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Reaching climate neutrality in Estonia: a progress update

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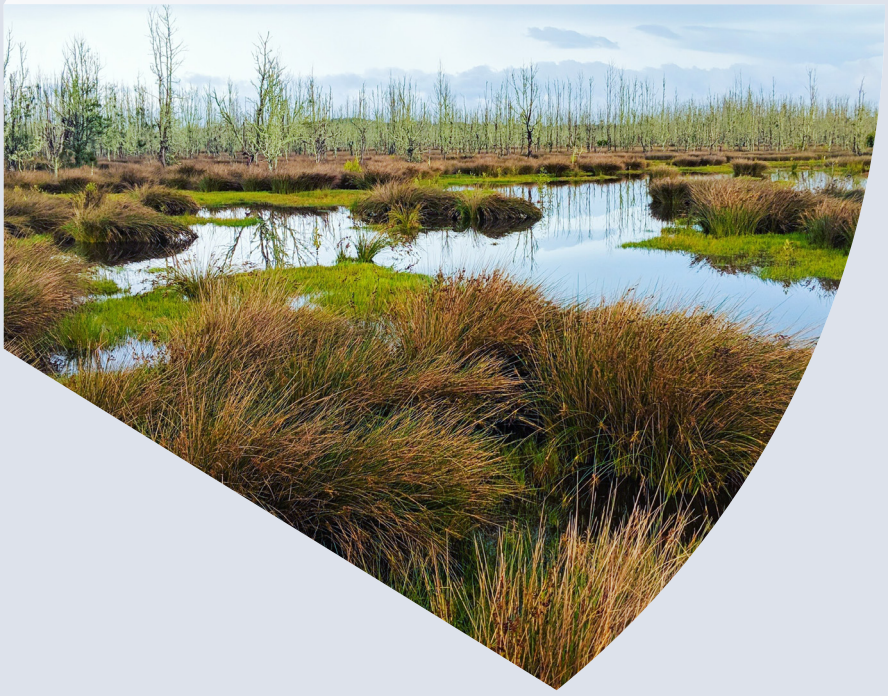

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Reaching Climate Neutrality in Estonia – a progress update
SEI Tallinn, 36 lk.
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Executive summary

This study, commissioned by the British Embassy in Tallinn, analyses progress made towards reaching climate neutrality in Estonia. In 2019, SEI Tallinn carried out a study looking into potential measures to help the country reach climate neutrality by 2050. That study concluded that it is technically possible if all sectors, including private, public and non-profit, contribute to the aim. This new study analyses progress made in Estonia to since 2019, especially with regard to implementation of the proposed measures.

Greenhouse gases in Estonia are following a negative trend as the total emissions fell from 18 687.4 kilotons CO_2 equivalent in 2018, to 11 555.8 kt CO_2e in 2020. Emissions have decreased for various reasons, such as increasing the share of district heating, greater renewable energy capacity, and efforts to renovate buildings for energy efficiency. Yet when analysing the main emitting sectors, it can be seen that there is much work to be done to reach climate neutrality in Estonia by 2050.

We identified the following key issues in each of the analysed sectors:

- The energy sector is showing a positive trend in terms of renewable energy produced and consumed, yet the pace of investment into new renewable energy capacities needs to grow considerably in the upcoming years (e.g. wind energy capacities which are expected to reach 2640 GWh by 2030 from 760 GWh in 2020) in order to effectively address price hikes and supply shortages.
- Currently the funding mechanism for renovations in the buildings sector is focusing entirely on apartment buildings and private houses, yet additional incentives are needed for renovating office, industrial, and commercial buildings in order to fulfil the climate neutrality target and the national target of 54 million m2 of buildings to be reconstructed by 2050. Targeting commercial, industrial and office buildings is also cost efficient because the investment required is modest compared to the CO2 savings potential.
- There is currently no government support for decarbonizing heavy industry in Estonia. There are existing plans for the upcoming years, for example the Ida-Virumaa region, in which the majority of Estonian heavy industry is located, receives EUR 340 million through the EU Just Transition Fund. Furthermore, the Estonian Recovery and Resilience funding includes the green transition for enterprises with an allocation of EUR 220.2 million.
- The Land use, land-use change, and forestry (LULUCF) sector needs attention. Since 2012 sequestering of carbon in the sector has decreased from -4 million tons of CO2e so that in 2020 it had become an emitting sector. There are no supporting measures in place to boost sequestering, and there is a need for greater efforts to curb emissions in the sector.
- The transport sector is struggling because of an ongoing decline in the number of people choosing to walk, cycle or use public transport. As part of the EU Effort Sharing Regulation, the transport sector has the largest emissions reduction potential.
- When it comes to agriculture sector, almost all of the suggested measures from 2019, as described below, have been adopted to some extent, yet emissions are still rising slowly yet steadily. Additional effort is needed to curb emissions in the sector, yet in many cases the savings from proposed measures would have an impact in other sectors, thus would not be reflected in the agriculture sector's greenhouse gas inventory.

1. Introduction

This analysis is commissioned by the British Embassy in Tallinn. The purpose of this study is to revisit the SEI study Reaching Climate Neutrality in Estonia,[1] which was published in 2019. That 2019 analysis was commissioned by the Estonian Government and looked into whether it would be feasible to achieve climate neutrality in Estonia by 2050, instead of the original goal of 80% reduction in greenhouse gas emissions, before committing to the goal of climate neutrality along with the other EU Member States. The study proposed various political measures and calculated corresponding investments needed as well as potential CO_2 emissions reduction achieved. The report concluded that reaching climate neutrality by 2050 is technically possible, if all sectors, including private, public and non-profit, contribute to the aim. Thus, at the end of 2019, Estonia pledged to achieve climate neutrality by 2050.[2]

Furthermore, adopting the measures and achieving the initial targets was found to be potentially profitable in the long term, if strategically sound decisions are made, such as choosing to implement the most cost-efficient measures first. The study concluded that the longer that the longer the delay to decisions and implementation of proposed measures, the more complex and costly achieving climate neutrality will become.

Since the 2019 study a multitude of new documents, strategies and goals, both nationally and at the EU level, have been adopted, as the EU raises its climate ambition to keep on track towards climate neutrality.

This study aims to analyse the progress made in Estonia since the publication of the 2019 climate neutrality study. This is done by assessing current statistics, investment plans, and how far proposed measures have been implemented.

The study begins with background information on new targets and goals set in the EU, followed by an overview of the trends in greenhouse gas emissions in Estonia. Next, the main emitting sectors in the Estonian economy are analysed with the aim of measuring progress. These sectors include buildings, energy production, industry, LULUCF (land use, land-use change and forestry), transport and agriculture. Each of these sections includes the suggested measures and corresponding investments, along with an analysis of the current situation. Each section concludes with a short summary and take-away messages for each sector.

1 https://www.sei.org/publications/reaching-climate-neutrality-in-estonia/

2 https://www.err.ee/987909/valitsus-toetab-euroopa-kliimaneutraalsuse-saavutamist-aastaks-2050

2. Background

In 2018, The European Commission set a goal of climate neutrality by 2050. At the end of 2019, the Estonian Government endorsed the country's alignment with the European long-term vision A Clean Planet For All, which sets 2050 as the target year for achieving climate neutrality in the EU.[3] Prior to that, the Estonian goal for 2050 was to reduce greenhouse gas emissions by 80%, as per the General Principles of Climate Policy until 2050 adopted in April 2017.

The European Green Deal focuses on achieving climate neutrality and sets an ambitious net greenhouse gas emissions reduction target of at least -55% by 2030. The European Green Deal highlights the following objectives.[4]

- Build an interconnected energy system and better integrated grids to support renewable energy sources
- Promote innovative technologies and modern infrastructure
- Boost energy efficiency and eco-design of products
- Decarbonize the gas sector and promote smart integration across sectors
- Empower consumers and help EU countries to tackle energy poverty
- Develop the full potential of Europe's offshore wind energy

Furthermore, the EU plan for a green transition includes the Fit for 55 policy package,[5] which proposes comprehensive changes to the EU Emissions Trading System (EU ETS), which would result in a 61% emission reduction by 2030 compared to 2005, for example by including maritime transport and aviation emissions into the EU ETS. The Fit For 55 package also includes a proposal to revise the Renewable Energy Directive with a new target of 40% renewable energy sources in the energy mix by 2030, instead of the current 32%.

The main propositions in the Fit For 55 package are summarized in Table 1 below.

Table 1 The EU Fit For 55 package targets compared to existing targets for 2030

Changes proposed with the Fit For 55 package	New ambitious goal	Existing goal
EU Emissions Trading System	61% decrease from GHG emissions in 2005	43% decrease from GHG emissions in 2005
Reduction target in the Effort Sharing Regulation (applied to transport, buildings, agriculture and waste) in the EU	40% decrease from GHG emissions in 2005	30% decrease from GHG emissions in 2005
Reduction target in the Effort Sharing Regulation (transport, buildings, agriculture and waste) in Estonia (national goal)	24% decrease from GHG emissions in 2005	13% decrease from GHG emissions in 2005
The EU-wide GHG reduction target	Net greenhouse gas emissions decreased by 55% compared to 1990 emissions	Net greenhouse gas emissions decreased by 40% compared to 1990 emissions
National LULUCF goal	-2.5 m tons CO_2 sequestered	emissions in the sector do not exceed removals
EU-wide LULUCF goal	-310 m tons CO_2 sequestered	NA
Renewable energy sources in the EU-wide final energy mix	40%	32%
Final energy consumption	787 m tons of oil equivalent (Mtoe)	<846 Mtoe
Primary energy consumption	1023 Mtoe	<1128 Mtoe

3 https://news.err.ee/987949/government-endorses-2050-as-target-year-for-climate-neutrality

4 https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/energy-and-green-deal_en

5 https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

The EU funding for overcoming the impacts that the Covid-19 pandemic had on the EU's economy and society is also something that will substantially affect the green transition in EU Member States. The Recovery and Resilience Facility aims to boost the economy with new funds, but funds must be allocated in a way that fosters green- and digital transition. It is a temporary recovery instrument which allows member states to implement reforms and make investments towards climate neutrality.

The Estonian Recovery and Resilience Facility (RRF) was approved by the Council of the European Union in October 2021 for a total of EUR 969.3 million in grants and allowing for the first allocation totalling EUR 126 million.[6] The key measures for green transition in the Estonian RRF are: investments in hydrogen technologies, strengthening the electricity grid and energy storage to increase renewable energy production capacity, construction of the Rail Baltic terminal in Tallinn, setting up a Green Fund to support enterprises with green transition and development of innovative green technologies.

The funds for greening the Estonian economy through the Green Fund is one of the largest investments in the plan. The funding is aimed at facilitating the development and uptake of new green technologies in the following strategic sectors: energy, agriculture, food production, transport and logistics, materials and chemistry industries, and the environment. The funding places special emphasis on achieving energy efficiency, adding value to bioresources and upgrading production technologies.

6 https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/698886/EPRS_BRI(2022)698886_EN.pdf

3. Methodology

This study builds on the 2019 SEI study Reaching Climate Neutrality in Estonia, and compares it to new developments in the field of energy and climate. Back in 2019, the climate neutrality analysis was presented to the Estonian Government, was discussed in ministries and also reached the public via high media coverage. The main objective of this report is to establish whether the measures that were proposed in the 2019 study are being implemented, and what progress has been made towards climate neutrality by 2050 through adoption of the proposed measures.

The analysis of whether there has been progress is measured by either statistics in a certain field, or – in cases where there is no specific data available – assessment of government investment into the sector through certain funding schemes (e.g. the Estonian Recovery and Resilience Facility funding, PRIA, Climate Investment Centre, Structure fund measures, Kredex). The climate neutrality study from 2019 mostly used data from 2017 because of the lag in data availability. Thus, comparisons are made mainly from 2017 onwards. It is not in the scope of this study to determine whether the measures proposed in 2019 should be altered and whether some should be replaced.

The tables in the following sections, which analyse progress using specific measures, also include calculations of the cost-efficiency of measures. The cost efficiency column shows whether the measure was “cheap” in terms of investment versus greenhouse gas reduction potential, or whether it was more costly. A positive number indicates that the cost is more than is achieved as greenhouse gas savings, and in terms of a negative value, the cost for implementing the measure is less than is achieved in greenhouse gas emissions reduction. These calculations are derived from the 2019 study Reaching Climate Neutrality in Estonia.

Table 2 summarizes the definition of the colour indicators which are used when analysing progress in the following sections.

Table 2. Methodology for analysing the measures in the economic sectors in the study

Progress indicator	Definition
Green	The measure has an active funding available, there is continuous work and effort in the field
Yellow	Yellow indicates one or many of the following: 1. There was funding available previously, which has been discontinued 2. Existing plans for future funding or a scheme currently being developed 3. Funding is available on regional level but not on a national level 4. Funding available to an extent but the investment is insufficient for progress in the sector
Red	No substantial progress can be seen

4. Greenhouse gas emissions in Estonia

Greenhouse gas emissions emitted in Estonia have been declining steadily since 1990, the base year for calculating emissions. In 2020, carbon dioxide comprised 80.9% of total greenhouse gas emissions, followed by methane (9.5%), nitrous oxide (8.0%) and fluorocarbons, which account for about 1.6% of total emissions.7 Total greenhouse gas emissions in Estonia were 11 555.8 kt CO_2e in 2020, which is a significant decrease from 18 687.4 CO_2e in 2018. Total greenhouse gas emissions have dropped 71.24% between 1990 and 2020.

The energy sector is the sector that contributes most to greenhouse gas emissions in Estonia, and in 2020 it contributed 81.9% of total emissions (excl. LULUCF)8. The energy sector comprises both the production of energy and the energy used in the transport sector. The second largest contributor is the agriculture sector (13.1%), followed by industrial processes and waste (2.6% and 2.5% respectively in 2020).

The LULUCF sector in Estonia has historically been a carbon sink, yet this was not the case in 2020, as emissions in the sector exceeded its binding capacity. Total emissions in the LULUCF sector were 1297.3 kt CO_2e in 2020.

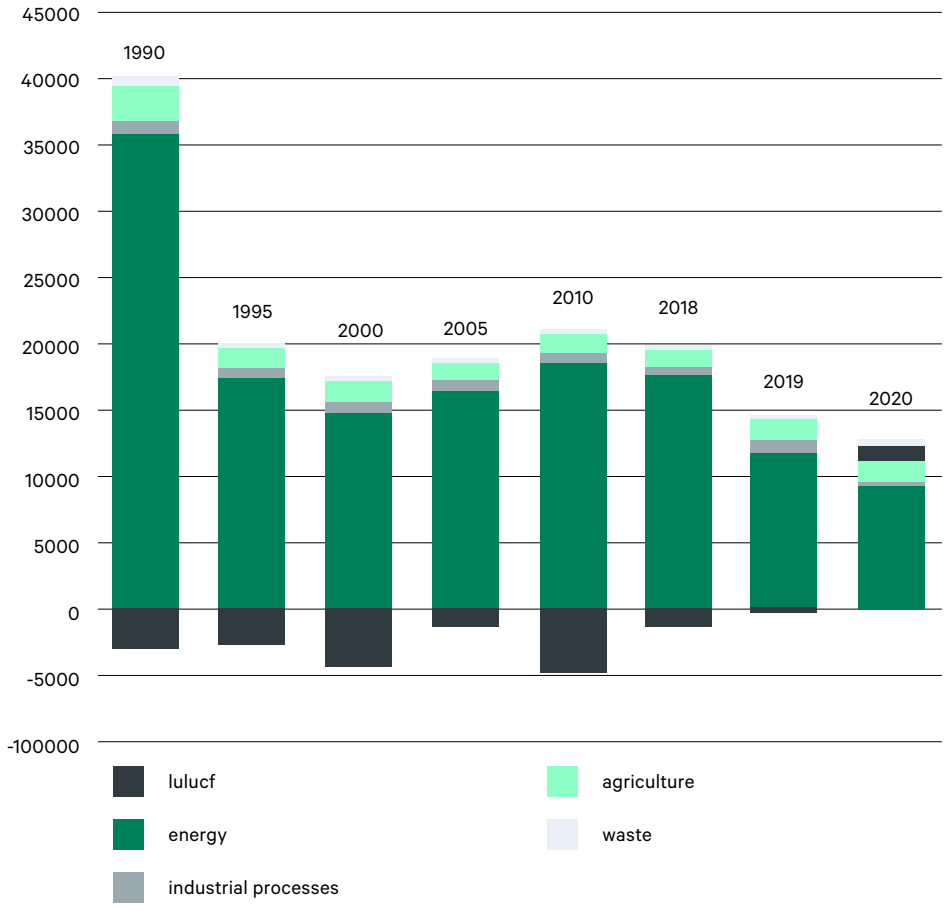

Figure 1. Greenhouse gas emissions from emitting sectors from base year 1990 to 2020.

Source: Greenhouse gas emissions in Estonia 1990–2020. National inventory report.

Compared to base year 1990, emissions from the energy sector have decreased by 66.8%.1 Oil shale has historically accounted for up to 80% of total electricity produced, yet due to the price increases of the

7 Republic of Estonia, Ministry of the Environment, Greenhouse Gas Emissions in Estonia 1990–2020. National Inventory Report. Submission to the European Commission. 2022

8 Republic of Estonia, Ministry of the Environment: Greenhouse Gas Emissions in Estonia 1990-2020. National Inventory Report. Submission to the European Commission. 2022

EU ETS allowances and different environmental and climate related national goals, the use of oil shale has been declining. Estonia has set a goal to stop using oil shale for electricity by 2035, and to stop using any kind of oil shale derived products in the energy sector by 2040.[9] In 2020 the share of oil shale used for electricity accounted for 40.3% yet there has been significant decrease from 75.8% of total electricity production in 2018 and 56.8% in 2019 (the usage and impact of oil shale is further analysed in the energy section, below).

9 Taastekava. https://rrf.ee/wp-content/uploads/2021/10/EE-Taastekava-051021.pdf

5. Progress towards climate neutrality in economic sectors

In the following chapters the progress in main emitting sectors in Estonia are analysed. These sectors are: buildings, energy carriers and energy production, industry, LULUCF, transport and agriculture. Each chapter consists of a short introduction, a status analysis of the measures proposed for achieving climate neutrality, and finally a short summary of the progress in the sector.

5.1 Energy consumption and energy efficiency in buildings

In Estonia, the energy consumption of households makes up 42.7% of the total energy balance (NECP 2030). Household greenhouse gas emissions in 2019 were 302.90 kt CO_2e and commercial/ institutional 257.54 CO_2 eq. The main energy consumed is electricity, gas and heat (via district heating systems – see note below). Due to the Estonian climate, heat is consumed in substantial amounts for at least seven months of the year, therefore the country consumes just slightly less electricity than heat (Figure 3).

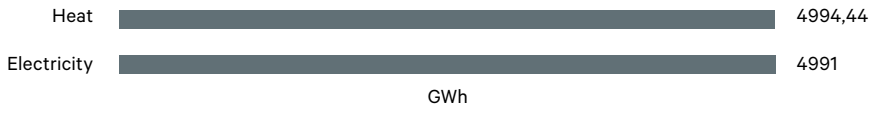

Figure 2 Energy consumption in buildings, source: Statistikaamet KE0230

In 2019, heat accounted for 34% of total final energy consumption, with households accounting for 62% of the total. The share of renewable energy in the heating and cooling sector accounted for 58.83% in 2020.[10]

Table 3 Fuel consumption in buildings.

Fuel type	Amount 2019
Other bituminous coal, thousand t	4
Liquefied petroleum gas (propane, butane), thousand t	8.7
Gas oils and diesel oils, excluding biofuels, thousand t	22
Heavy fuel oil, thousand t	3
Natural Gas, TJ	6 101
Primary solid biofuels (including firewood), TJ	16 302
Biogas, TJ	94

Source: Statistikaamet KE0230

District heating is used by 60% of the Estonian population and there are more than 200 district heating areas in Estonia. In areas where there is no district heating, a local heating method is used to provide heat. The most common heating systems or their combinations are electric heating, stoves, cookers, fireplaces, boilers, and heat pumps. The share of renewable sources in local heating consumption is 64%. The most commonly used fuel for local heating is wood (53%), followed by heat pumps (28%) and natural gas (19%). Unfortunately there is no reliable data on the use of electricity in heat production (except for heat pumps).[11]

The share of renewable energy in heating and cooling was 58.83% in 2020 and is expected to increase further, especially as smaller boiler houses that have been using fuel oil are converted to use of wood chips and other low-value wood. The need to increase the amount of renewable- and domestic fuels in district heating is very important, because the price of natural gas fluctuates and is supplied mainly from Russia, which is a geopolitical and national security risk. In addition, the regulation of nearly zero-energy buildings also helps to promote the transition to renewable fuels in the district heating network, because district heating using renewable energy sources and cogeneration would allow meeting the requirements for nearly zero-energy buildings without significantly increasing construction costs.[12]

10 SHARES-2020. https://ec.europa.eu/eurostat/web/energy/data/shares

11 Renewable Energy Chamber yearbook 2019, http://www.taastuvenergeetika.ee/wp-content/uploads/2020/10/ETEK_aastaraamat_A4_2019_veeb.pdf

12 TUT Institute of Thermal Engineering, TUT Design Institute, 2016

Greenhouse gas emissions reduction targets are set for the buildings sector as follows:

According to the European Union:

- GHG must be reduced by 60% by 2030
- energy consumption must be reduced by 14% by 2030
- Renovation of at least 3% of all public administration buildings annually

Fit for 55 package proposed targets:

- 35 million buildings renovated by 2030
- 49% share of renewable energy used in buildings

National targets set in Estonia:

- 50% of apartment buildings must be renovated by 2030 (ENMAK 2030)
- 40% of single houses must be renovated by 2030 (ENMAK 2030)
- 54 million m^2 of buildings renovated (single houses 12 million m^2, apartment buildings 18 million m^2, not residential buildings 22 million m^2) by 2050

Table 4. Measures suggested in the 2019 SEI Climate Neutrality study and the progress made since 2019. The cost-efficiency column shows the cost of reducing the emission of one tonne of CO_2. A blank box indicates that there was not enough data for a calculation to be made.

Measure	Proposed time of imple-mentation	Cost-efficiency for CO_2 reduction (EUR/t)	Investments since 2019	Progress
Renovation of welfare institutions	2020	2429	Measure 2014-2020.2.5.1: In 2019, the renovation of ten care homes for a total of EUR 2.26 million and the construction of eleven nearly zero-energy buildings for a total of EUR 5.57 million was granted. [13]	
Renovation of kindergartens	2020	409	Measure 2014-2020.9.1.2: Creating a new childcare and pre-primary education infrastructure[14] Investments to renovation of kindergartens is mainly municipal. The city of Tallinn invested EUR 4.29m to reconstruct the kindergartens of Sitsi and Männikäbi in 2019. Tallinn plans to renovate all municipal kindergarten buildings by 2030.[15]	
Renovation of single houses	2021	360	According to KredEx the total sum allocated to single houses in 2020 was EUR 1 million, and about 208 single houses were supported.[16] New support measures will be open in 2022 March/April.[17] New funding for renovation of single houses planned from 2023 onwards (budget EUR 35.1 million)[18] and an additional 2.4 million through the RRF.	

13 https://www.rahandusministeerium.ee/sites/default/files/document_files/REGO/co2_hooldekodud_sk_260918.pdf

14 "Creation of new childcare and pre-primary education infrastructure" is an activity under Measure 9.1 "Sustainable development of urban areas". The aim of the activity is to provide kindergarten and childcare facilities close to home for the residents of larger urban areas. According to the Ministry of Finance, 5 projects for the reconstruction or expansion of a kindergarten generated potential energy savings.

15 https://www.tallinn.ee/est/sitsi-lasteaed/Uudis-Pealinna-lasteaedade-uuendamine-jatkub-hoogsalt?filter_otsing_uudis_rubriik_id=379

16 https://issuu.com/sihtasutus_kredex/docs/sihtasutus_kredex_2020_aastaaruanne

17 https://kredex.ee/en/services/housing/private-home-renovation-support

18 Elamuinvesteeringute rahastu (ELIFO)

Renovation of apartment buildings	2021	117	Measure 2014-2020.6.1.1: Supporting the renovation of apartment buildings.[19] In 2019, 51 apartment buildings were renovated (average energy savings 38%). In 2020, 81 apartment buildings were renovated (energy savings 48%). In 2020 the total sum of renovations was EUR 27.8 million. KredEx is currently facing a new seven-year funding period, with EUR 366 million earmarked to support the reconstruction process.[20] Additionally, EUR 44.75 million is allocated for apartment building renovations from the RRF.	
Renovation of schools	2021	1	Measure 2014-2020.1.4.1: Modernization of sustainable schools in the process of reorganizing the school network[21] / Measure 2014-2020.4.1.1 Institutional development program for R&D institutions and universities: The aim of the measure is to help reorganize the school network and modernize the buildings in which educational establishments operate. 53 projects have received support in the amount of EUR 294.2 million.	
Renovation of office buildings	2021	8	No progress is seen at this stage. There is no existing obligation to reconstruct office buildings nor is there support available for doing so.	
Renovation of GHG emissions in the area of administration of the Ministry of Defence	2021		No substantial progress can be seen at this stage.	
Renovation of commercial service company buildings	2021	-796	No substantial progress is seen at this stage. There is no existing obligation to reconstruct nor is there support available for doing so.	
Renovation of industrial buildings (without energy consumption of processes)	2021	-415	No substantial progress can be seen at this stage.	

Compared to 2019, one of the main updates is the completion of the Long-Term Strategy for the Reconstruction of Buildings, prepared by Ministry of Communication and Economic Affairs and Taltech.[22] According to this strategy, one of the main aims for Estonia is the cost-effective renovation and conversion of the existing building stock into nearly zero-energy buildings by 2050. By 2030, 22% would have to be renovated on the basis of the strategy, 64% by 2040 and 100% by 2050. The document highlights that to achieve the target, in addition to single houses (14 million m^2), apartment buildings (18 million m^2) and non-residential buildings (22 million m^2), a total of 54 million m^2 of buildings would need to be renovated by 2050. According to the strategy, the total quantity to be renovated varies year by year, starting with 4 million m^2 in 2020-2025, to 11.8 million m^2 in 2036-2040. The most active time for renovations would be 2031-2045, with the peak time requiring up to five times the current pace of renovations. Similarly, the investment needs will grow from EUR 227 million in 2020, to EUR 1 billion per year in 2035.

The strategy foresees that with complete renovation, it is possible to achieve energy savings of approximately 7 TWh, of which 70% would be from heating and 20% from electricity. It is predicted, that when the renovations are complete, CO_2 emissions in the buildings sector will decrease by 90% by 2050.

19 https://www.sei.org/projects-and-tools/projects/el-rahastatud-meetmete-moju-energiamajandus/

20 https://issuu.com/sihtasutus_kredex/docs/sihtasutus_kredex_2020_aastaaruanne

21 https://www.sei.org/projects-and-tools/projects/el-rahastatud-meetmete-moju-energiamajandus/

22 https://ec.europa.eu/energy/sites/ener/files/documents/ee_ltrs_2020.pdf

Table 5. Renovation rates of apartment buildings; *Source: Kredex, majandusaasta aruanne 2020*

Year	Number of apartment buildings which have received renovation support from KredEx	Fund allocated in EUR
2019	51	17 778 994
2020	81	21 609 191 + 60 294 878 (Special Covid reconstruction support)

As Table 5 shows, an additional 30 apartment buildings received support through KredEx for renovation in 2020. According to KredEx, it is difficult to gather energy saving data for single houses. However, it is known that about 460 applicants requested support, the weighted average energy consumption of these 460 applicant's buildings was 300 kWh per m² before renovations and about 158 kWh per m². afterward. KredEx is currently facing a new seven-year funding period, with EUR 366 million earmarked to support the reconstruction process. (Foundation KredEx, 2020[23])

Currently, private households and large apartment buildings are achieving more attention than other building types. There are both more data available for them on energy consumption and more steady funding available for residential buildings. While public buildings such as welfare institutions, kindergartens and schools received renovation support in the last period, it is not clear whether this funding will continue. According to currently available data, only residential buildings will receive ongoing support in the near future. None of the other building types have a national investment scheme available. There is no information available for Ministry of Defence buildings nor for industrial buildings that are currently not receiving governmental support.

According to the EU Energy Directive, Member States need to reconstruct 3% of their public property each year. In 2018, the National Audit Office in Estonia stated in an audit that the situation is less than ideal in terms of improving the energy efficiency of public property. While the minimum requirements have been met, there is no plan or roadmap developed for this specific building type, nor is there budget allocated. This audit also highlighted that the government is lacking a clear understanding of the energy consumption of their buildings, which is making it difficult to make informed decisions on reconstruction needs. While Estonia has so far managed to fulfil the target by renovating approximately 25 000 m^2 of public buildings space,[24] the highlighted by the National Audit Office in 2018 still applicable today.

As can be seen from Table 4, cost efficiency (meaning the cost of cutting the emission of one tonne of CO_2) is lowest for the renovation of commercial service buildings and industrial buildings. This means that, with relatively low investment, a significant improvement is possible, yet unfortunately measures to renovate these types of buildings have not so far received attention.

Currently, office buildings and commercial service buildings (although being renovated) are not being renovated to the extent of at least C-energy class and thus will not help with reaching the climate neutrality goal. The Long-Term Strategy for the Reconstruction of Buildings indicates that between 2017 to 2020, 21% of all the renovations of non-residential buildings were fully reconstructed to at least C-level energy class. To achieve the target of the strategy and reaching climate neutrality the amount needs to be approximately four times more. Studies show that these buildings are renovated in order to raise functionality and indoor climate, yet energy efficiency is not considered as a main goal of renovations due to the cheap price of energy and lack of taxation on CO_2.[25] It is estimated that in current market conditions the CO_2 reduction goal for the buildings sector will not be achieved because of a lack of incentives to renovate: energy savings in monetary terms would only be about 2 to 3% of existing energy costs. The main issue is the long payback period (approximately 20-30 years) which is considered as risky by many. There is currently no existing obligation nor support for the renovation of office or commercial services buildings.[26] Because non-residential buildings in Europe account for about 25% of total building stock while consuming 40% of all the energy in the buildings sector, it is likely that the lack of renovation progress in these building types will threaten the goal of climate neutrality.

23 https://issuu.com/sihtasutus_kredex/docs/sihtasutus_kredex_2020_aastaaruanne

24 https://www.ekyl.ee/wp-content/uploads/Hoonete-rekonstrueerimise-pikaajaline-strateegia-l%c3%b5ppraport_2020-06-02.pdf

25 https://taltech.ee/uudised/arihoonete-raiskav-energiakasutus-ohustab-rohepooret

26 https://taltech.ee/uudised/arihoonete-raiskav-energiakasutus-ohustab-rohepooret

The long-term development plan for the buildings sector proposes the following measures for enhancing progress in the non-residential buildings sector:

1. Energy audits in non-residential buildings. This measure aims to raise awareness among property owners. The property owner would receive important Information about the potential to reduce the use of energy, about the cost of energy, and the potential energy and cost savings after renovation. As a side benefit, the government would receive a database of the energy use of non-residential houses.
2. Support for renovations based on CO_2 savings achieved. This measure aims to provide an incentive to renovate to a near zero-energy building. The support by the government would depend on the energy- and emissions saving achieved.

SUMMARY

- The buildings sector is facing very ambitious targets and there is still a lot of work ahead. The long-term strategy for the buildings sector projects that the pace of renovation will need to be five times the current pace in coming years
- Specific targets or data mainly exist for single houses and apartment buildings, or summarized categories of residential and commercial/ institutional buildings. As such, in the residential buildings sector (single houses + apartment buildings) it can be concluded that the reconstruction pace according to projections to reach the CO_2 reduction targets by 2050 must be increased
- Most focus and financial support measures are dedicated to the apartment buildings and single houses, whereas other building categories, i.e. commercial services, industrial buildings, schools etc do not have stable financial support measures. The lack of incentive to renovate these type of buildings (to nearly zero-energy buildings) will threaten reaching the goal set for the buildings sector.

5.2 Energy

As the production of energy accounts for more than 75% of the EU greenhouse gas emissions, decarbonizing the energy system is critical for reaching the climate neutrality target. Further, an important prerequisite in the sector of energy carriers is energy independence. For Estonia to achieve climate neutrality and at the same time fulfil its energy needs independently, large scale changes are necessary in the energy sector.

As seen from Table 6, Estonia, like the other EU Member States, has ambitious targets to achieve by 2050. The goal in all sectors is climate neutrality, but the pace in the race to get there varies greatly.

Table 6. National goals in the energy sector in Estonia for 2030 and 2050

Existing goal/indicator	2019	2020	2030	2035	2050
At least 50% of renewable energy in final energy mix (approx. 16 TWh)	31,90%	30,07%	42%	>55%	climate neutrality
Share of renewable energy final consumption in heating and cooling (%)	52,28%	58,83%	63%	NA	climate neutrality
Share of renewable energy in final energy consumption of electricity (%)	22%	28,29%	40%	NA	climate neutrality
Share of renewable energy in final energy consumption in the transport sector (%)	5,15%	12,16%	14%	24%	climate neutrality
Final energy consumption	32,88 TWh	34,05 TWh	32 to 33 TWh	NA	NA
Consumption of primary energy	54,8 TWh		<60 TWh	NA	NA
Energy consumption in transport sector	9,2 TWh		8,3 TWh	8,3 TWh	climate neutrality
Reconstruction of all the building stock built before year 2000 by 2050.	NA	NA	22%	NA	100% (54 million m^2, -7 TWh)

In Estonia, oil shale has historically accounted for up to 80% of total electricity produced, yet due to price increases under the EU ETS allowances and different environmental goals, use of oil shale has been declining. The share of oil shale used for electricity accounted for 75.8% of total electricity production in 2018, 56.8% in 2019 and 40.3% in 2020. Oil shale has been an important element in ensuring Estonia's energy independence, thus it is important to develop new climate neutral capacities in order to maintain this independence. As can be seen from Figure 3, there has been significant growth in the share of renewable energy in primary energy production, especially since 2017.

The share of renewables in primary energy production in 2017 was 26.5%, which has increased to 42.2% in 2020. This increase corresponds to the increased use of combined heat and power plants (CHP), which also mainly use renewable resources, such as wood and waste. The use of CHP in total electricity production grew from 12.1% in 2018 to 27.7% in 2020. The share of renewables in the transport sector is still lagging compared to other sectors, yet significant improvements can be seen since 2017, with an increase from 0.42% to 12.16% in 2020.

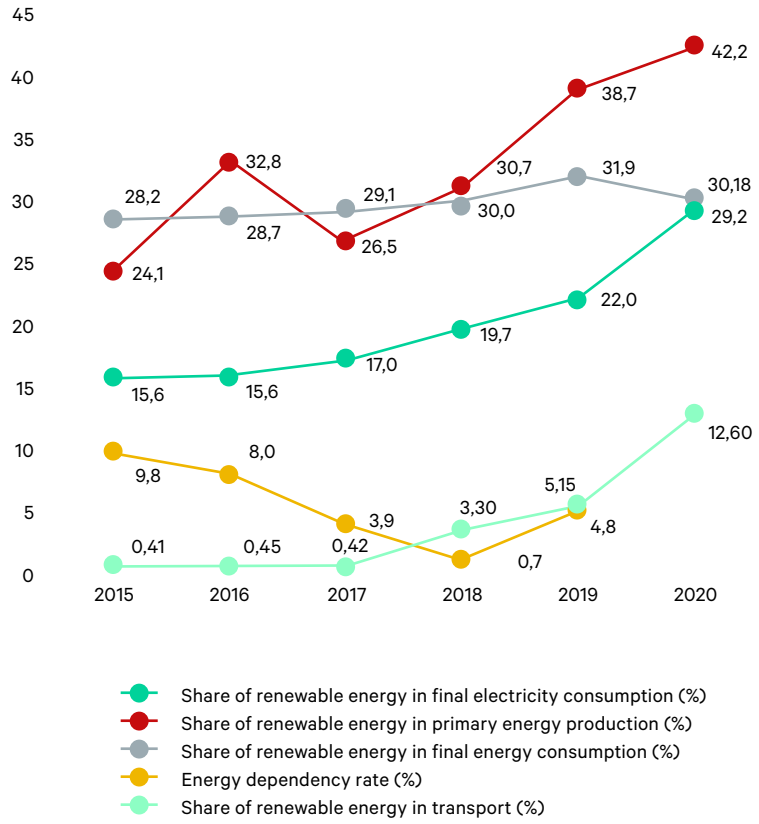

Figure 4. Share on renewable energy in different energy sectors.
Source: Statistikaamet (KE36) and Eurostat

The share of renewables used in total electricity production was 29.2% in 2020. As can be seen from Figure 5, the production of electricity mostly consists of oil shale and shale oil gas, yet the share of renewables is on the rise, and consists mostly of wind energy, along with wood chips and waste and biogases. The 2017 Estonian National Climate and Energy Development Plan from set a goal of 30% of renewables in final energy consumption by 2030, which was achieved in 2020.

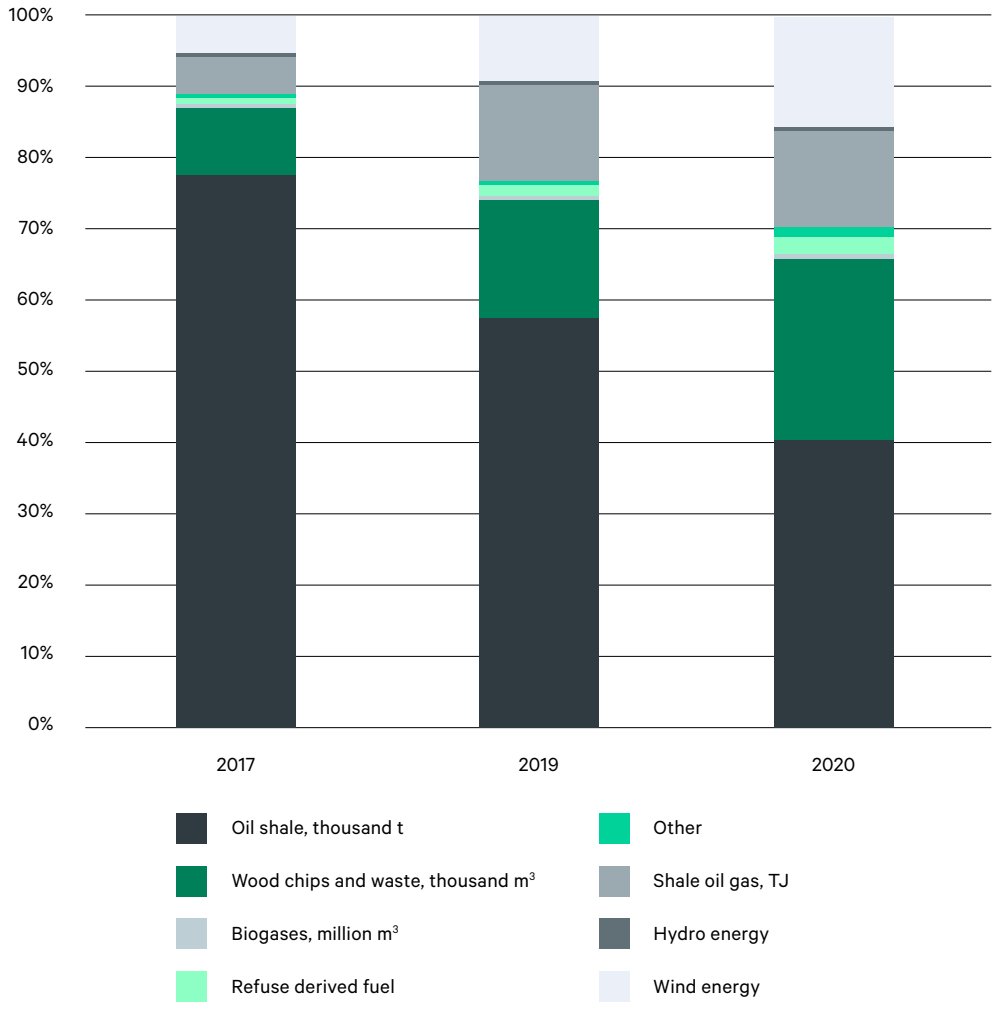

Figure 5 The share of produced electricity from various sources in Estonia in 2018, 2019 and 2020. Source: Statistikaamet

The Estonian climate neutrality study proposed the following measures for curbing the emissions from the energy sector, shown in Table 7, below:

Table 7. Measures in the energy sector. The coloured progress column shows whether investments have been made or there is still room for improvement. The cost-efficiency column shows the cost of reducing the emissions of one tonne of CO_2 (a blank box indicates that there was not enough data for calculations).

	Measure	Proposed time of implementation	Cost-efficiency for CO_2 reduction (EUR/ton)	Investments since 2019	Progress
ENERGY	Increasing the share of solar power in electricity generation	2020	180.5	Subsidies for private users for producing electricity through Elering, for the purchase of solar panels through Kredex renovation fund and from 2018 onwards through the investment subsidy for solar panels. While there is support available, current solar power production capacity is 100 GWh while the target in REKK is 400 GWh by 2030, which will not be reached with this pace.	
	Increasing the share of offshore wind power in electricity generation	2025	59.2	Off-shore wind parks are still in development phase. Estonia and Latvia have initiated a joint project for offshore wind energy production in the Baltic Sea. The project is in pre-development phase.	
	Increasing the share of onshore wind power in electricity generation	2020	25.7	Subsidy is granted through reverse auctions since 2019. Since then, there has been three reverse auctions which were intended for installations with a capacity between 50 kW and 1 MW. Nevertheless, these new installations are still in planning phase and currently no actual capacities are added to the mix.	
	Hydroenergy stations	2021	192.4	No substantial progress can be seen at this stage	
	Increasing the share of biomethane in transport sector	2020	5.3	Covered in structure fund measures 2014–2020. in 2019–2021, KIK funded three projects in three major cities in Estonia for the uptake of biomethane in public transport. The funding was a total of EUR 6.5 million. The funding for the measure continues beyond 2021. The Ministry of Economic Affairs and Communications is currently working on a biogas roadmap for Estonia for 2030. According to preliminary data, the main targets to be achieved are: 15 000 cars and 1500 heavy duty vehicles are to run on biomethane and 50 refuelling stations are to be built.	
	Renovating the district heating system	2021	-122.7	Covered by the structural fund measures, 2014–2020. In 2019-2021 KIK unded 67 projects renovating district heating systems with a total of EUR 10.3 million. The funding for the measure continues beyond 2021.	
	Renovating the district heating system's production facilities	2022	-74,8	Covered by structural fund measures 2014-2020. In 2019–2021, KIK funded 25 projects for renovating or establishing a new production facility with a total of EUR 11.1 million. The funding for the measure continues 2021+.	
	Installation of heat pumps	2020	1947,3	Opportunities for private house owners to apply for support for the uptake of heat pumps through Kredex.	
	Hot water from district heating system	2022		In 2021, the Ministry of Economic Affairs began investigating the potential of carbon neutral heating- and cooling in Estonia.	
	Establishing local heating systems instead of district heating	2022	227.5	Covered by structural fund 2014-2020. KIK support for seven projects in 2019-2021 with a total of EUR 314 077. Funding for the measure continues beyond 2021. The target set for the measure was 1.4MW, and 1.64 MW has been achieved by 2022.	
	Establishment of small reactors	2030	266.6	No substantial progress can be seen.	
	Using alternative fuels in agricultural machinery	2022	525.1	Ongoing support for agriculture and fisheries sector for the purchasing of specific diesel fuel for agricultural machinery. The current price in Estonia is EUR 100 per 1000 litres, which is five times higher than the minimum price set in EU (EUR 21/1000L). From 2023 onwards the price will be increased to EUR 133 /1000L. Compared to neighbours Latvia and Lithuania, the price is EUR 62.1 and 60 per 1000L, respectively.[27] There is no active measure supporting the uptake of alternative (e.g. bio-based) fuels.	
	District cooling systems	2020	-477.9	In 2021, the Ministry of Economic Affairs started investigating the possibilities of carbon neutral heating- and cooling in Estonia.[28]	
	LED street lightning	2021	749.9	Covered by structural fund measures 2014–2020. in 2019–2021, KIK funded a total of 55 projects renovating street lightning with a total of EUR 34.7 million. The funding for the measure continues in the next investment period.	
	Production of hydrogen (10% of the current share of natural gas)	2040	20.8	In January 2022 The government decided to support three companies in the hydrogen value chain (IPCEI) with EUR 111 million (2022-2026 amounts to EUR 67.5m) A measure for the piloting of the hydrogen value chains in Estonia.[29]	
	Increasing the production of shale oil	2023		In terms of reaching climate neutrality, this new facility is considered a negative action. A new shale oil production refinery is currently in the planning phase and projected to be in operation in 2024. The investment for the refinery is planned at EUR 286 million. The new refinery will increase production of shale oil to over 700 000 tons annually.	
	Large scale refineries	2023		In terms of reaching climate neutrality, this new facility is considered a negative action. A novel shale oil production refinery is currently in planning phase and projected to be in operation in 2024. The investment for the refinery is planned at EUR 286m.	

27 https://epkk.ee/erimargistatud-kutuse-suurem-aktsiisisoodustus-aitaks-leevendada-energiakriisi-mojusid/
28 https://www.sei.org/projects-and-tools/projects/susinikuneutraalsele-soojus-jahutusmajandusele-2050/
29 https://www.rahandusministeerium.ee/et/uudised/valitsus-kiitis-heaks-riigi-eelarvestrateegia-aastateks-2022-2025

Capacity for hydro, solar and wind energy has been increasing. In 2018, the capacity of hydropower plants for electricity generation was just 15 GWh, which by 2020 was doubled to 30 GWh. Solar power has also been increasing from 14.5 GWh in 2017 to 245.1 GWh in 2020.[30] There are governmental support options available for private users for the instalment of solar panels and for selling solar power back into the electricity grid. Nevertheless, the Estonian National Plan for Energy and Climate until 2030 (REKK), sets a target of 400 GWh for solar energy by 2030.[31]

The capacity of wind power plants has also increased from 636 GWh in 2018 to 760 GWh in 2020. REKK sets a target of 2640 GWh by 2030. Subsidies for wind electricity generation are granted through reverse auctions. Currently in Estonia there are only onshore wind parks, although there are various plans for the construction of offshore wind parks, some dating back over 10 years, yet no progress on these has yet been made. According to preliminary studies, Estonia has a 1700 km^2 area in the Baltic Sea, which would be appropriate for offshore wind parks and has the capacity to produce approximately a.[32] Regardless, the Ministry of Economy and Communications indicated that wind energy will mostly be generated onshore until 2030, with offshore becoming a reality from 2030 onwards.

Estonia and Latvia have initiated a joint project to produce offshore wind energy in the Baltic Sea, near Pärnu bay. The project is in a pre-development phase and currently dealing with the necessary permits. The planned capacity for the joint wind park is 700 to 100 MW and is expected to be completed by 2030. It is estimated that the wind park will produce 3.5 TWh electricity annually, which would cover approximately 40% of the annual electricity consumption in Estonia. The main barrier to realizing this potential, and also a prerequisite for offshore wind energy production, is the set-up of the energy network in the area.

Measures are included in the national Structural Fund 2014–2020 for renovating the district heating system and introducing LED street lightning, we well as local options for heating. Therefore, there are subsidies in place for renovating district heating systems and LED street lightning, and for the uptake of local heating systems in places where district heating is either not available or not reasonable. According to KIK, 160 projects at a combined cost of almost EUR 30m are currently ongoing that are aimed at renovating the district heating system. This will result in 177km of new or renewed water system. Additionally, 75 new or renovated district heating production facilities and eight new local heating operations. There were also numerous projects approved for the renovation of street lighting systems for improved energy efficiency in 2020 and 2021. As can be seen from Table 7 above, these activities are also cost efficient in terms of CO_2 reduction potential. The most cost-efficient measure in the energy section is district cooling, a topic which is currently being investigated.

Estonia not only uses oil shale for electricity, it is also used for the production of shale oil and shale oil gas. In 2019, 1.2 million tons of shale oil was produced, which compared to the use of oil shale for electricity, is two times more energy efficient and produces 3.3 times less CO_2.[33] Currently there is government support for the construction of a new shale oil refinery, which is set to operate during the transitional period in which Estonia is decreasing the total use of oil shale in energy production.[34] The European Commission has criticized the plan for phasing out oil shale as being slow and not using green taxation.[35] Also, in terms of reaching climate neutrality, the set-up of a shale oil refinery is considered as a step in the wrong direction. The establishment of a shale oil refinery is expected to cause emission of an additional 400 000 to 500 000 tonnes of CO_2e.[36] However, producing shale oil emits about 40% less CO_2 than burning oil shale for electricity.

One of the sectors which has taken off more than expected during the development of the Estonian climate neutrality study in 2019, is the production and use of hydrogen. The European Hydrogen Strategy for a climate-neutral Europe was published in 2020 and it expects that hydrogen will play an important role in achieving climate neutrality in Europe and have the potential to help decarbonize energy intensive industries

30 https://andmed.stat.ee/et/stat/majandus__energeetika__energia-tarbimine-ja-tootmine__aastastatistika/KE0230/table/tableViewLayout2

31 https://rtk.ee/toetusfondid-ja-programmid/taaste-ja-vastupidavusrahastu-rrf/eesti-taastekava

32 https://rtk.ee/toetusfondid-ja-programmid/taaste-ja-vastupidavusrahastu-rrf/eesti-taastekava

33 "Põlevkiviõli väärtusahela loodav Eesti rahvuslik rikkus" https://keemia.ee/sites/default/files/2020-12/Final_Polevkivioli_rahvuslik_rikkus.pdf

34 https://www.energia.ee/uudised/avaleht/-/newsv2/2020/03/27/valitsus-andis-eesti-energiale-rohelise-tule-uue-olitehase-ehituseks

35 https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/698886/EPRS_BRI(2022)698886_EN.pdf

36 https://cdn.sei.org/wp-content/uploads/2019/10/kliimaambitsiooni-anal%C3%BC%C3%BCs.pdf

and the transport sector.[37] The Estonian Government has also show interest, leading to several studies on the issue. In 2021, SEI Tallinn conducted a study on the potential of hydrogen in Estonia, which feeds into the current development of a hydrogen roadmap for Estonia created by the Ministry of Economic Affairs and Communications together with the Ministry of the Environment. Additionally, at the beginning of 2022, the Estonian Government decided to support various hydrogen projects in Estonia with EUR 111m[38] claiming that hydrogen will be one of the key fields in the green transition. Further, hydrogen is also seen as a key measure for Estonia's green transition in the Estonian Recovery and Resilience Facility, is set to receive more than EUR 50m in upcoming investments.

SUMMARY

- The share of renewable energy in the Estonian final energy mix has been increasing
- The pace of investment into new capacities is lagging behind leading countries in the region and needs to grow considerably in the upcoming years in order to effectively address price hikes and supply shortages.
- There are very few proposed measures in which there is no progress, mainly hydroenergy and the establishment of small nuclear reactors.
- The establishment of a novel shale oil refinery is considered a negative step since it does not help the country achieve the target of climate neutrality
- The government is expecting hydrogen to play an important role in the decarbonization of the economy, as there are multiple investments ongoing and planned for the future.

5.3 Industry

The cement production sector is the largest emitter of greenhouse gases in Estonian industry. The largest share of these emissions arises from the production of clinker. In 2018, the cement industry used 91.2% fossil fuels in the production of clinker and emitted 505 070 tons of CO_2. The main Estonian cement production facility in Kunda produced just 35 000 tons of clinker and 254 000 tons of cement in 2020, while the amount in 2019 was 503 000 tons and 405 000 tons in 2019, respectively.[39] This decrease translates into a decrease in CO_2 emissions from this company of 36 000 tons in 2020, compared to 547 000 tons in 2019.

The total energy used in the manufacturing of mineral products also decreased from 194 GWh in 2018 to 133 GWh in 2020,[40] and the total emissions from the sector of industrial processes decreased by 52% in 2020 compared to 2019.[41]

The limestone industry is the second largest-emitting sector in Estonian industry. One tonne of limestone produces 560kg of lime while the remainder is emitted as CO_2 and small particles.[42] In 2019, 73.1 kt of lime was produced, while in 2020 the amount decreased to 54.8 kt[43]

The cement and lime production sectors, along with the electricity, heat, shale oil, paper, and glass production industries are part of the EU ETS and thus affected by the emissions allowances quotas and CO_2 prices. In Estonia there are 44 producers that fall under the EU ETS regulation. Currently the existing target in the ETS is to reduce greenhouse gas emissions by 43% from 2005 levels. The Fit For 55 package proposes raising the target to 61% by 2030. Based on data from 2019, the current emissions reduction in the ETS was already 35% down from 2005 levels.[44]

37 https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

38 https://envir.ee/uudised/valitsus-toetab-vesiniku-vaartusahela-projektide-arendamist-eestis

39 https://www.knc.ee/et/node/12370

40 Statistikaamet KE062 & TO001

41 Republic of Estonia, Ministry of the Environment: 'Greenhouse gas Emissions in Estonia 1990-2020.' National Inventory report. Submission to the European Commission. 2022

42 https://cdn.sei.org/wp-content/uploads/2019/10/kliimaambitsiooni-anal%C3%BC%C3%BCs.pdf

43 Republic of Estonia, Ministry of the Environment: 'Greenhouse gas Emissions in Estonia 1990-2020.' National Inventory report. Submission to the European Commission. 2022

44 https://www.riigikogu.ee/download/db09c259-a214-4273-93e1-5812f0df3c04

Table 8. Measures proposed in the 2019 SEI Climate Neutrality study in the industry sector. The coloured progress column shows whether there is progress made in the field. The cost-efficiency column shows the cost of reducing the emissions of one tonne of CO_2. A blank box indicates that there was not enough data for calculations.

	Measure	Proposed time of implementation	Cost-efficiency for CO_2 reduction (EUR/t)	Investments since 2019	Progress
INDUSTRY	Decreasing the carbon intensity of the cement industry	2040	37,6	The Just Transition Fund and the Estonian RRF are allocating EUR 237million and EUR 220m, respectively, for the green transition of the industry. The first projects will begin in 2022. The cement industry is not specifically targeted.	
	Decreasing the carbon intensity of the limestone industry	2040	105,4	The Just Transition Fund and the Estonian RRF are allocating EUR 237m and EUR 220m, respectively, for the green transition of the industry. The first projects will begin in 2022. The limestone industry is not specifically targeted.	
	Ban on fluorinated greenhouse gases from the air conditioning units in motor vehicles	2020	1.8	A new ban on marketing certain products from 2020 and 2022. The decrease of the use of F-gases is regulated at EU level.	

At present, there is no active measure which helps the energy intensive industry sector with the green transition, yet there are planned funding for doing so in the upcoming years. The Estonian RRF plan includes funding for the green transition of the economy and its enterprises. The funding is aimed at facilitating the development and uptake of new green technologies in the following strategic sectors: energy, agriculture, food production, transport and logistics, the materials and chemical industries, and the environment. The funding specialized for achieving energy efficiency, adding value to bioresources and upgrading production technologies. The planned funding for enterprises for the green transition is EUR 220.2 million.

Ida-Virumaa region in Estonia is infamous for the oil shale industry existing there. The Estonian government has decided to allocate EUR 340 million, which is the entire Estonian share of the European Union Just Transition Fund to the Ida-Virumaa region as a measure towards climate-neutrality. According to the Ministry of Finance, the investments through the Fund can be divided in two. The first pillar, «diverse and Smart entrepreneurship", is the largest, receiving EUR 273 million, which is 80% of the whole investment. The aim is to diversify the economy in the region and redeploy people working in the oil shale sector. The second pillar, "attractive living environment", receives 20% of the funds (EUR 66.74 million) and deals with the social and environmental aspects and with local communities.[45]

The use of fluorinated gases is regulated at EU level by EU regulation No 517/2014, which aims to decrease the use of F-gases by 79% between 2015 and 2030.[46] These regulations have been in force in Estonia since 2016 through the Atmospheric Air Protection Act. Several bans have been put in place since the adoption of the law: from 2020 certain cooling devices were banned; from 2022 certain facilities using f-gases in their processes were banned, such as service bars, cold stores and refrigerators. The f-gases should be replaced with either CO_2 or a fluorinated gas that has a lower global warming potential.[47]

45 https://www.rahandusministeerium.ee/sites/default/files/Regionaalareng_poliitika/2021-12-15_jtf_ee.pdf

46 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014R0517

47 https://www.agri.ee/sites/default/files/content/komisjonid/kalandusnoukogu/kn-2021-03-15-niitaru-kriis.pdf

SUMMARY

- There is currently no existing measure which would help the energy intensive industry sectors in Estonia with the green transition, yet there is funding planned.
- The RRF funds are expected to facilitate the uptake of new green and innovative technologies. The preliminary list shows that the chemical industry will also be a target for the green transition. Additionally, as a large part of the Estonian industry is located in Ida-Virumaa, the Just Transition Funds allocated for the area will positively affect the decarbonization of the industry sector.

5.4 Land use, land-use change and forestry

The carbon sequestration and emission requirements for the land use, land use change and forestry sector (LULUCF) dates back to 2018 when the European LULUCF measure 2018/841 was adopted. Accordingly, the emissions in the sector need to be compensated by at least the same amount of binding in the sector.

Table 9. Emissions in the LULUCF sector 2012–2019

LULUCF emissions (GHG, thousand tonnes)[48]	2012	2013	2014	2015	2016	2017	2018	2019	2020
Estonia	-4 054,11	-3 570,3	-1 753,01	-2 625,97	-2 858,19	-1 946,2	-572,37	-715,61	1 297.27

Source: Estonian Ministry of the Environment

As can be seen in Table 9, the LULUCF sector in Estonia has been a carbon sink , meaning that more carbon is sequestered than is emitted as part of the economic activities in the land use, land use change and forestry sector[49] Carbon sequestration in Estonia is mostly related to the country's forest land. There are 2 330 600 hectares of forest in Estonia, accounting for 51.4% of total land area of the country.

However as can also be seen from Table 9 above, the binding of carbon in LULUCF sector has decreased from over 4 million tonnes in 2012 to just over 700 000 tonnes in 2019, and became an emitting sector in 2020. Compared to base year 1990, the uptake of CO2 in the LULUCF sector has decreased by 487.7%, and compared to the previous year by 141.1%. Currently the target for the LULUCF sector is for the emissions from the sector to not exceed the amount that the sector can bind.

According to LULUCF regulation, the so-called Forest Reference Level (FRL) is an estimate of the average annual net emissions or removals resulting from managed forest land within the territory of a country. The FRL for Estonia for the period 2021–2025 has been estimated at 1.75 Mt CO_2 equivalent per year.[50]Currently, the forest growing stock is expected to decrease until 2050 and increase again in the second half of the century. In order to find ways to compensate the CO_2 emissions caused by declining forest growing stock, two measures have been proposed: afforestation and the conversion of peat soils to natural grasslands. According to the Ministry of the Environment, afforestation is currently not an active measure.

Some 40% of the carbon emissions arising from the LULUCF sector are contributed by the use of peat soils. According to the Ministry of the Environment, the emissions arising from peat soils is approximately 2.3 to 8 million tonnes of CO_2 annually. Sowing on peatlands emits on average 22.37 t CO_2e per hectare, while converting these soils to natural grasslands would emit 5.71 t CO_2e per hectare.[51] This results in a saving of 16.66 tonnes of CO_2 e per hectare annually, if these soils are not used for agricultural purposes. Considering the potential this measure could have, alongside restoration of natural peatlands, these activities are of key importance in Estonia and should receive more attention from the government, because wetlands have greater potential for carbon sequestration than forests. Currently, there is a measure available through the EU Common Agricultural Policy that supports private landowners to convert their peatlands into natural

48 https://envir.ee/kliima/kliima/rahvusvaheline-aruandlus#kasvuhoonegaaside-in

49 https://envir.ee/en/water-forest-resources/forestry

50 National Forestry Accounting Plan 2021-2025, https://envir.ee/elusloodus-looduskaitse/metsandus/lulucf

51 https://cdn.sei.org/wp-content/uploads/2019/10/kliimaambitsiooni-anal%C3%BC%C3%BCs.pdf

grasslands. The measure has been active since 2015, and according to the Ministry of Rural Affairs, 58% of the area that is eligible has received support through the measure. It is important to take into account that the greenhouse gas savings from implementing the measure could take up to 20 years to have an impact. Thus it is even more important to support the existing measure with complementary actions to make sure that there is an effect as soon as possible.

Felling rates also have a strong impact on the forestry sector and the availability of forest carbon stock. Limits on felling rates are stipulated in the Estonian Forestry Development Plan for 2021–2030, which unfortunately has not yet been adopted. The plan has been under development since 2018. The main issue with this development plan was finding an appropriate impact evaluator. At the beginning of 2022, this plan was under impact evaluation that will be sent to the parliament later in the year.

The new ambitious EU-wide target proposed with the Fit For 55 package in the LULUCF sector is the carbon sequestration of 310 million tonnes of CO_2 equivalent in 2030. For Estonia specifically, this is set as 2.5 million tonnes of CO_2e by 2030. The European Commission has also produced a reference scenario, in which it is expected that in a business-as-usual scenario, the Estonian LULUCF sector would emit 1.4 million tons of CO_2e annually by 2030.52

The target proposed in the Fit For 55 package for the LULUCF sector in Estonia is highly ambitious and considered as unlikely to be reached even with the uptake of various measures supporting the sequestering of carbon. According to a study by the Environmental Agency and the Estonian University of Life Sciences regarding the carbon binding potential in the Estonian LULUCF sector[53], the estimated carbon sequestration could be up to -1.393 million tons of CO_2 equivalent annually in 2030 with the uptake of various additional measures for afforestation and curbing the emissions in the sector.

Table 10. Measures proposed in the SEI 2019 Climate Neutrality study for the energy production sector. The coloured progress column shows whether there is progress made in the field. The cost-efficiency column shows the cost of reducing the emissions of one tonne of CO_2 (a blank box indicates that there was not enough data for calculations)

	Measure	Proposed time of implementation	Cost-efficiency for CO_2 reduction (EUR/t)	Investments since 2019
LULUCF	Afforestation	2020	-9,6	There is currently no existing measure supporting afforestation.
	Conversion of peat soils into natural grasslands	2021	5,9	Subsidy for conversion of peat soils into natural grasslands. Subsidy available for producers through PRIA, in 2021 the budget for the measure was EUR 630 000.[54] The measure derives from the EU Common Agricultural Policy and has been active since 2015.

SUMMARY

- The Fit For 55 package proposes a target for the LULUCF sector in Estonia to capture 2.5 million tonnes of CO_2 equivalent by 2030. This target is seen as highly unlikely to be reached.
- The National Forestry Development Plan is currently not adopted – thus the sector does not have clear targets
- The LULUCF sector in Estonia has historically been a carbon sink, yet this was not the case in 2020, when the LULUCF sector emitted more greenhouse gases than was sequestered.
- In order to curb the emissions in LULUCF sector, it is most beneficial to target the use of peat soils in agriculture. There is an existing measure and funding allocated through PRIA since 2015 to convert peat soils into natural grasslands. As it can take up to 20 years for the savings arising from this measure to have a quantifiable impact, it is unclear whether the current investment is sufficient or additional effort is needed to limit the emissions. [54]

52 https://www.riigikogu.ee/download/db09c259-a214-4273-93e1-5812f0df3c04

53 https://envir.ee/media/4036/download

54 https://www.pria.ee/toetused/MULD_2021

5.5 Transport

On the basis of the climate targets set by the EU, the transport sector must reduce its greenhouse gas emissions by 90% by 2050 and become significantly less polluting, especially in urban areas, in order to achieve climate neutrality. Estonia aims to reduce greenhouse gas emissions from the transport sector to 1700 kt by 2035.

The Fit For 55 package proposes a new target through the Effort Sharing Decision (which includes transport, buildings, agriculture and waste) to reduce emissions by 24% from 2005 levels (the previous goal was a 13% reduction). According to the national prognosis, Estonia is expected to reach the currently existing goal of -13%, but additional effort is needed from all of the sectors in the Effort Sharing Decision in order to reach the goal proposed in the Fit For 55 package. [55] In Estonia, as in many other European countries, the largest potential for emissions reduction in the Effort Sharing Decision is in the transport sector.[56]

In 2020, the amount of greenhouse gases emitted by the transport sector was 2234.42 kt CO_2e. The share of the transport sector within the entire energy sector was 23.6%, and it contributed 19.3% of the total greenhouse gas emissions in Estonia in 2020. The transport sector is showing a decreasing trend of emissions since 2018.

Around 25% of the energy consumed in Estonia is used in the transport sector. Of that, that 94% is used in freight transport and cars.57 In the past few years, electricity consumption has risen rapidly in the transport sector from 46 GWh in 2017 to 68 GWh in 2020.58 Renewable energy accounted for 6.24% of the transport sector's energy consumption in 2019 and almost doubled in 2020 to 12.16%.

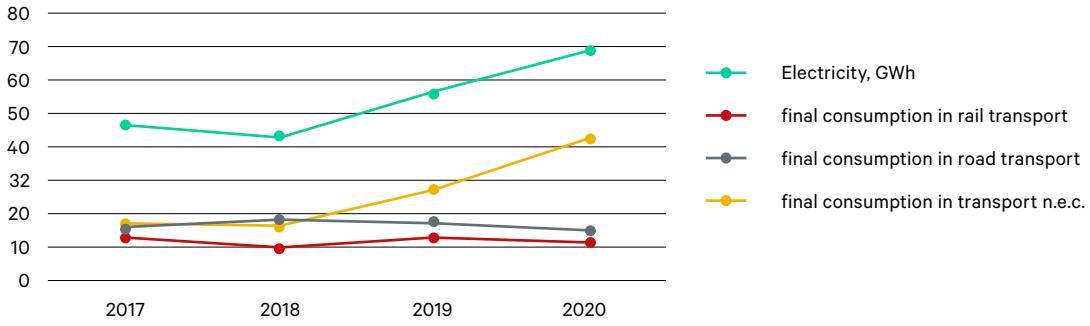

Figure 6. Electricity use in the transport sector, GWh

In recent years, road mileage has increased by about 4% per year. In the period 214 to 2017, total mileage increased by 14% in Estonia. In 2019 to 2021, the increase in road mileage was less, at 3.44%, because of people working from home during the Covid-19 pandemic.

The share of public transport users, walking and cycling is problematic in Estonia. Although since 2018 bus travel has been free for passengers on most regional routes and travel for residents in Tallinn has been free since before that, a modal shift in favour of public transport has not been achieved. In addition, there have been a number of investments in walking and cycling routes, which has also not helped to shift the habits. Only 36.9% of people used public transport, walked or cycled to work in 2020, in 2021 the figure further decreased to 34%. It is highly unlikely that the 2035 transport programme target of 55% will be met unless public transport and light transport are significantly prioritised in the meantime.[59].

55 https://www.riigikogu.ee/download/db09c259-a214-4273-93e1-5812f0df3c04

56 https://www.riigikogu.ee/download/db09c259-a214-4273-93e1-5812f0df3c04

57 https://www.mkm.ee/et/tegevused-eesmargid/energeetika/vedelkutused

58 https://andmed.stat.ee/et/stat/majandus__energeetika__energia-tarbimine-ja-tootmine__aastastatistika/KE0230/table/tableViewLayout2

59 https://www.mkm.ee/sites/default/files/mkm_transpordi_ja_liikuvuse_arengukava_2020_a4_web_small.pdf

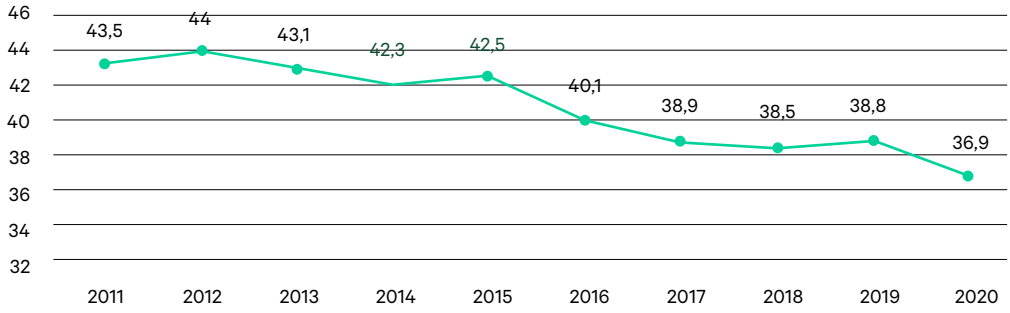

Figure 7. Percentage share of people commuting by public transport, by bicycle or on foot

Table 11. Measures proposed in the 2019 SEI Climate Neutrality Study for the transport sector, and progress made on them since 2019. The cost-efficiency column shows the cost of reducing the emissions of one tonne of CO_2 (a blank box indicates that there was not enough data for calculations).

	Measure	Proposed time of implementation	Cost-efficiency for CO_2 reduction (EUR/t)	Investments made since 2019	Progress
TRANSPORT	Increasing the share of CNG-fuelled cars	2021	-1 170	No substantial progress can be seen at this stage.	
	Increasing the share of electric cars	2021	-576	IIn 2019-2021, KIK carried out two application calls for the purchase of fully electric vehicles, the total amount of grants awarded in the two calls was EUR 1.26 million. Nevertheless, the total sum of these grants was not sufficient as there was much more demand than was granted.	
	Electrifying the railroad	2021	100	The government has approved the investment plan, but the electrification process has yet to begin.	
	Transferring the delivery of goods from highways to railroad	2021	0,9	No substantial progress can be seen at this stage.	
	Electric trains for Elron	2021	-22	Six new electric trains have been ordered through a public procurement process (EUR 55.2 million euros) and should arrive by the end of 2024. The procurement of additional 10ten trains is currently in planning phase.	
	Developing the tram system in Tallinn	2021	-394	Tallinn Old Port tram line construction will start in the second part of 2022 and is scheduled to be completed in 2024.	
	Local stops for Rail Baltic	2023	52	Covered under structural funds 2021-2027	
	Developing public transport tracks	2022	-857	No substantial progress besides approving the Estonian public transport action plan for 2021-2035	
	Rail Baltic	2027	-428	Land acquisition in progress, Ülemiste terminal design currently in procurement phase, the first objects (viaducts) on the Rail Baltic route are built.	
	Electric buses	2021	-119	KIK finances the procurement of 15 electric buses and the creation of the charging infrastructure in Tallinn with EUR 2.6 million. Funding planned for upcoming period 2022+ for at least eight electric buses.	
	CNG-fuelled busses	2021	-428	In 2019-2021, KIK funded three projects in three major cities in Estonia for the uptake of biomethane in public transport. The total funding was a total of EUR 6.5 million. The funding for the measure continues beyond 2021+.	
	Hydrogen-fuel-led vehicles	2040	-268	KIK carried out a call for the introduction of green hydrogen in public transport in 2021 with a budget of EUR 5 million.	
	Developing bicycle-infrastructure	2021	-299	In 2021 Tallinn city invested EUR 1.5 million into new bicycle lanes. In 2022 the city plans to invest the same amount of money in bicycle lanes. Considering that the bicycle lanes were painted on the road and eventually melted off the streets along with the first snow, progress is lacking.	
	Developing the tram system in Tartu	2031	28	Identification of light rail transport routes in Tartu and feasibility and a cost-benefit analysis was conducted in 2020 which concluded that tram lines in Tartu would be feasible and recommended.	
	Electrifying the ferry system	2021	67	One of the four ferries that run between the bigger islands and the mainland has been converted into a hybrid vessel and another is planned to be electrified in the coming years.	

To reduce the transport sector's greenhouse gas emissions and achieve the targets that have been set, Estonia needs to increase the number of vehicles that run on alternative fuels such as e.g. compressed natural gas (CNG), hydrogen, and electricity.

The most cost-efficient measure in the transport sector, and also the most cost-efficient measure among all the 57 suggested measures in this study, is increasing the share of CNG-fuelled cars. This measure requires far less investment to achieve significant reductions of greenhouse gas emissions.

To popularize the use of electric vehicles and reduce CO_2 emissions, KIK conducted two rounds of application calls for the purchase of fully electric vehicles in 2020, a total of 306 electric vehicles were supported. The amount of the grant was EUR 5000 per vehicle, with a maximum price of 50,000 euros net of VAT for one electric car. Both businesses and private individuals were eligible to apply. Initially, the budget for the grant scheme was EUR 1.2 million, which was increased by EUR 0.4 million because of the high number of applicants. A recent study by PricewaterhouseCoopers Advisors AS concluded that the support measure for electric vehicles should continue, but it should apply only to the purchase of all-electric vehicles and could be extended to cover the purchase of electric vans and cargo bikes. On the basis of the two previous calls for proposals, it can be said that the amount of support allocated was too small, because the speed with which the round was completed was unprecedented and does not match the objectives that have been set. [60,61,62,63,64]

In addition to electric cars, KIK carried out a procurement call for the purchase of electric buses and the creation of the charging infrastructure in 2021. The budget of the call was EUR 4 million, but only one application was submitted for EUR 2.6 million for 15 buses and the creation of the charging infrastructure. Tallinn city will contribute an additional EUR 6 million. These electric buses will start serving passengers from the summer of 2023.65

Besides electric vehicles KIK funded three projects in three major cities in 2019–2021 for the uptake of biomethane in public transport. The funding for this totalled EUR 6.5 million. Since 2020 there are almost 200 biomethane buses along with 10 filling stations in Estonia. It is estimated that these buses save 28 000 tonnes of CO_2e annually, which is approximately the annual CO_2 emissions of 7900 average cars.66

Further, the Recovery and Resilience Plan in Estonia highlights the use of biomethane in public transport. Estonia plans to support the use of biomethane in public transport under the Greener Estonia policy objective in the 2021–27 Structural Funds period by introducing CNG buses and supporting the construction of CNG refuelling stations, which will encourage the uptake and consumption of domestic biomethane. Support will be provided for the introduction of biomethane buses especially in rural areas (e.g. Valga, Võru, Rapla). The Estonian Ministry of Economics and Communications is also currently working on a 2030 Biogas Roadmap for Estonia. According to preliminary data, the main targets to be achieved are: 15 000 cars and 1500 heavy duty vehicles using biomethane and 50 refuelling stations are built.

The Estonian government approved at the beginning of 2022 new plans for railway developments until 2028. The plan includes railway electrification actions and its yearly investment plan up until 2028 as seen in Table 12. 67

Table 12. AS Eesti Raudtee electrification investment plan in the period 2021–2028 (in millions of Euros)

	2021	2022	2023	2024	2025	2026	2027	2028
Electrification of railways (Cohesion Fund 2021–27, plus public contribution and own financing)	1.5	9.7	28.2	50.6	74.2	63.6	44.1	2.3

60 https://www.kik.ee/et/artikkel/elektrisoidukite-ostuks-saab-taas-toetust-taotleda-oktoobri-teises-pooles

61 https://www.kik.ee/et/artikkel/peagi-eestimaa-teedel-lisaks-114-uut-elektriautot

62 https://www.kik.ee/et/rahastatud-projektid#edit-field-maakond-tid-i18n%3Dnull%26edit-field-taotlusvoor-value%3DKliima.5.1.1%26edit-field-rahastusallikas-tid-i18n%3Dnull%26edit-field-valdkonnagrupp-tid-i18n%3Dnull%26edit-title%3D%26edit-field-toetuse-saaja-nimi-value%3D%26edit-field-aasta-tid-i18n%3Dnull%26edit-field-with-research-value-i18n-1%3D1%26edit-field-with-research-value-i18n%3Don%26edit-sort-by%3Dtitle%26edit-sort-order%3DDESC

63 https://www.kik.ee/en/supported-activity/purchasing-fully-electric-vehicles

64 https://envir.ee/media/1426/download

65 https://www.kik.ee/et/artikkel/tallinna-linn-saab-elektribusside-kasutuselevotuks-toetust

66 https://kik.ee/et/artikkel/tallinna-gaasibussid-hakkavad-uuest-aastast-kasutama-eestis-toodetud-biometaani

67 https://mkm.ee/sites/default/files/avaliku_raudteeinfrastruktuuri_arendamist_suunav_tegevuskava_aastateks_2021-2028_0.pdf

Regarding marine transport decarbonization, one of the four ferries that run between the bigger islands and the mainland was converted into a hybrid vessel in 2019 with an investment of nearly EUR 1.6 million. TS Laevad installed battery banks that reduced diesel consumption by 20%, thereby reducing CO_2 emissions by 1600 tons per year.[68] Another of the four ferries is planned to be electrified in the near future.

The transport sector can also reduce greenhouse gas emissions through infrastructure development. Developing bicycle lanes, pedestrian pathways and public transport networks will give residents the opportunity to choose sustainable modes of transport such as public transport, cycling and walking instead of private cars, which will support the reduction of greenhouse gas emissions in the sector.

To improve the public transport network in Tallinn, the city government has decided to extend its tram network in the upcoming years. The construction of one of the planned projects, the Vanasadama tram line, will start in the second part of 2022 and is scheduled to be completed in 2024. The estimated cost for the tram line construction is EUR 15 to 20 million, financed jointly by the Rail Baltic, Tallinn city and Estonian government. The city of Tartu also plans to develop tram lines. A feasibility and a cost-benefit analysis from 2020 concluded that tram lines in Tartu are feasible and recommended.

Both of Estonia's major cities have made various investments in cycle paths. In 2021 Tallinn city invested EUR 1.5 million into new bicycle lanes. In 2022 the city plans to invest the same again.

On June 8, 2019, the city of Tartu opened a bicycle circuit, which consists of more than 90 bicycle parking spaces and nearly 750 bicycles. Almost 500 of these are electric and 250 are conventional bikes. The bike-sharing system was financed from the European Regional Development Fund's urban areas measure (EUR 1.7 million, including the city›s own contribution of EUR 250 000), and the European Commission-funded project under the SmartEnCity project (nearly EUR 800 000, including the city›s own contribution of EUR 133 000) and from the budget of the city of Tartu.

Additionally, under the RRF, EUR 5 million is planned for the development of cycle and/or pedestrian paths outside the three main urban areas of Tallinn, Tartu, and Pärnu. The government is planning to carry out an application call for bicycle and/or pedestrian path projects in 2022.

One of Estonia's biggest projects in the field of sustainable transport is Rail Baltic, for which planning work started in 2017 and is estimated to be completed in 2030. This railway will link together the Baltic States. Preparatory work has begun on constructing various parts of the new track. Additionally, the Ülemiste joint terminal, along with the surrounding railway infrastructure will be built with a total cost of around EUR 178 million.

SUMMARY

- There are support measures available for the purchase of alternative fuel vehicles, but no support for fuelling stations for electrical or CNG vehicles, which would support the uptake of these alternative fuels. Therefore, future actions should support the whole infrastructure of alternative fuels, as was done in the recent KIK hydrogen value chain call.
- The most cost-efficient measure for reducing greenhouse gas emissions in the transport sector is the uptake of CNG-fuelled cars, yet there are no current investments to bring this about.
- There are still no functioning, interconnected bicycle routes in Tallinn. Despite various investments in public transport and routes for cycling and walking, the use of private cars is on the rise and the use of public transport on the decline. In terms of reducing greenhouse gas emissions, it would be most beneficial to reverse this trend.

5.6 Agriculture

The Agricultural sector is the second largest greenhouse gas emitting sector in Estonia. Table below summarizes the emissions from the sector. As the table shows, emissions in the agriculture sector are increasing at a steady pace. According to a government prognosis, emissions from the agriculture sector are bound to increase by 2030: by 25% when compared to 2005 and by 4.5% compared to 2019.

68 https://www.praamid.ee/eesti-esimene-hubriidreisilaev-toll-asus-reisijaid-teenindama/

The Fit For 55 package sets an ambitious goal for the agriculture sector through the Effort Sharing Decision (which includes transport, buildings, agriculture and waste) to reduce emissions by 24% from 2005 levels (the current target is 13%). According to the national GHG prognosis, Estonia is expected to reach the currently existing goal of -13%, but additional effort is needed from all of the sectors in the Effort Sharing Decision in order to reach the goal proposed with the Fit For 55 package. [69]

Table 12. Greenhouse gas emissions in the agriculture sector in Estonia

GHG emissions in the Agriculture sector (thousand tonnes)	2012	2013	2014	2015	2016	2017	2018	2019	2020
Estonia	1 357,41	1 389,43	1 435,23	1 433,83	1 386,94	1 431,02	1 420,49	1 496,87	1 508,38

Source: Eurostat & Ministry of the Environment

The EU goal for the agriculture sector through the Green Deal is to reduce the environmental and climate footprint of the EU food system. This goal is set to be achieved through various targets such as reducing the use of pesticides by 50% and the use of fertilizers by 20%. This new target has been criticized as being problematic and potentially jeopardizing food production and food security.[70] According to a study from the University of Wageningen, a probable consequence from this would be declining yields along with price increases, as European exports decline and imports from outside Europe rise.

69 https://www.riigikogu.ee/download/db09c259-a214-4273-93e1-5812f0df3c04

70 https://www.wur.nl/en/research-results/research-institutes/economic-research/show-wecr/green-deal-probably-leads-to-lower-agricultural-yields.htm#:~:text=By%202030%2C%20the%20European%20Commission,and%20the%20loss%20of%20biodiversity.

Table 13. Measures proposed in the 2019 SEI Climate Neutrality study, and progress made on them since 2019. The cost-efficiency column shows the cost of reducing the emissions of one tonne of CO_2 (a blank box indicates that there was not enough data for calculations).

	Measure	Proposed time of implementation	Cost-efficiency for CO2 reduction (EUR/t)	Progress since 2019	Progress indicator
AGRICULTURE	Improving manure management techniques	2021	152,4	MAK2014-2020 ongoing measure.. Will be included in a new set of measures in the CAP strategy 2023-2027.	
	Neutralizing acidic soils	2021	90	Funding planned for the next period 2023-2027[71]	
	Subsidizing the purchase of precision farming technologies	2021	16,0	MAK2014–2020 ongoing measure. Will be included in a new set of measures in the CAP strategy 2023–2027.	
	Audits in larger agricultural enterprises	2021		A measure is currently under development and will be funded through the CO_2 quota system.	
	Investments in the energy efficiency and usage of renewable energy in greenhouses	2024	5 017,1	MAK2014–2020 ongoing measure. Will be included in a new set of measures in the CAP strategy 2023–2027.	
	Agricultural machinery on alternative fuels	2021		Ongoing support for agriculture and fisheries sector for the purchasing of specific diesel fuel for agricultural machinery. The current price in Estonia is EUR 100/1000L, which is around five times higher than the minimum price set in EU (EUR 21/1000L). Recently the government decided to decrease the price to the EU minimum. There is no active measure supporting the uptake of alternative (e.g. bio-based) fuels.	
	Increasing the share of livestock farming on grasslands	2021	1 249,7	No direct support yet subsidy has been available from 2014 onwards and will be available in period 2023–2027 for enhancing animal welfare through better living standards and for organic livestock farming in the period 2023–2027 (combined total funding over 70 million eur) Additionally the organic farming measure supports livestock farming on natural grasslands.	
	Improving the quality of feed for dairy cows	2021	112,7	In the 2019 study, the target for digestibility of feed for dairy cows was set at 70%. According to a latest study from 2020, the average feed digestibility was at 70% thus the previously set target is reached.	
	Winter crops	2021	45,7	Measure funded in MAK2014–2020[72]. Planned for future period 2023–2027 yet not as a subsidy but a compulsory activity.	
	Direct seeding	2021	-400	No governmental support. However, the agricultural enterprises are involved voluntarily because the measure is beneficial and reduces costs.	

Theoretically, the measure with the largest savings potential in terms of CO_2 emissions is neutralizing acidic soils. This measure is also quite cost efficient compared to the majority of measures in the agriculture sector. Over half of the agricultural land used in Estonia (545 000 hectares) is covered with acidic soils. Acidic soils are not as efficient at storing carbon, thus it is necessary to neutralize the soils not only to improve yields but also to bind carbon into the soil.

In the agriculture sector, it is difficult to reduce the emissions of greenhouse gases without reducing food production itself. The agriculture sector is also slow to show progress – one example of this being the measure to neutralize acidic soils, which would show results many years after the investment is made. Also,

71 https://www.pria.ee/toetused/keskkonnasobraliku-majandamise-toetus-2020

72 https://www.pria.ee/toetused/keskkonnasobraliku-majandamise-toetus-2020

it is seen as a problem that while many of the measures currently active or in development would also have a positive impact of the binding of carbon into the soil and thus improving the situation in the sector as a whole, yet this doesn't come across in the GHG inventory as certain methodologies are missing. Similarly, for some of the measures (e.g. the use of renewable energy in greenhouses or alternative fuels in agricultural machinery) the greenhouse gas savings would show in the energy sector's emissions inventory rather than the agriculture sector's inventory.

Currently, the majority of the measures suggested for the agriculture sector either have an active investment or are being developed for the next funding period. Yet it is difficult to achieve emissions reductions in the agriculture sector without a decrease in food production. The measures are seen as instruments to slow down the pace of emissions increase in the sector due to increased demand for food, yet emissions reductions are highly dependent on the quantity of food produced.

SUMMARY

- Almost all of the proposed measures are either already actively invested in or currently being developed for the upcoming investment period.
- The agriculture sector has a very limited potential for emissions decrease without impacting the food production.
- The sector has a very long payback period in which quantifiable results could be seen.
- Regarding some of the measures listed, while the activity involves agricultural enterprises, the emissions reductions would manifest in some other sectors, thus would not directly reduce the agriculture sector's emissions inventory.

5. Summary

This study analyses the progress Estonia has made in the recent years towards reaching climate neutrality, as agreed on in 2019.

The EU is becoming more ambitious in its endeavour to preserve the environment, limit greenhouse gases and reach climate neutrality. The European Green Deal and the Fit For 55 package recommend new ambitious goals to be achieved by 2030 in order to be on track for achieving climate neutrality by 2050. These targets are significantly higher than the existing ones and, if adopted, it can be seen that many sectors will struggle to meet them.

Below, a brief summary of each analysed sector is provided.

Buildings

In the buildings sector, current targets project that, by 2030, greenhouse gases must be reduced by 60%, energy consumption reduced by 14%, and of all the energy used in buildings, 49% is expected to be from renewable sources.

Additionally, the Estonian national goals for the building sector include the renovation of 50% of all apartment buildings and 40% of single houses by 2030. By 2050, this amounts to the reconstruction of 54 million m^2 of buildings reconstructed. In order for this to be achieved, the Estonian long-term strategy for the building sector foresees up to five times the current pace of renovation in the upcoming years

Main issues in the building sector:

- The specific targets or data mainly exist for residential buildings. As such, in the residential buildings sector (single houses + apartment buildings) it can be concluded that the pace of renovation must increase to reach the $CO_{2\,r}$eduction targets by 2050.
- Most focused and financial support is dedicated to apartment buildings and single houses, whereas other building categories (i.e. commercial services, industrial buildings, office buildings) do not have stable financial support measures. There is a lack of incentives in the private sector to renovate these type of buildings (to nearly zero-energy buildings) and this threatens achievement of the goal set for the buildings sector. Incentivizing the reconstruction of these types of buildings would also be a very cost-efficient measure because the savings of CO_2 emissions per Euro of investment is significantly larger than in the majority of other measures investigated.

Energy

The energy production sector in Estonia faces major reform in the coming years if it is to reach climate neutrality by 2050. Oil shale has historically accounted for up to 80% of total electricity produced in Estonia and, in order to decarbonize the sector, new carbon neutral capacities must be added into the energy mix. The share of renewable energy in total electricity consumption has increased to 29.2% in 2020 from 19.7% in 2018.

Main issues in the energy sector:

- The statistics on renewable energy used in the energy mix in Estonia show a positive trend, and the goal for renewables in final energy mix in 2030 is likely to be achieved.
- While the capacities of wind energy have grown steadily from 636 GWh in 2018 to 760 GWh in 2020, there are no capacities installed through the governmental subsidy of reverse auction that began in 2019. There are also no offshore wind power capacities installed. The national goal for wind energy by 2030 is 2640 GWh. So far, the pace of investments into new capacities has been lagging behind leading countries in the region and need to grow considerably in coming years, in order to effectively address price hikes and supply shortages.

Industry

The largest industries in Estonia are cement production and the limestone industry, which are also the main polluting industries. These industries are also part of the EU ETS.

The emissions arising from the cement industry have been declining in the recent years because of the increasing price of $CO_{2,}$ which is making it unprofitable to produce clinker, which was the largest emission source in the industry.

Main issues in the industry sector:

- There is currently no existing measure nor government support that would help the Estonian industry sector with decarbonization. The RRF and the EU Just Transition Fund are in the planning phase and aim at decarbonizing Estonian industry.

Land use, land use change and forestry

The LULUCF sector has historically been a carbon sink, sequestering more carbon than it emits. Unfortunately the binding of carbon has been decreasing significantly in recent years from -4 million CO_2 equivalent in 2012, to -715 000 in 2019. The LULUCF sector became an emitting sector in 2020. The forest growing stock is estimated to decrease up to 2050, thus there is a need to find new ways to compensate. Currently the target for the sector in the EU is for the emissions in the sector to not exceed the capacity to bind carbon in the soil. The main emitter in the sector (40% of the total) is the use of peat soils for agricultural purposes.

Main issues in the LULUCF sector:

- The LULUCF sector in Estonia has historically been a carbon sink, yet in 2020 the emissions exceeded the binding in the sector. The forest stock is further expected to decrease in the upcoming years.
- The EU Commission's drafted Reference Scenario for business-as-usual indicates that the Estonian LULUCF sector could become an emitting rather than a binding sector.
- The new proposed target through the EU Fit for 55 package for Estonia specifically is to bind 2.5 million tonnes of CO_2e by 2030. Estimated suggest this is highly unlikely to be achieved. Rather, studies show that with extensive support, it is possible to sequester a maximum of 1.3 million tons of $CO_{2.}$
- In order to curb the emissions in LULUCF sector, it would be most beneficial to target the use of peat soils in agriculture. There is an existing measure and funding allocated through PRIA since 2015 to convert peat soils into natural grasslands. As it can take up to 20 years for the savings arising from this measure to have a quantifiable impact, additional effort is needed to limit the emissions.

Transport

On the basis of the climate targets set by the EU, the transport sector must reduce its greenhouse gas emissions by 90% by 2050 and become significantly less polluting. The transport sector contributed 19.3% of all Estonian greenhouse gas emissions in 2020. The transport sector has shown a decreasing emissions trend since 2018. The share of renewable energy in the sector doubled to 12.16% in 2020 compared to 2019. As the sectors included into the EU ETS are facing more ambitious targets through the Fit For 55 package, it is estimated that the transport sector has the most GHG reduction potential.

Only 36.9% of people used public transport, walked or cycled to work in 2020, and the share is showing a decreasing trend. It is highly unlikely that the 2035 transport programme target of 55% will be met unless public transport, walking and cycling are significantly prioritized.

Main issues in the transport sector:

- The most cost-efficient measure of all the measures proposed in the study is increasing the share of CNG-fuelled cars. There is currently no progress in this regard.
- The importance of the uptake of biomethane has been highlighted. Today, three major cities in Estonia use biomethane buses in their public transportation routes. Biomethane in public transport is expected to be taken up by other cities as well.
- There are support measures available for the purchase of alternative fuel vehicles, but no support for the fuelling stations for electrical or CNG vehicles, which would support the uptake of these alternative fuels. Therefore, future actions should support the whole infrastructure of alternative fuels, as was done in the recent KIK hydrogen value chain call.
- Despite various investments in public transport and light traffic routes, the use of private cars is on the rise and the use of public transport on the decline. There needs to be extra effort to shift habits towards walking and using public transport.

Agriculture

Main issues in the agriculture sector:

- Almost all of the suggested measures are either actively invested in or currently being developed for the upcoming investment period.
- The sector has a very long payback period in terms of when quantifiable results would be seen.
- Activity under some of the measures, while aimed towards agricultural enterprises, would lead to CO_2 savings in the GHG inventories of other sectors (e.g. energy) and thus would not help to reach greenhouse gas reduction targets specifically in the agriculture sector.

6. Conclusion

All in all, there is much work still to do in all of the sectors analysed in the study. There are certain shortcomings in each and reaching the set goals is expected to be difficult.

It is clear that too little time has passed since the publication of the 2019 SEI climate neutrality to determine whether there has been real progress or failure. This is for two main reasons: the lag in data availability and the long time-span of funding schemes. Unfortunately, in many cases only data from 2019 is available for comparison, and do not reflect current status. Also, because the funding schemes are designed for a long time period (e.g. five to six years in most cases) and the previous funding (e.g. Structural Funds) ran until 2020, it is understandable that many of the measures are currently under development and quantifiable progress might not be available yet.

7. Policy implications and next steps

- **Significantly increase investments into energy efficiency.** This is especially necessary with regard to the renovation of non-residential buildings, because the pace of renovations is expected to increase significantly and currently there are no existing support mechanisms for the reconstruction of commercial-, office- or industrial buildings, yet these are the building types in which renovations would be the most cost effective for reducing greenhouse gases.
- **Incentivize and speed up investments into onshore and offshore wind energy.** While the share of wind energy produced in Estonia has increased, the pace of investment into new capacity is lagging behind leading countries in the region and needs to grow considerably in coming years, especially given the need to effectively address price hikes and supply shortages. These investments should be complemented by financial incentives for solar energy and micro solutions and balancing/ storage capacities.
- **Implement supportive measures in the LULUCF sector to curb emissions and enhance carbon sequestration.** Measures for curbing emissions in the LULUCF sector would have short-term benefits, while for the long term it is also important to support additional sequestration.
- **Develop financial instruments in the agriculture sector to invest in producing renewable energy, especially biomethane.**
- At the same time as adopting various measures for curbing emissions in the transport sector, i**t is equally important to influence people's behaviour towards walking and cycling, along with using public transport.** Currently, investments favour increased use of motor vehicles, while investments into the promotion of walking and cycling have been modest.
- Invest in the sustainability of the food system, through **awareness raising campaigns targeting the habits and preferences of consumers to make more sustainable choices**, e.g. on food waste.