legal framework of setting the mandatory minimum energy performance requirements for buildings, the general principles of mandatory energy efficiency certification of buildings, verification of buildings heating systems and air conditioning systems, etc. The Amendments (8th October 2022) include the provisions of the amending Directive 2018/844/EU.

### Energy Performance Indicators (EPI) for buildings

The governmental regulations on the energy efficiency of buildings includes the following:

- regulation on the energy certification of buildings (energy efficiency classes and energy performance indicators, etc.);
- regulation on the minimal requirements for existing, in exploitation, buildings (both residential and non-residential ones)[25];
- new national Construction Standard LBN 002-19 "Thermotechnics of Building Envelopes".

In 2013, six **energy efficiency classes** (A-F) for residential and non-residential buildings had been introduced[26]. In its turn, in the 16th April 2021 new Regulation[27] regarding energy certification of buildings came into force. The 2021 Regulation adjusts the specific energy consumption values for heating (kWh per $m^2$ per year) depending on the heated area of the building (before only unified approach had been applied), thus provides for cost-effective values in smaller buildings. The new Regulation introduces EPI for both: (1) energy consumption for heating, and (2) non-renewable primary energy consumption.

***New Buildings***. The nearly-zero energy building (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 3.3.

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[24] Law on the Energy Performance of Buildings (recast): http://likumi.lv/doc.php?id=253635

[25] Cabinet of Ministers Regulation No 730 (10th December 2020) "Minimal Requirements for Existing, in Exploitation, Buildings": https://likumi.lv/ta/id/319443

[26] Cabinet of Ministers Regulation No. 383 (09.07.2013) "Regulations Regarding Energy Certification of Buildings": historical version, in force 19th July 2013 – 15th April 2021: https://likumi.lv/doc.php?id=258322

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

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

| Time period of approval of a construction intention | for residential buildings | | for non-residential buildings | |
|---|---|---|---|---|
| | multi-apartment buildings | one-apartment or two-apartment buildings | buildings which are in the ownership of the State or local government and in the possession of the authorities and where the State or local government authorities are located | other non-residential buildings |
| **Until 31st December 2016** | ≤ 70 kWh/$m^2$ per year | ≤ 80 kWh/$m^2$ per year | ≤ 100 kWh/$m^2$ per year | ≤ 100 kWh/$m^2$ per year |
| **From 1st January 2017 to 31st December 2017** | ≤ 60 kWh/$m^2$ per year | ≤ 70 kWh/$m^2$ per year | ≤ 90 kWh/$m^2$ per year | ≤ 90 kWh/$m^2$ per year |
| **From 1st January 2018 to 31st December 2018** | ≤ 60 kWh/$m^2$ per year | ≤ 70 kWh/$m^2$ per year | ≤ 65 kWh/$m^2$ per year | ≤ 90 kWh/$m^2$ per year |
| **From 1st January 2019 to 31st December 2020** | ≤ 50 kWh/$m^2$ per year | ≤ 60 kWh/$m^2$ per year | nearly zero-energy building ≤ 45 kWh/$m^2$ per year | ≤ 65 kWh/$m^2$ per year |
| **From 1st January 2021** | nearly zero-energy building ≤ 40 kWh/$m^2$ per year | nearly zero-energy building ≤ 50-60 kWh/$m^2$ per year (depending on the heated area) | nearly zero-energy building ≤ 45-50 kWh/$m^2$ per year (depending on the type of use and heated area) | |
| The presented values for 2021 and afterwards correspond to the re-casted values provided by the new 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"[28]. 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;

[28] Latvia Construction Standard LBN 002-19 "Thermotechnics of Building Envelopes", in force 01.01.2020: https://likumi.lv/ta/id/307966

- 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 LBN "Thermotechnics of Building Envelopes" systematically increases the requirements. The Amendments[29] (in force since 22th April 2014) to the LBN 002-01 "Thermotechnics of Building Envelopes" had transposed the provisions of the recast EPB Directive 2010/31/EU. In 1st July 2015 the LBN 002-15 "Thermotechnics of Building Envelopes"[30] had come into force. From the 1st January 2020 the new LBN 002-19 "Thermotechnics of Building Envelopes" is in force. Due to the new Construction Standard incorporates direcly the EPI for heating (in kWh per $m^2$ annually), 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.

**Energy Efficiency Requirements for DH Systems**. The Cabinet of Ministers Regulation No 243 (2016)[31] 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 2018 – not higher than 19%, from 1st January 2019 – not higher than 17%).

**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 the 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)[32];

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

[30] Latvian Construction Standard LBN002-15 "Thermotechnics of Building Envelopes: http://likumi.lv/ta/id/275015

[31] Cabinet of Ministers Regulation No. 243 (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": http://www.likumi.lv/doc.php?id=281914

[32] Amendments (3rd November 2015) to the Cabinet of Ministers Regulation No. 876 (2008) "Heat Energy Supply and Consumption Regulations": http://likumi.lv/doc.php?id=277661

- from the 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 the 1st January, 2027[33];
- from the 26th October – applies to all renovation projects of multi-apartment buildings, connected to DH system (remote readability)[34].

**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 the 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 measures based on the Energy Efficiency Law, the Law on the Energy Performance of Buildings, governmental regulations issued pursuant to the Laws and efficiency requirements for DH systems are included in the WEM scenario.

### 3.2.2 Economic policies and measures

#### 3.2.2.1 Programmes for DH Systems

In **EU Funds planning period of 2014-2020** the co-financing of investment is provided by Cohesion Fund (CF) within the framework of the National Operational Programme (NOP) *"Growth and Employment"*, Thematic Objective (ThO) No.4 *"Supporting the shift towards a low-carbon economy in all sectors"*, the Specific Objective (SO) 4.3.1. *"To promote energy efficiency and use of local RES in district heating systems"*. Within the first two calls, in 2017, the support has been provided for: (i) new RES utilising heat production sources (both additional RES capacities to supply new DH consumers and replacement of existing fossil fuel capacities); reconstruction for increase of energy efficiency of existing heat production sources utilising RES (renovation of heat boilers, construction of heat accumulation units), (ii) construction (widening) and renovation of DH pipeline systems aimed at reducing heat losses[35]. RES-heat technologies include both combustible (biomass) and solar heat ones. In March 2022, the third Call provided the additional financing for: (i) construction (to replace existing one) or reconstruction of heat production capacities to utilise RES, (ii) reconstruction

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[33] Cabinet of Ministers 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 Cabinet of Ministers Regulation No. 876 (2008) "Heat Energy Supply and Consumption Regulations": http://likumi.lv/doc.php?id=336253

[34] Amendments (16th June 2020) to the LBN 231-15 "Heat Supply and Ventilation (Conditioning) of Residential and Public Buildings": https://likumi.lv/ta/id/315565

[35] Cabinet of Ministers Regulations No 135 (17th March 2017), No 495 (22th August 2017) and No 167 (8th March 2022) regarding the implementation of the measure: 1st (https://likumi.lv/ta/id/289471). 2nd (https://likumi.lv/ta/id/293209) and 3rd (https://likumi.lv/ta/id/330758) open Calls respectively.

of CHP plant to heat boiler utilising RES, and (iii) construction of heat accumulation units. The implementation of the projects will be finished in 2023. The measure is included in the WEM scenario.

#### 3.2.2.2 Programmes for Household sector

**Energy Efficiency in Apartment Buildings**

In **EU Funds planning period of 2014-2020** increasing of energy efficiency in multi-apartment buildings is co-financed by EU Regional Development Fund (ERDF) within the framework of the NOP *"Growth and Employment".* The basic financing is provided within the ThO No. 4 *"Supporting the shift towards a low-carbon economy in all sectors"*, SO 4.2.1.1 *"To increase energy efficiency in residential buildings"*. In July 2020, the additional (*React-EU)* financing is provided to implement the new SO 13.1.1.2 "*To support heat insulation of multi-apartment buildings*" as one of the recovery measures, due to COVID pandemics, of the national economics Beneficiaries - community of flat owners of multi-apartment buildings (including municipalities as the owner of social flats and non-privatised flats). The implementation of the projects shall be done up to 1st October 2023. The financial assistance is provided in the following forms: (1) subsidy (grant), up to 50% of cost of energy efficiency improvement project, (2) repayable low-interest loan, issued by the JSC "Development Finance Institution Altum" (ALTUM), (3) guarantee for the loan, issued by the commercial financial institutions (banks). The annual heat energy consumption for heating after renovation of the apartment building shall not exceed 90 kWh per $m^2$ [36]. The measure is included in the WEM scenario.

In **EU Funds planning period of 2021-2027** the support for energy efficiency improvement of apartment buildings continues. The NDP for 2021-2027 envisages to improve energy efficiency in at least 23.6 thousand households, including flats[37]. The energy efficient renovation of multi-apartment buildings can be combined with the installation of RES microgeneration technologies. The financing is provided by two funds - **Latvia's Plan of EU Recovery and Resilience Facility** (hereinafter - **RRF Plan**, the First Component "Climate Change and Environmental Sustainability" of the Plan) and **Latvia's EU Cohesion Policy Programme for 2021-2027 EU Funds planning period** (hereinafter – **CP Programme**, the SO 2.1.1 "Promotion of energy efficiency and reduction of GHG emissions"). Both noted financing measures are included in the WEM scenario.

Within **RRF Plan funding** the investment contracts shall be signed up to 31st December 2023 and the projects implemented up to 31st August 2026. The financial assistance is provided in the form of a combined financial instrument: a loan by ALTUM, a guarantee for the loan issued by the commercial financial institution, a subsidy (grant) up to 49% of the eligible costs of the

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[36] Cabinet of Ministers Regulation No 160 (2016) "Regulations regarding implementation of the 4.2.1.1. Measure "Energy Efficiency Measures in Residential Buildings" of the SO No 4.2.1 "To increase energy efficiency in public and residential buildings" and the 13.1.1.2 Measure "Support for Insulation of Apartment Buildings" of the SO 13.1.1 "Recovery measures in economics" of the NOP "Growth and Employment"": consolidated version https://likumi.lv/ta/id/281323

[37] National Development Plan of Latvia for 2021-2027. Direction "Housing": table of Indicators, page 66, https://www.pkc.gov.lv/sites/default/files/inline-files/NAP2027__ENG.pdf

project. The project shall aim to achieve at least 30% primary energy saving[38]. In its turn, the **CP Programme funding**[39] for energy efficient renovation of multi-apartment buildings will start after the implementation of the RRF Plan funded programme.

**RES Technologies Implementation in Single Family, Two-apartment and Twin buildings**

The following two programmes are included in the WEM scenario.

**The EAAI financed programme "GHG emissions reduction in households – support for utilisation of RES"** has been approved on 1st March 2022[40] and will continue up to 31th December 2023 (or all the programmes financial volume is allocated to the beneficiaries). The programme aims to reduce GHG emissions in residential buildings - such as single-family buildings, summer and garden houses, semi-detached and two-apartment buildings, row houses (2+ sections). It supports the purchase of (1) RES-heat technology (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 technology (solar photovoltaic (PV), wind energy, including inverters, up to total capacity of 11.1 kW). Within the single project the beneficiary can purchase several noted above technologies.

**The programme on energy efficiency improvement and RES-electricity technology implementation in single-family, semi-detached, row and two-apartment buildings** had been adopted in February 2021, re-casted in March 2022[41] and currently is financed by the revenues of the State Energy Efficiency Fund[42]. The programme includes three instruments: (i) guarantee of loan, issued by commercial financial institutions, (ii) technical assistance grant (1 thousand EUR) and (iii) investment grant. **This combined financial instrument is available for the families with child.** In its turn, the guarantee for the loan (up to 30% of the loan, up to 20 thousand EUR, up to 10 years) is available for any household of the eligible buildings. The programme consists of two principal parts (the grant does not add up):

- **energy efficiency improvement** of building and its engineering systems, RES-heat production equipment might be included (no requirement for a replacement of a fossil fuel utilising boiler). As a result of the project, heat energy consumption for heating should be reduced by at least 20% and should be not higher than 90-95 $kWh/m^2$ annually (depending on the heated area of the building), the grant for energy efficiency improvement is 5 thousand EUR;
- purchase and installation **RES-electricity equipment**, primary energy consumption should be reduced by at least 20%. The installation of the RES-electricity technology

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[38] Cabinet of Ministers 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"": https://likumi.lv/ta/id/334084.

[39] Latvia's EU Cohesion Policy Programme for 2021-2027 EU Funds planning period, approved by the Cabinet of Ministers Ordinance No793, 2nd November 2022, https://esfondi.lv/planosana-1

[40] Cabinet of Ministers 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 https://likumi.lv/ta/id/330568

[41] Cabinet of Ministers Regulation No 103 (11th February 2021, re-cast 8th March 2022) "Regulations Regarding Support Programme for Renovation and Energy Efficiency Improvement of Single-Family Buildings and Two-Apartment Buildings": consolidated version https://likumi.lv/ta/id/321021

[42] Currently revenues due to energy efficiency duty paid by non-compliant with the Energy Efficiency Law large electricity consumers

can be done without performing the energy efficiency improvement measures for the whole building.

The approved in 2022 projects demonstrate the domination of solar PV technologies within the both programmes (around 90% of all installations within EAAI programme[43] and around 80% of appoved projects within the second programme). The maximum grant for solar PV technology is 4 thousand EUR and depends on the installed capacity.

#### 3.2.2.3 Programmes for Industrial Buildings and Technologies

**Efficient use of energy resources, reduction of energy consumption and transfer to RES in manufacturing industry: 2014-2020 EU Funds planning period.** Investment for new, innovative energy-saving technology, measures increasing energy efficiency and share of RES is co-financed by CF within the framework of the NOP "*Growth and Employment*", ThO No. 4 "*Supporting the shift towards a low-carbon economy in all sectors*", the SO 4.1.1. "*To promote efficient use of energy resources and reduction in energy consumption in the manufacturing industry sector*". The target group are both small (micro), small, medium and large enterprises. The general intensity of support is 30%. The following quantitative criteria shall be reached by the beneficiaries as the result of the project implementation: (1) energy efficiency improvement shall be at least 15% after implementation of energy efficiency improvement measures, (2) heat energy consumption for heating of industrial building shall not be higher than 110 kWh per $m^2$ per year, not applicable if only improvements of energy efficiency in production process are implemented[44]. The implementation of the projects will be finished in 2023. The measure is included in WEM scenario.

In **EU Funds planning period of 2021-2027** the support for energy efficiency improvement and RES technologies implementation in manufacturing industry continues. The financing is provided by both **RRF Plan** and **CP Programme**. Both financing measures are included in the WEM scenario.

**RRF Plan funding**, within the Open Calls, provides aid for the wide range of activities which are divided into **two principal directions – energy efficiency improvement** (at least 30% primary energy saving to be reached) **and RES technologies implementation[45].** Beneficiaries are registered in Latvia both micro, small and medium-sized enterprises (SMEs) and large enterprises operating in any economic sector, except specific ones. The programme 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 (calculated not including Value Added Tax (VAT)), but

[43] Latvian Environmental Investment Fund. The statistics of the programme implementation: http://ekii.lv/index.php?page=atbalsts-majsaimniecibam. Accessed 19th October 2022

[44] Cabinet of Ministers Regulations No 590 (06.09.2016), No 38 (16.01.2018) and No 506 (05.11.2019) regarding the implementation of the measure: 1st (https://likumi.lv/ta/id/284596), 2nd (https://likumi.lv/ta/id/296683), and 3rd (https://likumi.lv/ta/id/310544*)* open tenders respectively, consolidated versions

[45] Cabinet of Ministers 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)": https://likumi.lv/ta/id/336032

not more than 1.5 MEUR. The decision on providing the aid may be adopted until the expiration of the Commission Regulations No 651/2014 and No 1407/2013, but not later than 31th December 2025. The deadline for allocating the costs of the RRF Plan is 31th August 2026. First Call in Q4 2022.

The **CP Programme funding** also includes investment aid for energy efficiency improvement and RES technologies implementation in industry and commerce sector. Demarcation with the RRF Plan funding is provided at the project level by the ALTUM, while the national regulations provide the provisions to eliminate the risk of double financing and to respect the aid intensity.

**Latvia's EU Just Transition Fund Territorial Plan**[46] includes the measure focused to greening the business sector by increasing energy efficiency of buildings and production technologies and implementation of RES technologies. The measure is included in the WEM scenario.

**Investments Support Programme to Improve Energy Efficiency in Food Processing Enterprises.** In **2014-2020 EU Funds planning period** (implementation 2017-2022 including) the support is provided within the framework of the Measure 04.2 *"Investments"* of the national Rural Development Programme (RDP) 2014-2020, co-financed by Agriculture Fund for Rural Development (EAFRD). Regarding the results of energy efficiency improvement project, the following provisions are stated[47]: 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 & conditioning equipment) – energy efficiency shall be increased by 20% as well compared to the replaced technology. In case of fulfilment these criteria the investment support intensity is increased by 10% to general support intensity, and respectively can be 50% for the enterprise which annual turnovers is up to 1 MEUR and 40% for the enterprise which annual turnover is above 1 MEUR. The support might be used also for implementation of RES technologies in the enterprise. The measure is included in the WEM scenario.

#### 3.2.2.4 Programmes for Public Sector

**Increasing Energy Efficiency in Municipal Buildings: EU Funds planning period 2014-2020.** Investment to increase energy efficiency in public buildings of local governments is co-financed by ERDF within the framework of the NOP *"Growth and Employment"*. The basic financing is provided within the ThO No. 4 *"Supporting the shift towards a low-carbon economy in all sectors"*, the SO 4.2.2. *"To facilitate the increase of energy efficiency in municipal buildings, according to the integrated development programme of the*

[46] Approved by the Cabinet of Ministers Ordinance No 793, 2nd November 2022, Annexes 8 and 9 (the measure No 3.2) of the *Latvia's EU Cohesion Policy Programme for 2021-2027 EU Funds planning period*

[47] Cabinet of Ministers Regulation No 600 (2014) "Regulations on the State and EU financial support for the Measure's "Investments" open tenders": http://likumi.lv//doc.php?id=269868/.

*municipality"*[48]. In 2020 and September 2021, the additional (*React-EU)* financing is provided to implement new SO 13.1.3.1 "*Energy efficiency increase in municipal infrastructure"* as one of the recovery measures, due to COVID pandemics, of the economics. Implementation of the projects will be finished up to 31th December 2023. The measure is included in WEM scenario.

In **EU Funds planning period of 2021-2027** the support for energy efficiency improvement and RES-heat and RES-electricity technologies implementation in **municipal buildings** (buildings of municipalities, municipal capital companies and public-private capital companies, including public services providers) and their directly related infrastructure continues. The financing is provided by both **RRF Plan** and **CP Programme. RRF Plan**[49] provides, within the Open Call, the grant for 100% of the eligible costs of the project, the projects shall provide at least 30% primary energy saving and shall be implemented up to 31th December 2025. Within the **CP Programme** the intensity of aid is 85%. The same buildings will not apply and receive the support from various EU funds. Both financing measures are included in the WEM scenario.

**Increasing Energy Efficiency in State Public Buildings: EU Funds planning period of 2014-2020.** Increasing of energy efficiency in state public buildings is co-financed by ERDF within the framework of the NOP *"Growth and Employment"*, ThO No.4 *"Supporting the shift towards a low-carbon economy in all sectors"*, the SO 4.2.1.2 *"To increase energy efficiency in state buildings* Implementation of the projects was finished in 2022. At least 30% of heat energy (or heat energy plus electricity) savings should be reached in the building as a result of the implementation of the energy efficiency project; thermal energy consumption for heating should not be higher 90 kWh per $m^2$ annually (1st tender) or 110 kWh per $m^2$ annually (2nd tender)[50]. The beneficiaries might be direct state management authorities, institutions supervised by them, derived public persons which are state high schools/universities and research institutions, state capital companies which fulfil the management of state real estates. The beneficiaries might be also state ltd. companies of the health care sector (hospitals, rehabilitation centres), culture sector, sport centres of national status, dedicated several vocational education institutes, and also several dedicated non-governmental organisations having status of public benefit organization and fulfilling state delegated tasks. The measure is included in WEM scenario.

**Increasing Energy Efficiency in General and Vocational Education Institutions: EU Funds planning period of 2014-2020.** The NOP *"Growth and Employment",* ThO No8 *"Education,*

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[48] Cabinet of Ministers Regulation No. 152 (2016) "Regulations regarding the implementation of the 4.2.2. Specific Objective "To Facilitate the Increase of Energy Efficiency and Utilisation of Renewable Sources in Municipal Buildings, according to the Integrated Development Programmes of Municipalities" and of the 13.1.3.1 measure "Energy Efficiency Increase in Municipal Infrastructure for Economics Improvement" of the 13.13 Specific Objective "Recovery Measures in Environmental and Regional Development Sectors" of the National Operational Programme "Growth and Employment": http://likumi.lv/doc.php?id=281111

[49] Cabinet of Ministers Regulation "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)": Draft, https://tapportals.mk.gov.lv/structuralizer/data/nodes/27535c7b-424c-424e-bb12-fe05cd4d92a4/preview

[50] Cabinet of Ministers Regulations regarding the implementation of 4.2.1.2 Specific Objective "Increase of Energy Efficiency in State Buildings" of the National Operational Programme "Growth and Employment": 1st tender's Regulation No 534 (adopted 09.08.2016 https://likumi.lv/ta/id/284333) and 2nd tender's Regulation No 13 (adopted 04.01.2018, https://likumi.lv/ta/id/296336 ) respectively.

*Skills and Lifelong Learning"*, the SO 8.1.2 *"To improve study environment of general education institutions"* provides complex support, based on strategies of municipalities or associations of municipalities, concentrating resources and improving the learning environment in general educational institutions established by municipalities. This complex support includes different eligible activities aimed both to buildings (both buildings of school and dormitories) and their engineering systems and lighting themselves and to learning environment infrastructure (renovation of classrooms for natural sciences, laboratories, libraries and upgrading of related learning tools and equipment, implementation innovative Information and communications technology (ICT) solutions). Thus, the support includes also energy efficiency and RES related measures. The 38 municipalities are involved in the support programme[51]. In its turn, the SO 8.1.3 *"To increase number of fully modernised vocational education institutions"* provides similar complex support for vocational educational establishments[52]. Within these 2 programmes around 125 education establishments will be fully modernised (30 gymnasiums/secondary schools, 24 vocational educational institutions as well as a range of regional primary schools). The implementation of projects will be finished in 2023. The measure is included in WEM scenario.

In **EU Funds planning period of 2021-2027** the support for energy efficiency improvement and RES technologies implementation in **state buildings** continues. There are the overall programme and the programmes which relates to the buildings of the specific sectors.

The **CP Programme** (aid intensity 85-50%) provides investment aid for the measures improving energy efficiency and implementing RES technologies in the buildings in overall owned by state institutions and state capital companies. The measure is included in WEM scenario.

The financing of investments to improve energy efficiency and promote transition to the use of RES technologies for the **cultural function buildings** is provided by both **RRF Plan** and **CP Programme. RRF Plan**[53] provides the grant for 100% of the eligible costs of the project, the project shall provide at least 30% primary energy saving, the projects shall be implemented up to 1st June 2026. Within the **CP Programme** the intensity of aid is 85%. The CP Programme funding will start after the contracting the projects within the RRF Plan funded programme. Both noted financing measures are included in the WEM scenario.

The **CP Programme** (aid intensity – 85%) provides investments for increase of energy efficiency of **vocational education institutions buildings** to modernize and improve the infrastructure of buildings and related engineering networks and to implement long-term

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[51] Cabinet of Ministers Regulation No 323 (2016) "Regulations regarding the Implementation of National Operational Programme's "Growth and Employment" 8.1.2 Specific Objective "To improve study environment of general education institutions": https://likumi.lv/ta/id/282516

[52] Cabinet of Ministers Regulation No 249 (2016) "Regulations regarding the Implementation of National Operational Programme's "Growth and Employment" 8.1.3 Specific Objective "To increase number of fully modernised vocational education institutions", https://likumi.lv/ta/id/281827

[53] Cabinet of Ministers Regulation "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 1.2.1.4.i "Improvement of energy efficiency in state sector buildings, including historical ones": Draft, https://tapportals.mk.gov.lv/structuralizer/data/nodes/9708d62f-5728-415b-8fbf-1cf144b924ca/preview

management solutions for energy saving or utilization of RES. The measure is included in the WEM scenario.

As presented above, in *EU Funds planning period of 2014-2020* the current focus is to improve study environment of **general education institutions** sited mostly in cities and administrative centres of municipalities. In its turn, **the RRF Plan** provides the investment which focuses to basic education (grades 1-9) schools outside the administrative centers of municipalities. Though this investment programme relates to the RRF Plan Third Component "Reducing Inequality", the section 3.1 "Regional Policy", part of the investments relates to energy efficiency improvement of the buildings and their engineering systems[54]. The measure is included in the WEM scenario.

**Investment Support Programmes to reduce GHG emissions: national EAAI.** The revenues due to the auctioning of Latvia's allocated EU ETS GHG emission allowances are used for co-financing the energy efficiency measures which have high demonstration value. Several EAAI programmes had been implemented in 2018-2021 (with several projects finished in 2022): energy efficiency improvement in the public buildings having the status of national significance architecture monuments; nearly zero energy public buildings (construction of new buildings as well as reconstruction of existing ones) comprising smart technologies; as well as use of smart technologies for energy efficiency (efficient outdoor lighting) in urban environment[55]. These measures are included in the WEM scenario.

In July 2022 two new EAAI financed programmes have been approved and are included in the WEM scenario.

**GHG emisssions reduction in the public buildings having the status of national significance architecture monuments: 2nd Call.** Wide range of building's eligible uses and beneficiaries are stated. The general EAAI support (grant) intensity is 85% of project's total eligible costs. Implementation of the projects expected up to 2027. Annual heat energy consumption for heating after implementation of the project should not be higher than 75 -90 kWh/$m^2$ annually (depending on the volume of particular project's financing). Eligible investments include both energy efficiency improvement of the building and its engineering systems and implementation of RES-heat and RES-electricity technologies[56].

**GHG emissions reduction in the municipal public areas lighting infrastructure.** The EAAI support (grant) intensity is 70% of project's total eligible costs. Implementation of the projects expected up to 2024 including. Eligible investments include both purchase and installation of new energy efficient lighting fixtures or their components, lighting level adjustment devices

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[54] Cabinet of Ministers Regulation No 619 (4th October, 2022) "Implementing Rules of the Latvia's Plan of the EU Recovery and Resilience Facility investment No 3.1.1.5.i "Improving and equipping the infrastructure of general educational institutions"": https://likumi.lv/ta/id/336152

[55] Ministry of Environmental Protection and Regional Development. Annual Report on Use of EAAI revenues, 2021: https://www.varam.gov.lv/lv/media/31901/download

[56] Cabinet of Ministers Regulation No35 (12th January 2016) "Regulations of the Open Tender "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: https://likumi.lv/ta/id/279830

and support elements of the existing lighting system, and implementation of RES-electricity technologies, providing electricity for lighting infrastructure[57].

**Programme for Solar (PV) Energy. In 2021-2027 EU Funds planning period** the **CP Programme** provides the support in the form of financial instrument – loan issued by ALTUM, guarantee for loan issued by the commercial financial institution, subsidy (grant) - for the implementation of solar PV technologies, related storage equipment and smart solutions to ensure the overall system operation. Wide range of beneficiaries are stated – companies, municipal capital companies, cooperatives, energy communities (including ones in rural areas), households. The measure is included in the WEM scenario.

**Soft Loan Programme to Improve Energy Efficiency and Promote Renewable Energy in Businesses,** provided by ALTUM[58], are important part of the complex financial instrument for the commercial sector. The loan can be received by wide range of interested parties – individual merchants, micro enterprises, SMEs, large enterprises, state and municipalities owned companies. The loan is available also for energy service companies (ESCO) to provide energy services for companies and natural persons. The areas, for which the loan is available, are: energy efficiency (payback period of the project should be 5-7 years), renewable energy (payback period 15 years), green non-residential buildings (payback period 15 years). The main criterion is adequate flow of money – payment of loan due to cost savings. The loan can be up to 5 MEUR and up to 90% of the project costs[59].

There is also available another type of loan – **Soft Loan for Company Sustainability,** issued by ALTUM from the financial resources provided by the ERDF. This loan finances the investments in renewable energy (solar panels, wind turbines, biomass technologies) and new buildings of A and A+ class. The loan can be up to 2.85 MEUR and up to 90% of the project costs, reduced collateral requirements are applied[60].

To promote the energy efficiency improvements in existing properties, ALTUM provides also grants (85% of the total costs) for energy auditing and technical assistance. The first agreement with the ELENA programme[61] had been signed in December 2018 for the period 2019-2021 (including), the grants had been issued starting from May 2019. The beneficiary should perform investments in energy efficiency up to middle of 2022 of at least 20-fold of the amount of technical assistance received. On 31th December 2021 69 grants were issued

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[57] Cabinet of Ministers 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": https://likumi.lv/ta/id/334008

[58] State-owned Development Finance Institution ALTUM In October 2017 has emitted 7 years Green Bond (20 MEUR): https://www.altum.lv/en/investors/bonds/programme-17-green-bonds/about-green-bonds/ As at 30 June 2022 Altum has committed a total of 18.5 MEUR and disbursed a total of 17.3 MEUR for green projects: https://www.altum.lv/wp-content/uploads/2022/09/ALTUM_Investor-Report_30-June-2022.pdf

[59] Altum. Loan for Energy Efficiency (*Aizdevums energoefektivitātei*): https://www.altum.lv/pakalpojumi/biznesam/aizdevumi-uznemumu-eneregoefektivitatei/?tab=1

[60] Altum. Loan for Company Sustainability (*Aizdevums uzņēmumu ilgtspējai*): https://www.altum.lv/pakalpojumi/biznesam/aizdevumi-uznemumu-eneregoefektivitatei/?tab=2

[61] ELENA (European Local Energy Assistance) is a joint initiative by the European Investment Bank and the European Commission under the Horizon 2020 programme

by ALTUM with the total sum of 824 thousand EUR[62]. In July 2022, the ALTUM has signed the Second agreement "Energogrants" with the ELENA programme for the period 2022-2025[63]. The grant can be received by wide range of interested parties – individual merchants, micro enterprises, SMEs, large enterprises, state and municipalities owned companies, associations (societies). The same condition – investment at least 20-fold of the amount of technical assistance received – continues.

The loan and grant measures are included in the WEM scenario.

### 3.2.3 Fiscal policies and measures

The following measures – fuel taxation and taxation applicable for electricity – are included in the WEM scenario.

#### 3.2.3.1 Fuel taxation

**The fuel taxation presented relates to fuel utilized for energy production.** For transport fuel taxation and taxation of diesel oil utilized in agriculture sector mobile machinery, see in the Section of Transport sector.

**Excise duty on natural gas.** Sections 6[1] & 15[1] of the Law "On Excise Duties"[64] determine the rates of duty for natural gas. Natural gas is the dominating fossil fuel in energy production in Latvia. Starting from the 1st January 2014 the differentiated rates are applied, see Table 3.4. The reduced rate promotes the industrial production and the particular activities of agriculture sector.

**Table 3.4 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 |
| **Utilised as fuel** | 17.07 EUR/1000 $m^3$ | 1.65 EUR/1 MWh highest calorific value (HCF) |
| **Utilised as fuel to provide (see note 1)**<br>**(i) industrial production processes as well as other processes related to production,**<br>**(ii) the operation of technological equipment for agriculture raw materials pre-treatment,**<br>**(iii) necessary climate condition in the premises of industrial production and agriculture sector's raw materials pre-treatment**<br>**(iv) utilised by entities placed in industrial parks** | 5.65 EUR/1000 $m^3$ | 0.55 EUR/1 MWh, HCF |

[62] ELENA project factsheet, https://www.eib.org/attachments/documents/gieep-factsheet-en.pdf ; ALTUM 2021 Consolidated Annual Report, page 7, https://www.nasdaqbaltic.com/market/upload/reports/altm/2021_ar_en_eur_con_ias.pdf
[63] ELENA project "Energogrants" factsheet (2nd stage 2022-2025): https://www.eib.org/attachments/documents/143-project-factsheet-energogrants.pdf ; ALTUM. Grant for energy efficiency (*Grants energoefektivitātes projektu izstrādei*): https://www.altum.lv/pakalpojumi/biznesam/aizdevumi-uznemumu-eneregoefektivitatei?tab=4
[64] Law "On Excise Duties": 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 |
| **Utilised to provide heating of greenhouses, industrial scale henhouses/sheds and incubators (see note 2)** | Exempted | Exempted till 30 April 2020<br>From the 1st May 2020 - 0.55 EUR/1 MWh, HCF. |
| **Used for other purposes (not as fuel), utilised in two ways (ncluding processes of chemical reduction, electrolytic and metallurgy processes)** | Exempted | |
| **Amount of NG used by the operator of NG transmission, storage and distribution system for the technological needs of NG supply, including losses during supply** | Exempted | |
| Notes:<br>(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 corresonds to the Annex I, part A "Agriculture, Forestry and Fishery", section 01.63 of the given Regulation.<br>(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 actual rates are: (i) residual fuel oil – 15.65 EUR/ton, (ii) kerosene, diesel (gas oil) – 60 EUR/1000 litres. The exempt is made for the oil products utilised for electricity production and for production in CHP mode. Oil gasses and other hydrocarbons if supplied to persons who use them as heating fuel or in gas furnaces (not as the transport fuel) are exempted from the duty as well.

**Duty on coal, coke and lignite (brown coal).** The procedure of taxation applicable for these fuels is prescribed by the **Natural Resources Tax Law**[65]. From the 1st January 2020 tax rate has been doubled and is 0.76 EUR/GJ or 21.3 EUR/ton if information of specific heating value of coal is not available. Up to 31th December 2019 zero tax rate had been stated for coal, coke and lignite utilised for electricity production and in CHP mode.

### 3.2.3.2 Taxation applicable for electricity

The procedure is prescribed by the **Electricity Tax Law**[66]. 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 engaged in the generation, distribution, supply, selling of electricity as well as purchasing electricity in spot exchange. The exemption applies for the autonomous producers, who generate and consume electricity for their own needs and fulfil the following requirements: the total generation capacity does not exceed 2 MW, and energy resources taxable with excise duty, coal taxable with the nature resource tax or electricity taxable with the electricity tax is

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

used for the generation of the electricity. Related to other end-use consumers, the exemptions/zero rate is applied to (i) household users, (ii) street lighting services. From the 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.

#### Energy Audits of Residential Multi-apartment buildings

The objective of the measure is more efficient use of final energy, reducing energy loss and emissions by providing reasoned quantitative information and recommendations for increasing energy efficiency. The financial support for preparation of technical documentation related to buildings' energy efficient renovation is stated as the eligible cost for multi-apartment building renovation co-financed by ERDF in 2014-2020 EU Funds planning period. Also, in the period after 2020, for instance, the RRF Plan programme on energy efficient renovation of multi-apartment buildings (see the section 3.2.2.2 above) includes the financial assistance for the preparation of the technical documentation of the project (grant up to 49% of the costs, not exceeding 10 thosand EUR). Also, within the on-going specially focused programme for energy efficiency improvement of single-family and two-apartment buildings, the technical assistance grant (1 thousand EUR) is available for families with child (pregnancy).

#### Informing Energy Consumers of Residential Sector

The measure motivates to renovate buildings in the frame of the ERDF co-financed measure of increasing energy efficiency in multi-apartment buildings. The programme *"Let's live warmer!''* had started in EU Funds 2007-2013 planning period. Currently the implementation of the 2014-2020 planning period of EU Funds is on-going**.** On 4th March 2020, the MoE, the MEPRD and 34 state administrative institutions, non-governmental organizations (NGOs) and state capital companies signed the renewed Memorandum of Cooperation, committing to jointly ensure the availability of information on possibilities of the renovation, reconstruction and energy efficiency improvement of buildings. Wide scope of methods is applied by the informative programme *"Let's live warmer!''* to reach and to inform and consult communities of the apartments' owners regarding conditions and benefits of energy efficiency increase and the best practices of it, to present the typical faults during energy efficient renovation process, etc. Important, the programme consults on not only renovation but also the practice of maintaining the apartment building after renovation (the particular theme "Life of building after renovation"). The NECP 2021-2030 provides the continuation of *"Let's live warmer!''* programme for the next period. As the particular programme on energy efficiency improvement of single-family and two-apartment buildings is ongoing, the *"Let's live warmer!"* is extending the activities to this target group as well.

### Labelling of appliances

The national legislative framework by transposition of the provisions of the Ecodesign Directive 2009/125/EC and of the revised Directive on Labelling and standard product information of Energy Related Products (2010/30/EU) has been implemented in due time[67]. The provisions, stated by the Energy Labelling Regulation 2017/1369/EU and particular Commission Regulations on eco-design and labelling for particular goods, are implemented directly by the responsible parties.

### 3.2.5 Voluntary negotiated measures

The Energy Efficiency Law includes the Section 8 stating the general procedure of energy efficiency improving agreements. In October 2016 the Cabinet of Ministers had adopted the Regulation No. 669[68] determining the detailed procedures for voluntary agreements on energy efficiency and having the following main provisions - at least 10% of energy efficiency improvement, development of energy efficiency action plan, agreement duration at least 5 years, reporting of energy savings. The participants of the agreement can be private companies, associations representing them, municipalities and associations/unions of municipalities, planning regions. At the moment the practice of the voluntary agreements is in the start phase: currently three voluntary agreements are in the operational implementation - two with municipal district heating utilities (duration – 5 years, signed in December 2017 and March 2018) and one with the local municipality (duration – 10 years, signed in December 2020)[69]. The measure is included in the WEM scenario.

## 3.3 TRANSPORT

### 3.3.1 Regulatory policies and measures

#### 3.3.1.1 Biofuel Blend Obligation

To ensure growth of the share of RES in the transport sector, on the 1st October 2009 Latvia had introduced the Biofuel Blend Obligation[70]. Table 3.5 presents the requirements in force from 2018. Blended biofuels shall correspond to the sustainability criteria. The measure is included in the WEM scenario.

The Regulation applies to fuels offered on the Latvian market for the operation of spark-ignition and compression-ignition engines both for motor vehicles and all-terrain vehicles,

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[67] (1) Cabinet of Ministers Regulation No. 941 (in force from 15.12.2011) "Regulations regarding Ecodesign Requirements for Energy-related Goods (Products)": http://likumi.lv/doc.php?id=241282 ; (2) Cabinet of Ministers Regulation No. 480 (in force 20.07.2011-19.05.2020 ) "Regulation regarding Labelling of Energy and Other Resources Consumption Related Products as well as Their Advertisment and Supervision": http://likumi.lv/doc.php?id=232553

[68] Cabinet of Ministers Regulation No 669 (2016) "Procedures for Concluding and Supervising a Voluntary Agreement on Energy Efficiency Improvement": https://likumi.lv/ta/id/285879

[69] State Construction Control Bureau of Latvia (the authority responsible for energy efficiency monitoring). Voluntary agreements (Brīvprātīgās vienošanās): https://www.bvkb.gov.lv/lv/brivpratiga-vienosanas

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

including agricultural and forestry tractors, inland waterway vessels, as well as recreational craft when not sailing at sea, taking into account the technical requirements of these engines in relation to health and environment protection.

**Table 3.5 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 | |

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;
- gasoline utilised: (i) in cars participating in sport competitions, (ii) in avio engines.

#### 3.3.1.2 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[71]. Mandatory systematic inspection of technical conditions relates also to tractors.

The measure is included in the WEM scenario.

To reduce administrative burden for owners of new cars, 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.

[71] Cabinet of Ministers Regulation No. 295 (2017) „Regulations on motor vehicles state technical inspection and technical roadside inspection": https://likumi.lv/doc.php?id=292396

#### 3.3.1.3 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

The Alternative Fuels Development Plan for 2017-2020[72] provided for the development of the electric vehicle (EV) charging infrastructure as well as liquefied petroleum gas (LNG) and compressed natural gas (CNG) fuelling infrastructure.

#### 3.3.2.1 Electromobility Development

**EV charging Infrastructure Development**

**EU Funds Planning Period of 2014-2020.** Development of country-wide EV charging infrastructure has been supported by the ERDF within the framework of the NOP "*Growth and Employment*", ThO No. 4 “*Supporting the shift towards a low-carbon economy in all sectors*”, the SO 4.4.1. The implementation of a single national level fast charging infrastructure coverage (139 EV direct current fast charging points with capacity up to 50 kW) has been finished at the end of 2021 promoting the development of EV market and increase of EVs in road transport[73].

Including also the EV charging points installed by private investors, the total number of EV charging infrastructure in Latvia at the end of October 2022 were 392 locations with total 1119 connectors (of which 487 – Type 2, 314 – CCS2, 299 – CHAdeMO, 19-others)[74].

**EU Funds Planning Period of 2021-2027.** The **CP Programme** (the SO 2.4.1 “To promote sustainable multi-modal mobility by developing EV charging infrastructure”) provides investment support to establish 14 large capacity EV charging points in the Trans-European Transport Network (TEN-T), including providing the smart applications for use of them.

**Electric Vehicles (EV) Charging Infrastructure Development in public areas.** Power Distribution System Operator SJSC “Sadales tīkls” in cooperation with other partners will install more than 2 thousand new publicly available EV charging points throughout Latvia. The project is implemented with the support of the **RRF Plan.** The infrastructure from the distribution network to the metering substation will be designed and built by DSO "Sadales tīkls", while from the substation to the charging equipment, as well as the installation of the charging equipment will be provided by co-operation partners – state authorities, municipalities, other derived public persons, state and municipal capital companies, public

[72] Alternative Fuels Development Plan 2017-2020. Approved by the Cabinet of Ministers Ordinance No 202 (25th April 2017): http://polsis.mk.gov.lv/documents/5893

[73] Cabinet of Ministers Regulation No. 637 (03.11.2015) “Regulations regarding the implementation of the Operational Programme’s “Growth and Employment” 4.4.1. Specific Objective “To Develop the Electric Vehicles’ Charging Infrastructure of in Latvia” : https://likumi.lv/doc.php?id=277693

[74] Electromaps: https://www.electromaps.com/en/charging-stations/latvia Acessed 24th October 2022.

private companies. Specific locations of charging points will be determined in the partnership agreement. The charging point is up to 22 kW [32 A, 0,4 kV][75].

Both measures above regarding EV charging infrastructure development are included in the WEM scenario.

### EV purchase support

**Households: EAAI programme in 2022-2023.** Support is provided both for (1) battery EV (BEV), both new and exploited ones of M1 and N1 category having zero emissions, and (2) plug-in hybrid EV (PHEV, only new ones of M1 and N1 category) having GHG emissions up to 50 g per km. The annual mileage per vehicle to be reached is stated 52000 km during 5 years (10400 km annualy in average). The amount of grant is differentiated: (1) purchase of new BEV – 4500 EUR, (2) purchase of exploited BEV and new PHEV – 2250 EUR. When purchasing a new BEV or PHEV, it is also provided support (1000 EUR) for the scrapping of an existing vehicle by handing it over to a treatment company. Also, the trader merchant - BEV and PHEV seller - shall offer the customer a program that has an additional incentive effect (discount, attractive leasing conditions, maintenance, etc.) of 1000 or 500 EUR respectively. The programme will be active up to 31th December 2023[76]. Around 3.3 thousand EVs of M1 and N1 category in total are expected to be purchased.

**Manufacturing industry: RRF Plan funding[77],** within the Open Calls, provide combined financial instrument consisting 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 aid is granted for the purchase of a new, industrially produced M1 category BEV which has not been previously registered in Latvia. The beneficiaries can be registered in Latvia both micro, SMEs and large enterprises on conditions their core business sector is the manufacturing industry and, in addition, one of the following criteria is met: the beneficiary in the last closed financial year (1) exported at least 51% of the production, or (2) export volume was at least 1 MEUR. The aid is granted as *de minimis* aid. The decision on providing the aid may be adopted by the ALTUM until the expiration of the Commission Regulation No 1407/2013, but not later than 31th December 2025; the deadline for allocating the costs of the RRF is 31th August 2026. First Call in Q4 2022. The maximum grant for the purchase of one BEV is 5000 EUR and up to 180 thousand EUR for the single beneficiary for the purchase of all BEV within the whole project. The grant shall not exceed the 30% of the eligible costs of the project. Around one thousand EVs of M1 category in total are expected to be purchased, with expected annual mileage 20 thousand km.

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[75] Cabinet of Ministers 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"", https://likumi.lv/ta/id/337225

[76] Cabinet of Ministers 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": http://likumi.lv/ta/id/328761

[77] Cabinet of Ministers 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)": https://likumi.lv/ta/id/336032

Both measures above regarding EV purchase supporting are included in the WEM scenario.

#### 3.3.2.2 Development of the infrastructure of environmentally friendly public transport (PT) in cities and for municipal sevices

**In EU Funds planning Period of 2014-2020** the development of the infrastructure of PT is co-financed by CF within the framework of the NOP "*Growth and Employment*", the SO 4.5.1. The increase of number of environmentally friendly vehicles of PT (trams[78] and buses) and length of tram lines is on-going. Thus, more effective urban transport infrastructure will be developed promoting the use of PT. Investments are made in accordance with city development plans[79,80]. These investments result in at least 20 km new and improved tram lines and purchase or upgrade of 123 environmentally friendly buses. The implementation of the projects will be finished in 2023. The measure is included in the WEM scenario.

**In the period up to 2030** the investment support to purchase clean public and municipal transport is provided by both RRF Plan and Latvia's Territorial Plan of EU Just Transition Fund[81] (JTF). The total number of new zero emission vehicles will constitute at least 70 buses, replacing previously used fossil fuel uitlizing ones, and 4 low-floor trams[82]. The measures below are included in the WEM scenario.

- **The RRF Plan,** within the Third Component "Reducing inequalities" (with focus on the consequences of 2021 administrative territorial reform) provides the support for the purchase of zero-emission (electric) school buses[83]. At least 15 zero emission buses (M2 and M3) and related charging equipment will be purchased up to 31th December 2025. As a result of their purchase, the beneficiary stops operating a vehicle of category M2 or M3 fueled by fossil fuels that has been in its possession for at least 3 years, is in technical order and whose age at the time of project submission, taking into account the year of its first registration, is at least 20 full calendar years and whose engine emission level is EURO III or more polluting. Beneficiary in this programme cannot be capital city Riga;

[78] In capital city Riga, Liepaja and Daugavpils cities

[79] Cabinet of Ministers Regulation No 467 (2020) "Regulations regarding Implementation of the Operational Programme's "Growth and Employment" Measure 4.5.1.1. "To Develop the Infrastructure of Environmentally Friendly Public Transport (Rail Transport)": http://likumi.lv/doc.php?id=316400

[80] Cabinet of Ministers Regulation No 848 (2016) "Regulations regarding Implementation of the Operational Programme's "Growth and Employment" Measure 4.5.1.2 "Development of Environmentally Friendly Public Transport (Buses) Infrastructure": http://likumi.lv/doc.php?id=287628

[81] Cabinet of Ministers Order No 503 (2022) "On the Territorial Plan of EU Just Transition Fund": https://likumi.lv/ta/id/334018-par-taisnigas-parkartosanas-teritorialo-planu

[82] On the 1st July 2022 there were 59 electric buses registered in Latvia, thus, the implementation of the measure will double the number of electric buses

[83] Cabinet of Ministers 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":

- The support for clean vehicles to provide municipal functions and services is included in the programme **funded by the JTF,** the purchase of at least 38 zero emission buses will be done[84];
- **The RRF Plan** provides wide complex investment for greening transport in the Riga metropolitan area.

**Greening transport in the Riga metropolitan area.** RRF Plan provides investment, within the first Plan's component "Climate Change and Environmental Sustainability", to develop an integrated, environmentally friendly and well-developed PT system. Three directions of investment are stated, implementation up to 2026 (including):

- environmentally friendly improvement of the Riga city PT system: zero emission PT vehicles (at least 17 electric buses and 7 charging stations, 4 low-floor trams), extension of tram lines, creation of new high-speed PT line, improvement of PT access infrastructure of particular railway stations in Riga area by creating smart digitalized multi-modal points;
- development of bicycling infrastructure, connecting five major suburbs, of the total length of around 60 km;
- competitive rail passenger transport, integrated in the common PT system of Riga metropolitan area.

The measure is included in the WEM scenario.

#### 3.3.2.3 Electrification and energy efficiency improvement of the Latvia's railway network

The policy of low-emission and zero-emission transport development, including railway, is included in the NDP for 2021-2027 to be implemented up to 2029 (including). The measures below are included in the WEM scenario.

The **CP Programme,** in the SO 3.1.1 "To develop a sustainable, climate-resilient, smart, secure and diverse TEN-T infrastructure" includes the measure, objectives of which is to improve energy efficiency of public passenger transport by investing in the modernization and development of the existing electrified railway network (for passenger transport), as well as in the expansion of the electrified railway network in the Riga agglomeration on routes where passenger transport is currently provided by diesel trains[85].

As presented above, **RRF Plan** invests for the complex improvement of electrification of railway system in Riga metropolitan area. 9 battery electric multiple unit (EMU) trains will be purchased up to 2026 and zero-emission railway infrastructure on 81 km of track along three

[84] Approved by the Cabinet of Ministers Ordinance No 793, 2nd November 2022, Annexes 8 and 9 (the measure 3.3) of the *Latvia's EU Cohesion Policy Programme for 2021-2027 EU Funds planning period*

[85] Measure description *by Annex 7 of the Latvia's EU Cohesion Policy Programme for 2021-2027 EU Funds planning period*

railway lines, including increase of total length of electrified lines and catenary replacement for transition to 25 kV electrification system, will be promoted by the RRF Plan.

Latvia's NECP2030 provides to promote the creation of multimodal PT points to combine the diversity of PT (road, rail and bicycle) and facilitate the transport shift from city centres. NDP2027 envisages the establishment of the multi-modal PT system having the rail transport as the central element. Passenger-convenient connecting points between rail and buses transport modes have to be ensured. The investment for the development of multi-modal PT network, including multi-modal mobility points and *Park&Ride* infrastructure, is included in the **CP Programme's** ThO "Sustainable mobility", the SO 2.3.1 "To promote the sustainable and diverse mobility in cities/towns".

#### 3.3.2.4 Loan Programme for Sustainable Transport

**Soft loans** are issued by the ALTUM. The overall conditions of the loans programme are presented above, in the section 3.2.2.6. One of the loans programme areas is sustainable transport. The activities can include, for instance, sustainable mobility, electrical vehicles, biogas-based transport. The main criterion is adequate flow of money – payment of loan due to cost savings. Payment period should be up to 7 years. E.g., using this loan, the electric car-sharing fleet (100 cars) has been established by the Latvian trade mark company "Figsy" in July 2020[86]. Other financed projects are electric bycicles and city electric buses[87]. There are also available another type of loan – **Soft Loan for Company Sustainability** which, among others, finances investments in electric vehicles and related infrastructure. The measure is included in the WEM scenario.

### 3.3.3 Fiscal policies and measures

The following fiscal measures are included in the WEM scenario.

#### 3.3.3.1 Excise Tax – Transport sector

Law "On Excise Duties" establishes procedure by which duty shall be imposed. The Sections 5, 14 and 18 determine the rates of duty for gasoline and diesel oil. The Sections $6^1$&$15^1$ determine the rate for natural gas (Table 3.6).

[86]News website, https://www.delfi.lv/bizness/biznesa_vide/foto-riga-darbibu-sacis-lielakais-koplietosanas-elektroauto-parks-latvija.d?id=52283647

[87] ALTUM Green Bond Project-by-project report (as Annex to ALTUM Green Bond Investor Report as at 30 June 2021): https://www.altum.lv/wp-content/uploads/2022/06/gb_project_by_project_30_06_2021_v0609_final_2a68a.pdf

**Table 3.6 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 |
| **Unlead gasoline** | 476 | 509 | 509 |
| **Unlead 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 |
| **Lead gasoline** | 594 | 594 | 594 |
| **Diesel oil (including diesel oil with any mix of biodiesel)** | 372 | 414 | 414 |
| **Diesel oil utilised in agriculture sector (earmarked amount per ha)** | 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 |
| **Oil gasses and other hydrocarbons (per 1000 kg)** | 244 | 285 | 285 |
| **Natural gas (per 1 MWh, highest calorific value)** | 9.64 | 9.64 | 1.91 (01.01.2021-31.12.2025)<br>10 (from 01.01.2026) |

To promote natural gas utilising vehicles, the reduced rate for natural gas - 1.91 EUR per MWh – is stated for the period 1st January 2021 – 31st December 2025. From the 1st January 2026 tax rate of 10 EUR per MWh will be applied.

### 3.3.3.2 Exemption from electricity taxation

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

### 3.3.3.3 Annual taxation of vehicles

The policy of taxation on vehicles based on their specific emissions is introduced in Latvia in several steps.

The vehicle annual operation tax based on the specific $CO_2$ emissions of the vehicle (plus fixed supplement for those engines capacity of which exceeds 3500 $cm^3$) has been introduced for the new cars (in force from 1st January 2017) and for the cars firstly registered from 1st January 2009 (tax applied starting from 2019)[88].

For light duty vehicles (gross weight up to 3500 kg) the annual operation tax, based on the specific $CO_2$ emissions, for the vehicles registered after 2011 came into force 1st January 2021[89].

For the cars and light duty vehicles with the specific $CO_2$ emissions not more than 50 grams per km zero tax rate is applied.

For buses with gross weight above 3500 kg and heavy duty vehicles with gross weight above 3500 kg the annual operational tax is based on EURO class, starting from 2021.

### 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 Cabinet of Ministers Regulation No. 608[90] 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 third trading period covered 2013-2020. The Latvia's National Emissions Allowances Allocation Plan for 2013-2020 was approved by the Ordinance of the Cabinet of Ministers No. 499 (2011, with amendments in 2013) "On Emissions Allowances Allocation for 2013-2020: List of installations and allowances"[91]. Actual amendments in the Plan had been included by the MEPRD Decisions on Allocation of Emission Allowances to Operators of EU ETS 2013-2020

[88] Law „On the Vehicle Operation Tax and Company Car Tax": https://likumi.lv/ta/id/223536
[89] For the older cars and light duty vehicles, registered before 2009 and 2011 respectively, the annual operation tax is also differentiated based on engine capacity, maximal power of engine and the gross weight of the vehicle. For light buses annual operational tax continues to base on the gross weight.
[90] Cabinet of Ministers Regulation No. 608 (2004) „Regulations Regarding Consumer Information to be Provided in Labelling and Promotional Publications on Fuel Consumption and $CO_2$ Emissions of New Passenger Cars": http://likumi.lv/doc.php?id=91538
[91] Cabinet of Ministers Ordinance No 499 (2011) "On Emissions Allowances Allocation for 2013-2020: List of Installations and Allowances": https://likumi.lv/ta/id/236986

period. In 2020 - 61 stationary installations (owned by 43 legal operators) and 1 avio operator participated in EU ETS.

The fourth trading period, which covers 2021-2030 and has been divided into two consecutive periods, will be implemented according to the Directive 2018/410/EU of 14th March 2018. The Latvia's National Emissions Allowances Allocation Plan for 2021-2025 was approved by the Ordinance of the Cabinet of Ministers No. 335 "On Emissions Allowances Allocation for 2013-2020: List of installations and allowances"[92]. Actual amendments in the Plan have been included by the MEPRD and MoCE Decisions on Allocation of Emission Allowances to Operators of EU ETS 2021-2025 period. In 2022 52 stationary operators and 2 avio operators participated in EU ETS.

### Emissions taxation

The procedure of emissions taxation is prescribed by the **Natural Resources Tax Law**[93]**.** 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 was introduced from the 1st July 2005. In the period 1st January 2017 - 31th December 2019 the tax rate was 4.5 EUR per ton of $CO_2$ emissions. From the 1st January 2020 tax rate per ton of $CO_2$ emission was 9 EUR. This rate is raised up to 12 EUR (in 2021) and 15 EUR (from the 1st January 2022) per ton of $CO_2$ emissions. The subject of $CO_2$ emission taxation is such $CO_2$ emitting activities (installations) which corresponds to EU ETS activities however the amount of the activity (installation) is below the threshold defined for inclusion in EU ETS. The tax shall not be paid for the emissions of $CO_2$ which emerges (i) while using RES, and (ii) from the installations participating in EU ETS. Untill 31st December 2020 the tax exemption was applied also to utilisation of local fuel – peat. In terms of phasing out harmful subsidies, the tax exemption regarding using peat in combusting instalations was cancelled.

Taxation on noxious air polluting emissions creates synergy with $CO_2$ taxation. The taxable are emissions of $PM_{10}$ (120 EUR/ton, from the 1st January 2023 – 135 EUR/ton), CO (7.83 EUR/ton), $NH_3$, $H_2S$ and other non-organic compounds (70 EUR/ton, from the 1st January 2023 – 90 EUR/ton), $SO_2$ and $NO_x$ (140 EUR/ton, from the 1st January 2023 – 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 2022 rates and 2023 onwards rates (if increased) indicated. The subject of air polluting emissions taxation is person who has a duty to receive a polluting activity permit or certificate.

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[92] Cabinet of Ministers Ordinance No 335 (2021) "On Emissions Allowances Allocation for 2021-2025: List of Installations and Allowances": https://likumi.lv/ta/id/323330

[93] Natural Resources Tax Law: http://likumi.lv/doc.php?id=124707

## Green Public Procurement (GPP)

Public Procurement Law[94] 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 environmental protection requirements, the rules regarding climate change mitigation (reduction of GHG emissions) and adaptation, energy efficiency (Section 20.4).

The Section 19 states the general framework for GPP detailed by the Cabinet of Ministers Regulation No. 353[95]. Regarding energy consumption, the GPP Regulation relates to:

- ICT equipment, including computers and imaging printing equipment, indoor lighting, street lighting, traffic signals (stated GPP criteria are mandatory, Annex 1);
- electricity, construction works, heat boilers, electronic equipment in health care sector (GPP criteria can be applied on voluntary basis, Annex 2).

Pursuant to the Public Procurement Law, the minimum energy efficiency requirements for goods and services (including tyres) procured by state central administration institutions are stated[96].

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

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

94 Public Procurement Law: https://likumi.lv/doc.php?id=287760
95 Cabinet of Ministers Regulation No 353 (2017) "Requirements of Green Public Procurement and the Procedures They shall be Applied": https://likumi.lv/ta/id/291867.
96 Cabinet of Ministers Regulation No. 180 (2017) “Requirements regarding Energy Efficiency to be Applied in the Goods’ and Services’ Public Procurements of State Direct Administration Institutions": https://likumi.lv/doc.php?id=289757

In its turn, in September 2021 the provisions of the **amending Directive 2019/1161/EU** regarding the procurement targets for the share of clean vehicles have been transposed[97]. 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 CO2 and up to 80% of applicable real driving emission (RDE) limits for NOx 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).

**Table 3.7 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[98]** | 35% | 50% |

In its turn, voluntary application of GPP criteria relates to such vehicles and services as new zero and low-emission cars and light duty vehicles (purchase or leasing), public transport – low emission buses (purchase, leasing or service providing), low emission waste collecting vehicles (purchase, leasing or service providing). For the traffic signals the GPP criteria are mandatory.

## 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”[99]. Law “On Pollution” states principal framework for the implementation of BAT. Namely, conclusions on the BAT is 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

[97] 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.
[98] Buses (vehicle category M3) – half of the target to be fulfilled by procuring zero-emission buses.
[99] Law on Pollution: https://likumi.lv/doc.php?id=6075

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:

- BAT are applicable to the most effective and progressive technological and operational methods development stage in which is shown the actual applicability of specific methods in order to prevent and – in cases where prevention is impossible – reduce emissions and the impact on the environment as a whole, and they are intended in order to specify the basic principle for the calculation of emission limits;
- 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) No. 517/2014 of The European Parliament and of the Council on fluorinated greenhouse gases and repealing Regulation (EC) No. 842/2006;
- The Directive 2006/40/EC of the European Parliament and of the Council relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC.

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

- improving the prevention of leaks from equipment containing F-gases. Measures comprise: containment of gases and proper recovery of equipment; training and certification of personnel and of companies handling these gases; labelling of equipment containing F-gases; reporting on imports, exports and production of F-gases. Several bans on the placing in the market, maintenance and service products and equipment containing HFCs with high GWPs are requirements of Regulation (EU) No. 517/2014;

- avoiding F-gases in some applications where environmentally superior alternatives are cost-effective. Measures include restrictions on placing in the market and use of certain products and equipment containing F-gases.

At national level the Regulation No. 704[100] of the Cabinet of Ministers of Latvia "Requirements for operations with ozone-depleting substances and fluorinated greenhouse gases" which replaces CoM Regulation No. 563 was adopted on 1st November 2021. The new CoM Regulation No. 704 was developed with the aim to improve the accuracy and quality of F-gases data and to implement more precisely Regulation (EU) No 517/2014. 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 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 Cabinet of Ministers No. 186[101] 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 Cabinet of Ministers No. 231 adopted on 3 April 2007 "Regulations Regarding the Limitation of Emissions of Volatile Organic Compounds From Certain Products" contains legal norms arising from Directive 2004/42/EC.

## 3.6. AGRICULTURE

### 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

[100]Cabinet of Ministers Regulation No.704 (2021) "Requirements for operations with ozone-depleting substances and fluorinated greenhouse gases": https://likumi.lv/ta/id/327117-prasibas-darbibam-ar-ozona-slani-noardosam-vielam-un-fluoretam-siltumnicefekta-gazem

[101]Cabinet of Ministers Regulation No.186 (2013) "Regulations to limit emission of volatile organic compounds from installations, in which organic solvents are used": https://likumi.lv/doc.php?id=256096

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

The purpose of Law "On Environmental Impact Assessment" (1998)[103] 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 Cabinet of Ministers No. 834[104] adopted on 23rd December 2014 "Requirements Regarding the Protection of Water, Soil and Air from Pollution Caused by Agricultural Activity" and Regulations of the Cabinet of Ministers No. 829 adopted on 23rd December 2014 "Special Requirements for the Performance of Polluting Activities in Animal Housing"[105].

#### 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 digesters 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.

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[102] Saeima (2001) "Law on Pollution": https://likumi.lv/ta/en/en/id/6075
[103] Saeima (1988) Law on Environmental Impact Assessment: https://likumi.lv/doc.php?id=51522
[104] Cabinet of Ministers No.834 (2014) "Regulations on protections of water and soil from pollution caused by nitrates from agricultural activities": https://likumi.lv/doc.php?id=271376
[105]Cabinet of Ministers No.829 (2014) "Special Requirements for the Performance of Polluting Activities in Animal Housing": https://likumi.lv/ta/en/en/id/271374

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

According to Cabinet of Ministers Regulation No. 834 (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 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 up 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 Cabinet of Ministers Regulation No. 834 (2014) “Regarding to Protection of Water and Soil from Pollution with Nitrates Caused by Agricultural Activity” in highly vulnerable zones farmers who 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 Cabinet of Ministers Regulation No. 1056 “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.[106] 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

[106] Cabinet of Ministers No.1056 (2009) “Requirements for Integrated Cultivation, Storage and Labelling of Agricultural Products and the Procedures for Control Thereof”: https://likumi.lv/ta/en/en/id/197883-requirements-for-integrated-cultivation-storage-and-labelling-of-agricultural-products-and-the-procedures-for-control-thereof

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 promote denitrification and 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 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 Cabinet of Ministers 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

The latest reform of the Common Agricultural Policy (CAP) introduces a new instrument, the green payment, to deal with the environmental impacts of agriculture. The green measures include crop diversification, maintaining permanent grasslands and introduction of ecological focus areas. 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 lead to the fertility improvement of the farm's agro system by fixing atmospheric nitrogen[107]. 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. 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 lead to the fertility improvement of the farm's agro system by fixing atmospheric nitrogen.

[107] Documents relating to the approval of the CAP Strategic Plans (2022): https://agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans/approved-csp-0_en?f%5B0%5D=document_country_document_country%3Ahttp%3A//publications.europa.eu/resource/authority/country/LVA

The new CAP strategic plan and its green architecture includes enhanced standards and measures, such as eco-schemes and agrienvironmental measures, to contribute to the environmental- and climate-related objectives. Eco-schemes are new support measure and are designed differently in each Member State based on its environmental needs. Eco-schemes are voluntary applicable for the farmers. In Latvia, eco-shemes 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. 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 Latvian University of Agriculture 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 National Energy and Climate Plan 2021-2030.

The "Law on Agriculture and Rural Development"[108] (2004) provide a legal basis for agricultural development and to specify sustainable agricultural and rural development policy in accordance with the CAP of the European Union. Regulations of the Cabinet of Ministers[109] based on the law sets procedures for awarding of payments to farmers. According to the law and resulting regulations following mitigation measures are taking place in Latvia.

### Introduction of leguminous plants on arable land

Growing leguminous plants considerably increase the accumulation of symbiotically fixed atmospheric nitrogen in soil. Legumes can fix up to 300 kg N $ha^{-1}$ and this N amount is equivalent obtained by means of fertilisers. In addition, legumes provide the aftercrop with the N accumulated in soil, which reduces the amount of N to be applied in the next season. The main aim of the measure is to expand arable land and increase number of farms were leguminous plants are included in crop rotation thus contibuting to atmospheric nitrogen fixation and reduction of application of inorganic nitrogen fertilizers.

### Organic farming and organic dairy farming (low emission dairy farming)

This measure includes environmentally friendly farming methods with no influence on nature, 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.

[108] Saeima (2004) "Law on Agriculture and Rural Development": https://likumi.lv/ta/en/en/id/87480
[109] Law on Agriculture and Rural Development (2004): https://leap.unep.org/countries/lv/national-legislation/law-agriculture-and-rural-development-2004

**Maintenance of amelioration systems**

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

### 3.6.2.1. Introduction of leguminous plants on arable land

Growing leguminous plants considerably increase the accumulation of symbiotically fixed atmospheric nitrogen in soil. Legumes can fix up to 300 kg N $ha^{-1}$ and this N amount is equivalent obtained by means of fertilisers. In addition, legumes provide the aftercrop with the N accumulated in soil, which reduces the amount of N to be applied in the next season. The main aim of the measure is to expand arable land and increase number of farms were leguminous plants are included in crop rotation thus contibuting to atmospheric nitrogen fixation and reduction of application of inorganic nitrogen fertilizers.

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### 3.6.2.3. Maintenance of amelioration systems

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

### 3.6.2.4. Promote the production of biogas and biomethane and the use of biomethane

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 (see the chapter 3.2.2.5). 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 and biogas purification (biomethane production) facilities on farms that do not yet have biogas production and purification facilities.

#### 3.6.2.5. Precision fertiliser application

Precision fertiliser application is a set of activities that involve the use of the newest technologies (the GPS, the GIS, sensors, software, applications, specially equipped fertiliser spreaders, etc.) in planning fertiliser application rates and in fertiliser spreading. This measure 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 are used in the planning of fertiliser schemes and spreading. Also, 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) in order to reduce the risks associated with the use of fertilisers in the long term and to reduce leakage.

#### 3.6.2.6. Promotion of feed ration planning and improvement of feed quality

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.

## 3.7. LAND USE, LAND USE CHANGE AND FORESTRY

### 3.7.1. Regulatory policies and measures

**National Development Plan of Latvia for 2021-2027** emphasize knowledge intensive bioeconomy and cost-effective local renewable energy resources as one of sustainable ways how to ensure competitiveness, economic growth, quality living environment and to reduce Latvia`s energy dependency on fossil fuels. Forest and agriculture related natural resources are expected to contribute to achieving these goals by sustainably intensified resource management. Increasing carbon sequestration and efficient use of bioresources are among measures foreseen to be implemented.

**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.

In Latvia, the reforms in forestry sector were started in 1998 when the Cabinet of Ministers of the Republic of Latvia adopted the **Forest Policy**. The main goal defined in the policy is to ensure a sustainable management of Latvian forests and it is being accomplished in accordance with documents of policy planning and regulations: the Forest Law, Forest-based Sector Development Guidelines and other forest related regulations.

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.

The **Forest Law**[110] 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 Cabinet of Ministers defines terms of evaluation of a sustainable forest management by meeting criteria and indicators of Pan-Europe. Following the definitions of this Law, the responsibility of a forest owner or legal possessor is to regenerate forest stand after regenerative felling.

**The Regulation on Determination Criteria of Compensation and Calculation of Deforestation**[111] defines a procedure of calculation of compensation and criteria for negative

[110]Parliament of Republic of Latvia. Forest Law (with changes till 01.07.2020). Latvijas Vēstnesis, 2000: https://likumi.lv/ta/id/2825-meza-likums

[111]Cabinet of Ministers of Republic of Latvia. Regulations on criteria, calculation and payment order of compensation for deforestation activities (Regulations of Cabinet of Ministers of Republic of Latvia No. 889). Latvijas Vēstnesis, 201 (4804), 2012: http://likumi.lv/doc.php?id=253624.

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.

**Forest-based Sector Development Guidelines**[112] is a medium-term policy planning document. Guidelines consist of the forest-based sector development medium-term (2014-2020) 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.

**Rural Development Programme (RDP) 2014-2020**[113] is the most important tool contributing to the climate change mitigation in LULUCF sector. The climate change mitigation measures in LULUCF sector are designated on the base of consultations with non-governmental organizations and considering national circumstances, in order to pursue the mitigation potential and contribute to implementation of other policies and ecosystem services, like biological diversity and water protection. Three long-term strategic rural development policy goals of Rural Development Programme 2014-2020 are:

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

**Guidelines for sustainable use of peat in 2018-2050**[114] have been prepared in order to provide a 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.

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[112]Ministry of agriculture of Republic of Latvia, Guidelines for the development of forest and related sectors: https://likumi.lv/ta/id/276929-par-meza-un-saistito-nozaru-attistibas-pamatnostadnem-2015-2020-gadam.
[113]The Ministry of Agriculture, Latvia - Rural Development Programme (National) (Ministry of agriculture, 2014: https://www.zm.gov.lv/lauku-attistiba/statiskas-lapas/2014-2020-gada-planosanas-periods-?nid=2187#jump
[114]https://likumi.lv/ta/id/319013-par-kudras-ilgtspejigas-izmantosanas-pamatnostadnem-20202030-gadam

### 3.7.2. Existing measures

The measures included in the LULUCF sector action plan (elaborated according to 529/2013/EU art 10) are based on the Rural Development Programme 2014-2020[115].

Existing measures in following chapters are arranged according to the target land use category – cropland and grassland or forest land. Initially the existing measures are completed in 2020-2022, and many of them are continued as additional measures, which are not yet started.

#### 3.7.2.1. Existing 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 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. Only $CO_2$ is considered in the calculation of the mitigation effect due to the fact that country specific methods for calculation of reduction of $CH_4$ emissions are not elaborated and use of the default IPCC values might lead to considerable overestimation of positive impact of the measure.

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 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 2006 IPCC guidelines for AFOLU sector[116] 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 equal to the value characteristic for high activity clays

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[115]The Ministry of Agriculture, Latvia – Rural Development Programme 2014-2020 (Ministry of Agriculture of Republic of Latvia, 2014): https://www.zm.gov.lv/zemkopibas-ministrija/statiskas-lapas/latvijas-lauku-attistibas-programma-2014-2020-gadam?id=15616#jump

[116]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).

(HAC soils) in temperate region – 95 tons ha$^{-1}$ at 0-30 cm deep soil layer. The alternate scenario – 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 tons C ha$^{-1}$.

The comparison of the situation when productivity is decreasing and the situation after reconstruction of the drainage ditches considers continuously high input of organic material (carbon stock change factor due to the organics input 1.1) after the reconstruction of drainage system due to higher productivity and application of more fertilizers. Respectively, no carbon stock changes in soil are considered if the measure is implemented and reduction of carbon stock takes place in case if the measure is not implemented. Summary of comparison of both scenarios is shown in Table 3.8; 20 years' transition period to reach equilibrium point is considered in the calculation. 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 after implementation of the measure. However, more studies are necessary to evaluate the proposed, as well as non-evaluated impacts, particularly on non-$CO_2$ gases, of the measure based on scientific results. Additional research is necessary also to identify conditions, where the implementation of the measure is the most beneficial and to elaborate guidelines for reconstruction of the drainage systems in croplands. Summary of the initially proposed impact of the measure is provided in Table 3.9.

**Table 3.8 Summary of comparison of scenarios of reconstruction of drainage systems on cropland**

| **Parameter** | Measurement unit | Measure is 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 | |

**Table 3.9 Summary of the impact of the measure**

| **Parameter** | Measurement unit | Value |
|---|---|---|
| **Implementation of the measure** | kha | 327 |
| **Total GHG reduction potential in 2030** | kt $CO_2$ eq. | 6051 |
| **Average annual GHG reduction potential per area unit** | kt $CO_2$ eq. year$^{-1}$ | 403 |
| | tons $CO_2$ eq. year$^{-1}$ ha$^{-1}$ | 1.23 |

### 3.7.2.1.2. Support to introduction and promotion of integrated horticulture

The measure applies to the establishment of new or reconstruction of existing orchards on existing cropland 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 Wetlands Supplement[117]. 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 tons C $ha^{-1}$ in above-ground biomass with the average accumulation rate of 2.1 tons C $ha^{-1}$ annually. Transition period according to the guidelines is 30 years. Initial carbon stock in soil is considered 95 tons $ha^{-1}$ (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 and moderate input – 1.00)[118]; respectively, before implementation of the measure average carbon stock in soil is 65.6 tons 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. Impact of establishment or maintenance of orchards is displayed in soil carbon stock changes (Table 3.10).

Implementation of the measure according to the Tier 1 method will contribute to the net $CO_2$ removals in soil – 8.9 tons $CO_2$ $ha^{-1}$ annually (267 tons $CO_2$ $ha^{-1}$ in total) during 30 years' period. More studies are necessary to evaluate the impact on emissions of the non-$CO_2$ gases and carbon stock change in soil due to change of the management system.

**Table 3.10 Summary of comparison of scenarios of establishment of new orchards**

| **Parameter** | Measurement unit | Measure is not implemented | Implementation of measure |
|---|---|---|---|
| **Carbon stock change factor – tillage** | - | 1.00 | 1.15 |
| **Carbon stock in soil 0-30 cm at the end of transition period** | tons C $ha^{-1}$ | 65.6 | 75.4 |
| **Total impact of the measure on soil carbon stock** | tons C $ha^{-1}$ | 9.83 | |
| **Annual soil carbon stock changes** | tons C $ha^{-1}$ year | 0.49 | |
| **Annual removals of $CO_2$ in soil** | tons $CO_2$ $ha^{-1}$ year | 1.80 | |

[117] 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).

[118] 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 is not implemented | Implementation of measure |
|---|---|---|---|
| **Carbon stock changes in living biomass** | | | |
| **Carbon stock at the end of transition period** | tons C $ha^{-1}$ | 63 | |
| **Transition period** | years | 30 | |
| **Average annual carbon stock changes** | tons C $ha^{-1}$ year | 2.1 | |
| **Average annual net $CO_2$ removals** | tons $CO_2$ $ha^{-1}$ year | 7.7 | |
| **Carbon stock changes in living biomass and soil** | | | |
| **Average net $CO_2$ removals in 30 years period** | tons $CO_2$ $ha^{-1}$ year | 8.9 | |
| **Total net $CO_2$ removals in 30 years period** | tons $CO_2$ $ha^{-1}$ | 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. Summary of the impact of the measure is provided in Table 3.11.

**Table 3.11 Summary of the impact of the measure**

| Parameter | Measurement unit | Value |
|---|---|---|
| **Implementation of the measure** | kha | 0.35 |
| **Total GHG reduction potential in 2030** | kt $CO_2$ eq. | 4 |
| **Average annual GHG reduction potential per area unit** | tons $CO_2$ eq. $year^{-1}$ | 2.9 |

### *3.7.2.1.3. Growing of legumes*

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)[119]. 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 scenarios (conventional cropping system and implementation of the measure) is shown in Table 3.12; 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 $CO_2$

[119] 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).

ha$^{-1}$ annually (26.4 tons $CO_2$ ha$^{-1}$ in total) during 20 years' period. Summary of the impact of the measure is provided in Table 3.13.

**Table 3.12 Summary of comparison of scenarios of growing of legumes**

| Parameter | Measurement unit | Measure is 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 | |

**Table 3.13 Summary of the impact of the measure**

| Parameter | Measurement unit | Value |
|---|---|---|
| **Implementation of the measure** | kha | 66 |
| **Total GHG reduction potential till 2030** | kt $CO_2$ eq. | 105 |
| **Average annual GHG reduction potential per area unit** | tons $CO_2$ eq. year$^{-1}$ | 7.0 |

### *3.7.2.1.4. Extensified crop rotation*

Support to use green manure 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)[120]. 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 scenarios (conventional cropping system and the system considering input with green manure) is shown in Table 3.14; 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 impact of the measure is provided in Table 3.15.

[120] 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).

**Table 3.14 Summary of comparison of scenario of extensified crop rotation**

| Parameter | Measurement unit | Measure is 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 $ha^{-1}$ $year^{-1}$ | 0.36 | |
| **Annual removals of $CO_2$ in soil** | tons $CO_2$ $ha^{-1}$ $year^{-1}$ | 1.32 | |

**Table 3.15 Summary of the impact of the measure**

| Parameter | Measurement unit | Value |
|---|---|---|
| **Implementation of the measure** | kha | 60 |
| **Total GHG reduction potential till 2030** | kt $CO_2$ eq. | 476 |
| **Average annual GHG reduction potential per area unit** | tons $CO_2$ eq. $year^{-1}$ | 32 |

### 3.7.2.2. Existing 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 (Figure 3.1) 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.

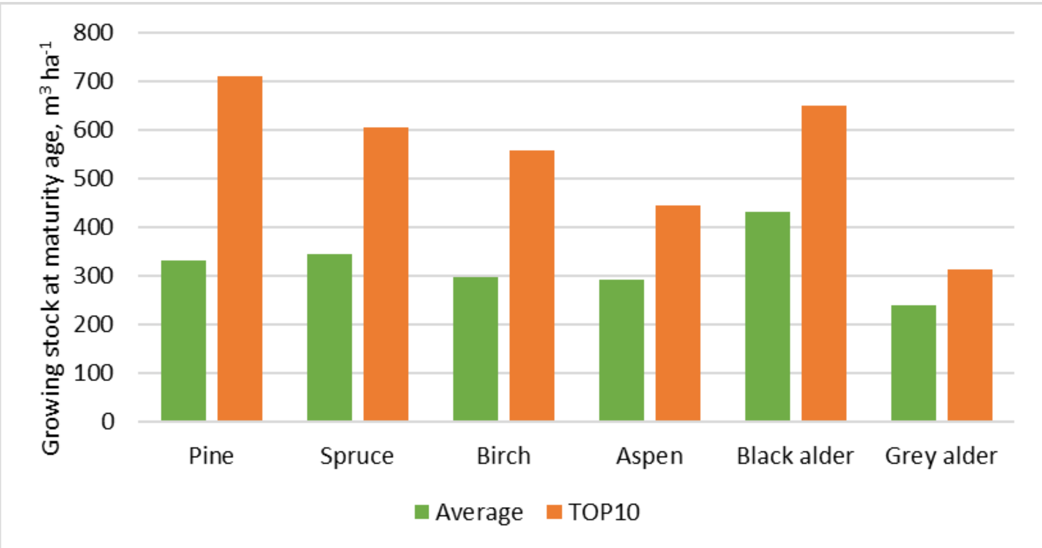


**Figure 3.1 Growing stock in mature forest stands representing the highest site indexes**

#### *3.7.2.2.1. Development and adaptation 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. Impact on the non-$CO_2$ GHG ($CH_4$ and $N_2O$) cannot be evaluated at reasonable level on uncertainty due to lack of reliable research data. Therefore, only impact on $CO_2$ emissions is evaluated.

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[121]. 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[122]. In wetlands, $CO_2$ emissions in rich rewetted organic soils in temperate climatic zone are 0.5 tons C $ha^{-1}$ annually[123]; 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[124]. The uncertainty of these factors is very high, comparing the source data and other publications[125,126,127]. Drainage of forest causes reduction of $CH_4$ emissions[128,129,130,131] 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 scenarios – in drained and wet organic soil is shown in Figure 3.2. 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 green columns and in case of rewetting – orange columns in Figure 3.2.

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121 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.

122 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).

123 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. http://www.ipcc-nggip.iges.or.jp/public/wetlands/pdf/Wetlands_Supplement_Entire_Report.pdf

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

125 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. https://doi.org/16/S0038-0717(03)00085-3

126 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. https://doi.org/16/j.landurbplan.2010.08.021

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

128 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. https://doi.org/10.1016/j.soilbio.2004.11.004

129 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. https://doi.org/10.1016/j.ecoleng.2014.09.075

130 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. https://doi.org/10.1016/j.foreco.2009.05.034

131 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. https://doi.org/10.1016/j.foreco.2005.02.031

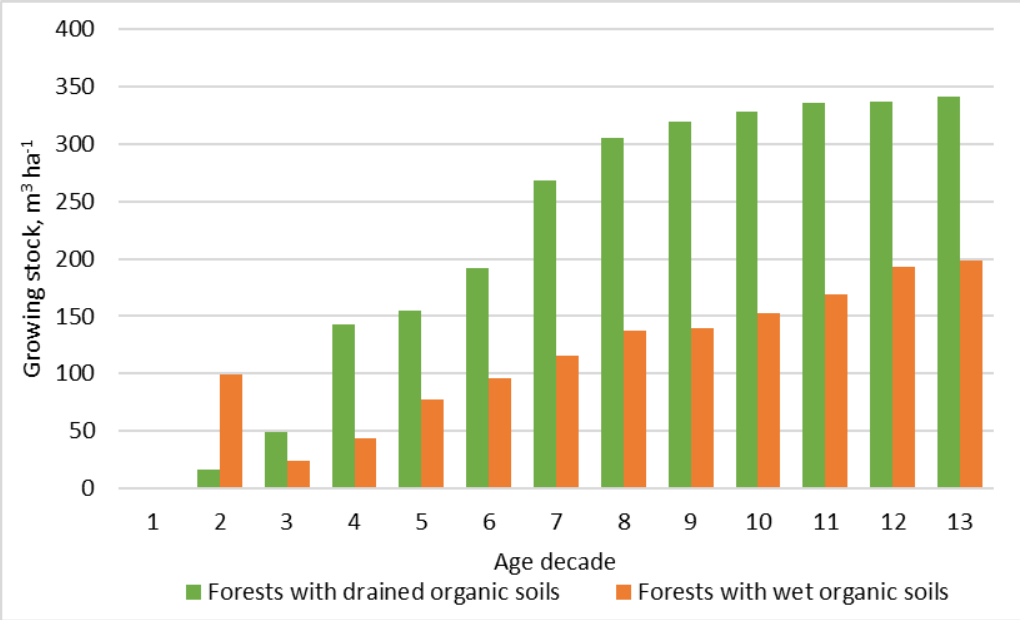


**Figure 3.2 Growing stock in drained and naturally wet pine stands with organic soil**

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.

The difference between both scenarios 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 3.16. 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)[132].

**Table 3.16 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 | 0.7 | 0.27 |
| **Drained mineral soils** | | | | |
| **Net changes, tons $CO_2$ yearly** | 1.5 | 1.11 | 1.6 | 1.63 |

[132]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. https://doi.org/10.1080/02827581.2017.1337923

$CO_2$ removals during the rotation period in case of maintenance of drainage systems reach values provided in Table 3.17. Additional removals can be considered in harvested wood products due to commercial thinning (about 30 % of the growing stock in mature stands).

**Table 3.17 $CO_2$ 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 3.18).

**Table 3.18 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% |

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 is provided in Table 3.19.

**Table 3.19 Summary of the impact of the measure**

| Parameter | Measurement unit | Value |
|---|---|---|
| **Implementation of the measure** | Kha | 125 |
| **Total GHG reduction potential in 2030** | kt $CO_2$ eq. | 1967 |
| **Average annual GHG reduction potential per area unit** | kt $CO_2$ eq. $year^{-1}$ | 131 |
| | tons $CO_2$ eq. $year^{-1}$ $ha^{-1}$ | 1.6 |

### *3.7.2.2.2. Afforestation and improvement of stand quality in naturally afforested areas*

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 3.20), 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 during 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 3.20 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 3.3).

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.

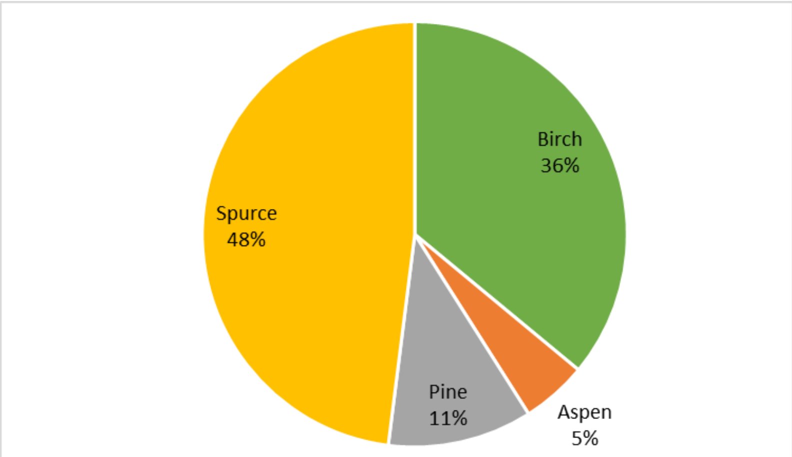


**Figure 3.3 Dominant species in afforested lands**

Summary of the impact of the measure is provided in Table 3.21. Total reduction impact of the measure will be nearly 4 million tons of $CO_2$ or 0.05 million tons of $CO_2$ in average annually.

**Table 3.21 Summary of the impact of the measure**

| Parameter | Measurement unit | Value |
|---|---|---|
| **Implementation of the measure** | Kha | 6.6 |
| **Total GHG reduction potential in 2030** | kt $CO_2$ eq. | 1072 |
| **Average annual GHG reduction potential per area unit** | kt $CO_2$ eq. $year^{-1}$ | 72 |
| | tons $CO_2$ eq. $year^{-1}$ $ha^{-1}$ | 6.6 |

### *3.7.2.2.3. Regeneration of forest stands after natural disturbances*

The measure supports regeneration of forests after natural disturbances, like forest fires and strong storms, as well as reconstruction of diseased valueless 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 predict the impact of the measure on these pools. In evaluation of carbon stock changes in living biomass two scenarios are compared – natural regeneration and planting of trees, considering that planted trees will grow faster according to recent research results[133,134,135]. Use of improved genetic material in the planting production is assessed according to expert judgement on a real situation in the market (Table 3.22). Average growing stock in natural regeneration scenario 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 3.4).

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).

**Table 3.22 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% |

[133]Jansons, Ā., & Baumanis, I. (2008). Parastās priedes (Pinus sylvestris L.) klonu atlase Kurzemes zonas 2. Kārtas sēklu plantācijas izveidei un sagaidāmais ģenētiskais ieguvums. Mežzinātne \textbar Forest Science, 17(50), 88–116.
[134]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).
[135]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).

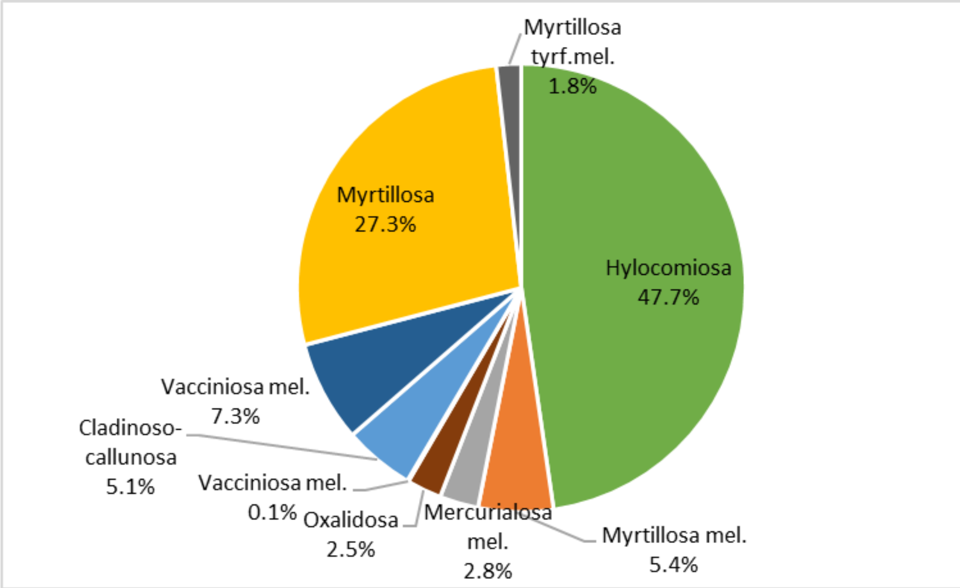


**Figure 3.4 Distribution of the forest stand types in recent forest fire statistics**

Summary of the impact of the measure is provided in Table 3.23. Duration of the impact of the activity is 100 years; however, most of the impact will be reached during the first 50 years.

**Table 3.23 Summary of the impact of the measure**

| Parameter | Measurement unit | Value |
|---|---|---|
| **Implementation of the measure** | kha | 2.7 |
| **Total GHG reduction potential in 2030** | kt $CO_2$ eq. | 539 |
| **Average annual GHG reduction potential per area unit** | kt $CO_2$ eq. $year^{-1}$ | 36 |
| | tons $CO_2$ eq. $year^{-1}$ $ha^{-1}$ | 1.0 |

### *3.7.2.2.4. 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, scenarios 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.

Summary of the expert judgement-based assumption on the impact of the measure is provided in Table 3.24.

**Table 3.24 Summary of impact of the measure**

| Parameter | Measurement unit | Value |
|---|---|---|
| **Implementation of the measure** | kha | Not estimated |
| **Total GHG reduction potential** | tons $CO_2$ eq. | Not estimated |
| **Average annual GHG reduction potential per area unit** | tons $CO_2$ eq. $year^{-1}$ | Not estimated |
| | tons $CO_2$ eq. $year^{-1}ha^{-1}$ | 133.4 |

### *3.7.2.2.5. Improvement of ecological value and sustainability of forest ecosystems*

The scope of the measure is to support pre-commercial thinning of young stands in private forests to ensure sustainable forest management practices[136,137,138,139] 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[140,141]. The basic for these principles is more intensive pre-commercial thinning to boost increment in following decades and to reduce the 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 $CO_2$ during 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[142,143,144]. The biomass expansion factors are taken from the GHG inventory report.

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[136] AS 'Latvijas valsts meži'. (2012). Kvalitātes prasības jaunaudžu kopšanas ciršu izpildei (Apstiprināts ar AS „Latvijas valsts meži" 20.04.2012. Rīkojumu Nr. 3.1-2.1_001a_200_12_12). AS 'Latvijas valsts meži'. http://www.lvm.lv/files/text/Jaunaudzu%20kopsanas%20kvalitates%20prasibas.doc
[137] Jansons, J., & Zālītis, P. (1998). Dabiski atjaunojamo lapu koku apmežojumu struktūra un kopšanas iespējas. Meža Dzīve, Nr.4, 12–15.
[138] Zālītis, P. (2004). Sastāva kopšanas cirtes. LVMI Silava.
[139] Zālītis, P., & Lībiete, Z. (2008). Kopšanas ciršu režīms egļu jaunaudzēs. LLU Raksti, 20 (315), 38–45.
[140] Latvijas Republikas Ministru Kabinets. (2012). Noteikumi par koku ciršanu mežā. VSIA Latvijas Vēstnesis. https://likumi.lv/doc.php?id=253760
[141] Parliament of the Republic of Latvia. (2000). Meža likums. VSIA Latvijas Vēstnesis. https://likumi.lv/doc.php?id=2825
[142] Zālītis, P. (2006). Mežkopības priekšnosacījumi. et cetera.
[143] Zālītis, P., Donis, J., Ruņģis, D., Gaitnieks, T., & Jansons, J. (2014). Četri mežzinātņu motīvi. Daugavpils Universitātes Akadēmiskais apgāds 'Saule'.
[144] Zālītis, P., & Jansons, J. (2009). Mērķtiecīgi izveidoto kokaudžu struktūra. LVMI Silava.

The net impact of the intensified pre-commercial thinning in comparison to standard forest management practice in private forests is summarized in Table 3.25. It is considered in the impact assessment, that the distribution of the dominant species (pine, spruce and birch)[145] in stands, where the measure will be implemented, is equal to distribution of these species in the previously thinned stands in private forests (Figure 3.5). The largest mitigation potential of the pre-commercial thinning can be observed in spruce stands.

**Table 3.25 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 |

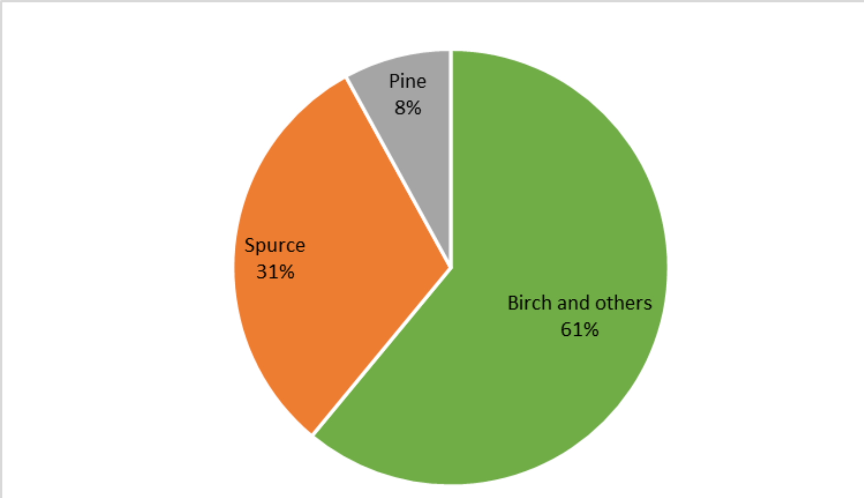


**Figure 3.5 Dominant species in thinned lands in private forest**

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. Summary of the impact of the measure is provided in Table 3.26.

**Table 3.26 Summary of the impact of the measure**

| Parameter | Measurement unit | Value |
|---|---|---|
| **Implementation of the measure** | kha | 15 |
| **Total GHG reduction potential in 2030** | kt $CO_2$ eq. | 289 |
| **Average annual GHG reduction potential per area unit** | kt $CO_2$ eq. $year^{-1}$ | 19 |
| | tons $CO_2$ eq. $year^{-1}$ $ha^{-1}$ | 1.3 |

[145]No quantitative data are available for other species and they are not considered in calculation.

### 3.7.2.3. Summary of effect of existing measures

The cumulative net reduction of GHG emissions or avoided emissions due to implementation of existing measures in 2050 would reach 18325 kt $CO_2$ eq. The intermediate net GHG emission reduction in 2030 would reach 10544 kt $CO_2$ eq. (Figure 3.6).

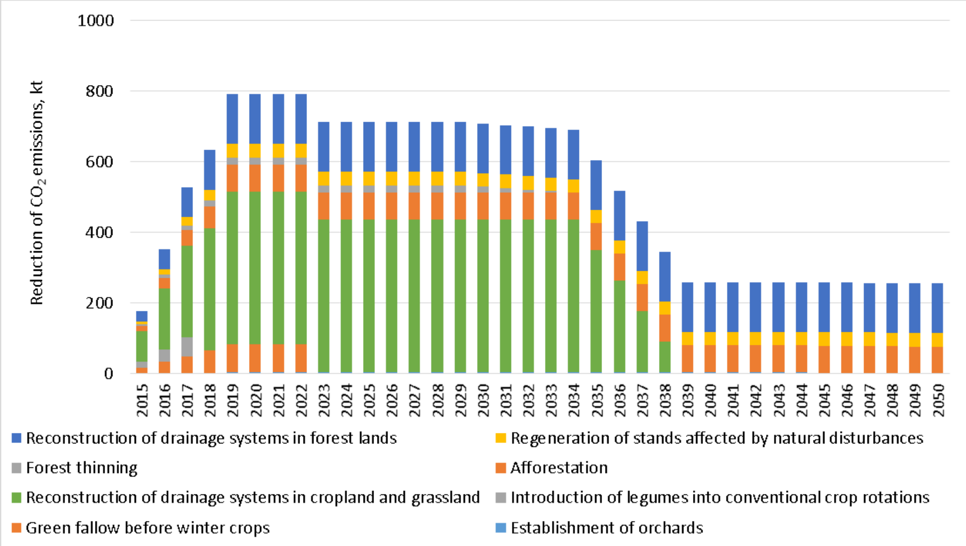


**Figure 3.6 Projections by impact of initially existing measures**

Majority of implemented measures are associated with additional removals of $CO_2$ or reduced GHG emissions (8642 kt $CO_2$ eq. in 2030 and 14096 kt $CO_2$ eq. in 2050) and the remaining effect (1901 kt $CO_2$ eq. in 2030 and 4228 kt $CO_2$ eq. in 2050) is associated with avoided increase of GHG emissions or reduction of $CO_2$ removals (Table 3.27).

**Table 3.27 Cumulative reduction of GHG emissions according to WEM scenario**

| Measures | Type of impact | Land use category | GHG emission reduction, kt $CO_2$ eq. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
| Establishment of orchards | Avoids emissions | Cropland | 12 | 28 | 44 | 59 | 75 | 90 | 93 |
| Green fallow before winter crops | Avoids emissions | Cropland | 317 | 476 | 476 | 476 | 476 | 476 | 476 |
| Introduction of legumes into conventional crop rotations | Avoids emissions | Cropland | 105 | 105 | 105 | 105 | 105 | 105 | 105 |
| Reconstruction of drainage systems in cropland and grassland | Reduces emissions | Forest land | 1729 | 3890 | 6052 | 8127 | 8645 | 8645 | 8645 |
| Afforestation | Reduces emissions | Forest land | 306 | 689 | 1072 | 1455 | 1838 | 2222 | 2605 |
| Forest thinning | Reduces emissions | Forest land | 84 | 189 | 290 | 315 | 315 | 315 | 315 |

| Measures | Type of impact | Land use category | GHG emission reduction, kt $CO_2$ eq. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
| **Regeneration of stands affected by natural disturbances** | **Avoids emissions** | **Forest land** | 154 | 347 | 539 | 732 | 924 | 1117 | 1309 |
| **Reconstruction of drainage systems in forest lands** | **Avoids emissions** | **Forest land** | 562 | 1264 | 1967 | 2669 | 3372 | 4074 | 4777 |
| **Total GHG emission reduction** | | | 3270 | 6988 | 10544 | 13938 | 15750 | 17043 | 18325 |

Actual contribution to reduction of GHG emissions and the avoided emissions due to implementation of the climate change mitigation measures exceeds the proposed impact; however, accuracy of the estimates still have to be improved, e.g., higher Tier methods have to be implemented in assessment of soil carbon stock changes. It should be also considered that the most of the GHG mitigation effect is estimated using Tier 1 method. These estimates will be updated, when Tier 2 and 3 methods will be implemented in the National GHG inventory. The most successful measures up to now relate to reconstruction of drainage systems in cropland, grassland and forest land.

### 3.7.3. Planned policies and measures

Additional measures include actions proposed for implementation within the scope of the post-2020 GHG mitigation strategies. These actions mostly continue measures that are started during the implementation of the Rural Development Programme 2014-2020, like afforestation, reconstruction of drainage systems and forest thinning to ensure high resilience of forest stands.

In case if the measures are continued from the previous period of the Rural Development Programme, only area affected by the measures during the next period of the CAP are reported as additional measures to avoid double counting with existing measures. The implementation period for additional measures is 2023-2027. In the calculation of long-term effect (after 2027) it is considered that the measures contributing to increase of carbon stock in croplands continues to receive financial support to maximize the proposed effect, respectively, at least 20 years.

#### 3.7.3.1. Additional measures in cropland and grassland

##### *3.7.3.1.1. Development and adaption of drainage systems in cropland*

The measure is continuation of measure listed in the Rural Development Programme 2014-2020 “Development and adaption of drainage systems in cropland”. All projects applied for the aid after 2027 will be counted as additional measures. The total area that could be affected by the measure until 2027 is 201 kha. This is indicative value and will be updated during adoption of the measure in the policy documents.

The objective of the measure is to rebuild and improve existing drainage systems in cropland to maintain and increase the economic value of the land and the productivity of the crops in the drained areas. The measure may have a direct and indirect impact on GHG emissions, both in the short and long term. The direct impact of the measure on arable land is linked to the accumulation of $CO_2$ in the soil due to increased productivity in reclaimed land and improved land management practices. Implementation of the measure contributes to the removal or to avoid losses of $CO_2$ in the soil – 1.32 t $CO_2$ $ha^{-1}$ per year for 20 years after the implementation of the measure. The calculation of the impact of the measure is based on the assumption that reconstruction of drainage systems takes place as preventive measure avoiding collapse of the existing drainage systems and decrease of productivity of affected croplands. More detailed description of the calculation methodology is provided in chapter 3.7.2.1.1 Development and adaptation of drainage systems in cropland and grassland.

The projection of the effect of the measure, especially between 2022 and 2030, is hampered by the fact that it is not currently possible to predict which areas will receive support and the status of the systems to be reconstructed, i.e., whether the implementation of the measure will significantly change the growth conditions in the affected areas by 2027 and whether we can predict an increase or no reduction of carbon stock in the soil compared to alternative scenarios.

The projected impact of the measure will be improved by development of methodologies for accounting of activity data of the measure and modelling of carbon stock change using remote techniques, which will allow to assess the impact of the reconstruction of drainage systems on GHG emissions. Significant methodological improvements have to be implemented to evaluate impact of this measure at a single field level.

Long term effect of the measure does not require additional investments, assuming that maintaining of the land value and requirement to implement sustainable agriculture practices will ensure high carbon input into soil. Summary of the proposed effect of the measure is provided in Table 3.28. This measure will contribute to retaining of existing carbon stock in soil, therefore, alternate scenario would lead to increase of emissions, while implementation of the measure will retain existing carbon stock.

**Table 3.28 Summary of the proposed effect of the measure**

| No. | Parameter and units | Value |
|---|---|---|
| 1. | **Affected area, kha** | 200.48 |
| 2. | **Duration of implementation, years** | 5 |
| 3. | **Duration of impact, years** | 20 |
| 4. | **Annual GHG reduction potential per area unit, tons $CO_2$ eq. $year^{-1}$ $ha^{-1}$** | 1.32 |
| 5. | **Total GHG reduction potential per area unit, tons $CO_2$ eq .$ha^{-1}$** | 26.44 |
| 6. | **Total GHG reduction potential, kt $CO_2$ eq.** | 5 300.44 |

#### *3.7.3.1.2. Establishment of new orchards*

The measure is continuation of the measure "Support to introduction and promotion of integrated horticulture" and "Organic famring" which is implemented within the scope of the Rural Development Programme for Latvia 2014-2020. The projected area of new orchards is 7.5 kha in the period between 2023 and 2027. This is an indicative value and will be updated during adoption of the measure in the policy documents.

The substantiation of the measure is based on increase of input of organic matter into soil with plant residues resulting in the increase of carbon stock in living biomass and soil. It is assumed that the measure is implemented in fertile croplands on mineral and organic soils. Additional impact accounted in organic soils and substantiating accumulation of carbon in soil is reduction of $CO_2$ emissions from soil due to land use changes.

Yasso model, country specific carbon input data and activity data will be used in estimation of the soil carbon stock changes. The project on elaboration of the biomass conversion factors and litter input data is now under implementation. Tier 1 based estimates are used to project carbon stock changes in living biomass.

Activity data used in calculation are the Field register data – area of new orchards characterized by target species and management alternatives (conventional or organic farming). Carbon input data in projections are estimated using Tier 1 method. More detailed description of the calculation methodology is provided in chapter 3.7.2.1.2 Support to introduction and promotion of integrated horticulture.

Long term effect of the measure does not require additional investments, assuming that orchards will be retained after the implementation period. Summary of the proposed effect of the measure is provided in Table 3.29. This measure will contribute to retaining of existing carbon stock in soil and biomass, therefore, alternate scenario would lead to increase of emissions, while implementation of the measure will retain existing carbon stock.

**Table 3.29 Summary of the proposed effect of the measure**

| No. | Parameter and units | Value |
|---|---|---|
| **1.** | **Affected area, kha** | 7.50 |
| **2.** | **Duration of implementation, years** | 5 |
| **3.** | **Duration of impact, years** | 30 |
| **4.** | **Annual GHG reduction potential per area unit, tons $CO_2$ eq. $year^{-1}$ $ha^{-1}$** | 8.90 |
| **5.** | **Total GHG reduction potential per area unit, tons $CO_2$ eq. $ha^{-1}$** | 267.00 |
| **6.** | **Total GHG reduction potential, kt $CO_2$ eq.** | 2 002.50 |

#### *3.7.3.1.3. Undergrowth plants sown with winter crops*

The measure has been implemented already within the scope of the Agricultural practice beneficial for the climate and the environment/greening; however, not considered as a climate change mitigation measure due to lack of activity data. The area to be affected by this measure is not set; therefore, climate change mitigation effect is not estimated.

The substantiation of the measure is based on increase of input of organic matter into soil with plant residues resulting in the increase of carbon stock in soil. Impact of the measure is accounted using Tier 1 method, assuming high carbon input in soil ensuring retaining of existing carbon stock in cropland soils. The Tier 2 methodology is under development. Basic assumptions considered in the calculation of the GHG mitigation projections conform to those provided in chapter 3.7.2.1.1 Development and adaptation of drainage systems in cropland.

Yasso model, country specific carbon input data and activity data will be used in evaluation of the soil carbon stock changes; however, the methodologies are still under development. The project on elaboration of the biomass conversion factors is now under implementation and will be completed before 2026.

Activity data used in calculation are the Field register data – area of cereals with undergrowth plants characterized by target species and management alternatives (conventional or organic farming). Soil maps (1960$^{ths}$-1980$^{ths}$) will be used to identify organic soils. Carbon input data in projections are estimated using Tier 1 method, Tier 3 method will be implemented until 2026. Cost of the mitigation effect will be calculated using data available at Rural Support Service. Carbon stock change will be calculated at a level of the NFI plot affected by the measure (these data should be provided by Rural Support Service) and extrapolated to the country area using statistical methods.

Long term effect of the measure requires continuous investments, assuming that this measure is associated with additional costs, which farmers would normally avoid. Summary of the proposed effect of the measure is provided in Table 3.30. This measure will contribute to increase of carbon stock in soil, therefore, alternate scenario would lead to retaining of existing carbon stock in soil, while implementation of the measure will increase carbon stock.

**Table 3.30 Summary of the proposed effect of the measure**

| No. | Parameter and units | Value |
|---|---|---|
| **1.** | **Affected area, kha** | - |
| **2.** | **Duration of implementation, years** | 10 |
| **3.** | **Duration of impact, years** | 20 |
| **4.** | **Annual GHG reduction potential per area unit, tons $CO_2$ eq. year$^{-1}$ ha$^{-1}$** | 1.32 |
| **5.** | **Total GHG reduction potential per area unit, tons $CO_2$ eq. ha$^{-1}$** | 26.44 |
| **6.** | **Total GHG reduction potential, kt $CO_2$ eq.** | - |

#### *3.7.3.1.4. Green fallow before winter crops*

Similarly, to the measure Undergrowth plants sown with cereals this measure has been implemented already within the scope of Agricultural practice beneficial for the climate and the environment/greening; however, not considered as a climate change mitigation measure due to lack of activity data. The total area which will be affected by this measure until 2027 is not yet defined; therefore, the potential effect is not estimated. It is assumed in the modelling that the measure will be implemented in the same field every 3rd year.

The substantiation of the measure is based on increase or retaining of input of organic matter into soil with plant residues due to additional input with "green manure" before sowing of cereals resulting in the increase of carbon stock in soil.

Yasso model, country specific carbon input data and activity data will be used in estimation of the soil carbon stock changes; however, methodologies are still under development. The project on elaboration of the biomass conversion factors is now under implementation and will be completed before 2026.

Activity data used in calculation are the Field register data – area of winter crops sown in green fallow characterized by target cereal species and management alternatives (conventional or organic farming). Carbon input data in projections are estimated using Tier 1 method. Cost of the mitigation effect will be calculated using data available at Rural Support Service.

Long term effect of the measure requires continuous investments, assuming that this measure is associated with additional costs, which farmers would normally avoid. Summary of the proposed effect of the measure is provided in Table 3.31. This measure will contribute to increase of carbon stock in soil, therefore, alternate scenario would lead to retaining of existing carbon stock in soil, while implementation of the measure will increase carbon stock.

**Table 3.31 Summary of the proposed effect of the measure**

| No. | Parameter and units | Value |
|---|---|---|
| **1.** | **Affected area, kha** | - |
| **2.** | **Duration of implementation, years** | 10 |
| **3.** | **Duration of impact, years** | 20 |
| **4.** | **Annual GHG reduction potential per area unit, tons $CO_2$ eq. year$^{-1}$ ha$^{-1}$** | 1.32 |
| **5.** | **Total GHG reduction potential per area unit, tons $CO_2$ eq. ha$^{-1}$** | 26.44 |
| **6.** | **Total GHG reduction potential, kt $CO_2$ eq.** | - |

##### *3.7.3.1.5. Introduction of legumes into conventional crop rotations*

The measure is continuation of the measure "Growing of legumes" which is implemented within the scope of the Agricultural practice beneficial for the climate and the environment/greening. All areas proposed for the support after 2022 are accounted under additional measures. The total area which will be affected by this measure until 2027 according to the projections will be 33 kha. This is indicative value and will be updated during adoption of the measure in the policy documents. It is assumed in the modelling that the legumes will be sown in the same field every 3rd year.

The substantiation of the measure is based on increase of input of organic matter into soil with residues of legumes resulting in the increase of carbon stock in soil. It is assumed that the measure is implemented in croplands on mineral and organic soils. In both cases, additional carbon input in soil will substitute $CO_2$ losses from soil. Similarly, to other activities aimed at increase of carbon stock in croplands, this measure will increase removals in comparison to WEM scenario ensuring increase of carbon stock in soil.

Yasso model, country specific carbon input data and activity data will be used in estimation of the soil carbon stock changes; however, the methodology is still under development. The project on elaboration of the biomass conversion factors is now under implementation and will be completed before 2026.

Activity data used in calculation are the Field register data – area of legumes sown between rotations of cereals characterized by target cereal species and management alternatives (conventional or organic farming). Carbon input data in projections are estimated using Tier 1 method, Tier 3 method will be implemented before 2026. Cost of the mitigation effect will be calculated using data available at Rural Support Service. More detailed description of the calculation methodology is provided in chapter 3.7.2.1.3 Growing of legumes.

Long term effect of the measure requires continuous investments, assuming that this measure is associated with additional costs, which farmers would normally avoid. Summary of the proposed effect of the measure is provided in Table 3.32. This measure will contribute to increase of carbon stock in soil, therefore, alternate scenario would lead to retaining or reduction of existing carbon stock in soil, while implementation of the measure will increase carbon stock.

**Table 3.32 Summary of the proposed effect of the measure**

| No. | Parameter and units | Value |
|---|---|---|
| **1.** | **Affected area, kha** | 33.29 |
| **2.** | **Duration of implementation, years** | 5 |
| **3.** | **Duration of impact, years** | 20 |
| **4.** | **Annual GHG reduction potential per area unit, tons $CO_2$ eq. year$^{-1}$ ha$^{-1}$** | 1.32 |
| **5.** | **Total GHG reduction potential per area unit, tons $CO_2$ eq. ha$^{-1}$** | 26.44 |
| **6.** | **Total GHG reduction potential, kt $CO_2$ eq.** | 880.06 |

#### *3.7.3.1.6. 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, building of warehouses for fruits and vegetables and others, which results in an increase of productivity and bigger inputs of carbon into soil by increased biomass of plant residues. These measures create cumulative effect, which can't be easily predicted 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 measure 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.

Yasso model, country specific carbon input data and activity data will be used in estimation of the soil carbon stock changes. The project on elaboration of the biomass conversion factors is now under implementation and results will be published before 2026.

Activity data used in calculation are the Field register data – productivity of crops characterized by target species. Carbon input data in projections are estimated using Tier 1 method. Cost of the mitigation effect will be calculated using data available at Rural Support Service.

#### 3.7.3.2. Additional measures in forest lands

Climate change mitigation measures proposed for implementation within the scope of the CAP in 2023-2027 are continuation of the actions already implemented within the scope of the Rural Development Programme 2014-2020. Only areas which will be affected by the measures implemented after 2022 are accounted under this scenario.

##### *3.7.3.2.1. Reconstruction of drainage systems in forest land*

The measure is continuation of the action "Development and adaptation of drainage systems in forest land" which is implemented within the scope of the Rural Development Programme for Latvia 2014-2020. All areas proposed for the support after 2023 are accounted under additional measures. The area which will be affected by this measure until 2027 is about 80.1 kha. This is indicative value and will be updated during adoption of the measure in the policy documents. It is assumed in calculation that age distribution of forest stands in areas with reconstructed drainage systems corresponds to average age distribution of forests on drained soils.

The substantiation of the measure is based on comparison of growing stock in forest stands growing on naturally wet and drained soils (Figure 3.7) assuming that reconstruction of drainage system leads to development of growing stock characteristic for drained soils and alternative scenario leads to formation of stands with the growing stock characteristic for naturally wet soils. The difference appears after regeneration of forest stands and in young stands ($1^{st}$ age class), respectively if drainage system is reconstructed in middle age stand, no difference is predicted. It is assumed that the measure is implemented in croplands on mineral and organic soils. Soil carbon stock changes in mineral soils are not considered; in organic soils the GHG emission factors applied in the National GHG inventory report are used in calculation.

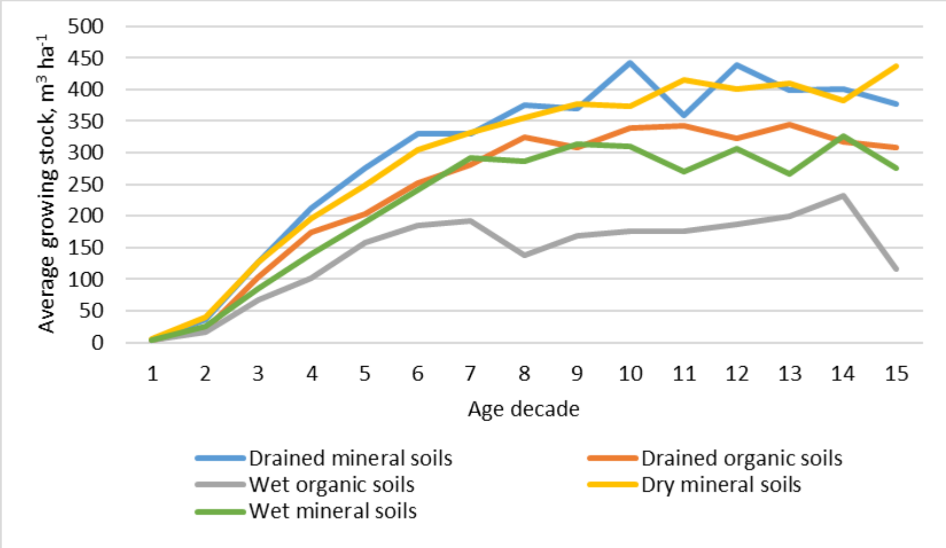


**Figure 3.7 Growing stock depending from growth conditions**

Growth models, country specific biomass expansion factors and emission factors for organic soils will be used in estimation of the carbon stock changes. The project on evaluation of input of organic material will be implemented before 2025.

Activity data necessary for the calculation of the mitigation effect are available at Rural Support Service – reconstruction projects, and State Forest Service – stand inventory data. Tier 3 method will be used for calculation of carbon stock change in living biomass, Tier 2 method will be implemented during following years for calculation of soil carbon stock changes. Cost of the mitigation effect will be calculated using data available at Rural Support Service. However, there is still need to develop methodologies for estimation of GHG emissions and carbon stock changes in soil.

#### *3.7.3.2.2. Afforestation of nutrient-poor soils in grassland and cropland*

The measure is continuation of the action "Afforestation and improvement of stand quality in naturally afforested areas" which is implemented within the scope of the Rural Development Programme for Latvia 2014-2020. All areas proposed for the implementation after 2023 are accounted under additional measures. The total area which will be affected by this measure until 2027 is 10.9 ha, including 7% of organic soils according to the average share of organic soils in the 2022 National GHG inventory report. This is indicative value and will be updated during adoption of the measure in the policy documents.

Methodology applied in projections of the mitigation effect is described in Chapter 3.7.2.3.2 Afforestation and improvement of stand quality in naturally afforested areas. Growth models, country specific biomass expansion factors and emission factors for organic soils will be used in estimation of the carbon stock changes. Reduction of GHG emissions due to afforestation of organic soils is calculated as difference of the emission factors applied in the National GHG inventory report in grassland and forest land. Carbon stock changes in mineral soil are not considered in the calculation due to high uncertainty of the effect of afforestation on the soil carbon stock changes.

Activity data for the calculation of the mitigation effect are available at Rural Support Service and State Forest Service. Tier 3 method will be used for calculation of carbon stock change in living biomass, Tier 2 method will be used for calculation of soil carbon stock changes in organic soils; Tier 3 method will be implemented for calculation of carbon stock changes in litter and mineral soil before 2026. Improvements of the accounting of carbon stock changes and GHG emissions from organic soils are proposed in the National GHG inventory. Cost of the mitigation effect will be calculated using data available at Rural Support Service.

#### *3.7.3.2.3. Pre-commercial thinning*

The measure is continuation of the action "Improvement of ecological value and sustainability of forest ecosystems" which is implemented within the scope of the Rural Development Programme for Latvia 2014-2020. All areas proposed for the implementation after 2022 are accounted under additional measures. The total area proposed for implementation of this measure until 2027 is 80.5 kha.

Methodology applied in projections of the mitigation effect is described in Chapter 3.7.2.3.5 Improvement of ecological value and sustainability of forest ecosystems. Growth models and country specific biomass expansion factors will be used in estimation of the carbon stock changes. Carbon stock changes in mineral soil due to increase of removals with litter and increase of dimensions of dead wood are not considered in the calculation due to limited information. Considerable upgrade of the methodology and transition to Tier 3 method will be done after improvement of national growth models and implementation of higher tier methods in calculation of GHG emissions.

Activity data necessary for the calculation of the mitigation effect are available at Rural Support Service and State Forest Service. Tier 3 method will be used for calculation of carbon stock change in living biomass. Tier 3 method will be implemented for calculation of carbon stock changes in litter and soil. Cost of the mitigation effect will be calculated using data available at Rural Support Service; however, significant methodological development is still needed to report effect of this measure.

#### *3.7.3.2.4. Regeneration of forest stands suffered by natural disturbances*

The measure is continuation of the action "Regeneration of forest stands after natural disturbances" which is implemented within the scope of the Rural Development Programme for Latvia 2014-2020. All areas proposed for the implementation after 2022 are accounted under additional measures. The total area which will be affected by this measure until 2027 is not stated. This is indicative value and will be updated during adoption of the measure in the policy documents.

The substantiation of the measure is based on comparison of growth rate of naturally and artificially regenerated forest stands. Regeneration with spruce, birch or pine is considered in the calculation. Methodology applied in projections of the mitigation effect is described in Chapter 3.7.2.3.4 Regeneration of forest stands after natural disturbances. Growth models and country specific biomass expansion factors will be used in estimation of the carbon stock changes. Carbon stock changes in mineral soil due to increase of removals with litter and increase of dimensions of dead wood are not considered in the calculation. Upgrade of the methodology and transition to Tier 3 method will be done after improvement of reflection of the forest breeding effect in the national growth models

Activity data necessary for the calculation of the mitigation effect are available at Rural Support Service and State Forest Service. Tier 3 method will be used for calculation of carbon stock change in living biomass. Tier 3 method will be implemented for calculation of carbon stock changes in litter and soil. Cost of the mitigation effect will be calculated using data available at Rural Support Service.

#### 3.7.3.3. Additional measures in wetlands

##### *3.7.3.3.1. Restoration of peat extraction sites*

Abandoned peat extraction sites are considerable source of GHG emissions. Afforestation, establishment of perennial energy crops or extraction of remaining peat layer with following flooding or rewetting of areas, where growing of perennial crops for biomass production is not possible, may lead to significant reduction of GHG emissions.

The measure is considered in the National Energy and Climate Plan 2021-2030. The area, which will be affected by this measure during 7 years period between 2023 and 2030, is 18 kha including 9000 ha 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[146], 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 evidences of the emission reduction in rewetted areas[147]. 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 3.33. 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. $ha^{-1}$.

[146] https://restore.daba.gov.lv/public/lat/optimizacijas_modelis1/

[147] 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. https://doi.org/10.22616/rrd.28.2022.006

**Table 3.33 Soil GHG emission factors according to LIFE REStore project[148]**

| GHG | 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 |

The GHG emission reduction potential is estimated considering that half of the degraded peatlands can be afforested. In practice this measure requires significant investments in regulation of water regime. Insufficient funding in modernization of drainage systems may result in significantly smaller GHG mitigation effect.

### 3.7.3.4. Summary of impact of additional measures

Additional measures, which are proposed for implementation between 2023 and 2027 will result in reduction of GHG emissions by 17 mill. tons of $CO_2$ eq. until 2050 (Table 3.34); however, some of the measures are not yet quantified 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 additional measures will reach 4.8 mill. tons of $CO_2$ eq. Implementation of the measures will increase forest area by 14.5 kha in 2027. Average annual contribution to GHG mitigation will reach 962 kt $CO_2$ eq. $yr^{-1}$ in 2030 and will remain 664 kt $CO_2$ eq. $yr^{-1}$ in 2050. 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 captured $CO_2$. Avoided emissions according to initial forecast are 5539 kt $CO_2$ eq. $yr^{-1}$ and additional $CO_2$ removals – 12379 kt $CO_2$ eq. $yr^{-1}$ in 2050 (Table 3.34).

**Table 3.34 Projected GHG emission reduction in WAM scenario**

| Measures | Type of impact | Land use category | Projection of GHG emission reduction, kt $CO_2$ eq. | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | **2025** | **2030** | **2035** | **2040** | **2045** | **2050** |
| **Establishment of orchards** | **Avoids emissions** | **Cropland** | 80 | 401 | 734 | 1068 | 1402 | 1736 |
| **Green fallow before winter crops** | **Avoids emissions** | **Cropland** | NE | NE | NE | NE | NE | NE |
| **Introduction of legumes into conventional crop rotations** | **Avoids emissions** | **Cropland** | 53 | 264 | 484 | 704 | 871 | 880 |

[148] Priede, A., & Gancone, A. (Eds.). (2019). Sustainable and responsible after-use of peat extraction areas. Baltijas Krasti.

| Measures | Type of impact | Land use category | Projection of GHG emission reduction, kt $CO_2$ eq. | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
| **Undergrowth plants sown with winter crops** | **Avoids emissions** | **Cropland** | NE | NE | NE | NE | NE | NE |
| **Reconstruction of drainage systems in cropland and grassland** | **Reduces emissions** | **Forest land** | 318 | 1590 | 2915 | 4240 | 5247 | 5300 |
| **Afforestation** | **Reduces emissions** | **Forest land** | 92 | 460 | 843 | 1226 | 1609 | 1992 |
| **Forest thinning** | **Reduces emissions** | **Forest land** | 135 | 676 | 1240 | 1668 | 1691 | 1691 |
| **Regeneration of stands affected by natural disturbances** | **Avoids emissions** | **Forest land** | NE | NE | NE | NE | NE | NE |
| **Reconstruction of drainage systems in forest lands** | **Avoids emissions** | **Forest land** | 169 | 843 | 1545 | 2248 | 2950 | 3653 |
| **Restoration of peat extraction sites** | **Avoids emissions** | **Forest land** | 123 | 616 | 1129 | 1642 | 2155 | 2668 |
| **Total GHG emission reduction** | | | 970 | 4849 | 8890 | 12796 | 15925 | 17919 |

The effect of the additional mitigation measures will reach maximum in 2027 and will reduce starting from 2037, according to the projection; however, due to the measures implemented in forests lands the effect will be long lasting and will continue also after 2050 (Figure 3.8). 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 forest lands and farnlands; 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. Similarly, restoration of peat extraction sites may be associated with measures leading to increase of emissions, e.g., flooding or rewetting to implement biodiversity targets or to afforestation and cropping systems ensuring reduction of GHG emissions in long-term. The measures with the highest accuracy of projections – afforestation, pre-commercial thinning and reconstruction of drainage systems in forest lands contributes to 41% of the proposed mitigation effect (Figure 3.9). The effect of other measures is certainly positive but needs more accurate assessment methods.

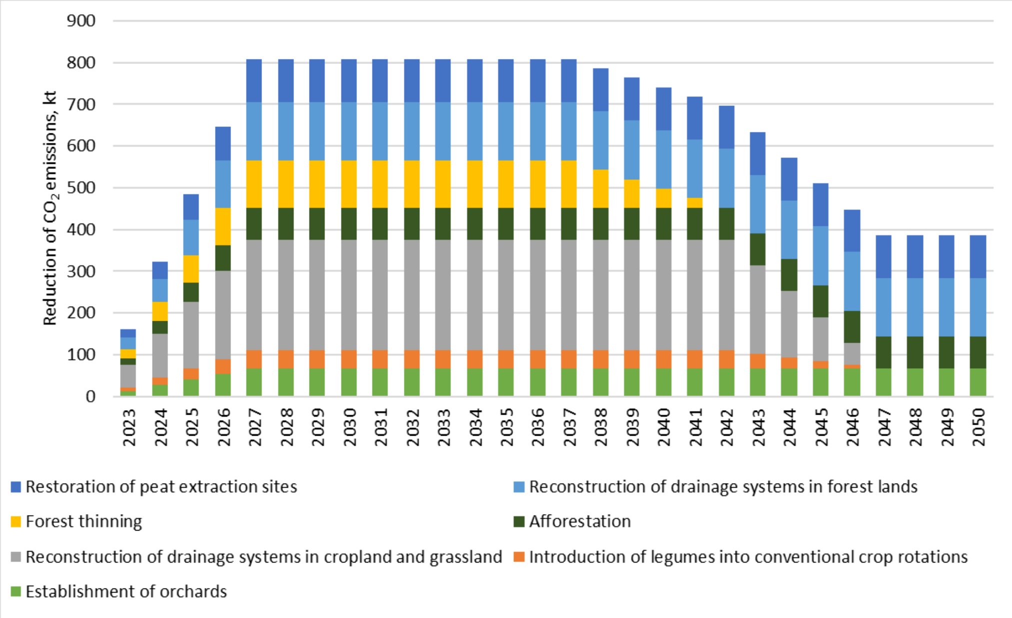


**Figure 3.8 Mitigation of the effect of proposed additional measures**

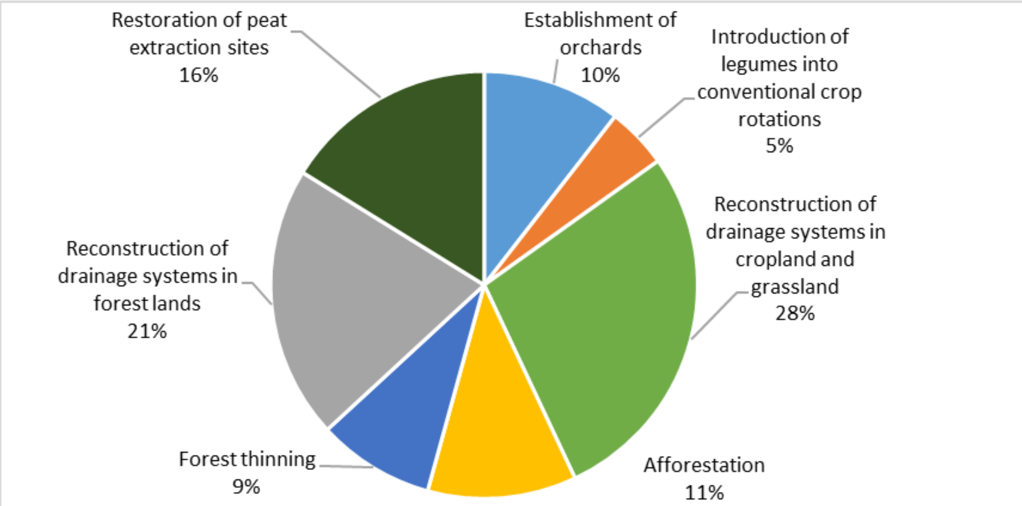


**Figure 3.9 Summary of effect of the proposed additional measures**

## 3.8. WASTE MANAGEMENT

The most important document that describes the Latvian progress and planned policies on waste management is "**Waste management plan 2021 - 2028**"[149], approved by the Cabinet of Ministers with Order No 45 22nd January 2021. The waste management system is one of the most important directions of 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 Cabinet of Ministers, which have an effect on GHG emissions within the waste sector:

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

- Regulations of the Cabinet of Ministers 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 Regarding Separate Waste Collection, Preparation for Re-use, Recycling and Material Recovery” adopted on 26th October 2021;
- Regulations of the Cabinet of Ministers No. 485 adopted on 21st June 2011 "Procedures for the Management of Certain Types of Hazardous Waste";
- Regulations of the Cabinet of Ministers No. 401 adopted on 24th May 2011 "Requirements for Incineration of Waste and Operation of Waste Incineration Plants";
- Regulations of the Cabinet of Ministers No. 470 adopted on 21st June 2011 "Mining waste management procedures".

In order to promote recycling and reuse of natural resources tax law sets the rate for waste disposal (Table 3.35).

**Table 3.35 The tax rates for waste disposal from 1st January 2017**

| No. | Waste type | Unit | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Municipal and industrial waste, which are not hazardous | EUR/t | 25.00 | 35.00 | 43.00 | 50.00 | 65.00 | 80.00 | 95.00 |
| 2. | Hazardous waste (also industrial hazardous waste) | EUR/t | 45.00 | 50.00 | 55.00 | 60.00 | 70.00 | 85.00 | 100.00 |

Main policies and measures, regulating **waste water handling sector**, are listed below:

- Urban Waste Water Directive 271/91/EEC (UWWTD) requires to implement at least secondary treatment (which means “well managed biological treatment” in the terms of IPCC 2006 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 waste water and thus be very small or even not at all source of $CH_4$ emissions. However, UWWTD requires as well, that all agglomerations, larger than 10 000 p.e., 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 IPCC 2006 Guidelines leads to increase of $N_2O$ emissions from modern, centralized treatment plants;

- “Investment Plan of Waste Water 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 waste water treatment plants, modernization of management of sewage sludge, measures to improve energy effectiveness in the waste water treatment sector and management of decentralized collecting systems;
- “Strategy of Sewage Sludge Management 2022 – 2027” has been developed and is in the process of official approval at the moment. This Strategy aims to define possible measures to manage sewage sludge in a sustainable way and in accordance with circular economy. Since it is not oficially approved yet, “Strategy of Sewage Sludge Management 2022 – 2027” is viewed within WAM scenario here.

# 4. PROJECTED GREENHOUSE GAS EMISSIONS UNTIL 2050

The scenarios underlying the emission projections in the 2023 submission have incorporated new insights with regard to economic and demographic developments, sector developments, fossil fuel prices, the $CO_2$ price and policies compared to projections of 2022 submission. In 2022, Latvia submitted updated GHG projections, where GHG recalculations were made taking into account changes in the emission factor of agricultural organic soils. In 2022 submission, the initial data (projections of macroeconomic, activity data) were not changed. The year 2020 (base year) and the inventory report submitted to the UNFCCC on 14 April 2022 has been used asa starting point for the projections.

GHG emissions in Latvia have been projected for the years 2025, 2030, 2035, 2040 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 2022, which means that it is a projection “with existing measures” (WEM). In addition to this scenario, there are also projected emissions with planned PaMs. This is the “scenario with additional measures” (WAM). Masures 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) and LULUCF sectors to evaluate the impact of GDP and population growth rate as well as changes in sectorial assumptions. More information is provided in Chapter 7.

Based on macroeconomic projection, it is expected that GDP will increase during 2020-2050. The number of population in Latvia is expected to continue to decrease by 10.5% from 1.900 to 1.701 million in 2020-2050 (Table 4.1).

**Table 4.1 The main macro economic indices applied for projecting GHG emissions**

| | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| **Number of inhabitants, thsd.** | 1900.45 | 1828.34 | 1768.22 | 1727.93 | 1707.61 | 1701.19 | 1700.85 |
| | **2018 - 2020** | **2021 – 2025** | **2026 – 2030** | **2031 - 2035** | **2036-2040** | **2041-2045** | **2046-2050** |
| **GDP growth, annual changes per period, %** | | 3.1 | 2.4 | 2.3 | 2.1 | 1.7 | 1.3 |
| agriculture | | 0.5 | 1.8 | 1.5 | 1.3 | 0.9 | 0.5 |
| service | | 3.3 | 2.4 | 2.4 | 2.2 | 1.8 | 1.4 |
| construction | | 2.7 | 2.4 | 2.4 | 2.2 | 1.8 | 1.5 |

Total GHG emissions (excluding LULUCF, including indirect $CO_2$) under the WEM scenario decrease by 7.1% in 2030 and by 39.5% in 2050 compared to 2020 (Table 4.2 and Figure 4.1).

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

| | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Energy (excluding Transport) | 3688.45 | 3433.31 | 3144.32 | 2098.76 | 1752.63 | 1671.48 | 1505.42 |
| Transport | 3104.88 | 3284.19 | 3165.07 | 2659.85 | 2182.63 | 1788.65 | 1594.07 |
| Industrial processes and product use | 855.78 | 844.14 | 807.80 | 796.64 | 797.64 | 799.66 | 799.90 |
| Agriculture | 2227.50 | 2216.88 | 2194.13 | 2156.05 | 2154.99 | 2154.58 | 2154.16 |
| Waste | 601.03 | 516.83 | 418.66 | 362.47 | 329.88 | 289.67 | 286.16 |
| Indirect $CO_2$ | 13.10 | 11.36 | 10.97 | 8.06 | 7.33 | 6.89 | 6.46 |
| **Total excluding LULUCF, including indirect $CO_2$** | 10490.74 | 10306.71 | 9740.94 | 8081.83 | 7225.09 | 6710.93 | 6346.17 |
| **Total including LULUCF and indirect $CO_2$** | 11159.92 | 11653.01 | 13035.54 | 11677.73 | 11207.20 | 11140.71 | 11755.37 |
| Land Use, Land-Use Change and Forestry | 669.18 | 1346.31 | 3294.60 | 3595.90 | 3982.10 | 4429.78 | 5409.21 |

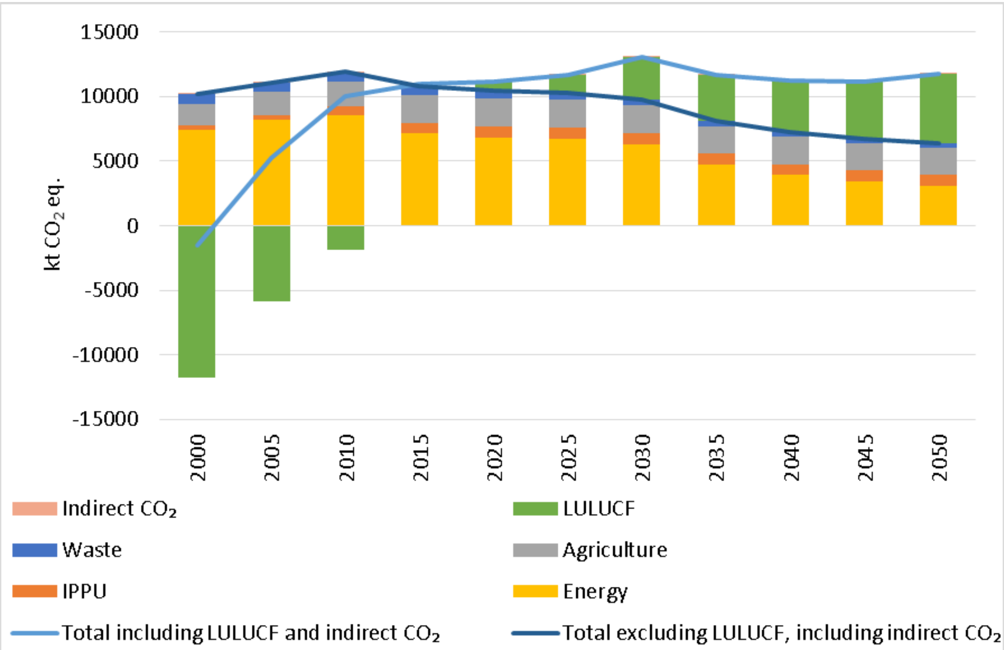


**Figure 4.1 GHG emission projections in WEM scenario**

The Energy sector (including Transport) will account for the largest share (64.8%) of the total projected GHG emissions in the year 2030, followed by the Agriculture sector with its share amounting to 22.5%, IPPU with 8.3% and Waste sector with 4.3%.

In 2050, the share of Agriculture, IPPU sector and Waste increases, constituting 33.9%, 12.6% and 4.5% respectively. At the same time the contribution of the Energy sector to total emissions decreases to 48.8%.

Carbon dioxide accounts for 66.8% of the total GHG emissions in 2020 and it is projected that $CO_2$ share of total emissions will increase by 1.4 precent point in 2030 compared to 2020. Methane and nitrous oxide accounts for 18.3% and 12.5% of the total GHG emissions in 2020 and it is projected that $CH_4$ share of total emissions will decrease by 1.7 percent point and the $N_2O$ share of total emissions will increase by 1.0 percent point in 2030 compared to 2020.

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 emissions are by 1.4% and 1.3% 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.**

| | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 | 2050 |
|---|---|---|---|---|---|---|---|
| Energy excluding transport | 3688.45 | 3435.62 | 3149.57 | 2075.97 | 1681.88 | 1549.65 | 1538.15 |
| Transport | 3104.88 | 3284.24 | 3166.36 | 2660.47 | 2183.57 | 1790.56 | 1593.88 |
| Industrial processes and product use | 855.78 | 844.14 | 807.80 | 796.64 | 797.64 | 799.66 | 799.90 |
| Agriculture | 2227.50 | 2120.74 | 2044.99 | 2009.67 | 2009.02 | 2008.81 | 2008.61 |
| Waste | 601.03 | 516.83 | 415.36 | 356.12 | 303.25 | 292.43 | 262.28 |
| Indirect $CO_2$ | 13.10 | 11.36 | 10.97 | 7.98 | 7.02 | 6.60 | 6.86 |
| **Total excluding LULUCF, including indirect $CO_2$** | 10490.74 | 10212.92 | 9595.06 | 7906.85 | 6982.38 | 6447.72 | 6209.67 |
| **Total including LULUCF and indirect $CO_2$** | 11159.92 | 11103.45 | 12158.95 | 10791.16 | 10327.77 | 10464.45 | 11071.20 |
| Land Use, Land-Use Change and Forestry | 669.18 | 890.53 | 2563.90 | 2884.31 | 3345.40 | 4016.73 | 4861.53 |

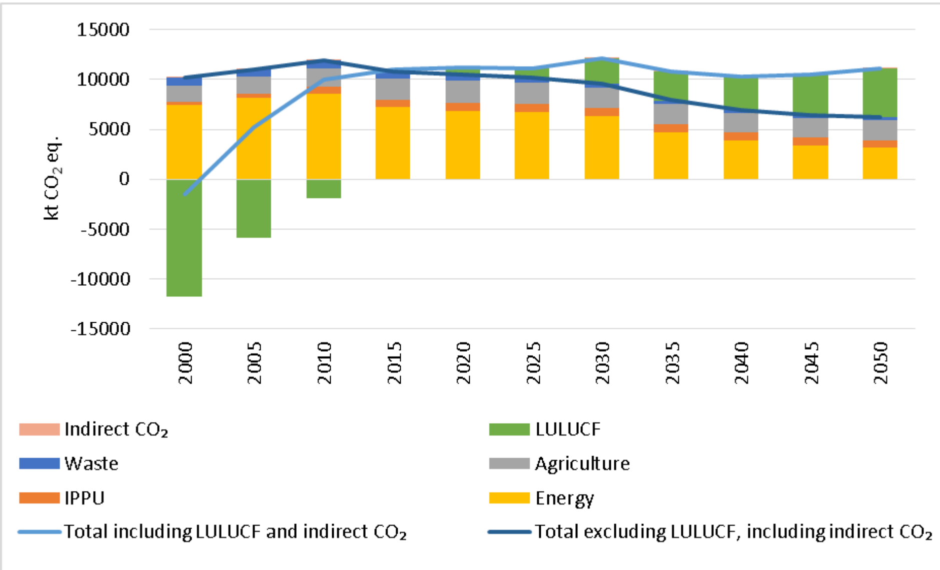


**Figure 4.2 GHG emission projections in WAM scenario**

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.

Current projections are based on different macroeconomic development (GDP, VA and population) scenario when compared with the projections of 2021 and 2022 submission. Macroeconomic projections are made by MoE.

There are several changes in the GHG inventory, which affected projections of emissions, for example, continuous improvement of activity data in land of area in LULUCF sector and organic soils area in Agriculture sector etc.

# 5. PROJECTED EMISSIONS PER SECTOR

## 5.1 ENERGY

GHG emission projections in the Energy sector are calculated namely, by means of the "scenario with existing measures" (WEM) and "scenario with additional measures" (WAM). 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", "Latvia's National Development Plan for 2021-2027" and "National Industrial Policy Guidelines 2021-2027". It also takes into account the impacts of the Covid-19 pandemic and analyze the processes that drive the development of the global economy.

With Russia invading Ukraine on 24$^{th}$ 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 (2022-2030), the baseline scenario projects GDP growth of an average of 2.5% 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 1.8% - 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 macroecoomic 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 geopolitical situation has significantly increased the uncertainty of fuel price forecasts. The greatest uncertainty relates to the medium time period, that is, in the time period of 2 to 4 years.

The EC price projections (for oil, coal and gas), the European Central Bank's price projections for oil (years 2022-2024) have been used as the basis for calculating fuel price projections. These projections have been adjusted taking into account 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[150] harmonised trajectory of the carbon price of the existing ETS in its current scope for WEM and WAM scenario.

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 and higher energy efficiency requirements for the construction of new buildings.

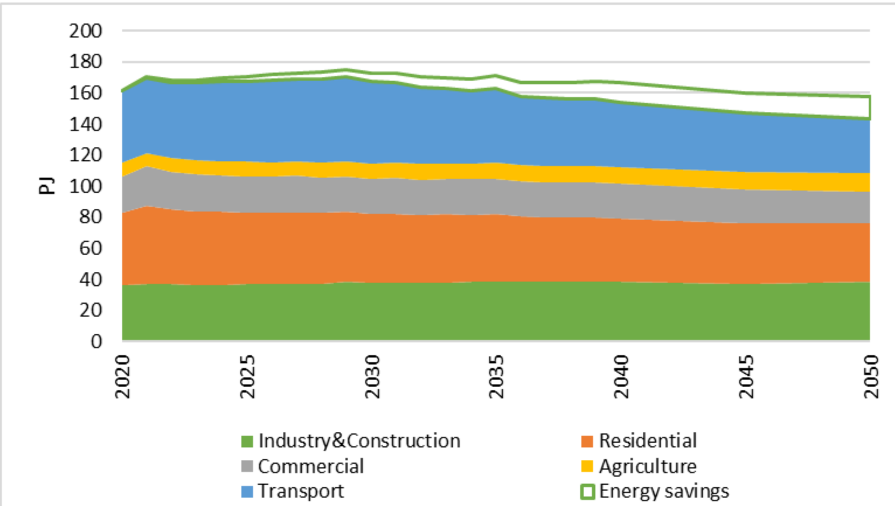


**Figure 5.1 FEC development in sectors under the WEM scenario**

[150] EC "Recommended parameters for reporting on GHG projections in 2023"

The calculated FEC projections anticipate that in 2030 Transport (including international aviation) and Residential sector will be the main FEC sectors consuming respectively 31.6% and 26.4% of total FEC. In its turn, Industry will consume 22.6% and Commercial&Public Service sector 13.5% 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 3.9% higher, compared to 2020. As it can be seen in Figure 5.1, 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.

In order to ensure the projected final energy demand, the following primary energy consumption (PEC) under the WEM scenario has been calculated (Figure 5.2). The main characteristics of gross primary energy consumption (GPEC) in the WEM scenario are as follows:

- calculated PEC in 2030 is per about 1.9% higher, compared to 2020. This PEC increase is mainly driven by an increase in FEC, but partly offset 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 41.4% in 2020 to 45.2% in 2030;
- WEM scenario results in the signifficant change of the primary energy resources structure. In the total PEC in 2030 the share of natural gas will decrease per about 3.5 percent points, in its turn, consumption of renewables (wind and solar) will increase per about 5.4 percent points.

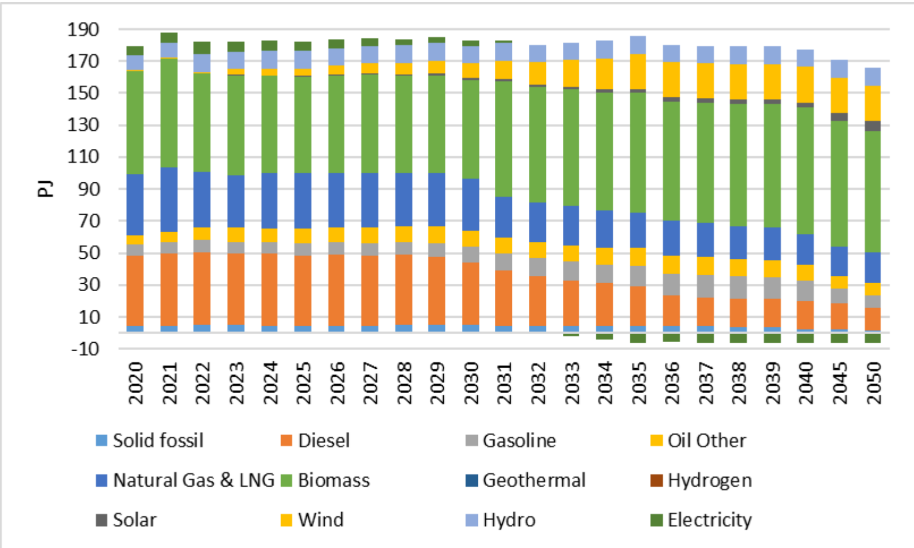


**Figure 5.2 PEC by fuels under the WEM scenario**

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 7.1% and in 2050 – per 54.4% lower compared to 2020 (Figure 5.3 and Table 5.1).

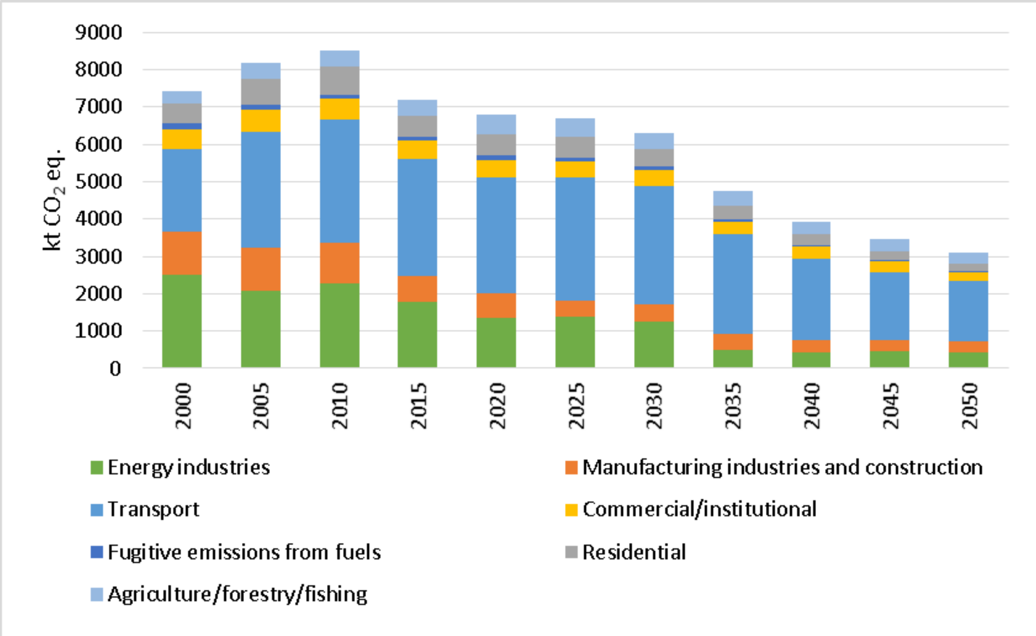


**Figure 5.3 GHG emission projections under the WEM scenario**

**Table 5.1 Projected GHG emissions under the WEM scenario**

| Sector, kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Energy industries[151] | 1367.32 | 1377.51 | 1252.68 | 508.64 | 424.12 | 454.05 | 433.46 |
| Manufacturing industries and construction | 658.03 | 438.63 | 454.25 | 429.72 | 340.79 | 315.10 | 304.95 |
| Transport | 3104.88 | 3284.19 | 3165.07 | 2659.85 | 2182.63 | 1788.65 | 1594.07 |
| Other sectors[152] | 1550.50 | 1521.72 | 1350.13 | 1108.15 | 944.92 | 858.96 | 726.12 |
| Fugutive emissions | 112.61 | 95.45 | 87.25 | 52.24 | 42.80 | 43.38 | 40.89 |

Since the WAM scenario does not include additional policies, the total calculated GHG emissions in the WAM scenario do not differ slightly from those projected in the WEM scenario. Calculated GHG emission projections in 2030 is per 7.0% and in 2050 – per 53.9% lower compared to 2020 (Figure 5.4).

[151] 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.

[152] 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.

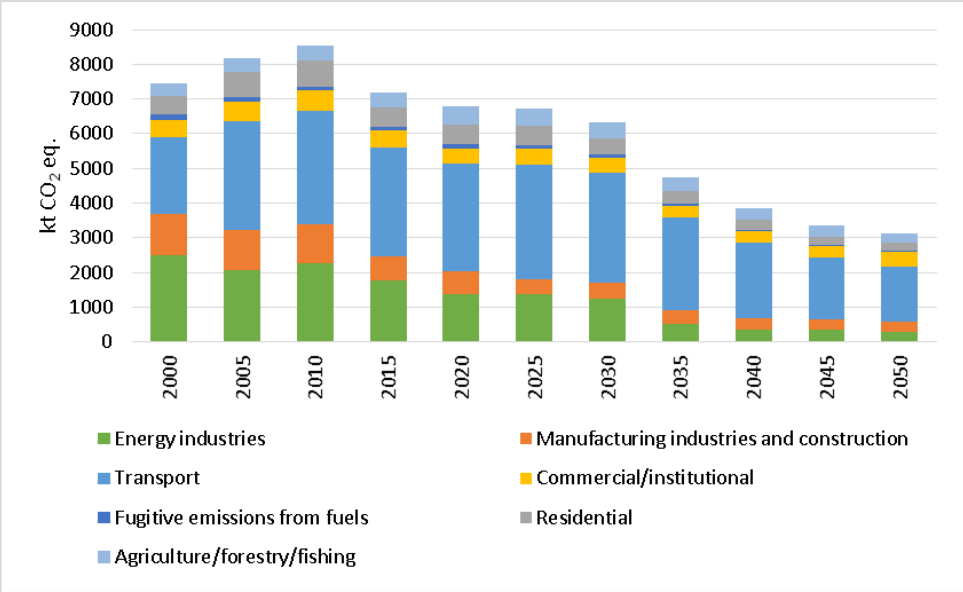


**Figure 5.4 GHG emission projections under the WAM scenario**

Energy sector (excluding transport) total emissions in the WEM scenario decrease by about 14.8% by 2030 and continues to fall by 2040, in 2050 they are about 59.2% less than in 2020.

As the district heating system to supply heat energy is widely developed in Latvia, energy consumption and thus GHG emissions in the energy industry sector are significantly affected due to this factor. District heating emissions historically have varied according to the heating demand (cold or warm winters). Until 2030, there will be no significant changes in the type of fuel utilised in district heat production. However, after 2030, the use of RES, especially biomass, in district heat production, will increase rapidly.

The second factor, influencing historical GHG emissions in the energy industry sector, had been electricity final consumption, weather conditions (hydro energy generation) and electricity import from neighbouring countries.

Electricity, district heating and industrial energy use is strongly affected by the EU ETS $CO_2$ allowance price, which makes the use of fossil fuel less and less feasible and cuts emissions in these sectors efficiently.

It is projected, electricity consumption will increase both by 2030 and beyond due to the substitution of fuels with electricity (mainly in transport and residential sectors) as well as due to the increase of electricity consumption in industrial production. As Latvia has not stated the political goal to provide full self-sufficiency in the produced electricity, the amount of imported electricity varies from year to year depending on the projected price in the common, with neighbouring countries, electricity market.

The WEM scenario projects two key trends until 2030: (1) electricity import will decrease, and (2) amount of electricity produced utilizing RES will increase. Electricity production from wind energy is increasing rapidly, however at the same time the increase in electricity production from solar energy should also be underlined. This trend continues also after 2030.

Simultaneously, the amount of electricity produced from natural gas in CHP plants is decreasing.

As there are no PaMs in Energy sector to be included in the WAM scenario, the WAM scenario differs from the WEM scenario only by the trajectory of the ETS price after 2030. The ETS price in the WAM scenario in 2040 and 2050 is significantly higher than in the WEM scenario.

Since the WAM scenario differs from the WEM scenario only with the ETS price after 2030, the most significant reduction of GHG emissions in the WAM scenario in 2040 and 2050, compared to the WEM scenario, is in energy industries (16.4% and 33%) and in manufacturing industries (0.9% and 6.1%). In the other sectors, the calculated GHG emissions in the WAM scenarios are almost unchanged compared to the WEM scenario. As GHG emissions are calculated by the optimisation model TIMES-LV, which applies elastic demand approach, demand for energy services are elastic to prices in the model, e.g., if demand getting cheaper energy then consumption increases. In some cases, this makes little difference for GHG emissions in the WEM and WAM scenarios, even under the same conditions in the sectors.

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

| Energy (including Transport), kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| WEM scenario | 6793.34 | 6717.50 | 6309.38 | 4758.60 | 3935.26 | 3460.13 | 3099.48 |
| WAM scenario | 6793.34 | 6719.85 | 6315.93 | 4736.43 | 3865.45 | 3340.22 | 3132.03 |
| **Difference WAM vs WEM, %** | | | 0.1% | -0.5% | -1.8% | -3.5% | 1.0% |

### 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 31.0% lower compared to 2020. The main reason for this is the replacement of fossil fuels with RES, mainly biomass.

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

| Manufacturing industries and construction, kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| WEM scenario | 658.03 | 438.63 | 454.25 | 429.72 | 340.79 | 315.10 | 304.95 |
| WAM scenario | 658.03 | 438.56 | 455.41 | 413.99 | 337.85 | 298.40 | 286.27 |
| **Difference WAM vs WEM, %** | | | | -3.7% | -0.9% | -5.3% | -6.1% |

### Residential and commercial sector

The emissions from individual heating of residential and commercial buildings will decrease in 2030 by 10.3% and in 2050 by 56.2% compared to 2020 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 4.0% and in 2050 by 16.6% compared to 2020 under the WEM scenario.

Due to the use the TIMES optimization model for the calculation of emission projections, the WAM scenario, taking into account the increase of the price of the ETS after 2030, replaces district heat produced in ETS plants with natural gas in final consumption. In the resulting WAM scenario, GHG emissions are slightly higher than in the WEM scenario.

**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. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| WEM scenario | 1550.50 | 1521.72 | 1350.13 | 1108.15 | 944.92 | 858.96 | 726.12 |
| WAM scenario | 1550.50 | 1521.21 | 1348.05 | 1109.98 | 949.52 | 872.73 | 916.80 |
| **Difference WAM vs WEM, %** | | | -0.2% | 0.2% | 0.5% | 1.6% | 26.3% |

## 5.2 TRANSPORT

Since the number of passenger cars per 1000 inhabitants in Latvia is still lower than the EU average, then, taking into account the projected increase in private consumption and GDP growth, in the period 2020-2050 the growth of total passenger-kilometres by 20.5% and total freight tonne-kilometres by 27.4% 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, particularly replacing diesel locomotives.

**Table 5.5 Transport emissions according to WEM and WAM scenarios projections**

| **Transport, without International bunkers, kt $CO_2$ eq.** | **2020** | **2025** | **2030** | **2035** | **2040** | **2045** | **2050** |
|---|---|---|---|---|---|---|---|
| WEM scenario | 3104.88 | 3284.19 | 3165.07 | 2659.85 | 2182.63 | 1788.65 | 1594.07 |
| WAM scenario | 3104.88 | 3284.24 | 3166.36 | 2660.47 | 2183.57 | 1790.56 | 1593.88 |
| **Difference WAM vs WEM, %** | | | 0.04% | 0.02% | 0.04% | 0.11% | -0.01% |
| International bunkers, kt $CO_2$ eq. | **2020** | **2025** | **2030** | **2035** | **2040** | **2045** | **2050** |
| **WEM scenario, total** | 896.97 | 1043.50 | 1192.14 | 1181.03 | 1164.08 | 1138.91 | 1106.52 |
| Aviation | 179.68 | 329.35 | 486.73 | 486.29 | 483.35 | 476.87 | 467.17 |
| Navigation | 717.29 | 714.15 | 705.42 | 694.75 | 680.73 | 662.04 | 639.35 |

The total projected GHG emissions under WEM scenario of the inland transportation will increase by 1.9% in 2030 and will decrease by 48.7% in 2050 against the 2020 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. The share of electricity in road transport FEC increases from 0.2% in 2020 up to 2.7% in 2030 and 17.2% 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 LPG – is increasing in certain road transport segments, such as trucks.

GHG emissions in the railway transport account for about 3% of the total projected emissions in the Transport sector in 2030.

GHG emission projections in International bunkers in the WEM scenario foresee different trends in aviation and navigation. In 2030, calculated GHG emissions in international aviation, compared to 2020 level, will increase around 2.7 times. Emission increase in aviation is caused by the increase of number of both flights and served passengers in the Riga International Airport. The main reason for this is the recovery of the aviation sector following the crisis caused by the COVID-19 pandemic.

## 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), then the growth of the construction sector and cement production are the main driving forces for GHG emission projection. In cement production emissions will increase by 4.4% in 2030 and by 14.0% in 2050 compared to 2020.

The total projected GHG emissions under WEM scenario in IPPU will decrease by 5.6% in 2030 and by 6.5% in 2050 compared to 2020 (Table 5.6).

**Table 5.6 IPPU emissions according to WEM and WAM scenarios projections**

| IPPU, kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| **WEM scenario** | 855.78 | 844.14 | 807.80 | 796.64 | 797.64 | 799.66 | 799.90 |
| **WAM scenario** | 855.78 | 844.14 | 807.80 | 796.64 | 797.64 | 799.66 | 799.90 |

As it can seen in Table 5.6. WEM and WAM scenario is the same. The distribution of IPPU emission projections by sectors is represented in Figure 5.5 and Table 5.7.

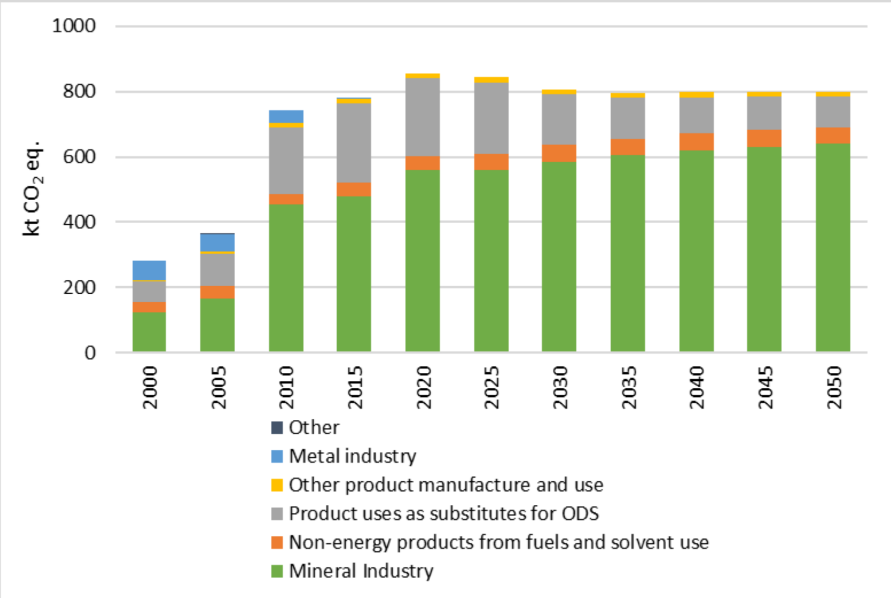


**Figure 5.5 GHG emission projections by IPPU sector under the WEM and WAM scenario**

**Table 5.7 The total emissions in IPPU sector under the WEM and WAM scenario**

| IPPU, kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Mineral Industry | 560.56 | 561.20 | 585.27 | 603.91 | 619.90 | 631.65 | 639.23 |
| 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 | 43.11 | 49.11 | 50.48 | 51.22 | 50.98 | 51.01 | 51.00 |
| Electronics industry | NO | NO | NO | NO | NO | NO | NO |
| Product uses as substitutes for ODS | 236.58 | 217.44 | 155.83 | 125.38 | 110.67 | 100.93 | 93.59 |
| Other product manufacture and use | 15.53 | 16.39 | 16.22 | 16.13 | 16.09 | 16.07 | 16.07 |

| IPPU, kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Other | NO | NO | NO | NO | NO | NO | NO |
| **Total:** | 855.78 | 844.14 | 807.80 | 796.64 | 797.64 | 799.66 | 799.90 |

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

### 5.3.1. F-gases

Currently emissions from refrigeration and air conditioning equipment constitute the mayor part of total F-gas emissions (97.4% in 2020) and it is expected that emissions from these appliances will constitute the biggest share from F-gas emissions in the future. It is projected that the trend of F-gas emissions will decrease not as a straight line, but with some fluctuations. Fluctuations in F-gas emissions 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 (517/2014) as well as according to prohibition to use mobile air-conditioning systems designed to contain F-gases with a GWP higher than 150 from a certain date.

### 5.3.2. Solvent Use

$CO_2$ emission projections in the Solvent use sector are based on two parts. For domestic solvent use subsector projections are based on number of inhabitant development scenario and private consumption development scenario. Emissions from other subsectors are based on GDP development scenario.

The total projected $CO_2$ emissions under the WEM and WAM scenario are projected to increase by 10.1% in 2030 and by 27.6% in 2050 compared to 2020 (Table 5.8).

**Table 5.8 Emissions in Solvent use sector per WEM and WAM scenario**

| Solvent use, kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| **WEM scenario** | 24.38 | 25.74 | 26.85 | 28.00 | 29.16 | 30.22 | 31.12 |
| **WAM scenario** | 24.38 | 25.74 | 26.85 | 28.00 | 29.16 | 30.22 | 31.12 |

## 5.4. AGRICULTURE

### 5.4.1. Projections of GHG emissions with existing measures

GHG emission projections from Agriculture sector in WEM scenario are based on projected livestock population, main harvested crops and area harvested, used lime materials, consumption of inorganic and organic N fertilizers.

It is projected that there will be a decreasing trend of total GHG emissions in the agriculture sector during the period 2020-2050. The total Agriculture GHG emissions will decrease by 1.5%

in 2030 and by 3.3% in 2050 compared to 2020. The most rapid decrease of emissions is related to manure management where it is expected that emission will decrease by 8.9% in 2030 and by 16.6% in 2050 compared to 2020. However, projections show an increase of emissions from liming and urea application during 2020-2050 by 93.6%. All emissions from the agriculture sector projected under WEM scenario are represented in Table 5.9 and Figure 5.6.

**Table 5.9 Projected GHG emissions from Agriculture sector in WEM scenario**

| Subcategory, kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Enteric fermentation | 958.75 | 897.33 | 884.63 | 855.02 | 849.00 | 845.99 | 842.98 |
| Manure management | 165.49 | 156.70 | 150.70 | 146.40 | 142.10 | 140.07 | 138.04 |
| Agricultural soils | 1032.28 | 1066.16 | 1052.77 | 1039.38 | 1037.55 | 1036.63 | 1035.71 |
| Liming and urea application | 70.97 | 96.69 | 106.04 | 115.25 | 126.34 | 131.89 | 137.44 |
| **Total:** | **2227.50** | **2216.88** | **2194.13** | **2156.05** | **2154.99** | **2154.58** | **2154.16** |

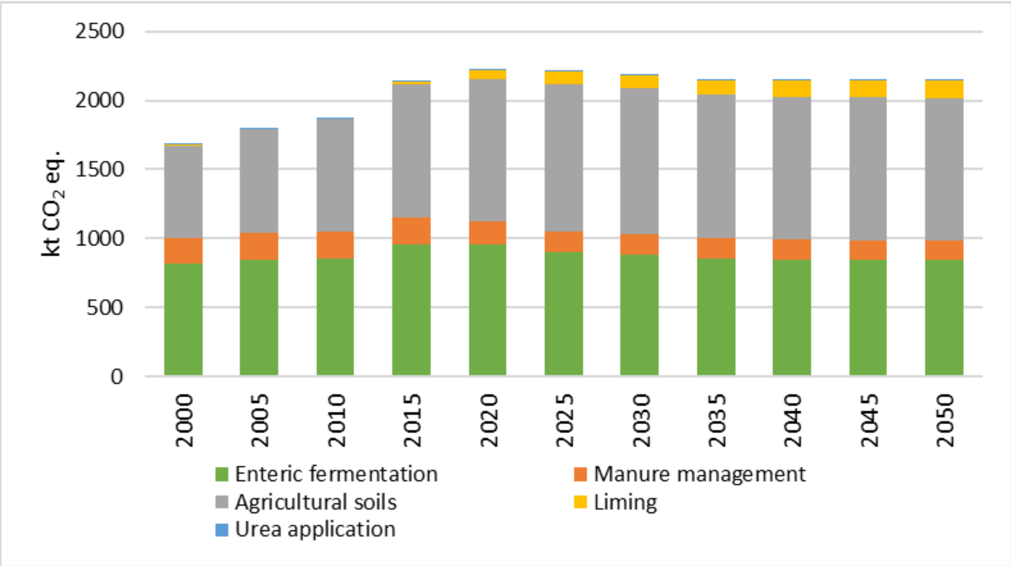


**Figure 5.6 GHG emission projections by Agriculture sector under the WEM scenario**

Historical and projected $CH_4$ emissions from enteric fermentation are included in Table 5.10. Projection results show the decrease of enteric fermentation emissions by 7.7% till 2030, compared to 2020. Enteric fermentation emissions will decrease by 12.1% till 2050, compared to 2020. The decrease is strongly related to the projected number of livestock.

**Table 5.10 Projected $CH_4$ emission from enteric fermentation**

| Subcategory, kt | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| $CH_4$ emission from enteric fermentation | 34.24 | 32.05 | 31.59 | 30.54 | 30.32 | 30.21 | 30.11 |

An important parameter that causes the large amount of enteric fermentation $CH_4$ emission is the population of ruminant livestock. More than 90% of $CH_4$ emissions by enteric fermentation is from the cattle. It is projected that population of dairy cows will decrease by 15.1% in 2030 compared to 2020 and by 22.0% in 2050 comparing to 2020. However, projections show that in 2030 the average annual milk yield per dairy cow will increase by +22.7% and by 39.6% in 2050 compared to milk yield level in 2020.

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 on the basis of 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 5.11.

**Table 5.11 Projections of the livestock number (thsd.) and milk yield per dairy cow (kg)**

| Type of livestock | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Dairy Cattle | 136.0 | 121.9 | 115.5 | 109.5 | 107.8 | 107.0 | 106.1 |
| Milk yield | 7163.0 | 8104.0 | 8790.0 | 9322.0 | 9661.0 | 9830 | 10000.0 |
| Cattle | 262.9 | 249.3 | 241.4 | 234.0 | 232.8 | 232.1 | 231.5 |
| Sheep | 91.9 | 90.3 | 90.3 | 90.3 | 90.3 | 90.3 | 90.3 |
| Goats | 11.5 | 11.2 | 11.0 | 10.8 | 10.6 | 10.5 | 10.4 |
| Horses | 8.3 | 8.4 | 8.4 | 8.4 | 8.4 | 8.4 | 8.4 |
| Swine | 306.8 | 266.4 | 267.5 | 263.2 | 258.7 | 256.5 | 254.2 |
| Poultry | 5837.9 | 5885.9 | 5896.4 | 5904.8 | 5914.0 | 5918.6 | 5923.2 |

Historical and projected $CH_4$ emissions from manure management are included in Table 5.12. Projections show that manure management $CH_4$ emission will decrease by 8.9% in 2030, and 16.6% in 2050 compared to 2020.

**Table 5.12 Projected $CH_4$ emissions from manure management**

| Subcategory, kt | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| $CH_4$ emission from manure management | 3.55 | 3.36 | 3.24 | 3.14 | 3.05 | 3.01 | 2.96 |

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 5.13). 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 5.13 Projections of MMS distribution (share) for dairy cattle and swine**

| MMS | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Dairy cattle | | | | | | | |
| Liquid | 0.437 | 0.533 | 0.588 | 0.637 | 0.637 | 0.637 | 0.637 |
| Solid | 0.383 | 0.312 | 0.261 | 0.217 | 0.217 | 0.217 | 0.217 |
| Pasture | 0.059 | 0.043 | 0.037 | 0.030 | 0.030 | 0.030 | 0.030 |

| MMS | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Anaerobic digesters | 0.121 | 0.112 | 0.114 | 0.116 | 0.116 | 0.116 | 0.116 |
| Swine | | | | | | | |
| Liquid | 0.643 | 0.661 | 0.674 | 0.679 | 0.679 | 0.679 | 0.680 |
| Solid | 0.048 | 0.030 | 0.017 | 0.012 | 0.012 | 0.012 | 0.010 |
| Pasture | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Anaerobic digesters | 0.309 | 0.309 | 0.309 | 0.309 | 0.309 | 0.309 | 0.310 |

Historical and projected $N_2O$ emissions from manure management are represented in Table 5.14. Fluctuations of $N_2O$ emissions from manure management in projected time series are related to relatively small emission factors for Latvia's typical manure management systems. The highest increase of $N_2O$ emission from manure management is referred to 2050, when emission from subcategory is projected to increase by 16.6% compared to 2020. In 2030 $N_2O$ emissions from manure management decrese by 8.9% comparied to 2030.

**Table 5.14 Projected $N_2O$ emissions from manure management**

| Subcategory, kt | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| $N_2O$ emissions from manure management | 0.25 | 0.24 | 0.23 | 0.22 | 0.21 | 0.21 | 0.21 |

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 on the basis of 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 kind of emissions. One of the measures to reduce emissions from manure management is to use manure for biogas production. Latvia uses anaerobic digesters as MMS for dairy and non-dairy cattle, swine and poultry that help to reduce a rapid increase of emissions of $N_2O$ from manure management.

Historical and projected $N_2O$ emissions from agricultural soils are represented in Table 5.15.

**Table 5.15 Projected $N_2O$ emissions from soils**

| Subcategory, kt | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| $N_2O$ emissions from soils | 3.90 | 4.02 | 3.97 | 3.92 | 3.92 | 3.91 | 3.91 |

Emissions in this category will increase by 2.0% till 2030 and 0.3% till 2050 comparing to 2020. Projections show that this synthetic feretilizers 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 5.16.

**Table 5.16 Projected activity data for estimation of GHG emissions from agricultural soils**

| Activity data | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Used N with synthetic fertilizers, kt | 84.3 | 87.6 | 86.3 | 86.5 | 86.7 | 86.8 | 86.9 |
| Used N with manure, kt | 2659.6 | 2695.2 | 2707.7 | 2801.5 | 2944.9 | 3016.6 | 3088.3 |
| Organic soils, ha | 308.9 | 224.8 | 212.1 | 201.1 | 187.8 | 181.2 | 174.5 |
| Wheat total yield, thsd. t | 178.4 | 130.0 | 133.6 | 137.3 | 143.1 | 146.0 | 148.9 |
| Barley total yield, thsd. t | 287.9 | 222.5 | 232.8 | 242.5 | 256.2 | 263.0 | 269.8 |
| Rye total yield, thsd. t | 137.2 | 146.0 | 152.2 | 157.3 | 163.0 | 165.8 | 168.6 |
| Oats total yield, thsd. t | 451.3 | 406.0 | 417.7 | 429.8 | 448.8 | 458.8 | 467.7 |
| Legumes total yield, thsd. t | 1277.1 | 1349.2 | 1332.1 | 1333.4 | 1335.5 | 1336.5 | 1337.5 |
| Rape total yield, thsd. t | 84.3 | 87.6 | 86.3 | 86.5 | 86.7 | 86.8 | 86.9 |
| Total sown area, thsd. ha | 2659.6 | 2695.2 | 2707.7 | 2801.5 | 2944.9 | 3016.6 | 3088.3 |

### 5.4.2. Projections of GHG emissions with additional measures

In order to identify potentional of additional GHG emission reducing-measures in Latvia, the following measures were evaluated according to National Energy and Climate Plan 2021-2030 and CAP Strategic plan 2023-2027.

**Promotion of organic dairy farming (low emission dairy farming).** The main aim of the measure is to promote transition of small and medium-sized conventional dairy farms to the organic farming system, thus facilitating low emission dairy farming.

**Support for fertilisation planning.** The main aim of measure is to expand arable land and increase number of medium-sized crop and livestock farms were fertilisation planning is based on knowledge about agrochemical properties of soil and have not been done previously.

**Agricultural practices to reduce nitrogen and ammonia emissions and pollution** has the aim to promote the accurate and efficient use of fertilisers in order to minimise the risks associated with the use of fertilisers the long term and to reduce leakage. The need for fertiliser must be justified by the preparation of a fertilisation plan. The fertilisation plan must be drawn up to determine the need for nitrogen.

**Promote inclusion of leguminous plants in crop rotation for nitrogen fixation.** The main aim of the measure is to expand arable land and increase number of farms where leguminous plants are included in crop rotation thus contributing to atmospheric nitrogen fixation and reduction of application of inorganic nitrogen fertilizers.

**Promote and support for precision application of inorganic nitrogen fertilisers.** The main aim of measure is to expand arable land and increase number of farms where precision technologies for application of inorganic nitrogen fertilisers are used in the planning of fertiliser schemes and spreading.

**Promote and support for direct incorporation of organic fertilisers into the soil.** The main aim of measure is to expand arable land where organic fertilisers are directly incorporated into the soil thus promoting more efficient use of organic fertilisers.

**Promote feed ration planning and improvement of feed quality.** The main aim of measure is to increase number of cows whose feed rations are balanced for reduced crude protein level without loss in milk production. As well as to increase the number of cows whose are fed with feed with high digestible energy.

**Maintenance and modernization of amelioration systems on agricultural land.** The main aim of measure is to increase arable land area with improved and maintained amelioration systems, thereby reducing nitrogen leaching and run-off from agriculture.

**Promote the production of biogas and biomethane and the use of biomethane.** The main aim of the measure is to ensure the installation of biogas production and biogas purification (biomethane production) facilities on farms that do not yet have biogas production and purification facilities.

**Increase of land area under organic farming** relative to total agricultural land promote methods with environmentally friendly influence on nature, reduction of synthetic nitrogen uses and leaching. This leads to increased biodiversity.

**Conservation farming practices** introduces respectful agricultural practices as minimal tillage (min-till), strip till or direct sowing (no-till) and has restrictions on the use of herbicides. Promotion of grassland conservation contributes to the mitigation of climate change, including the reduction of GHG emissions from agricultural practices and ensures maintenance of soil carbon stocks. **Increased welfare requirements and emissions-reducing livestock farming** supports to intervention activity "extended grazing for at least 160 days", that allow to improve pasture management as well, may lead to significant reduction of GHG emissions.

The results of the Agriculture emission projections under WAM scenario indicate that emissions in the Agriculture sector could decrease by 8.2% till 2030 and by 9.8% compared to 2020, or around 6.8% of emissions reduction potential is determined in relation to the baseline assumptions. These measures have resulted in savings of the use of nitrogen fertilizers, increasing of low emission dairy farming, and improving of manure management (Table 5.17 and Figure 5.7).

**Table 5.17 Projected GHG emissions from Agriculture sector by WAM scenario**

| Subcategory, kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Emission from enteric fermentation | 958.75 | 884.77 | 866.93 | 837.92 | 832.02 | 829.07 | 826.12 |
| Emission from manure management | 165.49 | 153.70 | 147.69 | 143.91 | 139.69 | 137.69 | 135.69 |
| Emission from soils | 1032.28 | 985.59 | 924.33 | 912.57 | 910.97 | 910.16 | 909.36 |

| Subcategory, kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Emission from liming and urea application | 70.97 | 96.69 | 106.04 | 115.25 | 126.34 | 131.89 | 137.44 |
| **Total:** | **2227.50** | **2120.74** | **2044.99** | **2009.67** | **2009.02** | **2008.81** | **2008.61** |

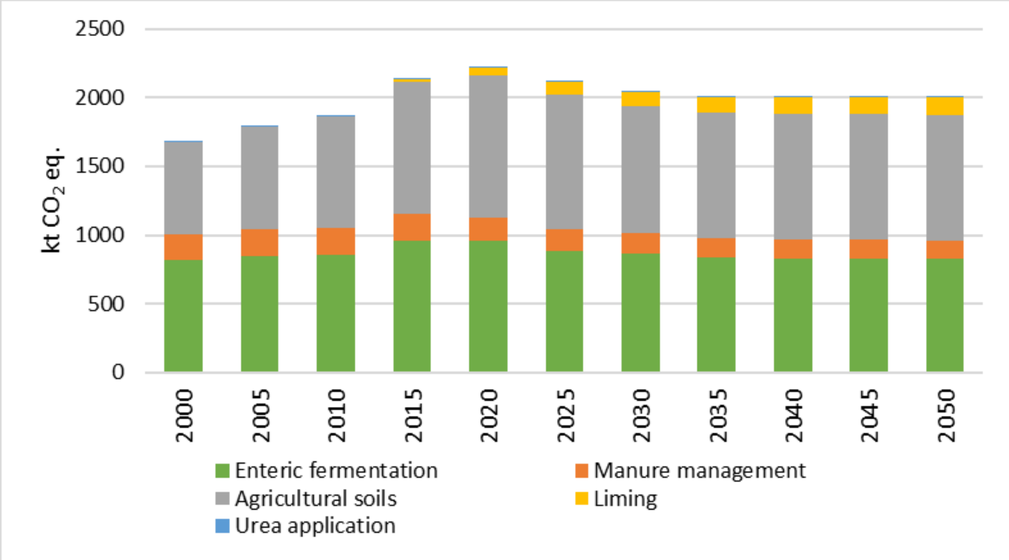


**Figure 5.7 GHG emission projections by Agriculture sector under the WAM scenario**

# 5.5. LAND USE, LAND USE CHANGE AND FORESTRY

## 5.5.1. Projections of GHG emissions with existing measures

The net GHG emissions in LULUCF sector based on WEM scenario are shown in Table 5.18 and Figure 5.8. Total GHG emissions in LULUCF sector will increase in 2030 and 2050, compared to 2020.

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

| Net emissions / Year | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| $CO_2$ emissions, kt $CO_2$, excluding harvested wood products | 1128.38 | 1948.73 | 3487.52 | 3683.82 | 3879.69 | 4218.14 | 4894.81 |
| $CO_2$ in harvested wood products, kt $CO_2$ | -1726.14 | -1952.23 | -1611.95 | -1489.56 | -1286.40 | -1177.19 | -873.98 |
| $N_2O$ emissions, kt $CO_2$ eq. | 665.66 | 581.46 | 563.24 | 538.17 | 518.72 | 518.72 | 518.69 |
| $CH_4$ emissions, kt $CO_2$ eq. | 601.29 | 768.35 | 855.79 | 863.46 | 870.09 | 870.10 | 869.70 |
| Net GHG emissions, kt $CO_2$ eq. | 669.18 | 1346.31 | 3294.60 | 3595.90 | 3982.10 | 4429.78 | 5409.21 |

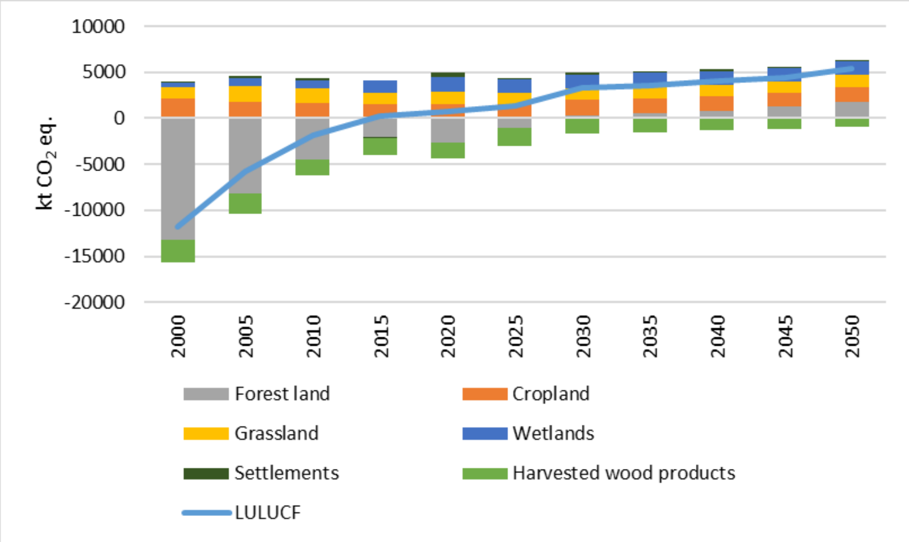


**Figure 5.8 GHG emission projections of LULUCF sector in the WEM scenario**

## 5.5.2. Projections of GHG emissions with additional measures

The impact of the additional climate change mitigation measures proposed for inclusion into the CAP for the period between 2023 and 2027 will reach maximum in 2027. Slight decrease of emissions is expected after 2037 due to reaching end of 20 years transition period in measures aimed at increase of carbon stock in soil in cropland. Measures in forest land and wetlands continues after 2050.

Reduction of the net removals in the LULUCF sector continues the trend of the approaching to equatity between increment and carbon loss. Increase of the GHG emissions in LULUCF sector is associated with reduction of net removals in living biomass in forest land due to ageing of forests resulting in decreasing increments and increasing natural mortality, while the projected harvest rate is about 65% of the increment.

Emissions under WAM scenario is summarized in Figure 5.9.

**Table 5.19 Summary of GHG emissions' projections in LULUCF sector in WAM scenario**

| Net emissions / Year | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| $CO_2$ emissions, kt $CO_2$, excluding harvested wood products | 1128.38 | 1492.95 | 2756.82 | 2972.23 | 3242.99 | 3805.09 | 4347.13 |
| $CO_2$ in harvested wood products, kt $CO_2$ | -1726.14 | -1952.23 | -1611.95 | -1489.56 | -1286.40 | -1177.19 | -873.98 |
| $N_2O$ emissions, kt $CO_2$ eq. | 665.66 | 581.46 | 563.24 | 538.17 | 518.72 | 518.72 | 518.69 |
| $CH_4$ emissions, kt $CO_2$ eq. | 601.29 | 768.35 | 855.79 | 863.46 | 870.09 | 870.10 | 869.70 |
| Net GHG emissions, kt $CO_2$ eq. | 669.18 | 890.53 | 2563.90 | 2884.31 | 3345.40 | 4016.73 | 4861.53 |

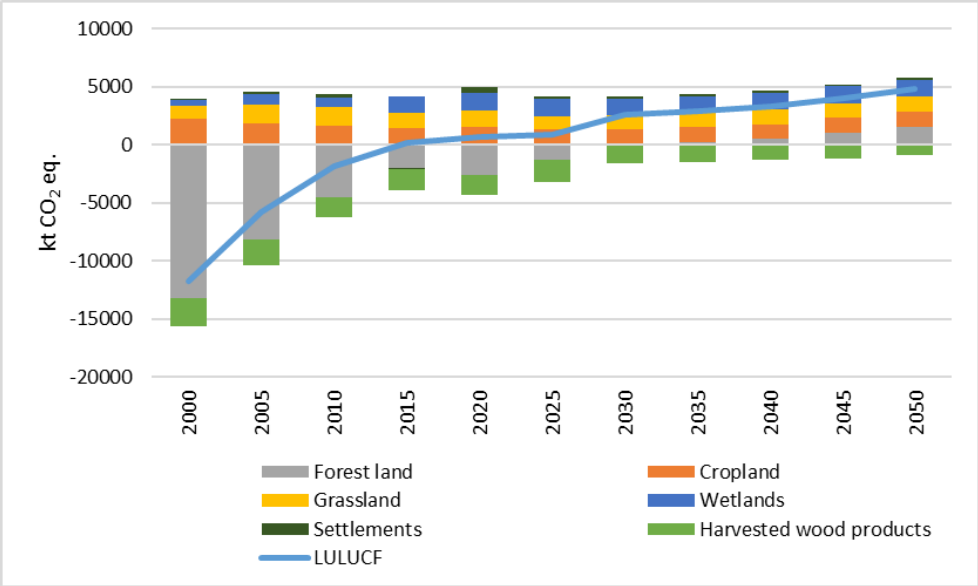


**Figure 5.9 GHG emission projections of LULUCF sector in the WAM scenario**

Further reduction of GHG emissions is possible by implementation of new measures that can contribute to reduction of GHG emissions in LULUCF sector; however, further investigations, particularly on climate change mitigation effect of these measures and possibilities to initiate voluntary carbon trading initiatives are necessary. Further development is necessary also to improve the methodologies applied, especially in calculation of GHG emissions from organic soils, dominating in sources of GHG emissions in Latvia, and possibilities to increase soil carbon stock in cropland and grassland.

## 5.6. WASTE MANAGEMENT

### 5.6.1. Main assumptions in the activity data projection

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

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

- Projections of national population and macroenonomic projections;
- **Urban Waste Water Directive 271/91/EEC (UWWTD)**, implemented in the Latvian legislation in 2002 with Regulations of the Cabinet of Ministers No. 34 adopted on $22^{nd}$ 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;

- For WAM scenario, all sewage sludge will be managed in the aerobic way no later than 2027, as it is planned according to Sewage Sludge Management Strategy.

### 5.6.2. Projections of GHG emissions by subsectors

#### 5.6.2.1. Solid waste disposal

SWD is the most essential GHG emission source in the waste sector (70.6% from total in 2020). 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 taken into account. 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 decrease of disposed municipal waste amounts till 10% in year 2035 is considered. Achievement of decrease is implemented in Waste Management plan 2021-2028.

***Biological processing of solid waste***

Composting corresponds to biological processing of solid waste. According to 2006 IPCC Guidelines emissions of two gases - $CH_4$ 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 according to time series from 2003 till 2020. From year 2023 increase of industrial composted amounts till 130 000 tonns is projected due to information about direct investments in Latvia waste companies.

***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 $N_2O$. From year 2026 projected emissions are reported as NO – not occurring.

#### 5.6.2.2. Waste water handling

Waste Water Handling subsector is source of $CH_4$ and $N_2O$ emissions. According to calculated projections, GHG emissions from Waste Water Handling will consequently decrease from

110.1 in 2020 to 81.0 kt $CO_2$ eq. in 2050. Contribution of this subsector in the Waste sector is projected to increase from 18.3% in 2020 to 28.3% 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 waste water, is not exptected to exceed threshold of 85% from national population (especially taking into account that requirements of Urban Waste Water Treatment Directive already have been fully implemented in Latvia on 31st December of 2015); nearly 15% of national population is expected to remain being served by septic tanks or latrines (in rural areas, where centralized collection of domestic waste water 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 over the time, while leakage emissions from recovery of $CH_4$ from digestion of sewage sludge will remain unsignificant. $CH_4$ emissions from handling of industrial waste water are exptected to decrease over the entire projected period, accordingly to historical trends.

With "Strategy of Sewage Sludge Management 2022 – 2027" in WAM scenario, emissions are projected to decrease from 110.1 in 2020 to 72.9 kt $CO_2$ eq. in 2050. In WEM scenario the share of Waste Water Handling subsector from total Waste sector is 23.2% in 2030 and 28.3% in 2050 but in WAM scenario the share is 20.5% in 2030 and 27.8% in 2050 from total Waste sector emissions.

### 5.6.3. Projections of GHG emissions with existing measures

WEM scenario from Waste sector divided by subsectors are included in the following Table 5.20 and Figure 5.10.

**Table 5.20 Projected GHG emissions from waste sector in WEM scenario**

| Subsector, kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Solid Waste Disposal | 424.59 | 347.22 | 256.58 | 206.16 | 177.73 | 140.00 | 140.00 |
| Biological Treatment of Solid Waste | 66.59 | 65.13 | 65.13 | 65.13 | 65.13 | 65.87 | 65.13 |
| Incineration and Open Burning of the Waste | 0.04 | 0.04 | NO | NO | NO | NO | NO |
| Waste Water Treatment and Discharge | 109.81 | 104.44 | 96.96 | 91.18 | 87.02 | 83.80 | 81.03 |
| **Total:** | **601.03** | **516.83** | **418.66** | **362.47** | **329.88** | **289.67** | **286.16** |

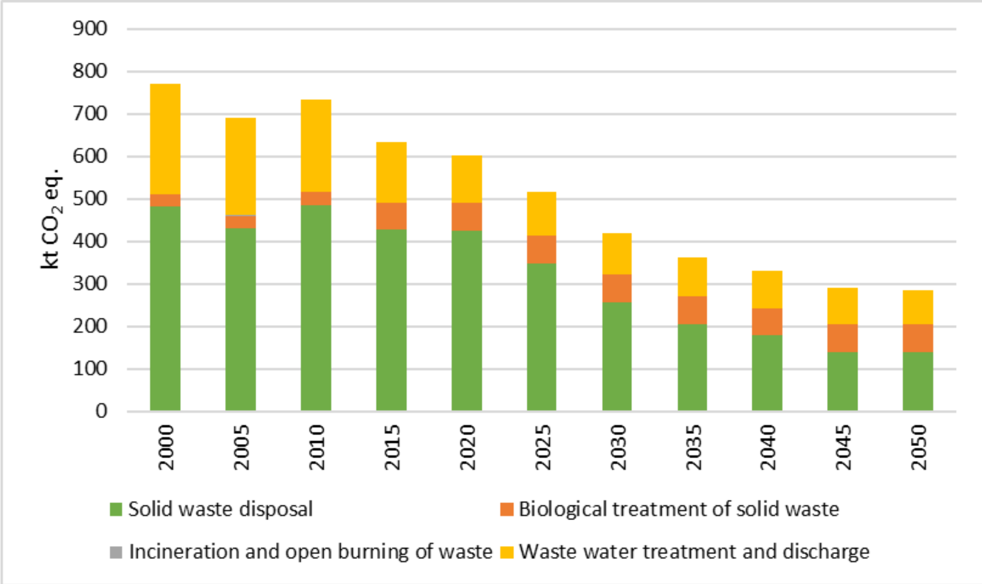


**Figure 5.10 GHG emission projections by Waste sector under the WEM scenario**

The total projected GHG emissions under WEM scenario in Waste management will decrease by 30.3% in 2030 and decrease by 52.4% in 2050, compared to 2020. The largest contributing subsectors are solid waste disposal (SWD) and waste water treatment and discharge. Solid waste disposal emissions are projected taken into account 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 Table 5.21 and Figure 5.11.

**Table 5.21 Projected GHG emissions from Waste sector in WAM scenario**

| Subsector, kt $CO_2$ eq. | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| Solid Waste Disposal | 424.59 | 347.22 | 261.43 | 197.95 | 148.34 | 140.00 | 112.00 |
| Biological Treatment of Solid Waste | 66.59 | 65.13 | 68.64 | 77.42 | 77.42 | 77.42 | 77.42 |
| Incineration and Open Burning of the Waste | 0.04 | 0.04 | NO | NO | NO | NO | NO |
| Waste Water Treatment and Discharge | 109.81 | 104.44 | 85.29 | 80.76 | 77.49 | 75.01 | 72.86 |
| **Total:** | **601.03** | **516.83** | **415.36** | **356.12** | **303.25** | **292.43** | **262.28** |

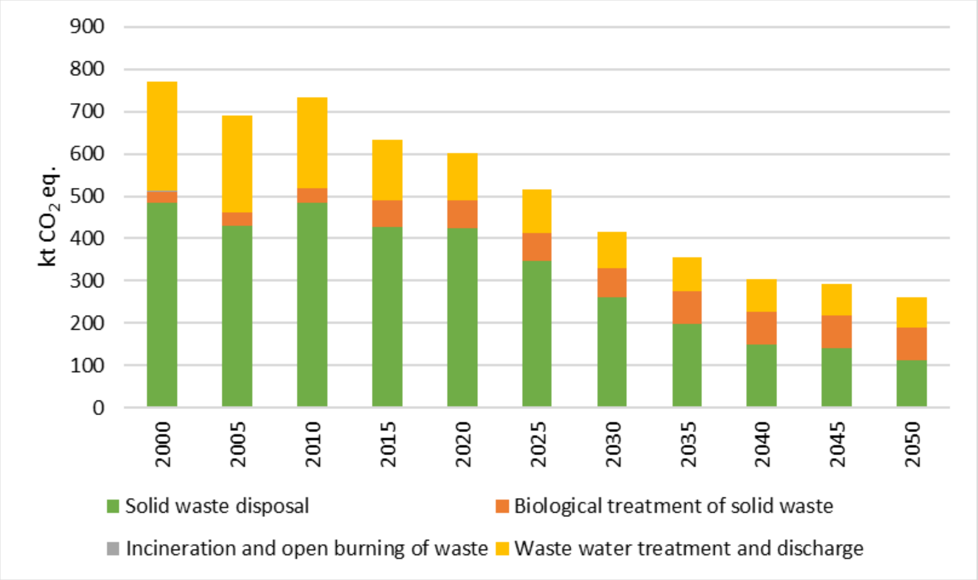


**Figure 5.11 GHG emission projections by Waste sector under the WAM scenario**

The total projected GHG emissions under WAM scenario in Waste sector will decrease by 30.9% in 2030 and by 56.4% in 2050, compared to 2020. Projections of WAM scenario shows 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 EFFORT SHARING REGULATION TARGET

Latvia's commitment for the sectors outside the EU Emissions Trading Scheme (non-ETS) according to the EC Implementing Decision (EU) 2020/2126 on determining Member States' annual emission allocations for the period from 2021 to 2030 to reduce emissions in 2030 by 6% compared to 2005 (ESR target).

Total GHG emissions (excluding LULUCF, including indirect $CO_2$) under the WEM scenario will decrease in 2030 by 7.1% and by 39.5% in 2050 compared to 2020. In 2030, under the WAM scenario emissions will be 1.5% and 2.2% lower in 2050 than in the respective years under the WEM scenario (Figure 6.1).

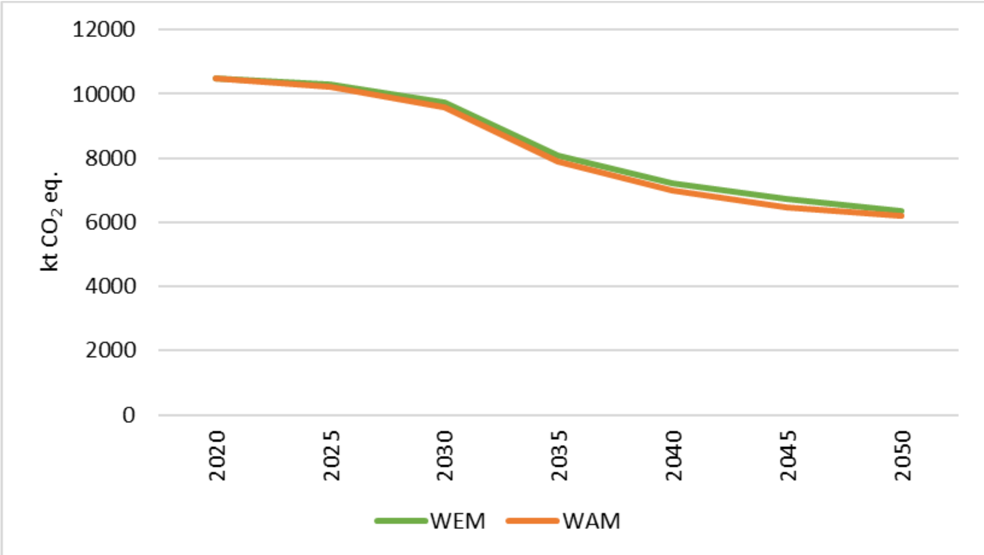


**Figure 6.1 Total GHG emissions under the WEM and WAM scenarios**

In 2020, 80.7% from total GHG emissions originated in the non-ETS sector (such as Transport, Agriculture and Waste), but remaining 19.3% comes from EU ETS (installations in power generation and manufacturing industry sectors). Projections show that in 2030 82.5% from total GHG emissions will arise in the non-ETS sector, but remaining 17.5% in EU ETS.

Projected non-ETS GHG emissions under the WAM are 1.9% lower in 2030 than the projected emissions under the WEM. Emission reduction under the WAM scenario for 2030 is due to additional measures in Agriculture and Waste sectors.

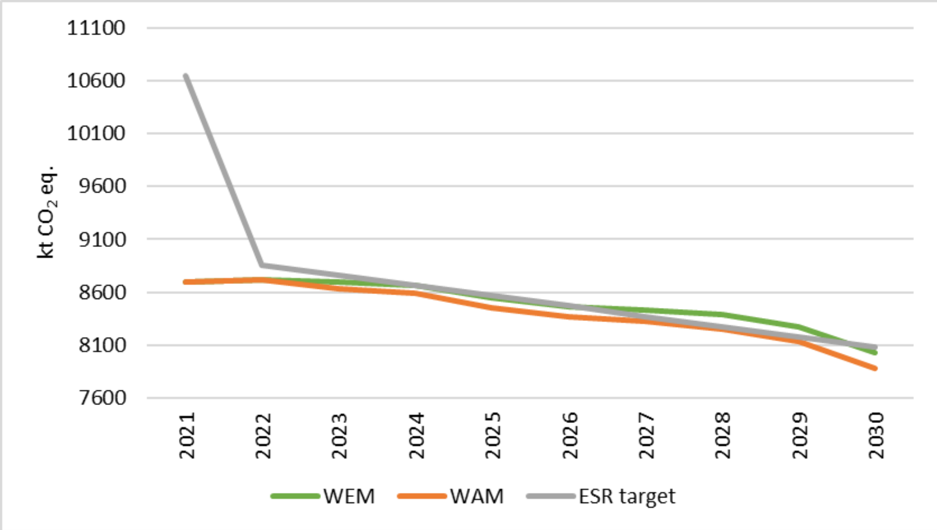


**Figure 6.2 Actual and projected GHG emissions under the WEM and WAM scenarios in the non-ETS sector against ESR target**

It is projected that under the WEM scenario in 2030 GHG emissions in the non-ETS sector will decrease by 6.6% compared to 2005. GHG emisions will not exceed the annual emission allocation in 2027-2029 in WEM scenario. In turn, GHG emisions will exceed the annual emission allocation in WAM scenario for all period 2021-2030 (Figure 6.2).

In accordance with the legal act of the Republic of Latvia "Law on Pollution"[153] Chapter X, Article 52 (3).

The MoCE in cooperation with MoA, MoT, MoE and other ministries each year prepare and submit by 31st December an Informative report to the Cabinet of Ministers on fulfilment of the commitments regarding GHG emission reduction and $CO_2$ removals. The following information shall be included in the above mentioned informative report:

- Evaluation of the fulfilment of the commitments related to reduction of GHG and $CO_2$ removals;
- The projections are used in these Informative reports 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 being monitored by the MoCE (in cooperation with State environmental service and LEGMC) through annual reporting in accordance with EU ETS.

[153]Law on Pollution https://likumi.lv/ta/en/en/id/6075-on-pollution

Non-ETS emissions are reported annually to the EC, as regulated in Governance Regulation, Regulation (EU) 2018/842[154] and Commission Implementation Regulation (EU) 2020/1208[155].

[154] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018R0842

[155] COMMISSION IMPLEMENTING REGULATION (EU) 2020/1208 of 7 August 2020 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) 2018/1999 of the European Parliament and of the Council and repealing Commission Implementing Regulation (EU) No 749/2014: 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.

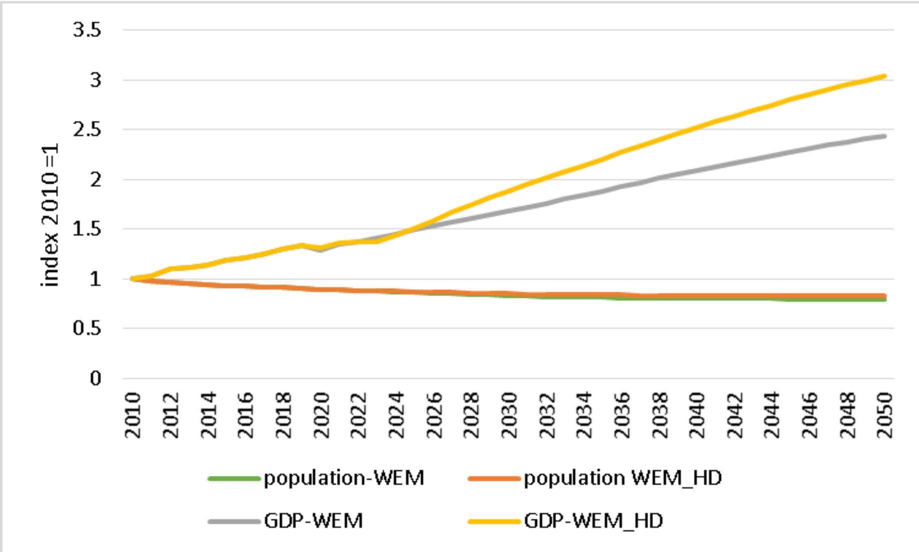


**Figure 7.1 Comparison of macroeconomic's indices used in the modelled WEM and alternative (WEM_HD) scenarios**

The alternative scenario (WEM_HD) assumes in 2030 the higher GDP per about 11.8% and higher number of population (per about 2.1%) against the WEM scenario level at 2030. At the end of the period (2050), this gap in the WEM_HD scenario against the WEM scenario increases, respectively GDP by 24.7% and population by 4.6%. A faster increase in GDP is based on the assumption of a more rapid use of innovative technologies and a more rapid growth in production productivity. The projected higher GDP growth rates and higher population in the WEM_HD scenario affect parameters such as floor area in residential sector, passenger kilometres and freight transportation (tkm) in transport, value added in manufacturing and others parameters.

As shown by the figure below, the assumptions on more rapid GDP growth rate and on stabilisation of population number result in 2030 in the increase of calculated FEC per 5.9% against the WEM scenario level at 2030. This increase of FEC varies in different sectors, being in 2030 in the range 3-9% against WEM scenario levels. The highest impact is seen in the residential, in which the higher number of population in the WEM_HD scenario causes per 8.7% higher FEC in 2030 against the WEM scenario level. High impact is seen also in manufacturing and transport sector in which in 2030 FEC in the alternative WEM_HD scenario increases per 6.2% and 5.3% respectively against the WEM scenario level.

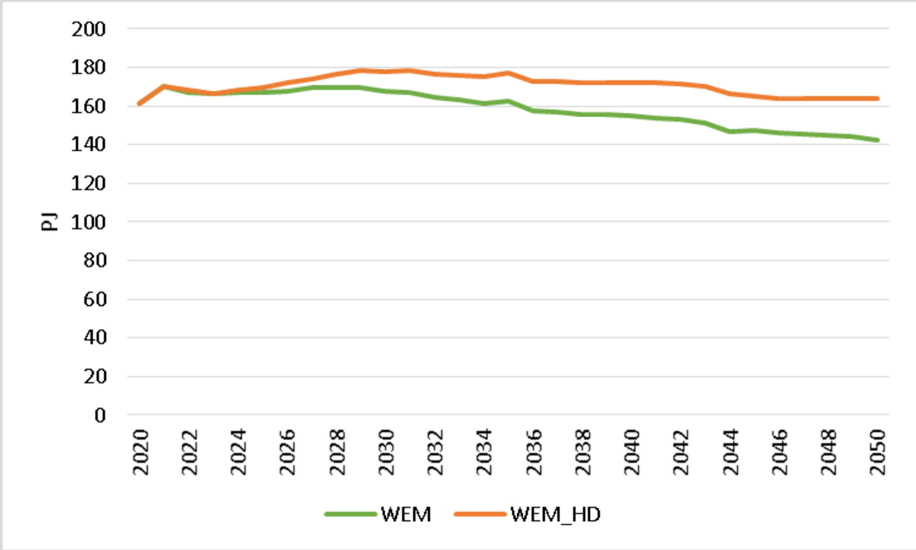


**Figure 7.2 Comparison of calculated final energy consumption projections in the modelled WEM and alternative (WEM_HD) scenario**

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 4.3% or per 274 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 (5.8%), transport (5.1%) residential (4.6%) and manufacturing industry (3.5%).

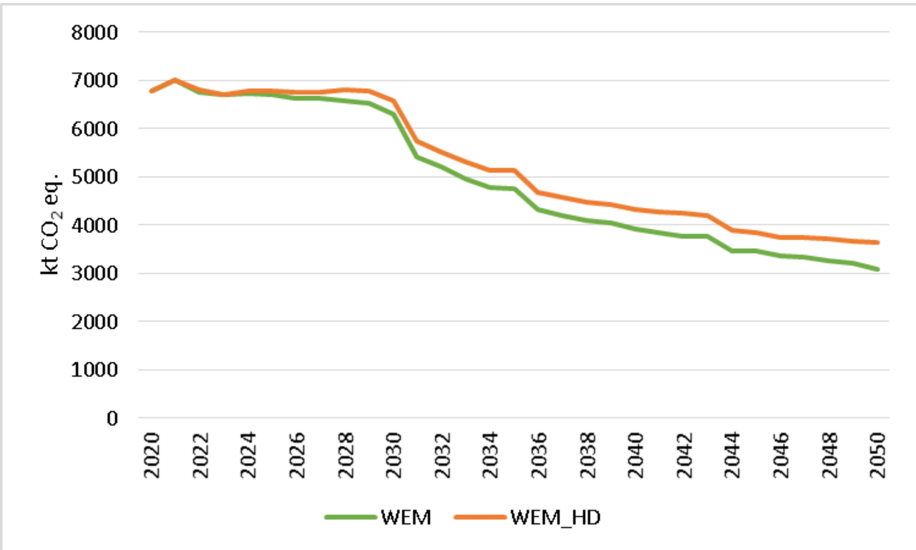


**Figure 7.3 Comparison of calculated GHG emissions projections in the modelled WEM and alternative (WEM_HD) scenarios**

## 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 can be seen in Figure 7.4. Results of the sensitivity analysis show that agricultural emissions could reach 2192.5 kt $CO_2$ eq. in 2030 and 2132.6 kt $CO_2$ eq. in 2050. Total emissions could be by 1.0% lower than in WEM scenario.

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

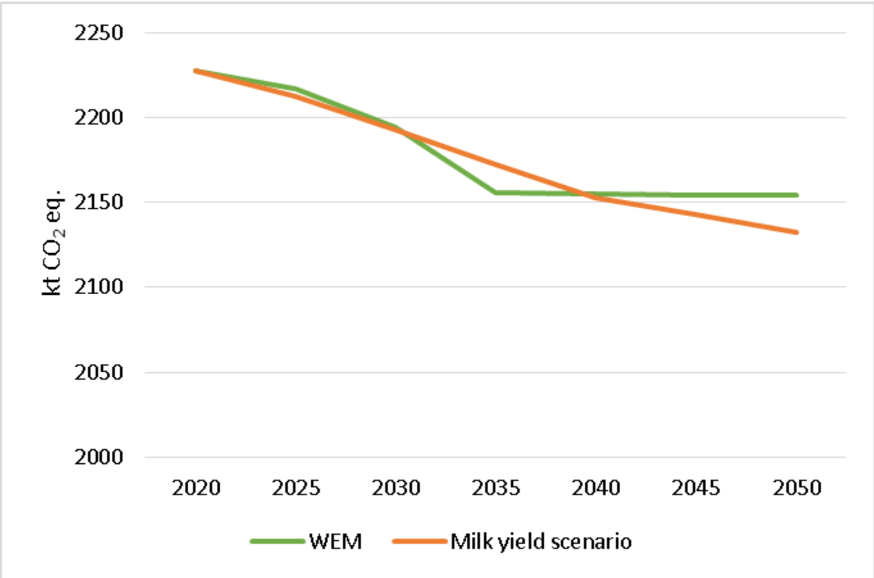


**Figure 7.4 Sensitivity analysis of GHG emission projections for Agriculture sector**

## 7.3. LAND USE, LAND USE CHANGE AND FORESTRY

Three scenarios are compared in the sensitivity analysis – WAM scenario and scenario considering partial implementation (75%, 50% and 25%) of the proposed additional measures. Net emissions are reducing proportionally to implementation of the measures (Figure 7.5).

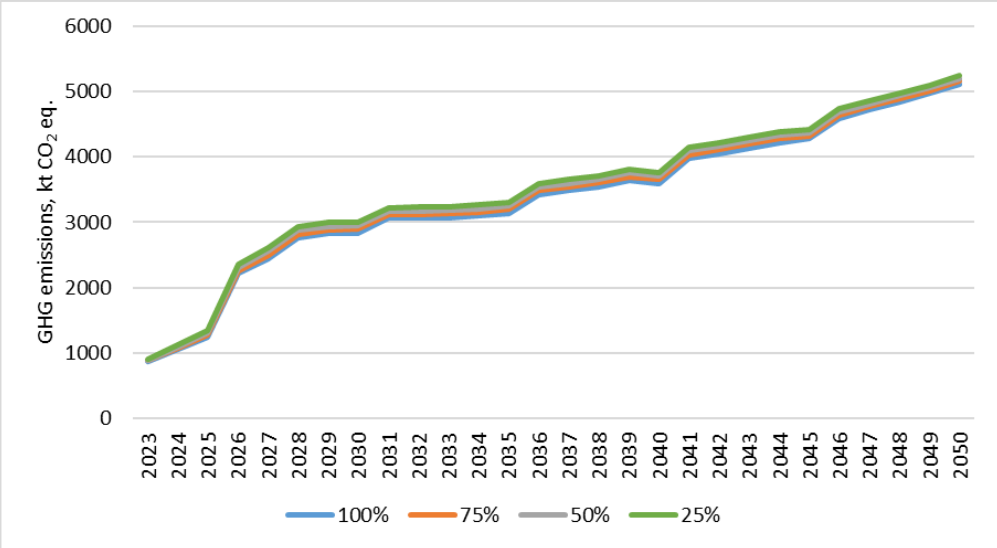


**Figure 7.5 Comparison of net emissions in case of different raste of implementation of the proposed meassures**

Reduction of GHG emissions is increasing proportionally to the rate of implementation of the measures. If the measure is implemented to 25% of the proposed rate, the maximum reduction of GHG emissions reaches 202 kt $CO_2$ eq $yr^{-1}$, while maximum rate of the GHG reduction in case of implementation of all of the proposed measures to 100% extend, the emission reduction or avoided emissions reach 808 kt $CO_2$ eq $yr^{-1}$.

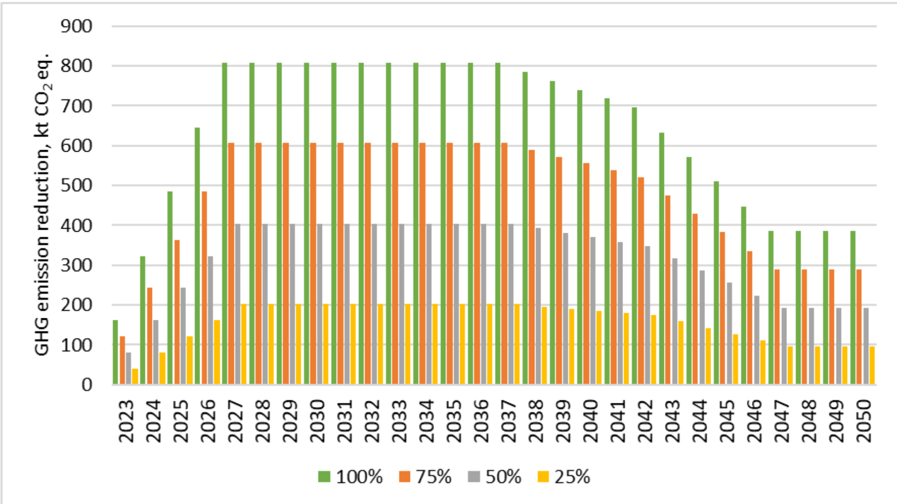


**Figure 7.6 Reduction of GHG emissions in case of implementation of different scenarios**

## 7.4. WASTE MANAGEMENT

### Solid waste disposal

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

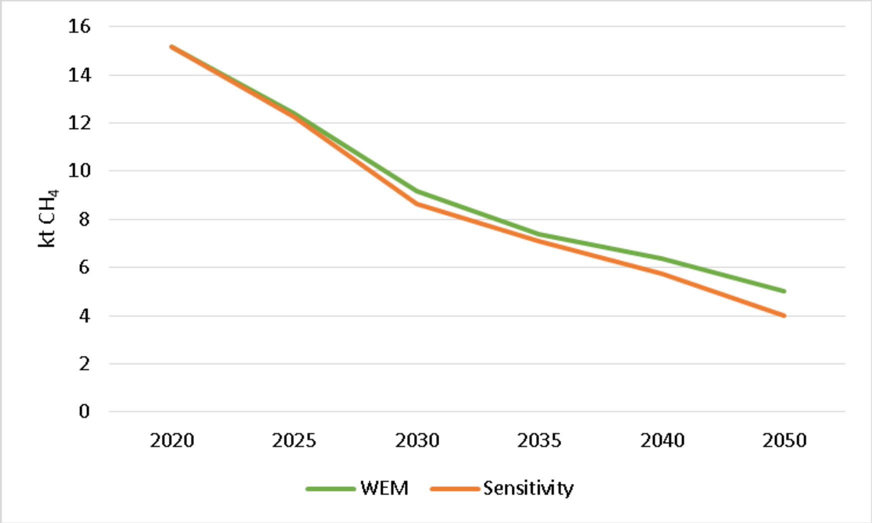


**Figure 7.7 Results of SWD sensitivity analysis WEM scenario compared to sensitivity scenario**

Results of analysis (Figure 7.7) show that in 2035, taking into account the different biological content in disposal waste, the total fluctuations in the SWD sector will be almost 6.75 kt $CO_2$ eq. by WEM scenario.

### Waste water handling

Emissions from storage of anaerobic sewage sludge contribute a considerable amount of $CH_4$ emissions in Waste Water Handling sector. Proper management of sewage sludge is subject of "Sewage Sludge Management Strategy 2022 – 2027", which is base for WAM scenario, deemed to phase out anaerobic storage of sewage sludge no later than 2027. One possible solution, addressed in this Strategy, is potential use of entire sewage sludge for biogas production, and this assumption was used as base for sensitivity analysis. Thus, it eliminates $CH_4$ emission from anaerobic storage of sewage sludge, however, it produces 5% leakage emissions from biogas $CH_4$ produced.

Results of sensitivity analysis are shown in Figure 7.8.

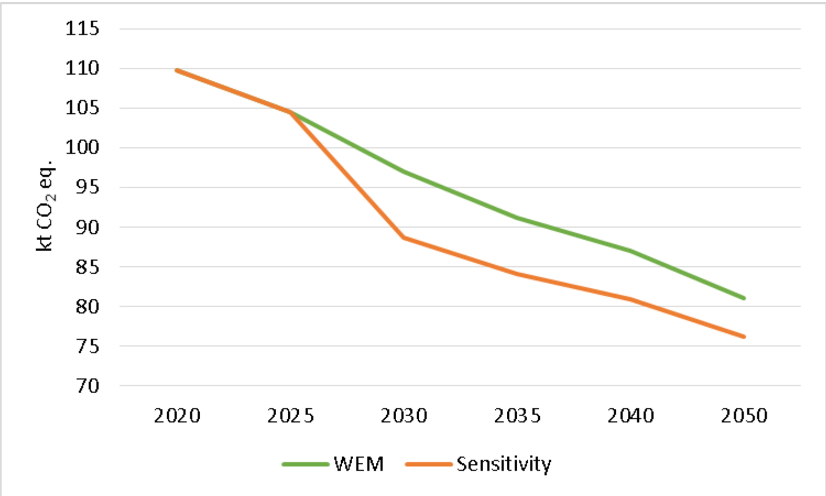


**Figure 7.8 Comparison of calculated GHG emissions projections in the WEM and sensitivity scenario for Waste Water Handling sector**

The results of analysis (Figure 7.8) show that complete transfer of sewage sludge for biogas production (also taking into account 5% $CH_4$ leakage emissions from biogas produced) compared to WEM scenario, cause a decrease from 81.0 to 76.2 kt $CO_2$ eq. in 2050 in the Waste Water 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 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, 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 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 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 2023"). These projections have been adjusted taking into account 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, taking into account 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 taking into account 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 is performed according to 2006 IPCC Guidelines and adjusted for projection estimation.

The use of F-gases is projected taking into account:

- number of inhabitants, households and the number of freezing equipment (refrigerators and freezers) used;
- the development of the service sector and the amount of stationary refrigeration used in it;

- changes in the number of 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 the EC regulation on F-gases (517/2014) repealing regulation 842/2006 and the EC directive on emissions from air conditioning systems in motor vehicles (2006/40/EC) (MAC Directive).

### 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 2019 and 2006 IPCC Guidelines.

## 8.3. AGRICULTURE

Emission projections under WEM scenario are based on primary activity data provided by MoA in collaboration with Latvia University of Life Sciences and Technologies. 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 Central Statistical Bureau of Latvia (CSB), EUROSTAT, domestic use balance sheets and FADN. The exogenous price projections until 2025 are gathered from the DG AGRI of the EC and Food and Agriculture Organization of the United Nations, further projected by the team of Latvia University of Life Sciences and Technologies. 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 Latvia University of Life Sciences and Technologies 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[156]. Projections of managed organic soils are provided by Latvian State Forest Research Institute *Silava*.

[156]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

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

## 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.

The NFI and research data are used to estimate time series for area, gross increment, mortality and harvest. Distinction between forest land remaining forest land and areas converted to forest land is made according to the age of dominant species in forests on afforested land – if age of dominant species is less than zero in 1990, it is considered as land converted to forest, in other cases it is considered as forest land remaining forest land. Additionally, areas afforested more than 20 years ago are reported as forest land remaining forest land. The same approach is used for other land use categories.

The activity data for calculation of emissions due to incineration of harvesting residues in felled area was based on the study until 2010. Now a questionnaire for private forest owners on utilization of harvesting residues is used[157]. According to this questionnaire in 2005-2009 about 7.0% of residues are left for incineration and in 2010-2020 – 4.1% of the residues are incinerated. In case of on-site incineration of harvesting residues during commercial harvesting, all emissions also are applied to the forest land remaining forest land category.

Area of organic soils in cropland and grassland is reported according to the results of research project implemented by Lazdiņš et al. in 2016[158]. Area of cropland and grassland in LULUCF reporting is synchronized with Agriculture reporting, including recalculation of cultivated organic soils.

Methodologies for calculating GHG emission projections for LULUCF are based on the Latvia's 2022 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 inventory report for the period 1990-2020. The potential effect of land use changes 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.

[157]Lazdiņš, A., & Lazdiņa, D. (2013). Meža ugunsgrēku un mežizstrādes atlieku dedzināšanas radītās siltumnīcefekta gāzu emisijas Latvijā (Greenhouse gas emissions in Latvia due to incineration of harvesting residues and forest fires). Referātu Tēzes, 133–137.

[158]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). https://drive.google.com/open?id=0Bxv4jQ_04jXZRExSMWhPMWhDNDg

### Forest land

Calculations of carbon stock changes and GHG emissions in forest lands are based on activity data provided by the NFI (area, living biomass and dead wood) and Level I forest monitoring data (soil organic carbon). Area of organic soils in the forest lands is reported according to structure of distribution of the forest stand types. National statistics data (CSB, State Forest service) are used to estimate commercial felling and forest wildfires related emissions and removals. The calculation of GHG emissions and $CO_2$ removals in historical forest lands is based mainly on research report "Elaboration of the model for calculation of the $CO_2$ removals and GHG emissions due to forest management"[159] and factors and coefficients elaborated within the scope of the research program on impact of forest management on GHG emissions and $CO_2$ removals[160]. $CO_2$ emission factors for drained organic soils are based on the study results[161].

Changes of organic carbon in litter and soil organic matter in naturally dry and wet soils are assumed to be zero according to research data on carbon stock in forest soil in 2006 and 2012[162] and Yasso modelling results[163]. Carbon stock changes are reported separately on naturally dry and wet mineral and organic soils and drained mineral and organic soils. Conversion of forest stands with drained organic soil to wet soil is accounted as rewetting.

Forest growth projections due to implementation of thinning, reconstruction of drainage system or afforestation measures are calculated using AGM model[164]. Similarly, forest growth projections under baseline scenario (WEM) 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

Area of cropland is estimated using remote sensing based research data on the base of the NFI. Carbon stock change in living and dead woody biomass is based on activity data provided by the NFI. Area of organic soils in cropland remaining cropland is reported according to the results of research results[165]. Area of organic soil in land converted to cropland is calculated

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[159] *Lazdiņš, A. (2012). Forest data national modelling tool in Latvia.*

[160] *Lazdiņš, A., Liepiņš, K., Lazdiņa, D., Jansons, Ā., Bārdule, A., & Lupiķis, A. (2013). Mežsaimniecisko darbību ietekmes uz siltumnīcefekta gāzu emisijām un $CO_2$ piesaisti novērtējums (pārskats par 2013. Gada darba uzdevumu izpildi) (5.5-5.1/001Y/110/08/8; p. 91).*

[161] *Lupiķis, A., & Lazdiņš, A. (2015). Soil carbon balance on drained and afforested transitional bog in forest research station Vesetnieki in Latvia. 17, 955. http://adsabs.harvard.edu/abs/2015EGUGA..17..955; Lupiķis, A., Lazdiņš, A., Okmanis, M., Butlers, A., Saule, Z., Saule, L., Martinsone, K., Saule, G., Purviņa, D., Bārdule, A., & Skranda, I. (2017). Empīrisku datu ieguve meža meliorācijas ietekmes uz CO2 emisijām no organiskajām augsnēm novērtēšanai (Elaboration of measurement data for evaluation of impact of amelioration systems on GH emissions from organic soils) (2015/13, līguma 1.13 punkts; p. 43). LVMI Silava.*

[162] Lazdiņš, A., Čugunovs, M., Zariņš, J., & Lūkins, M. (2013). Atbalsts klimata pētījumu programmai (Pārksats par projekta 2013. Gada darba uzdevumu izpildi) (p. 64).

[163] Bārdulis, A., Lupiķis, A., & Stola, J. (2017). Carbon balance in forest mineral soils in Latvia modelled with Yasso07 soil carbon model. Research for Rural Development, 1, 28–34.

[164] 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. https://doi.org/10.15544/RD.2019.065

[165] Petaja, G., Okmanis, M., Polmanis, K., Stola, J., Spalva, G., & Jansons, J. (2018). Evaluation of greenhouse gas emissions and area of organic soils in cropland and grassland in Latvia – integrated National Forest inventory data and soil maps approach. Agronomy Research, 16(4), 1809–1823. https://doi.org/10.15159/ar.18.183

using different approach than in cropland remaining cropland - the values characteristic for initial land use are applied. Respectively, if share of organic soil in forest land remaining forest in 1990 is 22%, it is considered, that area of organic soil in forest land converted to cropland in 1990 is 22%[166]. $CO_2$ emissions from drained organic soils are reported using research data[167], while $N_2O$ and $CH_4$ – using Tier 1 emission factors for temperate moist and cool climate zone according to IPCC Wetlands supplement. Changes in carbon stock in mineral soils due to land use changes or management changes are calculate using tier 1 method, comparing different carbon input and soil scarification rates.

### Grassland

Area of grassland is estimated using remote sensing-based research data on the base of the NFI. Area of organic soils in grassland is reported according to the results of research project implemented in 2016. Figures of carbon stock change in living and dead woody biomass is based on activity data provided by the NFI. Mortality rate are taken directly from forest land assuming that mortality in grassland is equal to average mortality (in percent of increment of living biomass) in forest land in a particular year. $CO_2$ emissions from drained organic soils are reported using research data[168], while $N_2O$ and $CH_4$ – using Tier 1 emission factors for temperate moist and cool climate zone according to IPCC Wetlands supplement. Changes in carbon stock in mineral soils due to land use changesto forest land are not considered assuming that mineral soils are not a source of GHG emissions.

### Settlements

The total area of settlements is estimated according to the information provided by the NFI. According to the expert estimation, increase of area of settlements during last 20 years took place due to conversion of forest land. Increase of area of settlements (deforestation) is generally associated with road construction. All roads, including forest roads are reported in the settlements category; therefore, the deforested area is considerably higher than official statistics, where forest roads are not accounted as deforested area. Area of land converted to settlements is estimated by evaluation of vegetation index of the permanent and temporal NFI points (23 thousand plots across the country) in series of satellite images produced in 1990, 1995 and 2000. Final land use was considered according to empiric data obtained during field visits (2004-2020) and using interpolation method published recently[169]. $CO_2$ removals in living and dead biomass in settlements are accounted using the NFI data. GHG emissions from drained organic soils are reported using Tier 1 emission factors for cropland in temperate moist and cool climate zone according to IPCC Wetlands supplement.

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[166]Lazdiņš, A., Bārdule, A., & Stola, J. (2013). Preliminary results of evaluation of area of organic soils in arable lands in Latvia. Abstracts of International Baltic Sea Regional Scientific Conference, 79–80.

[167]Licite, I., & Lupikis, A. (2020). Impact of land use practices on greenhouse gas emissions from agriculture land on organic soils. Engineering for Rural Development, 1823–1830. https://doi.org/10.22616/ERDev.2020.19.TF492

[168]Licite, I., & Lupikis, A. (2020). Impact of land use practices on greenhouse gas emissions from agriculture land on organic soils. Engineering for Rural Development, 1823–1830. https://doi.org/10.22616/ERDev.2020.19.TF492

[169]Krumšteds, L. L., Ivanovs, J., Jansons, J., & Lazdiņš, A. (2019). Development of Latvian land use and land use change matrix using geospatial data of National Forest inventory. Agronomy Research, 17. https://doi.org/10.15159/AR.19.195

### Wetlands

Total area of managed wetlands is reported according to the research results, including 3 kha of peatlands drained for peat extraction in 2020[170]. GHG emissions from soil are calculated using research results[171], except $CH_4$ emissions from drainage ditches. For this category Tier 1 emission factor is applied. Instant oxidation method is applied to peat used in horticulture, while higher tier method is under development.

# 8.5. WASTE MANAGEMENT

## 8.5.1. Solid waste disposal

Two separate calculations from IPCC Waste Model according the 2006 IPCC Gudelines 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 IPCC 2006 guidelines.

For managed sites method “waste by composition” in IPCC Waste Model 2006 was used. DOC and k values and other factors are taken from IPCC 2006 Guidelines. Waste composition is taken from Ltd Virsma research 2011 (Table 8.1). This waste compositon 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%. Data about waste compostion are reported in annual waste polygon reports. These reports are provided to state institutions each year. Waste compostion for 2016-2021 disposed waste was estimated.

Estimation is done for 3 types of waste streams:

- Disposed waste in disposal cells after sorting (data collected from waste polygon reports);

[170] Lazdiņš, A., Butlers, A., & Lupiķis, A. (2019). Contribution of LIFE REstore project to improvement of activity data for accounting greenhouse gas emissions due to management of wetlands. Sustainable and Responsible Management and Re-Use of Degraded Peatlands in Latvia, 23.
[171] Lazdiņš, A., & Lupiķis, A. (2019). LIFE REstore project contribution to the greenhouse gas emission accounts in Latvia. In A. Priede & A. Gancone (Eds.), Sustainable and responsible after-use of peat extraction areas (pp. 21–52). Baltijas Krasti.

- Direct disposed waste (without sorting) according to European Waste Catalogue (EWC) code (estimation for each EWC code is expert judgment);
- Stored waste in bioreactor (for biogas collection after sorting, estimation according weekly measurments is - 75% biological part and 25% inert part).

### 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 according to time series from 2003 till 2020. From year 2022 increase of industrial composted amounts till 130 000 tonns is projected due to information about direct investments in Latvia waste companies.

### 8.5.3. Waste water handling

Following approaches were used for projections of activity data to estimate GHG emission projections from waste water handling sector:

- For $CH_4$ emissions from domestic/commercial waste water handling subsector:
  - Projections of national population;
  - Expected distribution of national population by type and level of treatment, based on historical trends and requirements of UWWTD;
  - Projections of sewage sludge production based on its correlation with average annual amount of sewage sludge produced by a person and historical trend of share of anaerobic sludge.
- For $N_2O$ emissions from domestic/commercial waste water 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 waste water handling subsector projections of emissions were extrapolated from the historical emission trends of this subsector.

Based on projected activity data emission projections were calculated according to 2006 IPCC Guidelines. Country-specific emission factors were used to calculate $CH_4$ emissions, but for emissions of $N_2O$ default IPCC emission factors were used. Emissions factors used for projections are the same as in 2022 GHG inventory.