REPUBLIC OF ESTONIA
MINISTRY OF THE ENVIRONMENT

Report pursuant to Articles 13 and 14 of Regulation (EU) 525/2013

Estonia

Estonia 2019

PREFACE

Estonia is a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. Under these international agreements Estonia is committed to provide annually information on its national anthropogenic greenhouse gas emissions by sources and removals by sinks for all greenhouse gases not controlled by the Montreal Protocol.

As a member of the European Union (EU), Estonia has obligations also under the European Union (EU) Greenhouse Gas (GHG) Monitoring Mechanism Regulation (MMR) provided by the Regulation 525/2013/EC of the European Parliament and the Council.

According to the MMR Member States have an obligation to prepare a report in every two years, including:

a) A description of their national systems for reporting on policies and measures;

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

c) Information regarding the links between the different policies and measures and the way such policies and measures contribute to the different projection scenarios.

Estonia's 2019 report on policies and measures is comprised of this report and a reporting template (an Excel-file).

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Abbreviations

AD –	activity data
CHP –	combined heat and power
EF –	emission factor
ESD –	Effort Sharing Decision
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 –	kilotonne
kWh –	kilowatt hour
LULUCF –	Land use, land-use change and forestry
MMR –	Monitoring Mechanism Regulation
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

EEDP 2030 – – Estonian Energy Sector Development Plan 2030

GPCP 2050 – General Principles of Climate Policy 2050

ERDP – Estonian Rural Development Plan

CAP – Common Agricultural Policy

NWMP – National Waste Management Plan

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

Other pollutants

NMVOC – non-methane volatile organic compound

NO_x – nitrogen oxides

1. GREENHOUSE GAS EMISSIONS IN 1990–2016

This chapter sets out Estonia's greenhouse gas (GHG) emissions and their trends for the period 1990–2016 which is consistent with Estonia's 2018 submission to the UNFCCC on 27th of September 2018.

Estonia's total greenhouse gas emissions in 2018 without land use, land-use change and forestry (LULUCF) and with indirect CO_2 were 19 667.25 kt CO_2 eq and 16 942.81 kt CO_2 eq with LULUCF and indirect CO_2. Emission trends by sector are presented in Figure 1.1 and Table 1.1

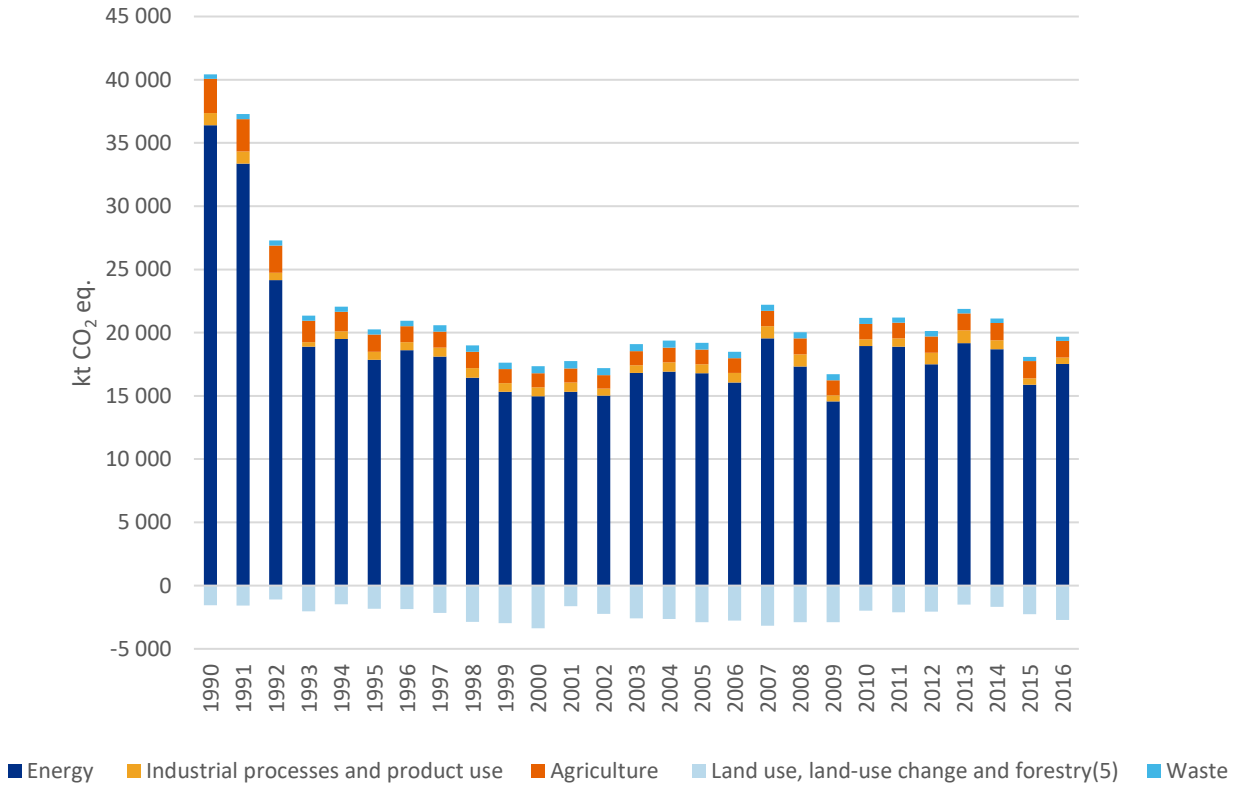

Figure 1.1. Estonia's greenhouse gas emissions by gas 1990–2016 (including LULUCF), kt CO_2 eq (National Inventory submitted on 27th of September 2018)

The decrease of CO_2 eq emissions (excl. LULUCF) by 51.4 per cent since 1990 (Table 1.1) is caused largely by CO_2 emissions from the Energy sub-sector of public electricity and heat production, which is a major source of CO_2 in Estonia. CO_2 emissions decreased 52.8 per cent. N_2O emissions decreased by 39.9 per cent, especially N_2O emissions from the Agriculture sub-sector of agricultural soils, which is the major source of N_2O in Estonia. Emissions of CH_4 decreased by 44.6 per cent, largely from the Agriculture sub-sector of enteric fermentation, which is the major source of CH_4 in Estonia.

Table 1.1. Greenhouse gas emissions and removals by gas and by sector in 1990, 1995, 2000, 2005, 2015 and 2016, kt CO_2 eq

GREENHOUSE GAS EMISSIONS	Base year (1990)	1995	2000	2005	2010	2015	2016	Change from base to latest reported year
	kt CO_2 eq							%
CO_2 emissions without net CO_2 from LULUCF (including indirect CO_2)	37 068.98	18 203.99	15 362.21	17 136.32	19 014.86	15 891.07	17 493.50	-52.81
…Inc. Indirect CO_2 (from NMVOCs reported under IPPU 2.D.3 Solvent use and road paving with asphalt)*	20.65	19.76	18.89	19.62	12.58	15.79	16.37	-20.73
CH_4 emissions without CH_4 from LULUCF	1 909.61	1 263.80	1 238.80	1 208.32	1 196.23	1 056.64	1 057.96	-44.60
N_2O emissions without N_2O from LULUCF	1 460.01	750.62	666.57	709.53	787.50	916.53	878.06	-39.86
HFCs	NO	28.45	79.15	134.96	175.54	223.23	235.18	100
PFCs	NO	NO	NO	NA,NO	NO	NO	NO	–
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	–
SF_6	NO	3.07	2.61	1.03	1.73	2.25	2.54	100
NF_3	NO	NO	NO	NO	NO	NO	NO	–
Total (without LULUCF)	40 438.59	20 249.94	17 349.33	19 190.16	21 175.85	18 089.73	19 667.25	-51.37
Total (with LULUCF)	38 894.85	18 430.92	13 978.18	16 306.43	19 189.34	15 833.99	16 942.81	-56.44
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**Base year (1990)**	**1995**	**2000**	**2005**	**2010**	**2015**	**2016**	**Change from base to latest reported year**
	kt CO_2 eq							%
1. Energy	36 397.39	17 855.16	14 974.85	16 787.35	18 939.30	15 869.66	17 524.76	-51.85
2. Industrial processes and product use	965.49	636.60	697.25	726.91	537.30	513.24	500.15	-48.20
3. Agriculture	2 705.81	1 360.47	1 114.43	1 162.01	1 225.05	1 384.27	1 336.11	-50.62
4. Land use, land-use change and forestry	-1 543.75	-1 819.02	-3 371.16	-2 883.73	-1 986.52	-2 255.74	-2 724.44	76.48
5. Waste	369.90	397.71	562.80	513.89	474.20	322.56	306.23	-17.21

*indirect CO_2 emissions are calculated from NMVOCs reported under IPPU 2.D.3 Solvent use and road paving with asphalt. These emissions are reported under paragraph 4.4.3.2 Solvent use in NIR and in CRF Reporter sectoral table 2(I).A-Hs2.

The Energy sector is by far the largest producer of GHG emissions in Estonia (Figure 1.2). The Energy sector accounted for 89.11% of total GHG emissions, followed by Agriculture (6.79%), Industrial processes and product use (2.54%) (including indirect CO_2) and Waste (1.56%).

LULUCF sector, acting as the only possible sink of greenhouse gas emissions in Estonia, plays an important role in the national carbon cycle. In 2016 the LULUCF sector acted as a CO_2 sink, with total uptake of -2 724.44 kt CO_2 eq.

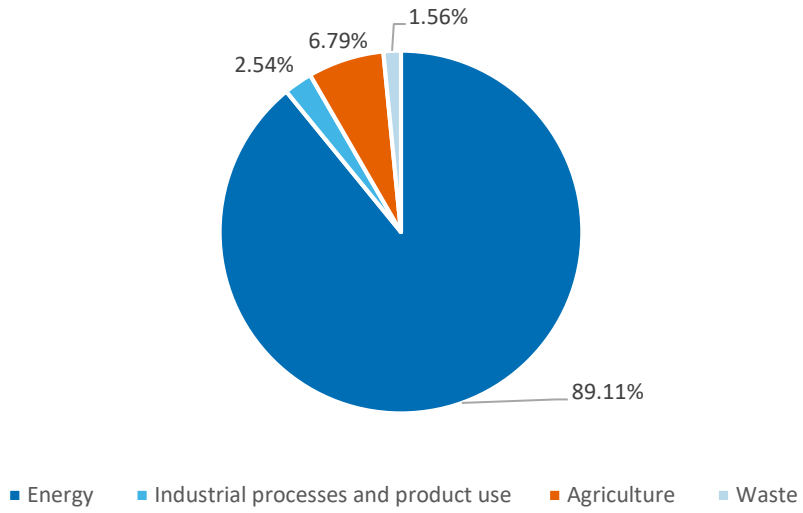

Figure 1.2. Greenhouse gas emissions by sector in 2016, per cent

In 2016, the main greenhouse gas in Estonia was carbon dioxide (CO_2), accounting for 88.95 per cent of all GHG emissions (excluding LULUCF), followed by methane (CH_4) on 5.38 per cent and nitrous oxide (N_2O) on 4.46 per cent. F-gases (HFCs, PFCs, SF_6 and NF_3[1]) collectively accounted for about 1.21 per cent of overall GHG emissions (Figure 1.3).

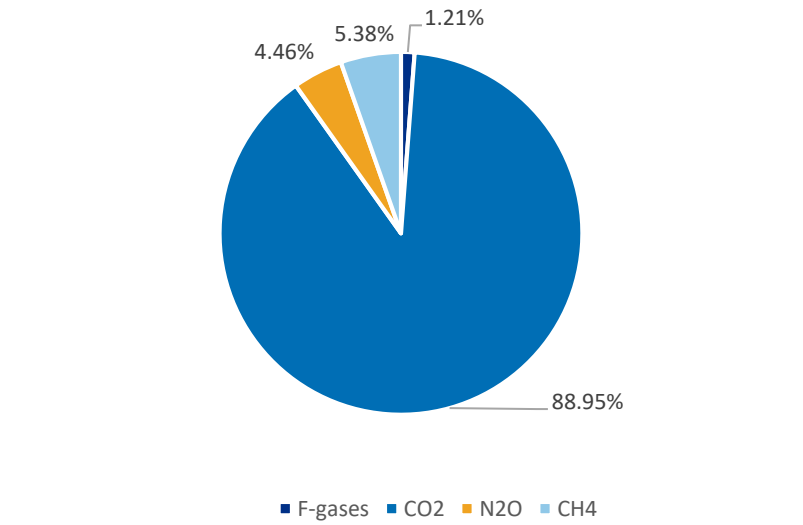

Figure 1.3. Greenhouse gas emissions by gas in 2016, per cent

[1] PFC and NF_3 emissions did not occur in Estonia in 2016.

2. ENERGY AND CLIMATE POLICY AND SECTORAL PROGRAMMES

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

Single national entity with overall responsibility for the Estonian greenhouse gas reporting is the Ministry of the Environment (MoE). In the beginning of 2018 with an aim to improve/optimize the GHG reporting process in Estonia, MoE decided to appoint the Estonian Environmental Research Centre (EERC) to be the institution to have the overall responsibility of maintaining the national systems for GHG reporting and submitting the final reports to the European Commission (EC) and to the UNFCCC on behalf of the MoE. Climate Department of EERC coordinates the compilation of the report on policies and measures and projections. The EERC is responsible for preparing the projections for the Energy, IPPU, Agriculture and Waste sectors. Forest Department of the Estonian Environment Agency (EstEA) is responsible for projections in Land use, land-use change and forestry (LULUCF) sector.

Estonia's national system for policies and measures and projections is set up to ensure the transparency, accuracy, consistency, comparability and completeness of the information reported on policies and measures and projections of anthropogenic GHG emissions by sources and removals by sinks.

See additional information regarding Estonia's national system in a separate document "National System for reporting on policies, measures and projections under Article 13 (1) (a) of Regulation (EU) No. 525/2013 and Article 20 of implementing Regulation (EU) No. 749/2014. ESTONIA".

2.2. Update relevant to Low-carbon development strategy

In 2011, the European Commission published *'A roadmap for moving to a competitive low carbon economy in 2050'*. Estonia finalized its report on *'Opportunities for Low-Carbon Economy in Estonia*' in 2013. In the report it was concluded, that for Estonia the 75% decrease in GHG emissions by the year 2050 (compared to 1990) would be the most optimal amount. On the basis of the report, in the beginning of 2015 the MoE started to prepare *Low Carbon Development Strategy 2050* (GPCP 2050), with the aim to decrease the GHG emissions 80% by 2050 compared to 1990. The GPCP 2050 was adopted by the Parliament on 5 April 2017.

GPCP 2050 is a vision document that sets a 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.

Principles and guidelines set in the document have to be taken into account when renewing and implementing the cross-sectoral and sectoral strategies and national development plans in place. Estonia will be transformed into an attractive environment mainly for the development of innovative technologies, products and services reducing the emission of GHG. In addition, the export and global implementation of such technologies, products and services shall be facilitated for the resolution of global problems.

The general sectoral policy guidelines and principles of GPCP 2050 include:

- Efficient interaction of the system as a whole when planning energy consumption centres

and new production capacities.

- Facilitating the implementation of technologies with a low emission factor of CO_2 and efficient use of resources in manufacturing processes.
- Considering economy and energy efficiency of the system as a whole when renovating the existing building stock and planning and constructing new buildings.
- Considering economy and energy efficiency when planning, building, managing and reconstructing grids within energy systems with the aim of achieving maximum energy and resource efficiency.
- Moving towards enhancing energetic value and the production of products with higher additional value to minimise the GHG emission in the oil shale treatment process in a way that does not entail an increase in other negative environmental impacts.
- Directing major participants in the energy and industry sectors towards a successful and cost-efficient reduction of GHG emissions while continuing the use of market based mechanisms.
- Ensuring energy security and security of supply with a gradual wider exploitation of domestic renewable energy sources in all sectors of final consumption with a view to increase the welfare of the society.
- Facilitating a well-functioning transportation system and reducing forced traffic through the integration of the planning of settlements and transportation and the design and implementation of mobility plans.
- Influencing the purchase of economical vehicles and sustainable alternative fuels through investments and tax policies of the public sector.
- Prioritising the development of public transportation, non-motorised traffic and energy efficient carriage of goods.
- Increasing and maintaining soil's carbon stock incl. developing and maintaining significant carbon stock of land areas.
- Encouraging efficient and ecological use of agricultural land while avoiding the falling out of agricultural use of such land.
- Enhancing the use of plant nutrients and replacement of mineral fertilisers with organic fertilisers and eco-friendly soil conditioners.
- Enhancing the production of bioenergy and using it in energy intensive manufacturing processes.
- Increasing the productivity of agriculture, with the focus on eco-friendlier manure management for limiting ammonia emissions.
- Increasing forest increment and ability to sequestrate carbon through timely regeneration of forests.
- Promoting the use of wooden products and increasing carbon storage in wooden products and buildings will help replace non-renewable natural resources and develop domestic wood production.
- Promoting the preservation of existing forest area and increasing carbon sequestration and emission reduction in other land-use categories.
- Preserving and increasing carbon stocks in wetlands. Avoiding further wetland drainage and already drained wetlands will be rewetted if possible to avoid further degradation.
- Preferring the development of research studies in Land use and forestry sector that will help to increase carbon sequestration and to find alternative uses for wood.
- Continuing the reduction of waste generation and making the separate collection of waste more efficient.
- Facilitating research, development and innovation that will help to increase the development of efficient energy technologies, renewable energy production technologies,

sustainable transportation and mobility, sustainable agriculture, carbon sequestration in forestry and finding alternative uses for timber will be preferred.

2.3. General documents

The *Sustainable Development Act* (RT I, 10.11.2016, 16) was adopted by the Parliament in 1995. It establishes the principles for the sustainable use of natural environment and resources. The *Estonian National Strategy on Sustainable Development – Sustainable Estonia 21* was approved by the Parliament in 2005 and is the most general national strategy document aimed at developing the Estonian state and society until the year 2030.
More concrete long-term environmental development objectives are formulated in the *National Environmental Strategy until 2030* endorsed by the Parliament in 2007.

The national reform program *'Estonia 2020'* was first approved by the Government in April 2011 and is updated yearly by the end of April. The last update was done in April 2018. The program sets 3 main targets regarding GHG emissions and environmental economy and energy:

1) The GHG emissions covered by the Decision no 406/2009/EC *(Effort Sharing Decision - ESD)* should not exceed the GHG level of 11% growth by 2020 compared to 2005.
2) 25% share of renewable energy in final energy consumption by 2020.
3) Keep the final energy consumption on the 2010 level (about 118 PJ).

The level of renewable energy in final energy consumption was 28.8% in 2016, which indicates that achieved level needs to be maintained in order to meet the target set for 2020.

Keeping the final energy consumption on the 2010 level by 2020 foresees the increase in energy efficiency in almost all subsectors (households, industry, transport and public sector have the key role in fulfilling the measures). The final energy consumption in 2016 was about 3% higher than the target for 2020. This indicates, that Estonia will success in keeping the final energy consumption in the 2010 level by 2020.

3. INFORMATION ON POLICIES AND MEASURES

In accordance with §143 of *Atmospherics Air Protection Act*, activities to reduce climate change are arranged by the Ministry of the Environment on the basis of the requirements for limitation of GHG emissions arising from the UNFCCC and the Kyoto Protocol to the UNFCCC and the European Union legislation. Ministry of the Environment keeps the record of the reports submitted to the UNFCCC and evaluates the progress towards the emission reduction targets.

3.1. 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 EU ETS is a cornerstone of the EU's policy to combat climate change and its key tool for reducing GHG emissions cost-effectively. It was established by Directive 2003/87/EC (the Emissions Trading Directive) and entered into force on 1 January 2005.

The share of Estonia's EU ETS emissions from all sectors is high– about 68%.

3.2. Energy

The Government of Estonia approved the *Estonian Energy Development Plan until 2030 (EEDP 2030)* on 19 October 2017. The development plan is aimed at ensuring an energy supply that is available to consumers at a reasonable price and effort and with an acceptable environmental condition, while observing the terms and conditions established in the long-term energy and climate policy of the EU. The most beneficial economic competitiveness aspects must be observed for the purposes of the implementation of EEDP 2030. The plan also drafts the benchmarks for renewable energy and energy efficiency operational programmes and the vision for the renovation of buildings.

Expected outcomes of the EEDP 2030+ include:

- reduction of GHG emission by 70%, (Energy sector);
- renewable energy sources account 50% of final energy consumption (and 28% of domestic primary energy consumption);
- final energy consumption in 2020 and 2030 at the same level as in 2010 (in accordance with the programme *Estonia 2020*);
- primary energy supply: 57.7 TWh.

The EEDP 2030 also includes plans for regional cooperation, particularly with Latvia and Lithuania in terms of security of Energy supply.

3.2.1. Electricity supply

The major national-level document aimed at the electricity sector is the *EEDP 2030*. The plan foresees a significant decrease in electricity production from oil shale and an increase in proportion of other sources of energy.

The plan emphasises that Estonia's electricity sector requires fundamental changes as the impact of electricity generation on the environment must be reduced. This process is also

affected by the need to use the resources of oil shale in a more sustainable way. Therefore, the plan provides scenarios for the restructuring of electricity production in Estonia. Also, the capacity of wind turbines (mainly wind farms) could be increased significantly, compared to when the development plant came into effect.

Regarding options for electricity generation, the plan considers four main development scenarios. The projected annual increase rate of the peak load is 1.6–3.8%, the average taken as 2.3% per annum. As for consumption, it is projected the electricity consumption (with transmission and distribution losses) will be at 10 TWh in 2030 if today's trends continue.

All scenarios include the following common elements for generation:

- the currently used oil shale-based units with fluidised bed boilers are still in operation;
- at least 200 MW of cogeneration units firing various fuels;
- some old units of oil shale pulverised combustion with desulphurisation equipment.

According to the *EEDP 2030* new electricity production units have to be competitive in the open electricity market without any subsidies. The support schemes for new production units are set in Electricity Market Act (RT I, 12.12.2018, 13) and are primarily aimed at renewable energy, combined heat and power (CHP) production and complying to the criteria of local production units.

The *EEDP 2030* measures estimated in the projections of the electricity supply are the following:

1) **Support for renewable and efficient CHP based electricity production** – The support rates are presented in Table 3.1.
2) **Investments for construction of wind parks** – It is estimated that by 2040 the production of wind power should be approximately 6 000 GWh. The wind parks are built in a competitive open market and through the support schemes of the Electricity Market Act.

The projected effects of the measures related to electricity production are presented in Table 3.2.

Table 3.1. Support for renewable and efficient CHP based electricity production

Level of subsidy	Conditions for receiving the subsidy
	Subsidies are paid for electricity that is produced:
0.0537 €/kWh	From renewable energy sources which do not exceed 100 MW
0.0537 €/kWh	From biomass in CHP mode. From 31.12.2010, producers who have started generating electricity from biomass can only get the subsidy for electricity generated in efficient CHP mode
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 10MW

Table 3.2. Projected effects of the WEM measures in electricity supply, kt CO_2 eq.

	2016	2020	2025	2030	2035	2040
Support for renewable and efficient CHP based electricity production	514.45	700.54	707.83	710.10	745.07	923.53
Investments for construction of wind parks	219.44	219.44	293.31	758.85	808.31	716.41

3.2.2. Heat supply

Heat supply, particularly district heating, is a sector with quite a large potential for increasing energy efficiency, which in turn will result in lower GHG emissions. The goals set in *EEDP 2030* are to use the full potential of CHP plants, promote the use of local fuels and to reduce the share of imported fuels in heat supply. It is expected, that the share of renewable energy in heat supply will be more than 60%, the share of imported fuels less than 30% and the use of primary energy less than 19 TWh per year by 2030.

Regarding biomass, a large amount of the primary energy arising from fuel wood (logs, chips, pellets and wood waste) is used in heat production. However, development is hindered by the large-scale exporting of biomass, due to which local energy producers in some cases do not have enough biomass resources. Exports result in elevated prices for some biomass products, especially wood pellets. The deployment of smaller-scale cogeneration CHP's as an element of decentralised energy production strategy would increase the security of energy supply in Estonia. A small heat load and the fact that new equipment producing only heat alone has already been installed in many areas with a favourable heat load can be indicated as hindrances to the development of combined heat and power production based on biomass.

As a rule, district heating is more environmentally benign as a heat supply option than local heating. Therefore, it is important that the District Heating Act (RT I, 03.03.2017, 12) enables the zoning of district heating as an element of regional heat supply planning. The Act gives local governments the power to introduce the zoning of heat supply based on analyses, carried out for alternative heat supply options during the planning phase. The zoning of heat supply as an instrument of regulation of the energy sector gives local governments the authority to avoid chaotic disconnection from district heating (DH) systems. The latter process had been taking place in some towns and cities for many years.

The main *EEDP 2030* WEM measures that have an effect on GHG emissions in Heat supply sector are the following:

1) **Development of the heat economy:**

- **Renovation of boilerhouses –** This measure includes fuel switch from oil fuels to renewable and/or local energy sources like biomass, peat, etc. The expected cost is projected to be about 37.5 million euros annually.
- **Renovation of heat networks –** The aim of this measure is to reduce the losses in district heating networks. The expected cost is projected to be about 3.8 million euros annually.
- **Transition of consumers to local and place heating –** District heat networks that are operating inefficiently (the amount of MWh sold per meter of heat pipes is less than 1.2) will be restructured to local and place heating. The expected cost is projected to be about 1 million euros annually.

The main *EEDP 2030* WAM measures that have an effect on GHG emissions in Heat supply sector are the following:

1) **Additional development of the heat economy:**
    - **Additional renovation of boilerhouses –** This measure includes additional implementation of the measure "Renovation of boilerhouses". This means that additional investments are planned to facilitate additional energy efficiency and additional GHG savings.
    - **Additional renovation of heat networks –** This measure includes additional implementation of the measure "Renovation of heat networks". This means that additional investments are planned to facilitate additional energy efficiency and additional GHG savings.
    - **Additional transition of consumers to local and place heating –** This measure includes additional implementation of the measure "Transition of consumers to local and place heating". This means that additional investments are planned to facilitate additional energy efficiency and additional GHG savings.

The projected effects of the measures in heat production are presented in Table 3.3 and Table 3.4.

Table 3.3. Projected effects of the measures in heat production in the WEM scenario, kt CO_2 eq

	2016	2020	2025	2030	2035	2040
Renovation of boilerhouses	22.5	34.7	134.7	165.1	108.7	115.5
Renovation of heat networks	16.7	25.7	99.8	122.4	99.5	112.0
Transition of consumers to local and place heating	6.8	10.5	41.0	50.4	26.5	25.9

WAM measures show an estimated GHG mitigation impact, should additional funding appear for the renovation of boiler houses and heat networks as well as transitioning consumers to local and place heating.

Table 3.4. Projected effects of the measures in heat production in the WAM scenario, kt CO_2 eq

	2016	2020	2025	2030	2035	2040
Additional renovation of boilerhouses	18.2	33.0	128.6	157.4	103.2	109.5
Additional renovation of heat networks	49.7	89.9	349.2	428.5	213.5	204.0
Additional transition of consumers to local and place heating	13.3	24.2	93.7	115.2	66.7	67.8

3.2.3. Energy consumption ─ Manufacturing industries and construction

The Second National Energy Efficiency Action Plan of Estonia (NEEAP2) declares that increasing the energy efficiency in Manufacturing industries is in Estonia mainly ensured by increasing environmental awareness and measures that are related to the wider energy policy,

such as the opening up of the electricity market, the renewable energy charge, fuel and electricity excise duties and reduced differences in excise duty rates. For example, in the beginning of 2017 MoE opened a measure for increasing industrial resource efficiency, of which the main objectives are gaining energy savings in small and medium sized companies. The actions supported are raising awareness, educating experts, conducting audits and making investments. Investment support is provided to five most important sectors: mining, food processing, wood, pulp, paper and non-metallic minerals industries. According to the Energy Sector Organization Act (RT I, 12.12.2018, 34), large companies are mandated to have regular energy audits.

3.2.4. Energy consumption – Other sectors (Commercial/institutional and residential sectors)

Measures from the *EEDP 2030*, which are taken into account in the Residential and Commercial/Institutional sector are mainly related to energy conservation through reconstruction of buildings. In Other sectors, the main measures having an effect on GHG emissions, that are already in place and therefore included in the WEM scenario[2]:

1) **Reconstruction of public and commercial buildings –** reconstruction of 10% of the existing buildings to energy efficiency class D by the year 2030.
2) **Reconstruction of private houses and apartment buildings –** reconstruction of 10% of existing private houses to energy efficiency class E and 15% of existing apartment buildings to energy efficiency class E by the year 2030. The expected cost of the measure is about 3.5 million euros annually.
3) **Implementation of the minimum requirements for nearly zero energy buildings** the requirements will be implemented as required by the Directive 2010/31/EU on the energy performance of buildings.

Few additional measures are still under discussion or waiting additional funds and henceforth are reported as WAM. These measures include[2]:

1) **Additional reconstruction of public and commercial buildings –** reconstruction of 20% of the existing buildings to energy efficiency class C by the year 2030.
2) **Additional reconstruction of private houses and apartment buildings –** reconstruction of 40% of existing private houses to energy efficiency class C or D and 50% of existing apartment buildings to energy efficiency class C by the year 2030.
3) **Reconstruction of schools and kindergardens –** reconstruction of 40% of the existing schools and kindergardens by the year 2030.
4) **Investments through European cohesion fund to street lighting reconstruction programme -** the aim of the programme is to increase the efficiency of the use of electricity in street lighting.

The projected effects of the measures are presented in Table 3.5 and Table 3.6.

[2] Effects of PaMs for the years 2020, 2025, 2030, 2035 and 2040 are not estimated by gas, only the total estimate of mitigation impact kt CO_2 eq. is available.

Table 3.5. Projected effects of the measures in Other sectors in the WEM scenario, kt CO_2 eq

	2016	2020	2025	2030	2035	2040
Reconstruction of public and commercial buildings	0.6	0.7	1.1	1.4	1.7	1.6
Reconstruction of private houses and apartment buildings	1.4	1.9	2.4	3.3	3.8	3.7
Implementation of the minimum requirements for nearly zero energy buildings	0.0	6.0	7.6	10.3	12.0	11.6

WAM measures show an estimated GHG mitigation impact, should additional funding appear for the reconstruction of public and commercial buildings; private houses and apartment buildings; schools and kindergardens. The measure "Investments through European cohesion fund to street lighting reconstruction programme" has been implemented since 2007 and the historical emission reduction and cost of implementation (through GIS) has been included, the emission reduction resulting from a follow up is not taken into account in the projections as it currently under development.

Table 3.6. Projected effects of the measures in Other sectors in the WAM scenario, kt CO_2 eq

	2016	2020	2025	2030	2035	2040
Additional reconstruction of public and commercial buildings	0.0	2.1	3.3	4.5	5.2	5.9
Additional reconstruction of private houses and apartment buildings	0.0	26.6	53.1	72.3	83.6	93.8
Reconstruction of schools and kindergardens	0.0	0.0	1.9	2.6	3.1	3.5

3.3. Transport

The Estonian Parliament approved the Transport Development Plan 2014–2020 in February 2014. The development plan sets forth the following relating to climate policy:

- Decreasing the use of vehicles in towns by improving the conditions for walking, cycling and using public transport and use smart solutions to offer various new services, particularly short-term bicycle and car rent.
- Increasing the number of departures and speed of connection for train traffic for trains to become the most favoured means of transport that connects Tallinn and other towns; improving the train connection with Latvia (on Tartu–Riga line, Rail Baltic) and Russia (the trip to St Petersburg should be shorter than 5 hours).
- Increasing the share of more economic vehicles that run on renewable energy so that biomethane or compressed gas generated from domestic biomass and waste would become the main alternative type of fuel in Estonia.

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 main WEM measures having an effect on GHG emissions, that are already in place, include:

1) **Increasing the share of biofuels in transport sector** – The main target of this measure is to achieve the 10% share of biofuels in transport sector by 2020 and 14% by 2030, (Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources).

2) **Promoting economical driving –** Includes promoting eco-driving. The expected cost of this measure is 14 million euros annually.

3) **Spatial and land-use measures for urban transport energy savings to increase and improve the efficiency of the transport system:**

    - **Improvement of the traffic system –** Includes updating parking policies in cities, planning land use to reduce the use of private cars, restructuring the streets in cities, etc. The expected cost is about 16.7 million euros annually.

    - **Reducing forced movements with personal vehicles–** Includes developing telecommunication and also developing short-term rental cars systems. The expected cost is about 0.5 million euros annually.

4) **Development of convenient and modern public transport –** Includes improving the availability of public transport, developing ticket systems and new services. The expected cost is about 16.7 million euros annually.

5) **Increasing fuel economy in transport** – Includes developing a support system for energy efficient cars, hybrid buses, hybrid trolleys, electrical buses etc. The expected cost is at least 6 million euros annually.

6) **Road usage fees for heavy duty vehicles** – Based on time, location, environmental aspects, etc.

Following measures are still under development and henceforth are reported as planned in the WAM scenario:

1) **Additional promotion of economical driving –** This measure includes additional implementation of the measure "Promotion of economical driving". This means that additional investments are planned to facilitate additional energy efficiency and additional GHG savings.

2) **Additional spatial and land-use measures for urban transport energy savings to increase and improve the efficiency of the transport system:**

    - **Development of light traffic routes -** Increasing the share of the use of light traffic routes.

    - **Additional improvement of the traffic system –** This measure includes additional implementation of the measure "Improvement of the traffic system". This means that additional investments are planned to facilitate additional energy efficiency and additional GHG savings.

    - **Ride sharing -** Includes promotion of ride sharing and short-term rental car systems.

- **Urban parking policy -** Renewal of urban parking requirements (development of optimal parking space requirements in planning and standards) and reduction of subsidisation of car parking spaces.

- **Remote work and e-services -** Includes developing e-services and also promotion of remote work.

3) **Additional development of convenient and modern public transport –** This measure includes additional implementation of the measure "Development of convenient and modern public transport". This means that additional investments are planned to facilitate additional energy efficiency and additional GHG savings.

4) **Electric car purchase support -** The investment will be directed to support the acquisition of high-mileage commercial electric vehicles (e.g taxies).

5) **Road usage fees for heavy duty vehicles –** Based on mileage, location, environmental aspects, etc.

6) **Vehicle tyres and aerodynamics -** The measure introduces better rolling resistance tyres and improves the aerodynamics of vehicles. The training materials for truck drivers will be complemented to highlight the importance of checking tyres and tyre pressures.

7) **Developing the railroad infrastructure (includes the building of Rail Baltic) –** The expected cost of Rail Baltic is 22.4 million euros annually. This measure also includes raising the speed limit to 160 km/h in Tallinn-Narva and Tapa-Tartu directions., which makes the total cost of the measure 30 million euros annually.

8) **The railroad electrification -** Electrification of existing railway and extension of its use (including the addition of convenient passenger trains).

9) **Ferry traffic electrification -** Includes the eletrification of the ferry traffic between the Estonian mainland and the islands.

The projected effects of the measures are presented in Table 3.7 and Table 3.8.

Table 3.7. Projected effects of the measures in transport sector in the WEM scenario, kt CO_2 eq

	2016	2020	2025	2030	2035	2040
Increasing the share of biofuels in transport	2.2	242.0	295.9	370.3	385.5	398.9
Promotion of economical driving	10.4	36.3	62.5	88.3	88.3	88.3
Spatial and land-use measures for urban transport energy savings to increase and improve the efficiency of the transport system	15.6	54.9	94.0	133.3	133.3	133.3
Development of convinient and modern public transport	6.3	22.2	38.0	53.8	53.8	53.8
Increasing fuel economy in transport	11.6	40.8	69.9	99.0	99.0	99.0
Road usage fees for heavy duty vehicles (based on time, location, environmental aspects, etc.)	0.0	94.6	181.7	268.3	301.0	301.0

WAM measures show an estimated GHG mitigation impact, should additional funding appear for promoting economical driving, improvement of the traffic system, development of light traffic routes, ride sharing, urban parking policy, remote work and e-services, developing convenient and modern public transport road usage fees for heavy duty vehicles, vehicle tyres and aerodynamics, developing the railroad infrastructure and ferry traffic electrification. The measure "The railroad electrification" is not included in the projections as it is currently under development.

Table 3.8. Projected effects of the measures in transport sector in the WAM scenario, kt CO_2 eq

	2016	2020	2025	2030	2035	2040
Electric car purchase support	0.0	0.0	42.9	78.9	78.9	40.4
Additional promotion of economical driving	0.0	0.0	28.7	51.0	73.7	96.0
Additional spatial and land-use measures for urban transport energy savings to increase and improve the efficiency of the transport system	0.0	0.0	175.0	284.6	284.6	284.6
Additional development of convenient and modern public transport	0.0	0.0	60.9	99.1	99.1	99.1
Road usage fees for heavy duty vehicles (based on mileage, location, environmental aspects, etc.)	0.0	0.0	20.2	19.8	19.8	19.8
Vehicle tyres and aerodynamics	0.0	0.0	28.4	46.1	46.1	46.1
Developing the railroad infrastructure (includes the building of Rail Baltic)	0.0	0.0	0.0	77.7	77.9	77.9
Ferry traffic electrification	0.0	0.0	24.4	24.4	24.4	24.4

A study carried out in 2018 to find cost-effective mitigation measures includes following transport measures affecting GHG emissions. These measures are under discussion and therefore are not included in the transport sector's projections.

1) **Developing and implementing a congestion charge system in cities -** The main target is to reduce traffic in the center of the cities.

2) **Road usage fees for passenger cars –** Based on mileage, location, environmental aspects, etc.

3) **Passenger car registration and annual tax -** Based on location, environmental aspects, etc.

Table 3.9. Projected effects of the measures in transport sector , kt CO_2 eq

	2016	2020	2025	2030	2035	2040
Developing and implementing a congestion charge system in cities	0.0	0.0	101.7	99.2	99.2	99.2
Road usage fees for passenger cars	0.0	0.0	247.6	322.0	322.0	322.0
Passenger car registration and annual tax	0.0	0.0	129.7	210.9	210.9	210.9

3.4. Industrial processes and product use

Estonia is reporting two measures for IPPU sector:

Implementing bans and duties stipulated in the Regulation (EU) No. 517/2014 on fluorinated greenhouse gases and Directive 2006/40/EC related to emissions from mobile air conditioners (MACs). The effect of this measure is the same on WEM as well as WAM scenario. Please see the effects in Table 3.10.

Consumption and emissions of fluorinated GHGs are phased-down by Regulation (EU) No 517/2014 which came into force in 2015. Directive 2006/40/EC prohibits since 01.01.2017 the sale of new passenger cars, pick-up trucks and vans with EU type approval which have refrigerant with global warming potential (GWP) over 150 in air conditioner. Estonia has not imposed significantly stricter requirements than in Regulation (EU) No 517/2014 and in Directive 2006/40/EC.

The beforementioned measure is further supported by **project-based promotion of alternative natural and low-GWP refrigerants in Estonia, considering the bans and duties from the Regulation (EU) No. 517/2014 on fluorinated greenhouse gases**

Project-based promotion of alternative refrigerants consists of three activities:

- ensuring up-to-date educational possibilities for refrigeration engineers to work with new refrigeration technologies and refrigerants;
- discouraging investments in technologies based on high-GWP refrigerants that are or will be subjects of strict restrictions;
- ensuring recovery, recycling and reclamation of such high-GWP refrigerants already placed on market; to ensure awareness of target groups on the restrictions and duties resulting from Regulation (EU) No. 517/2014.

These activities are supporting and boosting effects of Regulation (EU) No. 517/2014 and national legislation. Some activities already are ongoing but their effect cannot yet be estimated separately from effects of Regulation (EU) No. 517/2014.

Table 3.10. Projected effects of implementing the bans and duties stipulated in the Regulation (EU) No. 517/2014 on fluorinated greenhouse gases and Directive 2006/40/EC related to emissions from mobile air conditioners (MACs), kt CO_2 eq

	2016	2020	2025	2030	2035	2040
Reduction of HFC emissions	0.0	2.6	48.2	101.8	131.2	154.3

Additional measure on road transport – developing the railroad infrastructure (includes the building of Rail Baltic) – affecting subsector 2.D.3 Other – Urea based catalysts for motor vehicles. This measure is used in WAM scenario for IPPU. According to the WAM scenario diesel fuel consumption is decreased and consumption of urea based diesel exhaust fluid also. More information on this measure and cross sectoral parameters are presented Chapters 3.3 and 3.8

3.5. Agriculture

Climate change mitigation and adaptation have been considered in the development of different measures, and directly or indirectly the majority of environmental and investment grants along with different environmental awareness raising activities contribute to these efforts in the *Estonian Rural Development Plan 2014–2020 (ERDP)*. Most of the same measures are also referred in the *Climate Change Mitigation and Adaptation Action Plan in Agriculture sector 2012–2020* and in the *Estonian Organic Farming Development Plan 2014–2020,* strive to limit and reduce GHG emissions in the agricultural sector.

The measures of *ERDP* that contribute to reducing GHG are following:

1) **Knowledge transfer and awareness** ─ The general objective of the measure is to develop and enhance the technical, economical and environmental knowledge of the enterprisers and their employees in agriculture, food and forest sector to improve the bioeconomy and adapt new challenges to use resources sustainably. The measure aims to promote organisation of educational trainings, presentations, awareness-raising activities, organising workshops or visits to enterprises and long-term programs. Expected cost of implementing the measure is 5.9 million euros in 2018–2020.
2) **Advisory services, farm management and farm relief services** ─ The general objective of the measure is to enhance the sustainable management or effectiveness of agricultural holdings or enterprisers by providing high-quality advisory services to the people working for agriculture sector. Advisory services include inter alia environmental and climatic topics. Expected cost of implementing the measure is 7.0 million euros in 2018–2020.
3) **Agri-environmental measure and its submeasures**:
    - **Support for environment-friendly management** ─ The objectives of the submeasure are following: to promote the introduction and continual use of environmentally friendly management methods in agriculture, in order to protect and increase biological and landscape diversity and to protect the water and soil condition; to promote environmentally friendly planning in agriculture and to raise environmetal awareness of agricultural producers. Expected cost of implementing the submeasure is 170.3 million euros in 2014–2020.
    - **Support for regional water protection** ─ The objective of the submeasure is to preserve water quality by decreasing agricultural soil leaching. Expected cost of implementing the submeasure is 7.1 million euros in 2014–2020.
    - **Support for environment-friendly gardening** ─ The general objective is to promote the use of environment-friendly practices in gardening. One of the more specific aims is to decrease leaching. Expected cost of implementing the submeasure is 3.9 million euros in 2014–2020.
4) **Support for organic production** ─ 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 well-being. The measure helps to reduce GHG emissions by using organic fertilizers instead of mineral fertilizers. Additionally, emission per one hectare is lower compared to the conventional production. Expected cost of implementing the measure is 55.0 million euros in 2018–2020.

5) **Support for animal well-being ─** The measure should reduce animal stress level, e.g. by having more space per animal. Having less stress enables animal to achieve better feed digestibility which reduces emissions from enteric fermentation. Expected cost of implementing the measure is 26.4 million euros in 2018–2020.

6) **Reducing GHG and ammonia emissions from agricultural sector ─** This measure aims to include 49.6% of the agricultural land currently in use under economizing agreements by 2020. The objectives include promoting use of biomass, producing renewable energy, investing in livestock buildings (including manure storage) and increasing the technological capacity of agricultural enterprises.

On 16 December 2013 the Council of EU Agriculture Ministers formally adopted the four Basic Regulations for a reformed *Common Agricultural Policy (CAP).* **EU CAP Greening measure** aims to limit and reduce GHG emissions and enhance carbon sequestration on croplands. The greening is a requirement of direct area-based payments. The objective of the measure is to make farms with monocultures more environmentally friendly and sustainable. Expected cost of implementing the measure is 134.2 million euros in 2018–2020.

The objective of the *Estonian Dairy Strategy* to increase the volume of milk production by a third compared to 2011 is not a mitigation measure by nature and will affect the GHG emission balance by increasing CH_4 and N_2O emissions from animal husbandry. For this reason the Estonian Dairy Strategy has been shown in the report as an informative item.

Some of the objectives under the *Estonian Sheep Farming Development Plan 2018–2023* influence GHG emissions, such as homogenizing the quality of sheepmeat, simplification the realization of sheepmeat and rising its consumption. The feeding ration that may enable to achieve the homogenizing the quality of sheepmeat goal affects enteric fermentation and composition of manure and is associated with CH_4 and N_2O emissions. In contrary to the positive effect of homogenization the quality of sheepmeat for reducing GHG emissions, the simplification of realization and rising consumption of the sheepmeat would increase the emissions.

EEDP 2030 describes the objectives of Estonia's energy policy until 2030 and the vision of energy management until 2050, objectives and sub goals of *EEDP 2030* and measures of the implementation of the development plan. The production of biomethane and bioethanol, that can be produced using agricultural input, would enable Estonia to reach the mandatory national target set by the EU for renewable energy shares of final energy consumption in 2020, which also includes 10% of renewables in transport sector.

A study carried out in 2018 to find cost-effective mitigation measures includes following agriculture measures affecting GHG emissions. Because the following measures are under discussion, then they are not included in projections scenarios.

1) **Enhancing the quality of feed of dairy cows ─** The objective of the measure is to enhance the average digestibility of feed from 67% to 70%. The measure includes better feed preparation and timely harvesting of crops.

2) **Increase the proportion of grazing on grassland ─** The objective of the measure is to sequestrate nitrogen compounds from manure on grassland.

3) **No-till farming ─** The objective is to sequestrate nitrogen.This measure is also a part of the *ERDP* submeasures Support for regional water protection and Support for regional soil protection.

4) **Cover crops ─** The objective of the measure is to avoid leaching of nitrogen.

5) **Site-specific fertilization** ─ The objective is to compile a fertilization plan in coherence with the Water Law. This measure is also a part of the *ERDP* submeasures Support for environment-friendly management and Support for regional water protection.

6) **Replacement of mineral fertilizers by organic fertilizers** ─ The objective of the measure is to replace the use of mineral fertilizers by organic fertilizers and to avoid the removal of organic matter without any reason.

Measures to reduce nitrogen leakage from agriculture

The Accession Treaty for the new members of the European Union specified that the measures of the Nitrates Directive had to be implemented in Estonia by the end of 2008. Therefore a Code of Good Agricultural Practices were agreed upon between Ministry of Agriculture (now Ministry of Rural Affairs) and the MoE in 2001 and an Action program for establishment of Nitrate Vulnerable Zone (NVZ) was defined with the aim of being implemented by the end of 2008.

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. In 2001 the Code of Good Agricultural Practices and a Government decree on water protection requirements for fertilizer, manure and silage were introduced and both of these are relevant to Annex II and III in the Nitrates Directive. The *Water Act* (RT I, 22.02.2019, 32) is one of the principal legal acts that the prime measures in *Estonian Water Management Plan measure program 2015–2021* are grounded upon.

Measures in the *Estonian Water Management Plan measure program 2015–2021* striving to limit nitrogen exposure from agriculture to the environment (based on the *ERDP* measures) are following:

1) Training of agricultural producers for raising awareness and for the promotion of environmentally friendly production. Expected cost of implementing the measure is 0.1 million euros.

2) Introduction of effective fertilization technologies ─ Expected cost of implementing the measure is 7.9 million euros.

3) Reducing pollution caused by nutrients from agriculture (repair manure and silage storage facilities, support the promotion of environmentally friendly fertilizer spreading technologies, support the promotion of good agricultural practice) ─ Expected cost of implementing the measure is 0.9 million euros.

4) Reconstruction or construction of new livestock facilities (including manure and silage storage facilities) in order to prevent the environmental risks arising from production. Expected cost of implementing the measure is 21 million euros.

3.6. Land use, land-use change and forestry

The *Forest Act* (RT I, 29.06.2018, 33) provides the legal framework for the management of forests in Estonia. The main objective of the act is to ensure the protection and sustainable management of forests as an ecosystem. The *Forest Act* includes Reforestation measure that aims to support regeneration of forest after felling or natural disturbances. According to *Forest Act*, the forest owner is obliged to assure regeneration of forest no later than 5 years after felling or natural disturbances. Supporting fast reforestation after felling is beneficial to achieving continuous carbon sequestration on forest land and therefore maintaining the level of GHG removals by forests in Estonia.

The *Estonian Forestry Development Programme until 2020 (EFDP 2020)*, approved by the Parliament in 2011, is the official sustainable development strategy for the Estonian forest sector. The programme determines objectives and describes measures and tools for achieving them for the period 2011–2020. The main objective of the development plan is to ensure productivity and viability as well as to assure multiple and efficient use of forests. One of the aims is to increase the annual increment along with carbon sequestration in forests by implementing appropriate forest management activities like regeneration, cleanings and thinnings. In Table 3.11 the main indicators and target levels are presented for the current situation and for 2020.

Table 3.11. Indicators and target levels set in *EFDP 2020*

Indicator	Baseline level	Target level
Growing stock	442 million m^3 (NFI 2008)	450 million m^3
Increment	12.1 million m^3/yr (NFI 2008)	12.5 million m^3/yr
Annual volume and area of regeneration fellings	5.85 million m^3 22,400 ha/yr (NFI 2000–2008)	10.1 million m^3 34,500 ha/yr (2011–2020)
Annual area of cleanings	22,200 ha/yr (STAT 2009)	32,400 ha/yr
Annual area of thinnings	14,200 ha/yr (NFI 2007)	34,500 ha/yr
Woody biomass used in energy production	22 PJ/yr (2009)	30 PJ/yr

According to the *EFDP 2020* the state has set a goal to enhance the use of wood because the age structure of Estonian forests supports more cutting (12–15 million m^3 per year), and not using forest resources would be an unreasonable waste of renewables.

Achieving the objectives of the *EFDP 2020* is supported by the *ERDP*, through which most of the private forestry support measures are co-financed. The objective of the *ERDP* is to support Estonian rural development in a manner that is complementary to other measures of the EU Common Agricultural Policy, Cohesion Policy and the European Common Fisheries Policy. Additionally, Estonian Ministry of Rural Affaires wants to help raise the competitiveness of agriculture, improve the sustainable management of natural resources and improve the climate action through the implementation of the development plan. *ERDP* is implemented through measures, which are based on the needs and objectives identified during the preparation of the development plan. In total, it is intended to implement over 20 (sub) measures within the framework of the development plan.

The LULUCF sector's role as a sink or source of GHGs in the future will mainly be determined by forest management practices – the intensity of forest fellings, also usage of peat soils and practices applied in cropland and grassland.

Measures related to forest management

EFDP 2020 (renewed in January 2016) and the *ERDP* comprise the following measures that target sustainable use of forest, inter alia increase of forest carbon pools:

1) **Increasing forest increment and ability to sequestrate carbon through timely regeneration of forests for climate change mitigation** – the overall objective of the measure is to support activities related to timely regeneration of forests in order to mitigate climate change. Cost of the measure is expected to be about 5.5 million euros in the period 2016–2020.
2) **Promotion of regeneration of forests in managed private forests with the tree species suitable for the habitat type** – the measure grants the supply of tree species suitable for the habitat type to promote efficient and fast regeneration of private forests. Cost of the measure is expected to be about 7.5 million euros in the period 2016–2020.
3) **Improving forest health condition and preventing the spreading of dangerous forest detractors** – the measure provides support for monitoring and restoration of forests in order to improve forest health condition and prevent damage caused by fire, pests and storms. Cost of the measure is expected to be about 0.4 million euros in the period 2016–2020.
4) **Reducing the environmental impact related to the use of fossil fuels and non-renewable natural resources by increasing timber production and use in Estonia** – the objective of the measure is to encourage timber production and use in Estonia through supported activities. Cost of the measure is expected to be about 0.3 million euros in 2016–2020.
5) **Natura 2000 support for private forest land** – protected areas, special conservation areas and species protection sites on forest land will help to preserve forest carbon stock from those areas. The measure aims to maintain biological and landscape diversity in Natura 2000 areas covered with forests, which means support for private forest areas.
6) **Maintaining biological processes and preserving population of species that are common to Estonia.** Cost of the measure is expected to be about 1 million euros in 2016–2020.
7) **Improvement of forest economic and ecological vitality** – the overall objective of supporting forestry as an integral part of rural life, is sustainable and effective forest management which promotes raising vitality of forests by improving its species composition or implementing other silvicultural techniques, maintaining and renewing forest biological diversity, integral ecosystem and protection function by helping to preserve forest's multifunctional role and its spiritual and cultural heritage. Cost of the measure is expected to be about 13.8 million euros in 2016–2020.

Measures related to Cropland management

ERDP's following measures pursue to limit and reduce GHG emissions and enhance carbon sequestration:

1) **Support for growing plants of local varieties** – 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. Cost of the measure is expected to be about 0.6 million euros.
2) **Regional support for soil protection** – the aims of the measure are to: limit GHG emissions, limit soil erosion, reduce nutrient leaching and maintain and raise the content of soil organic matter. Cost of the measure is expected to be about 2.45 million euros.

Measures related to Grassland, Wetland and Grazing land management

ERDP measures related to Grassland, Wetland and Grazing land management that have a GHG mititgation impact are:

1) **Support for the maintenance of semi-natural habitats ─** the overall objectives of this measure are: to improve the quality of maintenance of semi-natural habitats whereas increasing the share of semi-natural habitats maintained by farm animals, to preserve and increase biological and landscape diversity; to increase the area of land under maintenance; to improve the condition of species related to semi-natural habitats. Cost of the measure is expected to be about 40 million euros.
2) **Ensuring the favourable conservation status of habitats** – the measure aims to improve the conservation status of at least 14 habitat types in Estonia due to the applied protection measures. The immediate outcome of the activity of the measure is 10,000 hectares of fen and transition mire habitats and raised bog margins (lag-zones, mixotrophic and ombrotrophic forests, degraded raised bogs still capable of natural regeneration) in protected areas. Cost of the measure is expected to be about 2.7 million euros in 2017.

3.7. Waste

General waste related requirements and rules are stipulated under *Waste Act (*RT I, 12.12.2018, 40) according to which all landfills had to meet the EU established requirements by 16 July 2009 and had to be conditioned in accordance with the requirements no later than 31 December 2015.

The Estonian *Waste Act* (RT I, 12.12.2018, 40) includes following measures to limit and reduce GHG emissions:

1) **Prohibition concerning percentage of biodegradable waste deposited** – the percentage of biodegradable waste in the total amount by weight of municipal waste deposited in landfills in Estonia shall not exceed: 45% by 16 July 2010; 30% by 16 July 2013 and 20% by July 2020. Reducing the amount of biodegradable waste deposited is also included in the *Estonian Waste Management Plan 2014–2020 (NWMP)* . The amount of biodegradable waste in the total amount by weight of municipal waste deposited in landfills was 57% in 2011 and decreased to 48% by 2014.

2) **Increasing reusing and recycling of waste materials** – to meet the requirements of the directive 2009/98/EC, the *Waste Act* stipulates that by 1st of January 2020, reuse and the recycling of waste materials such as paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households, shall be increased at least to the extent of 50% of the total weight of such waste per calendar year. The same target is also included in the *NWMP*. The level of reusing and recycling of waste materials was 27% in 2011, which increased to 35% by 2014.

Establishment of waste management rules incl. adoption and updating the waste management plan is stipulated under the *Local Government Organization Act* (RT I, 05.02.2019, 8) and is the responsibility of the local government. Most of local government waste management plans also stipulate prohibition of open burning of municipal solid waste (MSW).

The *National Environmental Strategy until 2030* includes following policy:

1) **Reducing landfilling waste** – by 2030, landfilling waste is reduced by 30% and the hazard of waste is reduced significantly. Reaching the target is supported by measures that are included in the *NWMP*.

The objective of the *NWMP* is to introduce sustainable waste management that follows waste hierarchy principle, mainly focusing on modern product design, clean resource saving productions and recycling of already produced materials. Also, the reduction of hazardous substances in materials and products. NWMP has set following target levels for 2020 (Table 3.12).

Table 3.12. Target levels in NWMP

NWMP	Target level 2020
Recycling percentage of biodegradable waste in the total amount by weight of municipal waste.	13%
The share of biodegradable waste in total landfilled MSW	20%
Recycling percentage of municipal solid waste in the total amount by weight of municipal waste.	50%

The NWMP comprises following measures to limit and reduce GHG emissions:

1) **Promoting the prevention and reduction of waste generated, incl. reducing the hazard of waste –** the overall objective of the measure is to improve the resource efficiency of Estonia's economy and promoting waste prevention to reduce the negative impact on environment and human health. The state is supporting the prevention of waste by dissemination of information. A variety of initiatives, implementation of environmental management tools, additional research projects and investment and completion of the necessary legal regulations will help to implement this measure. Measure helps to reduce GHG emissions in solid waste disposal subsection. Expected cost of implementing the measure is 3.73 million euros.

2) **Recycling or reusing waste at the maximum level** – This strategic objective is set to increase recycling of municipal waste and biodegradable waste in the total amount of MSW and developing a nationwide waste collection network with intensified waste reporting system. Consistent waste reuse and recycling guidance and simple expanding system for waste handling will thereby increase the amount of waste separately collected and decrease the amount of waste landfilled. Establishing the state-wide biodegradable waste collection and treatment network is especially important when reducing the GHG emission from solid waste disposal. Expected cost of implementing the measure is 32.46 million euros.

3) **Reducing environmental risks arising from waste, improvement of monitoring and supervision** – the overall objective of the measure is to improve hazardous waste treatment options and reducing environmental risks arising from waste disposal. Landfills closed for waste deposit have to be conditioned in accordance with the requirements. Strengthening the supervision of waste management will help to reduce illegal waste disposal. In 2013 there were 5 operating mixed municipal waste landfills. Measure is supporting the previously mentioned measures. Expected cost of implementing the measure is about 27.77 million euros.

In 2013, Eesti Energia finished building the modern and efficient waste-to-energy power unit at the Iru power plant to generate heat and electricity from mixed municipal waste. With the

completion of the Iru waste-to-energy unit, the large-scale depositing of mixed municipal waste in landfills is decreasing. In Iru's *Air pollutants emissions reduction action plan 2013–2030* it is estimated that the total amount of mixed municipal waste used for energy production is 260 kt per year. Iru CHP plant is mostly burning Estonia's mixed municipal waste that is supported by imported waste to keep up the yearly capacity target of 260 kt.

Projected effects of the WEM scenario measures that were able to be quantified are presented in Table 3.13. The measures "*Prohibition concerning percentage of biodegradable waste deposited and increasing reusage and recycling of waste materials*" are an integral part of projecting emissions from Solid waste disposal and Open burning of waste subsector, therefore the effects of the measures are presented as aggregated CO_2 eq not by subsectors. Measure "*Increasing reusing and recycling of waste materials in the Biodegradable Treatment of Solid Waste*" is affecting Composting subsector projections. Criteria, for calculating projected effects was, that the measures will not have a full effect 2020 but will achieve effect by 2035.

Table 3.13. Projected effects of the measures in the Waste sector WEM scenario, kt CO_2 eq

	2016	2020	2025	2030	2035	2040
Prohibition concerning percentage of biodegradable waste deposited and Increasing reusing and recycling of waste materials	0	4.69	29.55	59.95	73.27	71.72

*Projected effect is calculated as a sum in Solid waste disposal, Open burning of waste and Biological treatment of solid waste sectors

3.8. Cross sectoral parameters and measures

Following cross-cutting measures with potential for GHG reduction in both LULUCF and Agriculture sector are:

1) **Fostering carbon conservation and sequestration in agriculture and forestry** (ERDP measure) has an aim to have at least 14.8% of the agricultural and forest land currently in the use under management practices that enhance further carbon sequestration by the year 2020. The measure is supported by the regulation on Good agricultural and environmental conditions of land, in which is stated that the proper agrotechnical techniques to hinder erosion has to be implemented when cultivating the arable land on the areas where slope exceeds 10%. The appropriate techniques include soil cultivation across the slope, establishing permanent grassland, growing grass, minimizing soil cultivation, establishing buffer zones on the hillslopes or on the shores of water bodies or any other activity that inhibits the soil erosion. Expected cost of implementing the measure is included under ERDP 2014–2020 submeasure Support for regional soil protection.
2) **EU CAP Greening measure** aims to limit and reduce GHG emissions and enhance carbon sequestration on croplands. The objective of the measure is to make farms with monocultures more environmentally friendly and sustainable. Another aim is to preserve permanent grasslands. The greening is a requirement of direct area-based payments. Expected cost of implementing the measure is 134.2 million euros in 2018–2020. Following sub-measures are important and affect Agriculture and LULUCF emissions:
    - **Crop diversification measure** . The objective of the measure is to make farms with monocultures more environmentally friendly and sustainable. A farmer must cultivate at least two crops when his arable land exceeds 10 hectares and at least three crops when his arable land exceeds 30 hectares. The main crop may

cover at most 75% of arable land, and the two main crops at most 95% of the arable area.

- **Preservation of permanent grassland**. The objective of the measure is to avoid massive conversion of grassland to arable land. The member state is obliged to maintain the total area of permanent grassland. Estonia has to maintain the area of permanent grassland at least on the level of the year 2005.

3) **Support for regional soil protection** (ERDP Agri-environmental submeasure). The general objective is to ensure the sustainable use of eroded and peat soils and to minimize soil degradation. The measure includes bringing agricultural lands with erosion and peat soils under permanent grassland. Expected cost of implementing the submeasure is 6.0 million euros in 2014–2020.
4) **Support for maintaining semi-natural habitats** (ERDP Agri-environmental submeasure). The general objective is to improve the conditions of semi-natural habitats and its species. Expected cost of implementing the measure is 37.5 million euros in 2014–2020.
5) **Support for growing plants of local varieties** (ERDP Agri-environmental submeasure). The objective of this measure is to ensure the preservation of the local crop varieties and domestic animal breeds 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.
6) **Convert cropland on organic soils to permanent grassland** (a measure from a study carried out in 2018 to find cost-effective mitigation measures). The objective of the measure is to sequestrate carbon.
7) **Natura 2000 support for agricultural** land (ERDP Supports under Natura 2000 and Water Framework Directives submeasure). Its objectives are to assure the implementing the requirements of nature protection, help to adopt with its limitations and preserve agricultural activities. Expected cost of implementing the measure is 2.8 million euros in 2018–2020.

There are also cross-cutting measures with potential for GHG reduction in Energy and Agriculture sector:

1) **Facilitating the supply and use of renewable sources of energy, by-products, wastes, residues and other non-food raw material for purposes of the bio-economy** (in ERDP). The main requirement underlined within this measure is to support the production of heat and electricity from biogas. Expected cost of implementing the submeasure is 20.5 million euros in 2014–2020.
2) **Investments into diversification of non-agricultural economic activity in rural regions** (ERDP Modernisation of agricultural holdings and entrepreneurship submeasure). Under the submeasure investments for producing renewable (bio-, solar, wind) energy is supported. Input of bioenergy production can be of agricultural origin, e.g. manure or crop residues. Compared to the ERDP measure Investments into material properties this measure is aimed to benefit a wider society, e.g. to produce bioenergy for sale. Expected cost of implementing the submeasure is 52.9 million euros in 2018–2020.
3) Investments into material properties measure includes a submeasure of **Investments into improved performance of agricultural holdings** which aims to support reconstruction or construction of new livestock facilities (incl. manure and silage storage facilities) and

provide investments into bioenergy, which is affecting emissions under both Agriculture and Energy sector.

The additional Agriculture objective of the measure is to increase the competitiveness of agricultural producers, so that the producers would get support for their agricultural work. For instance, the bioenergy produced with the support is used for the farm activities. Expected cost of implementing the submeasure is 118.4 million euros in 2018–2020.

There is one cross-cutting measures with potential for GHG reduction in Energy, Transport and Agriculture sector:

1) **Biomethane from manure** (a measure from a study carried out in 2018 to find cost-effective mitigation measures). The objective of the measure is to produce biogas from manure, incl. slurry, to replace the use of fossil fuels in energy and transport.

Parameters

Cross sectoral parameter between Waste and Energy sector is real GDP growth rate projected by Estonian Ministry of Finance.

Cross sectoral parameter between Waste and IPPU is population projection.

There are several cross sectoral parameters between IPPU and Energy sector:

1. Estonia's cement industry projected production capacity ─ The production capacity used in IPPU sector corresponds with the fuel consumption for the same industry in Energy sector.
2. Presumption that chemical industry will not consume natural gas as feedstock in future.

Projected trend of diesel fuel consumption in road transport was taken into account when projecting WEM and WAM scenario emissions from urea catalysts in used by vehicles with diesel engines (IPPU subcategory 2.D.3 Other in GHG inventory).

4. PROJECTED GREENHOUSE GAS EMISSIONS UNTIL 2040

The main objective of this chapter is to give an indication of future trends of GHG emissions in Estonia, given the policies and measures implemented and adopted within the current national climate policies. Projections are given for all GHGs considered in UNFCCC and in Kyoto Protocol, presented in the following sectors (CRF categories): Energy (including Transport); Industrial processes and product use; Agriculture; LULUCF and Waste.

4.1. Starting point for the projections

Two projections scenarios of GHG emissions have been calculated for the period from 2017–2040. Reference year 2016 used in projections is consistent with Estonia's 2018 submission to the UNFCCC on 27th of September 2018. The 'With Existing Measures' (WEM) scenario evaluates future GHG emission 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.

4.2. Key assumptions used

The key underlying assumptions used in the projections are presented in Table 4.1.

Table 4.1. Key assumptions used in projections

Parameter used	Reference year (2016)	2020	2025	2030	2035	2040
Population,WEM = WAM, thousands	1 316	1 318	1 312	1 306	1 295	1 284
Gross domestic product (GDP), real growth rate, WEM = WAM, %	2.1	3.0	2.6	1.9	1.4	1.4
Gross domestic product (GDP), constant prices, WEM = WAM, constant EUR million	18 268	20 819	23 872	26 630	28 851	30 890
EU ETS carbon price, WEM=WAM, EUR/EUA	5.5	15.5	23.3	34.7	43.5	51.7
International (wholesale) fuel import prices: Electricity Coal, WEM=WAM, EUR/GJ	2.23	2.64	3.16	3.79	4.01	4.18
International (wholesale) fuel import prices: Natural gas, WEM=WAM, EUR/GJ	7.52	8.91	9.64	10.49	11.20	11.58
Final energy consumption: Industry, WEM=WAM, TJ	8 716	7 632	8 090	8 548	8 749	8 950
Final energy consumption: Transport WEM, TJ	32 353	32 928	35 661	37 603	39 092	40 410
Final energy consumption: Transport WAM, TJ	32 353	31 918	29 515	26 560	27 667	29 264
Final energy consumption: Residential WEM, TJ	19 157	18 629	18 629	18 629	18 629	18 629
Final energy consumption: Residential WAM, TJ	19 157	18 629	14 530	12 854	11 922	11 177
Final energy consumption: Agriculture/Forestry, WEM=WAM, TJ	3 835	3 911	4 146	4 380	4 483	4 586
Final energy consumption: Services WEM, TJ	2 188	1 371	1 368	1 364	1 349	1 334
Final energy consumption: Services WAM, TJ	2 188	1 309	1 272	1 235	1 199	1 162

Parameter used	Reference year (2016)	2020	2025	2030	2035	2040
Final energy consumption: Other, WEM=WAM, TJ	653	532	532	532	532	532
Final energy demand for road transport WEM, TJ	30 869	31 626	34 359	36 301	37 790	39 108
Final energy demand for road transport WAM, TJ	30 869	30 616	28 533	25 578	26 685	28 282
Livestock: Total cattle, thousands	248	264	274	285	296	296
Livestock: Sheep, thousands	91	98	108	118	129	129
Livestock: Swine, thousands	266	317	337	357	357	357
Livestock: Poultry, thousands	2 395	2 763	2 763	2 763	2 763	2 763
Nitrogen in crop residues returned to soils, kt	23 251	29 123	29 123	29 123	29 123	29 123
Application of synthetic fertilizers, kt	56	57	60	61	61	61
Area of cultivated organic soils, 1000 ha	30	30	30	30	30	30
Municipal solid waste (MSW) generation, WEM=WAM, kt MSW	315 222	329 643	351 600	369 826	381 714	391 618

4.3. Methodology

4.3.1. Energy

The Balmorel model was used for the electricity generation projections in the Public heat and electricity generation sector. It is a model for analysing the electricity and Combined heat and power sectors in 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. 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. In addition, European Commission´s recommended projection parameters (EU ETS carbon price, international crude oil, gas and coal prices) for national energy and climate plans were used as input. The projected future usage of fuel based on the model was applied while using the emission calculations of the 2006 IPCC Guidelines. The projections of fuel consumption for electricity generation are based on Estonia's *GPCP 2050.*

The projections for heat generation in the Public heat and electricity generation sector are based primarily on the reconstruction rate of the buildings. The projections in the heat production are based on the analysis of past fuel consumption trends of the sector and *EEDP 2030*. The

scenarios developed in the *EEDP 2030* were used in combination with the methodology of the 2006 IPCC Guidelines.

The projections of the GHG emissions of shale oil production in the Manufacturing of solid fuels and other energy industries were calculated based on the input of shale oil companies. The companies provided their future development plans of the expansion of the shale oil production. The amounts of oil shale used and the rate of construction of new shale oil production plants were used for the GHG projections.

The GHG projections in the Manufacturing industries and construction sector and in Other sectors are also based on the analysis of past fuel consumption trends of the sectors and scenarios created in *EEDP 2030*. The emissions are calculated based on the methodology of the 2006 IPCC Guidelines.

4.3.2. Transport

The projections in the Transport sector are based on the thorough analysis of *transport and mobility scenarios* in *EEDP 2030* along with expert judgements as well as emission factor data from 2006 IPCC Guidelines using country-specific emission factors were used to estimate GHG emissions.

The projections are based on the 2018 National GHG Inventory, the presumtions were confirmed by group of experts. The activity data of the WAM measures is taken from the study carried out in 2018 to find cost-effective mitigation measures, which is based on the *Transportation Development Plan 2014-2020* and *EEDP 2030*. The projections for the WEM scenario are also in line with Regulation (EC) No 443/2009, which stipulates that by year 2021, the average emissions target for a new passenger car is 95 gCO_2/km and with Regulation (EU) No 510/2011 147 gCO_2/km for light duty vehicles.

4.3.3. Industrial processes and product use

The Estonian industry sector is relatively small. The majority of emissions from subcategories, such as 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. Due to the specific character of the sector, top-down assessments are used only in 2.F.1.d Mobile air conditioning, 2.F.2 Foam producing and 2.D subcategories: 2.D.1 Lubricant use, 2.D.2 Paraffin wax use and 2.D.3 Other - Urea based catalysts for motor vehicles. Otherwise, bottom-up data gathering, companies' production forecasts, GDP and population projections 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.

Mineral industry's projected emissions are based on industries' operator's projections taking into account planned production capacities and and/or maximal production capacities according companies' environmental permits.

According to the chemical industry's operators informations, there are no plans to restore production in near future.

The Metal Industry´s projected emissions are based on industries´ operators production forecasts and quantities of raw materials they have used in past 5 years.

Consumption of lubricants is in line with GDP projections and corresponds to projected GDP growth.

Consumption of paraffin waxes is affected by GDP growth and slight population decline and is projected to stay roughly at current level.

Indirect CO_2 emissions from Solvent use sector, affected both by GDP growth and population decline, are projected to decrease a little because of statistical corrections in solvent use levels and trending use of water based paints.

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 is consistent with projections of the Transport sector (see Chapter 4.3.2);
3. the average diesel fuel consumption of vehicles is based on COPERT model.
4. previous year's trend in vehicle sales (data from Estonian Road Administration).

Emissions of fluorinated gases are projected according GHG inventory's calculation methods. Emissions from each group of HFC-containing equipment are projected separately. Forthcoming bans and restrictions stipulated in the Regulation (EU) No. 517/2014 and Directive 2006/40/EC were taken into account. Trends in domestic market of refrigeration and air-conditioning could be seen from 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. Also, some importers of pre-charged air conditioning equipment and standalone refrigeration equipment were interviewed. Their intentions were included into calculations.

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 contain HFC-s with GWP of 2500 or more (the ban comes into effect in 2020);
   - commercial refrigeration equipment (hermetic equipment with HFC-s, multipack systems (40 kW or more) with HFC-s except multilevel cascade systems partly with HFC-134a (in 2020);
   - single split stationary air conditioners and heat pumps that contain HFC-s with GWP of 750 or more (in 2025);
   - fire protection equipment with HFC-23 (additionally, HFC-227ea containing fire protection systems have a sharply decreasing trend);
   - one component foams that contain HFC-s with GWP 150 or higher
   - ban of sale of new vehicles with EU type approval having refrigerant with GWP over 150 in air conditioner since 01.01.2017 is taken into account (according to the Directive 2006/40/EC);
2. Ban of refilling equipment that contain HFC-s with GWP of 2500 or more (in 2020);
3. Rapidly diminishing amounts of HFC-s placed onto market (due to quota system) after 2023 probably cause extreme price increase and deficit of higher GWP refrigerants especially.

As ongoing promotion of alternative and low-GWP refrigerants is planned it was assumed that majority of commercial and industrial refrigeration is switching to alternative refrigerants (CO_2 and NH_3 based systems respectively). In categories where use of banned, high-GWP HFC-s 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 trend of foam production and use in 2014–2017, real GDP growth rate and population size. Projection of emissions from 2.F.4 Aerosols is based on trend of medical aerosol use in 2014–2017 and population size.

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 the methods of GHG inventory while taking into account plans on equipment replacement by the electrical network operators in Estonia. The projection is also linked to real GDP growth rate.

Regarding N_2O – consumption data was provided by wholesalers who explained that sales either stay at current level or decline slowly.

4.3.4. Agriculture

Estonia's agricultural GHG emissions and its projections consist of CH_4 emissions from enteric fermentation of domestic livestock, CH_4 and N_2O emissions from manure management systems, direct and indirect N_2O emissions from agricultural soils and CO_2 emissions from liming and urea fertilization. Direct N_2O emissions include emissions from synthetic and organic fertilizers applied to agricultural soil, emissions from animal waste, emissions from crop residues, emissions from cultivation of organic soils and emissions from mineralization associated with loss of soil organic matter. Indirect N_2O emissions include emissions from atmospheric deposition and leaching and run-off.

Projections of emissions are calculated based on the 2006 IPCC methodology applied in the Estonian Greenhouse Gas Inventory. Projected values of agricultural output and fertilizer use are the expert judgements of the officials of the Ministry of Rural Affairs of Estonia.

As a result of the EU new Common Agricultural Policy (CAP) on the abolition of milk quotas and the growth of global food demand in many regions of the world, milk production is presumed to increase in Estonia. Pursuant to the *Estonian Dairy Strategy 2012–2020,* milk production may increase by a third, which means that the number of dairy cows must be increased and it is also presumed that the average milk yield may increase up to 19% by the year 2020. CO_2 emissions from liming are foreseen to increase during the whole projected time series as the current level of liming used for neutralizing the naturally acidic agricultural soils is presently insufficient in Estonia. The calculations of emissions from liming are based on the amounts of lime fertilizers projected in *GPCP 2050*.

Feed intake parameters and the methane conversion rate are harmonized with the national GHG inventory. Gross energy (GE) intake of dairy cows was calculated on the basis of projected milk yields. Expert judgement on projected livestock numbers is based on the following assumptions:

Since 2010 there has been a general increasing trend in the number of cattle which is expected to continue as the agricultural producers have made considerable investments in the sector. However, upward trend turned into temporary downtrend in 2015 and 2016 due to the economic

sanctions imposed by Russia on EU starting from August 2014. Eventually, there was a slight rise in the number of cattle in 2017, which may indicate that the crisis might have passed its lowpoint. Global demand for meat- and dairy products along with suitable climatic conditions favour cattle production in Estonia to expand. With the supporting mechanisms of Common Agricultural Policy raising sheep and goats may be presumed to grow moderately. Demand after lamb and goat meat, wool and milk will grow. The number of horses is projected to continue to rise according to historical yearly 5% growth rate. The population of rabbits is expected to remain at today's level. The population of fur animals is expected to rise again after the enlargening of the cages´ size by 2017. The number is expected to rise until 2020 and then projected to remain at the stable level. The number of pigs is anticipated to rise distinctly at the antecedent level of the outbreak of African swine fever of 2014 by 2035 and will remain at the same level by 2040. The number of poultry production is expected to stay at today´s level. Projected values of livestock population are presented in Table 4.1.

Average milk yield per cow should increase until 2025. Projected values for the period 2025–2030 are in accordance with projections in *GPCP 2050*. Milk fat (%) for the projected period until 2040 was assumed to be the same as in 2017 (3.94%).

Main activity data for the calculation of CH_4 and N_2O emissions from manure management are livestock population, data on animal waste management systems (AWMS) and milk yields.

For calculation of N_2O emissions from manure management systems the listed projected parameters (Table 4.1) were used: livestock population, milk yield (kg/head/year) and AWMS systems. Estonia-specific VS and N excretion values of dairy cows have been calculated on the basis of projected milk yields.

Projected N_2O emissions from the Agricultural soils subsector are based on the amount of organic and synthetic N-containing fertilizers applied to soil, quantities of harvested crops and area of cultivated organic soils.

As a result of the increasing global food demand, it is foreseen that Estonia's crops production is going to increase compared to 2017, which will probably raise the use of synthetic fertilizers in Estonia. The projected data on crop production and the data on the use of synthetic N fertilizers are presented in Table 4.1.

4.3.5. Land use, land-use change and forestry

Land Use, Land-Use Change and Forestry (LULUCF) sector comprises Forest land, Cropland, Grassland, Wetlands and Settlements, therefore there are several cross-cutting as well as land category based strategic documents and policies addressing the LULUCF sector.

About half of Estonian's territory is covered with forest, of which 10% is strictly protected. Forestry is of great importance for the Estonian economy and environment, therefore forest policies have a major effect on the development of the LULUCF sector as a whole.

Estimates of CO_2, N_2O and CH_4 projections for Cropland, Grassland, Wetlands, Settlements and Other land were calculated as an average of:

a) linear forecast over whole time series 1990–2016;

b) average of time series 1990–2016;

c) average of time series 2000–2016;

d) estimation of reference years.

Regarding Forest land and Harvested wood products projections methodology has changed compared to the last report (2017). It is due to the fact that LULUCF regulation 2018/841 stipulate that reference level shall be consistent with the national projections reported under *Regulation (EU) No 525/2013*. General approach for estimating the forest reference level is based on forest management planning regulation and felling coupe calculations with the 2000-2009 reference period. Additional information is provided in the *National Forestry Accounting Plan 2021-2025*[3].

The LULUCF sector emissions were quite volatile during last decades. Year 2005 is the starting point of the current trend of all relevant factors. Both, intensive felling period and afforestation of agricultural areas, stopped at this time. The main reason for the use of multiple averages in projection calculations is to reduce the sudden or abnormal trends and tendencies.

4.3.6. Waste

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 IPCC for estimating CH4 emissios from solid waste disposal sites. The MSW generation projections take into account population projection (Eurostat) and the annual real GDP growth rate (the Ministry of Finance). The composition and the amount of generated MSW were also connected with the amount of incinerated MSW in Iru CHP plant, decrease percentage of biodegradable waste in the total amount by weight of MSW allowed to be deposited in landfills by 2020 and the increasing amount of biologically treated waste. *Mixed Municipal Solid Waste Composition Study* carried out in 2013 was used for a precise 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 annual real GDP growth rate (the Ministry of Finance). This is applied to the previous year's biologically treated solid waste amount. While calculating, it is considered, that the biodegradable waste in the total amount by weight of municipal waste recycling percentage will reach 13% by 2020 (*NWMP 2014–2020*) and that there will be additional biodegradable waste from industrial sources (calculated under Solid waste disposal subcategory). An expert judgement of increasing amount of biologically treated sludge has been included to calculations (*GPCP2050*).

Only small amount of waste gets incinerated without energy recovery. Projections in the subcategory Waste incineration and Open burning was done using the assumptions of no burning without energy recovery nor will open burning take place after 2030. 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 SWD.

Projections of GHG emissions in Wastewater treatment and discharge subcategory account population projection (Eurostat) and an expert judgement given by the MoE on the usage of

[3] National Forestry Accounting Plan 2021-2025 [www] https://www.envir.ee/sites/default/files/national_forestry_accounting_plan_2021-2025_estonia.pdf

different wastewater treatment types and the coverage of centralised wastewater system. Different waste water treatment systems are covering both high and low density settlements. GHG emissions from Industrial wastewater, was conducted using a stable production throughout the time series of 2016-2040.

The projection of memo item Long-term storage of C in waste disposal sites is conducted using the same parameters as in subcategory Solid waste disposal on land.

4.4. Sectoral projections

4.4.1. Energy

The Energy sector 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; Transport; Other sectors (Commercial/institutional, Residential and Agriculture/Forestry/Fishing/Fish farms sub-sectors) and Fugitive emissions from natural gas distribution.

The Energy sector's projected emissions in the WEM scenario are presented in Table 4.2 and Figure 4.1. In the WEM scenario, the emissions are projected to decrease by 37.9% from 2016 to 2040. The largest decrease occurs in the Energy industries sector.

The electricity producing plants in Estonia mainly use oil shale. Due to the phasing out of direct oil shale combustion in these plants, the building of a more effective oil shale combustion plant, and the introduction of new shale oil production plants is taking place. Total GHG emissions from the Energy industries sector are projected to decrease by 50.3% by 2040 compared to 2016.

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 30.3% by 2040 compared to 2016. In this sector, only one WEM scenario is projected, as there are no additional planned policies or measures.

The emissions from the Transport sector are projected to increase by 8. 2%, mainly due to the increased mileage of passenger cars. At the same time, the share of biofuels and electricity in transport sector is expected to increase from 0.5% in 2016 to 14.0% in 2040 in the WEM scenario.

The emissions in Other sectors (Commercial/institutional, Residential and Agriculture/Forestry/Fishing/Fish farms) are expected to decrease by 4.4% in 2040 compared to 2016. GHG emissions from other sources are projected to decrease by 18.2% by 2040 compared to 2016. For the Agriculture/Forestry/Fishing and Other only the WEM scenario is projected, as there are no additional policies or measures defined. Due to usage of natural gas, the Fugitive emissions are expected to increase by 3.8% by 2040 compared to 2016.

Table 4.2. Total projected WEM scenario GHG emissions from Energy sector, kt

Energy WEM	GHG	2016 (2018 inventory)	2020	2025	2030	2035	2040
Energy industries	CO_2	13747.67	13636.30	11944.98	8461.31	7442.46	6647.96
	CH_4	1.68	1.36	1.47	1.52	1.85	2.08
	N_2O	0.12	0.25	0.26	0.23	0.51	0.59
	Total CO_2 eq	13 825.81	13745.13	12059.03	8568.81	7640.45	6874.80
Manufacturing and construction	CO_2	515.86	578.30	612.99	647.69	662.94	678.18
	CH_4	0.11	0.03	0.03	0.03	0.03	0.03
	N_2O	0.02	0.01	0.01	0.01	0.01	0.01
	Total CO_2 eq	523.14	581.26	616.13	651.01	666.33	681.66
Transport	CO_2	2347.21	2160.66	2305.86	2372.97	2466.28	2548.82
	CH_4	0.15	0.12	0.13	0.14	0.14	0.15
	N_2O	0.09	0.06	0.06	0.06	0.06	0.07
	Total CO_2 eq	2 376.91	2180.97	2327.18	2395.05	2489.25	2572.37
Other sectors	CO_2	558.85	541.57	536.80	544.03	549.57	559.22
	CH_4	5.09	4.82	4.86	4.87	4.87	4.86
	N_2O	0.16	0.07	0.07	0.07	0.07	0.07
	Total CO_2 eq	733.31	682.17	678.59	686.10	691.80	701.15
Other	CO_2	47.51	38.97	38.97	38.97	38.97	38.97
	CH_4	0.00	0.00	0.00	0.00	0.00	0.00
	N_2O	0.00	0.00	0.00	0.00	0.00	0.00
	Total CO_2 eq	48.51	39.69	39.69	39.69	39.69	39.69
Fugitive emissions	CO_2	0.03	0.03	0.03	0.03	0.03	0.03
	CH_4	0.68	0.71	0.71	0.71	0.71	0.71
	Total CO_2 eq	17.08	17.73	17.73	17.73	17.73	17.73
Energy total	**CO_2**	**17217.13**	**16955.82**	**15439.64**	**12065.01**	**11160.25**	**10473.19**
	CH_4	**7.72**	**7.04**	**7.19**	**7.26**	**7.61**	**7.83**
	N_2O	**0.38**	**0.39**	**0.40**	**0.38**	**0.65**	**0.73**
	Total CO_2 eq	**17524.76**	**17246.94**	**15738.36**	**12358.39**	**11545.26**	**10887.40**

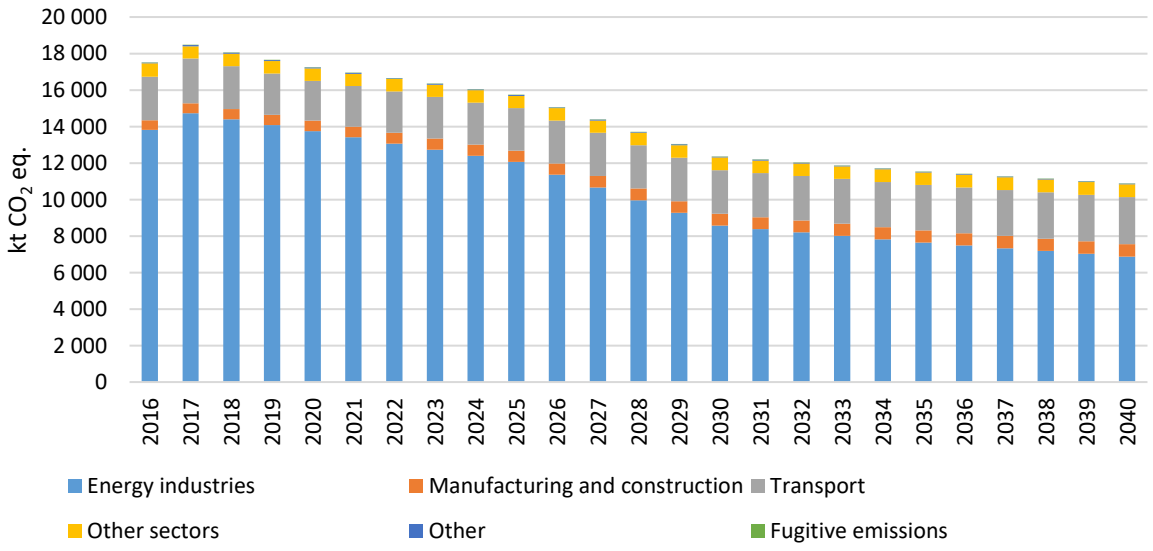

Figure 4.1. Total projected WEM scenario GHG emissions from Energy sector, kt CO_2 eq

The projected emissions of the Energy sector in the WAM scenario are presented in Table 4.3 and Figure 4.2. In the WAM scenario, the emissions are projected to decrease by 44.7% in the period of 2016–2040. 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 occurs in the Energy industries sector. The decrease is projected to be 53.0% in the period of 2016–2040.

The emissions of the Transport sector are projected to decrease by 20.7% by 2040 compared to 2016 in the WAM scenario. The larger decrease compared to the WEM scenario is caused by additional measures measures, e.g. increasing the use of public transport, rail transport, also result in lowered private transport demand which in return lowers emitted GHGs.

Table 4.3. Total projected WAM scenario GHG emissions from Energy sector, kt

Energy WAM	GHG	2016 (2018 inventory)	2020	2025	2030	2035	2040
Energy industries	CO_2	13747.67	13490.68	11381.72	7775.86	7082.32	6309.94
	CH_4	1.68	1.34	1.34	1.30	1.50	1.42
	N_2O	0.12	0.25	0.24	0.20	0.46	0.50
	Total CO_2 eq	13 825.81	13598.04	11487.62	7867.76	7257.05	6493.53
Manufacturing and construction	CO_2	515.86	578.30	612.99	647.69	662.94	678.18
	CH_4	0.11	0.03	0.03	0.03	0.03	0.03
	N_2O	0.02	0.01	0.01	0.01	0.01	0.01
	Total CO_2 eq	523.14	581.26	616.13	651.01	666.33	681.66
Transport	CO_2	2347.21	2094.8	1927.9	1696.88	1766.27	1866.28
	CH_4	0.15	0.11	0.10	0.09	0.10	0.11
	N_2O	0.09	0.06	0.05	0.05	0.05	0.05
	Total CO_2 eq	2 376.91	2114.66	1946.55	1714.05	1784.17	1884.94
Other sectors	CO_2	558.85	538.21	497.93	492.67	490.36	492.05
	CH_4	5.09	4.82	3.80	3.36	3.13	2.92
	N_2O	0.16	0.07	0.05	0.05	0.05	0.04
	Total CO_2 eq	733.31	678.80	608.85	591.18	581.95	577.84
Other	CO_2	47.51	38.97	38.97	38.97	38.97	38.97
	CH_4	0.00	0.00	0.00	0.00	0.00	0.00
	N_2O	0.00	0.00	0.00	0.00	0.00	0.00
	Total CO_2 eq	48.51	39.69	39.69	39.69	39.69	39.69
Fugitive emissions	CO_2	0.03	0.03	0.03	0.03	0.03	0.03
	CH_4	0.68	0.71	0.71	0.71	0.71	0.71
	Total CO_2 eq	17.08	17.73	17.73	17.73	17.73	17.73
Energy total	**CO_2**	**17217.13**	**16741.02**	**14459.54**	**10652.11**	**10040.90**	**9385.45**
	CH_4	**7.72**	**7.01**	**5.97**	**5.49**	**5.46**	**5.19**
	N_2O	**0.38**	**0.38**	**0.36**	**0.31**	**0.57**	**0.60**
	Total CO_2 eq	**17524.76**	**17030.18**	**14716.57**	**10881.41**	**10346.92**	**9695.38**

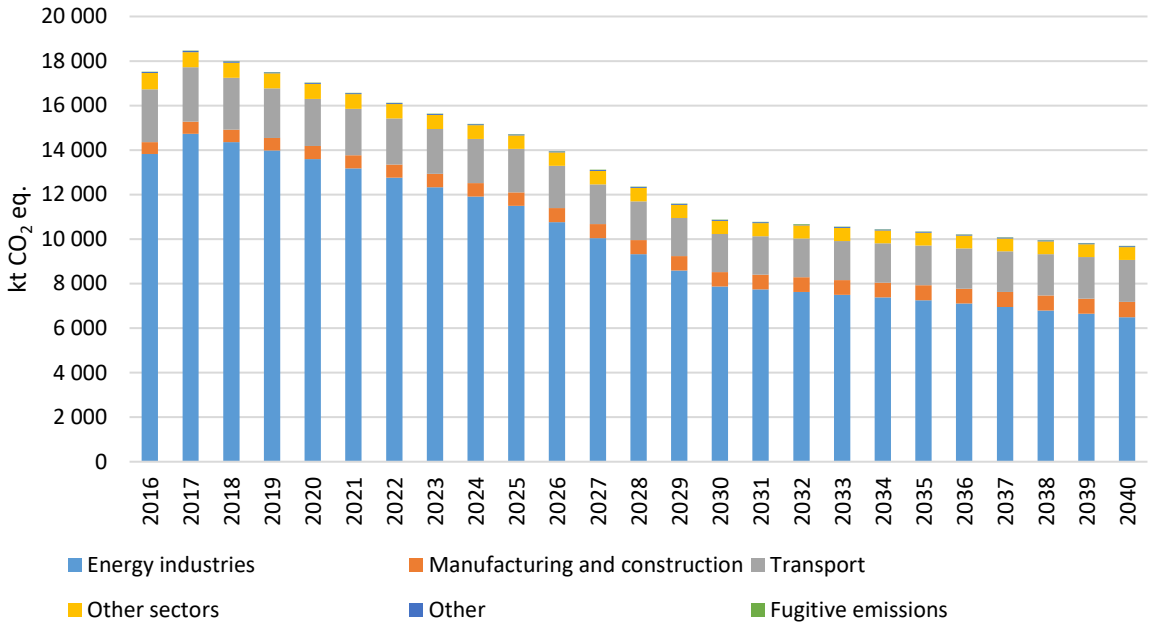

Figure 4.2. Total projected WAM scenario GHG emissions from Energy sector, kt CO_2 eq

4.4.2. Transport

The main share of GHG emissions in the Transport sector originate from road transport. Historically, the share of GHG emissions of road transport have been more than about 95% of total GHG emissions of the Transport sector.

The emissions in the Transport sector in the WEM scenario are expected to rise about 8.2% in 2040 compared to 2016. The emissions in the Road transportation are projected to increase in the future. Domestic aviation and Railways sector emissions are expected to stay at the same level during the period of 2016–2040. Domestic navigation emissions are projected to decrease due to decreased fuel consumption. The total projected GHG emissions in the WEM scenario are presented in Table 4.4 and Figure 4.3.

Table 4.4. Total projected WEM scenario GHG emissions from Transport sector, kt

Transport WEM	GHG	2016 (2018 inventory)	2020	2025	2030	2035	2040
Domestic aviation	CO_2	1.40	3.83	3.83	3.83	3.83	3.83
	CH_4	0.00	0.00	0.00	0.00	0.00	0.00
	N_2O	0.00	0.00	0.00	0.00	0.00	0.00
	Total CO_2 eq	1.41	3.87	3.87	3.87	3.87	3.87
Road transportation	CO_2	2239.03	2062.39	2207.59	2274.70	2368.01	2450.55
	CH_4	0.15	0.11	0.12	0.13	0.14	0.14
	N_2O	0.07	0.04	0.04	0.04	0.04	0.04
	Total CO_2 eq	2262.52	2075.66	2221.87	2289.74	2383.95	2467.06
Railways	CO_2	47.01	55.85	55.85	55.85	55.85	55.85
	CH_4	0.00	0.00	0.00	0.00	0.00	0.00
	N_2O	0.02	0.02	0.02	0.02	0.02	0.02
	Total CO_2 eq	52.58	62.45	62.45	62.45	62.45	62.45

Transport WEM	GHG	2016 (2018 inventory)	2020	2025	2030	2035	2040
Domestic navigation	CO_2	59.77	38.59	38.59	38.59	38.59	38.59
	CH_4	0.01	0.00	0.00	0.00	0.00	0.00
	N_2O	0.00	0.00	0.00	0.00	0.00	0.00
	Total CO_2 eq	60.40	39.00	39.00	39.00	39.00	39.00
Other transportation	CO_2	NO	NO	NO	NO	NO	NO
	CH_4	NO	NO	NO	NO	NO	NO
	N_2O	NO	NO	NO	NO	NO	NO
	Total CO_2 eq	NO	NO	NO	NO	NO	NO
Transportation total	**CO_2**	**2 347.21**	**2160.66**	**2305.86**	**2372.97**	**2466.28**	**2548.82**
	CH_4	**0.15**	**0.12**	**0.13**	**0.14**	**0.14**	**0.15**
	N_2O	**0.09**	**0.06**	**0.06**	**0.06**	**0.06**	**0.07**
	Total CO_2 eq	**2 376.91**	**2180.97**	**2327.18**	**2395.05**	**2489.25**	**2572.37**

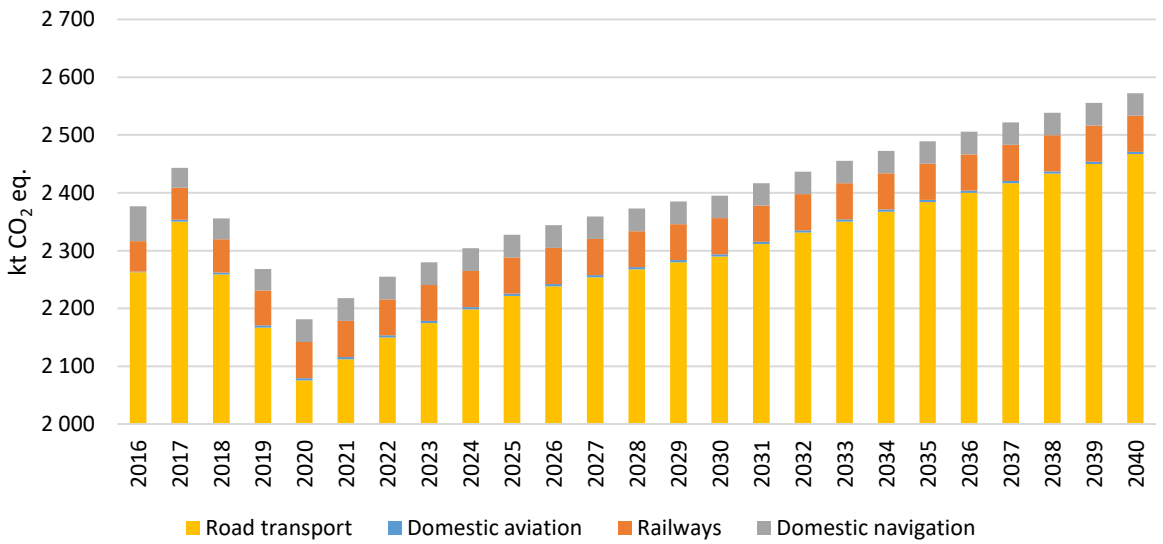

Figure 4.3. Total projected WEM scenario GHG emissions from Transport sector, kt CO_2 eq

The emissions in the Transport sector in the WAM scenario are expected to decrease significantly (20.7%) in 2040 compared to 2016. Domestic aviation and the Railways emissions are expected to stay approximately at the same level (as in the WEM scenario) during the period of 2016–2040. Domestic navigation and Road transportation emissions are projected to decrease compared to the base year. The largest emission reductions occur in Road transportation sector – emissions are projected to decrease by 20.3% in 2040 compared to 2016 – a total of 458.51 kt CO_2 equivalent (eq.), which is the result of additional measures, thus a lower demand for private transport. The total projected GHG emissions in the WAM scenario are presented in Table 4.5 and Figure 4.4.

Table 4.5. Total projected WAM scenario GHG emissions from Transport sector, kt

Transport WAM	GHG	2016 (2018 inventory)	2020	2025	2030	2035	2040
Domestic aviation	CO_2	1.40	3.83	3.83	3.83	3.83	3.83
	CH_4	0.00	0.00	0.00	0.00	0.00	0.00
	N_2O	0.00	0.00	0.00	0.00	0.00	0.00
	Total CO_2 eq	1.41	3.87	3.87	3.87	3.87	3.87
Road transportation	CO_2	2239.03	1996.55	1854.01	1622.99	1692.39	1792.39
	CH_4	0.15	0.11	0.10	0.09	0.09	0.10
	N_2O	0.07	0.03	0.03	0.03	0.03	0.03
	Total CO_2 eq	2262.52	2009.36	1865.62	1633.12	1703.25	1804.01
Railways	CO_2	47.01	55.85	55.85	55.85	55.85	55.85
	CH_4	0.00	0.00	0.00	0.00	0.00	0.00
	N_2O	0.02	0.02	0.02	0.02	0.02	0.02
	Total CO_2 eq	52.58	62.45	62.45	62.45	62.45	62.45
Domestic navigation	CO_2	59.77	38.59	38.59	38.59	14.20	14.20
	CH_4	0.01	0.00	0.00	0.00	0.00	0.00
	N_2O	0.00	0.00	0.00	0.00	0.00	0.00
	Total CO_2 eq	60.40	39.00	14.61	14.61	14.61	14.61
Other transportation	CO_2	NO	NO	NO	NO	NO	NO
	CH_4	NO	NO	NO	NO	NO	NO
	N_2O	NO	NO	NO	NO	NO	NO
	Total CO_2 eq	NO	NO	NO	NO	NO	NO
Transportation total	**CO_2**	**2 347.21**	**2094.82**	**1927.90**	**1696.88**	**1766.27**	**1866.28**
	CH_4	**0.15**	**0.11**	**0.10**	**0.09**	**0.10**	**0.11**
	N_2O	**0.09**	**0.06**	**0.06**	**0.06**	**0.06**	**0.05**
	Total CO_2 eq	**2 376.91**	**2114.66**	**1946.55**	**1714.05**	**1784.17**	**1884.94**

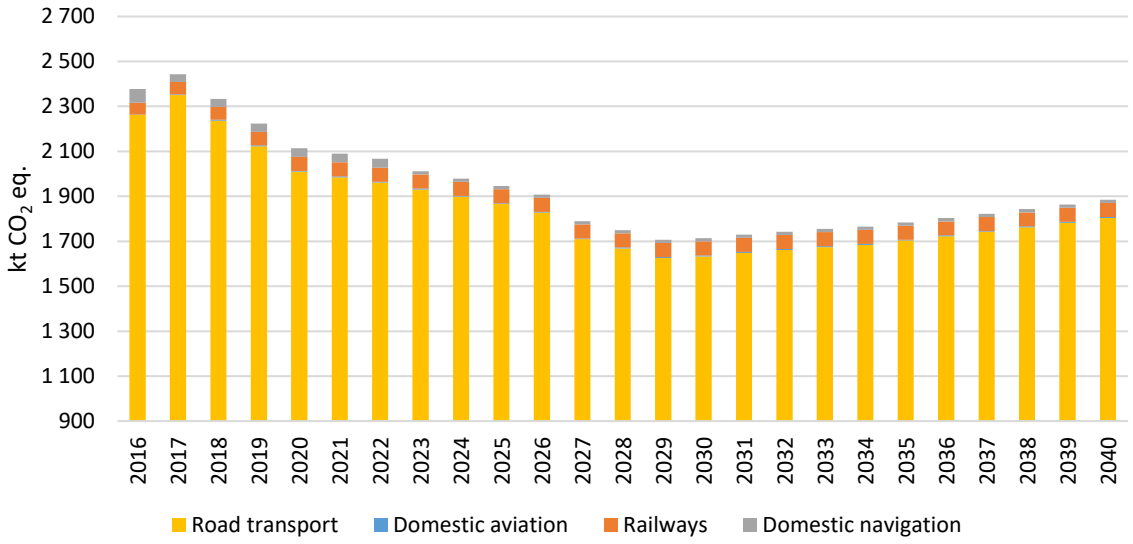

Figure 4.4. Total projected WAM scenario GHG emissions from Transport sector, kt CO_2 eq

4.4.3. Industrial processes and product use

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

Projections of GHG emissions from IPPU sector by subsector and GHG type according to WEM scenario are presented in Figure 4.5.

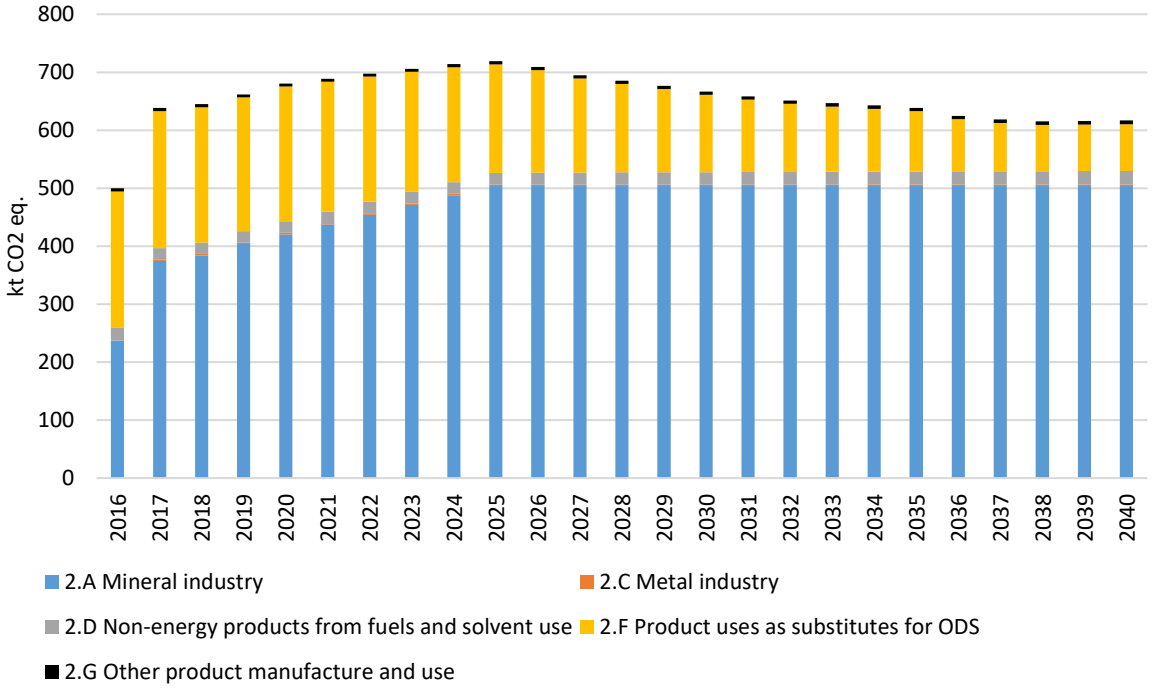

Figure 4.5. Total projected WEM scenario GHG emissions from IPPU sector, kt CO_2 eq

Table 4.6. Total projected WEM scenario GHG emissions from IPPU, kt

IPPU	GHG	2016 (2018 inventory)	2020	2025	2030	2035	2040
Mineral industry	CO_2	236.95	420.52	503.53	503.53	503.53	503.53
	Total CO_2 eq.	236.95	420.52	503.53	503.53	503.53	503.53
Chemical industry	CO_2	NO	NO	NO	NO	NO	NO
	Total CO_2 eq.	NO	NO	NO	NO	NO	NO
Metal industry	CO_2	NA*	2.46	2.55	2.64	2.72	2.79
	Total CO_2 eq.	NA*	2.46	2.55	2.64	2.72	2.79
Non-energy products from fuels and solvent use	CO_2	5.98	6.07	6.88	7.64	8.38	8.97
	Indirect CO_2	16.37	13.69	13.59	13.87	14.16	14.39
	Total CO_2 eq. (incl. indirect CO_2)	22.35	19.76	20.47	21.51	22.54	23.36
Product uses as substitutes for ODS	HFC-s	0.11	0.11	0.09	0.08	0.07	0.07
	Total CO_2 eq.	235.18	232.56	187.02	133.42	103.96	80.85
Other product manufacture and use	SF_6 kt·10^{-3}	0.11	0.11	0.12	0.13	0.14	0.15
	N_2O	0.01	0.01	0.01	0.01	0.01	0.01
	Total CO_2 eq.	5.66	5.30	5.54	5.78	5.98	6.14
IPPU total	CO_2	242.93	429.05	512.96	513.81	514.63	515.29
	Indirect CO_2	16.37	13.69	13.59	13.87	14.16	14.39
	HFC CO_2 eq.	235.18	232.47	186.50	132.17	101.36	77.85
	N_2O kt	0.01	0.01	0.01	0.01	0.01	0.01
	SF_6 CO_2 eq.	2.54	2.56	2.79	3.01	3.20	3.35
	Total CO_2 eq.	**500.15**	**680.59**	**719.12**	**666.88**	**638.72**	**616.67**

*Category Mineral industry; Other process uses of carbonates (CRF 2.A.4.b) is substituted with category Metal industry; Lead production (CRF 2.C.5) in 2019 year´s GHG inventory submission and also projections (see Chapter 4.9.3).

The WAM scenario for IPPU is projected because of additional measure – developing the railroad infrastructure (includes the building of Rail Baltic) – affect subsector 2.D.3 Other – Urea based catalysts for motor vehicles. According to the WAM scenario diesel fuel consumption is decreased and consumption of urea based diesel exhaust fluid also. Please see more information on this measure and cross sectoral parameters in Chapters 3.3 and 3.8.

Table 4.7. Total projected WAM scenario GHG emissions from IPPU, kt

IPPU	GHG	2016 (2018 inventory)	2020	2025	2030	2035	2040
Mineral industry	CO_2	236.95	420.52	503.53	503.53	503.53	503.53
	Total CO_2 eq.	236.95	420.52	503.53	503.53	503.53	503.53
Chemical industry	CO_2	NO	NO	NO	NO	NO	NO
	Total CO_2 eq.	NO	NO	NO	NO	NO	NO
Metal industry	CO_2	NA*	2.46	2.55	2.64	2.72	2.79
	Total CO_2 eq.	NA*	2.46	2.55	2.64	2.72	2.79
Non-energy products from fuels and solvent use	CO_2	5.98	6.07	6.61	7.02	7.62	8.13
	Indirect CO_2	16.37	13.69	13.59	13.87	14.16	14.39
	Total CO_2 eq. (incl. indirect CO_2)	22.35	19.76	20.21	20.89	21.68	22.52
	HFC-s	0.11	0.11	0.09	0.08	0.07	0.07

IPPU	GHG	2016 (2018 inventory)	2020	2025	2030	2035	2040
Product uses as substitutes for ODS	Total CO_2 eq.	235.18	232.56	187.02	133.42	103.96	80.85
Other product manufacture and use	SF_6 kt·10^{-3}	0.11	0.11	0.12	0.13	0.14	0.15
	N_2O	0.01	0.01	0.01	0.01	0.01	0.01
	Total CO_2 eq.	5.66	5.30	5.54	5.78	5.98	6.14
IPPU total	CO_2	242.93	429.05	512.96	513.81	514.63	515.29
	Indirect CO_2	16.37	13.69	13.59	13.87	14.16	14.39
	HFC CO_2 eq.	235.18	232.47	186.50	132.17	101.36	77.85
	N_2O kt	0.01	0.01	0.01	0.01	0.01	0.01
	SF_6 CO_2 eq.	2.54	2.56	2.79	3.01	3.20	3.35
	Total CO_2 eq.	**500.15**	**680.59**	**718.85**	**666.26**	**637.96**	**615.83**

* Category Mineral industry; Other process uses of carbonates (CRF 2.A.4.b) is substituted with category Metal industry; Lead production (CRF 2.C.5) in 2019 year´s GHG inventory submission and also projections (see Chapter 4.9.3).

When comparing the Table 4.6 and Table 4.7 it can be seen that WAM scenario for diesel fuel consumption (and therefore urea based diesel exhaust fluid consumption reported under category 2.D.3 Other) only marginally decreases projected emissions from 2.D subsector and total emissions from IPPU.

Projected emissions for all other IPPU subsectors will be explained below.

Some smaller producers selling their products in EU plan increasing their production capacities but this does not affect total emissions projections. All the plants are already using best available technologies (BATs) according to current reference documents for BATs (BREFs), therefore no reduction of emissions due to newer technologies is planned today.

The Metal industry´s output has been stable after recovery from economic recession in 2009. As the operators have no plans to increase their production volumes, the emissions are projected to stay at the same level from 2017 until 2040 (in WEM as well as WAM scenarios)

Emissions from non-energy products from fuels and solvent use are projected to increase from 2021 onwards in WEM scenario (17% from 2021 until 2040) and in WAM scenario (14% from 2021 until 2040). This difference in WAM scenario is mainly caused by curbing diesel fuel consumption and urea containing diesel exhaust fluid consumption via additional measure – developing the railroad infrastructure. Emissions from lubricants, paraffin waxes and solvents are projected to increase slightly, ca 0.5 kt CO_2 from each product group from 2017 until 2040. Consumption of these products depends on economic situation of many small industries (linked to real GDP growth rate) and solvent use also depends much on population size. Given the economic growth (Ministry of the Finance) and population growth rate (Eurostat), these emissions are projected to increase slightly. Decrease of emissions from this subcategory in 2020 in comparison to 2016 (Table 4.6 and Table 4.7) is connected to the statistical corrections in solvent use (and indirect CO_2) that was done retrospectively but did not affect 2016 year´s data in 2018 year´s GHG inventory submission.

Emissions of HFC-s (substitutes for ozone-depleting substances (ODS) are projected to be the same in WEM and WAM scenarios. CO_2 equivalent of emissions of HFC-s are projected to decrease significantly only after 2025 (20% reduction of emissions in 2025 in comparison to 2016 year´s emissions). Main cause is that in 2020 installation and servicing bans for many

refrigeration equipment are applied and their effect is boosted after 2023 when the quota limit of HFCs for whole EU is decreased 2 times relative to 2018-2020 year´s level.

Directive 2006/40/EC has a gradual effect on HFC emission until 2030 when most old vehicles equipped with HFC-134a based air conditioners should have been replaced.

By 2030 emissions from F-gases (in CO_2 equivalent) are projected to have decreased 43% and in 2035 56%. This will be the result of Regulation (EU) No. 517/2014 and measure consisting of project-based activities to support effects of regulation.

The actual amounts of HFC-s emitted do not decrease as much as their CO_2 equivalent because in some equipment only alternative refrigerant is a blend of lower GWP HFC-s.

Emissions of SF_6 reported under CRF subcategory Other Product Manufacture and Use are projected to rise steadily until 2040 when they possibly will be 27% larger than today (according WEM and 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 some SF_6 insulated equipment will exceed their service life and probably needs to be replaced.

N_2O emissions from the subcategory Other Product Manufacture and Use are projected to stay at 2017 year´s level until 2040.

4.4.4. Agriculture

Since there are no additional measures intended in the Agriculture sector, which effects on GHG emissions were numerically evaluated, then the WAM scenario emissions are equal to the WEM scenario emissions (Table 4.8 and Figure 4.6).

In the WEM scenario total emissions from agriculture sector are projected to grow steadily reaching 1 625 kt CO_2 eq in 2040 increasing 22% compared to 2016. An upward trend (Figure 4.6) in GHG emissions in the Agriculture sector is contributed by Enteric fermentation, Manure management and Agricultural soils due to the growth in livestock numbers and an increased milk yield, in case of dairy cows. Also, the emissions from Liming subsector are projected to increase. The rise in emissions from agricultural soils is the result of the expected increase in the use of synthetic and lime fertilizers, as well.

Table 4.8. Total projected WEM scenario GHG emissions from Agriculture sector, kt

Agriculture	GHG	2016 (2018 inventory)	2020	2025	2030	2035	2040
Enteric fermentation	CH_4	21.32	23.00	24.56	25.74	26.9	26.89
	Total CO_2 eq	533.09	575.01	613.93	643.47	672.49	672.22
Manure management	CH_4	2.90	3.32	3.54	3.72	3.81	3.81
	N_2O	0.18	0.19	0.20	0.21	0.21	0.21
	Total CO_2 eq	126.85	140.53	147.82	153.98	157.87	157.84
Agricultural soils	N_2O	2.22	2.37	2.46	2.52	2.56	2.57
	Total CO_2 eq	660.16	706.42	733.73	750.93	762.35	764.51
Liming	CO_2	13.33	17.18	20.42	23.66	26.90	30.14
	Total CO_2 eq	13.33	17.18	20.42	23.66	26.90	30.14
Urea application	CO_2	2.68	0.11	0.11	0.11	0.11	0.11
	Total CO_2 eq	2.68	0.11	0.11	0.11	0.11	0.11
Agriculture total	CO_2	16.01	17.28	20.53	23.77	27.01	30.25
	CH_4	24.22	26.32	28.09	29.45	30.71	30.70
	N_2O	2.40	2.56	2.66	2.72	2.77	2.78
	Total CO_2 eq	1 336.11	1 439.25	1 516.01	1 572.14	1 619.72	1 624.82

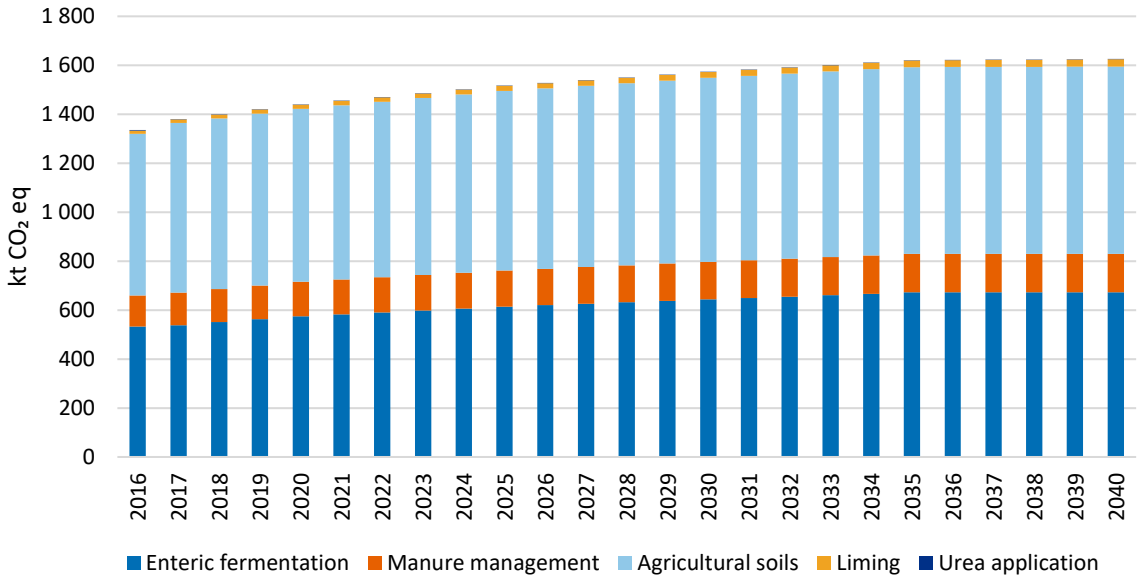

Figure 4.6. Total GHG emissions from Agriculture sector, kt CO_2 eq

4.4.5. Land use, land-use change and forestry

LULUCF sector includes emissions and removals of GHG-s from Forest land, Cropland, Grassland, Wetlands, Settlements, Other land and Harvested wood products. There are a number of factors that have affected the use of land during the last 25 years. The most important of these is the land reform, but also accession to the European Union, economic rises and falls.

Table 4.9. Projected land use in the LULUCF sector, thousand hectares

Land use class	2015 (2018 inventory)	2016 (2018 inventory)	2020	2025	2030	2035	2040
Forest land	2 419.1	2 419.2	2 419.2	2 419.2	2 419.2	2 419.2	2419.2
Cropland	1 049.8	1 049.7	1 049.2	1 048.3	1 047.4	1 046.6	1045.7
Grassland	281.0	280.6	278.2	276.0	273.7	271.4	269.1
Wetlands	416.7	416.7	416.2	415.5	414.9	414.2	413.6
Settlements	331.0	331.4	335.8	340.8	345.8	350.8	355.8
Other Land	36.3	36.3	35.3	34.1	32.9	31.7	30.5
LULUCF Total	4 533.9	4 533.9	4 533.9	4 533.9	4 533.9	4 533.9	4533.9

Predicted area of land use by classes is presented in Table 4.9. Forest area has been growing steadily, but for the projection the area was considered as a constant in coherence with FRL calculation rules. At the same time, decrease of arable land took place since 1990s. This process has been stopped since 2004 after Estonia became a member of the EU and agricultural subsidies were implemented. However, area of cropland is now expected to start to decrease. Grasslands should continue to decline in the near future, mainly due to natural afforestation. Infrastructure and settlements area extend continuously, at the expense of all other land use classes. According to *EFDP 2020* regeneration fellings, cleanings and thinnings are expected to increase further. This described management with the fact that Estonia has a significant amount of old aged forests temporarily decreases GHGs sink from forest land (Table 4.10 and Figure 4.7). Since there are no additional measures intended in the LULUCF sector then the WAM scenario emissions are equal to the WEM scenario emissions.

Table 4.10. Total GHG emissions from LULUCF sector, kt

LULUCF	GHG	2015 (2018 inventory)	2016 (2018 inventory)	2020	2025	2030	2035	2040
Forest Land	CO_2	-2 987.56	-3 149.02	-2 356.81	-1 279.02	-1 610.55	-1 355.33	-863.67
	CH_4	0.0001	0.0002	0.0004	0.0004	0.0004	0.0003	0.0003
	N_2O	0.0022	0.0021	0.0032	0.0036	0.0040	0.0045	0.0049
Cropland	CO_2	639.80	635.48	716.44	817.64	918.85	1020.05	1121.25
	N_2O	0.005	0.005	0.007	0.009	0.011	0.013	0.015
Grassland	CO_2	30.77	31.08	28.05	24.27	20.50	16.72	12.94
	CH_4	0.000003	0.000009	0.000199	0.000074	0.000024	0.000024	0.000024
	N_2O	0.0000003	0.000001	0.000018	0.000007	0.000002	0.000002	0.000002
Wetlands	CO_2	801.99	604.92	565.77	516.84	467.91	418.97	412.65
	CH_4	0.0024	0.0024	0.0022	0.0022	0.0021	0.0020	0.0020
	N_2O	0.0045	0.0045	0.0042	0.0040	0.0039	0.0038	0.0037
Settlements	CO_2	266.19	240.54	277.32	323.29	369.26	415.23	461.19
	N_2O	0.043	0.043	0.050	0.060	0.070	0.081	0.091
Other Land	CO_2	30.34	30.69	34.06	38.27	42.49	46.70	50.91
	N_2O	0.004	0.004	0.007	0.009	0.010	0.012	0.014

LULUCF	GHG	2015 (2018 inventory)	2016 (2018 inventory)	2020	2025	2030	2035	2040
HWP	CO_2	-1 058.43	-1 139.54	-688.70	-537.81	-446.54	-442.92	-456.76
Other*	N_2O	0.012	0.012	NE	NE	NE	NE	NE
LULUCF total	**CO_2**	**-2 276.90**	**-2 745.85**	**-1 423.87**	**-96.52**	**-238.10**	**119.41**	**738.51**
	CH_4	**0.003**	**0.003**	**0.003**	**0.003**	**0.002**	**0.002**	**0.002**
	N_2O	**0.071**	**0.072**	**0.071**	**0.086**	**0.100**	**0.114**	**0.129**
	Total CO_2 eq	**-2 255.74**	**-2 724.44**	**-1 402.56**	**-70.94**	**-208.24**	**153.55**	**776.93**

* Indirect N_2O Emissions from Managed Soils (Nitrogen Leaching and Run-off) are reported as indirect emissions in GHG inventory and their projections have not been estimated.

The LULUCF sector is expected to start to release carbon according to the projections (Figure 4.7). It is mainly caused by the increased emissions from Croplands to cover growing food demand. Expanding settlements area will also increase the emissions from Settlements. In coming years forest growing stock reaches the peak and then begins to decrease. Therefore, it is also expected that CO_2 sequestration from Forest land is going to decline. It is projected that the production of HWP will not increase in the future as the reference period average annual fraction of feedstock for HWP production originating from domestic harvest was low (77% compared to 97% in 2015-2017).

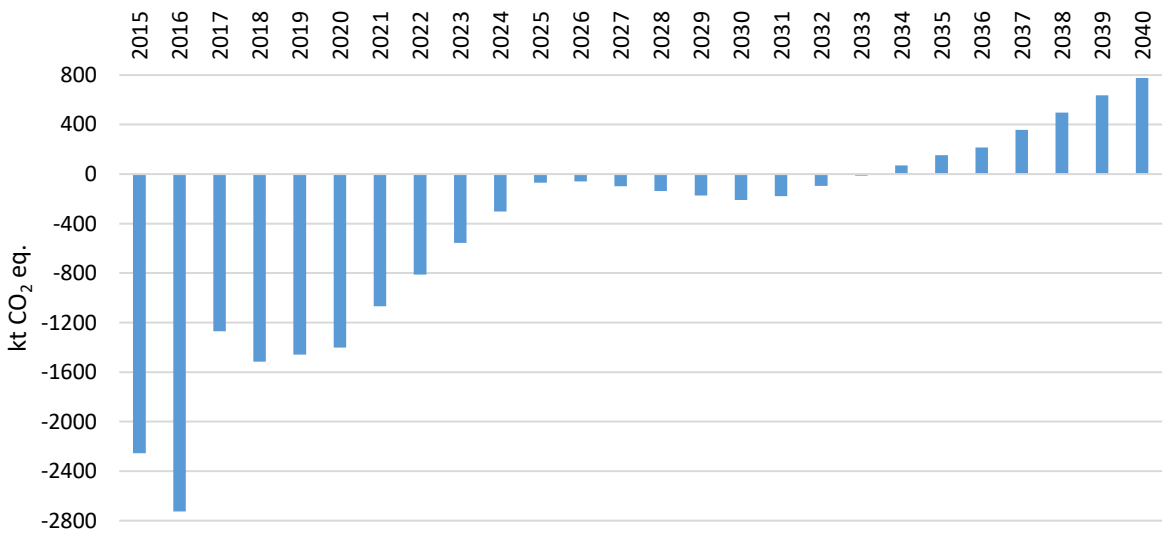

Figure 4.7. Total GHG emissions from LULUCF sector, kt CO_2 eq

4.4.6. Waste

Since there are no additional measures intended in the Waste sector then the WAM scenario emissions are equal to the WEM scenario emissions Table 4.11 and Figure 4.8.

Compared to 2016, 2040 WEM scenario CO_2 eq projections from Waste sector are decreasing by 40%. Emission decrease is mainly related to the increase of reusing and recycling waste materials (from 35% in 2014 to projected 50% in 2020), decreasing amount of biodegradable waste deposited in landfills (from 48% in 2014 to projected 20% in 2020) and to waste

incineration in Iru CHP plant. Increase in GHG emissions from biological treatment of solid waste is correlated to the decreased amount of biodegradable waste in the total amount of solid waste disposed in landfills. The emission decrease from wastewater treatment and discharge is connected with the expanding sewerage network.

Table 4.11. Total projected WEM scenario GHG emissions from Waste sector, kt

Waste	GHG	2016 (2018 inventory)	2020	2025	2030	2035	2040
Solid waste disposal on land	CH_4	6.43	6.83	4.89	3.50	2.63	2.08
	Total CO_2 eq	160.78	170.78	122.28	87.51	65.82	51.93
Biological treatment of solid waste	CH_4	0.81	0.86	0.96	1.05	1.12	1.18
	N_2O	0.05	0.05	0.06	0.06	0.07	0.07
	Total CO_2 eq	34.92	36.95	41.13	44.90	47.94	50.73
Waste incineration and open burning	CO_2	1.06	1.31	0.70	NO	NO	NO
	CH_4	0.02	0.01	0.01	NO	NO	NO
	N_2O	0.0003	0.0003	0.0001	NO	NO	NO
	Total CO_2 eq	1.62	1.74	0.93	NO	NO	NO
Wastewater treatment and discharge	CH_4	2.27	2.05	2.04	2.02	2.00	1.99
	N_2O	0.101	0.109	0.109	0.108	0.107	0.107
	Total CO_2 eq	86.78	83.75	83.35	82.80	82.08	81.38
Other (Burning biogas in a flare)*	CH_4	0.85	NO	NO	NO	NO	NO
	N_2O	0.003	NE	NO	NO	NO	NO
	Total CO_2 eq	22.13	NE	NO	NO	NO	NO
Waste total	**CO_2**	**1.06**	**1.31**	**0.70**	**NE**	**NE**	**NE**
	CH_4	**10.38**	**9.75**	**7.89**	**6.57**	**5.75**	**5.25**
	N_2O	**0.15**	**0.16**	**0.17**	**0.17**	**0.17**	**0.18**
	Total CO_2 eq	**306.23**	**293.23**	**247.68**	**215.21**	**195.84**	**184.03**

* Biogas Burnt in a flare is not included in the 2019 GHG inventory and GHG projections. During the ESD review in 2018 it was noted, that there may be errors with the reported amount of flared landfillgas reported under Burning biogas in a flare. After investigation of this topic, it emerged that one landfill reported the amount landfill gas flared based on the maximum capacity of the flare and not the actual amount of landfill gas flared. Based on this information recalculations were made which resulted with significantly lower emissions and based on the UNFCCC 24/CP.19, Paragraph 37(b) the emissions under this subcategorie can be considered insignificant as the biogas burnt in a flare comprised 0.05 kt which is 0.00024 % of total emissions. Therefore Estonia will not continue to report the emissions in the GHG inventory and in projections.

Increase of CO_2 eq emissions in 2017 compared to 2016 is connected with the recalculations of flared landfillgas done in the 2019 NIR. Please see more information in the 2019 NIR, chapters 7.2.5 and 7.6.

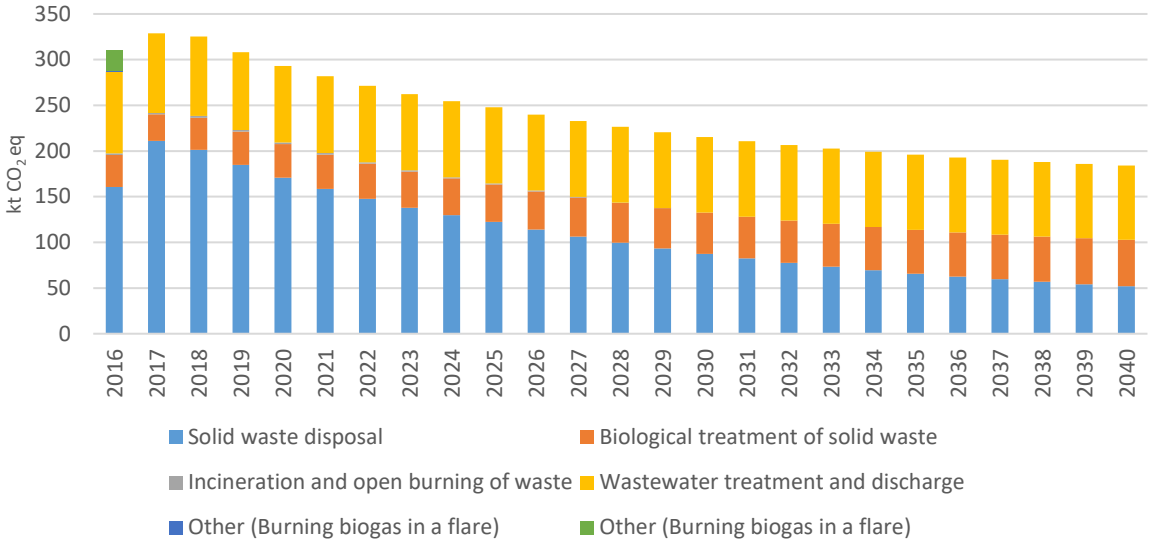

Figure 4.8. Total GHG emissions from Waste sector, kt CO_2 eq

4.5. Total projected GHG emissions of Estonia

The projected GHG emissions of Estonia are presented in Table 4.12 and Figure 4.9.

Estonia's GHG emissions are expected to decrease about 32.3 per cent in the WEM scenario (without LULUCF) and about 38.4 per cent in the WAM scenario (without LULUCF) by 2040 compared to the base year of 2016. GHG emissions in WEM scenario (with LULUCF) are expected to decrease about 16.8 per cent and in the WAM scenario (with LULUCF) about 23.9 per cent by 2040 compared to the base year of 2016.

Table 4.12. Total GHG projections until 2040, kt CO_2 eq

	2016 (2018 inventory)	2020	2025	2030	2035	2040
Energy WEM	17 524.76	17 246.94	15 738.36	12 358.39	11 545.26	10 887.40
Energy WAM		17 030.18	14 716.57	10 881.41	10 346.92	9 695.38
IPPU WEM	500.15	680.59	719.12	666.88	638.72	616.67
IPPU WAM		680.59	718.85	666.26	637.96	615.83
Agriculture WEM=WAM	1336.11	1 439.25	1 516.01	1 572.14	1 619.72	1 624.82
LULUCF WEM=WAM	-2724.44	-1402.56	-70.94	-208.24	153.55	776.93
Waste WEM=WAM	306.23	302.61	293.23	215.21	195.84	184.03
Total WEM (excluding LULUCF)	19667.25	19660.01	18 221.16	14 812.63	13 999.54	13 312.92
Total WAM (excluding LULUCF)		19443.25	17 199.11	13 335.03	12 800.44	12 120.07
Total WEM (including LULUCF)	16942.81	18257.45	18 150.23	14 604.39	14 153.08	14 089.85
Total WAM (including LULUCF)		18040.69	17 128.17	13 126.79	12 953.98	12 896.99

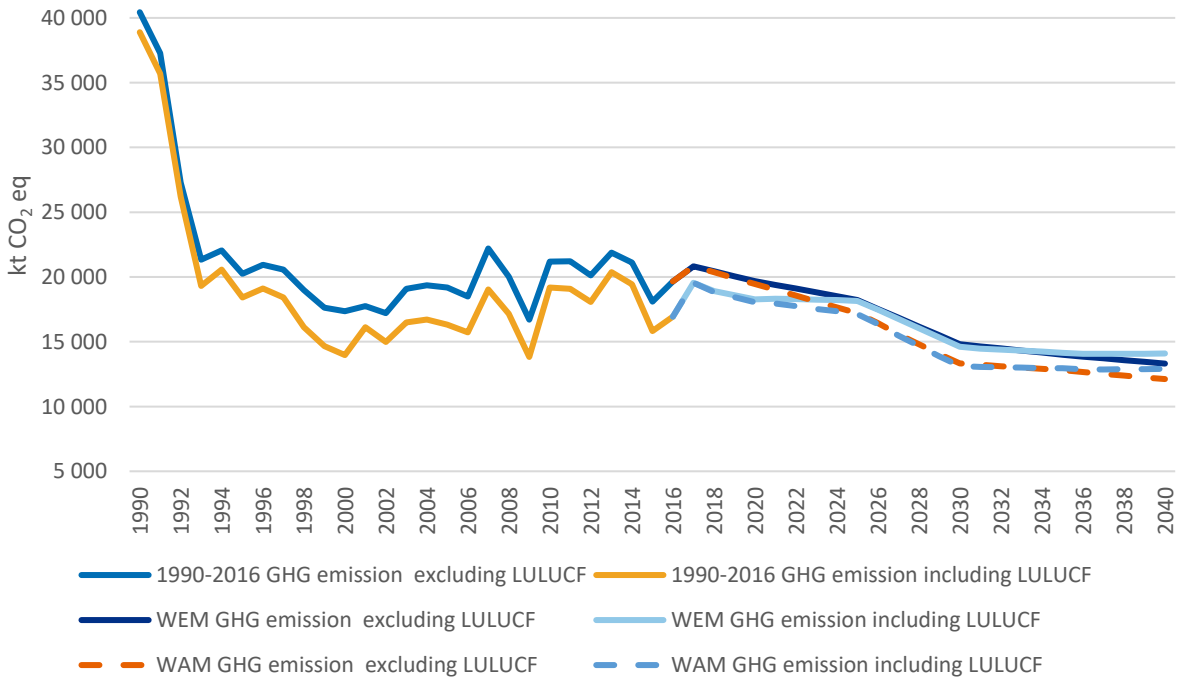

Figure 4.9. Total GHG projections until 2040, kt CO_2 eq

4.6. Split to EU-ETS/non-ETS sectors and aggregate projections

Split to EU-ETS and non-ETS in the WEM scenario can be observed in Table 4.13. The total ETS emissions are projected to decrease 47.9% from 2016 to 2040 in the WEM scenario. The total ESD emissions are projected to decrease 1.4% from 2016 to 2040 in the WEM scenario. The split of EU ETS and ESD emissions is estimated based on historical ETS data and known plants that are included in the ETS.

Table 4.13 Split to EU-ETS/non-ETS in the WEM scenario, kt CO_2 eq

WEM	Sector	2016	2020	2025	2030	2035	2040
EU-ETS	Energy (including transport)	13 211.14	13 309.69	11 670.37	8 239.67	7 258.36	6 503.27
non-ETS		4 312.21	3 933.38	4 064.12	4 114.86	4 283.03	4380.27
EU-ETS	IPPU	236.72	420.47	503.48	503.48	503.48	503.48
non-ETS		263.43	260.12	215.63	163.40	135.24	113.19
EU-ETS	Agriculture	NO	NO	NO	NO	NO	NO
non-ETS		1 336.11	1 439.25	1 516.01	1 572.14	1 619.72	1 624.82
EU-ETS	Waste	NO	NO	NO	NO	NO	NO
non-ETS		306.23	293.23	247.68	215.21	195.84	184.03
EU-ETS	Total	13 447.86	13 730.17	12 173.85	8 743.15	7 761.84	7 006.75
non-ETS		6 217.98	5 925.97	6 043.45	6 065.61	6 233.83	6 302.31

Split to EU-ETS and non-ETS in the WAM scenario can be observed in Table 4.14. The total ETS emissions are projected to decrease 49.6% from 2016 to 2040 in the WAM scenario. The total ESD emissions are projected to decrease 14.2% from 2016 to 2040 in the WAM scenario.

Table 4.14. Split to EU-ETS/non-ETS in the WAM scenario, kt CO_2 eq

WAM	Sector	2016	2020	2025	2030	2035	2040
EU-ETS	Energy	13211.14	13164.26	11149.99	7629.61	6997.73	6279.15
non-ETS		4312.21	3862.06	3562.71	3247.93	3345.33	3412.37
EU-ETS	IPPU	236.72	420.47	503.48	503.48	503.48	503.48
non-ETS		263.43	260.12	215.37	162.78	134.48	112.35
EU-ETS	Agriculture	–	–	–	–	–	–
non-ETS		1336.11	1439.25	1516.01	1572.14	1619.72	1624.82
EU-ETS	Waste	–	–	–	–	–	–
non-ETS		306.23	293.23	247.68	215.21	195.84	184.03

WAM	Sector	2016	2020	2025	2030	2035	2040
EU-ETS	Total	13447.86	13584.73	11653.47	8133.10	7501.21	6782.63
non-ETS		6217.98	5854.65	5541.77	5198.07	5295.36	5333.57

4.7. Projection of memo item International bunker fuels

CO_2 emissions from aviation have been included in the EU ETS since 2012. Under the EU ETS, all airlines operating in Europe, European and non-European alike, are required to monitor, report and verify their emissions, and to surrender allowances against those emissions. They receive tradeable allowances covering a certain level of emissions from their flights per year. In October 2016, the International Civil Aviation Organization (ICAO) agreed on a Resolution for a global market-based measure to address CO_2 emissions from international aviation as of 2021. The agreed Resolution sets out the objective and key design elements of the global scheme, as well as a roadmap for the completion of the work on implementing modalities. The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) aims to stabilise CO_2 emissions at 2020 levels by requiring airlines to offset the growth of their emissions after 2020. Airlines will be required to monitor emissions on all international routes, offset emissions from routes included in the scheme by purchasing eligible emission units generated by projects that reduce emissions in other sectors (e.g. renewable energy). A regular review of the scheme is required under the terms of the agreement. This should allow for continuous improvement, incl. in how the scheme contributes to the goals of the Paris Agreement. Work is ongoing at ICAO to develop the necessary implementation rules and tools to make the scheme operational. Effective and concrete implementation and operationalization of CORSIA will ultimately depend on national measures to be developed and enforced at domestic level. Estonia, as all other EU Member States, will participate in the voluntary Phase I (2021–2026). Participation of states in the will become mandatory in Phase II (as of 2027) and exemptions will then apply for some states.

International Maritime Organization's (IMO) Marine Environment Protection Committee (MEPC) continues to address GHG emissions from international shipping, with work on track for the adoption of an initial IMO strategy on the reduction of GHG emissions from ships in 2018. Considerable efforts to agree such an approach have been made over recent years within both the IMO and the UNFCCC also with a view to ensure a fair contribution of the sector to the objective of the Paris agreement to limit the average increase of the temperatures to +1,5 °C. In 2016 the IMO in its MEPC 70 meeting reached an agreement on a global data collection system as the next step in their action to tackle CO_2 emissions. Also MEPC 70 agreed to develop a Roadmap for addressing CO_2 emissions from international shipping, with initial CO_2 reduction commitments to be agreed in MEPC 72 by April 2018. In 2017 MEPC 71 adopted guidelines for administration verification of ship fuel oil consumption data (Resolution MEPC.292(71)) and guidelines for the development and management of the IMO ship fuel oil consumption database (Resolution MEPC.293(71)).

In June 2013, the EC set out a strategy to progressively integrate maritime emissions into the EU's policy for reducing its domestic GHG emissions consisting 3 consecutive steps:

1. monitoring, reporting and verification of CO_2 emissions from large ships using EU ports;

2. GHG reduction targets for the maritime transport sector;

3. further measures, incl. market-based measures, in the medium to long term.

EU has already taken the first step: monitoring, reporting and verification of CO_2 emissions from large ships using EU ports. Large ships over 5000 gross tonnes loading/unloading cargo/passengers from 1 January 2018 at EU maritime ports are to monitor and later report their related CO_2 emissions and other relevant information in accordance with their monitoring plan. Monitoring, reporting and verification of information shall be done in conformity with Regulation 2015/757 (as amended by Delegated Regulation 2016/2071).

Historically, the emissions from Aviation bunkering form about 14% of all bunkering emissions. The projected GHG emissions of International bunkering are presented in Table 4.15. The emissions of Aviation bunkering are projected to increase by 132.9% in 2040 compared to 2016. The total GHG emissions of Marine bunkering are also expected to increase by 18.6% in 2040 compared to 2016. Overall, the GHG emissions from International bunkering are expected to increase by 26.8% in 2040 compared to 2016 from the increase of international carriage of passengers.

Table 4.15. Total GHG emissions of International bunkering, kt

International bunkering	GHG	2016 (2018 inventory)	2020	2025	2030	2035	2040
Aviation bunkering	CO_2	64.74	150.81	150.81	150.81	150.81	150.81
	CH_4	0.00	0.00	0.00	0.00	0.00	0.00
	N_2O	0.00	0.00	0.00	0.00	0.00	0.00
	Total CO_2 eq	65.32	152.10	152.10	152.10	152.10	152.10
Marine bunkering	CO_2	830.92	985.13	985.13	985.13	985.13	985.13
	CH_4	0.08	0.09	0.09	0.09	0.09	0.09
	N_2O	0.02	0.03	0.03	0.03	0.03	0.03
	Total CO_2 eq	839.71	995.53	995.53	995.53	995.53	995.53
International bunkering total	CO_2	895.66	1135.94	1135.94	1135.94	1135.94	1135.94
	CH_4	0.08	0.10	0.10	0.10	0.10	0.10
	N_2O	0.02	0.03	0.03	0.03	0.03	0.03
	Total CO_2 eq	905.03	1147.63	1147.63	1147.63	1147.63	1147.63

4.8. Sensitivity analysis

4.8.1. Energy

The Shale Oil Production industry is a growing branch in Estonia. According to the projections, the companies are planning to expand their production approximitaly 3 times in the next twenty years. However, this scenario is optimistic and such a wide expansion might not happen. Therefore, an alternative scenario has been modelled (SEN scenario).

In the SEN scenario, it is expected that instead of five additional solid heat carrier (SHC) technology shale oil production plants, only three will be built in the period of 2020–2040. This could happen if the economic situation is not suitable for shale oil production etc. This means that instead of about 20 million tons of oil shale (geological[4]), 4.1 million tons of oil shale will be used less for shale oil production. By this, the amount of oil shale gas used for electricity production is reduced compared to the WEM scenario. In the SEN scenario, it is expected that the amount of electricity produced from oil shale gas is imported. The results of the SEN scenario are presented in Figure 4.10.

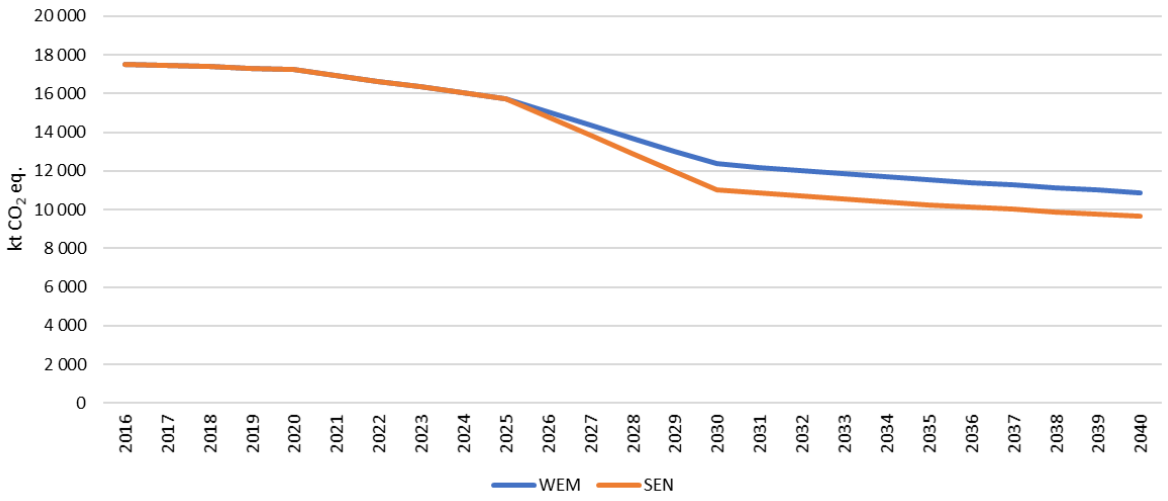

Figure 4.10. Comparison of GHG emissions of WEM and SEN scenarios, kt CO_2 eq

4.8.2. Industrial processes and product use

Sensitivity analysis for IPPU sector emissions are based on the population and annual real GDP growth rate harmonised values Table 4.16) given by the European Commission (*Recommended parameters for reporting on GHG projections in 2019* 23.07.2019).

Table 4.16. Harmonised values given by the European Commission

Indicator	2020	2025	2030	2035	2040
GDP (in market prices), million euros	20.46	22.24	24.02	25.80	27.58
Population in Estonia, million	1.28	1.24	1.20	1.18	1.16

[4] 20 million tons of geological oil shale equals approximately 25 million tons of commercial oil shale.

Under SEN scenario (Table 4.17), population and/or GDP growth rate values from Table 4.16 were used in calculations of IPPU categories 2.C Metal industry (GDP), 2.D Non-energy products from fuels and solvent use (GDP and population), 2.F Product uses as substitutes for ODS according (GDP and population) and 2.G Other product manufacture and use (GDP) according to the methodology of the WEM scenario. The methodology for calculating WEM scenario is provided in chapter 4.3.3. The category 2.A is not affected by the change of population or GDP growth rate.

Table 4.17. Comparison of IPPU sector GHG emissions per category, WEM and SEN scenarios, kt CO_2 eq

Industrial process and product use	2016 (2018 inventory)	2020	2025	2030	2035	2040
2.A Mineral industry WEM	236.95	420.52	503.53	503.53	503.53	503.53
2.C Metal industry WEM	NA*	2.46	2.55	2.64	2.72	2.79
2.C Metal industry SEN		2.45	2.49	2.55	2.61	2.67
2.D Non energy products from fuels and solvent use WEM	22.35	19.76	20.47	21.51	22.54	23.36
2.D Non energy products from fuels and solvent use SEN		19.51	19.70	20.28	21.08	21.77
2.F Product uses as substitutes for ODS WEM	235.18	232.56	187.02	133.42	103.96	80.85
2.F Product uses as substitutes for ODS SEN		232.46	186.80	133.08	103.57	80.44
2.G Other product manufacture and use WEM	5.66	5.30	5.54	5.78	5.98	6.14
2.G Other product manufacture and use SEN		5.29	5.48	5.68	5.87	6.01
IPPU total WEM	500.15	680.59	719.12	666.88	638.72	616.67
IPPU total SEN		680.22	718.00	665.11	636.65	614.41
Difference (WEM-SEN), kt CO_2 eq	0	0.37	1.12	1.77	2.08	2.26

* Category Mineral industry; Other process uses of carbonates (CRF 2.A.4.b) is substituted with category Metal industry; Lead production (CRF 2.C.5) in 2019 year´s GHG inventory submission and also projections (see Chapter 4.9.3).

4.8.3. Agriculture

Sensitivity analysis for Agriculture sector emissions is based on the scenario, where the population of dairy cows will not grow at the rate expected by the projections presented in Table 4.1, instead, the number of dairy cows grows at the rate shown in Table 4.18. The number of dairy cows is the main driver affecting the emissions from Agriculture sector. Moreover, due to the Russian sanctions, we have seen how the decreasing number of dairy cows can influence the sectoral projections. The alternative more pessimistic projected numbers of dairy cows were obtained from the Ministry of Rural Affairs.

Table 4.18. Changed indicator used for sensitivity analysis

Indicator	2020	2025	2030	2035	2040
Livestock: Dairy cows, thousands	87	88	89	89	89

The results of SEN scenario emissions are presented in Table 4.19. The methodology for calculating WEM scenario is provided in Chapter 4.3.4. The results of SEN scenario show that the number of dairy cows is an important factor affecting the amounts of projected emissions.

Table 4.19. Comparison of Agriculture sector GHG emissions per category, WEM and SEN scenarios, kt CO_2 eq

Agriculture	2016 (2018 inventory)	2020	2025	2030	2035	2040
3.A Enteric fermentation WEM	533.09	575.01	613.93	643.47	672.49	672.22
3.A Enteric fermentation SEN		563.35	589.71	603.11	611.95	611.68
3.B Manure Management WEM	126.85	140.53	147.82	153.98	157.87	157.84
3.B Manure management SEN		138.95	144.54	148.51	149.68	149.65
3.D Agricultural soils WEM	660.16	706.42	733.73	750.93	762.35	764.51
3.D Agricultural soils SEN		703.24	727.18	740.02	745.99	748.15
Agriculture total WEM	1336.11	1439.25	1516.01	1572.14	1619.72	1624.82
Agriculture total SEN		1422.82	1481.96	1515.41	1534.61	1539.72
Difference (SEN-WEM)	0%	-1.2%	-2.3%	-3.7%	-5.5%	-5.5%

4.8.4. Waste

Sensitivity analysis for Waste sector emissions are based on the scenarios, where population and annual real GDP growth rate (Table 4.20) are based on the harmonised values given by the European Commission (*Recommended parameters for reporting on GHG projections in 2017* 14.06.2016).

Table 4.20. Recommended parameters by European Comission for reporting on GHG projections in 2017

Indicator	2020	2025	2030	2035	2040
Annual real GDP growth rate (in market prices), %	20.46	22.24	24.02	25.80	27.58
Population in Estonia, million	1.28	1.24	1.20	1.18	1.16

Under SEN scenario (Table 4.21), population and GDP growth rate from Table 4.20 were both implemented in calculations. The methodology for calculating WEM scenario is provided in Chapter 4.3.6. The subcategories Waste incineration without energy recovery and Other (Burning Biogas in a flare) are not affected by the change of population and GDP growth rate.

Table 4.21. Comparison of Waste sector GHG emissions per category, WEM and SEN scenarios, kt CO_2 eq

Waste	2016 (2018 inventory)	2020	2025	2030	2035	2040
Solid waste disposal on land WEM	160.78	170.78	122.28	87.51	65.82	51.93
Solid waste disposal on land SEN		180.13	121.88	86.42	60.45	43.63
Biological treatment of solid waste WEM	34.92	36.95	41.13	44.90	47.94	50.73
Biological treatment of solid waste SEN		40.06	42.77	45.48	48.17	48.71
Waste incineration and Open burning WEM	1.62	1.74	0.93	NO	NO	NO
Waste incineration and Open burning* SEN		1.69	0.85	NO	NO	NO
Wastewater treatment and discharge WEM	86.78	83.75	83.35	82.80	82.08	81.38
Wastewater treatment and discharge SEN		81.87	80.55	79.10	78.31	78.16
Other (Burning biogas in a flare)	22.13	NO	NO	NO	NO	NO
Waste total WEM	306.23	293.23	247.68	215.21	195.84	184.03
Waste total SEN		302.57	247.28	214.13	190.46	175.74
Difference (SEN-WEM)		-1%	-19%	-30%	-38%	-43%

* Emissions from waste incineration without energy recovery are not affected by the change of population and GDP growth rate, but the emissions from open burning of waste are.

4.9. Changes with respect to the 2017 submission

Comparison of parameters and CO_2 equivalent emission in current projection submission with respect to the 2017 submission are presented in Table 4.22.

Table 4.22. Comparison of parameters and CO_2 equivalent emission with respect to the 2017 submission

Submission		2016	2020	2025	2030	2035	2040[5]
2017	Population, thousand		1 313.27	1 297.40	1 276.00	1 250.73	–
2019			1 317.94	1 312.06	1 306.18	1 294.96	1 283.73
2017	Gross domestic product (GDP), real growth rate, %		3.3%	3.0%	2.5%	2.5%	–
2019			3.0%	2.6%	1.9%	1.4%	1.4%
2017	WEM total emissions (without LULUCF), kt CO_2 eq	18262.54	19 331.98	18 983.25	17 033.46	16 430.55	–
2019		19667.25	19660.01	18221.16	14812.63	13999.54	13312.92
2017	WAM total emissions (without LULUCF), kt CO_2 eq	18040.48	18 759.23	17 901.65	15 197.73	14 249.23	–
2019		19667.25	19443.25	17199.11	13335.03	12800.44	12120.07

4.9.1. Energy

The comparisons of CO_2 eq emissions with respect to the 2017 submission are presented on Table 4.23 and Table 4.24, for WEM and WAM scenarios, respectively. The changes in Energy industries category have two 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. Secondly, the projections in the heat production are based on the analysis of past fuel consumption trends of the sector to reflect the actual fuel consumption trends in the sector. Thus, influencing also the projections of the WAM measures in the WAM scenario. Thirdly, in the latest projections, the number of new shale oil production plants planned by the companies have been reduced due to changed economic situation. The changes in Manufacturing and construction sector and Other sectors occur, because the emission calculation in this sector takes historical data into account and consequently this has influenced emission projections. Fugitive emissions have lowered due to lower projected consumption of natural gas in the future. In addition in the newest projections the emissions of natural gas transmission are taken into account.

Table 4.23. Comparison of 2017 and 2019 WEM scenario Energy sector projections, kt CO_2 eq

Submission	Energy WEM	2016	2020	2025	2030	2035
2017	Energy industries	12 335.36	12 727.88	12 131.06	9 991.37	9 455.56
2019		13825.81	13745.13	12059.03	8568.81	7640.45

[5] The projection year of 2040 was not included in the 2017 projection submission.

Submission	Energy WEM	2016	2020	2025	2030	2035
2017	Manufacturing industries and construction	541.12	715.07	747.06	779.06	793.11
2019		523.14	581.26	616.13	651.01	666.33
2017	Transport	2366.17	2 359.29	2 489.01	2 626.03	2 530.44
2019		2376.91	2180.97	2327.18	2395.05	2489.25
2017	Other sectors	760.23	751.56	769.05	786.54	790.93
2019		733.31	682.17	678.59	686.10	691.80
2017	Other	27.26	27.26	27.26	27.26	27.26
2019		48.51	39.69	39.69	39.69	39.69
2017	Fugitive emissions	17.75	26.63	23.33	22.75	22.65
2019		17.08	17.73	17.73	17.73	17.73

Table 4.24. Comparison of 2017 and 2019 WAM scenario Energy sector projections, kt CO_2 eq

Submission	Energy WAM	2016	2020	2025	2030	2035
2017	Energy industries	12143.68	12 451.67	11 806.81	9 394.13	8 664.39
2019		13825.81	13598.04	11487.62	7867.76	7257.05
2017	Manufacturing industries and construction	541.12	715.07	747.06	779.06	793.11
2019		523.14	581.26	616.13	651.01	666.33
2017	Transport	2101.47	2 115.30	1 808.67	1 491.65	1 269.08
2019		2376.91	2114.66	1946.55	1714.05	1784.17
2017	Other sectors	750.39	702.40	695.14	687.88	670.30
2019		733.31	678.80	608.85	591.18	581.95
2017	Other	27.26	27.26	27.26	27.26	27.26
2019		48.51	39.69	39.69	39.69	39.69
2017	Fugitive emissions	17.82	23.24	20.23	17.29	14.48
2019		17.08	17.73	17.73	17.73	17.73

4.9.2. Transport

Comparison of Transport sector CO_2 eq emissions with respect to the 2017 submission in the WEM scenario is presented in Table 4.25. The previous WEM projections in the transport sector were based on the analysis of transport and mobility scenarios in EEDP 2030. As the data in EEDP 2030 of transport sector is outdated for the present day, the 2019 projections are based

on 2018 National GHG Inventory and baseline indicators (e.g passenger car turnover rate, increase of mileage relative to GDP growth etc.), which were confirmed by a group of transportation experts. In addition, the projections for the WEM scenario are also in line with Regulation (EC) No 443/2009, which stipulates that by year 2021, the average emissions target for a new passenger car is 95 gCO_2/km and with Regulation (EU) No 510/2011 147 gCO_2/km for light duty vehicles. Also, some emission factors have been updated according to latest data.

Table 4.25 Comparison of 2017 and 2019 WEM scenario Transport sector projections, kt CO_2 eq

Submissions	Transport WEM	2016	2020	2025	2030	2035
2017	Domestic aviation	1.25	1.25	1.25	1.25	1.25
2019		1.41	3.87	3.87	3.87	3.87
2017	Road transportation	2220.47	2240.65	2352.78	2458.85	2364.20
2019		2262.52	2075.66	2221.87	2289.74	2383.95
2017	Railways	108.38	96.73	113.00	142.55	141.83
2019		52.58	62.45	62.45	62.45	62.45
2017	Domestic navigation	36.07	20.66	21.98	23.38	23.16
2019		60.40	39.00	39.00	39.00	39.00
2017	Other transportation	NO	NO	NO	NO	NO
2019		NO	NO	NO	NO	NO
2017	Total CO_2 eq emissions	2366.17	2359.29	2489.01	2626.03	2530.44
2019		2376.91	2180.97	2327.18	2395.05	2489.25

Comparison of Transport sector CO_2 eq emissions with respect to the 2017 submission in the WAM scenario is presented in Table 4.26. The previous WAM projections in the transport sector were based on the analysis of transport and mobility scenarios in EEDP 2030. As the data in EEDP 2030 of transport sector is outdated for the present day, the 2019 WAM scenario measures´ activity data are based on a study carried out in 2018 to find cost-effective mitigation measures, which the 2019 projections are based on.

Table 4.26 Comparison of 2017 and 2019 WAM scenario Transport sector projections, kt CO_2 eq

Submissions	Transport WAM	2016	2020	2025	2030	2035
2017	Domestic aviation	1.25	1.25	1.25	1.25	1.25
2019		1.41	3.87	3.87	3.87	3.87
2017	Road transportation	1977.34	1943.12	1642.48	1331.57	1123.67
2019		2262.52	2009.36	1865.62	1633.12	1703.25
2017	Railways	87.62	153.66	149.43	145.08	132.62

2019		52.58	62.45	62.45	62.45	62.45
2017	Domestic navigation	35.26	17.28	15.51	13.75	11.54
2019		60.40	39.00	14.61	14.61	14.61
2017	Other transportation	NO	NO	NO	NO	NO
2019		NO	NO	NO	NO	NO
2017	Total CO_2 eq emissions	2101.47	2115.30	1808.67	1491.65	1269.08
2019		2376.91	2114.66	1946.55	1714.05	1784.17

4.9.3. Industrial processes and product use

In current submission emission quantities are projected to be smaller than in 2017 year´s submission (please see Table 4.27 Also, due to cross sectoral parameters (see Chapter 3.8), in 2019 year's submission, a WAM scenario was calculated for category 2.D.3 Other.

Significantly smaller emission quantity from 2.A category in 2017 in comparison with previous projection is caused by smaller production volumes projected by some producers because different economical and political situations (e.g imposed sanctions and market difficulties).

Projections of emissions from 2.F category (substitutes for ODS – these are F-gases) – have a high uncertainty. Regulation (EU) No 517/2014 clearly stipulates F-gas reduction goals for the whole EU, but leaves some choice for member states how they manage F-gas phase-down. Richer countries might switch to zero-GWP refrigerants immediately but the poorer countries probably 1) substitute high GWP F-gases for lower GWP F-gases in old equipment at first; and 2) use recycled HFC-s until their use is banned in 2030. In 2017 when previous projection was compiled it seemed that installation of zero-GWP refrigerants already had an upward trend in Estonia. According to Estonian GHG inventory´s 2018 and 2019 years submissions still lot of new equipment containing high-GWP refrigerants are installed. Therefore the phase-down of HFC-s is much slower in comparison with previous projections.

Another small difference is substitution of category Mineral industry; Other process uses of carbonates (CRF 2.A.4.b) with category Metal industry; Lead production (CRF 2.C.5) in 2019 year´s GHG inventory submission and also projections. The emissions that were relocated from 2.A.4.b to 2.C.5 and recalculated are small (ca 2-3 kt yearly) and have little effect on total emissions.

Projections of emissions from 2.G category do not differ much from previous projections. The plans of electrical network operators to install new substations with SF_6 insulated switchgear have not changed.

Table 4.27. Comparison of 2017 and 2019 IPPU sector projections, kt CO_2 eq

Submission	IPPU WEM	GHG	2016	2020	2025	2030	2035
2017	Mineral industry	CO_2	291.62	784.09	837.31	837.32	837.31
2019			236.95	420.52	503.53	503.53	503.53
2017	Chemical industry	CO_2	NO	NO	NO	NO	NO
2019			NO	NO	NO	NO	NO
2017	Metal industry	CO_2	NO*	NO*	NO*	NO*	NO*
2019			NA*	2.46	2.55	2.64	2.72
2017	Non-energy products from fuels and solvent use	CO_2 (including indirect CO_2)	20.17	20.25	20.43	20.33	19.97
2019			22.35	19.76	20.47	21.51	22.54
2017	Product uses as substitutes for ODS	CO_2 eq. kt of HFC-s	215.62	194.70	149.97	108.72	83.51
2019			235.18	232.56	187.02	133.42	103.96
2017	Other product manufacture and use	CO_2 eq. kt of SF_6 and N_2O	5.77	5.97	6.04	6.10	6.05
2019			5.66	5.30	5.54	5.78	5.98
2017	Total CO_2 eq emissions	CO_2 eq. kt	533.18	1 005.01	1 013.75	972.47	946.84
2019			500.15	680.59	719.12	666.88	638.72

* Category Mineral industry; Other process uses of carbonates (CRF 2.A.4.b) is substituted with category Metal industry; Lead production (CRF 2.C.5) in 2019 year´s GHG inventory submission and also projections

4.9.4. Agriculture

The main reason for the fall in projected emissions in the 2019 submission compared to the 2017 submission (Table 4.28) is explained by the anticipation of more pessimistic agricultural output especially due to the economic sanctions imposed by Russia on EU in 2014. This has reduced the accounted number of cattle compared to the projections in the previous submission for the years 2016 and 2017. As a consequence, the starting position for projecting the emission amounts has decreased in the base year 2016 and all together, the projected number of cattle is reduced compared to the previous submission. Nevertheless, since 2010 there has been a general rising trend of the number of cattle. In 2017, there was a slight rise in the number of cattle compared to 2016, so the crisis may have passed its lowpoint and the rising trend since 2010 is projected to continue and is expected to accelerate as the agricultural producers have made considerable investments in the sector. Global demand for meat- and dairy products along with suitable climatic conditions favour cattle production in Estonia to expand. With the supporting mechanisms of Common Agricultural Policy raising sheep and goats may be presumed to grow moderately. Demand after lamb and goat meat, wool and milk will grow.

The production of grains has projected to be smaller and the use of synthetic fertilizers is projected to be less intensive in 2035 compared to the previous submission. The outlook for agricultural sector's development has been even further improved considering the newest available information from the Ministry of Rural Affairs. The change in total emission values reflect also remarkably the corrections performed in GHG emission calculation methodology under different subsectors. Emissions from nitrogen excretion by the domestic animals have decreased due to the corrections in calculations and bringing Estonian GHG inventory IPCC 2006 Guidebook methodology in accordance with EMEP/EAA methodology when calculating indirect N_2O emissions from volatilization. In Urea application subsector, projected emissions have decreased due to the change in the methodology of Estonian GHG inventory, since 2019 submission, as emissions based on marketing data of urea fertilizers were homogenized by earlier years´ emissions in the time series by using surrogate data technique. The base year of the current projections is in coherence with the changes made in 2018 autumn Estonian GHG inventory resubmission. The increase of projected emissions in Agricultural soils subsector has been caused by including the area of drained grasslands into emission calculations in this subsector.

Table 4.28. Comparison of 2017 and 2019 of Agriculture sector parameters and projections, kt CO_2 eq

Submission	Agriculture WEM	2016	2020	2025	2030	2035
2017	Livestock: Total cattle, thousand heads	259.04	270.45	281.19	292.35	303.97
2019		248.20	264.00	274.00	285.00	296.00
2017	Livestock: Sheep, thousand heads	90.32	98.40	108.24	117.98	127.42
2019		91.28	98.40	108.24	117.98	129.0
2017	Livestock: Goats, thousand heads	5.18	5.40	5.94	6.47	6.99
2019		5.45	5.40	5.94	6.47	7.10
2017	Livestock: Swine, thousand heads	307.06	317.29	337.12	356.95	356.95
2019		265.90	317.29	337.12	356.95	357.00
2017	Livestock: Horses, thousand heads	6.62	7.90	8.30	8.70	9.10
2019		6.30	7.90	8.30	8.70	9.10
2017	Use of synthetic fertilizers, kt	56.20	57.00	60.00	61.00	62.00
2019		55.19	57.00	60.00	61.00	61.00
2017	Total CO_2 eq emissions	1 363.72	1 468.13	1 566.06	1 623.55	1 678.56
2019		1 336.11	1 439.25	1 516.01	1 572.14	1 619.72

4.9.5. Land use, land-use change and forestry

The main difference for the change between 2017 and 2019 submissionis (Table 4.29) is in Cropland projections which is caused by the new methodology for calculating C stock changes in mineral soils for Cropland remaining cropland subcategory. Changes in Forest land and HWP projections are caused by the new methodology set in the LULUCF Regulation for the Forest Reference Level calculations. Smaller changes in Grassland, Wetlands, Settlements and Other land estimates are caused by updated activity data from the National Forest Inventory (NFI). More detailed information about renewed NFI is described in the National Inventory Report 2018 "Greenhouse Gas Emissions in Estonia 1990-2016".

Table 4.29. Comparison of 2017 and 2019 LULUCF sector projections, kt CO_2 eq.

Submission	LULUCF	2016	2020	2025	2030	2035
2017	Forest land	-2 393.38	-2 067.49	-1 660.13	-1 252.76	-845.39
2019		-3 148.38	-2 355.86	-1 277.94	-1 609.34	-1 353.98
2017	Cropland	132.05	155.79	185.47	215.14	244.82
2019		636.92	718.57	820.37	922.16	1023.96
2017	Grassland	36.70	33.11	28.62	24.14	19.65
2019		31.08	28.06	24.28	20.50	16.72
2017	Wetlands	788.06	756.43	716.90	677.37	637.84
2019		606.33	567.07	518.10	469.13	420.16
2017	Settlements	222.11	254.22	294.35	334.48	374.61
2019		253.47	292.22	341.23	390.25	439.26
2017	Other land	20.04	6.54	-10.33	-27.21	-44.08
2019		32.01	36.09	40.84	45.60	50.35
2017	Harvested wood products	-1 119.85	-1 278.41	-1 476.62	-1 674.83	-1 873.04
2019		-1 139.54	-688.70	-537.81	-446.54	-442.92
2017	Total LULUCF sector CO2 eq. emissions	-2 314.27	-2 139.81	-1 921.74	-1 703.67	-1 485.59
2019		-2 724.44	-1 402.56	-70.94	-208.24	153.55

4.9.6. Waste

The general reason for the projection differences in the 2019 submission compared to the 2017 submission (Table 4.30) connected with the GDP and more optimistic population growth rate, both parameters are essential and affecting waste sector emissions greatly, especially emissions from Solid waste disposal

The emission changes from Biological treatment of solid waste is strongly connected with the treated waste amount during baseyear. As we have seen a decline in the amount of waste biologically treated the projections of GHG also decrease. 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 centralised wastewater system. There is no emission projection for the Burning biogas in a flare due to recalculations of flared landfillgas done in the 2019 NIR. Please see more information on that the 2019 NIR, chapters 7.2.5 and 7.6.

Table 4.30. Comparison of 2017 and 2019 Waste sector projections, kt CO_2 eq

Submission	Waste WEM	2016	2020	2025	2030	2035
2017	Solid waste disposal on land	168.73	110.30	73.01	57.94	35.03
2019		160.78	170.78	122.28	87.51	65.82
2017	Biological treatment of solid waste	37.04	44.01	48.92	54.10	59.38
2019		34.92	36.95	41.13	44.90	47.94
2017	Waste incineration and open burning	1.41	1.38	0.73	NE	NE
2019		1.62	1.74	0.93	NE	NE
2017	Wastewater treatment and discharge	90.31	84.51	83.06	81.45	79.84
2019		86.78	83.75	83.35	82.80	82.08
2017	Other (Burning biogas in a flare	20.24	10.95	10.95	10.95	10.95
2019		22.13	NE	NE	NE	NE
2017	Total CO_2 eq emissions	317.75	251.16	216.67	204.44	185.21
2019		306.23	293.23	247.68	215.21	195.84

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