REPUBLIC OF ESTONIA
MINISTRY OF THE ENVIRONMENT

Report pursuant to Article 39 of Regulation (EU) 2018/1999

Estonia

Estonia 2023

PREFACE

As a member of the European Union (EU), Estonia has also obligations for reporting on national policies and measures and national projections of anthropogenic greenhouse gas emissions under Article 39 of Regulation (EU) 2018/1999 of the European Parliament (Governance Regulation) and of the Council and Articles 36, 37 and 38 of Commission Implementing Regulation (EU) 2020/1208.

According to the Commission Implementing Regulation (EU) 2020/1208 Member States have an obligation to prepare a report in every two years, including:

a) National systems for policies and measures and projections

b) Updates relevant to their low-carbon development strategies;

c) Planned additional policies and measures

d) Links between the different policies and measures and the contribution of those policies and measures contribute to different projection scenarios.

Estonia's 2023 report on policies and measures and GHG projections up to 2050 is comprised of this report and Reportnet 3 datasets.

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Abbreviations

AD –	activity data
BAT –	best available technology
CHP –	combined heat and power
EF –	emission factor
ESR –	Effort Sharing Regulation
ETS –	Emissions Trading System
EU –	European Union
eq –	equivalent
F-gas –	fluorinated greenhouse gas
GDP –	gross domestic product
GHC –	gaseous heat carrier
GHG –	greenhouse gas
GWh –	gigawatt hour
GWP –	global warming potential
IPCC –	Intergovernmental Panel on Climate Change
IPPU –	Industrial processes and product use
kt –	kiloton
kWh –	kilowatt hour
LULUCF –	Land use, land-use change and forestry
MoE –	Ministry of the Environment
NFI –	National Forest Inventory
NIR –	National Inventory Report
PAM –	policies and measures
PJ –	petajoule
SHC –	solid heat carrier
TJ –	terajoule
UNFCCC –	United Nations Framework Convention on Climate Change
WAM –	with additional measures
WEM –	with existing measures
yr –	year

Documents

EFDP 2020–	The Estonian Forestry Development Programme until 2020
EFDP 2030 –	Forestry Development Plan until 2030
ENMAK 2030 –	Estonian Energy Sector Development Plan 2030
GPCP 2050 –	General Principles of Climate Policy 2050
CAP –	Common Agricultural Policy
NWMP –	National Waste Management Plan 2014–2020, extended to 2023
NECP 2030 –	National Energy and Climate Plan
ERDP –	Estonian rural development plan 2014–2020, extended to 2023/2024
AFDP –	Agriculture and fisheries development plan until 2030

Greenhouse gases

CH_4 –	methane
CO_2 –	carbon dioxide
N_2O –	nitrous oxide
HFC –	hydrofluorocarbons
PFC –	perfluorocarbons
SF_6 –	sulphur hexafluoride
NF_3 –	nitrogen trifluoride

Atmospheric pollutants

NMVOC –	non-methane volatile organic compound
NH_3 –	ammonia
NO_x –	nitrogen oxides

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1. GENERAL INFORMATION

1.1. Information on changes to national system for reporting on policies and measures and projections

Information the national system is included in Reportnet 3 dataset on National systems for policies and measures and projections.

1.2. Progress in achievement of quantified economy-wide emission reduction targets and relevant information

1.2.1. Emissions trading under the EU Emissions Trading System

The European Union Emissions Trading System (EU ETS) is one of the key policy instruments implemented in the EU to achieve its climate policy objectives. The legislative framework of the EU ETS for its new trading period (phase 4 in 2021–2030) was revised in early 2018 to enable it to achieve the EU's 2030 emission reduction targets and as part of the EU's contribution to the Paris Agreement. According to the revision, the pace for annual reductions in allowances increased to 2.2% as of 2021.

The share of Estonia's EU ETS emissions from all sectors is high – in 2020 about 58% (without LULUCF), according Estonia's 2022 submission to the European Commission on 15th of March (2022 NIR).

1.2.2. The Effort Sharing Regulation and the LULUCF Regulation (2021-2030)

Under the current legislation, EU Member States have binding annual greenhouse gas emission targets for 2021–2030 for those sectors of the economy that fall outside the scope of the EU Emissions Trading System (EU ETS). These sectors, including transport, buildings, agriculture, non-ETS industry and waste, account for almost 60% of total domestic EU emissions.

In October 2014, EU leaders set a binding economy-wide domestic emission reductions target of at least 40% by 2030 compared to 1990. The *Regulation (EU) 2018/842 of the European Parliament and of the Council (Effort Sharing Regulation - ESR)* translates this commitment into binding annual greenhouse gas emission targets for each Member State (totalling 30% reduction), based on the principles of fairness, cost-effectiveness and environmental integrity.Estonia's *ESR* 2030 target for greenhouse gas emissions in sectors not covered by the EU Emissions Trading System (non-ETS) is -13% compared to 2005.

The European Commission has put forward a series of legislative proposals to make its policies fit for delivering the updated 2030 greenhouse gas emissions net reduction target of 55% below 1990 levels, as set out in the 2030 Climate Target Plan and written into the European Climate Law.

The European Commission submitted a proposal on 14 July 2021, to review the collective and national targets set up in the Effort-sharing Regulation (ESR). In order to contribute to the -55% GHG emission reduction target, sectors covered by the ESR should achieve a collective reduction of 40 % in their emissions by 2030 compared to 2005. Estonia's new target by 2030 for reducing emissions in sectors covered under the ESR is -24% compared to 2005.

The revision of the Land Use, Land Use Change and Forestry (LULUCF) regulation is one of the 'Fit for 55′ proposals as the sector must contribute to achieving the EU's GHG reduction goal. The Council and Parliament have agreed on a general EU-level target of 310 Mt of CO_2 eq net sequestration in the LULUCF sector by 2030. In addition, according to the new agreement the member states must ensure compliance with the so-called no-debit rule in 2021-2025, i.e. the sector's emissions must be compensated by an equivalent of removal. Estonia's 2030 goal, according to the update of the LULUCF regulation, is a net reduction of greenhouse gases of 2545 kt CO_2 eq. which means that Estonia must increase GHG sequestration by 434 kt CO_2 eq compared to the base level (2016-2018 average). The national budget for the sequestration of greenhouse gases for the years 2026-2029 will be set in the coming years.

The cumulative projected emissions/removals in accordance with *Regulation (EU) 2018/841* for the periods 2021–2025 and 2026–2030 are presented in Reportnet dataset Table 5b. Cumulative emissions are compared to the reference values or base period emissions for calculating the accounted quantities, except for the afforested and deforested lands, where total cumulative net emissions are accounted. Accounting of Managed wetlands is mandatory starting from 2026, and Estonia has not selected this category for accounting in the 2021–2025 period. According to the projections, total accounted removals exceed accounted emissions in the first commitment period.

1.2.3. Long Term Strategy

Estonia’s long-term **Low Carbon Development Strategy 2050 (GPCP 2050)** is a vision document setting the long term GHG emissions reduction target and policy guidelines for adapting to the impact of climate change or ensuring the preparedness and resilience to react to the impact of climate change. In February 2023, the Parliament adopted an amendment to the long-term target in accordance to the 2050 climate neutrality goal set in Estonia’s development strategy **Estonia 2035**. Estonia's long-term goal according to the GPCP 2050 is to balance GHG emissions and sequestration by 2050 at the latest, i.e. reduce net greenhouse gas emissions to zero by then. In the amendment indicative target for 2030 was removed from the GPCP 2050, as on 12 May 2021 the Parliament adopted Estonia’s long term strategy Estonia 2035 together with an action plan that sets a target level for net emissions of greenhouse gases (incl. the LULUCF sector) of 8 Mt CO_2 eq. by 2035, that is more ambitious target than the previous 2030 target was.

1.2.4. General documents

On 12 May 2021 the Parliament adopted Estonia’s development strategy **Estonia 2035**. The strategy sets out five long-term strategic goals that are value-based goals which are the basis for making the country’s strategic choices and to the implementation of which all Estonian strategic development documents contribute. They are also taken into account in the state budget strategy and in the preparation of the government’s action programme. In order to reach the goals, it is necessary to take into account Estonia’s development needs, global trends, the policy framework of the European Union, and the global objectives of sustainable development. According to the strategy, by 2050, Estonia will be a competitive, climate-neutral country with a knowledge-based society and economy and a high quality and species-rich living environment, willing and able to reduce the adverse effects of climate change and make the best use of its positive aspects. Coordinated development of the cultural, social, environmental and economic fields is a prerequisite for achieving the goals of sustainable development. In Estonia, knowledge-based decisions are made, with effective and innovative approaches being preferred when choosing solutions.

The Estonia 2035 action plan is updated annually, if necessary, by the government based on domestic events affecting the development of Estonia and changes in the foreign environment. The Estonia 2035 action plan is also the Estonan reform plan submitted within the framework of the European Semester for the coordination of economic policies. The current action plan was approved by the government on April 28, 2022. The action plan sets a target level for net emissions of greenhouse gases (incl. the LULUCF sector) of 8 million tons of CO_2 eq. by 2035. There is also a target level for net emissions of greenhouse gases in the Transport sector of 1700 kt CO_2 eq**.**

2. INFORMATION ON POLICIES AND MEASURES

This chapter includes sectoral information on Policies and Measures (PaMs) in 'With Existing Measures' (WEM) and 'With Additional Measures' (WAM) scenarios. Also, additional measures that are planned and not yet adopted are reported under 'Not included in projections' (NIP) scenario. Additional information on PaMs is included in Reportnet 3 dataset on Integrated national policies and measures.

2.1. Energy

Policies and measures for electricity supply, heat supply, energy consumption – commercial/institutional and residential sectors and energy consumption – and manufacturing industries are included in this chapter, cross-sectoral measures are included in Chapter 2.7.

The Government of Estonia approved the **Estonian Energy Development Plan until 2030 (ENMAK 2030)** in 2017 and has planned to update the document. The renewed **Energy Development Plan until 2035** aims to update the trends, goals and activities of the energy economy included in the ENMAK 2030. It will also include the development vision, goals, bottlenecks and policy instruments of the Estonian energy economy in moving towards climate-neutral energy production and consumption and ensuring energy security. The deadline for approving the renewed Energy Development Plan until 2035 is set for 2025.

According to the development strategy **Estonia 2035**, the target level of the share of renewable energy in the total final energy consumption set is >55%.

In accordance with Directive 2018/2001, Estonia must ensure that the share of energy from renewable sources amounts to 25% of the gross final consumption of energy by 2020. The share of renewable resources in final energy consumption was already reached in 2015 (29.0%) and reached 30.1% in 2020. Therefore, Estonia has reached its 2020 target.

2.1.1. Electricity supply

The Electricity Market Act (2005) governs the generation, transmission, sale, export, import and transit of electricity and the economic and technical management of the power system. This Act prescribes the principles of the operation of the electricity market, based on the need to ensure an effective supply of electricity which is provided at a reasonable price and which meets environmental requirements and the needs of consumers, and the utilisation of energy sources in a balanced manner, in an environmentally clean way and with a long-term perspective. It states that electricity undertakings shall always facilitate activities performed by consumers for the purpose of conserving electricity.

Table 2.1. Support for renewable and efficient CHP-based electricity production (Electricity Market Act §59)

Level of subsidy	Conditions for receiving the subsidy
	Subsidies are paid for electricity that is produced:
0.0537 €/kWh	Electricity generated from a renewable energy source except biomass if the net capacity of the production machinery does not exceed 125 MW
0.0537 €/kWh	From biomass in CHP mode. From 1 July 2010, producers who have started generating electricity from biomass can only get the subsidy for electricity generated in efficient CHP mode

Level of subsidy	Conditions for receiving the subsidy
0.032 €/kWh	In efficient CHP mode from waste as defined in the Waste Act, peat or oil shale retort gas
0.032 €/kWh	In efficient CHP mode using generating equipment with a capacity of not more than 10 MW

The Estonian Recovery and Resilience Plan (RRP) is one of the "Estonia 2035" action plan annexes, focusing on the goals, reforms and investments financed by the Recovery and Resilience Fund (RRF), covering all pillars of the Recovery Fund and addressing the country-specific recommendations by the European Commission in conjunction with other EU funds. RRP includes following measures that are not jet included in the projections scenarios:

1. **Encouraging the introduction of biomethane** (PaM ID# 18) – Policy plan is to support the use of biomethane in public transport in the period of structural funds 2021-2027 within the framework of the "Greener Estonia" policy goal, by adopting CNG-powered buses and supporting the construction of CNG filling stations, which would encourage the introduction and consumption of domestic biomethane. Support is provided for the introduction of buses running on biomethane, especially in rural areas.
2. **Promoting the deployment of complete hydrogen technologies** (PaM ID# 19) – Promoting the deployment of complete hydrogen technologies. As a result of the support, the introduction and consumption of green hydrogen as an energy carrier will be accelerated. The purpose of the support is to test complete hydrogen chains from hydrogen production to final consumption in Estonian conditions within the framework of pilot projects. The implementation of green hydrogen pilot projects supports the achievement of the goals of NECP 2030 and the goals stipulated in the sectoral development plans and development documents, and contributes to the achievement of the long-term climate and energy policy goals of both the EU and Estonia
3. **Energy storage pilot programme** (PaM ID# 21) – supports measures to increase the deployment of renewable energy by enabling the deployment of heat storage devices to reduce the demand for fossil fuels during peak loads.
4. **Electricity grid reinforcement programme to increase renewable energy production capacity and adaptation to climate change** (PaM ID# 20) – Implementation of this measure would increase the capacity of the Estonian electricity system while introducing renewable energy increases and new renewable energy production capacities are added to the electricity system.
5. **Residential Investment Fund** (PaM ID# 64) – The housing investment fund allows the possibility to ensure consistent financing (loans, loan guarantees) in regions where the real estate value is low and the residents' opportunities to carry out reconstruction under market conditions are limited. The fund brings together resources from the public sector, including European Union structural funds, and resources from the private sector.

Electricity supply WEM scenario measures include:

1. **Renewable energy support through underbidding auctions (technology neutral)** (PaM ID# 9) – The aim of this measure is to increase energy production from renewable energy sources. Support for renewable energy production is regulated by the Electricity Market Act (technology neutral auction).

2. **Support for renewable and efficient CHP-based electricity production** (PaM ID# 1) – The aim of this measure is to increase energy production from renewable energy sources and promote cogeneration (Table 2.1)
3. **Investment support for wind parks** (PaM ID# 2) – The aim of this measure is to increase electricity production from renewable energy sources.
4. **Increasing the share of solar energy in electricity generation** (PaM ID# 12) – The aim of this measure is to increase electricity production by increasing the proportion of solar energy.
5. **Introduction of renewable energy in maritime surveillance radar stations on small islands** (PaM ID# 11) – Increase energy production from renewable energy sources. Many small islands in Estonia do not have a permanent connection to the electricity grid. However, small islands have various state-owned facilities or buildings and permanent residents.
6. **Renewable energy support through underbidding auctions (technology specific)** (PaM ID# 10) – Support for renewable energy production through technology-specific auction. Increase energy production from renewable energy sources.The projected effects of WEM measures related to electricity supply is included in Reportnet 3 dataset on Integrated national policies and measures.

In addition to the planned measures, there are additional electricity-supply-related measures that have either a direct effect on GHG emissions or support the implementation of WEM/WAM measures. The following additional measures are under discussion and therefore not part of the projection scenarios:

1. **The acquisition of air surveillance radars for the development of wind farms** (PaM ID# 22) – Supporting the development of wind energy through the construction of radars and other compensation measures in order to promote the development of renewable energy in Estonia, freeing the areas of onshore and offshore wind farms from height and national defence restrictions, which enables the construction of wind farms.

2.1.2. Heat supply

The District Heating Act (2003) governs activities related to the production, distribution and sale of heat by way of district heating networks and connection to district heating networks.

Due to the large share of buildings in the total energy use, the improvement of energy efficiency in the residential and tertiary sectors also has an important role from the emissions reduction aspect. Here, the impact of EU Directive 2002/91/EC and its recast 2010/31/EU on the energy performance of buildings (EPBD) should be highlighted. In Estonia, the implementation of the EPBD is the responsibility of the MoEAC. The provisions of the EPBD have been transposed into the Building Code. Several detailed requirements were enforced using secondary legislation. The most important secondary-level act is the regulation (No 55 of 3 June 2015) for Minimum requirements for energy performance regulation that establishes **minimum requirements for the energy performance of buildings**, including low energy buildings and nearly zero-energy buildings. The regulation applies to new as well as existing ones undergoing major renovations.

Heat supply WEM scenario measures include:

1. **Construction of local heating solutions instead of district heating solution** (PaM ID# 3) – The aim of the measure is to reduce the final consumption of energy. As part of the measure, inefficient district heating will be replaced with local heating, provided that the district heating company continues to provide the service through the local heating solution.
2. **Renovation of depreciated and inefficient heat pipelines** (PaM ID# 4) – Renovation of depreciated and inefficient heat pipelines and/or construction of new heat pipelines.
3. **Renovation of district heating boilers and fuel change** (PaM ID# 5) – Renovation and/or construction of district heating boilers and fuel exchange.
4. **Oil boiler replacement programme** (PaM ID# 15) – The aim of the measure is to replace local inefficient fossil fuel heating systems with efficient modern systems.

Heat supply WAM scenario measures include:

1. **Additional renovation of depreciated and inefficient heat pipelines** (PaM ID# 7) – Additional renovation of depreciated and inefficient heat pipelines and/or construction of new heat pipelines.
2. **Additional renovation of district heating boilers and fuel change** (PaM ID# 8) – Additional renovation and/or construction of district heating boilers and fuel exchange.
3. **Additional construction of local heating solutions instead of district heating solution** (PaM ID# 6) – Additional replacement of inefficient district heating with local heating, provided that the district heating company continues to provide the service through the local heating solution.

The projected effects of the WEM and WAM measures in heat supply is included in Reportnet 3 dataset on Integrated national policies and measures.

2.1.3. Energy consumption ─ Manufacturing industries and construction

WEM scenario measures in energy consumption in manufacturing industries include:

1. **Support for energy- and resource audits in industries** (PaM ID# 16) – Raising awareness in energy and resource usage efficiency in the manufacturing industries.
2. **Energy and resource efficiency in industries** (PaM ID# 17) – Supporting investment in energy and resource usage efficiency in the manufacturing industries.

2.1.4. Energy consumption ─ Other sectors (Commercial/institutional and residential sectors)

The Product Conformity Act (2010) sets out the competence of authorities participating in market surveillance and stipulates that the Technical Surveillance Authority must exercise state surveillance over compliance of household appliances, heating appliances and devices with energy efficiency, ener gy performance labels and ecological design requirements,

Energy Sector Organisation Act (2017) provides the measures for achieving the national target of energy efficiency, the principles for promoting renewable energy and the requirements

for improving energy efficiency and the parties on whom obligations are imposed in the public as well as in the private sector.

WEM scenario measures in energy consumption in other sectors include:

1. **Support for making the processing of fishery and aquaculture products more energy and resource efficient** (PaM ID# 13) – The aim of the measure is to increase the energy saving and resource productivity of companies through the introduction of more sustainable technologies and solutions, while reducing the impact on the environment. The implementation of an energyor resource-saving solution based on an energy or resource audit is supported.
2. **Energy efficiency in local government buildings** (PaM ID# 47) – The purpose of the measure is to increase the energy efficiency of local government buildings, reduce greenhouse gas emissions, support the use of renewable energy and reduce general heating costs.
3. **Energy efficiency in central government buildings** (PaM ID# 48) – The purpose of the measure is to increase the energy efficiency of central government buildings, reduce greenhouse gas emissions, support the use of renewable energy and reduce general heating costs.
4. **Arrangement of the basic school network** (PaM ID# 49) – The aim of the measure is to support the construction of new schools to replace old ones or the complete renovation of old school buildings.
5. **Arrangement of the gymnasium network** (PaM ID# 50) – The aim of the measure is to support the construction of new gymnasiums to replace old ones or the complete renovation of old gymnasium buildings.
6. **Reorganisation of special care institutions** (PaM ID# 51) – The aim of the measure is to support the construction of new care institutions to replace old ones or the complete renovation of old care institution buildings.
7. **Institutional development programme for R&D institutions and higher education institutions** (PaM ID# 52) – The measure supports the construction and reconstruction of new buildings for research and development institutions and schools.
8. **Modernisation of health centres** (PaM ID# 53) – The aim of the measure is to support the construction of new health centres to replace old ones or the complete renovation of old health centres.
9. **New childcare and pre-primary education infrastructure** (PaM ID# 54) – The aim of the measure is to support the renovation of childcare and pre-primary school buildings.
10. **Kindergarten renovation** (PaM ID# 55) – The aim of the measure is to support the renovation of kindergarten buildings.
11. **Supporting the reconstruction of apartment buildings** (PaM ID# 56) – The aim of the measure is to increase the energy efficiency of apartment buildings and improve the indoor climate. Across all investments, the goal is to reconstruct an estimated net area of 3.2 million m^2 of apartment buildings.
12. **Supporting the reconstruction of private houses** (PaM ID# 57) – The aim is to support the complete reconstruction of small houses and to reduce the energy

consumption of small houses. The goal is to reconstruct 80 small houses. The investment in small houses will support the energy efficiency and reconstruction of an estimated 13,000 m^2 of net space.

13. **Street lighting reconstruction programme investments** (PaM ID# 58) – The purpose of the programme is to improve the use of electricity in street lighting through the renovation of the street lighting infrastructure.

WAM scenario measures in energy consumption in other sectors include:

1. **Supporting the reconstruction of non-residential buildings in the private sector** (PaM ID# 63) — The aim is to support the complete reconstruction of the non-residential buildings by 2050.
2. **Additional reconstruction of municipal buildings** (PaM ID# 59) – The aim is to support the complete reconstruction of the municipal buildings by 2050.
3. **Additional reconstruction of central government buildings** (PaM ID# 60) – The aim is to support the complete reconstruction of the central government buildings by 2050**.**
4. **Additional reconstruction of apartment buildings** (PaM ID# 62) – The aim is additional support for the complete reconstruction of the apartment buildings by 2050.
5. **Additional reconstruction of private houses** (PaM ID# 61) – The aim is additional support for the complete reconstruction of the small houses by 2050.
6. **Investments into energy saving of greenhouses and vegetable warehouses and dissemination of renewable energy** (PaM ID# 23) – Supporting investment in energy and resource usage efficiency in agriculture.

There are additional energy-consumption-related measures in other sectors that have either a direct effect on GHG emissions or support the implementation of WEM/WAM measures. Following measures are in planned status and therefore not jet included in the projections scenarios:

1. **Support for energy and resource audits of fishery and aquaculture products establishments** (PaM ID# 14) – The aim is to support the conducting of an energy and resource audit. The energy and resource audit identifies those investments in the processing of fishery and aquaculture products that help save energy or reduce the impact on the environment, including investments in waste processing. The measure directs companies to a more economical way of thinking and promotes cost-effective measures.
2. **Preparation of a heat economy development plan** – Support of preparation of the heat management development plan in local governments.

The projected effects of the WEM and WAM measures is included in Reportnet 3 dataset on Integrated national policies and measures.

In addition to the WEM/WAM scenario measures, there are measures under discussion that have either a direct effect on GHG emissions or support the implementation of WEM/WAM measures. As there is no agreement for the implementation of these measure, then they are excluded from the projection scenarios.

Heat-supply-related measures under discussion:

1. **Use of residual heat in the server park** – The aim of the measure is to raise the efficiency of energy use.

Electricity-supply-related measures under discussion:

1. **Government actions for the construction of small modular reactors** – A small modular reactor could be built in 2030 if the preparatory activities are started in the 2020s. There are no small reactors suitable for Estonia (so-called "modular reactors") in the world as yet. As a result, the construction of a nuclear power plant in Estonia will not affect the fulfilment of the GHG emission reduction target set for 2030.
2. **Government actions to capture and store carbon or to promote its use** – Tallinn University of Technology's 2019–2021 project "Climate change mitigation through CCS and CCU technologies", aims to evaluate the suitability of various carbon capture technologies and develop scenarios for the application of these technologies in the Estonian oil shale industry. The environmental impact of the most effective solutions and the technological and economic capacity of the Estonian industrial sector to use captured CO_2 are also analysed. The economic analysis focuses on the differences in unit costs of the most suitable capture technologies, the sensitivity to EU ETS allowance price and electricity prices, and the need for investment subsidies, as well as the export potential of the captured CO_2.

Energy-consumption-related measures under discussion:

3. **Training and events promoting the more sustainable use of energy and resources** – The aim of the environmental awareness programme is to create an understanding that a human is a part of nature, nature is the basis of economy and culture, and there must be a balance between protecting and using the environment. The programme supports activities in learning about the principles of sustainable environmental use, the relationship between nature and human society, natural processes and biodiversity. One of the results of the project is the development of an energy-saving way of thinking.
4. **Alternative fuels in forest and agricultural machinery** – The aim of the measure is to replace 25% of the total diesel consumption of tractors, harvesters and forestry machines with biofuels or other alternative fuels that meet sustainability criteria, and 50% by 2030.

2.2. Transport

The Liquid Fuel Act (2003) provides the bases and procedure for handling liquid fuel, the liability for violations of this Act and the arrangements for exercising state supervision, with a view to ensuring the payment of taxes and guaranteeing the quality of the more widely used motor fuels.

The main focus of the **Transport and Mobility Development Plan 2021–2035** (MoEAC, 2021**)** is to reduce the environmental footprint of the transport means and system to contribute to the achievement of climate goals by 2050. In order to manage people's behavioural changes in the future, emphasis is placed on the 'polluter pays' principle and, among other things, to taxation of fuels according to their emission factors and energy content. Also, according to the development plan, it is necessary to introduce low-carbon fuels in all modes of transport.

For this development plan, the Ministry of Economic Affairs and Communications also commissioned a report from the International Transport Forum (ITF) The Future of Passenger Mobility and Goods (ITF, 2020), the goal of which was to assess Estonia´s transport sector and give recommendations for future improvements from an external observer's perspective.

Reducing GHG emissions in the Transport sector is one of the key questions for Estonia in meeting the ESR targets in the future as the energy consumption has been growing in the same trend as the gross domestic product (GDP). The main goals for the measures implemented or planned in the Transport sector are directed at increasing the efficiency of vehicles and reducing the demand in domestic transport.

In the transport sector, the WEM measures having an effect on GHG emissions that are already in place include:

1. **Increasing the share of biofuels in transport** (PaM ID# 24) – The total energy content of the petrol, diesel and biofuel released for consumption, as well as of the electricity supplied for use in road transport, must include a total energy content of biofuels, or of biomethane or electricity supplied for final consumption, at the value, as a weighted average for the calendar year, of at least 7.5% by the end of that year.
2. **Promoting the use of electricity in passenger cars** (PaM ID# 25) – The aim of the measure is to develop a support system for expanding infrastructure that is needed for switching to electric cars.
3. **Promoting the use of biomethane in buses** (PaM ID# 40) – The aim of the measure is to increase the supply of biomethane in the market, creating demand for fuels produced from renewable energy sources and supporting the construction of filling stations.
4. **Promoting the use of electricity in buses** (PaM ID# 41) – This measure includes the development of a support system for the infrastructure to switch to electric buses (including the use of trolleybuses).
5. **Promoting the use of biomethane in heavy-duty vehicles** (PaM ID# 26) – The aim of the support is to offer the market an alternative fuel source (biomethane or bio-LNG) to replace diesel-fuelled heavy-duty trucks.
6. **Promotion of economical driving** (PaM ID# 27) – This measure includes promoting eco-driving, which helps to save fuel, and reduce noise level, emissions, accidents and vehicle repair costs.
7. **Reduction of forced movement by passenger car** (PaM ID# 28) – Implementing the measure helps to plan land use to reduce urbanisation and car dependency (forced mobility). It includes the development of telecommunications and also the development of a short-term rental car network. The measure requires stronger spatial planning at the regional level, because the activities of the measure go beyond the borders of one municipality. The aim of the measure is also to ease the transport burden during peak hours.
8. **Reorganisation of city streets** (PaM ID# 29) – The measure includes updating parking policies in cities, planning land use to reduce the use of private cars, restructuring city streets, etc. The measure also requires stronger spatial planning at the regional level, because the activities of the measure go beyond the borders of one municipality. The aim of the measure is also to ease the transport burden during peak hours.
9. **Development of convenient and modern public transport** (PaM ID# 30) – This

measure includes improving the availability of public transport, along with the development of ticket systems and new services. The measure also requires stronger spatial planning at the regional level, because the activities of the measure go beyond the borders of one municipality.

10. **Road usage fees for heavy-duty vehicles based on time** (PaM ID# 31) – This measure includes the establishment of road user charges based on time, location, environmental aspects, etc. for vehicles with a gross weight greater than 3,500 kg (heavy trucks).
11. **Electric car purchase support** (PaM ID# 32) – The purchase subsidy for electric cars is aimed at companies and individuals with high transport needs. The condition for receiving the subsidy is that the vehicle is driven 80,000 kilometres within four years from the payment of the subsidy. This means that an average of 20,000 km is covered per year. At least 80% of this, or 16,000 km, must be travelled in Estonia.
12. **Promotion of clean and energy-efficient road transport vehicles in public procurement** (PaM ID# 42) – The government must implement the system provided in the Clean Vehicles Directive within 24 months, i.e., from August 2021. The aim is to promote the procurement of clean and energy-efficient vehicles in the public sector.
13. **The railroad electrification** (PaM ID# 38) – Electrification of existing railway and extension of its use.
14. **Acquisition of additional passenger trains** (PaM ID# 43) – Additional acquisition of comfortable new passenger trains.
15. **Developing the railroad infrastructure (includes the building of Rail Baltic)** (PaM ID# 37) – This measure includes building Rail Baltic, additional stops and raising speed limits. In addition to transport, the measure also concerns emissions from the Industry and solvent sector (IPPU). The impact of Rail Baltic on the fuel consumption of heavy trucks is evaluated, which in turn means reducing the consumption of AdBlue (exhaust gas catalyst liquid) and the CO_2 released from it.
16. **Pilot project for hydrogen** (PaM ID# 44) – A project covering the entire hydrogen use chain, i.e., from production, transport, storage to consumption in public transport (hydrogen taxi).
17. **New tram lines in Tallinn** (PaM ID# 45) – Includes the development of two new tram lines.
18. **Making a domestic ferry climate neutral** (PaM ID# 39) – Includes the electrification of one ferry.

The following measures are still in discussion and henceforth are reported as planned in the WAM scenario:

1. **Additional spatial and land-use measures for urban transport energy savings to increase and improve the efficiency of the transport system** (PaM ID# 34) — This measure includes additional investments for the *Reduction of forced movement by passenger car, Reconstruction of city streets and Development of convenient and modern public transport* measures. This means that additional resources are planned to achieve additional energy efficiency and additional GHG emission savings. As this is a proposed measure, it is not yet clear when it will be implemented.
2. **Making an additional domestic ferry climate neutral** (PaM ID# 46) — Includes the

transfer of one additional ferry sailing between the Estonian mainland and the islands to electricity or biofuel that meets the sustainability criteria.

3. **Additional promotion of economical driving** (PaM ID# 33) — This measure includes additional implementation of the measure "Promotion of economical driving", which means planning additional resources to achieve additional energy efficiency and additional GHG emission savings. As this is a proposed measure, it is not yet clear when it will be implemented.
4. **Road usage fees for heavy-duty vehicles based on mileage** (PaM ID# 35) — This measure includes the establishment of road user charges based on mileage, location, environmental aspects, etc.
5. **Vehicle tyre pressure and tyre energy label** (PaM ID# 36) — The measure introduces tyres with better rolling resistance which also improves the aerodynamics of vehicles. Training materials for truck drivers are being updated to emphasise the importance of checking tyres and tyre pressure.

Cross-sectoral measures are included in Chapter 2.7 nad the projected effects of the WEM and WAM measures is included in Reportnet 3 dataset on Integrated national policies and measures.

In addition to the WEM/WAM scenario measures, there are measures under discussion that have either a direct effect on GHG emissions or support the implementation of WEM/WAM measures. As there is no agreement for the implementation of these measure, then they are excluded from the projection scenarios.

1. **Annual vehicle tax** – Registration and/or annual tax for passenger cars depending on the energy class (fuel consumption) of cars is one way to design a more fuel-efficient car fleet. The purpose of the tax is not to tax the car as such and to increase the state's tax revenues, but rather to influence consumer choices and design a more economical vehicle fleet.
2. **Congestion charge** – Congestion charge is the flexible taxation of road use, with the aim of reducing motor vehicle traffic during peak hours and covering costs related to congestion in cities and/or their immediate surroundings. Depending on the scope of the toll system and the size of the tolls, Tallinn's congestion charge can operate in parallel with kilometre-based tolls on highways or as a separate measure before the implementation of road user tolls.
3. **Taxation of company vehicles based on CO_2** – Taxation of company vehicles according to the CO_2 indicator of the vehicle.
4. **Restrictions on imports of second-hand vehicles** – Import ban on used cars from a certain EURO class, CO_2 indicator or other environmental indicator.
5. **Subsidising biofuels that meet sustainability criteria or imposing a sales obligation on service stations** – Setting a 50% obligation to sell biofuel that meets sustainability criteria to gas stations.
6. **Additional new tram lines in Tallinn** – Expanding the tram network (including acquiring trams) and improving it in such a way that the movement of trams is not obstructed by cars, both within the city and across borders. In doing so, the goal must be to increase the average speed of trams, i.e. to gain time for passengers. Tallinn projects (indicative list: Viimsi, Rae (Peetri), Kesklinn–Endla, Mustamäe (Sõpruse), Stroomi, Tondi–Tammsaare road, Lasnamäe, Tondi– Järve, Vana–Sadama, approximately 50 km in total).

7. **Tallinn taxis using electricity** – Companies offering the Tallinn taxi service are obliged to use electric cars.
8. **Making additional domestic ferries climate neutral** – Includes the transfer of all ferries (an additional 10) plying between the Estonian mainland and the islands to electricity or biofuel that meets the economic criteria.

2.3. Industrial processes and product use (IPPU)

Emissions from the IPPU sector are regulated by the duty for manufacturing industries to implement the **best available technologies (BAT)** (stipulated in the Industrial Emissions Act (IEA) (2013) and Industrial Emissions Directive 2010/75/EU) (PaM ID# 88). The purpose of the **Industrial Emissions Act** is to achieve a high level of protection of the environment taken as a whole by minimising emissions into the air, water and soil and the generation of waste in order to prevent adverse environmental impacts. In addition, the IEA determines industrial activities of high environmental hazard, provides the requirements for operation therein and liability for failure to comply with the requirements, and the organisation of state supervision.

A production plant has to comply with the BAT. The requirements of the IEA include emission limit values, and monitoring and emission reduction measures through the implementation of BATs if an environmental permit is issued. This does not result in an additional reduction of emissions because all production plants have to comply with BATs as they operate.

In the IPPU sector, the main measure having an effect on GHG emissions is the Bans and duties from the **Regulation (EU) No 517/2014** on fluorinated greenhouse gases and **Directive 2006/40/EC** related to emissions from mobile air conditioners (MACs) (PaM ID# 87), consisting of two policies:

Regulation (EU) No. 517/2014 on fluorinated greenhouse gases. This regulation only affects GHG emissions, similarly in the WEM and WAM scenarios. The effect is ongoing until at least 2030. The objectives are to significantly reduce fluorinated greenhouse gas emissions and replace fluorinated greenhouse gases with refrigerants with low GWP, limiting the total amount of the most important F-gases that can be sold in the EU from 2015 onwards and phasing them down in steps to one-fifth of 2014 sales in 2030. To achieve this, a phase-down scheme of F-gases brought onto the EU market is stipulated, bans on placing on the market and servicing of certain equipment, (certification) duties for operators and servicing personnel, duty of collecting the gases from decommissioned equipment.

Directive 2006/40/EC related to emissions from mobile air conditioners (MACs) only affects GHG emissions, similarly in the WEM and WAM scenarios. The objective of MACs Directive 2006/40/EC is to reduce F-gas emissions from passenger cars and vans by prohibiting the use of F-gases with a GWP of more than 150 times greater than carbon dioxide (CO_2) in new types of cars and vans introduced from 2011, and in all new cars and vans introduced to the market from 2017.

Cross-sectoral measures are included in Chapter 2.7 and additional information is included in Reportnet 3 dataset on Integrated national policies and measures.

2.4. Agriculture

Development of the Agriculture sector and the implementation of various targeted measures are mostly governed by the **Common Agricultural Policy (CAP) Strategic Plan 2023– 2027** (approved 11.11.2022) and **Agriculture and fisheries development plan until 2030** (AFDP 2030) (MoRA, 2021). In addition, there are some measures from the **Estonian rural development plan 2014–2020** (ERDP 2014–2020) that are still applying as the funding for the implementation of the measures is in place until 2023 and/or 2024.

The CAP Strategic Plan 2023–2027 includes four specific objectives, that also contain climate-related actions:

1. Contribute to climate change mitigation and adaptation, including by reducing GHG emissions and enhancing carbon sequestration, as well as promoting sustainable energy. This specific objective includes the following identified needs:
   - To prefer environmentally sustainable production, investments, solutions based on the circular bioeconomy;
   - To increase carbon sequestration in soils and protect soil organic carbon stocks.
2. Foster sustainable development and efficient management of natural resources such as water, soil and air. This specific objective includes the following identified needs:
   - Continued support for land improvement investments;
   - Contribute to the use of agricultural practices that conserve surface and groundwater;
   - Neutralisation of acidic soils;
   - Encouraging the development and introduction of environmentally friendly technologies;
   - Development of environmental consulting;
   - Implementation of the requirements and measures resulting from the air pollutant emission reduction programme;
   - Maintenance of soil fertility.
3. Contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes
4. Improve the response of EU agriculture to societal demands on food and health, including safe, nutritious and sustainable food, food waste, as well as animal welfare. This specific objective includes the following identified needs:
   - Increasing organic production in organic agriculture by reducing the processing of organic products as conventional products;
   - Diversity of agricultural and garden (horticultural) crops, availability of varieties suitable for local conditions;
   - Increase livestock keepers' knowledge of livestock health and well-being in general.

As regards impact on the environment, the **Organic Farming Act** (2007) is important among the legislation regulating the agricultural sector, as it provides for the requirements for operating in the area of organic farming to the extent not regulated by the regulations of the EU, as well as for the grounds and extent of supervision exercised over persons operating in the area of organic farming, and for the liability for violation of the requirements established by such legislation. In

addition, a number of secondary legislative acts have been issued on the basis of this act to regulate aspects of organic farming.
Actions to reduce nitrogen losses from agriculture, for example, based on the requirements of the *Nitrates Directive*, have led to reduced nitrogen emissions to the aquatic environment with indirect positive effects for the mitigation of climate gas emissions. The legislation which is relevant for the implementation of the *Nitrates Directive* is the *Water Act*, which was enacted in 1994 and has been revised since, especially in connection with the accession into the European Union. An updated *Code of Good Agricultural Practices* and a Government decree on water protection requirements for fertiliser, manure and silage (revised several times) were introduced. The **Water Act** (2019) is one of the principal legal acts that the prime measures in the Estonian Water Management Plan measure programme 2015–2021 are grounded upon. Additional measures to promote water protection in agriculture are mainly based on the ERDP and its measures.

ERDP 2014–2020 measures that continue to contribute to WEM scenario GHG emission reduction include:

1. **Agri-environment-climate measures with three sub-measures** (PaM ID# 69)**:**

- Regional water protection support – The objectives are to prevent and reduce water nitrogen pollution to preserve the water quality by decreasing agricultural soil leaching.
- Support for growing local plant varieties – The objective is to ensure the preservation of the local plant varieties valuable for cultural heritage and genetic diversity. The measure helps to preserve crop varieties more suitable for local conditions (more resistant to locally spread diseases and climate conditions) and therefore gives a good basis for developing new breeds and supports organic farming.
- Support for keeping animals of local endangered breeds – The objective is to ensure the preservation of animal breeds that are endangered and considered important for cultural heritage and genetic diversity.

2. **Organic production** (PaM ID# 68) — The objectives of the measure are to develop organic production, increase the competitiveness of organic production, preserve and improve biodiversity and landscape diversity, preserve and enhance soil fertility and water quality, and develop animal welfare. The measure helps to reduce GHG emissions by using organic fertilisers instead of mineral fertilisers. Additionally, emission per one hectare is lower compared to the conventional production.

3. **Knowledge transfer and information actions** (PaM ID# 70) — The general objective of the measure is to develop and enhance the technical, economic and environmental knowledge of the enterprisers and their employees in the Agriculture, food and forest sector to improve the bioeconomy and adapt new challenges to use resources sustainably. The measure aims to promote the organisation of educational training, presentations, awareness-raising activities, organising workshops or visits to enterprises and long-term programmes.

4. **Advisory services, farm management and farm relief services** (PaM ID# 71) — The general objective of the measure is to enhance the sustainable management or effectiveness of agricultural holdings or enterprises by providing high-quality advisory services to people working in the agriculture sector. Advisory services include inter alia environmental and climatic topics by providing high-quality advisory services to the people working in the agriculture sector. Advisory services include inter alia environmental and climatic topics.

There are additional agriculture-related measures WEM measures from the CAP Strategic Plan 2023–2027 (approved 11.11.2022).These measures are similar to the measures implemented under ERDP 2014–2020. The CAP Strategic Plan contains important support activities and sectoral interventions affecting GHG emissions which include:

1. **Eco-scheme for organic farming** (PaM ID# 76) – The support is granted to farmers who start conversion to organic farming and engage in organic farming. Support is granted on the basis of the area of their agricultural land under organic farming.
2. **Support for maintenance of ecosystem services on agricultural land** (PaM ID# 78) – Intervention will support a diversified agricultural landscape, the preservation of landscape features and natural areas, with the aim of ensuring the natural enemies of arable land pests in providing natural pest management ecosystem services.
3. **Animal welfare support** (PaM ID# 82) – The overall objective of the intervention is to raise animal welfare awareness among livestock farmers and to support farmers who meet higher animal welfare standards and thereby improve animal welfare and health. In addition, the support helps to reduce the negative environmental impact of livestock farming on air and soil and to increase the number of animals grazed extensively in order to maintain grassland biodiversity without encouraging an increase in the total number of animals and stocking densities. The intervention shall support:
   - Environmentally friendly grazing of dairy cattle and horses;
   - Increased housing area per pig, feeding plans approved by a veterinarian, feed containing mycotoxin binders and/or acidifiers and the use of anaesthesia and analgesia in the case of castration of piglets;
   - Implementation of alternative systems in poultry farming, larger housing area per laying hen and quail.
5. **Support for the development of knowledge transfer and advisory services (AKIS)** (PaM ID# 84) — Coherent AKIS is important for the sustainable development of the Agriculture and food sector and helps to increase the competitiveness of companies in the sector, creating additional opportunities for the modernisation of agriculture and rural life, promoting and sharing knowledge, supporting innovation and digital transition, and encouraging their adoption.
6. **Support for Advisory Services** (PaM ID# 85) — This measure helps to increase awareness of the mutual impact of climate, climate changes and agriculture.
7. The **Cover crops** (PaM ID# 83) requirement is targeting arable land and land under permanent crops that shall be at least 50% under winter vegetation cover. 'Winter vegetation cover' means crops on arable land from 1 November to 31 March, including catch crops, stubble and plant remnants. By way of exception, the requirement for winter vegetation cover is 30% for horticultural producers. This measure was proposed by a study to find cost-effective mitigation measures.

The WAM scenario includes one measure contributing to reducing GHG emissions

1. **Improvement of manure management** (PaM ID# 73) — CO_2 reduction potential of this measure is reflected by significantly lower CH_4 emissions from covered storages compared to uncovered storages with a natural crust. Furthermore, more accurate reductions in GHG emissions need to be explored through research and pilot projects.

Cross-sectoral measures are included in Chapter 2.7 and additional information on measures is included in Reportnet 3 dataset on Integrated national policies and measures.

In addition to the WEM and WAM measures, there are additional agriculture-related measures that either have a direct effect on GHG emissions or support the implementation of WEM/WAM measures. These are however not included in the GHG projection scenarios:

1. **Audits in large agricultural holdings** (PaM ID# 74) — The measure includes methodology development, training of the audit team and conducting the audits. As part of the audits, the current situation of companies is assessed and the main measures to improve the situation are proposed.
2. **Studies and pilot projects** (PaM ID# 75) — The studies and pilot projects would enable the possibility to evaluate the effect of different agricultural practices and technologies on climate more precisely and to develop country-specific emission factors. This is a prerequisite for the effective development and implementation of several agricultural and the EU Common Agricultural Policy´s measures, as the impact of these measures will only contribute to meeting Estonian climate policy objectives in the case that the impact of these measures can be reflected in the GHG inventory.

A study on finding the most cost-effective measures to achieve the goals of climate policy and the ESR includes a measure of **replacement of mineral fertilizers by organic fertilizers** (PaM ID# 72) to reduce N_2O emissions from arable soils.

National emission control programme for air pollutants (MoE, 2019) submitted under National Emissions reduction Commitments (NEC) Directive (2016/2284/EU) includes **limiting ammonia emissions from the use of mineral fertilisers** activity that reduces GHG emissions in Agriculture sector. Using rapid application of fertilisers to the soil enables to limit NH_3 emissions caused by the use of mineral fertilisers.

The Agriculture, food and rural life programme 2022–2025 includes activities contributing GHG emission reduction. The purpose of **agri-environment** activities include the reduction of negative environmental impact related to the use of fertilisers, plant protection products and GHG emissions and ensuring the preservation of the biodiversity of agricultural land and the diversity of landscapes. In addition, the aim of the programme's activities is to ensure the wider use of environmentally friendly practices in agriculture. In order to further ensure environmental protection, the adoption and continued use of environmentally sustainable management methods in agriculture is encouraged, among other things, with the help of subsidies. The purpose of the **land improvement** activities is to ensure the targeted use of drained agricultural and forest land.

These include the reduction of negative environmental impact related to the use of fertilisers, plant protection products and GHG emissions and ensuring the preservation of the biodiversity of agricultural land and the diversity of landscapes. In addition, the aim of the programme's activities is to ensure the wider use of environmentally friendly practices in agriculture. In order to further ensure environmental protection, the adoption and continued use of environmentally sustainable management methods in agriculture is encouraged, among other things, with the help of subsidies. The purpose of the **land improvement** activities is to ensure the targeted use of drained agricultural and forest land.

2.5.Land use, land-use change and forestry (LULUCF)

The Forest Act (2007) provides the legal framework for managing the Estonian forests to ensure protection and sustainable management of the forest as an ecosystem. The Forest Act encompasses the reforestation measure aiming at the recovery of the forest after logging or natural disaster. According to the Forest Act, the forest owner is obliged to ensure reforestation at the latest within five years after the logging or natural disaster. Supporting the fast reforestation after logging favours consistent carbon capture on the woodland and hence preservation of the GHG capture level of Estonian forests. The state also supports private forestry by the training of private forest owners and agricultural advisers, and investments aimed at increasing the economic, ecological, social and cultural value of the forest. Voluntary protection of key habitats in forests is encouraged through compensation for private forest owners.

The **Estonian Forestry Development Plan until 2020 (EFDP 2020)** (MoE, 2011) determined the forestry targets for 2011–2020 and described the measures and resources to achieve these targets. The main objective of the EFDP 2020 was to ensure forest productivity and vitality, and the diverse and efficient use of this resource. The EFDP 2020 also included measures for the protection of natural processes and threatened species. Financing of the EFDP 2020 measures that are considered in the projections continues and they are also likely to be included in the next Forestry Development Plan.

The MoE has prepared the draft **Forestry Development Plan until 2030 (EFDP 2030)** (MoE, 2023). Currently, the EFDP 2030 programme, or implementation plan, is being prepared. The aim of the development plan is to achieve a social agreement on the sustainable management of forests, taking into account social, economic, environmental and cultural aspects. Sustainable forestry means the management of forests in a way that ensures their current biological diversity, productivity, capability for regeneration, vitality and potential and enables the possibility to also perform all functions in the future, without causing harm to other ecosystems. The following planned policy directions have an impact on the LULUCF sector:

- Adaptation of forestry to climate change – The aim is to increase the carbon sequestration and storage in forests in order to alleviate climate change and raise the resilience of forests to the effects of climate change;
- Improving the state of biodiversity in forest ecosystems – Forest management takes into account biodiversity, environmental and climate objectives;
- Enhancing the competitiveness of the Forest sector – One aim of this policy is to ensure greater productivity, quality and good health status of forests;
- Better valorisation of wood – More efficient and resource-efficient wood use is encouraged and supported in the forest and timber industries.

According to the **Earth's Crust Act** (2017), the owner of the extraction permit is obliged to restore the land disturbed by mining. The objective of the restoration is to adjust the land degraded by extraction to forest land, water body, land with recognised value or to any other kind of land that can be used for beneficial purposes.

The main objectives of the **Nature Conservation Act** (2004) are the promotion and preservation of biodiversity, the preservation of the natural environments of cultural or aesthetic value, as well as the promotion of the sustainable use of natural resources. The Act also stipulates the application of compensatory measures for the Natura 2000 areas.

The **Estonian Action Plan for Protected Mires** (2016– 2023) (MoE, 2015) has been prepared to preserve and restore the biodiversity and ecosystem services of Estonia's protected mires.

One of the objectives of the plan is to develop methodologies for the restoration of mires and to restore a near-natural water regime in the most prioritised of the degraded mires.

In order to contribute to the preservation of Estonian semi-natural communities, an **action plan for semi-natural grasslands (2021–2027**) (Environmental Board, 2021) has been drawn up. By 2027, the goal is to maintain heritage meadows on at least 50,000 hectares. Planned activities include continued funding for the maintenance of semi-natural communities and the restoration of new habitats, taking into account the coherence and species protection aspects.

European structural and investment funds and LIFE programme have supported several projects to preserve and restore Estonian protected habitats and semi-natural grasslands, and to restore the water level in abandoned cut-away peatlands and degraded wet habitats.

Several activities for supporting the private forestry, and maintaining semi-natural habitats and Natura 2000 sites are (co-)financed through the CAP. Specific objectives set in Estonian CAP Strategic Plan 2023–2027 include contribution to climate change mitigation and adaptation by reducing GHG emissions and enhancing carbon sequestration, and promoting the sustainable and efficient management of natural resources.

LULUCF WEM scenario measures include:

1. **Supporting the reforestation in private forests with native tree species of best possible hereditary characteristics suitable for the site** (PaM ID# 95) – The overall objective of the measure is to support activities related to the timely regeneration of forests in order to improve the quality of forest resources and ensure the efficient use of forest land production potential. The measure has a positive effect on the growth of new forest which helps to increase carbon uptake.
2. **Reduction of environmental impacts related to the use of fossil fuels and non-renewable natural resources by increasing the Estonian timber production and use** (PaM ID# 93) – The measure helps to reduce the GHG emissions of fossil fuels and deposit carbon in harvested wood products. Specific activities include information campaigns to promote the use of wood and encouraging the use of wood through green public procurement (public buildings, energy, etc.). The construction of a wooden reference building is planned with the aim of creating experience in the construction of large wooden buildings and thereby increasing the export potential of the Estonian wood sector and promoting the valorisation of local raw materials.
3. **Compensation for nature conservation restrictions on private forest areas outside the Natura 2000 network** (PaM ID# 96) – Subsidies are paid to the owners of private forests outside Natura 2000 areas in limited management zones, limited-conservation areas and in areas where protection proceedings have been initiated. Protected areas on forest land help to preserve the forest carbon stock.
4. **Protection of woodland key habitats** (PaM ID# 99) – In state forests, conservation of key habitats is organised by the State Forest Service. Private forest owners may conclude a contract for the protection of a key habitat for 20 years, and the state pays the owner remuneration.
5. **Prevention of bark beetle damage** (PaM ID# 100) – The aim of the aid is to prevent damage to private forests. Supported activities include the use of trapping trees, the acquisition and installation of pheromone traps and the elimination of fresh storm damage.

6. **Ensuring the protection of biodiversity** (PaM ID# 97) – The objective of this measure is to ensure the favourable condition of species and habitats, and the diversity of landscape so that the habitats function as a single ecological network and the ecosystem services provided by biodiversity are sustainable. The measure also includes restoration of habitats (mires, semi-natural communities) to achieve their favourable status.

The CAP Strategic Plan 2023–2027 includes the following LULUCF WEM measures:

1. **Investments to support forest adaptation to climate change** (PaM ID# 98) – Forest investments contribute to mitigating and adapting to climate change, as a growing forest, in particular, accumulates carbon. Maintenance felling in stands up to 30 years old is supported and investments are made for the development of nurseries. The measure also provides support for preventing and eliminating damage caused by fire, pests and storms.
2. **Promoting biodiversity in Natura 2000 private forests** (PaM ID# 94) – The measure aims to maintain biological and landscape diversity in Natura 2000 areas and outside the Natura 2000 protected areas in the conservation zone, covered with forests.

No additional measures are planned in the LULUCF sector. Cross-sectional measures with GHG reduction potential in Agriculture and LULUCF are described in Chapter 2.7 and additional information on measures is included in Reportnet 3 dataset on Integrated national policies and measures.

2.6. Waste

The **Waste Act** (2004) provides waste management requirements for preventing waste generation and the health and environmental hazards arising from waste, including measures for improving the efficiency of the use of natural resources and reducing the adverse impacts of such use and progressive reduction of landfilling of waste that is suitable for recycling or other recovery. The act also includes organisation of waste management including bases and extent of state supervision.

In the beginning of 2021, the Minister of the Environment initiated the preparation of the **National Waste Plan 2022– 2028** (NWP 2022-2028) (MoE, 2022b) which will be finalised in the first quarter of 2023. The vision for the NWP 2022– 2028 is avoiding waste generation. Products are reused and repaired, generated waste is collected separately which is part of everyday behaviour. The vision is supported by a user-friendly, efficient, transparent and functioning innovative waste management system based on the waste hierarchy. Also, new value is created from waste as raw material.

NWP 2022–2028 is based on three strategic goals:

1. sustainable, conscious production and consumption promotion of waste prevention and re-use;
2. increasing safe material circulation;
3. consideration of the effects of waste management on both the human and natural environment as a whole.

The Circular Economy White Paper (MoE, 2022c) brings together the vision of the ministries and interest groups, the principles of the circular economy and the directions of circular economy development, which are the basis for future activities. The document supports various parties to make the circular economy an overarching framework in planning, consumption, production, politics, lifestyle, culture and values. In the future, the circular

economy activity plan includes the activities and metrics of various fields which are highlighted.

In the waste sector, the main measures having an effect on GHG emissions that are already in place include:

1. **Limiting the percentage of biodegradable waste going to landfill and increasing the reuse and recycling of waste materials** (PaM ID# 89) – The focus of the measure is to increase the volume of recycling of municipal waste, including increasing the recycling of biodegradable waste and reducing the share of biodegradable waste in landfilling, also developing a nationwide waste collection network with a more efficient reporting information system. Consistent guidance on recycling and preparation for re-use of waste and an expanding and simple waste management system will help to increase the amount of waste collected separately and reduce the proportion of biodegradable waste in landfills. The establishment of a national biodegradable waste collection and treatment network is particularly important for reducing GHG emissions from solid waste disposal.
2. **Promoting the prevention and reduction of waste generated, including the environmentally sound management of waste** (PaM ID# 90) – The general objective of the measure is to improve the resource efficiency of the Estonian economy and to promote waste prevention in order to reduce the negative effects on the environment and human health. The state supports waste prevention by disseminating information. Various initiatives will be used to implement the measure, environmental management measures will be implemented, additional studies will be carried out, investments will be made and the necessary legislation will be supplemented.
3. **Reducing environmental risks arising from waste, improvement of monitoring and supervision** (PaM ID# 91) – The general objective of the measure is to supplement the range of methods used for the management of hazardous waste and to reduce the environmental risks associated with waste disposal. Closed landfills must be properly managed. Strengthening the monitoring of waste management will help reduce illegal dumping.
4. **Circular material use rate** (PaM ID# 92) – In order to increase the recycling of different materials and the use of secondary raw materials, we promote the adoption of sustainable production and consumption models. Resource efficiency, including energy efficiency, must be improved in companies, for example by supporting industrial symbiosis, digitalisation and more resource-efficient technologies. Waste management is reorganised based on the waste hierarchy, adopting innovative solutions to reduce waste generation, increase material recycling and ensure the separate collection of waste.

In addition to WEM measures, there are additional waste-related measures that have either a direct effect on GHG emissions or support the implementation of WEM measures. The following additional measures are under discussion and therefore not part of the projection scenarios.

1. **Reduction of food waste —** This measure originates from the Estonian food waste prevention plan which is enforced through other action plans. The aim of the measure is to reduce the generation of food waste and food loss in the entire food supply chain, i.e. primary production, food processing and preparation, food retailing and wholesale and other means of delivery, as well as catering and households. This ensures savings in natural resources, economic resources and the burden on the social system.

2.7. Cross-sectoral parameters and measures

Excise duties under the **Energy tax measure** (PaM ID# 121)) (Table 2.2) are one of the fiscal measures in Estonia with an impact on GHG emissions. The excise duty rate has been temporarily reduced in the period of 01.06– 31.12.2022.

Table 2.2. Excise tax on fuels and electricity (as of April 2022, ETCB)

Fuel/energy type	Unit	EUR/unit
Unleaded petrol	1,000 l	563
Leaded petrol	1,000 l	563
Aviation spirit	1,000 l	563
Kerosene	1,000 l	330.1
Diesel oil	1,000 l	372
Diesel oil for specific purposes	1,000 l	21[1]
Light heating oil	t	372
Heavy fuel oil	t	422
Heavy fuel oil[2]	t	58
Shale-derived fuel oil	t	414
Shale-derived fuel oil[3]	t	57
LPG (used as heating fuel)	t	55
LPG (used as motor fuel)	t	193
Natural gas (used as heating fuel)	1,000 m^3	40
Natural gas (to a gas-intensive undertaking with a permit for exemption from excise duty)	1,000 m^3	11.30
Motor natural gas (which is used as motor fuel, including in stationary engines)	1,000 m^3	40
Motor natural gas in liquefied form (which is used as used as motor fuel, including in stationary engines)	1,000 kg	55.79
Solid fuels (coal, brown coal, coke, oil shale; heat production	GJ (GCV)	0.93
Electricity	MWh	1
Electricity (to an electro-intensive undertaking with a permit for exemption from excise duty)	MWh	0.5

[1] The excise duty rate has been temporarily reduced in the period of 01.06–31.12.2022.
[2] Heavy fuel oil, which density is >900 kg/m^3 at 15 °C, viscosity is >5 mm^2/s at 40 °C, contains >0.5% sulphur.
[3] Shale-derived fuel oil, which density is >900 kg/m^3 at 15 °C, viscosity is >5 mm^2/s at 40 °C, contains >0.5% sulphur.

Pollution charges are a second fiscal measure in Estonia with an impact on GHG emissions. The government's tax policy is based on objectives aimed at reducing environmental impact by increasing the rates of charges on pollution and resource use.

The Environmental Charges Act (2006) This Act provides the grounds for determining the natural resource charges, the rates of the pollution charge, the procedure for calculation and payment thereof, and the grounds and specific purposes for using state budget revenue obtained from environmental use. Environmental charges are established and imposed based on the need for environmental protection, the economic and social situation of the state and, in the events specified in this Act, also based on the value created by natural resources subject to the charge as well as the purpose and manner of use of the environment. A mineral resource extraction charge that exceeds the minimum rates provided for in this Act is established based on the state's goal of earning revenue. In the case of an energy mineral resource, the added value generated by the energy mineral resource is relied upon in addition to the goal of earning revenue.

In Estonia a pollution charge for releasing CO_2 into the ambient air was introduced in 2000. Currently, the Environmental Charges Act obliges the owners of combustion equipment to pay pollution charges for several pollutants emitted into the air. The pollution charge in the case of emissions into ambient air must be paid by all enterprises that are required to have an air pollution permit. The air pollution permit is obligatory for all enterprises which own and operate combustion equipment (utilising solid, liquid or gas fuel) with a rated capacity equal to or higher than 1 MWth in one location. Thermal power producers pay a pollution charge for the CO_2 emissions into the ambient air based on the quantity of CO_2 emitted into the environment upon the amount of CO_2 emitted. The CO_2 charge has been 2 EUR/t. Installations that emit sulphur oxide, carbon monoxide, particles, except heavy metals and compounds of heavy metals, nitrogen oxides, volatile organic compounds, heavy metals and compounds of heavy metals into the ambient air also pay a pollution charge. CH_4 and fluorinated gases (HFC – hydrofluorocarbons, PFC and SF_6) are not subject to pollution charges.

As an exception, the Environmental Charges Act provides the option of replacing the pollution charge (incl. the CO_2 charge) with environmental investment by enterprises. The obligation to pay the pollution charge is substituted by the obligation to finance environmental protection measures for pollutants or types of waste whose quantity is reduced by at least 15% by the planned environmental protection measures.

Cross-cutting measures with a potential for GHG reduction in both LULUCF and Agriculture sector in the WEM scenario include:

1. The **Agri-environment-climate measures with three sub-measures** (PaM ID# 101)**.**
   - Support for environment-friendly horticulture – The general objective is to promote the use of environment-friendly practices in gardening. One of the more specific aims is to decrease leaching.
   - Regional soil protection support — The general objective is to ensure the sustainable use of eroded and peat soils and to minimise soil degradation by improving the management of soils and using other activities improving cropland management. The measure includes bringing agricultural lands with erosion and peat soils under grassland.
   - Support for maintaining semi-natural habitats – The general objective is to ameliorate the conditions of semi-natural habitats and its species by improving grazing land or grassland management.

This measure is from the Estonian rural development plan 2014–2020 (ERDP 2014–2020) and is still applying as the funding for the implementation of the measures is in place until 2023 and/or 2024.

In addition, the Common Agricultural Policy (CAP) Strategic Plan 2023–2027 (MoRA, 2022) includes an **environmentally friendly management** (PaM ID# 67) measure with the sub-measures cultivation of catch crops and neutralisation of acid soils measures. The aim of the neutralisation of acid soils measure is to neutralise the acid soils to achieve the optimal conditions for the plant growth. As a result, the loss of agricultural land in use can be avoided and the soil carbon pool will be increased. The neutralisation of acid soils measure was first proposed as a GHG reduction measure in the Analysis of the opportunities to increase climate ambition in Estonia (SEI, 2019). Additional CAP Strategic plan 2023-2027 havin an effect in Agriculture and LULUCF sector include:

1. **Eco-scheme for ecological focus areas** (PaM ID# 77)v The support promotes the creation of non-productive areas and landscape features on arable land in order to contribute to biodiversity and mosaic landscapes.
2. **Soil and water protection support** (PaM ID# 79) – In terms of soil protection, the aim of this intervention is to reduce carbon emissions and protect soil organic carbon stocks and peat soils. The highest organic carbon emissions in agriculture occur from peat soils and cultivated peat soils have the highest organic carbon content and these soils are vulnerable to mineralisation. The aim of the intervention is to reduce the cultivation of peat soils and to promote the transfer of arable land under long-term grassland and vice versa, avoiding cultivation of arable crops instead of grassland.
3. **Support for the maintenance of valuable permanent grassland** (PaM ID# 80) – The aim of the intervention is to preserve permanent grasslands of a high biological value, where natural vegetation has been developed or preserved and thus the conditions for species richness are guaranteed. Support for the maintenance of valuable permanent grassland is intended for semi-natural grasslands located outside protected areas and permanent grassland intended by experts as valuable permanent grassland.
4. **Support for maintaining semi-natural grassland** (PaM ID# 81) – The aim of the intervention is to preserve semi-natural grasslands in Natura 2000 areas and thereby the richness of species on agricultural land. Semi-natural grasslands also play an important role in adapting to climate change and the sequestration of organic carbon into soils.

Cross-cutting measures with a potential for GHG reduction in both the Energy and Agriculture sector in the WAM scenario include **Investments into improved performance of agricultural holdings** (PaM ID# 65)**.** The aims are to support the reconstruction or construction of new livestock facilities (including manure and silage storage facilities) and provide investments into renewable energy through investments in bioenergy and promote its production. The objective of the measure is to increase the competitiveness of agricultural producers, so that the producers would receive support for their agricultural work. For instance, the bioenergy produced with the support is used for the farm activities.

In addition, the Common Agricultural Policy (CAP) Strategic Plan 2023–2027 (approved 11.11.2022) includes **Material and intangible investments by farmers** (PaM ID# 66) includes six sub-actions:

- Investments in the establishment of environmentally friendly renewable energy solutions and energy savings on the farm.
- Purchase of precision fertilisation sensor systems.
- The acquisition of clean refrigeration units or the replacement of items of refrigeration equipment for more environmentally sustainable ones.
- Construction of manure storage facilities and silos, covering of manure storage facilities and construction of leak-proof substrates for deep litter housing.
- Investments in manure spreading equipment.
- Purchase of filters that capture ammonia.

In addition, CAP Strategic Plan 2023–2027 (approved 11.11.2022) includes a measure that is not yet implemented and therefore not part of the projection scenarios.

Investments in exploitation of bioresources (PaM ID# 86) — is aimed at contributing to providing higher economic added value to bio-resources, increasing R&D and innovation capacity and reducing GHG emissions. Giving higher added value to bioresources increases the profitability of companies, helps reduce dependence on domestic and foreign non-

renewable resources, and accelerates the replacement of non-renewable resources in line with the EU's climate goals. The new jobs created will promote the regional economy, including in peripheral areas. The intervention also promotes (inter-sectoral) cooperation, the formation of co-operatives and clusters, and introduces the possibilities of the bioeconomy to a wider target group. Enhancement of bio-resources is financed from the Recovery and Resilience Facility and the CAP Strategic Plan 2023–2027 (approved 11.11.2022).

The following measures mainly affect the Transport sector in the WEM and WAM scenarios, but will also have a small effect on the IPPU sector WEM and WAM scenarios through a reduction of final energy demand for road transport and diesel fuel exhaust fluid (usage of Ad Blue is reported under the IPPU sector. Additional information on the measures is provided under Chapter 2.2.

WEM measures:

1. **Promoting the use of electricity in passenger cars** (PaM ID# 25)
2. **Promoting the use of biomethane in buses** (PaM ID# 40)
3. **Promoting the use of electricity in buses** (PaM ID# 41)
4. **Promoting the use of biomethane in heavy-duty vehicles** (PaM ID# 26)
5. **Promotion of economical driving** (PaM ID# 27)
6. **Reduction of forced movement by passenger car** (PaM ID# 28)
7. **Reorganisation of city streets** (PaM ID# 29)
8. **Development of convenient and modern public transport** (PaM ID# 30)
9. **Road usage fees for heavy-duty vehicles based on time** (PaM ID# 31)
10. **Electric car purchase support** (PaM ID# 32)
11. **Promotion of clean and energy-efficient road transport vehicles in public procurement** (PaM ID# 42)
12. **Developing the railroad infrastructure (includes the building of Rail Baltic)** (PaM ID# 37)
13. **Pilot project for hydrogen** (PaM ID# 44)
14. **New tram lines in Tallinn** (PaM ID# 45)

WAM measures:

1. **Additional spatial and land-use measures for urban transport energy savings to increase and improve the efficiency of the transport system** (PaM ID# 34)
2. **Additional promotion of economical driving** (PaM ID# 33)
3. **Road usage fees for heavy-duty vehicles based on mileage** (PaM ID# 35)
4. **Vehicle tyre pressure and tyre energy label** (PaM ID# 36)

3. PROJECTED GREENHOUSE GAS EMISSIONS UNTIL 2050

3.1. Key assumptions and parameters used

The key underlying assumptions used in the projections are presented in Reportnet 3 dataset Table 2 and Table 3.

3.2. Sectoral WEM and WAM projections

Detailed information on sectoral projections with WEM and WAM scenarios are included in Reportnet 3 dataset Table 1a. GHG projections have been calculated using AR5 GWPs.

3.2.1. Energy

3.2.1.1. Methodology

Two projections scenarios of GHG emissions have been calculated for the period 2021–2050. The reference year 2020 used in projections is consistent with Estonia's 2022 submission to the UNFCCC on 15th of April 2022 (National Greenhouse Gas Inventory Report 1990–2020, 2022). The 'With Existing Measures' (WEM) scenario evaluates future GHG trends under current policies and measures. In the second scenario a number of additional measures and their impact are taken into consideration, forming the basis of the 'With Additional Measures' (WAM) scenario.

The scenarios projecting GHG emissions in the Energy sector are mainly based on the measures of the Ministry of the Environment and Ministry of Economic Affairs and Communications, which are funded through the Recovery and Resilience Facility, Environmental Investment Centre and the State Shared Service Center. In addition, the scenarios were updated based on the input received from the Ministry of Economic Affairs and Communication, the Ministry of Environment and input from the meeting points of the Government´s Climate and Energy Committee (2020).

The Balmorel model was used for the electricity generation projections in the Electricity generation sector. It is a model for analysing the Electricity and Combined heat and power sectors from an international perspective while minimising the total costs of the system. The Balmorel model combines the approach of bottom-up modelling in a classic technical modelling tradition with top-down economic analysis, projections and forecasts. Some of the key strengths of the Balmorel model include the flexible handling of the time and space dimensions and the combination of operation and investment optimisation. The existing functionality and structural suitability for extensions make it a useful tool for assessing challenges in the ongoing energy transitions. However, the downsides of the Balmorel model are complex user interface, the speed of the model and adding additional sectors to make the energy model more complete. The Balmorel model can differentiate, for example, the fuel consumption between the electricity and heat production, which is useful on order to avoid double counting. Furthermore, the Balmorel model makes estimated projections for both heat and power, to what extent it is reasonable to use a type of fuel (like biomass) to meet energy demand.

The main assumption for the projection was that step-by-step, the use of oil shale shall decrease for the production of electricity and increase for the production of shale oil. The retort gas that occurs as a side product during the production of shale oil is used for electricity production. The projected future usage of fuel based on the model was applied while using the emission calculations of the 2006 IPCC Guidelines.

The projections for heat generation in the Public heat and electricity generation sector are primarily based on the reconstruction rate of the Shared Service Center, Analysis of the opportunities to increase climate ambition in Estonia measures (SEI-Tallinn, 2019) and Long-term strategy for building reconstruction scenarios (TalTech, 2020). The projections in the heat production are based on measures funded through the Environmental Investment Centre and measures highlighted in the Analysis of the opportunities to increase the climate ambitions in Estonia.

The projections of the GHG emissions of shale oil production in the Manufacturing of solid fuels and other energy industries were calculated based on input from the industry. The amounts of oil shale used and the construction of a new shale oil production plant were used for the GHG projections.

The GHG projections in the Manufacturing industries and construction sector and in Other sectors are also based on historical trends, long term real GDP growth rate (the Ministry of Finance), Shared Service Center measures and Longterm strategy for building reconstruction scenarios (TalTech, 2020). The emissions are calculated based on the methodology of the 2006 IPCC and EMEP/EEA 2019 Guidebook.

3.2.1.2. GHG emissions projections

Projections of GHG emissions have been calculated for the period of 2021–2050 and 2020 from the NIR 2022 has been used as a reference year. Two scenarios are presented. The WEM scenario evaluates future GHG emission trends under the current policies and measures. In the second scenario, a number of additional measures and their impact are taken into consideration, forming the basis for the WAM scenario.

The Energy sector (excluding transport) includes GHG emissions from the consumption and production of fuels and energy (electricity and heat). The main sub-sectors in this sector are: Energy industries; Manufacturing industries and construction; Other sectors (incl. Commercial/institutional, Residential, Agriculture/Forestry/ Fishing/Fish farms and Military) and Fugitive emissions from natural gas distribution. The GHG emission decrease in 2020 compared to the previous two years was primarily in the Energy industries, because of the EU ETS emission allowance price increase and lower electricity prices.

The Energy sector's projected emissions in the WEM scenario are presented in Figure 3.1. In the WEM scenario, the emissions are projected to decrease by 75.5% from 2020 to 2050. The largest absolute decrease occurs in the Energy industries.

The main electricity producer in Estonia is Enefit Power AS incl. the Eesti Power Plant and the Balti Power Plant. Both plants mainly use oil shale for electricity production. Enefit power plants are also the largest producers of GHG emissions in Estonia. This is due to the phasing out of oil shale pulverised combustion in these plants, the building of a more effective Auvere oil shale combustion plant, and the introduction of new shale oil production plants (fluidised bed combustion). It is planned by the companies to phaseout shale oil in solid heat carrier technology based shale oil plants, which causes a larger decrease in GHG emissions between 2040 and 2041 (Figure 3.1). The GHG emissions are projected to decrease by 95.4% by 2050 compared to 2020 in the Energy industries sector.

GHG emissions in the Manufacturing and construction sector (divided into iron and steel; non-ferrous metals; chemicals; pulp, paper and print; food processing, beverages and tobacco; non-metallic minerals; and other industries) are projected to increase by 28.3% by 2050 compared to 2020. In this sector, only one scenario (WEM=WAM) is projected, as there are no additional planned policies or measures.

The emissions in Other sectors (Commercial/institutional, Residential and Agriculture/Forestry/Fishing/Fish farms) are expected to decrease by 4.6% in 2050 compared to 2020.

The projected emissions together with the 2022 NIR information of the Energy sector in the WAM scenario are presented in Figure 3.1. In the WAM scenario, the emissions are projected to decrease by 77.9% in the period of 2020 — 2050. The increased reduction of GHGs in the WAM scenario results from higher energy efficiency requirements for buildings (entails additional funding for renovation purposes) and district heating networks, which help to decrease energy consumption for heat production. Decreased GHG emissions also result from an increased amount of energy unions that help to produce energy more efficiently for certain locations or interest groups. The largest absolute decrease in WAM scenario occurs in the Energy industries sector. The decrease is projected to be 96.6% in the period of 2020 — 2050.

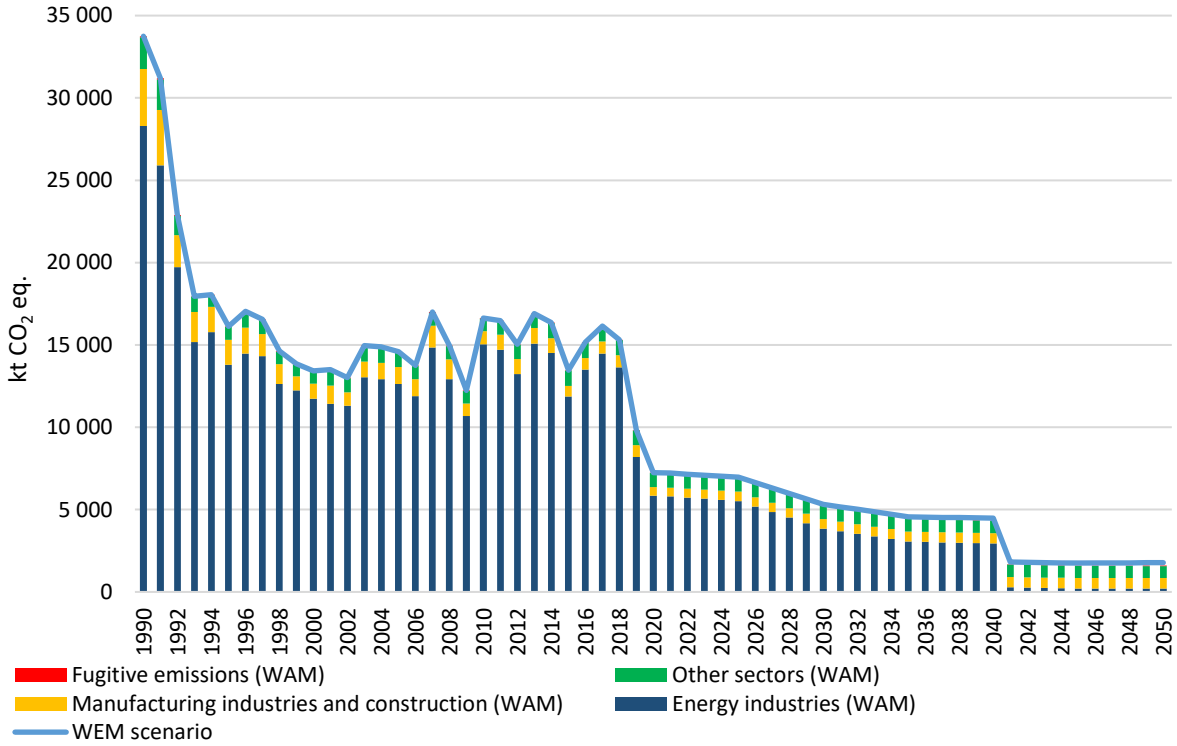

Figure 3.1. Historical GHG emissions (1990–2020) (NIR, 2022) and projected emissions (2021–2050) from the Energy sector according to the WEM and WAM scenarios (using AR5 GWP), kt CO_2 eq.

3.2.2. Transport

3.2.2.1. Methodology

Two projections scenarios of GHG emissions have been calculated for the period 2021–2050. The reference year 2020 used in projections is consistent with Estonia's 2022 submission to the UNFCCC on 15th of April 2022 (National Greenhouse Gas Inventory Report 1990–2020, 2022). The 'With Existing Measures' (WEM) scenario evaluates future GHG trends under current policies and measures. In the second scenario a number of additional measures and their impact are taken into consideration forming the basis of the 'With Additional Measures' (WAM) scenario.

Sybil baseline model was used for the GHG projections in the road transport sector. The model uses a bottom-up approach requiring data about the vehicle fleet, technology (EURO class) and road activity. The biggest strength of the model is compatibility with COPERT, which is used for the compilation of road transport in the national inventory report and kept up to date by EMISIA, the same team as for COPERT. On the other hand, its weakness is the high time consumption of calculating the effect of each individual measure. For that reason, it is easier to calculate separately the effects of the measure and insert the sum effect into the model.

The projections in the Transport sector are based on the information from the ITF report "The Future of Passenger Mobility and Goods", the TalTech report "Traffic survey manual and the business as usual forecast", the Ministry of Economic Affairs and Communication, the Ministry of Environment and input from the meeting points of the Government´s Climate and Energy Committee (2020). To estimate GHG emissions emission factor data from the 2006 IPCC and EMEP/EEA 2019 Guidebook along with country-specific emission factors were used.

The projections for the WEM scenario are also in line with Regulation (EC) No 2019/631 of the European Parliament and of the Council. In addition, it is also taken to account that by 2035, the average emissions target for a new passenger car is 0 gCO_2/km and 130 gCO_2/km for light duty vehicles.

3.2.2.2. GHG emissions projections

The main share of GHG emissions in the Transport sector originate from road transport. In 2020, the share of GHG emissions from road transport was around 97.4% of total GHG emissions of the Transport sector.

The emissions in the Transport sector in the WEM scenario are expected to decrease by around 80.2% in 2050 compared to 2020. The emissions in Road transport are projected to decrease in both the WEM and WAM scenario. The total projected GHG emissions in the WEM and WAM scenarios are presented in the Figure 3.2.

The emissions in the Transport sector in the WAM scenario are expected to decrease by 82.0% in 2050 compared to 2020. Domestic aviation and Railway emissions are expected to stay at approximately the same level (as in the WEM scenario) during the period of 2018–2050. Domestic navigation and Road transport emissions are projected to decrease compared to the base year. The largest emission reductions occur in the Road transport sector — emissions are projected to decrease by 82.3% in 2050 compared to 2020 to a total of 385.03 kt CO_2 eq in the WAM scenario, which is the result of implementing additional measures that will help lower demand for private transport even more. However, the biggest driver for the steep decrement of GHG emissions in the WEM and WAM scenarios is the uptake of electric vehicles. This is

reinforced by measures which support the promotion of electric vehicles and the notion that from 2035 all new passenger cars have to meet the criteria of 0 gCO_2/km.

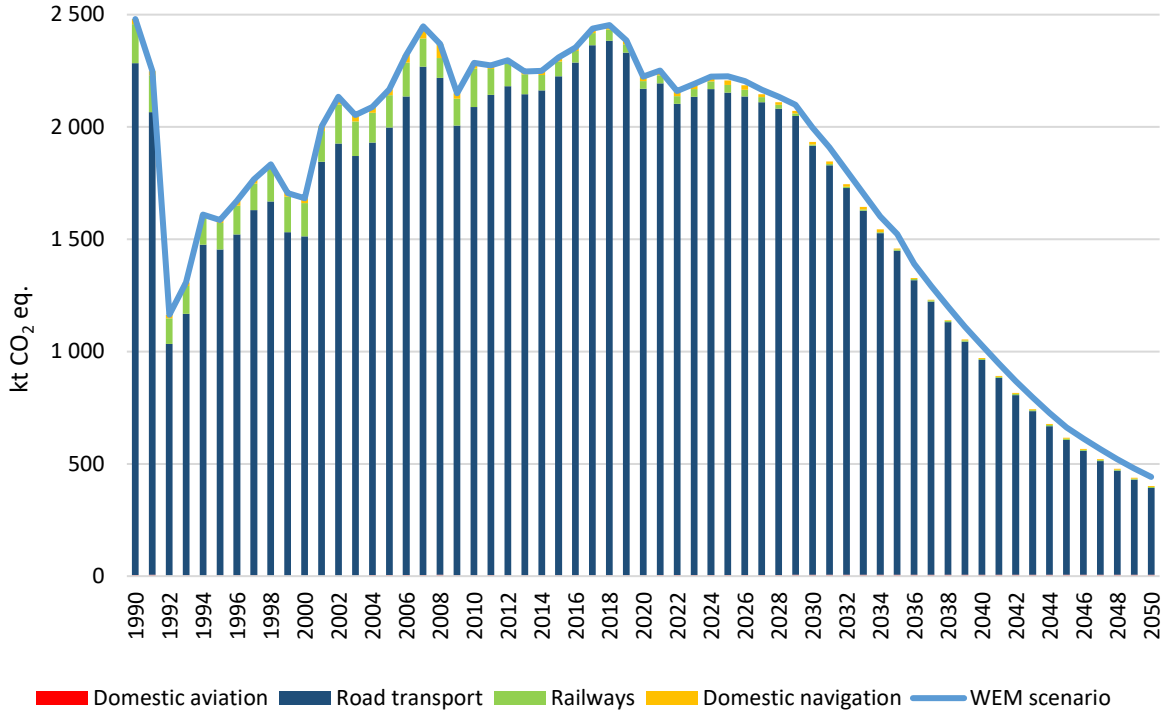

Figure 3.2. Historical GHG emissions (1990–2020) (NIR, 2022) and projected emissions (2021–2050) from the Transport sector in the WEM and WAM scenarios (using AR5 GWP), kt CO_2 eq.

3.2.3. IPPU

3.2.3.1. Methodology

Two projection scenarios for GHG emissions have been calculated for the period 2021–2050. The reference year 2020 used in projections is consistent with Estonia's 2022 submission to the UNFCCC on 15th of April 2022 (National Greenhouse Gas Inventory Report 1990–2020, 2022). Emissions from the IPPU sector are projected according to the 'With Existing Measures' (WEM) scenario, which evaluates future GHG trends under current policies and measures and the 'With Additional Measures' (WAM) scenario, whereby WAM only affects the emission from urea-based catalysts for motor vehicles The Estonian industry sector is relatively small. The majority of emissions from subcategories, such as the Mineral industry, Non-energy products from fuels and solvents, and Other product manufacture, as well as their respective subcategories, comprise emissions from the activity of only a few companies who also influence the emissions' trend. In most subsectors bottom-up data gathering, companies' production forecasts, population projection (Statistics Estonia), the long-term real GDP growth rate (the Ministry of Finance) and expert judgements are combined and used. This approach ensures the most proximate projections that reflect the actual situation in subcategories with a limited number of emitting agents.

The Mineral industry's projected emissions are based on industries' operator projections taking into account planned production capacities and and/or maximal production capacities according to companies' environmental permits. The Chemical (ammonia) industry is no longer active in Estonia and emissions from that sector are not occurring. The Metal industry´s projected emissions are based on industries' operator production forecasts. Consumption of

lubricants is based on 2014–2021 (as the data for the year 2021 were known while compiling the projections' consumption trend and projection of GDP growth rate and is slightly increasing. Consumption of paraffin waxes (candles and other paraffin waxes) is based on the average consumption of the years 2017–2021 (as the data for the year 2021 were known while compiling the projections) and will decrease compared to 2020 in the years 2021–2022 and then stabilise.

Indirect CO_2 emissions from the Solvent use sector, affected by both GDP growth and population decline, are projected to decrease a little because of decreasing emission factors in the Domestic solvent use and Coating (paint use) categories.

Emissions from urea-based catalyst AdBlue are projected taking into account:

1. broadening of NO_X emission standards to light vehicles (Euro 6 standards);
2. the forecast of the number of vehicles and their average fuel consumption is consistent with the projections of the Transport sector

Emissions of fluorinated gases are projected according to the GHG inventory's calculation methods. Emissions from each group of HFC-containing equipment are projected separately. Bans and restrictions stipulated in the Regulation (EU) No. 517/2014 and Directive 2006/40/EC were taken into account. Trends in the domestic market of refrigeration and air-conditioning could be seen from the national database for F-gases (according Article 6 paragraph 2 of Regulation (EU) No. 517/2014). Some companies who service large commercial refrigeration systems were interviewed about their intentions towards restrictions of Regulation (EU) No. 517/2014. Trends in the import of pre-charged air conditioning equipment could be seen from import reports of companies.

Emissions were calculated from large and small commercial refrigeration equipment, industrial refrigeration and cooling, stationary air conditioning/cooling, mobile refrigeration, mobile air conditioning, fire protection equipment and foam producing by taking the following bans into account:

1. Bans on placing on the market, e.g.:
   - stationary refrigeration equipment that contains HFCs with GWP of 2500 or more (from 2020);
   - commercial refrigeration equipment (hermetic equipment with HFCs, multipack systems (40 kW or more) with HFCs except multilevel cascade systems partly with HFC-134a (from 2020);
   - single split stationary air conditioners and heat pumps that contain HFCs with GWP of 750 or more (from 2025);
   - fire protection equipment with HFC-23 (additionally, HFC-227ea containing fire protection systems have a sharply decreasing trend);
   - one-component foams that contain HFCs with GWP 150 or higher;
   - ban of the sale of new vehicles with EU-type approval having refrigerant with GWP over 150 in the air conditioner since 01.01.2017 is taken into account (according to the Directive 2006/40/EC);
2. Ban of refilling equipment that contains HFCs with GWP of 2500 or more (from 2020).

It is assumed that an effect of a completed project of the promotion of alternative and low-GWP refrigerants is that the majority of commercial and industrial refrigeration is switching

to alternative refrigerants (CO_2 and NH_3 based systems respectively). In categories where the use of banned, high-GWP HFCs was subtracted but there is no information about alternatives, substitutions with lower GWP HFC-s were taken into account.

It was assumed that HFC refrigerants are properly collected from discharged equipment.

Projection of emissions from subsector 2.F.2 Foam blowing agents is based on forecasts of foam producers, real GDP growth rate and population size. Projection of emissions from 2.F.3 Fire protection is based on expert opinion from service companies concerning new equipment and a method of calculating the stock based on the GHG inventory. Projection of emissions from 2.F.4 Aerosols is based on the trend of medical aerosol use in 2014–2020, population size and real GDP growth rate.

SF_6 emissions (from 2.G Other product manufacture and use) are not regulated by the Regulation (EU) No. 517/2014. SF_6 emissions were calculated according to the methods of GHG inventory while taking into account plans on equipment replacement by the electrical network operators in Estonia.

Regarding N_2O — consumption of medical N_2O was provided by wholesalers who explained that sales will decline and consumption of N_2O in aerosols was calculated with the projection of population size and average emissions of N_2O per population in 2020–2021 (as the data for the year 2021 were known while compiling the projections).

3.2.3.2. GHG emissions projections

Emissions from the IPPU sector are projected according to the WEM and WAM scenarios whereby WAM only affects the emissions from urea-based catalysts for motor vehicles.

The WAM scenario for IPPU is projected because additional measures in the transport sector– additional promotion of economical driving, road usage fees for heavy-duty vehicles, vehicle tyres and aerodynamics – have an effect on subsector 2.D.3 Other — Urea-based catalysts for motor vehicles. In the WAM scenario diesel fuel consumption decreases, as does the consumption of urea-based diesel exhaust fluid.

The overall emissions from the IPPU sector are projected to decrease by 45.81% from 2020 until 2050 in the WEM scenario and 45.82% in the WAM scenario.The main decrease comes from the mineral industry (because a large plant has ceased its clinker production) and product uses as substitutes for ODS (F-gases).

Emissions from the mineral industry already decreased in 2020 when the cement industry ceased burning clinker in wet process kilns because it was not economically feasible anymore (production only took place in the first 3 months of 2020). The plant does not foresee starting production again. Other mineral industries estimated future production volumes in 2025 either as the same as in 2020 or up to 50% higher. After 2025 the production volumes will stabilise. Nevertheless, total emissions from the mineral industry sector remain ca 5 times lower than before the shutdown of clinker production.

Estonia's chemical industry sector emissions originate from the ammonia industry. The plant operator has announced that it has sold all of its production equipment and no longer plans to continue ammonia production activities, as ammonia production in Estonia has not been profitable since 2014 due to low global market prices for ammonia and rising natural gas prices.

In the metal industry production volumes will rise by around 10% from 2020 to 2022, as will the emissions from this category, and then stay the same until 2050. The metal industry made

up 0.47% of the emissions in the year 2020 (2.9 kt CO_2 eq.), therefore the rise will not strongly influence the overall emissions.

Emissions (both direct and indirect CO_2) from non-energy products from the Fuels and solvent subsector use (2.D.3) in most subcategories (Use of diesel exhaust fluid AdBlue and Use of paraffin wax and solvents) are projected to decrease and emissions from the subcategory lubricant use is projected to increase both in WEM and WAM scenarios. This difference in WAM scenario is mainly caused by curbing diesel fuel consumption and urea containing diesel exhaust fluid consumption as a result of additional measures in the transport sector. Consumption of these products depends on the economic situation of many small industries (linked to real GDP growth rate). Given the economic growth (the Ministry of the Finance) these emissions are projected to increase. Emission of NMVOCs from the solvents sector and indirect CO_2 from NMVOCs is projected to decrease. Although the consumption of solvent containing products has an upward trend because of its correlation with GDP growth, the emission factors have a declining trend. Concerning paints (2.D.3.d Coating applications) probably the Directive 2004/42/CE on the limitation of emissions of VOCs from paints and varnishes and vehicle refinishing products has contributed to declining emission factors. The same declining trend of emission factors can be seen in the Domestic use of solvents (2.D.3.a) and it results from the restrictions of the regulations (EC) No 648/2004 on detergents, (EC) No 1223/2009 on cosmetic products and (EU) No 528/2012 on biocidal products. In some subcategories NMVOCs decrease because of the declining population. In comparison to 2020 the emissions are projected to decrease by 24% by 2030 and stay around the same level until 2050.

Emissions of HFC-s (substitutes for ozone-depleting substances (ODS) are projected to be the same in the WEM=WAM scenarios. HFC emissions projections will decrease by 70% from 2020 to 2050. The majority of R-404A containing equipment (to which installation and servicing bans are applying from 2020) should be decommissioned until 2035 and also most old split-type air conditioners and heat pumps. Directive 2006/40/EC has a gradual effect on HFC emissions until 2030 when most old vehicles equipped with HFC-134a based air conditioners should have been replaced.

Emissions of SF_6 reported under the subcategory Other product manufacture and use are projected to rise steadily until 2050 when they are projected to be 62.3% larger than today (according to the WEM=WAM scenarios). SF_6 insulated electrical equipment is not directly affected by Regulation (EU) No. 517/2014. Until 2030 new equipment is installed instead of old air insulated switchgear. After 2030 emissions continue to rise because many items of SF_6 insulated equipment exceeding their service life will be decommissioned. After 2040 it is assumed that no more medium-voltage switchgear with SF_6 will be installed.

N_2O emissions from the subcategory Other product manufacture and use are projected to decline from 2020 to 2050 by 87.8% as the use of N_2O is connected to declining population numbers.

The historical and projected emissions in 1990–2050 according to WEM and WAM scenarios are depicted in Figure 3.3.

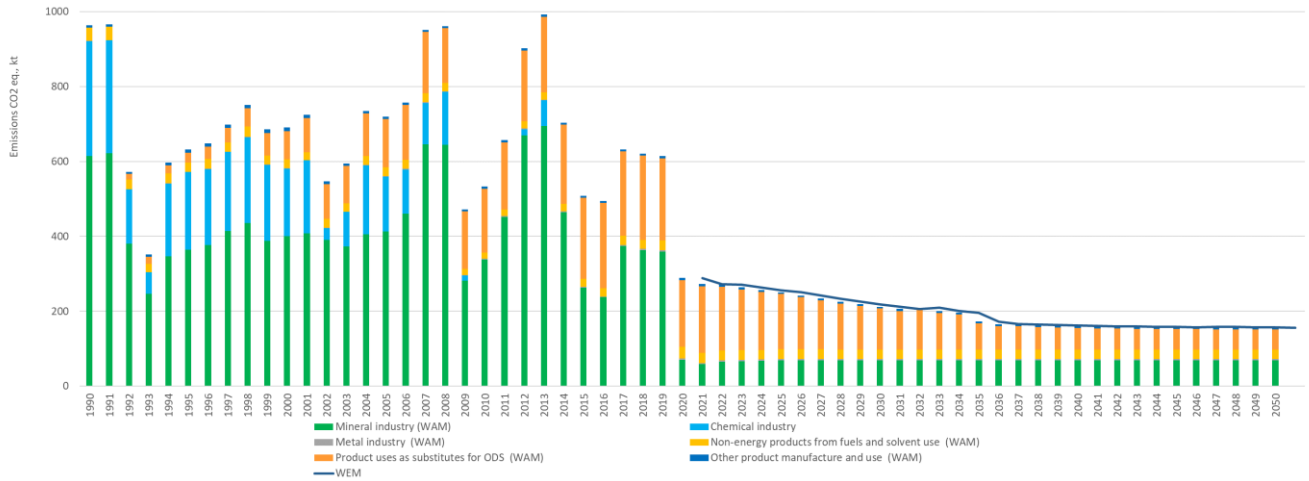

Figure 3.3. Historical GHG emissions (1990–2020) (NIR, 2022) and projected emissions (2021–2050) from the IPPU sector (with Solvent use) according to the WEM and WAM scenarios (using AR5 GWP), kt CO_2 eq.

3.2.4. Agriculture

3.2.4.1. Methodology

Two projections scenarios of GHG emissions have been calculated for the period 2021–2050. Reference year 2020 used in projections is consistent with Estonia's 2020 submission to the UNFCCC on 15th of April 2022 (National Greenhouse Gas Inventory Report 1990–2020, 2022). The 'With Existing Measures' (WEM) scenario evaluates future GHG trends under current policies and measures. In the second scenario one additional measure is taken into consideration forming the basis of the 'With Additional Measures' (WAM) scenario.

Estonia's agricultural GHG emissions are projected to increase due to global demand for meat and dairy products along with suitable climatic conditions favouring cattle production in Estonia to expand. Therefore, the highest impact on CH_4 emissions comes from Enteric fermentation due to the projected increase of domestic livestock. Aricultural soils is the second largest GHG emission source in Estonia, of which emissions are mostly driven by synthetic N-containing fertilisers applied to soils, however also organic soils cultivation, crop production, other organic fertilisers applied to soils, data about mineralization, and sewage sludge applied to soils are affecting the total projections. Other categories, e.g. Manure management (driven by the livestock numbers), CO_2 emissions from Liming and Urea fertilization do not have a significant impact on the GHG emission trend.

Projections of emissions are calculated based on the 2006 IPCC methodology applied in the Estonian Greenhouse Gas Inventory. The projected numbers of animals, crop productions and the amounts of mineral fertilisers used are based on the results of the Agriculture Projection Model (APM), developed in 2021 by Agricultural Research Centre. This model considers the characteristics common to Estonia and provides opportunities to analyse different policy scenarios and changing market and macroeconomic conditions. All animal numbers from the APM results were rounded to an integer. Also, average sheep, goat and poultry annual numbers were calculated for keeping consistency with the GHG inventory methodology. The quarterly sheep and goat numbers were divided with the last five-year average ratio of sheep and goats used in the inventory. The total number of broilers was projected based on the last five years in

the 2022 NIR. The number of other hens and roosters was calculated based on the average ratio of the animal group used in the 2022 NIR. Poultry, layers and other poultry projections are based on the APM result.

Main activity data for calculating CH_4 emissions from Enteric fermentation and CH_4 and N_2O emissions from Manure management are livestock population, distribution of animal waste management systems (AWMS) and milk yield and pregnancy rate for dairy cows. Estonian-specific volatile solids (VS) and N excretion rates (kg/head/year) of dairy cattle have been calculated on the basis of projected milk yields. With the supporting mechanisms of the Common Agricultural Policy (CAP) Strategic Plan 2023-2027, the practise of raising sheep and goats may be presumed to grow moderately. Demand for lamb and goat meat, wool and milk will grow. The number of horses is projected to rise steadily until 2022 and then stay at that level. The population of rabbits is expected to grow steadily until 2031 and then stay at the same level until 2050. The population of fur animals will decrease steadily to zero in 2026, when fur farms will be banned in Estonia. The number of pigs is anticipated to decrease moderately until 2022, then start rising again until 2031 and then remain at that level until 2050. The level of poultry production is expected to fluctuate until 2031 and then remain at that level until 2050. Feed intake parameters and the methane conversion rate are harmonised with the national GHG inventory. Gross energy intake of dairy cows was calculated on the basis of projected milk yields. Average milk yield per cow is projected to increase until 2031. Projected values are in accordance with the projections in GPCP 2050. Fat content in milk (%) for the projected period is assumed to remain at the same level as in 2021 (3.9%) until 2050.

Projected N_2O emissions from the Agricultural soils subsector are based on the amounts of organic and synthetic N-containing fertilisers applied to soil, quantities of harvested crops, carbon stock change in mineral soils, and area of cultivated organic soils. Direct N_2O emissions include emissions from synthetic and organic fertilisers applied to agricultural soils, emissions from animal manure, emissions from crop residues, emissions from the cultivation of organic soils and emissions from mineralization associated with loss/gain of soil organic matter. Indirect N_2O emissions include emissions from atmospheric deposition and from leaching and run-off. The quantities of sewage sludge and composted organic waste applied to soils are harmonised with the Waste sector projections (see Waste sector GHG projections chapter), data for calculating carbon stock change in mineral soils and organic soils cultivation are provided by the LULUCF sector expert. The use of synthetic fertilizers increased in 2021 compared to 2020. From 2022, it is projected to drop back to around the same level as in 2020 and remain there until 2030, in 2031 it is projected to drop even more and then remain at that level until 2050. Estonia's crop production is projected to decrease in 2021 compared to 2020. From 2022, it is projected to fluctuate steadily until 2031 and then remain at that level until 2050.

The amount of lime applied to soil is calculated using the moving average of the last three years until 2031. Then it will remain at that level until 2050. Therefore, emissions from liming are projected to increase in 2021, then they are projected to decrease slightly and start steadily fluctuating until 2031, from then on they will remain at that year's level. Emissions from the Agriculture sector are projected according to the WEM and WAM scenarios. According to the WAM scenario, the use of low-emission manure storage technologies (storage of liquid manure in tented roof or concrete roof storage facilities, as well as in closed steel or plastic tanks) will increase by 2030 compared to 2020. The WAM scenario uses reduced NH_3 emission amounts from the Estonian Atmospheric pollutant emissions projections until 2050, as input data for GHG projections.

3.2.4.2. GHG emissions projections

According to the WEM scenario, emissions from the Agriculture sector will increase from 1,501.5 kt CO_2 eq. in 2020 to 1,568.3 kt CO_2 eq. (4.45%) by 2050 (Figure 3.4). Increase in the Enteric fermentation sub-sector is projected to be 91.43 kt CO_2 eq., in Manure management 24.08 kt CO_2 eq., in Agricultural soils the emissions are projected to decrease by 55.02 kt CO_2 eq., in Liming to increase 6.31 kt CO_2 eq. and in Urea application to stay at the same level, at 0.13 kt CO_2 eq. in 2050 compared to 2020. According to the WAM scenario, emissions will increase from 1,501.5 kt CO_2 eq. to 1,568.62 kt CO_2 eq. (4.47%) by 2050.

Differences in WEM and WAM scenarios' results were caused by implementing the measure Improvement of manure management. The WAM measure only affected the Manure management and Agricultural soils sub-sectors due to the projected changes in the shares of types and covers of the manure stores. As the measure aims to increase the share of covering of manure storages, it decreases NH_3 emissions due to the decrease of direct sunlight (temperature impacts) and wind effects on the storage surface. On the contrary, covering the manure storages increases N_2O emissions as more N_2O is emitted in anaerobic conditions. This caused the increase of WAM scenario´s total GHG emissions from the Agriculture sector compared to WEM scenario.

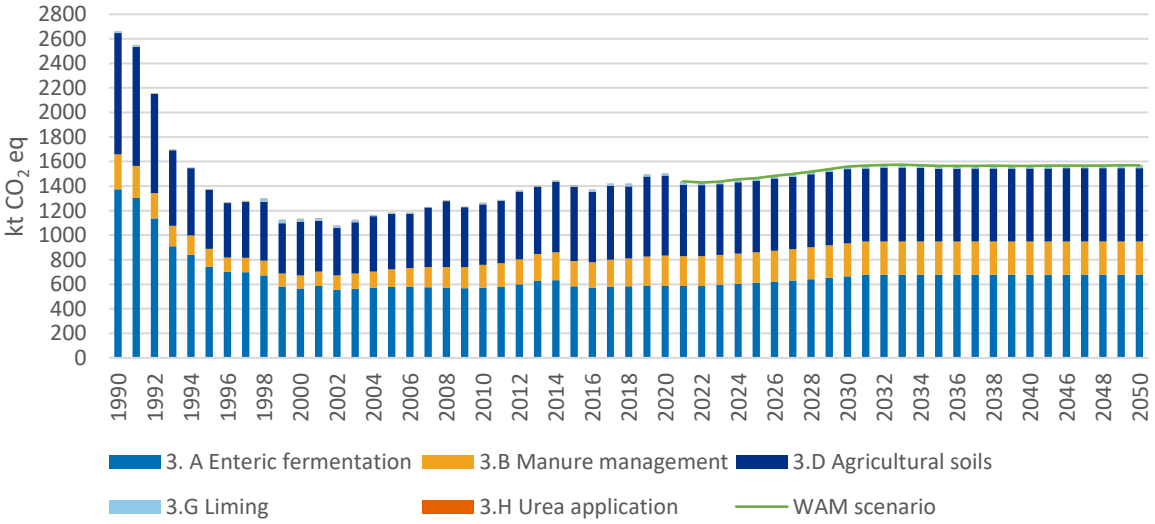

Figure 3.4. Historical GHG emissions (1990–2020) (NIR, 2022) and projected emissions (2021–2050) from the Agriculture sector in the WEM and WAM scenarios (using AR5 GWP), kt CO_2 eq.

3.2.5. LULUCF

3.2.5.1. Methodology

LULUCF sector 'With Existing Measures' (WEM) scenario and 'With Additional Measures' (WAM) scenario GHG projections have been calculated for the period from 2021–2050. The reference year 2020 used in projections is consistent with Estonia's 2022 submission to the UNFCCC on 15th of April 2022 (National Greenhouse Gas Inventory Report 1990–2020, 2022). The WEM scenario evaluates future GHG emission trends under the current policies and measures. In the second scenario one alternative policy direction, uniform final felling, is taken into consideration forming the basis of the WAM scenario. It is based on the draft Forestry Development Plan until 2030.

The LULUCF sector includes emissions and removals of GHGs from Forest land, Cropland, Grassland, Wetlands, Settlements, Other land and Harvested wood products.

The projections of land use categories are based on the following assumptions and planned activities:

- Annual land conversions will generally continue to occur at the same level as the average of 2016–2020, except for the conversions described below;
- Forest land and Cropland total areas will remain equal to the area in 2020, annual land use changes to/from Forest land and Cropland are balanced by the Grassland category;
- Deforestation of 22,000 ha of Forest land due to the restoration of heritage meadows (Grassland category) was divided equally between 2022–2050 (MoE);
- The following changes in land use were expected due to the construction of Rail Baltic (Steiger, 2021) in the period of 2023–2028:
  - Forest land converted to settlements 722.3 ha
  - Cropland converted to settlements 157.5 ha
  - Grassland converted to settlements 29.8 ha
  - Wetlands converted to settlements 38.8 ha
  - Other land converted to settlements 106.5 ha
- Deforested area due to the establishment of training grounds for the Defence Forces was assumed to be split in half between categories Forest land converted to grasslands and Forest land converted to settlements. Total projected deforested areas were:
  - development of the central polygon of Defence Forces — deforested area 4,275 ha (Skepast & Puhkim, 2022) in the period 2022–2031
  - Sirgala training ground — deforested area 1,500 ha (Estonian Centre for Defence Investment), in the period 2023–2028
- Shares of drained organic soils from the total area of organic soils for Forest land remaining forest land and Grassland remaining Grassland were estimated as an average of 2016–2020.

Projected areas of land use categories and methods described in the NIR 2022 Chapter 6 were used for estimating GHG emissions and removals. Additional assumptions for specific categories are stated below.

Future harvesting rates in Estonia depend on adopted and planned policies. WEM projections for Forest land are based on the business as usual scenario and WAM projections on the uniform final felling scenario, both composed by the Estonian Environment Agency. The following assumptions and methods were applied in WEM scenario projections for Forest land category:

- Total final felling volume was expected to be 11.5 mln m^3 $year^{-1}$, which is the average of years 2017–2021 (NFI, 2021). Felling rates were projected as a ten-year average;
- In modelling the final fellings, actual harvesting distribution between dominant tree species in recent years was used. The calculation of the final felling area is only applied in the case of forest available for wood supply. Strictly protected forests are modelled without fellings;
- Final fellings are projected by dominant tree species and site quality classes depending on the age, diameter and stocking of the stand;
- The improvement of forest growth (site quality class) was only projected in the areas that are regenerating during the period. Site quality class indicates the productivity of the habitat. However, the growing stock of young forests is small, and therefore the effect is insignificant (on average less than 1 mln m^3 additional growing stock by 2050);
- The growing stock volume in Forest land was projected by decade and was obtained by multiplying the area in age class with the average growing stock per hectare in the relevant age class;
- Distribution of forest area by dominant tree species remains the same during the entire period;
- The share of the forest not available for wood supply is 17.5% (NFI, 2021). It is projected to remain at the same level;
- In the case of forest available for wood supply with additional protective measures (excluding water protection forests on banks; 8.5% from total Forest land), half of the uniform final felling coupe intensity was applied;
- Growing stock in Forest land remaining forest land was calculated as the difference between projected value for total forest land and estimated Land converted to forest land growing stocks;
- Changes in dead wood C stock in Forest land remaining forest land were estimated by multiplying the 5-year average carbon stock change per hectare by the projected area;
- Non-CO_2 emissions from drained organic forest soils were estimated as the average of the 2016–2020 period.

According to the WAM scenario, the uniform annual final felling area is assumed during the whole rotation period. The final felling volume is expected to be 9.4–9.8 mln $year^{-1}$. The distribution of felling areas by dominant tree species is optimal and does not consider the actual harvesting distribution (as in WEM).

Estimations for the HWP pool are based on the projected harvest levels; therefore, both WEM and WAM scenarios have been projected. The fraction of harvest for the HWP commodity production and the share of HWP commodities were assumed to remain at the current level.

For calculating C stock changes in the mineral soils of the Cropland remaining cropland category, it was assumed that the present land use (shares of long-term cultivated, perennial and set-aside areas, as well as the shares of crops with different C inputs) and management practices (shares of areas under full tillage, reduced tillage and no-till) will continue; therefore average mineral soil SOC stock for the period 2016–2020 was used in calculations. Estimated annual SOC change values were smoothed using a moving average in order to reduce inter-annual variations.

The majority of emissions from the Wetlands category derive from the horticultural use of peat. The amount of peat removed for horticultural use is calculated as the difference between total peat production and the primary production of energy peat, and is assumed to be oxidised

in the year of extraction. The long-term average total peat extraction was calculated as the average of the 2017–2021 period. The use of energy peat has had a declining trend which was expected to continue, and, after 2035, all extracted peat was projected to be used in horticulture. The area of active and unrestored peat extraction sites will decrease linearly from 25.55 kha in 2020 to 19 kha in the period 2026–2050 (MoE). Land area by which the area of active extraction sites is smaller than the total peat extraction area as assumed to be rewetted. GHG emissions from rewetted sites were estimated according to the IPCC Wetlands Supplement (IPCC, 2014), Chapter 3. Default emission factors for the temperate zone nutrient-poor sites were applied.

CH_4 and N_2O emissions from wildfires were estimated as the average of the 2016–2020 period. Reported and projected non-CO_2 emissions from biomass burning in Land converted to forest land areas are included under the Forest land remaining forest land category. Similarly, CH_4 and N_2O emissions from biomass burning in the Grassland remaining grassland category also include emissions from Land converted to grassland and Wetlands categories. GHG emissions from wildfires were not estimated for Croplands and Settlements as they were considered insignificant in terms of the overall level and trend in national emission.

3.2.5.2. GHG emissions projections

GHG emissions from the LULUCF sector are projected according to the 'With Existing Measures' (WEM) and 'With Additional Measures' (WAM) scenarios. The WAM scenario only concerns the Forest land and HWP categories: the WEM scenario assumes the continuation of current forest management practices and intensity, whereas the WAM scenario is based on the assumption of uniform final felling which is proposed in the draft Forestry Development Plan until 2030 (MoE, 2022).

The projected area of land use by classes is the same for both the WEM and WAM scenarios and is presented in Table 3.1.

Table 3.1. Projected land use in the LULUCF sector, thousand hectares

Land use class	2020 (2022 inventory)	2025	2030	2040	2050
Forest land	2,443.5	2,443.5	2,443.5	2,443.5	2,443.5
Cropland	985.6	985.6	985.6	985.6	985.6
Grassland	274.7	268.0	260.9	250.5	240.4
Wetlands	428.4	427.4	426.4	424.5	422.6
Settlements	359.8	366.9	374.3	385.4	396.2
Other Land	42.0	42.5	43.1	44.4	45.6
LULUCF Total	**4,533.9**	**4,533.9**	**4,533.9**	**4,533.9**	**4,533.9**

Total Forest land and Cropland areas were expected to remain equal to the area in 2020. The projected areas of Wetlands and Other land categories are also relatively stable. Grassland area will decrease when the current land-use trends continue, even considering the planned restoration of semi-natural communities (heritage meadows). The area under Settlements will increase, as a result of the continuation of current trends and several planned large infrastructure projects.

According to the projections, the LULUCF sector is expected to remain a source of GHGs in both scenarios (Figure 3.5 and Figure 3.6), meaning that total emissions arising from the sector will exceed total removals. The projected overall emissions from the LULUCF sector are

2,767.95 and 652.15 kt CO_2 eq. in 2050 according to the WEM and WAM scenarios, respectively.

In the WEM scenario (total felling volume is 11.5 mln m^3 $year^{-1}$), the only category that sequesters C is HWP. Forest land will act as a net source. Projected changes in forest growing stock primarily depend on the age distribution of forests, growing stock changes were projected as ten-year averages. Due to the high proportion of mature and premature forest stands and increasing proportion of forest area belonging to the first development classes (treeless area, area under regeneration and young stands), the capacity of carbon sequestration in tree biomass has decreased in recent years and the decline is expected to continue during the next decades. According to the WEM scenario, total forest growing stock will be approximately 11% lower in 2050 than it is now. In addition, conversion from other land categories to Forest land has been slowing in recent years, and in the future, cumulative areas of Land converted to forest land categories will decrease further. Net emissions from the Forest land category are projected to increase from 117.67 kt CO_2 eq. in 2020 up to 1,480.73 kt CO_2 eq. in 2041. After that, net emissions will decrease to 646.57 kt CO_2 eq. in 2050 as the decline of the forest growing stock is expected to slow down.

In the WAM scenario (total felling volume is 9.4–9.8 mln m^3 $year^{-1}$), Forest land and HWP will sequester carbon. It is expected that in 2022–2041 the forest growing stock will remain stable and CO_2 sequestration from Forest land will increase slightly over the period to -826.88 kt CO_2 eq. by 2041. Net removal from Forest land will increase due to increasing growing stock in 2042–2050 and net removal reaches -1,662.39 kt CO_2 eq.

C sequestration in HWP will decrease in the WEM and WAM scenarios. According to the WEM scenario, removals from HWP will decrease from -922.24 kt CO_2 in 2020 to -520.35 kt CO_2 by 2050. In the WAM scenario, the removals are projected to decrease to -327.18 kt CO_2 in 2050. It is likely that the production of wood products will become more efficient and thus it can be assumed that production volumes and consequently carbon sequestration has been considered rather conservatively. Estonia is also planning to build a pulp mill, which will have a bigger impact in the first ten years, during which the HWP category would sequester an additional 200 kt CO_2 per year.

Emissions from the Cropland category are expected to increase compared to the base year level (417.29 kt CO_2 eq.), although the total cropland area, land use and management practices are expected to remain the same. This is because Estonia uses the default method with aggregated activity data for calculating C stock changes in cropland mineral soils. According to this methodology, soil organic C reaches a stable value over 20 years given that land use and management practices do not change during that period. In 2050, the projected emissions from the Cropland category are 651.44 kt CO_2 eq. Emissions mainly originate from the cultivation of organic soils, and smaller part also from land conversion to croplands.

Net emissions from the Grassland category are projected to increase from 64.14 kt CO_2 eq. in 2020 up to 255.61 kt CO_2 eq. in 2050. Currently, emissions mostly result from the drainage of organic soils; these emissions are expected to remain stable, but C losses from deforestation due to the restoration of heritage meadows will increase significantly in the future.

In total, estimated emissions from the Wetlands category are expected to increase by 20.5% in the 2020–2050 period, reaching up to 1,362.40 kt CO_2 eq. in 2050. Of this, 1,189.85 kt CO_2 results from the production and use of horticultural peat and 152.01 kt CO_2 eq. are emitted by active and rewetted peat extraction sites.

Under the Settlements and Other land categories, only emissions arising from the land conversions have been reported. Several planned infrastructure projects will increase land

conversion to Settlements significantly in the period of 2022–2031. Projected emissions will reach the maximum value (535.79 kt CO_2 eq.) in 2024 and then decline to 308.24 kt CO_2 eq. in 2050. There are no quantitative estimates of land use changes for a number of proposed projects, such as military training grounds and onshore wind farms, and therefore these effects are not included in the projections.

It was assumed that annual land conversions to Other land will continue to occur at the same level as the average of 2016–2020. The total cumulative area of Land converted to other land category and related emissions are expected to decrease slightly, to the level of 64.02 kt CO_2 eq. in 2050.

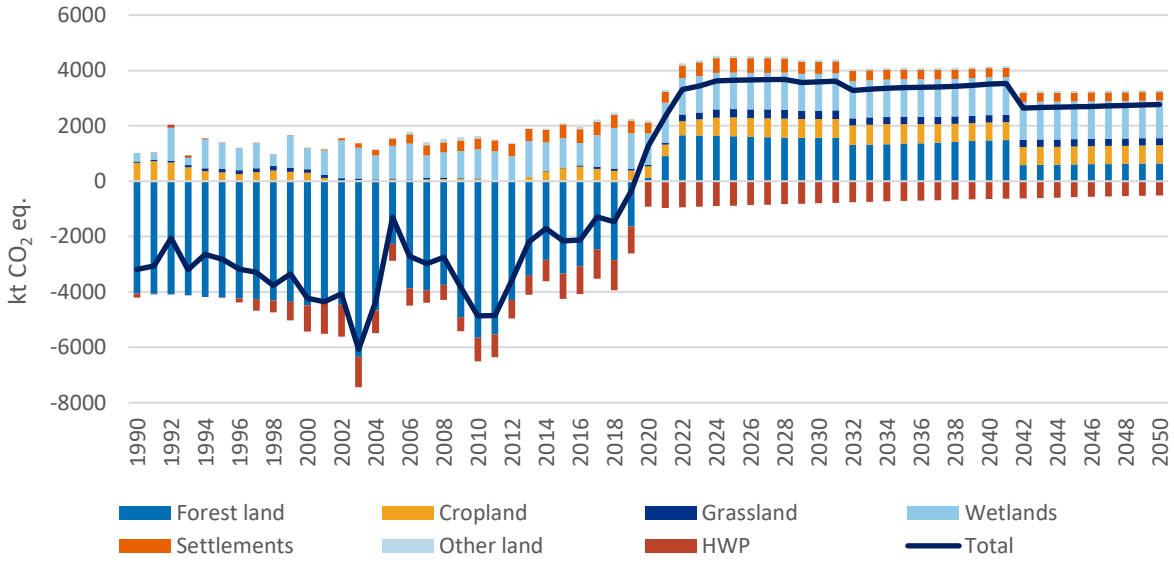

Figure 3.5. Historical GHG emissions (1990–2020) (NIR, 2022) and projected emissions (2021–2050) from the LULUCF sector by land use class according to the WEM scenario (using AR5 GWP), kt CO_2 eq.

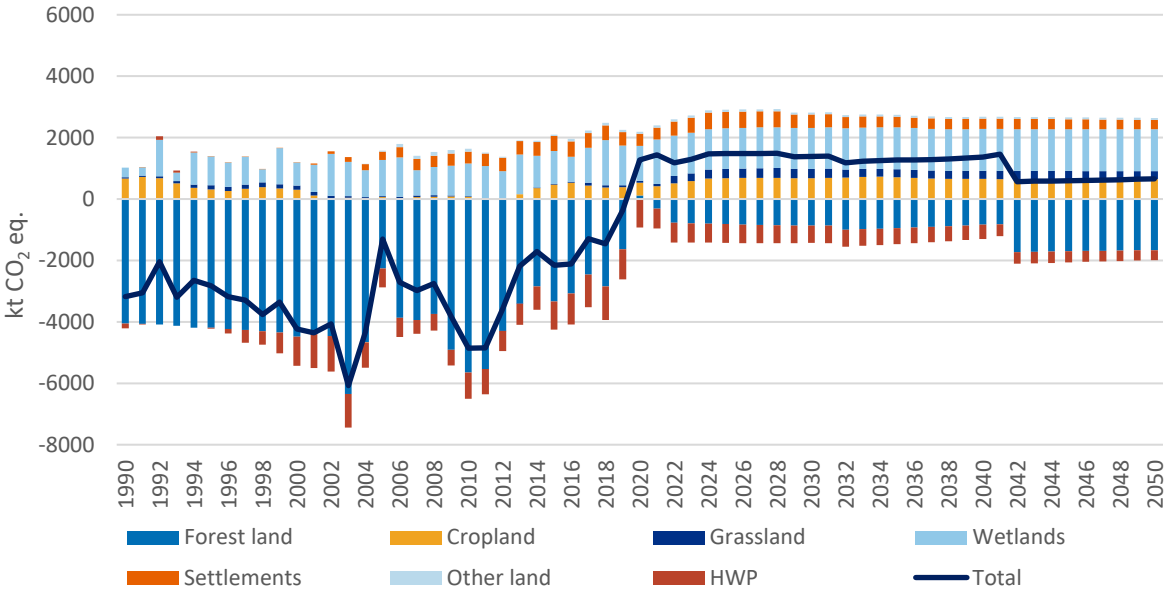

Figure 3.6. Historical GHG emissions (1990–2020) (NIR, 2022) and projected emissions (2021–2050) from the LULUCF sector by land use class according to the WAM scenario (using AR5 GWP), kt CO_2 eq.

The cumulative projected emissions/removals to the WEM scenario in accordance with Regulation (EU) 2018/841 for the periods 2021–2025 and 2026–2030 are presented in Table 3.2. Cumulative emissions are compared to the reference values or base period emissions for calculating the accounted quantities, exept for the afforested and deforested lands, where total cumulative net emissions are accounted. Accounting of Managed wetlands is mandatory starting from 2026, and Estonia has not selected this category for accounting in the 2021–2025 period. According to the projections, total accounted removals exceed accounted emissions in the first commitment period (Table 3.2). It is not yet possible to predict if the LULUCF sector will achive its commitments under the Regulation in the 2026–2030 commitment period. The proposed national target for 2030 for Estonia is -2,545 kt CO_2 eq.; in addition, each EU country will be assigned a carbon budget for 2026-2029 and a trajectory of indicative, annual values on removals and emissions. Due to the development of methodologies, a methodological adjustment may result in a change in the value of the base period and in the total amount of the commitment. The integrated use of climate and biodiversity measures across all LULUCF sectors is essential to achieve the national target.

Table 3.2. Projections of accounted emissions and removals from the LULUCF sector according to the WEM and WAM scenarios in accordance with Regulation (EU) 2018/841

Land use category	Summary emissions/ removals, kt CO_2 eq.		Reference value/ base period emissions*, kt CO_2 eq	Accounted emissions/ removals, kt CO_2 eq.
	2021–2025	2026–2030		2021–2025
Managed forest land (incl. HWP), WEM scenario	4,521.20	5,115.90	-8,750.00	13,271.20
Managed forest land (incl. HWP), WAM scenario	-5,013.91	-5,857.46	-8,750.00	3,739.09
Afforested land	-1,496.81	-1,200.87	–	-1,496.81
Deforested land	3,466.86	3,790.75	–	3,466.86
Managed cropland	3,284.95	3,786.30	429.74	2,855.21
Managed grassland	128.12	239.25	-86.07	214.19
Managed wetland	6,618.05	6,565.29	4,978.29	Not selected

*Managed forest land reference value in the first commitment period is Forest Reference Level (FRL) multiplied by 5, other categories are compared with the average of period 2005–2009 multiplied by 5. In the second commitment period, the proposed national target has been set.

3.2.6. Waste

3.2.6.1. Methodology

Waste sector 'With Existing Measures' (WEM) scenario GHG projections have been calculated for the period of 2020– 2050. The reference year 2020 used in projections is consistent with Estonia's 2022 submission to the UNFCCC on 15th of April 2022 (National Greenhouse Gas Inventory Report 1990–2020, 2022). The WEM scenario evaluates future GHG emission trends under the current policies and measures.

GHG emissions emitted from the Waste sector include CO_2, CH_4 and N_2O. CO_2 is emitted from the Waste incineration category. The main share of CH_4 from the Waste sector comes from Solid waste disposal on land. CH_4 and N_2O emitted from Wastewater treatment and discharge, Biological treatment and Waste incineration.

CH_4 emission projections in the Solid waste disposal on land (SWD) subcategory are done using the 2006 IPCC Waste Model, which has been developed by the IPCC for estimating CH_4 emissions from solid waste disposal sites, for projections, additional sheets have been interlinked with the existing Waste model template sheets which are easy to adjust the to reflect the country specific needs. Also it is possible to interlink cells making the calculations easy. It is difficult to point out the weakness of the model as the calculations difficulties depend on the adjustments and activity data. In the IPCC 2006 Waste Model, synergies of waste decomposition over time period is taken into account in the calculation. There are no overlaps, because the input data is clearly divided to different waste groups.

The MSW generation projections take into account population projection (Statistics Estonia) and the long-term real GDP growth rate (the Ministry of Finance). The composition and the amount of generated MSW is taking into account, that from 2035 at least 65% of the municipal waste shall be prepared for re-use and recycled. In addition, starting from 2030 it is prohibited to deposit waste suitable for recycling or other recovery, in particular municipal waste. Also, from 2030 the quantity of municipal waste deposited in a landfill shall not exceed 10 % by weight of the total quantity of municipal waste generated in the same year. For textile waste, local governments will start separate collection of textile waste no later than 2025 and implement separate collection or recycling at source no later than 2023, which decrease the amount of degradable waste at landfills. Projections also take into account the amount of waste incinerated MSW in Iru CHP plant (emissions from this activity is included in the Energy sector projections).

Mixed Municipal Solid Waste Composition Study carried out in 2020 (SEI-Tallinn, 2020) was used for a MSW composition projection. Real GDP growth rate was also used for projecting industrial waste generation.

Projections in the subcategory Biological treatment of solid waste are based on the long-term real GDP growth rate projections by the Ministry of Finance applied to the previous year's biologically treated solid waste amount. While calculating, it is considered, that more biological waste is separated from the municipal solid waste and that there will be additional biodegradable waste from industrial sources (calculated under Solid waste disposal subcategory).

Only a small amount of waste gets incinerated without energy recovery. Projections in the subcategory Waste incineration and open burning were done using the assumptions of no open burning taking place after 2030 and that a small amount of waste will be incinerated without energy recovery (for burning contraband, utilising hazardous waste, etc.). Open burning of municipal solid waste is prohibited, nevertheless an expert judgment is used to evaluate the

amount of waste that might be open-burned based on the amount MSW generated. The MSW generation is in accordance with the subsector Solid waste disposal on land. Activity data about generated MSW is projected under the SWD subcategory.

Projections of GHG emissions in Wastewater treatment and discharge subcategory account for population projection (Statistics Estonia) and an expert judgement given by the MoE on the usage of different wastewater treatment types and the coverage of centralised wastewater system. Different wastewater treatment systems are covering both high and low density settlements. GHG emissions from Industrial wastewater was conducted using stable production throughout the time series of 2021–2050.

3.2.6.2. GHG emissions projections

Since there are no additional measures intended in the Waste sector then the WAM scenario emissions are equal to the WEM scenario emissions (Figure 3.7).

Compared to 2020, the 2050 WEM scenario CO_2 eq. projections from the Waste sector are projected to decrease by 40.8%. Emission decrease is mainly related to the increase of reusing and recycling waste materials, decreasing amount of biodegradable waste deposited in landfills and to waste incineration in the Iru CHP plant. The decrease of 2050 emissions from the Solid waste disposal subcategory are projected to decrease by 83.9% compared to base year emissions.
Increase in GHG emissions from biological treatment of solid waste (121% increase in 2050 compared to 2020) is correlated to the decreased amount of biodegradable waste in the total amount of solid waste disposed in landfills.

Open burning of waste will end by 2030 and a marginal amount of waste will be incinerated without energy recovery, the emissions will decrease by 99.9%.

The emission decrease from wastewater treatment and discharge (11.8% in 2050 compared to 2020) is connected to the expanding sewerage network and upgrading wastewater treatment systems in low-density settlements.

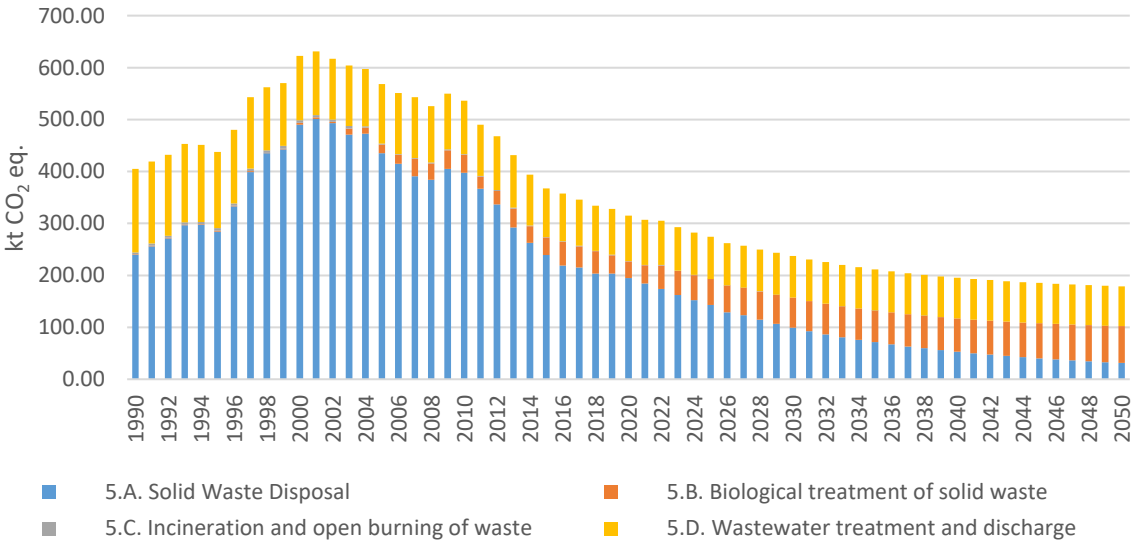

Figure 3.7. Historical GHG emissions (1990–2020) (NIR, 2022) and projected emissions (2021–2050) from the Waste sector according to the WEM=WAM scenario (using AR5 GWP), kt CO_2 eq.

3.3. Total projected GHG emissions of Estonia

Estonia's total projected GHG emissions and historigal inventory information using AR5 GWP are presented in Figure 3.8 and Figure 3.9. The GHG emission reduction compared in 2050 compared to base year 2020 is included in Table 3.3.

Table 3.3. GHG reduction in WEM and WAM scenarios in 2050 compared to 2020, (using AR5 GWPs)

	Scenario	Reduction in 2050 compared to 2020, %	Reduction in 2050 compared to 2020, %
Without LULUCF	WEM	-7457.52	-64.4%
	WAM	-9673.97	-83.6%
With LULUCF	WEM	-5961.70733	-46.4%
	WAM	-10293.94	-80.1%

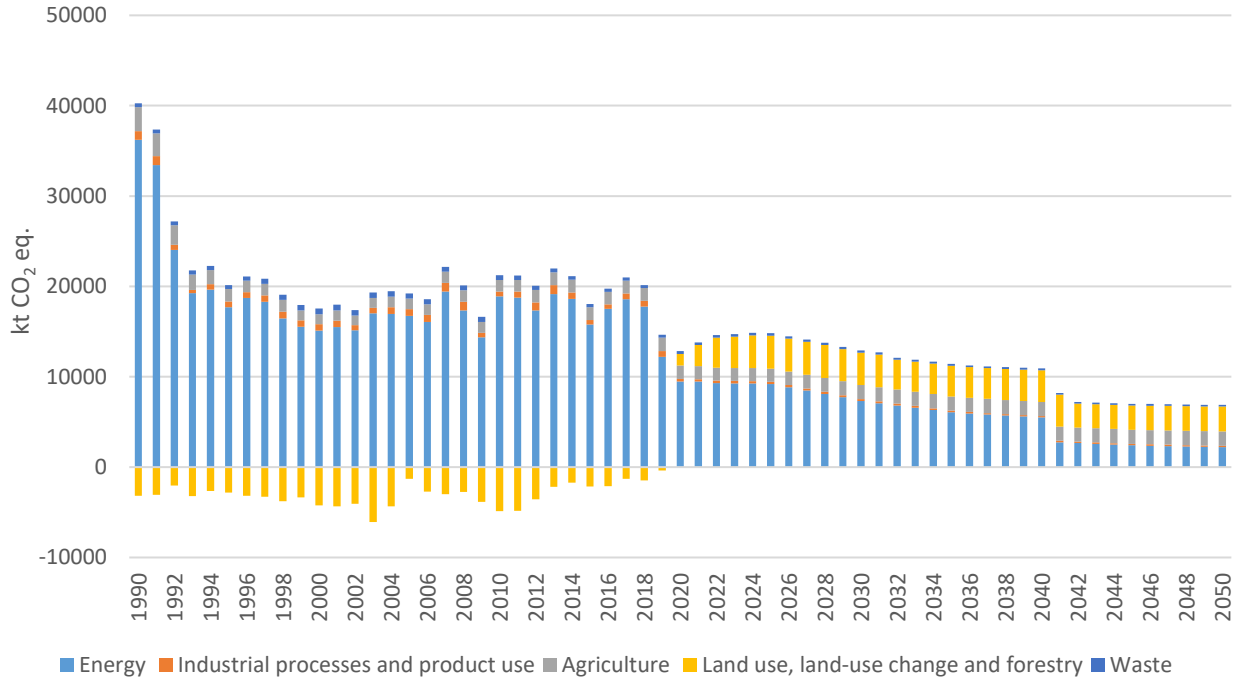

Figure 3.8. Historical GHG emissions (1990–2020) (NIR, 2022) and projected emissions (2021–2050) for the WEM scenario, kt CO_2 eq. (using AR5 GWP)

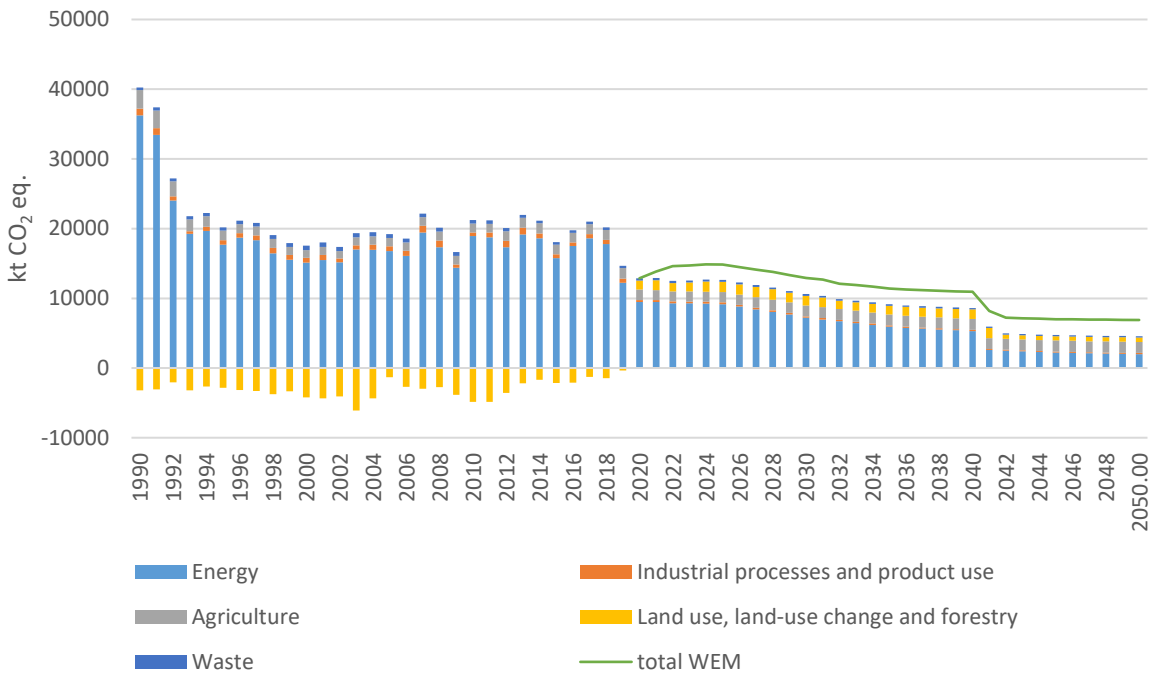

Figure 3.9. Historical GHG emissions (1990–2020) (NIR, 2022) and projected emissions (2021–2050) for the WEM and WAM scenario, kt CO_2 eq. (using AR5 GWP)

While the Energy sector´s subcategory Energy industries dominated total emissions in 1990, its emissions decreased sharply in the beginning of the time series and fluctuate but are projected to continue on a decreasing pathway, reaching a reduction of 94.6% in WEM scenario and 95.1% in WAM by 2050 compared to 1990.

Emissions from the Transport sector, are driven by the Road transport category, as its share of the total transport sector was approximately 98.5% in 2020. Therefore, it will also be the biggest driver for the decrease of GHG emissions in the road transport sector due to the uptake of electric vehicles. The total decrease of emissions by 2050 compared to 1990 is projected to be 87.2% in the WEM scenario and 88.5% in the WAM scenario.

Historically, the IPPU sector emissions were driven by the Mineral industries subcategory, however the cement industry ceased burning clinker in wet process kilns and does not foresee future production, which will already decrease starting from 2020. HFC emissions projection will decrease and it is projected that the majority of R-404A containing equipment and old split-type air conditioners and heat pumps are gradually decommissioned. The total decrease of emissions by 2050 compared to 1990 is projected to be 83.771% in the WEM scenario and 83.774% in the WAM scenario.

Agriculture emissions are projected to decrease by 41.04% compared to 1990 in the 2050 WEM scenario and 41.3% in WAM scenario. The projections foresee a slight increase of 4.45% compared to 2020 by 2050 in WEM scenario (in the WAM scenario the emissions are projected to increase by 4.47% by 2050 compared to 2020). Estonia´s agriculture sector is driven by the Enteric Fermentation and Agricultural soils subcategories that are an important food source.

According to the projections, the LULUCF sector is expected to remain a source of GHGs in the WEM and WAM scenarios from –3,159.9 kt CO_2 eq. total sequestration in 1990 to 2,767.95 kt CO_2 eq. and 652.15 kt CO_2 eq. in 2050 according to the WEM and WAM scenarios,

respectively. In the WEM scenario (total felling volume is 11.5 mln m^3 $year^{-1}$), Forest land will act as a net source. Due to the high proportion of mature and premature forest stands and the increasing proportion of forest area belonging to the first development classes (treeless area, area under regeneration and young stands), the capacity of carbon sequestration in tree biomass has decreased in recent years and the decline is expected to continue during the next decades. In the WAM scenario (total felling volume is 9.4–9.8 mln m^3 year-1), Forest land and HWP will sequester carbon.

The increasing trend of waste sector emissions in 1990– 2001 is linked to low rate of waste recycling. However, the emission decrease until 2050 is mainly related to the increase of reusing and recycling waste materials, the decreasing amount of biodegradable waste deposited in landfills and to waste incineration in the Iru CHP plant in 2013. The decrease of emissions by 2050 is reaching 55.9% compared to 1990 in WEM=WAM scenarios.

3.4. Sensitivity analysis

During every projection compilation period, trajectories for parameters for reporting on national GHG projections in 2023 are provided by the European Commission (EC) for all the EU Member States. These include harmonised values to be considered for the 2023 national GHG projections on the international oil, gas and coal import prices, the EU ETS carbon prices, population and GDP.

For the projection compilation, it was possible to use Estonia's Ministry of Finance´s updated the long term real GDP growth rate from September 2022 and population projection by Statistics Estonia which were considered more up to date. The EC parameters were used for sensitivity analysis to validate national data used in the projections.

3.4.1. Energy

Manufacturing industries' and construction (1.A.2) and Agriculture/Forestry/Fishing/Fish farms (1.A.4.c) GHG projections are based on the future GDP growth of Estonia. The GDP projections until 2050 by the Ministry of Finance were used. However, a GDP scenario was also provided by the European Commission. Therefore, an alternative scenario has been modelled (SEN scenario).

Comparing the GDP projections from the Ministry of Finance with GDP projections from the European Commission, it was seen that the Commissions GPD projections were somewhat more optimistic in the future growth of Estonia, which also reflects in the GHG projections. When comparing GHG emissions between the WEM and SEN scenarios, the emissions are projected to increase by 4.4% by 2050 in the SEN scenario. The results of the SEN scenario are presented in Figure 3.10. A sharp drop in the emissions in 2040–2041 is due to the companies phasing out shale oil in solid heat carrier technology based shale oil plants.

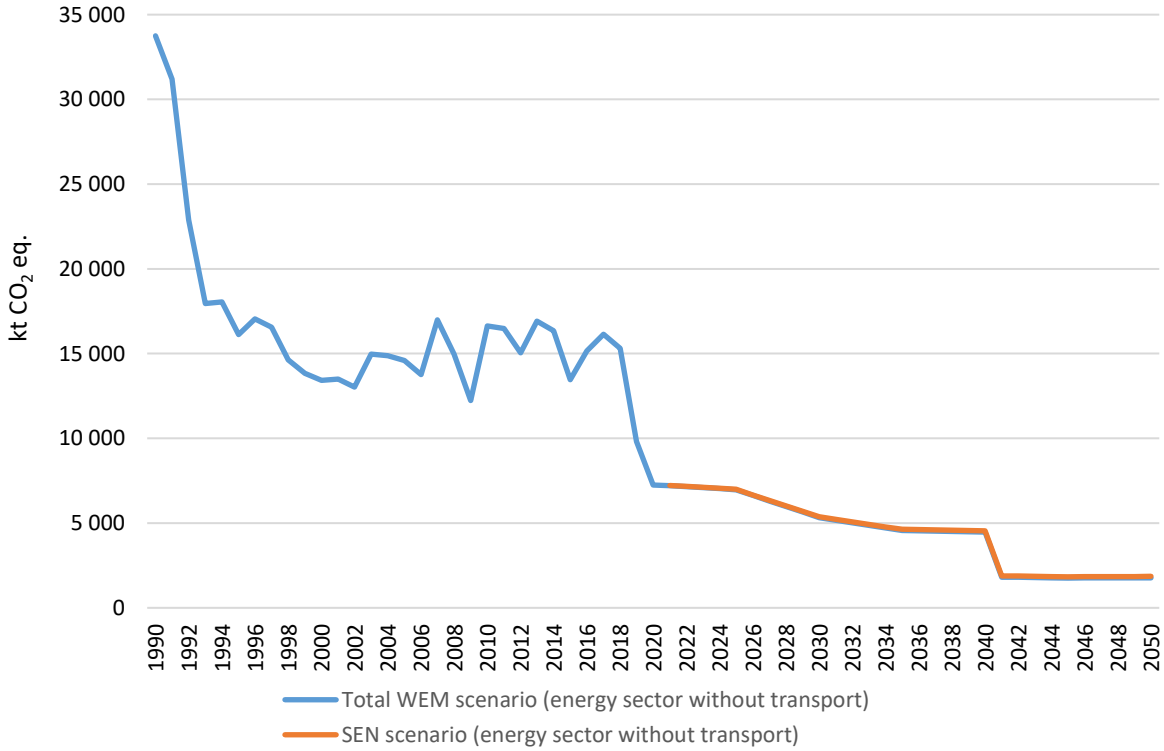

Figure 3.10. Comparison of GHG emissions of WEM and SEN scenarios in Energy sector, kt CO_2 eq. (using AR5 GWP)

3.4.2. LULUCF

Forest is the prevailing land-use category in Estonia and has the largest influence on the whole LULUCF sector's total carbon balance. The felling scenarios try to predict the future changes in Forest land and HWP carbon stocks under different felling intensities. Sensitivity analysis for LULUCF sector emissions is based on the scenarios, where total felling volume has been projected at 9 million m^3 (SEN1) and 7 million m^3 (SEN2) levels. For other land use categories, WEM=WAM scenario was created and no additional SEN analysis was carried out.

Under the SEN1 scenario (Figure 3.11. Comparison of total GHG emissions of the LULUCF sector SEN1 (total felling volume 9 million m3), SEN2 (total felling volume 7 million m3) and WEM (total felling volume 11.5 million m3) scenariosFigure 3.11) it is expected that during the period of 2021–2050, Forest land and HWP will sequester carbon, but this cannot compensate emissions from other land use categories. Therefore, the LULUCF sector remains a GHG source. Net removal from Forest land is projected to increase, reaching up to -1,765.22 kt CO_2 eq in 2029 and will decrease slightly to -1,662.39 kt CO_2 eq in 2050. HWP net removal will decrease from -922.24 kt CO_2 in 2020 to -309.82 kt CO_2 by 2050. The projected overall emissions from the LULUCF sector under the SEN1 scenario decrease to 403.28 kt CO_2 eq. in 2022 and after that remain relatively stable, reaching 706.85 kt CO_2 eq. in 2041 and decrease slightly to 669.50 kt CO_2 eq. in 2050.

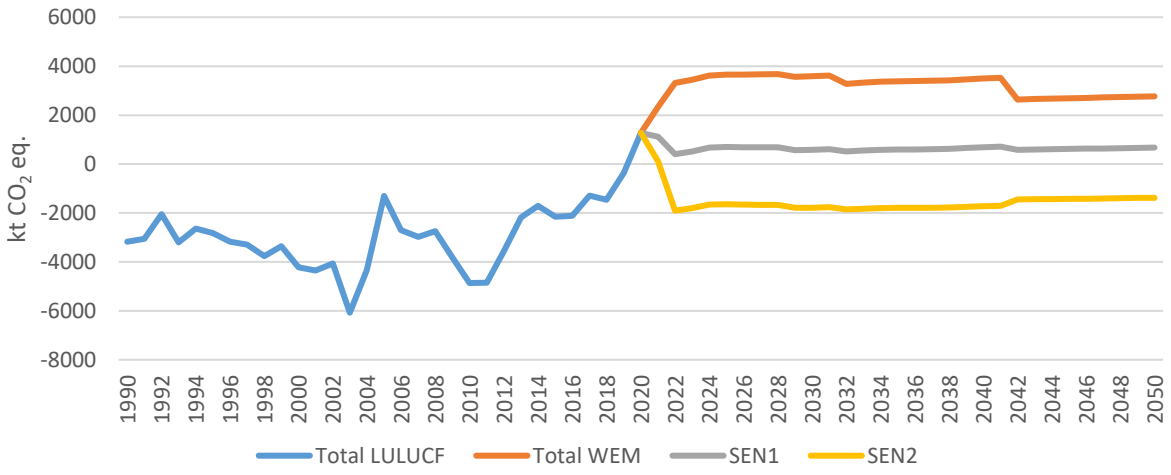

Figure 3.11. Comparison of total GHG emissions of the LULUCF sector SEN1 (total felling volume 9 million m^3), SEN2 (total felling volume 7 million m^3) and WEM (total felling volume 11.5 million m^3) scenarios (using AR5 GWP), kt CO_2 eq.

In the SEN2 scenario (Figure 3.11), the LULUCF sector is expected to become a CO_2 sink throughout the considered period. The total forest growing stock increases rapidly in the first decades and therefore carbon sequestration in tree biomass increases. Net removal from Forest land is projected to increase significantly in the first two decades, reaching -4138.56 kt CO_2 eq. in 2041 and will decrease slightly reaching -3821.54 kt CO_2 eq. in 2050. HWP net removal will decrease significantly due to the lower felling volume (from -922.24 kt CO_2 in 2020 to -183.51 kt CO_2 in 2050). Total removals in the LULUCF sector are projected to decrease from -1,905.32 kt CO_2 eq. in 2022 up to -1,384.87 kt CO_2 eq. in 2050.

3.4.3. Waste

Sensitivity analysis for Waste sector emissions is based on the population and annual real GDP growth rate harmonised values provided by the European Commission (2022 draft trajectories for parameters for reporting on national GHG projections in 2023) (Table 3.4).

The methodology for calculating the SEN (and WEM) scenario is provided in Chapter 3.2.6.1. All subcategories in the Waste sector are either affected by the change of population projections and/or fluctuations in GDP.

Table 3.4. Harmonised parameters given by the European Commission

Indicator	2025	2030	2035	2040	2050
GDP (growth rate), %	2.68	2.48	2.14	1.61	1.26
Population in Estonia, million	1.322	1.308	1.294	1.282	1.256

The results of the SEN analysis show that Waste sector emissions in general are dependent on the population projections and changes in GDP estimations. The Incineration and open burning of waste and Wastewater treatment and discharge categories are not highly affected when using SEN parameters. Incineration and open burning subcategory have a marginal share in the total share of emissions and the Wastewater treatment and discharge subcategory would be more affected by the change of different wastewater treatment methodologies. However, population and GDP growth are affecting the Solid waste disposal and Biological treatment of solid waste subcategories. When comparing 2050 emissions, total GHG emissions are projected to decrease by 5.2% in the WEM scenario compared to the SEN scenario.

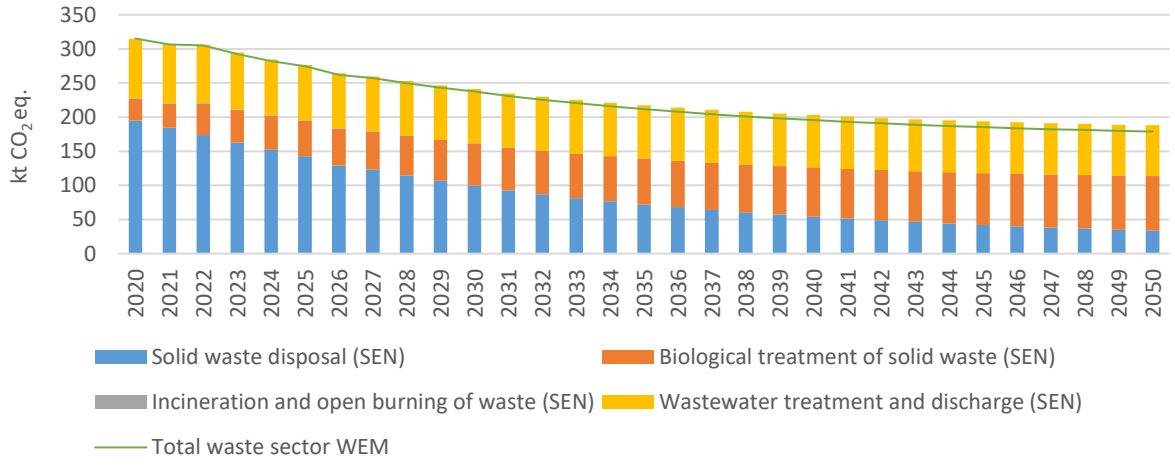

Figure 3.12. Comparison of GHG emissions of the SEN and WEM scenarios waste sector total emissions, kt CO_2 eq. (using AR5 GWP)

3.5. Changes with respect to the 2021 submission

3.5.1. Energy

The comparisons of CO_2 eq. emissions with respect to the 2023 submission are presented on Table 3.5 and Table 3.3.6, for WEM and WAM scenarios, respectively. The changes in Energy industries category have three main reasons. Firstly, electricity generation emissions are now based on an updated Balmorel scenario of fuel consumption for electricity generation due to a changed economic situation and re-assessment the impact assessment of measures. Secondly, the projections in the heat production is based on updated analysis of past fuel consumption trends of the sector to reflect future and also reassessment the impact assessment of measures. Thus, influencing also the projections of the WAM measures in the WAM scenario. Thirdly, in 2023 projections, the number of new shale oil production plants planned by the companies have been reduced due to future outlook.

The changes in Manufacturing and construction sector and Other sectors occur, because in the previous submission input from *NECP 2030* was used. However, in the latest submission projections of reconstruction are based on the Longterm strategy for building reconstruction scenarios. Also, the emission in these sectors have been updated taking into account the latest historical activity data from NIR 2022.

Fugitive emissions have been updated taking into account the latest historical activity data from NIR.

Table 3.5. Comparison of 2023 and 2021 WEM scenario Energy sector projections, kt CO_2 eq.

Submission	Energy WEM	2025	2030	2035	2040	2050
2023	Energy industries	5520.35	3869.76	3108.95	3012.39	270.67
2021		7440.63	7188.77	5710.82	4891.21	4521.39
2023	Manufacturing industries and construction	568.64	583.52	602.82	620.37	655.75
2021		615.49	649.28	687.80	726.96	811.23
2023	Transport	2223.91	1995.93	1521.77	1027.46	441.75
2021		2064.88	1880.96	1769.06	1302.79	410.68
2023	Other sectors	856.84	843.21	831.69	815.31	824.63
2021		838.99	804.60	772.75	745.13	729.37
2023	Fugitive emissions	23.95	23.95	23.95	23.95	23.95
2021		25.00	25.00	25.00	25.00	25.00
2023	Total, kt CO_2 eq.	9193.69	7316.36	6089.18	5499.48	2216.74
2021		10985.00	10548.61	8965.44	7691.09	6497.68

Table 3.3.6. Comparison of 2023 and 2021 WAM scenario Energy sector projections, kt CO_2 eq.

Submission	Energy WAM	2025	2030	2035	2040	2050
2023	Energy industries	5516.82	3841.03	3055.20	2943.19	197.88
2021		7284.04	7131.92	5392.36	4860.84	4299.51

Submission	Energy WAM	2025	2030	2035	2040	2050
2023	Manufacturing industries and construction	568.64	583.52	602.82	620.37	655.75
2021		615.49	649.28	687.80	726.96	811.23
2023	Transport	2207.08	1933.88	1458.13	971.34	401.10
2021		2039.41	1810.36	1697.44	1230.59	366.07
2023	Other sectors	852.71	823.79	791.47	753.41	719.82
2021		835.80	799.66	766.54	738.72	719.84
2023	Fugitive emissions	23.95	23.95	23.95	23.95	23.95
2021		25.00	25.00	25.00	25.00	25.00
2023	Total, kt CO_2 eq.	9169.20	7206.17	5931.56	5312.26	1998.50
2021		10799.74	10416.23	8569.14	7582.11	6221.65

3.5.2. Transport

Comparison of Transport sector CO_2 eq. emissions with respect to the 2023 submission in the WEM scenario is presented in Table 3.7 and in the WAM scenario is presented in Table 3.8. The previous WEM and WAM projections in the transport sector were based on the information in the ITF report "*The Future of Passenger Mobility and Goods*". Also, using the input from Ministry of Economic Affairs and Communication, the Ministry of the Environment and from the meeting points of the Government´s Environment and Climate Commission, which also taken into account in the latest projections. However, the biggest driver for the steep decrement of GHG emissions in the latest WEM and WAM scenarios is the uptake of electric vehicles. This is reinforced by measures which support the promotion of electric vehicles and the notion that from 2035 all new passenger cars have to meet the criteria of 0 gCO_2/km. Previously no such assumption was made in this regard. In addition, the impact assessment of measures was reassessed.

Table 3.7 Comparison of 2023 and 2021 WEM scenario Transport sector projections, kt CO_2 eq.

Submissions	Transport WEM	2025	2030	2035	2040	2050
2023	Domestic aviation	5.47	5.73	6.01	6.30	6.93
2021		4.62	4.84	5.08	5.32	5.85
2023	Road transportation	2163.98	1972.92	1498.48	1003.88	417.55
2021		2012.39	1827.35	1714.32	1246.90	352.54
2023	Railways	34.35	5.26	5.26	5.26	5.26
2021		27.34	27.34	27.34	27.34	27.26

2023	Domestic navigation	20.11	12.01	12.01	12.01	12.01
2021		20.53	21.43	22.33	23.23	25.03
2023	Other transportation	NO	NO	NO	NO	NO
2021		NO	NO	NO	NO	NO

Table 3.8 Comparison of 2023 and 2021 WAM scenario Transport sector projections, kt CO_2 eq.

Submissions	Transport WAM	2025	2030	2035	2040	2050
2023	Domestic aviation	5.47	5.73	6.01	6.30	6.93
2021		4.62	4.84	5.08	5.32	5.85
2023	Road transportation	2147.15	1910.88	1442.96	955.89	385.03
2021		2003.48	1773.31	1659.25	1191.25	324.49
2023	Railways	34.35	5.26	5.26	5.26	5.26
2021		27.34	27.34	27.34	27.34	27.26
2023	Domestic navigation	20.11	12.01	3.89	3.89	3.89
2021		3.98	4.88	5.78	6.68	8.48
2023	Other transportation	NO	NO	NO	NO	NO
2021		NO	NO	NO	NO	NO

3.5.3. IPPU

Comparison of IPPU sector CO_2 eq. emissions with respect to the 2023 submission in the WEM scenario is presented in Table 3.9 and in the WAM scenario is presented in Table 3.10.

The WEM and WAM scenario in 2023 as well as in 2011 submission differ only in emissions from the category 2.D. Non-energy products from fuels and solvent use.

In 2021 submission emissions from chemical industry were projected to start from 2024 as the ammonia production plant planned relaunching and gains full production volume in 2025. In the 2023 submission, the chemical (ammonia) industry is no longer active in Estonia and there are no emissions projected.

Projected emissions from metal industry are at a similar level in 2021 and 2023 submissions. The Metal industry´s projected emissions are based on industries' operator production forecasts. Emissions from subsector 2.D Non-energy products from fuels and solvent use were projected to decrease very little in 2021 submissions´ WEM scenario, which caused by decreasing emission factors. For the 2023 submission dereasing emission factors, GDP growth and population decline was taken into account.

Projection of emissions in 2023 and 2021 submission from subsector 2.F.2 Foam blowing agents is based on forecasts of foam producers, real GDP growth rate and population size. Projection of emissions from 2.F.3 Fire protection is based on expert opinion from service companies concerning new equipment and a method of calculating the stock based on the GHG inventory. Projection of emissions from 2.F.4 Aerosols is based on the trend of medical

aerosol use in 2014–2020, population size and real GDP growth rate. Aa the base year changes for this the 2.F category so does the projections.

In the category 2.G Other product manufacture and use the projected emissions are larger in 2021 submission than in 2023 submission. The methodology has remaided the same however the base year GHG inventory while the base year has changed considering also the plans on equipment replacement by the electrical network operators in Estonia. Regarding N_2O – consumption of medical N_2O was provided by wholesalers who explained that sales will decline and consumption of N_2O in aerosols was calculated with the projection of population size.

Table 3.9. Comparison of 2023 and 2021 WEM scenario IPPU sector projections, kt CO_2 eq.

Submissions	WEM	2025	2030	2035	2040	2050
2023	2.A Mineral industry	69.04	69.04	69.04	69.04	69.04
2021		72.60	72.60	72.60	71.56	71.56
2023	2.B Chemical industry	NO	NO	NO	NO	NO
2021		105.93	105.93	105.93	105.93	105.93
2023	2.C Metal industry	3.24	3.24	3.24	3.24	3.24
2021		2.62	2.68	2.74	2.80	2.94
2023	2.D Non-energy products from fuels and solvent use	26.05	25.85	25.73	25.28	25.27
2021		22.10	22.14	22.53	22.47	22.45
2023	2.F Product uses as substitutes for ODS	147.84	109.18	69.37	57.65	53.53
2021		173.20	124.48	90.21	82.11	79.48
2023	2.G Other product manufacture and use	4.37	4.81	5.19	5.34	5.23
2021		6.30	6.81	6.93	7.06	4.57
2023	Total CO_2 eq.	250.55	212.13	172.57	160.55	156.31
2021		382.76	334.64	300.94	291.94	289.93

Table 3.10. Comparison of 2023 and 2021 WAM scenario IPPU sector projections, kt CO_2 eq.

Submissions	WAM	2025	2030	2035	2040	2050
2023	2.A Mineral industry	69.04	69.04	69.04	69.04	69.04
2021		72.60	72.60	72.60	71.56	71.56
2023	2.B Chemical industry	NO	NO	NO	NO	NO
2021		105.93	105.93	105.93	105.93	105.93
2023	2.C Metal industry	3.24	3.24	3.24	3.24	3.24
2021		2.62	2.68	2.74	2.80	2.94
2023		26.03	25.79	25.53	25.22	25.25

Submissions	WAM	2025	2030	2035	2040	2050
2021	2.D Non-energy products from fuels and solvent use	22.06	21.98	22.30	22.25	22.23
2023	2.F Product uses as substitutes for ODS	147.84	109.18	69.37	57.65	53.53
2021		173.20	124.48	90.21	82.11	79.48
2023	2.G Other product manufacture and use	4.37	4.81	5.19	5.34	5.23
2021		6.30	6.81	6.93	7.06	7.57
2023	Total CO_2 eq.	250.52	212.06	172.37	160.49	156.28
2021		382.72	334.48	300.72	297.71	289.72

3.5.4. Agriculture

The main reason for the fall in projected WEM emissions in the 2021 submission compared to the 2023 submission (Table 3.11) is explained by the anticipation of more pessimistic agricultural output. 2021 submission did not include WAM scenario projections in Agriculture sector.

The numbers of projected animals have generally decreased compared to the previous submission. The change in total and subsectorial emission values reflect also remarkably the corrections performed in GHG emission calculation methodology under different subsectors.

In Enteric fermentation subsector lower emissions are projected by the year 2050 both in WAM and WEM scenarious when comparing the 2021 and 2023 projections. In Manure management subsector, the emissions are projected to increase in 2023 submission compared to the 2021 submission, both in WEM and WAM scenarios. This is mainly caused by the updated values for distribution of cattle and swine manure management systems for the years 2016-2020. The respective updates are based on a study by A. Kaasik (2020). The increase of the share of liquid manure management systems for some animal categories increased the CH_4 emissions. In Agricultural soils subsector, the emissions are projected to decrease in 2023 projections because projected amounts of inorganic fertilizers decreased compared to previous submission. In Liming subsector, the emissions are projected to decrease in 2023 projections compared to the previous submission because the projected amounts of lime fertilizers have decreased. In Urea application subsector, projected emissions were similar to the previous projections, a small increase was projected in 2023 projections which was associated with the increased urea use.

Table 3.11. Comparison of 2023 and 2021 WEM scenario Agriculture sector projections, kt CO_2 eq.

Submissions	Agriculture WEM	2025	2030	2035	2040	2050
2023	Enteric fermentation	611.43	665.48	678.03	677.72	677.72
2021		647.04	658.93	673.20	686.11	686.11
2023	Manure management	249.30	266.55	270.55	270.68	271.15
2021		227.73	233.01	236.22	239.17	239.17
2023	Agricultural soils	583.02	605.09	593.04	594.37	597.26
2021		632.05	637.77	639.68	643.03	644.91

Submissions	Agriculture WEM	2025	2030	2035	2040	2050
2023	Liming	21.50	22.09	22.04	22.04	22.04
2021		36.23	36.23	36.23	36.23	36.23
2023	Urea application	0.13	0.13	0.13	0.13	0.13
2021		0.08	0.08	0.08	0.08	0.08
2023	Total, kt CO_2 eq.	1465.39	1559.35	1563.79	1564.93	1568.30
2021		1543.14	1566.02	1585.42	1604.62	1606.50

Table 3.12. Comparison of 2023 and 2021 WAM scenario Agriculture sector projections, kt CO_2 eq.

Submissions	Agriculture WAM	2025	2030	2035	2040	2050
2023	Enteric fermentation	611.43	665.48	678.03	677.72	677.72
2021		647.04	658.93	673.20	686.11	686.11
2023	Manure management	249.22	266.34	270.33	270.46	270.89
2021		216.42	220.50	223.61	226.46	226.46
2023	Agricultural soils	583.22	605.50	593.49	594.84	597.80
2021		634.06	640.91	642.87	646.26	648.13
2023	Liming	21.50	22.09	22.04	22.04	22.04
2021		36.23	36.23	36.23	36.23	36.23
2023	Urea application	0.13	0.13	0.13	0.13	0.13
2021		0.08	0.08	0.08	0.08	0.08
2023	Total, kt CO_2 eq.	1465.51	1559.55	1564.02	1565.19	1568.62
2021		1543.74	1566.96	1586.37	1605.58	1607.46

3.5.5. LULUCF

Differences in projected emissions between 2023 and 2021 submissions are presented in . 2021 submission did not include WAM scenario projections in the LULUCF sector.

The main differences in projections have occurred in the Forest land and HWP categories as a result of new felling scenarios used for calculations. Also updated activity data from the NFI (areas, growing stocks) and parameters were applied for all land use categories. Due to the large forest land area, even moderate changes in activity data have a large impact in the projected values.

In the current submission, land use and land use change areas were generally estimated based on recent trends from the 2016-2020 period. In addition, the areas of different land use categories on the Rail Baltic route were specified, and additional land use changes due to the restoration of heritage meadows and the establishment of military training fields were considered. This has affected mostly the Grassland and Settlements categories.

Projected emissions for the Wetlands category have increased compared to the 2021 submission due to the new methodology for estimating the amount of peat removed for horticultural use.

More detailed information about recalculation of historical time-series, on which the projections are based, can be found in the NIR 2021 and NIR 2022.

Table 3.13. 2021 submission did not include WAM scenario projections in the LULUCF sector.

The main differences in projections have occurred in the Forest land and HWP categories as a result of new felling scenarios used for calculations[1]. Also updated activity data from the NFI (areas, growing stocks) and parameters were applied for all land use categories. Due to the large forest land area, even moderate changes in activity data have a large impact in the projected values.

In the current submission, land use and land use change areas were generally estimated based on recent trends from the 2016-2020 period. In addition, the areas of different land use categories on the Rail Baltic route were specified, and additional land use changes due to the restoration of heritage meadows and the establishment of military training fields were considered. This has affected mostly the Grassland and Settlements categories.

Projected emissions for the Wetlands category have increased compared to the 2021 submission due to the new methodology for estimating the amount of peat removed for horticultural use. More detailed information about recalculation of historical time-series, on which the projections are based, can be found in the NIR 2021[2] and NIR 2022[3].

Table 3.13. Comparison of 2023 and 2021 WEM scenario LULUCF sector projections, kt CO_2 eq.

Submission	LULUCF	2025	2030	2035	2040	2050
2023	Forest land	1,619.00	1,565.57	1,352.75	1,469.63	646.57
2021		-2,633.22	-2,633.22	-1,299.65	-1,299.65	-1,934.68
2023	Cropland	682.01	678.90	712.50	652.66	651.44
2021		687.03	737.28	711.34	722.41	722.41
2023	Grassland	302.07	299.71	259.73	265.67	255.61
2021		72.53	72.53	72.53	72.53	72.53
2023	Wetlands	1,320.76	1,338.94	1,359.46	1,360.27	1,362.40
2021		1,117.10	1,117.10	1,117.10	1,117.10	1,117.10
2023	Settlements	534.70	434.12	345.20	333.54	308.24
2021		473.76	423.45	423.45	423.45	418.79
2023	Other land	73.04	60.91	65.76	64.02	64.02
2021		69.37	69.37	69.37	69.37	69.37
2023	Harvested wood products	-882.23	-792.50	-713.00	-641.78	-520.35
2021		-639.31	-576.61	-501.14	-451.69	-327.99
2023	Total CO_2 eq.	3,649.35	3,585.65	3,382.40	3,504.01	2,767.95
2021		-852.74	-790.11	592.98	653.50	137.52

[1] The felling scenarios composed by Estonian Environment Agency using the latest activity data (NFI 2021)
[2] National Greenhouse Gas Inventory Report 1990-2019. (2021). Contracting entity: The Ministry of the Environment. https://unfccc.int/documents/273444 (10.02.23).
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3.5.6. Waste

The general reason for the projection differences in the 2021 submission compared to the 2023 projections (Table 3.14) is connected with the changes in GDP and population growth rate, both parameters are essential and affecting waste sector emissions greatly, especially emissions from Solid waste disposal which is the main source for projection changes comparing the 2023 and 2021 submission. The emission changes from the Biological treatment of solid waste is strongly connected with the treated waste amount during base year and the amount of waste separately collected. It was expected that waste burning without energy recovery and open burning of waste will stop by 2030 and small amount of waste incineration without energy rcovery is included.. The emission changes from Wastewater treatment and discharge are connected with the updated projections of different wastewater treatment types in high-density settlements and the coverage percentage of the centralised wastewater system and it is expected that the emissions will remain at a similar level compared to the 2021 submission.

Table 3.14. Comparison of 2023 and 2021 WEM=WAM scenario Waste sector projections, kt CO_2 eq.

Submission	Waste WEM	2025	2030	2035	2040	2050
2023	Solid waste disposal on land	142.81	99.56	71.42	52.96	31.28
2021		131.56	91.69	65.99	49.73	33.64
2023	Biological treatment of solid waste	49.88	57.60	60.97	64.16	70.92
2021		42.77	45.81	49.29	52.82	60.42
2023	Waste incineration and open burning	0.50	0.00001	0.00001	0.00001	0.00001
2021		0.46	0.05	0.05	0.05	0.04
2023	Wastewater treatment and discharge	81.22	80.22	79.26	78.45	76.56
2021		83.66	82.99	82.37	81.77	80.50
2023	Total, kt CO_2 eq	274.42	237.38	211.64	195.56	178.76
2021		258.45	220.55	197.69	184.36	174.60

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