Support to the renovation wave - energy efficiency pathways and energy saving obligation in Estonia

Deliverable 2: Report on data collection and baseline scenario

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Trinomics TAL TECH Energex ENERGY EXPERTS SWECO

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Support to the renovation wave - energy efficiency pathways and energy saving obligation in Estonia (REFORM/SC2022/067)

Authors

Professor Jarek Kurnitski (TalTech)

Professor Anna Volkova (TalTech)

Inge Roos (TalTech)

Professor Kati Kõrbe (TalTech)

Reeli Kuhi-Thalfeldt (TalTech)

Miikael Einstein (TalTech)

Markus Tamm (Energex)

Rander Süld (Energex)

Ling Ying Lee (Trinomics)

Contact person

Mr. Frank Gérard

T: +32 (0) 496 38 92 78

E: Frank.Gerard@trinomics.eu

Date

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Disclaimer

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In association with:

TAL TECH

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1 Introduction

In the context of the European Green Deal, on 14 October 2020 the Commission published the strategy 'A Renovation Wave for Europe' to boost renovation in the EU. This strategy aims to at least double annual energy renovation rates in the next ten years and to foster deeper renovations. These renovations will enhance the quality of life for people living in and using the buildings, reduce Europe's greenhouse gas emissions, and create a significant number of green jobs in the construction sector. However, achieving the objectives of the Renovation Wave is challenging. The additional investment needed cannot be covered by public finance alone. Renovation is held back by barriers at different points throughout the value chain –from the initial decision to engage in renovation, to financing and completion of the project. For example, renovation can be costly, difficult to organize and lengthy to carry out. Mobilizing financing can be difficult, in particular at local and regional level and public funds are frequently scarce and difficult to blend due to regulatory obstacles and lacking capacity in public administrations.

The European Commission has pointed out in its assessment of Estonia's National Energy and Climate Plan (NECP) that the ambition level for reducing final energy consumption by 2030 is very low, and few additional energy efficiency measures have been identified in the NECP. To this purpose, DG REFORMs launching a Request for Service under the Multiple Framework Contract for the Support to Structural Reforms in EU Member States, for the provision of:

- A report on data collection and baseline scenario;
- A comprehensive study of energy efficiency pathways for Estonia;
- An action plan for implementing the optimal energy efficiency pathway;
- A detailed concept of the energy efficiency flagship policy, including a monitoring and verification approach;
- A catalogue of energy saving measures and calculation methodologies.[1]

This Deliverable 2 report on data collection and baseline scenario consists of two main parts:

- Data report, i.e. the database, which includes historical data about sectoral energy consumption, main energy efficiency indicators, information of fuel and energy prices, etc.; and
- Analysis, which includes the development of the baseline scenario.

The reports consist of:

- An overview of the final energy consumption trends by main end-use sectors;
- An overview of implemented measures in the 2014-2020 period, including an in-depth assessment of the share of these measures in the final energy consumption and the share of each measure in total energy savings;
- Desk research of relevant reports, strategies, plans, and statistical data at national and regional level;
- Analysis of the most critical obstacles to Estonian energy efficiency;
- Analysis of the institutional structure;
- Development of energy consumption source scenarios for housing, business and service, transport and industry sectors.

[1] *Request for Service Title: Support to the Renovation Wave -Energy Efficiency Pathways and Energy Saving Obligation in Estonia. REFORM/SC2022/067*

It is important to note that the documents that have been reviewed and data that has been retrieved and used in this report for Deliverable 2 **do not reflect the changes arising from the new deal on the Energy Efficiency Directive** that was agreed between the Council of the EU and the EU Parliament on 10 March 2023 - a development that occurred after the drafting of this report. Under this new agreement, Member States will now have to achieve higher savings, i.e. 1.49% average annual savings on the final energy consumption from 2024 to 2030, deriving at 1.9% savings by 2030. This translates to a higher energy saving obligation of 21 279 GWh to be fulfilled by Estonia from 2021 to 2030, instead of 14 767 GWh previously.

This report focuses on developing a baseline scenario which considers the existing energy efficiency measures; it was thus deemed as not critical to address the new EED savings target in this report. The achievement of this new target will be addressed in the next deliverables of the project when designing the policy pathway options and the action plan.

2 Establishing the baseline scenario

2.1 Understanding the economic context

In recent years, the Estonian economy has been in a strong position in terms of employment, income and export capacity. Economic growth has been averaging almost 3.6% over the last 11 years. Despite the moderate growth, there have been no significant internal imbalances in the Estonian economy. Table 2-1 shows the change in the volume indices of industrial production, and the changes in producer and consumer prices compared to the previous year for the period of 2010 to 2021.

Table 2-1 Key annual development indices of economy (2010-2021), in percentages

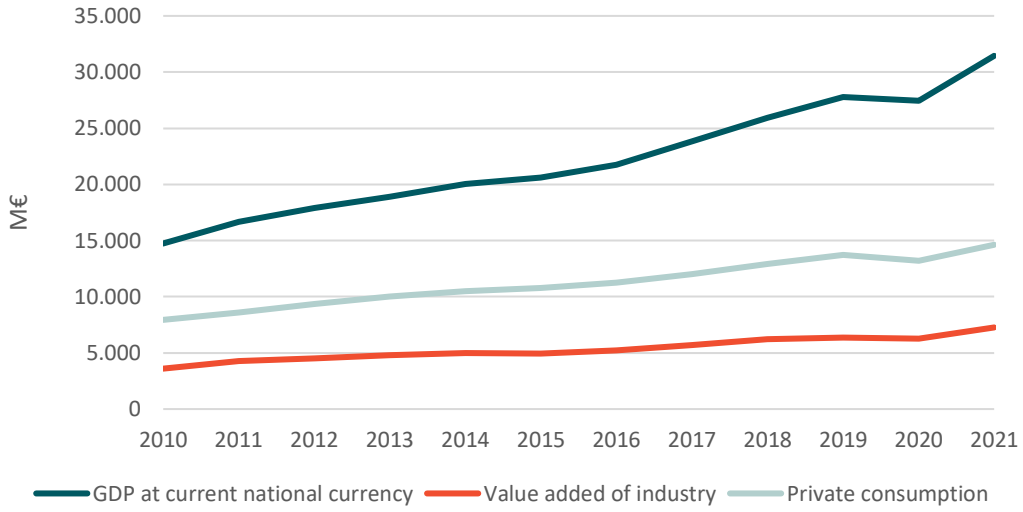
Annual index	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
GDP - CLV[2]	2.4	7.3	3.2	1.5	3.0	1.9	3.2	5.8	3.8	5.7	-0.6	5.8
Industrial production volume[3]	1.2	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.2
Producer prices[3]	3.3	4.4	2.3	4.1	-1.6	-2.0	-0.7	3.6	2.6	-0.2	-2.4	12.4
Consumer prices[3]	3.0	5.0	3.9	2.8	-0.1	-0.5	0.1	3.4	3.4	2.3	-0.4	4.7

In 2021, Estonia's GDP at current prices amounted to EUR 31.45 thousand million[4]. On average, the growth rate of Estonia's GDP over the period of 2010-2021 is 53%; The annual growth is about 4.8% (Figure 2-1).

[2] Chained value change compared to the same period last year, %
[3] Compared to last year
[4] Database from Statistics Estonia, Table RAA0042

Figure 2-1 Macroeconomic development in Estonia from 2010 to 2021, in million euros

Macroeconomic development in Estonia from 2010 to 2021, in million euros



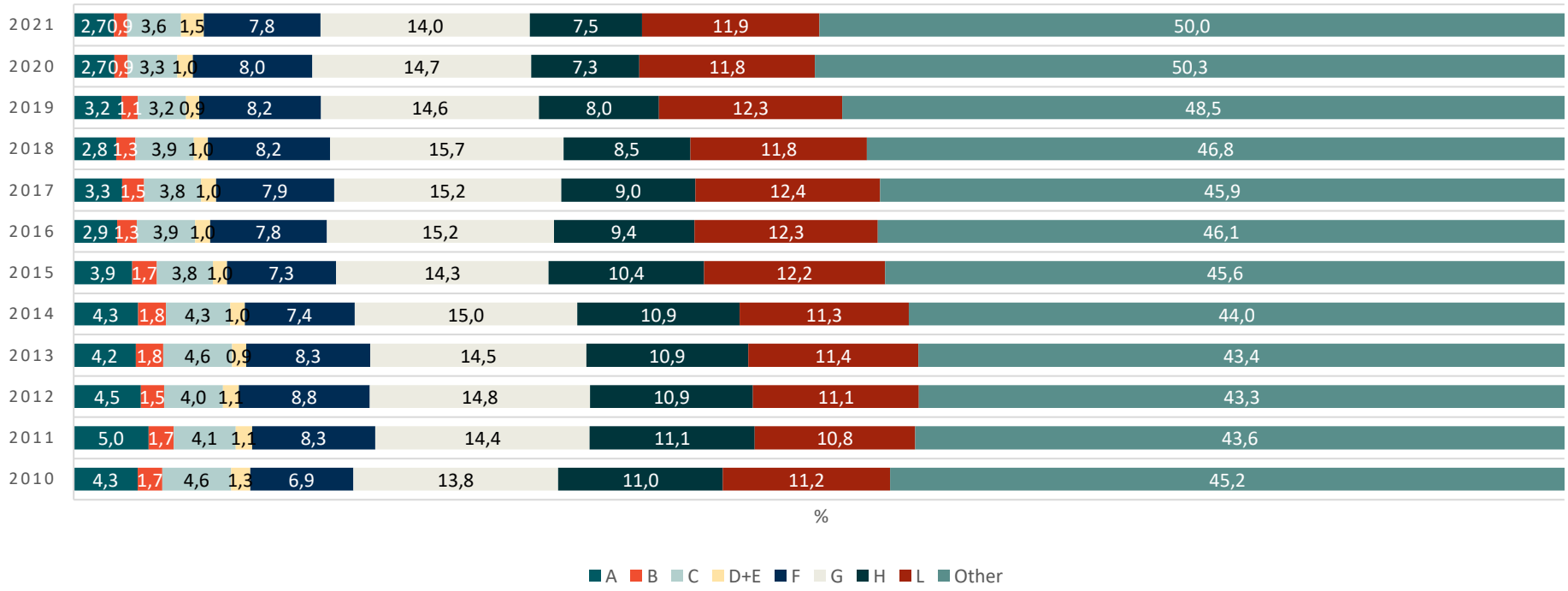
Source: Statistics Estonia

Figure 2-2 below shows that the value added of various industries generally follow a similar trend throughout the same period. In 2021, value added was driven mainly by activities focused on domestic consumption, in particular by trade, including wholesale and retail (14%), followed by real estate activities (11.9%) and information and communication (7.9%)[5]. Economic growth was also supported by a small increase (around 3%) in the value added of the building and health (under the category of 'Construction' in Figure 2-2) and social care sector (under category of 'Other' in Figure 2-2). Due to the small size of the Estonian economy, the main driver of economic growth is exports. After the global economic downturn in 2009, Estonian exports of goods grew at a rapid pace, but in the last two years, foreign demand has weakened and export growth has remained lower.

Several sectors experienced a decline in the share of value added in GDP between 2010 and 2021; this includes the mining sector (-47%), agriculture and forestry sector (-37%), transport and storage sector (-32%), and manufacturing (-21%).

[5] Information and communication sector is included within the Other sector. Calculated by Taltech on the basis of the Table RAA0042 of the Statistics Estonia, Database

Figure 2-2 Value added of industries from 2010 to 2021, in percentages

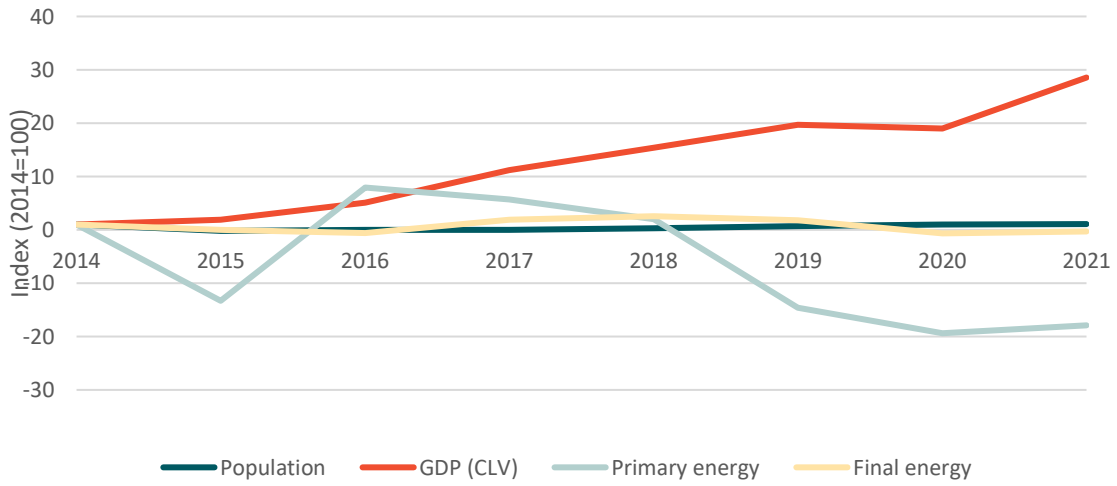


A-Agriculture and Forestry
B-Mining
C-Manufacturing
D+E-Energy and water supply
F-Construction
G-Trade
H-Transportation and storage
L- Real estate activities

Source: Statistics Estonia

The development of some macro-level indicators during the period 2014–2021 as relative to 2014 is presented in Figure 2-3. While the number of population and final energy consumption has remained fairly stable, the GDP has increased by approximately 29% in 2021 compared to 2014, and the supply of primary energy has decreased by approximately 18%. This shows that there is no correlation between GDP and final energy consumption. **Therefore, GDP growth forecasts are not used in this research when preparing baseline scenarios for sectoral energy consumption.**

Figure 2-3 GDP, energy consumption and population numbers in Estonia between 2014 and 2021, relative to 2014



Source: Statistics Estonia

2.2 Past trends in energy consumption, by fuel and by sector from 2010 to 2021

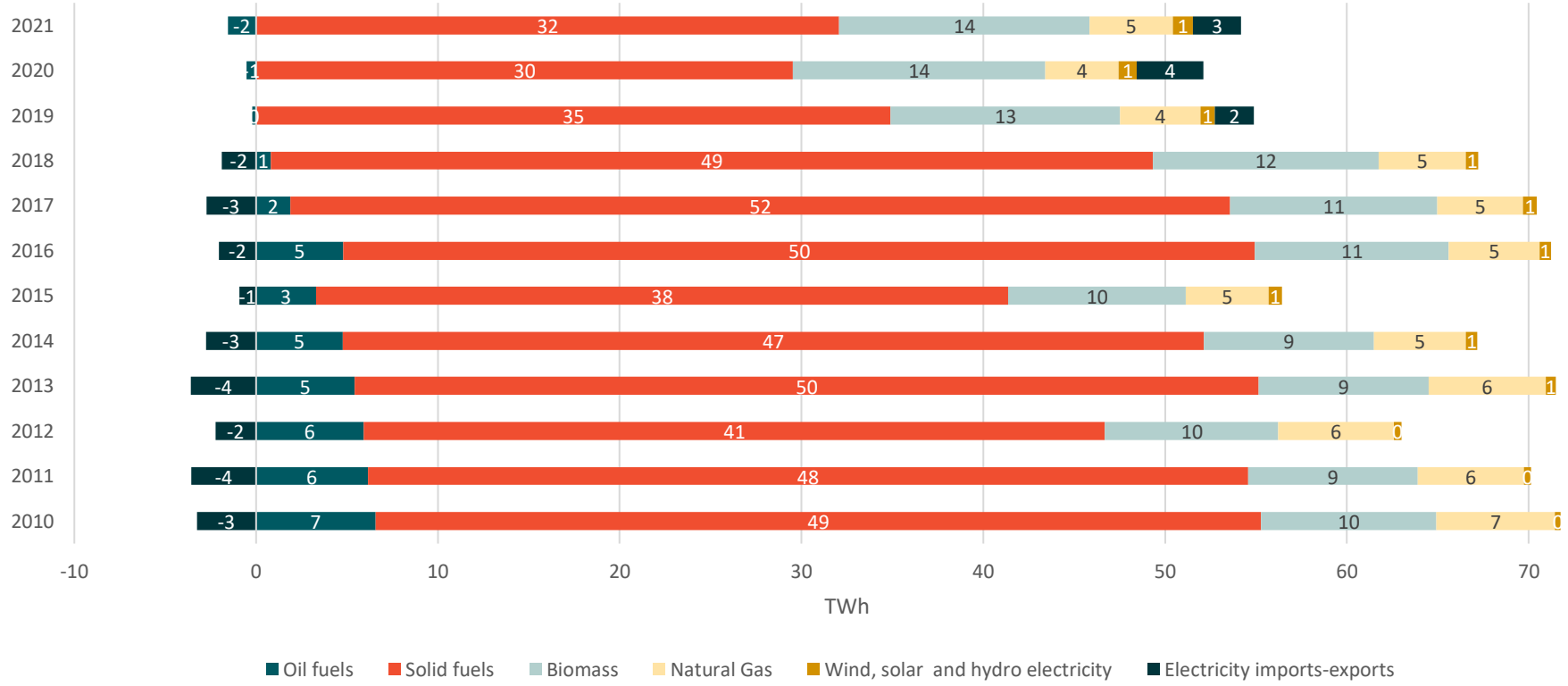
The analysis of energy consumption trends is essential in the development of future energy consumption forecasts. One of the bases for the preparation of the baseline scenario is the consideration of energy consumption trends of the previous period, and the upcoming changes in light of today's knowledge of the development of industry, housing, transport and services, the size of the population, incomes and their distribution, investment opportunities, technological development, competitive energy types (gas, district heating etc.) of uses and resources and other possible factors that are unknown today.

In Estonia, the situation of security of energy supply has always been quite good, as the total dependence on energy imports has been low. However, since 2014, the share of energy imports has increased significantly, reaching 11.6%, although it decreased slightly to 10.5% in 2020. The share of energy imports was particularly high in 2019, reaching 58%. The increase in the share of imported energy is related to the increase in the share of imported electricity. Domestic oil shale electricity has turned out to be more expensive than imported electricity due to high CO_2 taxes.

2.2.1 *Primary energy*

Erreur ! Référence non valide pour un signet. shows the contribution of various fuels towards the primary energy use in Estonia from 2010 to 2021. The overall structure of the primary energy supply sources has been quite stable, but changes were visible in 2021. Solid fossil fuels (mainly local oil shale), which consistently accounted for 67-76% of primary energy supply, have dropped to 61% in 2021. The proportion and absolute volume of petroleum-based fuels, i.e., oil fuels, have been constantly decreasing, as they have been gradually replaced mainly by biomass. The share of biomass is relatively large and has increased from 14% in 2010 to 26% in 2021. The share of wind, solar and hydro energy has been constantly increasing, but its share in the primary energy supply is still small, about 2%. The share of natural gas has decreased from 10% in 2010 to 9% in 2021.

Figure 2-4 Primary energy use in Estonia from 2010 to 2021, in TWh



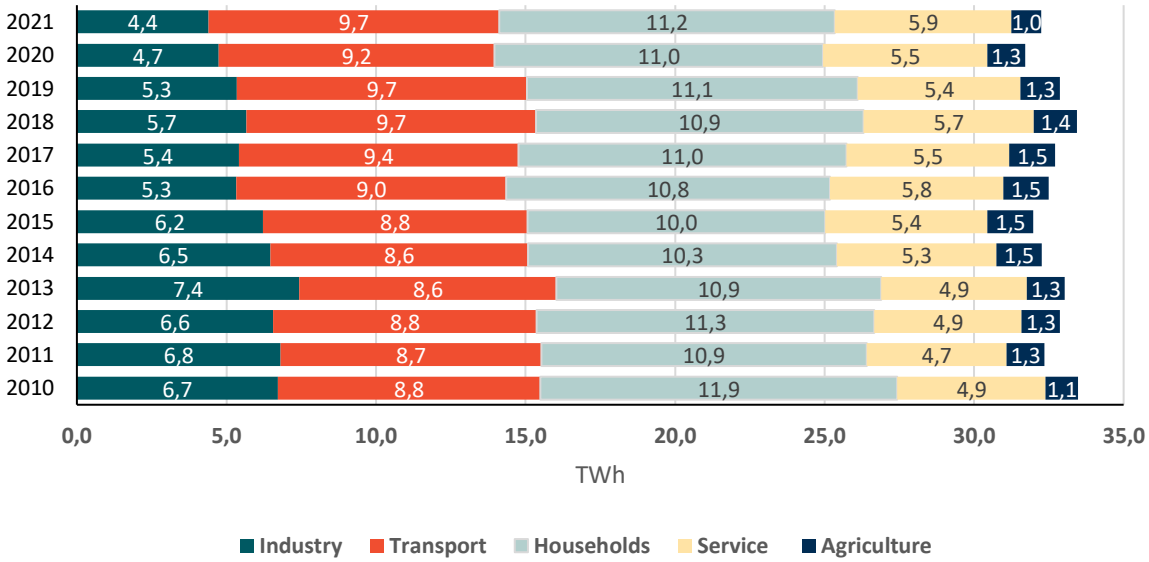
Source: Statistics Estonia

2.2.2 *Final energy consumption*

The final energy consumption has been quite stable throughout the period 2014-2021, remaining in the range of 32-33 TWh per year (2.7-2.9 Mtoe). Trends of final energy consumption by sector from 2010 to 2021 is presented in Figure 2-5; the data shown here is also the input data for the preparation of the baseline scenario. The percentage share of final energy consumption by sector for 2020 is shown in Figure 2-6.

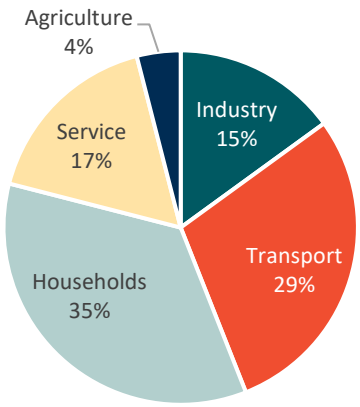
Households consume the largest part of the final energy. Although the share of this sector has decreased from 36% in 2010 to 35% in 2020, households continue to be the largest final consumer. The second largest final energy consumer is the transport sector, which has increased from 26% in 2010 to 29% in 2020 (and will continue in the future). Between 2010 and 2020, the share of energy consumption in the service sector has increased by two percentage points, making up 17% of final energy consumption in 2020 (compared to 15% in 2010). On the contrary, final energy consumption in the industrial and agricultural sectors is on a downward trend.

Figure 2-5 Trends of the final energy use by sector from 2010 to 2021, TWh



Source: Statistics Estonia

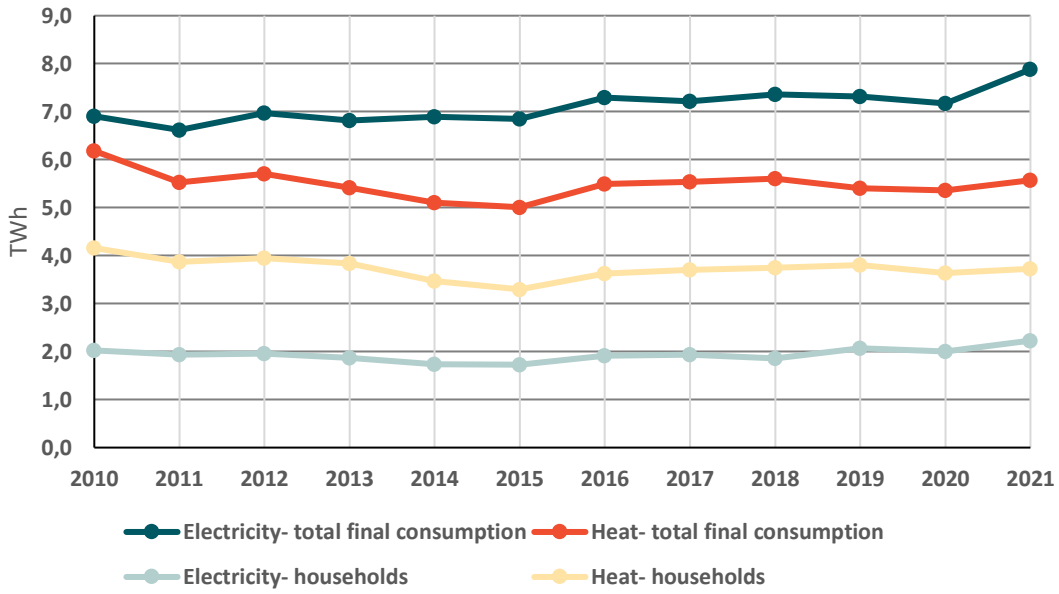
Figure 2-6 Share of final energy use by sector in 2020, in percentages



Source: Statistics Estonia

The dynamics of the final consumption of electricity and heat since 2010 is presented in Figure 2-7. Compared to 2010, electricity consumption increased by 14.3% in 2021 (from 6.9 TWh to 7.9 TWh), while heat consumption has decreased by 9% (from 6.2 TWh to 5.6 TWh). Household electricity consumption has increased by 10% (2.0 TWh in 2010 and 2.2 TWh in 2021) as many household heating systems have switched to heat pumps. Heat consumption has decreased by 11% over the same period, from 4.2 TWh-3.7 TWh), as a result of the renovation of both heat networks and buildings.

Figure 2-7 Final electricity and heat consumption from 2010 to 2021, TWh



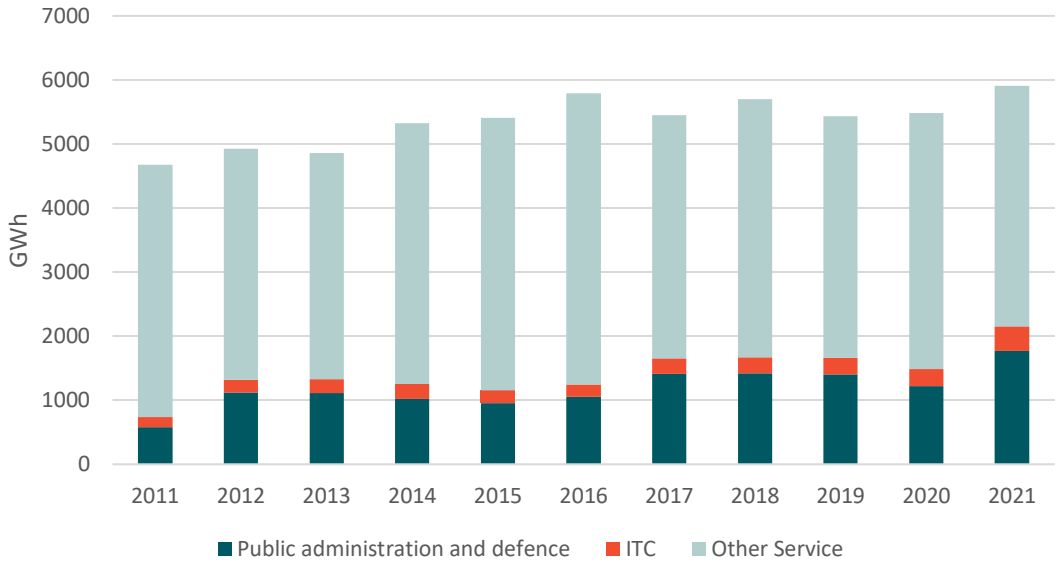
Source: Statistics Estonia

This study also analyses separately, the share of public administration and national defence and information and communication (ICT) fields and the entire service sector in energy consumption, as well as the change in the share of these fields in the years 2011-2021.[6]

The share of the ICT sector was 3.4% in 2011 and 6.4 % in 2021 of the total energy consumptions of the entire service sector, while energy consumption in the field of public administration and national defence continues to rise. In 2011, the share of public administration and national defence sector was 12.3% and in 2011 already 30% of the total final energy consumption of the service sector.

[6] 2010 data in the Estonian Statistics database is missing on this sector

Figure 2-8 Share of the total final energy consumption of the public administration and national defence and ITC sub-sectors within the service sector, in GWh



Source: Statistics Estonia

2.3 Analysing the impact of energy saving measures implemented from 2014 to 2020

Energy Efficiency Policy in Estonia

A common framework has been established at the EU level for the Member States to promote energy efficiency in order to achieve the EU energy efficiency targets for 2020 and 2030. In particular, the EED (2012/27/EU) committed to increase the EU's energy efficiency by 20% in 2020, i.e., the final energy consumption had to be a maximum of 1086 Mtoe and the primary energy consumption 1 483 Mtoe. In 2018, the amended EED ((EU)2018/2002) updated the goal to increase the EU's energy efficiency by 32.5%, i.e., the maximum level in final energy consumption in 2030 is 956 Mtoe and the primary energy consumption is 1 273 Mtoe.

The Energy Efficiency Directive (EED) has been transposed into Estonian legislation by the Energy Management Organisation Act[7] and its by-laws[8] since its adoption in 2012. Since then, Estonia has implemented various energy efficiency policies and measures. The national energy saving measures implemented in the period 2014-2020 were focused on making residential buildings, health centres, kindergartens, special care institutions and schools more energy efficient. In order to make the production and transmission of thermal energy more efficient, the renewal of the outdated district heating network infrastructure has also been supported. To reduce the energy consumption of the industrial sector, the efficiency of the resource use of companies has been supported through energy and resource audits. In the transport sector, energy efficiency has been promoted through the electrification of the transport sector and the promotion of light traffic.

[7] Energy Management Organisation Act. Available at: https://www.riigiteataja.ee/en/eli/502092016001/consolide.
[8] This includes the Energy Efficiency Directive 2012/27/EU and Directive (EU) 2018/2002 of the European Parliament and of the Council.

The Estonian National Energy Development Plan 2030+[9] and Estonia's National Energy and Climate Plan (NECP)[10] set a goal for 2030 to keep final energy consumption at 32 to 33 TWh per year (2.75 to 2.84 Mtoe), and to reduce primary energy consumption by up to 14% compared to the peak of recent years. Within the framework of the implementation of Estonia's energy policy, the focus is on the organisation of energy saving activities in the following energy end-use sectors:

- Buildings, in both the public and private sectors, as they account for the largest share of final energy consumption and the potential for energy savings is probably economically the most viable;
- Transport, as without the implementation of measures, energy consumption would increase significantly, which would in turn lead to increasing dependence on imports of liquid fuels;
- Industry, as this is the third most important end-use sector, where both the energy consumption and energy prices are, together, increasingly affecting the sector's competitiveness;
- Street lighting, where the ability of local authorities to bring their systems to a new quality in terms of lighting requirements, reliability and energy efficiency is limited due to a lack of financial resources.[11]

The following sub-chapters present an overview of energy efficiency measures implemented in various sectors during the period 2014-2020, and the cumulative energy savings that have been achieved until 2020. This includes the residential, transport, service, industry, and other cross-cutting measures, followed by an impact analysis of these measures per sector. A consolidation of all these measures is available in Annex 1.

2.3.1 Residential sector

The Development Plan of the Energy Sector until 2030 (approved by the Government in October 2017), which replaces an earlier document, i.e., the National Development Plan for Housing Sector 2008–2013, has been key to drive the efficient use of energy in the residential sector. One of its main objectives is one at improving the quality and sustainability of the housing stock in Estonia, where there are several measures presented in the plan. However, the energy saving effect of the plan has not been ex-ante estimated.

The residential sector and energy economy in Estonia are closely interconnected, as the energy demand of buildings forms a significant part of Estonia's energy balance. At the same time, there is also a high potential for energy savings, as the energy costs of buildings accounted for about 25.96% of the total energy consumption in the EU in 2020. In comparison, energy consumption of Estonian households accounted for 35% of the total energy consumption in 2021.

Through renovation of the building stock, thermal energy (consumption?) in buildings may be reduced by up to 50% and thereby achieved, among other things, a reduction in the volume of imported fossil fuels and CO_2 emissions. Concurrently, it is also possible to improve the quality of the living environment and reduce the maintenance costs of the housing stock, which have a direct impact on people's livelihoods.[12]

[9] This is a document that is currently being updated based on the document "National Development Plan of the Energy Sector until 2030" that was prepared in 2017. The 2017 document is available at: https://faolex.fao.org/docs/pdf/est199996.pdf
[10] https://energy.ec.europa.eu/system/files/2022-08/ee_final_necp_main_en.pdf
[11] Based on data from Odyssee-Mure, available at: https://www.odyssee-mure.eu/
[12] https://www.odyssee-mure.eu/publications/national-reports/

Renovation of apartment buildings

In April 2019, the Minister of Entrepreneurship and Information Technology adopted a new regulation, No. 24 which specifies the '*Conditions and procedure for granting support for the reconstruction of apartment buildings*'.[13] The Regulation was established to implement the objectives of the action 'Supporting the reconstruction of apartment buildings' and of the measure 'Achieving energy efficiency in housing' of the priority direction 'Energy efficiency' of the Cohesion Policy Funds Implementation Plan 2014-2020.

The objectives of the grant are listed below:

1. Modernisation of the housing sector;
2. Improvement of public space and living environment;
3. Ensuring the safety of apartment buildings;
4. Achieving energy efficiency and a better indoor climate in apartment buildings;
5. Encouraging the introduction of renewable energy;
6. Reduction of household energy costs;
7. Reduction of energy dependence and greenhouse gas emissions.

This Regulation contributes to the achievement of the following output indicators of the measure 'Achieving energy efficiency in housing', namely:

1. Increasing the number of apartments with an improved energy consumption class;
2. Increasing the area of reconstructed buildings;
3. Reducing CO_2 emissions per year.

Between 2014-2020, a total of 785 apartment buildings received a support decision. The breakdown per year is shown in the table below.

Table 2-2 No. of apartment buildings that received a support decision between 2014 to 2020, per year

Year	No. of apartment buildings that received a support decision
2014	39
2015	45
2016	148
2017	209
2018	0
2019	51
2020	293

Based on the measured energy consumption of apartment buildings completed before and after the renovations, the average decrease in heat energy use is 84 kWh / square meters per year (m^2a). This accounts approximately for a 55% reduction of heat energy usage before the renovation was carried out; the average increase in electricity consumption is 2 kWh / (m^2a) (about 5%). The small increase in electricity consumption is due to the installation of ventilation systems. The energy saving numbers refer

[13] Regulation No 24 of the Minister of Entrepreneurship and Information Technology, Conditions and procedure for granting support for the reconstruction of apartment buildings. Available at: https://www.riigiteataja.ee/akt/129122021052?leiaKehtiv

to heated surfaces. The average cost of a complete renovation of apartment buildings was about 290 €/m^2 of net area.

Renovation of private buildings

The renovation of private buildings is supported through the framework of Regulation No. 27 of the Minister of Economy and Communications, '*Conditions and procedures for using the green investment scheme 'Support for the reconstruction of small houses*'.[14] The purpose of the support is to increase the quality and energy efficiency of the indoor climate of existing residential buildings, to reduce the energy consumption of small residential buildings and to promote the introduction of various renewable energy technologies.

The measure supports:

1. Reconstruction works to reduce the energy consumption of a small house and the acquisition of building products and building materials necessary for their implementation;
2. Design of small house reconstruction works, which also includes calculation of energy consumption;
3. Carrying out owner supervision of reconstruction works of a small house;[15]
4. Acquisition and installation of renewable energy production equipment for a small house.

Renovation of rental apartments

Renovation of rental apartments are supported within the framework of Regulation No. 28 of the Minister of Entrepreneurship and Information Technology '*Conditions and procedure for providing case-based investment support for the development of the housing stock of a local government unit*'.[16] The regulation outlines how case-based investment support can be provided from the funds allocated for the development of the local government's housing fund in the Ministry of Economic Affairs and Communications budget, as per the State Budget Act.

Support is given to a local government unit located outside the cities of Tartu and Tallinn and the local government units adjacent to them; it can also be provided to a unit under its ruling influence, whose statutory activity is the organisation of housing in the territory of the local government unit and which, based on an administrative act or administrative contract, performs the corresponding public tasks.

Atmospheric air protection programme, including heating equipment for apartment associations

Regulation No. 10 of the Minister of the Environment *'Procedure and conditions for granting support from the environmental programme'* stipulates the requirements for the application for financing projects in the field of environmental protection. This includes the criteria for evaluating applications, supported activities, the procedure for decision-making, control of contract execution and reporting.[17]

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[14] Regulation No 27 of the Minister of Economic Affairs and Communications, Conditions and procedure for using the green investment scheme "Support for reconstruction of small houses". Available at: https://www.riigiteataja.ee/akt/120042012007?leiaKehtiv

[15] For renovation works that are carried out by contractors, supervision of the works to ensure quality and the fulfilment of project conditions can be done either by the owners themselves, or by independent third parties that are hired by the owners to do so. For renovation works carried out by the owners themselves, independent third parties should then carry out the supervision.

[16] Regulation No 28 of the Minister of Entrepreneurship and Information Technology 'Conditions and procedure for providing case-based investment support for the development of the housing fund of the construction and local government units'. Available at: https://www.riigiteataja.ee/akt/115072017003

[17] Regulation No. 10 of the Minister of the Environment 'Procedure and conditions for granting support from the environmental programme'. https://www.riigiteataja.ee/akt/113042021008?leiaKehtiv

The aim of the Atmospheric Air Protection Programme is to support the management of health risks arising from the environment and the improvement of the quality of life, the quality of the outdoor air, the mitigation of the consequences of climate change and the provision of radiation safety.

In connection with reducing the negative environmental impact of energy in the residential sector, the following activities are supported:

1. Construction of systems for cleaning ambient air pollutants of combustion equipment, including the application of the best possible technique;
2. Reconstruction or construction of a boiler house not located in the district heating network for the production of thermal energy from wood fuels;
3. Building a local heating system based on a geothermal heat pump, if there is no possibility to connect to the district heating network and green energy is used to operate the heat pump;
4. Replacing a heating device that runs on biomass or fossil fuel (except natural gas) or a heating device that uses direct electric heating of apartment cooperatives with a heating device that uses renewable fuel, or connecting a residential building managed by an apartment cooperative to a district heating network, if the residential building was built before 1 January 2010.

2.3.1.1 Assessment of impact of measures taken in the residential sector

A semi-quantitative analysis on the impact of measures taken in the residential sector is carried out, with some degree of expert judgement applied when evaluating the impact of the measures. The table below provides an overview of the analysis. Measures are categorised by three impact levels—low, medium and high—defined by the percentage share of energy savings based on the overall electricity or energy consumption of the residential sector, where:

- Low impact: < 0.1%;
- Medium impact: 0.1% to < 0.5%; and
- High impact: ≥ 0.5%.

The last column presents the share of the *cumulative* energy savings obtained from the implementation of the measures, measured against the energy consumption of the residential sector in 2020.

Table 2-3 Energy efficiency measures of the residential sector from 2014-2020

	Measure	Semi-quantitative impact	Energy savings		Share of savings
			ktoe	GWh	%
1.	Renovation of apartment buildings (2014-2020)	High	20.15	234.39	2.13%
2.	Renovation of private buildings (2019-present)	Medium	1.84	21.35	0.19%
3.	Renovation of rental apartments (2016-present)	Low	0.03	0.37	0.003%
4.	Atmospheric air protection programme, including replacing fossil fuel-based heating equipment for apartment associations (2014-present)	Medium	0.71	8.28	0.08%
	Total		**22.73**	**264.39**	**2.41%**

Source: Ministry of Economic Affairs and Communications (January 2023)

2.3.2 Transport sector

Regarding the public transport, one of the main problems in Estonia is the poor condition of rolling stock. The average age of buses in public transport is more than 10 years.[18] Currently, public transport subsidies are used to compensate up to 70% of the costs connected to providing public transport services on local

[18] Transport Agency – Vehicle statuses. Available at: https://avaandmed.eesti.ee/datasets/soidukite-staatused-eestis

bus lines.[19] Compensation payments are paid in accordance with the regulation No. 1370/2007 of the European Parliament and of the Council.[20] However, the compensation mechanism has not stimulated public transport service providers to make sufficient investments into the rolling stock.

In March 2011, the Estonian Government decided to launch the Electric Mobility Programme (EMP), combining the extensive introduction of electric vehicles with the financing available through the Kyoto Protocol mechanisms. KredEx supported the acquisition of electric vehicles in the period 2011-2014, which resulted in a purchase of 657 vehicles amounting to EUR 10.5 million. The average annual mileage of the 657 vehicles is 11.6 million km, and the reduction of CO_2 emissions is 1 960 tons. No calculations were carried out to measure energy savings.[21]

Electric car purchase and rental programme

In 2019, the Government of the Republic adopted a new regulation, the 'Conditions and procedure for granting aid for the purchase of all-electric vehicles.[22] The aim of the regulation is to reduce CO_2 emissions in the Estonian transport sector through a wider introduction and promotion of electric transport. The support is provided from the auctioning revenues of the EU Greenhouse Gas Emissions Trading Scheme and the support measure was developed by the Ministry of the Environment. A company can buy an electric vehicle for its main or secondary activity. The support is provided for the purchase of new fully electric M1[23] or N1[24] category vehicles, which will be used mainly in Estonia[25]. An electric vehicle must cover at least 80 000 kilometres and at least 80% of it in Estonia within four years of the payment of the support.

In 2019, the average emission of a new passenger car in the European Union was 123 grams of CO_2 per kilometre; in the same year the average emission of a passenger car in Estonia was 130.1 grams of CO_2 per kilometre.[26]

Time-based road toll for heavy duty vehicles

According to the Traffic Act[27], the Road Transport Act[28] and the Taxation Act[29], a time-based road toll for heavy duty vehicles is valid in Estonia, where the payment of a toll fee offers a right to use road for a certain period. The fee does not depend on the mileage, and is to be paid before driving. Payment of this fee can be done 24 hours a day, 7 days a week. It is saved electronically, and a paper printout is not required. From 1 January 2018, the fees must be paid for all lorries over 3.5 tonnes on the public road network; this applies to not only trucks registered in Estonia, but also trucks that are registered abroad.

[19] Regulation 52 of the (then) Ministry of Roads and Communications 'Procedure for support for public transport and repayment of public transport support'. RTL 2000, 81, 1188. Available at: https://www.riigiteataja.ee/akt/82902
[20] Regulation No 1370/2007 of the European Parliament and the Council. Internal market and State aid — public passenger transport services by rail and road. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=LEGISSUM:l24488
[21] National reports: Energy efficiency Detailed information | ODYSSEE-MURE. Available at: https://www.odyssee-mure.eu/publications/national-reports/
[22] Regulation No. 69 of the Minister of the Environment, Conditions and procedure for granting aid for the purchase of electric vehicles. https://www.riigiteataja.ee/akt/113122019018
[23] The M1 category refers to vehicles used for carriage of passengers, comprising not more than eight seats in addition to the driver's.
[24] The N1 category refers to vehicle used for the carriage of goods and having a maximum mass not exceeding 3.5 tonnes.
[25] The procedures for calculating mileage travelled in Estonia is laid out in this document: https://kik.ee/sites/default/files/maaruse_seletuskiri_0.pdf
[26] National reports: Energy efficiency Detailed information | ODYSSEE-MURE. Available at: https://www.odyssee-mure.eu/publications/national-reports/
[27] Traffic Act. RT I 2010, 44, 261. Available at: https://www.riigiteataja.ee/akt/117032011021
[28] Road Transport Act RT I, 30.12.2015, 9. Available at: https://www.riigiteataja.ee/akt/111012018001
[29] Taxation Act RT I, 24.12.2016, 2. Available at: https://www.riigiteataja.ee/akt/109042021011

The rate of toll charges is dependent on the gross weight of the truck and its trailer, the number of axles and the emission class of the truck. The owner of the truck is obliged to pay the fee. If the responsible user of the truck is entered in the traffic register, the responsible user is obliged to pay the fee.[30] This measure will help encourage off-peak travel and thus reduce congestion, as well as promote route optimisation, etc.

Eco-driving

The regulation Conditions and Procedure for the Preparation of a Motor Vehicle Driver and Curricula for the Preparation of a Motor Vehicle Driver regulates the preparation and advanced training of a motor vehicle driver.[31] Sustainable driving training is also part of the training curricula which includes a theory course, and a practical driving course which would also require application of the theoretical knowledge. The fuel consumption is observed, and the driver's driving style and behaviour are also being evaluated.

Walking and cycling roads

This is a measure of the "*State Shared Service Centre: Support scheme for walking and cycling roads*".[32] The purpose of the walking and cycling road support scheme is to contribute to the improvement of road safety, to increase the share of people travelling by bicycle or on foot and to ensure better access to services, including public transport and workplaces by bicycle or on foot. Projects that are funded with this scheme help to resolve important light traffic management bottlenecks by connecting existing light traffic routes, improving the connectivity of the walking and cycling networks and connecting public facilities to a settlement centre or residential areas. Existence of a safe alternative to car traffic increases the general spatial quality and people's satisfaction with their living environment. The measure promotes residents to consider alternative sustainable modes of transport.[33]

Mobile speed cameras

§ 199 of the Traffic Act stipulates the methods of traffic supervision.[34] Paragraph 1.4 allows supervision to be carried out with a portable or stationary technical device. The requirements for the measurement procedure of the speed measurement system and the processing of the measurement results can be found in the regulation of the Government of the Republic.[35]

The automatic speed measurement system must be properly installed and configured to measure driving speed. Compliance with the requirements established for automatic speed measurement, including the installation, and setting of the measurement system, is ensured by the owner of the measurement system.

2.3.2.1 Assessment of impact of measures taken in the transport sector

A semi-quantitative analysis on the impact of measures taken in the transport sector is carried out. The table below provides an overview of the analysis. Measures are categorised by three impact levels—low,

[30] By law, the fees must always be paid by the owner of the vehicle. Sometimes the owner of the vehicle is also the user of the vehicle (self-employed person).
[31] Regulation No 60 of the Minister of Economic Affairs and Communications "Conditions and Procedure for the Preparation of a Motor Vehicle Driver and Curricula for the Preparation of a Motor Vehicle Driver". Retrieved from: https://www.riigiteataja.ee/akt/128062011039.
[32] Amendment of Directive No. 1-23/78 of the Minister of Public Administration of August 24, 2015 "Support Scheme for Light Traffic Roads". Available at: https://rtk.ee/meede-kergliiklusteede-toetusskeem
[33] Subsidy scheme for light traffic roads. Available at: https://rtk.ee/meede-kergliiklusteede-toetusskeem.
[34] Traffic Act. RT I 2010, 44, 261. Available at: https://www.riigiteataja.ee/akt/117032011021
[35] Regulation No. 217 of the Government of the Republic of December 21, 2009: "Changing the procedure for performing traffic supervision". Available at: https://estlex.ee/estlex/?id=76&aktid=118665&fd=1&leht=595

medium and high—defined by the percentage share of energy savings based on the overall electricity or energy consumption of the transport sector, where:

- Low impact: < 0.1%;
- Medium impact: 0.1% to < 0.5%; and
- High impact: ≥ 0.5%.

The last column presents the share of the *cumulative* energy savings obtained from the implementation of the measures, measured against the energy consumption of the transport sector in 2020.

Table 2-4 Energy efficiency measures of the transport sector from 2014-2020

	Measure	Semi-quantitative impact	Energy savings		Share of savings
			ktoe	GWh	%
1.	Eco-driving (2011-ongoing)[36]	High	10.05	116.83	1.27%
2.	Walking and cycling roads (2015-2018)	High	12.77	148.48	1.61%
3.	Mobile speed cameras (2019-on-going)	Low	0.04	0.47	0.01%
4.	Time-based road toll for heavy duty vehicles (2018-on-going)	Medium	3.80	44.21	0.15%
5.	Electric car purchase and rental programme (2019-on-going)	Medium	1.19	13.84	0.48%
	Total		**27.85**	**323.85**	**3.51%**

Source: Ministry of Economic Affairs and Communications (January 2023)

2.3.3 Service sector

The energy saving measures in the service sector that were implemented in Estonia during the period of 2014-2020 are described below.

Aid for energy and resource-efficient processing of fishery and aquaculture products

Regulation No 15 of the Minister of Rural Affairs "*Support for the performance of energy and resource audits of enterprises handling fishery and aquaculture products*", establishes the procedure for granting subsidies for energy and resource audits in enterprises handling fishery and aquaculture products. The aim of this measure is to support the fish and enterprise in conducting energy and resource audits within the framework of the *European Maritime and Fisheries Fund Implementation Plan 2014-2020*.[37] The energy and resource audit help to identify investments that help achieve energy savings or reduce the impact on the environment in the processing of fishery and aquaculture products, including the processing of waste.

Renovation of healthcare centres

According to Government of the Republic Order No.301 of 8 September 2016, the Ministry of Social Affairs is the implementing agency, and the Ministry of Finance is the implementing unit for the measure 2.4 'Ensuring accessible and high-quality health services to increase employment retention and return to employment' which includes activity 2.4.2 'Supporting investments in the centres of attraction of primary health care centres by ensuring accessible and diverse primary care services.[38]

[36] To clarify, even though the measure began in 2011, energy savings reflected in the table are for the period of 2014-2020 only.
[37] Regulation No. 15 of the Minister of Rural Affairs, "Support for the performance of energy and resource audits of enterprises handling fishery and aquaculture products", RT I, 17.02.2017,1. Available at: https://www.riigiteataja.ee/akt/117022017001?leiaKehtiv
[38] Approval of the investment plan of the European Regional Development Fund measure 2.4 of activity 2.4.2 "Supporting investments in primary health center infrastructure centers, ensuring accessible and versatile primary services". Available at: https://www.riigiteataja.ee/akt/313092016001

The Regulation No. 5 of the Minister of Health and Labour, '*Modernisation of health centres',* lays down the conditions for granting support.[39] Within the framework of the activity of the measure, the following are to be built or reconstructed:

1. At least 35 primary health care centres; and
2. one modernised general hospital with networks to primary health care.

The aim of the measure is to support the construction of infrastructure of health centres, including energy-efficient buildings, by ensuring accessible and diverse health care services, improving access to services, thereby reducing health inequalities.

Modernisation of street lighting

To increase the efficiency of electricity use, the Ministry of Economic Affairs and Communications initiated in 2016, the measure '*Renovation of the Street Lighting Infrastructure'*. Support for the financing of this activity is paid for by the European Union Cohesion Fund. The aim of the measure is to renovate obsolete street lighting infrastructure with the use of modern lighting and control technology which reduces the use of energy. As a result of the measure, at least 7 000 street lighting points have been renovated by 2018, at least 14 000 street lighting points by 2020 and at least 22 000 street lighting points by 2023.The conditions and procedure for receiving support for the measure are provided by the regulation No. 48 of the Ministry of Economic Affairs and Communications *'Conditions for supporting the renovation of street lighting infrastructure'*.[40]

Renovation of social care homes

According to the regulation of the Public Administration No: 40 'Conditions and procedure for using support provided for the conversion of local government welfare institutions into energy-efficient buildings and the construction of energy-efficient buildings of welfare institutions', support is provided to local governments to improve the energy efficiency and use of renewable energy.[41]

The measure aims to improve energy efficiency through investments in public buildings, reduce greenhouse gas emissions, reduce energy supplied to the buildings and the cost of maintaining the buildings, promote the use of renewable energy and reduce energy-intensive public buildings by replacing them with near-zero energy buildings. Support will be provided to achieve the objective of the measure. The measure was financed from the proceeds of the auctioning of emission allowances.

Renovation of primary and secondary school buildings

Regulations No. 50 of the Minister of Education and Research 'Organising of the primary school network in the period 2014-2020'[42] and No. 22, 'Organisation of the secondary school network in the period 2014-

[39] Regulation No. 5 of the Minister of Health and Laboure, Modernisation of health centres. RT I, 16.03.2018, 3. Available at: https://www.riigiteataja.ee/akt/116032018003
[40] Regulation No. 48 of the Minister of Ministry of Economic Affairs and Communications, "Conditions for supporting the renovation of street lighting infrastructure" RT I, 09.08.2016, 1. Available at: https://www.riigiteataja.ee/akt/117072018008
[41] Regulation of the Minister of Public Administration No 40. "Conditions and procedure for the use of support provided for the conversion of local government welfare institutions into energy-efficient buildings and the construction of energy-efficient buildings of welfare institutions". RT I, 16.10.2018, 1. Available at: https://www.riigiteataja.ee/akt/116102018001
[42] Regulation No 50 of the Minister of Education and Research 'Organisation of the Basic School Network in the Period 2014–2020'. Available at: https://www.riigiteataja.ee/akt/128112015008

2020'[43] establish the procedure for awarding grants to the measure. Support is provided for investments in primary school buildings with the aim of supporting the reorganisation of the school network to ensure that study environment and conditions are adapted to demographic changes, with the aim of maintaining high-quality, home-based basic education using the principles of inclusive education.

The project grants were expected to achieve the following:

1. the buildings of the basic schools that received the grant are modernised;
2. the school network of the local governments that received support has been reorganised and the study space of the schools under their maintenance has been optimised;
3. the project must contribute to the achievement of the output indicator of the measure (modernised area in square meters).

A total of 12 primary schools have been renovated or built in the cities of Kohtla-Järve, Narva, Kärdla, Tartu, Tallinn, Haapsalu, Jõhvi, Pärnu, Türi, Kuressaare, Sillamäe and Rakvere. 85% of the funding for these activities were supported by the European Regional Development Fund and the rest (15%) were self-funded.[44]

Renovation of university and R&D institutions

The aim of the measure is to support energy efficiency, smart energy management and the use of renewable energy in research and development institutions and universities. The procedure for awarding grants is provided by Regulation No. 17 of the Minister of Education and Research '*Institutional Development Programme for Research and Development Institutions and Higher Education Institutions*'.[45]

Projects that improve the conditions, efficiency and quality of teaching and research will be supported. For example, support is provided for the construction of research and study buildings, the modernisation of infrastructure. The implementing agency is the Ministry of Education and Research, and the implementing unit is the State Support Services Centre. The eligibility period for projects is from 1 January 2014 to 31 August 2023. The energy savings achieved by 2020 are shown in Table 2-5.

Renovation of kindergarten buildings

The Minister of State Administration's regulation titled "*Conditions and Procedure for Using Support to Promote Energy Efficiency and Renewable Energy in Kindergarten Buildings*" outlines how 54% of the proceeds from the auction of permitted emission units in 2015-2017 in the local government sub-sector will be used. This funding is designated for the implementation of the measure "Promoting Energy Efficiency and Renewable Energy Use in Public Sector Buildings," as specified in the state budget strategy for the years 2017-2020.[46] The purpose of the measure is to improve energy efficiency through investments in public sector buildings, to reduce energy demand of building and building maintenance

[43] Regulation No 22 of the Minister of Education and Research, 'Organisation of the Secondary School Network in the Period 2014-2020'. Available at: https://www.riigiteataja.ee/akt/115082018001
[44] The measure 'Renovation of primary and secondary school buildings' continues, a new procurement for the 2021-2030 funding period will be announced
[45] Regulation No. 17 of the Minister of Education and Research, "Institutional Development Programme for Research and Development Institutions and Higher Education Institutions". RT I, 10.04.2015 (current version RT I, 06.01.2021, 19). Available at: https://www.riigiteataja.ee/akt/106012021019?leiaKehtiv
[46] Regulation of the Minister of State Administration No 2: „Conditions and procedure for using support for promoting energy efficiency and the use of renewable energy in kindergarten buildings". RT I, 17.01.2017, 9. Available at: https://www.riigiteataja.ee/akt/113082019002?leiaKehtiv

costs, or to promote the use of renewable energy. Support is provided to achieve the objective of the measure.

New childcare and pre-primary education infrastructure

The regulation of the Minister of the Interior 'Conditions for granting support in the measure '*Sustainable development of urban areas''* lays out the conditions and procedure for granting structural support towards the measure 'Sustainable development of urban areas', and in particular, to the following activities: 'Development of sustainable urban mobility and human and environmentally friendly public urban space' and 'Creation of new childcare and early childhood education infrastructure'. This support has been approved by both the Government of the Republic and the European Commission in the 'Cohesion Policy Funds Implementation Plan 2014–2020'.[47]

The eligible target areas for the activities of the measure are the urban areas of Tallinn, Tartu and Pärnu. The purpose of the measure is to improve energy efficiency through investments in new childcare and pre-primary education infrastructure buildings, to reduce energy demand of building and building maintenance costs, or to promote the use of renewable energy.

Support for improving the energy efficiency of coastal fishing vessels

The conditions and procedure for granting support is stipulated by the Regulation No. 56 of the Minister of Rural Affairs, *"Support for improving the energy efficiency of coastal fishing vessels"*. Support is granted for improving the energy efficiency of coastal fishing vessel, either through engine replacement or modernisation, if it complies with Regulation (EU) No. 508/2014 of the European Parliament and of the Council on the European Maritime and Fisheries Fund and which repeals Council Regulations (EC) No. 2328/2003, (EC) No. 861/2006, (EC) No. 1198/2006 and (EC) No. 791/2007 and Regulation (EU) No. 1255/2011 of the European Parliament and of the Council (OJ L 149, 20.05.2014, pp. 1–l66), the purposes specified in Article 41(1)(a) and Article 44(1)(d).[48]

Subsidy is granted once per coastal fishing vessel during the programme period and on the condition that the coastal fishing vessel's engine capacity does not increase as a result of the modernisation. The minimum rate of self-financing is 70% of the eligible cost of the supported activity.

2.3.3.1 Assessment of impact of measures taken in the service sector

A semi-quantitative analysis on the impact of measures taken in the service sector is carried out. The table below provides an overview of the analysis. Measures are categorised by three impact levels—low, medium and high—defined by the percentage share of energy savings based on the overall electricity or energy consumption of the service sector, where:

- Low impact: < 0.1%;
- Medium impact: 0.1% to < 0.5%; and
- High impact: ≥ 0.5%.

The last column presents the share of the *cumulative* energy savings obtained from the implementation of the measures, measured against the energy consumption of the service sector in 2020.

[47] Regulation No. 9 of the Minister of the Interior "Conditions for granting support in the measure "Sustainable development of urban areas", RT I, 06.03.2015, 30. Available at: https://www.riigiteataja.ee/akt/106032015030?leiaKehtiv

[48] Regulation No. 56 of the Minister of Rural Affairs, "Support for improving the energy efficiency of coastal fishing vessels", RT I, 04.10.2016, 5. Available at: https://www.riigiteataja.ee/akt/104102016005

Table 2-5 Energy efficiency measures of the service sector from 2014-2020

	Measure	Semi-quantitative impact	Energy savings		Share of savings
			ktoe	GWh	%
1.	Aid for energy and resource-efficient processing of fishery and aquaculture products (2017-on-going)	High	2.98	34.61	0.63%
2.	Renovation of healthcare centres (2016-on-going)	Low	0.13	1.53	0.03%
3.	Modernisation of street lighting (2016-on-going)	Medium	0.71	8.3	0.15%
4.	Renovation of social care homes (2017-on-going)	Low	0.09	1.02	0.02%
5.	Renovation of school buildings (2018-on-going)	Medium	1.02	11.85	0.22%
6.	Renovation of university and R&D institutions (2016-on-going)	Medium	0.60	6.99	0.13%
7.	Renovation of kindergarten (2017-on-going)	Medium	0.93	10.79	0.20%
8.	New childcare and pre-primary education infrastructure (2016-on-going)	Low	0.24	2.77	0.05%
9.	Support for improving the energy efficiency of coastal fishing vessels (2019-on-going)	Low	0.05	0.56	0.01%
	Total		**27.85**	**323.85**	**3.51%**

Source: Ministry of Economic Affairs and Communications (January 2023)

2.3.4 Industry sector

The energy saving measures in the industry sector that were implemented in Estonia during the period of 2014-2020 are described below.

Resource efficiency measure to support investments in manufacturing and mining industry

Improving resource efficiency is one of the most important activities for maintaining a clean and naturally diverse living environment, which helps to ensure the sustainable use of natural resources in modern society. It also guides companies to think about how to increase their added value: the efficient use of resources in production is more beneficial for both the company and the environment.

Increasing competition for natural resources is creating scarcity and raising prices, which is affecting the world economy. At the same time, however, many valuable materials are not used in economic activities or are left as a by-product. This situation can be remedied by the introduction of new technologies that can make fuller use of resources, and to reuse and recycle the waste generated. Making fuller use of resources and recycling waste will, on the one hand, save the environment and human health and, on the other hand, increase the competitiveness of companies through the efficient use of resources.

The activities of the measure are financed from the European Union Regional Development Fund with a total of EUR 67 million. The bulk of the budget, EUR 66 million, is for investment in businesses (177 projects). For example, support is provided for activities related to the transformation and increasing efficiency of the production process, which, in turn, reduce the resources used in production. Innovative solutions play an important role in this, as innovative solutions are required to increase efficient use of resources in production and to reduce the resources needed. The greatest potential for resource savings

in Estonia is in the mining, food, wood, paper, and pulp industries and in the processing of mineral materials.

To receive support for innovations, companies must first prepare a detailed analysis of resource use – they need to conduct a resource audit. The analysis evaluates the company's use of resources comprehensively and offers solutions for making production activities more efficient.

The conditions and procedure for receiving support for the measure are provided by the Regulation No. 27 of the Ministry of the Environment 'Conditions for granting support in the measure "Resource efficiency of enterprises" of the activity "Investments in the best possible resource efficient technology; Support for Resource Management Systems and Supporting IT Applications" for applications open to small projects.[49]

Electro intensive enterprises tax reduction

ISO 50001 is quite similar in nature, structure, and content of requirements to other ISO standards. The overarching principle is both the systematic reduction of energy costs and the reduction of the impact of energy consumption on the environment.

As of 1 January 2019, amendments to the Alcohol, Tobacco, Fuel and Electricity Excise Duty Act entered into force, which establish a more favourable excise rate than usual for electricity consumed by enterprises with a high share of electricity costs in the manufacturing or information sector.[50]

Costs on electricity form a significant part of the total costs of the Estonian manufacturing sector compared to neighbouring countries for example. With the amendment to the law, the State wants to contribute to increasing the competitiveness of companies. Companies that meet the criteria set out in the law and apply for this purpose can purchase electricity at an excise rate of 0.5 € per MWh. The standard rate of excise duty is as of 01.05.2020 €1.0 per megawatt-hour, which means that the change in the law will allow electricity-intensive companies to save €0.5 per megawatt-hour. The law entered into force on 1 January 2019, but also applies retroactively to the costs of 2018, from the moment when the company meets the criteria necessary for receiving the benefit, including the establishment and certification of an energy management system.

2.3.4.1 Assessment of impact of measures taken in the industry sector

A semi-quantitative analysis on the impact of measures taken in the industry sector is carried out. The table below provides an overview of the analysis. Measures are categorised by three impact levels—low, medium and high—defined by the percentage share of energy savings based on the overall electricity or energy consumption of the industry sector, where:

- Low impact: < 0.1%;
- Medium impact: 0.1% to < 0.5%; and
- High impact: ≥ 0.5%.

[49] Regulation No. 27 of the Minister of the Environment 30.07.2018. a "Conditions for Granting Support in the Measure "Resource Efficiency of Enterprises" of the activity "Investments in the best possible resource efficient technology; Support for Resource Management Systems and Supporting IT Applications" for applications open to small projects", RT I 29.03.2019,11. Available at: https://www.riigiteataja.ee/akt/129032019011

[50] Alcohol, Tobacco, Fuel and Electricity Excise Duty Act RT I, 2007, 45, 319. Available at: https://www.riigiteataja.ee/akt/127062018008

The last column presents the share of the *cumulative* energy savings obtained from the implementation of the measures, measured against the energy consumption of the industry sector in 2020.

Table 2-6 Energy efficiency measures of the industry sector from 2014-2020

	Measure	Semi-quantitative impact	Energy savings		Share of savings
			ktoe	GWh	%
1.	Energy and resource efficiency in industries (2016-on-going)	High	12.62	146.75	3.1%
2.	Electro intensive enterprises tax reduction (2018-on-going)	Medium	4.94	57.45	1.2%
	Total		**17.56**	**204.21**	**4.3%**

Source: Ministry of Economic Affairs and Communications (January 2023)

2.3.5 Cross-sectoral measures

The cross-sectoral energy saving measures that were implemented in Estonia during the period of 2014-2020 are described below.

Fuel and energy excise taxes

Excise duties paid to the state budget make an indirect, but still significant, contribution to the financing of energy saving measures for final consumers. In Estonia, the excise duties on fuels were introduced in 1995, initially for motor fuels only and with relatively low rates. As a member state of the EU since 2004, Estonia must comply with the EU requirements (Directive 2003/96/EC, amended by Directives 2004/74/EC and 2004/75/EC) for taxation of fuels and energy. All legal issues on energy related excise duties are provided in the Alcohol, Tobacco, Fuel and Electricity Excise Duty Act.[51] The current tax rates stipulated in the Alcohol, Tobacco, Fuel and Electricity Excise Duty Act are presented in the table below.

Table 2-7 Excise tax on fuels and energy (as of 1 January 2023)

Fuel/energy	Unit	Rate, € /unit	EU minimum, €/unit
Unleaded petrol	1 000 l	563	359
Diesel oil	1 000 l	372	330
Kerosene	1 000 l	330.10	330
LPG (as motor fuel)	t	193	125
Heavy fuel oil	t	58	15
Shale oil heating oil	t	414	15
Light fuel oil	1 000 l	372	21
Coal, coke	GJ	0.93	0.15/0.3
Oil shale	GJ	0.93	0.15/0.3
Natural gas for heating	1 000 m^3	40	0.15/0.3
Electricity	MWh	1	0.50/1.00

Sources: Ministry of Ministry of Economic Affairs and Communications (2023) and European Commission[52]

For estimating the potential energy savings of the final energy consumption, a study was performed by the ÅF-Consulting AS. Applying several assumptions about the price of energy, final consumption quantities, tax rates and the price elasticity coefficient, the potential energy savings in the final consumption of energy were calculated for the period 2014–2020.

[51] Alcohol, Tobacco, Fuel and Electricity Excise Duty Act RT I, 2007, 45, 319. Available at: https://www.riigiteataja.ee/akt/127062018008

[52] European Commission. (n.d.). Excise Duty on Energy. Available at: https://taxation-customs.ec.europa.eu/taxation-1/excise-duties/excise-duty-energy_en

Requirement for remotely readable electricity meters

According to the directive of the European Parliament and of the Council on energy efficiency (i.e., the EED), which entered into force in 2018, the water, heating, gas and electricity meters of all end-users must be remotely readable by 1 January 2027.

According to the Electricity Market Act, remotely readable electricity meters have been mandatory in Estonia since 2017.[53] The EED, which entered into force in 2018, also provides for an obligation for other types of meters (heating, gas, etc.) from 2026 onwards. To facilitate the transition, new meters to be installed from 26.10.2020 must be remotely readable. The EED, which is the basis for the requirement to read meters remotely, is designed to help achieve the 2030 energy savings targets. It stipulates that meter readings must also be provided to the end users so that the consumers can have a better idea of electricity, water, heating and gas consumption and the resulting costs.

Remotely readable meters have several advantages for both building managers and end users. For example, it is not necessary to remember in each period that the meter readings must be recorded on the correct date and forwarded to the building manager or service provider. As already mentioned, the bonus is also to get a better overview of the energy consumption. This helps to better detect various disturbances in the building, such as water leaks. Remote reading also allows for a better analysis of which consumers are the main sources of costs and thus to draw conclusions on how best to save water and energy.

For the end user, it may turn out to be more economical to plan some activities with higher electricity costs to be run during late evening hours instead of peak hours. In the case of service providers, remote reading also helps to better track unexpected service interruptions and, for example, to help speed up the reconnection in the event of a power failure.

The replacement of meters also offers an opportunity to introduce more modern technology. New meters are generally more accurate than old ones – for example, digital remotely readable electricity meters are significantly more accurate than old mechanically operated meters.

In the case of water meters, more modern water meters based on ultrasonic technology have a significantly longer service life than their predecessors, which wear out due to faster moving parts.

Modernisation of heating systems, oil boiler replacement

The measure is based on the Atmospheric Air Protection Act[54] and the Regulation No. 10 of the Minister of the Environment '*The procedure and conditions for granting support from the environmental programme*'[55]. The law stipulates the system for collecting environmental charges and establishes the rates of charges. Environmental charges are channelled into Atmospheric Air Protection Programmes (Environmental Programme), which aim to support the management of environmental health risks and improve the quality of life, improve ambient air quality, mitigate the effects of climate change, and ensure radiation safety.

[53] Electricity Market Act, RT I 2003, 25, 153. Available at: https://www.riigiteataja.ee/akt/113032019045
[54] Atmospheric Air Protection Act, RT I, 05.07.2016, 1. Available at: https://www.riigiteataja.ee/en/eli/504092017005/consolide
[55] Regulation No. 10 of the Minister of the Environment, Procedure and Conditions for Granting Support from the Environmental Programme. RT I 04.02.2020. Available at: https://www.riigiteataja.ee/akt/104022020002?leiaKehtiv

The Environmental Programme is a set of sectoral programmes that are funded through supported and implemented projects. In connection with the reduction of the negative environmental impact of energy, application for the support from this Programme can be made by housing associations, local government units, companies, environmental protection institutions, non-profit associations, foundations, legal persons in public law and self-employed persons. Grants can be requested for buildings built before 1 January 2010. In the period 2014-2020, a total of 87 projects have been funded, as provided in the table below.

Table 2-8 Overview of projects that have been funded by the Environment Programme in the period of 2014-2020[56]

Type of project	No. of funded projects
Conversion of heating systems in apartment buildings and schools to renewable energy sources, including heat pumps	19
Connection of apartment buildings to district heating	23
Conversion of boiler houses to renewable fuels	29
Conversion of heating systems in production buildings to use renewables	1
Modernisation of boiler houses and heating systems	15
Total	**87**

2.3.5.1 Assessment of impact of general cross-cutting measures taken

A semi-quantitative analysis of the impact of cross-sectoral measures has also been carried out. The table below provides an overview of the analysis. Measures are categorised by three impact levels—low, medium and high—defined by the percentage share of energy savings based on the overall electricity or energy consumption of these general cross-cutting measures, where:

- Low impact: < 0.1%;
- Medium impact: 0.1% to < 0.5%; and
- High impact: ≥ 0.5%.

The last column presents the share of the *cumulative* energy savings obtained from the implementation of the measures, measured against the total final energy consumption of Estonia in 2020.

Table 2-9 Energy efficiency measures of general cross-sectoral measures from 2014-2020

	Measure	Semi-quantitative impact	Energy savings		Share of savings
			ktoe	GWh	%
1.	Fuel and energy excise taxes and renewable energy fee (2012-on-going)	High	623.55	7 251.86	0.23
2.	Electricity smart meters (2015-on-going)	High	57.51	668.86	0.02
3.	Energy efficiency investments by electricity distribution companies (2020-on-going)	Low	0.09	1.00	0.00
4.	Profit distribution based corporate income tax (1991-on-going)	High	35.10	408.22	0.01
5.	Oil boiler replacement (2015-on-going)	Low	0.84	9.80	0.0003
	Total		**717.09**	**8 339.74**	**0.26**

Source: Ministry of Economic Affairs and Communications (January 2023)

[56] Statistical data on completed projects have been obtained from KREDEX with an information request.

2.4 Impact analysis of measures

To estimate the energy savings, Estonia could employ the system of energy efficiency obligations and/or alternative policy measures. During the period 2014-2020, Estonia chose alternative policy measures (energy taxes) to forecast the energy saving. In a report prepared by KPMG on behalf of the Ministry of Economic Affairs and Communications, the impact of energy taxes on energy consumption is analysed for the period 2014-2020.[57] it is observed that approximately 80% of energy savings was achieved in the reporting period due to the implementation of alternative policy measures. Therefore, it is expected that Estonia will use energy taxes to achieve its energy saving targets for the next reporting period for 2021-2030.

In the previous reporting period, the mathematical formula used for deriving monetary savings from energy tax measures is based on the European Commission Directive (EU) 2018/2002 transposition recommendation document.[58] The main principles of this formula are as follows:

- Monetary savings are accounted only if the energy tax rate is higher than the minimum rates stipulated in Directives 2003/96/EC and 2006/112/EC;
- The impact assessment of tax measures must consider the energy demand as well as the price variation.

The purpose of the formula presented by the European Commission is to calculate the consumption based on the minimum rates of the European Union (hereafter EU) and to compare it with the consumption based on the country specific rates. The calculation methodology used in the reporting for the period 2014-2020 is based on the principles for the formula proposed by the European Commission, i.e., the expected percentage change in consumption is calculated based on Estonian rates.

However, there has since been a change in the structure of the formula since the European Commission's recommendation document was published at the end of 2019. **While the modified formula was not applied to estimate the energy savings for the period 2014-2020, it is being used to prepare the forecasts for the analysed period (2021-2030) in this study.**

The table below shows a further breakdown of the general cross-sectoral measure 'Fuel and energy excise taxes and renewable energy fee' (see Table 2-9) in line items 1.1 to 1.7. Together with line item '2. Profit distribution based corporate income tax', they form a total package of tax measures. Line item 3. 'Other measures', sums up all remaining measures as presented in the earlier chapters.

Table 2-10 Share of tax measures and other alternative measures in the total cumulative energy savings in 2014-2020

Line item no.	Measure	Savings, GWh	Share of the measure in the total savings, %
1.	**Fuel and energy excise taxes and renewable energy fee**	**7 251.86**	**78.8%**
1.1	*Excise and value added tax of natural gas*	*880.02*	*9.6%*

[57] Development of calculation methodologies for financial measures suitable for fulfilling the national energy saving obligation and assessment of energy saving potential. August 2020. Available at: https://www.mkm.ee/media/443/download

[58] Directive (EU) 2018/2002 of the European Parliament and of the Council. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.328.01.0210.01.ENG.

Line item no.	Measure	Savings, GWh	Share of the measure in the total savings, %
1.2	*Excise and value added tax of electricity*	*745.35*	*8.1%*
1.3	*Excise and value added tax in heating sector*	*985.96*	*10.7%*
1.4	*Excise and value added tax of gasoline*	*1 001.44*	*10.9%*
1.5	*Excise and value added tax of diesel fuel and light fuel oil*	*1 965.21*	*21.3%*
1.6	*Value added tax of firewood*	*581.38*	*6.3%*
1.7	*Renewable energy fee*	*1 092.50*	*11.9%*
2.	**Profit distribution based corporate income tax**	**408.22**	**4.4%**
1+2	**Total tax measures (Measures 1 + 2)**	**7 660.08**	**83.2%**
3.	**Other measures**	**1 550.48**	**16.8%**
	Total cumulative savings 2014 -2020	**9 210.56**	**100.0%**

Estonia's overall energy efficiency obligation in the period 2014–2020 was 7 101 GWh, which is provided in the Energy Management Organisation Act.[59] In the period 2014-2020, a total of 25 energy efficiency measures were implemented in Estonia, which achieved a total energy savings of 9 211 GWh (792 ktoe) (see Annex 1). This means that Estonia has fulfilled 130% of its energy saving obligation for the period of 2014-2020.

3 Understanding the current state of play for achieving energy efficiency targets in Estonia

This chapter provides an overview of the results of previously conducted and ongoing studies, which could be taken into account when preparing the baseline scenario for final energy consumption forecasts. An overview of the results of the interviews that were conducted with interest groups, the institutional structure and new technologies that can be used to improve energy efficiency in various final energy consumption sectors is also given.

3.1 Analysis of key reports

Prior to the compilation of the database, the working group conducted a data analysis of relevant reports, strategies, plans and statistical data at the national and regional levels. The following reports were reviewed:

1. **Energy roadmap update – roadmap 2023**[60]

[59] Energy Management Organisation Act. Available at: https://www.riigiteataja.ee/en/eli/502092016001/consolide
[60] Energy roadmap update – Roadmap 2023. Green tiger. Available at: https://rohetiiger.ee/wp-content/uploads/2022/10/Teekaardilugu2023-1.pdf

- The Roadmap report proposes 26 TWh for all of Estonia's energy needs in 2031 and 21 TWh in 2040. However, this is only if all the saving measures described in the roadmap document have been implemented. Unfortunately, this study does not fit the input of the baseline scenario forecast of final energy consumption.

2. **Long-term strategy for building renovation**[61]

   The main goal of the long-term strategy of building renovation, by 2050, is a full renovation of the building stock built before 2000. The depth of the full renovation is expressed by the minimum required energy performance of a building after a major renovation, which, according to the Estonian energy performance regulations, currently corresponds to the energy class C. The strategy document was the basis of the Energy Consumption Model of Buildings created by the Institute of Construction and Architecture of Tallinn University of Technology.

3. **The Impact of Measures Financed by EU Structural Funds on the Fulfilment of National Energy Economy Objectives**[62]

   The focus of this study was on the impact of measures financed by the EU Structural Funds on the fulfilment of national energy economy objectives in Estonia. The contribution of the financed projects to the fulfilment of the goals of the energy economy, the prevention of climate change, and the improvement of the environmental and socio-economic situation was also evaluated. The activities of 18 measures were analysed within the program period of 2014-2020. The main objectives of the study were to assess the impact of the actions, whether the objectives of the "energy efficiency" priority were achieved and assess contributions to fulfil the energy savings obligation of these activities within the scope of the funding schemes. The projects' impacts to achieve the national energy strategy objectives, climate change prevention, environmental status and socio-economic improvement were also assessed. In addition, the study included analyses of the impact of measures from 2021–2030. The data presented in the report is a good reference material for the preparation of the Deliverable 6.

4. **Estonia's 2030 National Energy and Climate Plan (NECP 2030)**[63]

   The Estonia's 2030 National Energy and Climate Plan (NECP 2030) is a national cross-sectoral plan. NECP 2030 is a communication that has been drawn up to meet the requirement laid down in Article 3 (1) of Regulation (EU) No 2018/1999 on the Governance of the Energy Union and Climate Action, according to which each Member State is to prepare and submit to the Commission its national Energy and Climate Plan every ten years. The key objectives of NECP 2030 are as follows:

   - Achieve an 80% reduction in GHG emissions by 2050 (including 70% by 2030);
   - Achieve at least a 42% share of renewable energy in total final consumption must be at least 42% by the year 2030.[64] In 2030, production of renewable energy will be 16

[61] TalTech. (2020). Long-term strategy for building renovation. Available at: https://energy.ec.europa.eu/system/files/2020-09/ee_2020_ltrs_official_translation_en_0.pdf

[62] SEI Tallinn and Tepsli OÜ. (2021). The Impact of Measures Financed by EU Structural Funds on the Fulfilment of National Energy Economy Objectives. Available at: https://www.sei.org/projects-and-tools/projects/eu-structural-funds-national-energy-economy-objectives/

[63] Estonia's National Energy and Climate Plan (NECP 2030). Available at : https://energy.ec.europa.eu/system/files/2022-08/ee_final_necp_main_en.pdf; The NECP is currently undergoing an update – a draft is to be submitted in June 2023, and is expected to be finalised in June 2024.

[64] Since the last NECP was published, the Estonian government has also agreed on a goal for all energy consumed in Estonia to be produced using renewable energy sources by 2030 – see article at: https://investinestonia.com/estonia-to-use-100-renewable-energy-by-2030/

TWh, which is 50% of final energy consumption, including 4.3 TWh renewable electricity, renewable heat 11 TWh and transport 0.7 TWh.

- Maintain the final energy consumption of Estonia at 32-33 TWh in 2030. Estonia's economy is growing, so significant measures are needed to keep consumption at the same level. The general energy saving objective of 14.7 TWh for the period 2020-2030 applicable under Directive 2012/27/EU (the EED) will help keep final energy consumption at the same level.[65]

5. **Study to determine Estonian electricity demand scenarios[66]**

   The study determined Estonian electricity demand scenarios for household, services, industry and transportation sector up to 2050. This analysis will be useful for fulfilling Deliverable 6 of this study.

6. **Development of calculation methodologies for financial measures suitable for fulfilling the national energy saving obligation and assessment of energy saving potential[67]**

   One of the main objectives of this study is to estimate how much energy savings can be achieved through the implementation of previously existing tax measures. The study also analysed additional measures, through the implementation of which it would be possible to fulfil the energy saving obligation. The analysis showed that the estimated energy savings from the existing tax measures in the period 2021-2030 is 6 745.8 GWh, which is insufficient to fulfil the savings obligation for the period; the energy savings deficit is estimated to be approximately 8 021 GWh. If savings resulting from additional measures are considered in the savings forecasts, then in the most positive scenario, the energy savings for the period 2021-2030 will be approximately 10 918 GWh. However, the energy savings that can be achieved in the most positive scenario still fall short of approximately 3 849 GWh that is needed to meet the obligation.

7. **Opinion survey on energy efficiency of residents, entrepreneurs and local governments[68]**

   This study provides results on the awareness and willingness of Estonian residents regarding energy efficiency, which had 1 174 participants. It reflects the attitude of Estonian companies' (with a participation of 250 companies) towards energy efficiency investments, development opportunities and potential. It also captures the willingness of local governments regarding energy efficiency investments and development opportunities, which had 40 local governments participating in the survey. The study also identifies the main barriers related to energy efficiency for these stakeholders. Output of this research has been used as an input for Chapter 4.6 below.

8. **Transition to climate-neutral electricity production[69]**

[65] A new target for 2021-2030 has been set at ~21 TWh, see Chapter 5.
[66] Energex Energy Experts OÜ, Ea Energianalyse A/S, Elering. 2022. Available at: https://elering.ee/sites/default/files/2022-10/Study%20-%20Electricity%20demand%20scenarios.pdf
[67] Development of calculation methodologies for financial measures suitable for fulfilling the national energy saving obligation and assessment of energy saving potential. August 2020. Available at: https://www.mkm.ee/media/443/download
[68] Kantar. 2022. Available at: https://www.mkm.ee/media/7853/download
[69] Trinomics, SEI Tallinn and E3-Modelling. 2022. Available at: https://www.sei.org/projects-and-tools/projects/uleminek-kliimaneutraalsele-elektritootmisele-eestis/

The study was commissioned by the European Commission's Directorate-General for Structural Reform Support. The report will help the Estonian Ministry of Economic Affairs and Communications to select a suitable scenario to achieve climate-neutral electricity production by 2050 and to develop an action plan supporting the implementation of the chosen strategy.
The results of the report provide Estonian policymakers with a clear overview of the costs and benefits associated with possible carbon emission reduction scenarios, as well as evidence-based recommendations for future policy measures that would support Estonia's transition to low-carbon electricity generation.

The study suggests that once the full impact on the economy has been considered, pathways with a focus on offshore wind and renewable gas, even if expensive, present the best outcomes in terms of renewable generation, security of supply and socioeconomic impacts. A strategy led by renewables also aligns well with deployment in neighbouring countries, is based on proven 33 technologies and the actions required are relatively straightforward. The report recommends that Estonian government needs to show clarity on its decarbonisation strategy and the commitment to it. Once a scenario has been chosen, and before the decarbonisation strategy has been defined, the government should perform an analysis of the chosen scenario under a system integration perspective. This analysis should examine the impact of trajectories and actions associated with the preferred scenario and the impact of decarbonisation strategies on all final consumption sectors.

Key sectors to consider are the heating and cooling; buildings (energy efficiency); and the transport sectors. In the frame of the study, actions have been identified that would allow Estonia to potentially follow the possible pathways to climate-neutral electricity production. As possible solutions, the following technologies were modelled: deployment of an offshore wind electricity production and storage, addition of three small modular nuclear power plants, adding carbon capture technologies to two large oil shale power plants and implementation of biogas power plants.

In relation to the energy efficiency topic, a short term recommended action was suggested to set up an energy and climate agency that can support other government objectives in the energy field, including topics on energy efficiency and the reduction of greenhouse gases emissions. Another recommended action included a holistic set of measures to support vulnerable households, including providing support to facilitate energy consumption reduction, both via behavioural change and via access to grants to stimulate the installation of insulation and energy efficient equipment and providing access to dedicated finance instruments to support investments in energy efficiency measures. Another suggestion made is to provide public guarantees to banks that finance households with low credit scores. The State guarantee allows banks to offer loans at reduced interest rate and make investments more accessible.

9. **Transitioning to a carbon neutral heating and cooling in Estonia by 2050**[70]

The study aims to identify and analyse scenarios for achieving carbon-neutral heating and cooling in Estonia by 2050. The study proposes carbon neutral heating and cooling scenarios covering

[70] Trinomics, SEI Tallinn and Pilvero OÜ. 2022. Available at: https://www.sei.org/projects-and-tools/projects/transitioning-to-carbon-neutral-heating-and-cooling-in-estonia-by-2050/

the different sustainable energy vectors and infrastructural changes and developed a pathway Action Plan for the eventual adoption of carbon-neutral heating and cooling sector in Estonia.

The report estimates that heating demand in Estonia would decrease from 12.6 TWh in 2021 to 11.8 TWh in 2030 and to 8.5 TWh in 2050. The cooling demand is estimated to increase from 325 GWh in 2021 to 697 GWh in 2030 and to 1.4 TWh in 2050. Renovation of Estonian building stock will play a major role in bringing the heat demand levels down. That is why, it is of utmost importance to make sure that Estonia meets 2030 and 2050 building renovation targets.

Increase in cooling demands will most likely happen mainly due to the new demand evolution by the new building constructions. The cooling demands will mainly evolve due to the increase in services and commercial building stock. The report considered four different scenarios which are: (1) all-electric, (2) technology-neutral, (3) district heating and cooling shift, and (4) local heating and cooling shift. According to the report, the best solution for Estonia to achieve full decarbonisation of heating and cooling by 2050 would be a mix of all-electric and district heating and cooling shift scenarios. The mixture of both scenarios would mean a more balanced electricity demand and reduced bioenergy dependency for the heating and cooling sector (balancing electricity demand between 1.8 – 6.5 TWh and bioenergy-based fuel demand between 0 – 11.4 TWh).

Regarding energy efficiency, it was underlined in the report that all pathways require the Renovation Wave to be effectively implemented to make buildings sufficiently energy efficient. The main barriers related to Energy efficiency are following: lack of ambitious targets for energy efficiency in NECP (policy barrier); lack of awareness of owners and end-users on available energy efficiency and renewable heating and cooling solutions (social barrier). The following actions have been suggested to increase energy efficiency: to establish integrated infrastructure planning at local level, ensuring that any energy infrastructure planning fully integrates the energy efficiency of the consumer or the development of new buildings, capitalise on local renewable resources, and should also be considered a part of a broader spatial planning at territory level. Another action, directly related to energy efficiency increase is energy efficiency/renewable system mortgages, as an efficient way to provide available financing for renovation as well as to incentivise building owners to improve energy efficiency, possibly on a longer term than with a common loan. Energy efficiency mortgages (EEMs) are loans with a lower interest rate to finance energy efficiency improvements of the building.

Other source

- EU Reference Scenario 2020 Report. Energy, transport and GHG emissions – Trends to 2050[71]
  This study has shown that according to the calculations based on the EED and Eurostat data, the final energy consumption of Estonia should be reduced by 1 270.7 ktoe or 14.8 TWh in the period 2021-2030.[72] The results are based on the analysis of a selection of 31 measures, including existing, additional and planned measures. The main aspects of their implementation have also been described. Tax measures were not considered. This analysis will be useful for fulfilling Deliverable 6 of this study.

[71] European Commission. Available at: https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en

[72] Although a new target for 2021-2030 has already been set at ~21 TWh, see Chapter 5.

3.2 On-going studies / projects

In addition, there are also on-going studies and projects that could also provide future insights to the energy consumption trends for various sectors in Estonia. These are listed below.

- Gas decarbonisation pathways for Estonia[73]
  The study will provide the Energy Department of the Estonian Ministry of Economic Affairs and Communications (MEAC) and DG Reform with the necessary recommendations to achieve the main outcome of developing a new legislative framework adopted for decarbonising the Estonian gas market by 2050. As part of this study, a climate-neutral pathway modelling, socio-economic impact assessment, risk analysis and the development of a policy action plan will be carried out. This will provide structured, comprehensive recommendations that will assist MEAC in improving its capacity to design, develop and implement the necessary reforms to achieve a fully climate-neutral gas market by 2050. This study is expected to conclude by 2023.

- Coherent policy development for high-quality and sustainable living environment[74]
  This study aims to Provide the Department for Energy of the Estonian Ministry of Economic Affairs and Communications (MEAC) and DG Reform with the necessary recommendations to achieve the main outcomes of:
  - ✓ The adoption of a spatial planning development strategy concept and an action plan for the development of the digital services to support high-quality spatial development;
  - ✓ Putting in place the institutional arrangements to support the implementation of the strategy and action plan, including policy framework and coordinating system, and the roles and responsibilities of all stakeholders.

  This study is expected to conclude by 2023.

- The Odyssee-Mure project supported by LIFE-CET programme of the European Commission
  The general objective of the project is to provide a comprehensive monitoring of energy consumption and efficiency trends as well as an evaluation of energy efficiency policy measures by sector for EU countries, Switzerland and Energy Community countries, by evaluation and comparing of energy efficiency progress by sector, and relate this progress to the observed trends in energy consumption and contribution to the evaluation of national energy efficiency policy measures and analyse their dynamics of implementation. Team members of the project are representatives of Estonia in Odyssee-Mure project consortium. The project will run until 2025.

- LIFE IP BuildEST
  This project is funded by the European Climate, Infrastructure and Environment Executive Agency (CINEA) through the LIFE IP (Integrated Projects) program for environmental and climate action projects. The total budget is EUR 16.3 million, of which EUR 9.5 million is supported by the EU LIFE programme. The project will run until 2028.

[73] Trinomics, SEI Tallinn, E3-Modelling. See https://www.sei.org/projects-and-tools/projects/gas-decarbonization-pathways-for-estonia/
[74] Trinomics, Hendrikson & Ko., SWECO, TalTech. See https://www.sei.org/projects-and-tools/projects/coherent-policy-development-for-high-quality-and-sustainable-living-environment-in-estonia/

This project is a renovation marathon that updates and implements the objectives of the long-term strategy for the renovation of Estonian buildings (mentioned above) and engages in the green transition in terms of energy efficiency and climate resilience of buildings. The long-term strategy for building renovation requires renovation to achieve at least energy class C. The renovation wave will make a significant contribution to meeting climate targets, as buildings emit about half of Estonia's total CO_2 emissions. The broader aim of the project is to ensure that environmental and climate issues are closely linked to the development of the built environment – in a holistic and sustainable way, keeping the long-term perspective in mind.

3.3 Summary of desk research

The table below provides an overview of the relevance of various reports and sources for the calculation of the final energy consumption forecast for the baseline scenario (WAM scenario - scenario with additional energy saving measures).

Table 3-1 Overview of the relevance of reports/projects to consider in the baseline and WAM scenarios

	Report	Impact on final energy consumption forecast scenarios	Baseline scenario	WAM scenario
1.	Energy roadmap update – roadmap 2023. Green Tiger	The roadmap report proposes 26 TWh for all of Estonia's energy needs in 2031 and 21 TWh in 2040. However, this is only if all the saving measures described in the roadmap document have been implemented.		✓
2.	Long-term strategy for building renovation	The main goal of the long-term building renovation strategy for the year 2050 is the complete renovation of the building stock built before the year 2000, which according to the Estonian energy efficiency regulation currently corresponds to energy class C.		✓
3.	The Impact of Measures Financed by EU Structural Funds on the Fulfilment of National Energy Economy Objectives	The study includes analyses of the impact of measures for the years 2021-2030 prepared by the Ministry of Economic Affairs and Communications.		✓
4.	Estonia's 2030 National Energy and Climate Plan (NECP 2030).	In 2030, the final energy consumption must remain at the level of 32-33 TWh: including 4.3 TWh renewable electricity, renewable heat 11 TWh and transport 0.7 TWh. NECP is currently in the renewal phase and new goals will be set for the year 2035. For example, a new target that is being discussed at the moment could lead to the share of renewable energy sources from the primary energy consumption to be set at 65% by the year 2030.	✓	✓
5.	Study to determine Estonian electricity demand scenarios	The study determined Estonian electricity demand scenarios for household, services, industry, and transportation sector up to 2050.		✓
6.	Development of calculation methodologies for financial measures suitable for fulfilling the national energy	The analysis showed that the estimated energy savings from the existing tax measures in the period 2021-2030 is 6 745.8 GWh, which is insufficient to fulfil the savings obligation for the period, and the energy savings deficit is estimated to be approximately 8 021 GWh.		✓

	Report	Impact on final energy consumption forecast scenarios	Baseline scenario	WAM scenario
	saving obligation and assessment of energy saving potential			
7.	Opinion survey on energy efficiency of residents, entrepreneurs, and local governments	The study identifies the main barriers related to energy efficiency for these stakeholders. Output of this research has been used for chapter 4.6 of the current report.	✓	✓
8.	Transition to climate-neutral electricity production'	The results of the study are not directly related to the final energy consumption forecasts; however, the results of the study provide certainty for increasing the share of electricity in the final consumption sectors.	✓	✓
9.	Transitioning to a carbon neutral heating and cooling in Estonia by 2050	Since the production of heat and cold belongs to the energy conversion sector, we do not consider it when preparing scenarios for final consumption. Nevertheless, some actions have been suggested in the report for energy efficiency increase: to establish integrated infrastructure planning at local level, ensuring that any energy infrastructure planning fully integrates the energy efficiency of the consumer or the development of new buildings, capitalise on local renewable resources, and comes as a part of a broader spatial planning at territory level.		✓
10.	Gas decarbonization pathways for Estonia (ongoing)	Ongoing research. The results of this study are related to the energy conversion sector. Nevertheless, one action is mentioned in the report for energy efficiency increase: Accelerate energy efficiency improvements in buildings and industry, that will lead to gas consumption reduction for heat by close to an additional 2 billion cm^3 within a year.		✓
11.	Odyssee-Mure project (ongoing)	The general objective of the project is to provide a comprehensive monitoring of energy consumption and efficiency trends as well as an evaluation of energy efficiency policy measures by sector for EU countries.	✓	
12.	LIFE IP BuildEST (ongoing)	Ongoing research, not considered in this report.		
13.	EU Reference Scenario 2020 Report. Energy, transport and GHG emissions – Trends to 2050 (EU report)	In this study, possible impact of 31 measures, including existing, additional and planned measures have been analysed, and the main aspects of their implementation have been described. Tax measures were not considered.		✓

4 Institutional setup

The section below describes the key institutions that play an important role in the implementation of energy saving measures in Estonia, before the reorganisation of the ministries—resulting from the new coalition agreement drawn after the March 2023 elections— were finalised.

4.1.1 Ministry of Economic Affairs and Communications

The Ministry of Economic Affairs and Communications sets the national energy efficiency target and prepares the national energy efficiency action plan. It is the task of the Energy Department of the Ministry of Economic Affairs and Communications to monitor the effect of legislation on or influencing energy efficiency.

This work is carried out continually, mainly by examining and commenting on draft legislation or strategies. Every year, the Ministry of Economic Affairs and Communications organises the renovation of real estate owned by the central government to the extent of 3% of the total usable area of the buildings used by the central government. The goal is to meet at least the minimum energy efficiency requirements for buildings in use undergoing major renovation.

4.1.2 Estonian National Building Registry

The Estonian National Building Registry is a national database through which construction-related documents can be submitted and processed. Data obtained from the register can be used for evaluation of energy efficiency measure implementation. The registry is managed by the Estonian National Building Registry unit of the Ministry of Economic Affairs and Communications

The focus of the long-term development of the Building Registry and e-construction platform is aimed at supporting the work of Construction department of the Ministry of Economic Affairs and Communications. This includes improving the productivity of the construction sector, green transition and energy efficiency. In the future, the database will become more dynamic, assisting in decision-making processes and in measuring the success of implemented measures.

4.1.3 Ministry of Finance

State Real Estate Ltd. (*Riigi Kinnisvara AS*) under the administration of Ministry of Finance manages state-owned real estate. The purpose of State Real Estate Ltd. is to provide real estate services mainly to state institutions and public service providers and to advise them on real estate-related issues, including the energy efficiency of buildings.

The State Shared Service Center, which also falls under the administration of the Ministry of Finance, is responsible for the use of cohesion policy funds, i.e. European Union structural funds. The structural funds are divided between the European Regional Development Fund, the Cohesion Fund, the European Social Fund+ and the Just Transition Fund.

4.1.4 Statistics Estonia

Statistics Estonia is a governmental authority operating in the area of government of the Ministry of Finance which produces official statistics, provides data sharing services. The collected data are used for making development plans and projections, including ENMAK 2035, strategies and scenarios in energy sector.

4.1.5 Estonian Business and Innovation Agency (previously known as KredEx)

KredEx is a foundation set up by the Ministry of Economic Affairs and Communications in 2001 with the aim of providing financial solutions based on the best practices in the world. One of the goals of KredEx is to offer state-backed guarantees and grants for private individuals to purchase dwellings and improve

energy efficiency. Starting from 2022, KredEx and Enterprise Estonia are merged, and the legal name of the new organisation is the Estonian Business and Innovation Agency.

4.1.6 Ministry of Environment

Ministry of Environment is responsible for some measure implementation (i.e., related to European Cohesion Foundation). Environmental Investment Centre (EIC) belongs to the administration area of the Ministry of the Environment.

4.1.7 Environmental Investment Centre (EIC)

The role of the EIC is to help give momentum to the major projects which consider environmental and climate aspects. This includes projects which look at, for example, the challenges that the changing climate pose to the construction sector – such as the impact of flood risks and stronger storms; how to renovate buildings in the most circular economy and nature-based way possible; and what are the opportunities for innovative financial incentives, such as measuring and reducing the environmental footprint of buildings. In addition, the EIC is responsible for implementing measure "Renovation of Street Lighting" (European Cohesion Foundation).

4.1.8 Ministry of Agriculture

The task of the Ministry of Agriculture is to give momentum to agricultural and rural projects that take environmental, climate and energy efficiency aspects into account Through the Agricultural Registers and Information Board, an implementation unit under the Ministry, the project for the promotion of rural life and the development of entrepreneurship in rural area is supported.

4.1.9 Analysis of the institutional setup in Estonia

The current energy efficiency management framework in Estonia is logical, needs-based and well-functioning, although there is a lack of an overarching and holistic strategy to achieve energy efficiency targets across sectors which fall under the domains of different ministries. Each ministry, together with the implementing agencies in its administrative area, contributes to the development, implementation and announcement of application rounds for subsidising the implementation of energy efficiency measures in its area of responsibility. No overlaps in the current institutional setup have been identified. In addition, in view of the ongoing reorganisation of ministries, as laid out in the coalition agreement, and the ongoing discussions regarding the exact roles and responsibilities within them, it is difficult to carry out the analysis at this stage of the project. Nonetheless, this topic on governance will be further discussed in the next deliverable of this project, as we discuss about the action plan that is needed to achieve the energy efficiency target of Estonia.

4.2 Energy efficiency technologies

The costs and expected impact of a comprehensive list of available and potential technologies that can be used in the energy efficiency field within the near and distant future will be analysed in detail in the catalogue of energy efficiency measures in Deliverable 6. A preliminary list of potential energy efficiency technologies in the residential, service and transport sectors are shown in the table below.

Table 4-1 List of energy efficiency technologies by sector

Sector	Technology	Availability	Remarks
Residential	Insulation	Yes	New materials are being developed (active insulation)
	Improved architectural design (i.e., strategically designing window placement)	Yes	In new districts, this can be considered during renovation for some cases. However, it cannot always be realised in urban districts.
	High efficiency home heating ventilation and air conditioning (HVAC systems)	Yes	More efficient HVAC systems will be implemented
	Efficient appliances (i.e., clothes washers, etc.)	Yes	
	HVAC system digitalisation	Partly	Will be implemented more widely in new buildings
Service	Efficient consumers electronics for energy consumption regulation (heating/cooling)	Yes	
	LED lighting with sensors	Yes	More lights will be replaced with these in the future
	High speed performance doors	Partly	
	Electrochromic windows	Partly	Expensive
	Efficient commercial refrigeration/cooling	Partly	Not all commercial
Transport	Fuel standards, Fuel-saving tire design	Partly	Will be developed further in the future

4.3 RenoWave database

Within the scope of this task (Deliverable 2), an Excel-based final energy consumption database has been prepared, which:

- ✓ Consists of data from different sectors presented in different worksheets: industry, transport and buildings (which includes both residential and non-residential buildings), as these sectors have the greatest energy saving potential;
- ✓ Has data that is compiled in two units: in thousands of tonnes of oil equivalent (ktoe) and in gigawatt hours (GWh);
- ✓ Is based mainly on data sources from the Estonian Statistical Office, Eurostat (European Statistics), Estonian Transport Administration, Environment Agency, Tallinn University of Technology and the Health Statistics and Health Research Database;
- ✓ Is supplemented with additional information that was collected through various strategies, plans and studies prepared in cooperation with MEAC (e.g., Long-term renovation strategy, strategy for improving the energy efficiency of the Estonian gas system, report on the impact of measures financed from EU structural funds on the achievement of the country's energy economy goals, etc.).

The so-called energy consumption baseline scenario until the year 2050 has been prepared based on the data of the databases and the data obtained from the interviews of interest groups.

4.3.1 Data quality assessment

Historical data for the RenoWave database and energy consumption forecasts are mostly obtained from the Estonian Statistics Office database and their quality is good. According to Statistics Estonia's assessment, their published data reflect the actual situation with a 95% probability. The rest of the data presented in the RenoWave database is obtained from other sources. For example, degree-day data from Eurostat, data on the specific fuel consumption and mileage of vehicles presented in the Transport sector by vehicle type (road transport, rail transport, domestic flights and inland water transport) were ordered from the Environmental Agency, and more detailed data on the vehicle fleet by vehicle engine power and used fuel from the Estonian Transport Administration with a special data request. The quality of the ordered data is also good. In general, data retrieved from national institutions are considered to be of high quality; they are also being checked by Eurostat.

4.3.2 Data gaps

Households and the service sector

The original data on the surfaces of residential buildings and other buildings were obtained from the Building Registry. To obtain this data, queries with multiple codes and data processing have been used to screen out buildings where energy is used to provide indoor climate and to exclude buildings that have already been demolished. Please note that data on building surfaces are not available as public data from Statistics Estonia. While there are some limitations experienced with using data from the Building Registry, this register is expected to become more dynamic, as a large-scale improvement work to the register is being carried out since 2022.

Statistics Estonia does publish data on the number of dwellings and the average area of dwellings in both apartment buildings and detached houses, but not the total size of heated and ventilated dwellings. The is also the case with non-residential premises.

The decommissioning and demolition of buildings, and rates of energy-weighted renovation of buildings to the C energy label level are also not available from Statistics Estonia. Analyses made in the long-term renovation strategy of buildings have been used to obtain these data.

When renovating buildings, state support is very important as the rate of renovation is directly related to the state support / funding that is available. The existing building renovation measures will end in 2027 and there are no further forecasts.

Transport sector

Statistics Estonia does not publish data by the number of vehicles, fuel used and engine power. All such data have been obtained from the Transport Board and data on the average annual mileage of vehicles and average fuel consumption from the Environmental Agency with a special data request.

Industry sector

Historical data on energy consumption in the industrial sector is available in the Statistics database and there are no data gaps. However, there is very little raw data for the preparation of industrial energy consumption forecasts. For example, it is not known which energy-intensive production companies will be developed in Estonia in the next decades. We have received information about this only from the media.

In conclusion, the availability and quality of *historical* data is found to be good; the data gaps of Statistics Estonia could be filled by other data sources and national registers. However, there is still room for improvement with regards to data availability. As mentioned in Chapter 4, the various ministries and implementing agencies contribute to application rounds for subsidising the implementation of energy efficiency measures in their respective area of responsibility. While information on most of these funded projects are publicly available on energiatalgud.ee and on the MEAC webpage, there is currently a general lack of public information on the evaluation of the results of completed projects.

As for the data needed to make forecasts, the preliminary budget forecast prepared by the Ministry of Economic Affairs and Communications considers only the existing energy efficiency measures planned for the years 2021-2030, but there is no such forecast for additional measures.

4.4 Results of interviews with stakeholders in different sectors

With the purpose of obtaining better insights into the possibilities of increasing energy efficiency in different sectors, a qualitative assessment based on interviews conducted with representatives of relevant stakeholders was carried out. The aim of the interviews was to:

- Have a better overview of energy efficiency measures implemented to date;
- Better understand the fields and activities with the greatest potential for the short- and long-term future;
- Obtain a general outlook of developments until 2050 in the respective sectors;
- Understand the role of and the expectations to the government with regards to investments in energy efficiency;
- Discuss the primary barriers inhibiting the adoption of energy savings measures; and
- Gain insights on the impact of the energy crisis on the achievement of higher energy efficiency targets and on energy use.

The participants were selected in cooperation with the Ministry of Economic Affairs and Communications with the intention of having a wide representation from a range of sectors in order to get a holistic overview of the problems and opportunities that are present.

A total of 20 interviews were carried out. In addition, two other participants declined to give an interview. Most interviews were carried out virtually with a couple of exceptions taking place physically. The interviews were semi-structured; the participants received the primary questions prior to the interview and further questions were discussed during the conversations to clarify the statements made. The duration of the interviews was generally in the range of 45 to 75 minutes. Minutes of the interviews were taken, which form the basis of the qualitative assessment carried out.

The results of the interviews were divided into subsections depending on the field and sector of the interviewed stakeholder. Questions varied depending on the interviewed stakeholder, but the main topics discussed covers the following:

- The prognosis of the sector and energy usage of sector until 2050;
- Main problems regarding energy efficiency, including barriers preventing further investments;
- Energy efficiency measures, impact and cost effectiveness of different measures;
- Sectors and fields that show the biggest potential for energy efficiency;
- Impact of energy crisis to energy use;

- How to support energy efficiency investments, for example through policy making, grants etc.

The sections below provide a summary of the discussions per sector / sub-topics.

4.4.1 *Power and heat production sector*

Interviewees

Enefit Power AS (electricity production), AS Utilitas Eesti, Union of Electricity Industry of Estonia, Estonian Power and Heat Association

Current situation

- Heat and electricity sector does not have too much room to increase efficiency further, although some smaller district heating networks can upgrade heat production to use biomass fuels. In some cases, secondary flue gas condensers are planned to be installed to Combined Heat and Power plants (CHPs), to further increase the heat output of co-generation power plants.
- There is still room to reduce heat losses in district heating networks, but there will always be some heat loss and it is not economically reasonable to only focus on heat losses of network. Rather, the bigger potential lies in consumer side, both in electricity and heat. In smaller cities, the district heating volume has remained the same; bigger cities have seen a small increase because of new consumers that are connected to the grid – impact has been bigger than the impact of renovations.
- Electrification has taken effect on electricity consumption volumes, and this trend will continue.
- There is an increasing number of heat pumps installed in homes and power production.
- In addition to energy efficiency, there is also more focus placed on energy reliability and cost of energy.

Prognosis (2050)

Heating and cooling

- District heating networks will be as cost efficient in 2050 as they are now, in bigger cities. The increase in district heating consumers and the decrease of district heating consumption resulting from renovations will balance each other out.
- District heating will be more diversified where cooling and heating will be combined.
- Short term heat accumulation will be implemented in district heating networks; long term heat accumulation is considered more problematic and may not be implemented by 2050.
- Heat pumps will be more integrated into district heating systems.
- The trend is to use more electricity in district heating. It is assumed that electricity prices will fall near 0 €/MWh occasionally which will result in an increasing use of heat pumps and direct heating from electricity.

Electricity production

- Old oil shale power plants will not be closed, but held in reserve to occasionally guarantee the stability of the grid.
- Oil shale power plants will not work against the market prices even with implemented CCU technologies as it would be too expensive considering alternative methods of power generation.
- Off-shore wind, solar energy, biofuels, natural gas (only to cover of peaks) and nuclear energy are seen as possible replacements to oil shale power plants.

- There will be a need for controllable power generation capacities for at least two months of the year. It would be up for the government to decide on the type of controlled power generation unit to be deployed for this purpose, which should also serve as a reserve capability.
- Local power generation will be integrated to productions and homes in a larger scale to reduce grid costs. The grid will function as a battery for many electricity producers.
- Short-term accumulation of electricity (i.e., pumped-storage hydroelectric power stations) will be implemented.
- Estonia will be a net exporter of electricity. The development of offshore wind presents a large potential to export excess electricity.

Problems and barriers

- District heating law restricts using waste heat in industries and co-generation of heat and cooling.
- Instead of upgrading the electricity grid themselves (to improve stability), Elering should create appropriate markets in Estonia or agree upon a common market in the Baltics.
- Regarding oil shale power plants and policies regarding the electricity price, a decision from the government is expected. For e.g., will the old oil shale units be kept as reserve capacity for a longer duration? Should state-owned enterprises work with a loss during energy crisis?
- Electricity grid capacity has become a problem in implementing new projects. Focus should be on expanding the grid, so that new power generation units can be developed.

Proposals and solutions

- Change the law on district heating so that it would consider all the new innovative solutions on the market. Waste heat is not directed to the district heating network because of the strict regulation.
- District heating networks will either invest in accumulation to overcome daily discrepancy of heat load and/or consumers should have variable daily cost of heat in district heating networks.

4.4.2 Industry sector

Interviewees

A. Le Coq AS, Enefit Power AS (oil production), Estonian Cell AS, Ida-Virumaa Industrial Areas, Estonian Chamber of Commerce and Industry

Current situation

- Industries with high energy consumption have been investing into energy efficiency continuously even before the energy crisis. The energy crisis has not fundamentally changed the investment plans, but energy efficiency investments are done more at a more rapid pace.
- More focus is placed on local production units, solar panels and CHPs.
- Outlook for industry (especially energy intensive industries) is not good, mainly due to high resource costs and unfair competition – many countries in the common market support energy intensive industries generously.
- At the moment, most of the industries have managed to pass on the increase in the production costs to consumers. Nevertheless, while the increase in the cost of resources has been mostly manageable, the problem of unfair competition remains.

Prognosis (2050)

- In 2050, wood and paper industry will not experience significant increases in production volumes nor energy use, but the value added by industry will further increase.
- Chemical industry (shale oil) will not have any new production facilities, with a transition to recycling (plastic, tyres)
- The food industry will remain on the same level as it is now, there is not much room for increasing volumes and therefore energy usage.
- The proportion of industry in Estonian energy balance will likely decrease, which will lead to a similar trend with regards to the total energy consumption.

Problems and barriers

- In the common EU market, the subsidies for energy intensive companies vary a lot, there is no real competition if resource costs are heavily affected by subsidies (*Estonian Cell AS* compared subsidies for energy-intensive productions in the common EU market and brought out differences between the Member States).
- District heating law is outdated; companies are not motivated to make investments in waste heat recovery to district heating networks although such investments are not restricted.
- There is a big potential to use district heating more efficiently, raising low temperature waste heat with heat pumps to higher temperatures.
- Energy and resource costs are high, even when compared with the other Member states in the EU. To combat with high energy and resource costs, enterprises have focused on local energy production, mainly solar panels, but also CHPs, biogas. However, grid capacity and permits have become an obstacle. Because district heating is regulated and the price of heat does not depend on current supply-demand ratio, there is no motivation for consumers to manage consumption.

Proposals and solutions

- The Government should not support companies directly (excluding situations where other governments have decided to help industry generously). Instead, it should grant a suitable ecosystem and infrastructure for the free market.
- The difficulty and long processing time to apply for permits for energy efficient solutions or new power generation units, including large solar parks, were also raised. Issues regarding planning and permit processing, and regulation, were raised. The proposal is to facilitate the permitting process of energy efficiency and local power production projects.

4.4.3 Energy efficiency

Interviewees

Tartu Regional Energy Agency (TREA), DeltaE Engineering Office (DeltaE)

Current situation

- The biggest potential to increase energy savings is in the building sector, although it is also the most difficult to achieve. Potential in residential sector is the biggest as many buildings are not energy efficient.
- The heat and electricity consumption of buildings is usually not equipped with technologies for smart consumption management.
- There is also a big potential to reduce energy savings in energy intensive industries (technology).

Prognosis (2050)

- Production volumes and energy use of industry will fall.
- Buildings will become more energy efficient thanks to increasing volumes of renovations.
- The volumes of energy intensive industries will depend on political decisions regarding whether or not to include / keep certain industries in Estonia.
- Consumption will be smarter, for example during morning heat load peaks in district heating, radiators are temporarily shut off to balance the system. Energy use management will be implemented in a larger scale.

Problems and barriers

- The current law on district heating is not favourable to use more innovative solutions in district heating networks, for e.g. integrating cooling and waste heat.
- Problems in Ida-Viru County and inequality of Russian speaking population in terms of renovation were also discussed.
- Issues with large enterprise energy audits were also raised. Currently, energy audits in Estonia do not give good input and are made just to fulfil the obligation. The content of the energy audit is not helpful – it merely states data of the company and offers recommendations with generic measures. On the other hand, cost of energy audit must be proportional, and requirements cannot be too restricting. 1 GWh/year energy usage should be the start of obligation for an audit for companies. The Energy Efficiency Directive is currently under revision, with a new proposed limit of 2.77 GWh/year.

Proposals and solutions

- In order to have a smart manageable consumption, buildings that are renovated with KredEx reconstruction grants should obligate the use of building automation at least at the central level (central management of pumps, heating, lighting). Building automation in apartments should remain voluntary.
- Tailored approaches towards people with different cultural backgrounds should made.
- District heating law should be changed. The Estonian Competition Authority should set new guidelines for implementing waste heat in district heating networks.
- Obligating the need to implement and investments recommended by energy audits, coupled with state support would have a significant impact on energy efficiency.

4.4.4 The State

Interviewees

Consumer Protection and Technical Regulatory Authority, Ministry of Environment, Ministry of Education and Research, Transport Administration

Current situation

Biological resource for energy production

- The Ministry of Environment is of the opinion that when it comes to the usage of biological resource for energy production, the efficiency levels are generally quite high and not much is wasted.
- Wood, agricultural by-products and leftover food are the main resources for energy production.
- Biogas produced from waste could be treated further to be used as biomethane in transport, however the feasibility should be assessed on a case-by-case basis.

- Most of the wood waste is used for energy production.
- The greatest energy savings can be achieved in sectors with their own heating solutions by increasing their efficiency.

Industry

- Industrial companies that have identified existing problems and are already working on implementing solutions especially in the context of increased energy prices. In addition to production optimisation, the consumption of energy also needs to be optimised with smarter equipment. To assess the results, measurement systems are necessary.

Transport

- It is necessary to reduce the carbon footprint arising from cars usage.
- The greatest impacts can be achieved by developing public transport in Tallinn and the surrounding areas and restricting the urban sprawl.
- People should be guided away from using a personal car towards alternatives with taxation.

Building renovations

- Consumer Protection and Technical Regulatory Authority is satisfied with the first pilot renovation project carried out using prefabricated modules and believes that the technology has a lot of potential.
- When it comes to partial renovation, it should be done with the intention of fully renovating the building in the longer run.

Energy audits

- Prior to the energy crisis, large enterprise energy audits were mostly conducted because of the requirement, however they have now become of more importance for the companies.
- It is expected that more innovative solutions will be devised and proposed in the energy audits in the following years. Enterprises should partake in the development and innovation accelerators to develop new energy saving ideas that could be adopted elsewhere.
- Audits provide a good overview of progress over the past years. In larger manufacturing companies, the major issues have already been solved, while there is more room for improvement in commercial real estate and the service sector.

Prognosis (2050)

- None of the interviewees believe that the energy saving obligations objectives can be achieved, however the progress will speed up.
- The Ministry of Environment sees ambitious goals as a necessary way to influence developments in the market in the right direction. Positive examples have started to show up in renovation and energy efficiency, however, the speed of the process needs to be increased by state intervention. Milestones need to be set to evaluate the progress.
- The Consumer Protection and Technical Regulatory Authority sees that technical and administrative progress must take place. Positive examples of innovative renovation projects are needed to influence other property owners. The quality of renovation will have to increase. By 2030, the pace of renovation will need to have increased significantly to reach a satisfactory result by 2050.
- The usage of cars will remain stable in the coming years but will start to decrease in the longer run and be replaced by alternative ways of transportation.

Problems and barriers

- In the manufacturing industry, energy consumption is usually not the focus of the management as energy forms a small share of the total costs and there is also a lack of knowledge about how to improve energy efficiency. Energy efficiency technologies are expensive and require trained and skilled personnel to install and operate them.
- Regarding renovation of apartment buildings, the primary barrier is the lack of communication between the residents, especially in larger buildings. For smaller buildings with up to 12 apartments, the main concerns are mainly about financing.
- The bureaucracy related to subsidy applications is also a hurdle for building renovations and requires hiring a technical consultant. Since every apartment in an apartment block is a separate private property, a lot of work needs to be done to get the approval of residents for carrying out the renovation.
- Awareness needs to be increased, with differently targeted campaigns and information for the Russian speaking population especially in Ida-Viru County, for example local information centres and information brochures in the residents' local language.
- With the higher energy prices, people are more interested in renovating their buildings, however, the costs of renovation works have also increased and there is both a lack of materials and staff in the building renovation sector.
- On transport, the primary barrier preventing people from switching to alternative transport methods is a combination of comfort, lack of good public transport networks and economic decisions. Car ownership costs have increased less than the average salary, which has made it a comfortable and budgetary suitable option regardless of the climate impact of the car. There is no taxation based on the energy efficiency or power of the vehicle.
- The low capability of professional associations across sectors does not enable them to help develop the companies and fields they are representing and protect their interests on the European Union level. This leads to situations where solutions need to be implemented that are not best suited for the Estonian context. Research and development advisors have been incorporated in professional associations, but it is still at an early stage.

Proposals and solutions

- Solving the material crisis should be the primary focus according to the Ministry of Environment.
- Developing renewable energy production is of importance for the whole energy system.
- New regulations can have a significant impact to energy efficiency. For building renovations, the government can increase awareness and support through subsidies, although a direct involvement would not be efficient. The focus should be on supporting larger apartment buildings first and detached houses with specific requirements[75] and low energy savings being supported last.
- In addition to renovation, local municipalities should also build rental houses as a way of offering people to move to a more energy efficient and modern living space. This could be seen as a measure for creating suitable conditions for the elderly and the disabled while freeing up apartments for people more willing to contribute to the renovation of apartment buildings.
- When it comes to companies, projects with a payback period of less than three years should not be supported with subsidies being directed to less cost-effective measures instead.

[75] For.e.g., a large proportion of buildings in Estonia are built similarly through standard projects. It could therefore be more efficient to focus on this type of buildings.

- Taxation should be used to limit the number of cars used. Separate support mechanisms are not effective. It would be reasonable to make the polluter pay and support the ones that pollute less by, for example, binding the price of parking to the emissions of the car. Raising awareness and separate support schemes on their own cannot have a significant impact on reducing car usage.
- The state needs to be the role model in implementing new solutions and carrying out pilot projects to encourage others. The measure for innovative state procurements has been developed, but the usage of the measure so far has been limited.

4.4.5 Government agencies providing financial solutions

Interviewees

KredEx, Estonian Environmental Investment Centre, State Shared Service Centre

Current situation

Currently there are three main directions for supporting investments in energy efficiency, namely:

- Renovation of buildings;
- Improving the energy and resource efficiency of manufacturing companies; and
- Efficient generation and distribution of energy.

In general, if current investment volumes and activities are not changed, energy saving obligations will not be achieved. New measures and/or additional funding is required.

Prognosis (2050)

Buildings

- The Estonian objective is for all buildings to be renovated to meet the requirements of at least energy class C, for new buildings energy class A. The accomplishment of that objective depends strongly on funding and the implementation of new technological solutions (i.e. factory reconstruction).
- Renovation with prefabricated panels can increase the pace of renovation in the coming ten years with new technologies expected beyond that.
- The stability of financing is of key importance.
- It is likely that renovation volumes will increase largely in the next 15 to 20 years, however, the objective for 2050 does not seem feasible.

District heating

- Increasing the efficiency of district heating has a major impact on total energy efficiency.
- The development of district cooling will also become more important.
- There is a lot of interest towards the energy and resource efficiency measures for enterprises, but the lack of resources limits the number of investments carried out.
- Overall, more funding is needed to reach the objectives set.

Problems and barriers

- The main barrier for all investments is the limited nature of funding opportunities.
- The current situation in the construction industry with increased prices has made it more challenging for people to invest in renovation.

- A general lack of knowledge about the opportunities and the impact of renovation is also limiting the volume of renovations.
- In certain regions, it is difficult to be approved for a loan due to the low value of real estate.
- Regardless of the opportunities present and the positive impacts, there will always be people who are fundamentally against renovation and can prevent the renovation of buildings even when there is support from other residents.
- There are also cultural differences within Estonia, with the Russian speaking population, especially in Ida-Viru County, having reserved opinions about renovation.
- Larger construction companies with greater know-how and skills have shown little interest towards the renovation market due to its complexity and the risk that comes with the client.
- Bureaucracy that accompanies the use of subsidies is of major concern especially for property owners, but also for companies.
- When it comes to the renovation of buildings, the representatives are not experts in procurement, law, or other requirements that they need to fulfil and they are not interested in those aspects, which slows the process and can cause financial difficulties when some procedures are not carried out correctly.
- The threat of financial corrections, i.e., having to return part of the disbursed grant (mostly due to non-compliance with certain guidelines/requirements which can be rather complicated), is also preventing private property owners and apartment associations from applying for subsidies.
- Certain regions with a declining population are facing the problem of empty houses in which case it would be reasonable to concentrate residents to buildings that are in better condition and demolish buildings that become empty. However, since the apartments are private property, the residents cannot be moved against their will. Another issue is that especially in Ida-Viru County a considerable number of apartments are owned by citizens of the Russian Federation who do not reside in Estonia.
- The greatest barrier for companies is the permitting procedure and the time requirements especially with regards to developing renewable energy projects.
- Public opposition to renewable energy projects is also a hurdle for the green transition.

Proposals and solutions

- The Environmental Investment Centre brought out that 30% of investment grants are with neutral impact to the budget as taxes bring back about the same amount to the budget. Therefore, more resources should be allocated to achieve the desired objectives.
- For every support measure, the administrative side needs to be evaluated annually to determine ways of simplifying and speeding up the processes.
- A major aspect brought out by KredEx is the need to improve the quality of construction supervision to ensure the quality of renovation projects and avoid conflicts between the client and the construction company. For that, a system of technical consultants has been implemented, but the quality of experts varies too much.

4.4.6 *Property owners and construction*

Interviewees

Estonian Association of Construction Entrepreneurs, Estonian Property Owners Central Association.

Current situation

- As of 2022, most of the Estonian building stock still needs to be renovated, which presents a challenge for both owners of properties and construction companies.
- The Estonian Property Owners Central Association sees a problem in the lack of overview regarding the currently existing housing stock and believes that as a first step in tackling the renovation of buildings.
- A comprehensive study should be carried out to estimate the condition of the housing stock to determine, for which buildings renovation is feasible and in which cases it is more feasible to deconstruct existing buildings instead due to excessive amortisation.
- Likewise, the Estonian Association of Construction Entrepreneurs also emphasised the importance of the demolition of older buildings.
- Of the buildings considered suitable for renovation, the renovation priority should be placed on all buildings constructed before 2000 as energy efficiency was not of high importance during that era and they form most of the housing stock.
- Currently the pace of renovation is too slow. When it comes to the solutions, prefabricated production of panels is seen to have a strong potential with the market eventually determining the preferred solutions.
- Increasing the efficiency of construction processes and adopting new innovative materials can improve the speed of renovation.
- In construction, it is important to consider the materials used and their standard measurements in the design and planning phase to reduce material consumption and the corresponding energy consumption, waste production and limit the number of work operations on site.
- More widespread adoption of BREEAM (Building Research Establishment Environmental Assessment Method) and LEED (Leadership in Energy and Environmental Design) certificates enables to assess the energy efficiency of buildings over their whole life cycle.
- Energy demand management and automation will play an increasingly important role in the coming years.
- Although higher energy prices have made it a necessity to find solutions for improving energy efficiency, it has also reduced the capacity of residents to invest in those solutions. The fast increase in construction prices has in turn made renovation economically less feasible and requires larger expenditures from property owners.

Prognosis (2050)

- Both sector representatives are of the opinion that with the current pace of renovations it is not possible to achieve targets set; it is more likely that a quarter or a third of the housing stock might be renovated by 2050.
- Renovation volumes need to increase significantly. On the other hand, there are regions which are falling out of favour, where demolition is seen as the only solution, primarily towns in Ida-Viru County, but also in other areas of Estonia.
- The Estonian Association of Construction Entrepreneurs believes that Estonian construction companies can double the renovation capacity. However, to reach the goal of renovating all buildings, there would have to be a fivefold increase for some period, which is not achievable.
- The aftermath of the war in Ukraine can have a significant impact of construction capacity (materials).

Problems and barriers

- The primary barrier is the lack of financial resources of property owners. With the current speed of renovation, some buildings will not last until the renovation procedure commences. A major issue specifically for apartment building is to have an agreement with the residents of the building to make the decision of renovation. Another important hurdle is the bureaucracy that property owners and apartment associations must go through when applying for subsidies and carrying out the renovations with support. For detached houses, the requirement that information about the building needs to be inserted in the buildings registry and the building needs to have an act of acceptance is limiting the possibility of applying for renovation subsidy, as not all the older buildings have been officially registered.
- From the perspective of construction, limited workforce is a barrier, however, the availability of materials and the functioning of supply chains is of greater concern.
- Regarding the renovation of apartment buildings, the number of companies active in the market is relatively small, with larger companies having opted against entering the market primarily due to the risks related to the client and the need to handle many end customers. This complicates the construction process and therefore makes it less profitable than developing new real estate for example.
- There are also technical barriers with regards to the Estonian Building Registry and legislation. In 2022, the Building Registry was updated, however, with the update a lot of technical errors and failures occurred, which partially are yet to be solved. This caused delays in handling construction projects that resulted in increased costs and increased time consumption. The legislation concerning construction should be more systematic and stakeholders should be involved more in the creation of law.

Proposals and solutions

- Both parties agree that subsidies for carrying out investments are a necessity, and they need to continue in the future.
- The lack of stability and clarity in allocating the renovation grants needs to be addressed.
- To ensure continuous stable pace of renovation, there needs to be a stable long-term mechanism to support it financially. This can provide a sense of security for property owners with regards to planning their budgets and to construction entrepreneurs in developing their business plans in accordance with the measures planned. It can also benefit companies producing construction materials and overall increase the cost efficiency of renovation.
- In addition to aid from the European Union, the government should use domestic resources to bridge the gaps in funding.

4.5 Main barriers to the implementation of energy efficiency improvement measures

The table below describes the top ten barriers to the implementation of energy efficiency measures as a summary. The selection is done based on the frequency of which they were mentioned, and based on expert judgement by the stakeholders and project team. These barriers are described in more detail in the sub-chapters after the table.

Table 4-2 Main barriers to implementing energy efficiency measures

	Barrier	Description
1.	District heating regulation makes utilising waste heat and low temperature sources (e.g. geothermal or other renewable sources) difficult due to imposed obligations and is economically unattractive	District Heating Act § 2 defines waste heat as the unavoidable heat produced as a side product in industrial production, electricity generation or the service sector. According to § 4 point 4, efficient district heating area is defined as an area, that uses at least 50% of heat produced from renewable sources, 50% waste heat, 75% of heat produced in cogeneration regime or at least 50% of heat produced from renewable sources and a combination of waste heat and cogenerated heat. According to the current regulation, adding a waste heat source to the district heating network is considered as purchase of heat by heating company; the addition of waste heat to the network leads to a decrease in price for the end consumer. This regulation is difficult to fulfil and due to uncertainty in the costs of utilising waste heat, the adoption of waste heat is also restricted. The regulation should be changed to allow easier utilisation of waste heat to increase energy efficiency and the share of renewable energy used for heating. Waste heat usage in district heating network is possible under the current District Heating Act but has not been attractive for industries because of price calculation methodology and obligations.
2.	Limited availability of materials and constrained supply chains, limiting the speed of building renovations	With the COVID-19 pandemic and the Russian invasion of Ukraine, international supply chains have come under pressure with the lack of resource availability and decreased materials production capacity, congestion in logistics, longer delivery times and an overall increase in resource prices. This has become a major barrier for investments in energy efficiency, as the renovation of buildings is material intensive, and the owners of properties have limited financial capabilities.
3.	Insufficient financial support measures for building renovations	Increasing energy efficiency requires large investments that need to be financially supported by the government and/or other institutions. The lack of funds is the primary limiting factor in the volume of renovation of residential buildings. The demand for renovation support is higher than the amount supports available. Limited financial opportunities also slow the progress of increasing energy efficiency in the industrial and service sectors and in the generation and supply of energy, specifically heat.
4.	Lack of stability in support mechanisms due to cyclical nature of funding rounds	Financial support is distributed through financing rounds that temporarily increase investment activity significantly, whereas investment volumes decrease in between the rounds. This is a major concern for the renovation of buildings, as it does not create any certainty in planning of their activities neither for the owners of properties, the construction companies nor the producers of construction material. The cyclical

	Barrier	Description
		nature of funding makes it more complicated to carry out renovations and increases the cost of energy efficiency.
5.	Bureaucracy and slow permitting procedure	The increasing number of requirements and the pace of permitting and processing are becoming an increasingly more significant hurdle in carrying out energy efficiency measures and in choosing to invest in energy efficiency in the first place. In Ida-Viru County, restrictions for renewable energy projects are placed because of state security reasons. Permits for connecting electricity production units to the grid building permits and prior assessments are time consuming.
6.	Energy efficiency not being the focus area of industries, in particular the manufacturing sector	In the manufacturing sector, the consumption of energy is generally not the focus of the companies as energy forms a rather small share of their total costs. Therefore, investments in other activities that have a greater financial impact are preferred over investments into energy efficiency. There is also a lack of awareness and skills in determining the opportunities for saving energy and how to implement the necessary solutions.
7.	Unwillingness of residents of apartment buildings to invest in renovation as some are not willing and/or able to take on additional financial burden, while others may be uninterested/unengaged with the topic	Apartment buildings consist of many private properties with their respective owners having varying outlooks on investing in renovation. For some residents, the added financial burden resulting from the cost of renovation and loan payments is not acceptable, whereas others are fundamentally against renovation regardless of the conditions. There is also the problem of foreigners, primarily citizens of the Russian Federation, having acquired apartments in Estonia previously to gain easier access to the Schengen area, without having much interest in the apartments themselves. Without an agreement between the residents of a specific apartment building, it is not possible to renovate the building. Therefore, raising awareness and better communication is vital to achieving the renovation objectives. The communication also needs to be tailored specifically to different population groups, with the Russian speaking population requiring an improved approach for raising awareness.
8.	Lack of an efficient public transport network and a lack of price signal to discourage car use	Transport is a sector which it is very difficult to achieve energy efficiency targets, as it requires the effort from a lot of people. Currently, using cars is the most comfortable way of transportation and it is economically viable. This supports the urban sprawl, which in turn increases the usage of cars and the resulting energy consumption. Alternative methods of transport are not developed well enough to support the transition from private vehicles. The cost of owning a car has become cheaper over the years in comparison to the increase in average salary, which

	Barrier	Description
		further disincentivises people from considering more energy efficient ways of transport.
9.	Low requirements for the energy audit	Large enterprises that do not have an energy management system in place have to conduct an energy audit every four years. The current minimum requirements for the audit enable companies to fulfil the requirement without going into too much detail in their energy consumption. This means that the results of the audits have achieved less impact than desired. In previous years, large enterprises have seen the requirement of conducting energy audits as an additional burden and have been satisfied by meeting the minimum criteria set for the minimum price possible. Therefore, energy consumption and measures are not analysed in detail and large enterprises will not act on the results of the energy audit or get a good overview of their problems. However, with the increase in energy prices, the expectations from large enterprises have increased although the requirements need to be raised to increase energy savings potentials.
10.	High renewable energy tax reduces competitiveness of Estonian companies and in turn reduces willingness / ability to invest in energy efficiency measures	Energy-intensive industries appealed to the government to impose a tax ceiling of 15 percent of the normal rate on the fee for renewable energy, which is one component of the price of electricity. According to entrepreneurs, this would increase the competitiveness of Estonian companies, as electricity is significantly more expensive for large consumers in Estonia than in neighbouring countries. Expensive electricity for large consumers worsens the competitiveness of energy-intensive products produced in Estonia, both domestically and on export markets. The petition has been signed by Estonian Cell, Kunda Nordic Cement, Horizon Cellulose and Paper AS and Viru Keemia Grupp. Unfair competition and too high resource costs discourages investments, which can include energy efficiency investments.

4.5.1 Lack of regulation regarding the utilisation of waste heat in district heating

Key takeaways

- Regulation should be changed to allow easier utilisation of waste heat to increase energy efficiency and the share of renewable energy used for heating.
- Waste heat usage in district heating network is possible under the current District Heating Act but has not been attractive for industries because of price calculation methodology and obligations.

According to the District Heating Act § 2 waste heat is defined as the unavoidable heat produced as a side product in industrial production, electricity generation or the service sector. According to § 4 point 4, efficient district heating area is defined as an area, that uses at least 50% of heat produced from

renewable sources, 50% waste heat, 75% of heat produced in cogeneration regime or at least 50% of heat produced from renewable sources and a combination of waste heat and cogenerated heat.[76]

Based on § 10 section 1 points 3 and 6 of the Energy Sector Organisation Act, an undertaking prepares a cost-benefit analysis concerning the transformation of an installation, within the meaning of the Industrial Emissions Act, into a high-efficiency installation, when it plans:

- The building of a new industrial installation whose total rated thermal input exceeds 20 MW, and which generates waste heat at a useful temperature level, or a major renovation of an existing one;
- A major renovation of an existing thermal electricity generation installation in a manner that permits to effectively utilise waste heat from a nearby industrial installation.[77]

According to the current regulation, adding a waste heat source to the district heating network is considered as purchase of heat by heating undertaking. Therefore, the heating undertaking must arrange a procurement for the purchase of heat and obtain the approval for the price of heat from the Competition Authority. When purchasing waste heat for a lower price than heat produced by the heat producer, the price for the end consumer must decrease. This on the one hand is acceptable for the heat undertaking as it increases their competitiveness and can motivate potential consumers to join the district heating network, however, on the other hand, it involves risks. If the company providing the waste heat goes through bankruptcy, reprofiles their manufacturing processes, has lengthy interruptions in production or other issues, the heating undertaking still needs to guarantee the supply of heat to consumers. This might mean the need to use reserve capacity that has an impact on the price of heat. For short time periods, the heating undertaking can cover the increased costs from their justified profitability.[78]

In practice, there are obstacles in the process that make the result unpredictable and lengthen the administrative processing period. The Competition Authority has yet to develop the methodology for taking the purchase of waste heat by heating undertakings into account when defining the price of heat. Determining the technical terms can be complicated and offer a favourable position for one company over another, which would violate the terms of competition. Simplified conditions for the adoption of industrial waste heat in district heating should be created. The district heating undertaking could have the liberty of choosing to purchase waste heat, if it is economically beneficial. The waste heat purchased should not increase the price of heat for the end consumer, therefore the purchase can only be feasible when the price is cheaper than that of the variable costs for the heating undertaking. The district heating undertaking is interested in acquiring waste heat if it ensures price stability of enables to decrease the price as it increases their competitiveness compared to local heating solutions.[79]

The obstacles described in the previous paragraph could be eliminated by covering the topic of waste heat thoroughly in the District Heating Act or in the regulations related to the act. When supplementing the legislation, existing guidelines agreed upon at the European Union level should be followed, of which the most important one is Directive (EU) 2018/2021 of the European Union and the Council on the

[76] District Heating Act. Available at: https://www.riigiteataja.ee/akt/109082022026
[77] Energy Management Organisation Act. Available at: https://www.riigiteataja.ee/en/eli/502092016001/consolide.
[78] KPMG Baltics OÜ. 2020. Development of calculation methodologies for financial measures suitable for fulfilling the national energy saving obligation and assessment of energy saving potential. Retrieved from: https://energiatalgud.ee/sites/default/files/2022-04/Energiat%C3%B5husus%20L%C3%95PPARUANNE.pdf
[79] District Heating Act. Available at: https://www.riigiteataja.ee/en/eli/ee/520062017016/consolide/current.

promotion of use of energy produced from renewable energy sources (hereinafter the Renewable Energy Directive). Article 24, especially sections 46 deals with connecting third-party suppliers to district heating and cooling systems. In addition, Article 24, section 4, point a) of the Renewable Energy Directive obliges member states with a share of renewable energy and waste heat in district heating and cooling of less than 60% to implement measures to increase the share of renewable energy or waste heat by at least one percentage point per year. A competent authority should develop and publish non-discriminatory and transparent criteria, based on which waste heat can be utilised in the district heating network in accordance with the three cases presented in Article 24, section 4, point b:

i. meet demand from new customers;
ii. replace existing heat or cold generation capacity;
iii. expand existing heat or cold generation capacity.[80]

The more opportunities arise for the adoption of waste heat in district heating, especially in the summer period, the more certain is the need for adopting a dual or multi-tariff heat price. If, for example the price of heat is decreased in the summer, consumers that use electric boilers for heating water would be more motivated to purchase domestic hot water from the district heating network. To fulfil this purpose, hot water distribution pipelines within buildings need to be built or restored. This requires investment, which should be subsidised. The increased utilisation of district heat during the summer will increase the heat load which is beneficial for the efficiency of utilising waste heat from combined heat and power plants and from other sources.[81]

There is a lack of financial support measures for utilising waste heat. Without a subsidy for investments for using waste heat, it might not be cost effective. In general, there is not much need for low temperature heat in companies. Where the utilisation of such waste heat has been profitable, suitable measures have already been taken.

Potential for waste heat usage from industries has also been analysed in an ongoing study "Transitioning to a carbon neutral heating and cooling in Estonia by 2050".[82] The study concludes that waste heat is likely to be utilised in district heating networks by 2050 with the help of heat pumps or directly.

In conclusion, regulation should be changed to allow easier utilisation of waste heat to increase energy efficiency and the share of renewable energy used for heating. Waste heat usage in district heating network is possible under the current District Heating Act but has not been attractive for industries because of price calculation methodology and obligations.[83]

[80] Renewable Energy Directive (EU) 2018/2001. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018L2001&from=ET
[81] KPMG Baltics OÜ. 2020. Development of calculation methodologies for financial measures suitable for fulfilling the national energy saving obligation and assessment of energy saving potential. Retrieved from: https://energiatalgud.ee/sites/default/files/2022-04/Energiat%C3%B5husus%20L%C3%95PPARUANNE.pdf
[82] SEI in cooperation with Trinomics, Finantsakadeemia, Pilvero "Transitioning to a carbon neutral heating and cooling in Estonia by 2050"
[83] District Heating Act. Available at: https://www.riigiteataja.ee/en/eli/ee/520062017016/consolide/current.

4.5.2 Limited availability of materials and constrained supply chains

Key takeaways

- With the COVID-19 pandemic and the Russian invasion of Ukraine, international supply chains have come under pressure with the lack of resource availability and decreased materials production. capacity, congestion in logistics, longer delivery times and an overall increase in resource prices.
- The increasing cost of resources (materials and workforce) reduce the cost-effectiveness and the feasibility of building renovations, posing a threat to achieving energy savings obligations through such measures.

Due to the trade restrictions with the Russian Federation and Belarus, the COVID-19 pandemic and increasing demand for renovation volumes, international supply chains have come under pressure with the lack of resource availability and decreased materials production capacity, congestion in logistics, longer delivery times and an overall increase in resource prices. This has become a major barrier for investments in energy efficiency, as the renovation of buildings is material intensive, and the owners of properties have limited financial capabilities.

The increasing demand for materials is reflected in cost of materials that affect the cost of renovation which makes renovation with or without additional incentives less feasible. Renovation volumes with state aid cannot be raised over a certain volume or the usefulness of aid will reduce as the overall cost of building rises. Renovation volumes must therefore follow the realistic pace of renovation. The representative of Estonian Association of Construction Entrepreneurs highlighted that the pace of renovations could be doubled but further increase would cause serious problems in terms of cost effectiveness of renovations. Further, the resource scarcity can have an impact on a local and global scale as some materials can be transported with less cost than other materials.

Renovation must be agreed upon in the apartment association by qualified majority as regardless of participation, i.e., over 50% of the property owners must agree to renovate. Properties with a large share of lower income residents are inclined to decline propositions to renovate their apartment buildings if the cost effectiveness of renovation decreases. If cost of materials and renovation increases faster than the cost of energy, then either subsidies to encourage people to renovate must increase even further or the rate of renovation will fall.

In addition to materials, workforce as a resource might also play a big role in the cost effectiveness of renovations. The war in Ukraine can affect the local construction market as a significant part of the workforce is made up of people from Ukraine. If the level of construction increases further, the need for foreign workers might increase further. The war in Ukraine will have an impact on the availability of workforce in Estonia as when employees are needed to rebuild Ukraine, the number of construction workers currently in Estonia is likely to decrease.[84]

The barrier of resource availability (both in workforce and materials) can be a significant obstacle for achieving energy saving obligations as it impacts the cost of renovation. According to the long-term strategy of building renovation, 32% of the cost of renovations is returned to the state budget. Therefore,

[84] ERR. 13.09.2021. There are currently 28 000 migrant workers in Estonia. Retrieved from: https://www.err.ee/1608337181/eestis-on-praegu-28-000-voortoolist

any aid more than that would be an additional burden to the state budget. The long-term strategy of building renovation document and also the representative of the Estonian Association of Construction brought out the importance of contracyclical investment strategy to mitigate the risk. If economic activity is lower, then state aid should be increased to boost the economy and level the decrease of economic activity in the construction sector. Inversely, during periods of high economic activity, state interventions should be limited. The long-term strategy also indicates that the end energy use is more dependent on economic activity than climate or other factors.[85]

According to the long-term renovation strategy, the second largest county in terms of net surface area of apartment buildings is Ida-Virumaa. The same area also has the second lowest property prices in Estonia according to the Land Board of Estonia. Such areas are more sensitive to the increase of the cost of renovation as the value of property is a considerable factor in renovating and in securing loans.

4.5.3 *Insufficient support measures*

Key takeaways

- Additional measures are required to encourage the more passive apartment associations to take up building renovations, for e.g. by providing financial support to passive apartment associations, raising awareness amongst residents on the benefits of buildings renovations, or to impose regulations / obligations for them to do so.
- A tailored approach would be required to address the disparity in renovation rate between different areas/counties in Estonia, which is largely driven by fact that in areas with lower property prices, the market value of renovated buildings increases less than the cost of renovation and energy savings.
- Education and outreach on the benefits of energy renovations should also be available in Russian or other local languages to engage the broader population.

Supporting renovation will be harder in the future as more active apartment associations have already used the possibility to renovate their apartments with or without aid. The apartment buildings that have not yet renovated their buildings are less interested in that possibility. 45% of the residents in apartment buildings have said that their apartment building has no plans to further increase energy efficiency in any way. This implies that after a certain threshold, convincing residents to renovate their apartment building will be harder. Active apartment associations are already preparing to renovate or have consultations in that regard, the problem is with the other half that see no need for renovation. Higher or different level of state aid might be necessary to meet the goals.[86]

KredEx brought out that there is a significant gap in apartment associations in terms of willingness to renovate. As time goes on, reaching passive apartment associations becomes more important as these buildings are mostly built before the year 2000 and these buildings have a lot of potential to increase energy efficiency. The barrier consists of two main parts, financial capabilities of apartment associations and raising awareness about the benefits of renovation amongst the residents. Up to this point, passive apartment associations have not been the primary focus area, although work to raise awareness has been

[85] KredEx. 2014. Apartment renovation market overview and analysis of the impact of apartment renovation subsidies for the period of 2010-2014. Available at: https://kredex.ee/sites/default/files/2019-03/Korterelamute%20renoveerimisturu%20%C3%BClevaade%20ja%20perioodi%202010-2014%20korterelamute%20rekonstrueerimistoetuse%20m%C3%B5ju%20anal%C3%BC%C3%BCs.pdf
[86] Kantar. 2020. Opinion survey on energy efficiency of residents, entrepreneurs and local governments. Available at: https://www.mkm.ee/media/7853/download

ongoing. The aid for renovation has so far been used up rather quickly and the need to encourage less active apartment associations to participate in renovating their apartments has been thus low. As renovation volumes and the percentage of apartment buildings that are renovated increases, more focus must be directed to passive apartment associations.

KredEx noted the problem of equality during the interview conducted. At some point, additional measures must be taken to encourage more passive apartment associations. This can take the forms of either having additional regulations or obligations to force the apartment associations to take action, or to increase the state aid for renovation for the passive counterparts to start renovating more actively. Higher grants for less active apartment associations on the other hand are seen as problematic as it would put apartment associations that have renovated buildings with lesser state aid in an unfair position. If it is more beneficial to be a passive apartment association, then it would rightfully anger those who have renovated their buildings before with lesser aid. For that reason, more innovative solutions to encourage renovation is needed.

Part of the barrier can be relieved with raising awareness and the use of technical consultants to advise apartment associations before the renovation process. KredEx has already worked to increase awareness of apartment associations as much as possible, including participating in apartment associations meetings. But raising awareness is only one part of the problem; the biggest motivation for renovation in Estonian apartment buildings is financial motivation with the most important contributor being high energy costs. If the residents believe that renovation is financially useful, then the likelihood of renovation will increase. Therefore, residents of apartment associations should be approached with the angle that renovations will lead to an increase in the value of the property and result in lower energy costs, which will help to justify the renovation loan.[86]

In areas with lower property values, the problem is greater as the market value increases less than the cost of renovation and energy savings might not justify the loan in the eyes of the residents. For that reason, KredEx has varying subsidy rates for different areas. Higher subsidy rates have so far not been effective enough as the highest volume of renovation has remained in Harju County, even with lower subsidy rates. During the last support period, 61% of the apartments that were renovated with a grant were located in Harju County, which houses 34% of all apartment buildings in Estonia.[87]

According to the Land Board of Estonia, lowest property prices are in Valga and Ida-Viru counties. These are areas that should be looked at separately. The following table is from the period of 2010-2014 but is used to describe differences of counties to renovation volumes. Disparities between counties has been more than tenfold (Tallinn and Ida-Viru) and such disparities have not been successfully eliminated with higher levels of state aid according to the feedback from interviews.[87]

Table 4-3 Renovation volumes with KredEx aid 2010-2014 [87]

County	Number of apartment building that applied for a renovation grant	% of buildings renovated with grant	Apartment building built before 1991	% of buildings built before 1991	Apartment buildings % that have had renovation grants of all apartment buildings
Harjumaa	402	60.63	7346	34.33	5.47
Tartumaa	107	16.14	2689	12.56	3.98
Pärnumaa	41	6.18	1770	8.27	2.32
Lääne-Virumaa	27	4.07	1318	6.16	2.05
Raplamaa	19	2.87	665	3.11	2.86
Viljandimaa	14	2.11	1232	5.76	1.14
Ida-Virumaa	10	1.51	2098	9.80	0.48
Valgamaa	9	1.36	631	2.95	1.43
Jõgevamaa	8	1.21	653	3.05	1.23
Läänemaa	7	1.06	526	2.46	1.33
Saaremaa	5	0.75	511	2.39	0.98
Järvamaa	4	0.60	721	3.37	0.55
Põlvamaa	6	0.90	468	2.19	1.28
Võrumaa	3	0.45	600	2.80	0.50
Hiiumaa	1	0.15	173	0.81	0.58
Total:	**663**	**100.00**	**21401**	**100.00**	**3.10**

A proposition of using different measures at the same time was discussed during the interviews. This includes the following:

- Engage technical consultants to raise awareness and explaining the procedure of renovating building with a grant;
- Offer loan guarantees to help apartment associations to get a loan;
- Offer higher grant levels to overcome the high cost of renovation;
- Applying a tailored approach where applicable, for e.g. in areas with minorities. Especially in Ida-Viru County, but also in other areas with high percentage of minorities, raising awareness should also take place in Russian or other local language to achieve the best result.

As highlighted by the long-term strategy for building renovation for Estonia, the annual financing for reconstructions must increase almost fivefold from EUR 200 million to at least EUR 900 million to achieve full renovation of buildings erected before the year 2000 with the target of reaching at least energy class C. [88]. In addition, buildings that are not suitable for renovation must be demolished with an estimated cost of EUR 15 million annually. Based on the interviews carried out, it can be concluded that the increasing volume of financing for renovation will not be sufficient to increase the rate of renovation nearly five times. As described in the previous barrier: "*…the pace of renovations could be doubled but further increase would cause serious problems in terms of cost effectiveness of renovations*".

[87] KredEx korterelamute renoveerimisturu ülevaade ja perioodi 2010–2014 korterelamute rekonstrueerimistoetuse mõju analüüs. Available at: https://kredex.ee/sites/default/files/2019-03/Korterelamute%20renoveerimisturu%20%C3%BClevaade%20ja%20perioodi%202010-2014%20korterelamute%20rekonstrueerimistoetuse%20m%C3%B5ju%20anal%C3%BC%C3%BCs.pdf

[88] TalTech. 2020. Long-term strategy for building renovations. Available at: https://www.mkm.ee/media/155/download

As the rate of renovation must increase almost fivefold and the cost-effectiveness of renovations will start to decrease due to an imbalance in supply and demand. A fundamental problem appears between the required renovation volumes and cost-effectiveness of fast paced large scale renovation if renovation volumes are more than doubled.

4.5.4 Lack of stability in support mechanisms

Key takeaways

- The cyclical nature of funding makes it more complicated to carry out renovations and increases the cost of energy efficiency.
- The lack of stability and transparency of support mechanisms available in the future reduces the cost-effectiveness and quality of building renovations, and poses as a barrier to achieving the targets for energy efficiency.

Financial support is distributed through financing rounds that temporarily increase investment activity significantly, but sees a decrease in investment volumes in between the financing rounds. This is a major concern for the renovation of buildings, as it does not create any certainty in planning their activities neither for the owners of properties, the construction companies nor the producers of construction material. The cyclical nature of funding makes it more complicated to carry out renovations and increases the cost of energy efficiency.

Support mechanism is heavily linked to EU funding periods that define the volume of subsidies available for a certain period. The European Union agrees upon a budget for seven-year periods. The funds available over that period for each member state and for each field of activities are predetermined at the start of the period and handed out over a number of financing rounds. The current program period lasts from 2021 to 2027. The current EU long-term budget and the instrument NextGenerationEU support the recovery plan for Europe. The previous programme period ran from 2014–2020. In general, there is a delay in implementing the measures developed to provide subsidies due to lengthy administrative processes and the need to coordinate activities between the Member States and the European Union level, as measures applied in Member States need to be approved by the European Commission. This often leads to a situation where there are long gaps between the end of application rounds from one programme period to the commencement of the new application rounds under new regulative guidelines in the following programme period.[89]

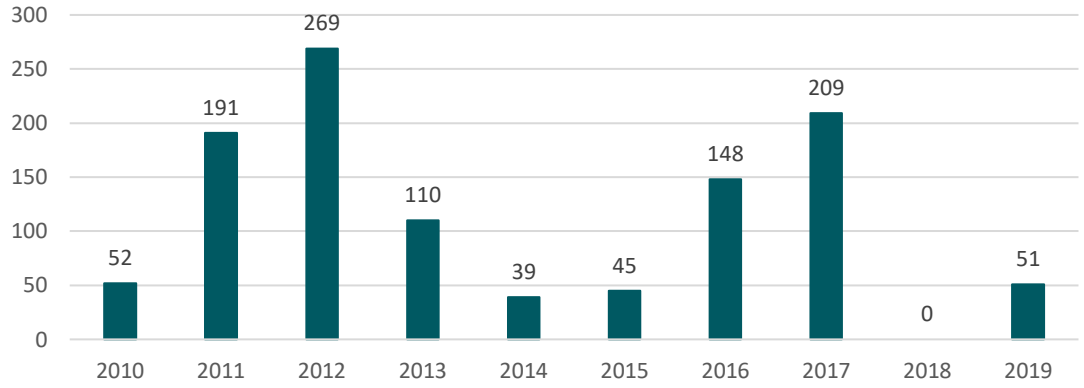
A good example of that is the reconstruction grants programme for apartment building administered by the joint organisation of Enterprise Estonia and KredEx as of 2022 and previously by KredEx as a single entity. The last reconstruction grants awarded from the resources allocated from the budget period were awarded in 2020. In 2021 and 2022, no reconstruction grants have been awarded from the financial resources allocated for the 2021–2027 programme period. Even though the expected commencement year of the first round of applications was expected to be in 2022, as of January 2023, the conditions for the grant are yet to be published. In effect, this means that the volume of renovation has decreased significantly, and stakeholders are waiting for the next financing round.[90]

[89] European Commission 2021-2027 long-term EU budget. Available at: https://commission.europa.eu/strategy-and-policy/eu-budget/long-term-eu-budget/2021-2027_en
[90] KredEx Reconstruction grant 2022-2027. Available at: https://kredex.ee/en/kodudkorda

In addition to instability in financing that is related to the change of European Union programme periods, there is also a lot of instability within the period. When it comes to the reconstruction of apartment buildings, the instability of the support mechanism has become the main concern. When the support mechanism is initially introduced, the number of applications tends to be lower, as was evident for 2010 and 2015. In the years following the introduction of the opening of the call for applications, the number of applications increased and the funds are exhausted. More stable funding would help to avoid the accumulation of construction volumes and the accompanying price increase.

The figure below shows the number of positively evaluated apartment building reconstruction grant applications per year during the period of 2010-2019.

Figure 4-1 Number of positively evaluated apartment building reconstruction grant applications per year for the period of 2010-2019



Source: TalTech. 2020. Long-term strategy for building renovations. Available at: https://www.mkm.ee/media/155/downloadhttps://www.mkm.ee/media/155/download

Whereas stability and a sense of security of support mechanisms for the future is a requirement for housing associations and owners of private residences, it also plays a crucial role for other stakeholders, primarily construction companies and the producers of construction materials. Without any transparency regarding the potential construction volumes for the coming years, it is difficult to make long term plans and carry out the necessary investment to be in the position of being able to offer the services when they are required. In order for a construction company to be able to take the reconstruction of apartment buildings and other residences into account when developing their business strategy, they need more information about the planned support schemes. Otherwise, they might make decisions which are not financially feasible and will eventually result in higher prices for reconstruction. This, in turn, limits the number of buildings that can be renovated with the amount of support available. This has resulted in a situation where the market for reconstruction is relatively chaotic with larger or even medium-sized construction companies not interested in participating renovation projects and focusing on other areas in their strategies. Therefore, the level of competition is lower than it could be, which lowers the cost effectiveness of reconstruction and also the quality of the renovations.

The previous paragraphs focus primarily on the instability and lack of transparency of support mechanisms for the reconstruction of apartment buildings, which have a direct impact to residents and a large overall impact on energy efficiency. However, the same principal issues is also observed for other support mechanisms in other sectors as well. Therefore, there is a wider problem that affects the competitiveness of Estonian companies and hinders the progress to achieve greater energy efficiency. With additional

administrative and bureaucratic barriers, the problem has worsened over the years and with the current outlook, the instability of support mechanisms will have a large negative impact in achieving energy efficiency targets in the years to come.

4.5.5 Bureaucracy and slow administrative procedures

Key takeaways

- Technical issues experienced with the National Building Register has led to delay in carrying out energy efficiency investments.
- There are already various specific requirements to fulfil for support mechanisms and procurement processes, any additional requirements would further increase complexity and slow down administrative processes, and consequently the pace of implementing energy efficiency measures.
- The extensive and increasing bureaucratic processes and time needed to handle planning and permitting applications have reduced the competitiveness of Estonia and are slowing the achievement of energy efficiency targets.

The increasing number of requirements and the speed of handling and managing these procedures are becoming significant hurdles to carry out energy efficiency measures and deciding to invest in energy efficiency in the first place. These concerns relate to all sectors, with specific issues described in more detail in the following paragraphs.

The National Building Register is a database with the purpose of storing, providing and disclosing information about planned, under construction and existing buildings and related procedures.[91] The Register, which is administered by the Ministry of Economic Affairs and Communications, underwent a thorough renewal process and the new version was released in May 2022. The renewed version of the Register has been plagued with problems that have created a major hurdle for the construction sector, which negatively impacts the pace of carrying out energy efficiency investments.

The problems with the updated Register are primarily technical and require time for troubleshooting and error corrections. The issues faced includes the data not flowing from one system to another; and the generating of permits with incorrect data. In some cases, the permission or notice to use the building has been approved and is ready to be issued, but technical problems with the Register can delay the final issuance of permits by months.[92]

Without a permit, other processes are put on hold. Since the release of the updated system, local municipalities have struggled with processing applications and cannot meet deadlines.[93] For construction companies, the technical problems have resulted in economic loss, as their normal economic activity has been inhibited.[94] This has resulted in extended construction periods and higher costs, which in turn has made investments in energy efficiency less cost-efficient. As the problems continued throughout the year,

[91] Statute of the building register. Available at: https://www.riigiteataja.ee/akt/128062019019
[92] ERR. 01.11.2022. The building register, which was updated in the spring, has not yet started working properly. Available at: https://www.err.ee/1608774352/kevadel-uuendatud-ehitisregister-pole-siiani-korralikult-toole-hakanud
[93] ERR. 14.06.2022. Municipalities-cities are in trouble with deadlines due to errors in the new building register. Available at: https://www.err.ee/1608629245/vallad-linnad-on-uue-ehitisregistri-vigade-tottu-tahtaegadega-hatta-jaanud
[94] Ärigeenius. 21.06.2022. Real estate companies: problems with the building register crippled economic activity. Available at: https://ari.geenius.ee/rubriik/uudis/kinnisvarafirmad-probleemid-ehitisregistriga-halvasid-majandustegevust/

the Estonian Chancellor of Justice intervened and ordered the Ministry of Economic Affairs and Communications to assess the situation and find the required measures to solve the problems.[95]

As energy efficiency measures are often carried out with the support of grants and subsidies, the projects planned need to follow various EU and state level regulation with regards to state aid. This also includes specific requirements of support mechanisms and procurement processes, amongst others, during the application, implementation, and monitoring periods. Errors in any of those phases, which do not necessarily reflect on the performance of the projects themselves, can result in having to return part of the disbursed grant (mostly due to non-compliance with certain guidelines/requirements which can be rather complicated) or prevent a valuable project from being implemented.

One example of additional requirements that need to be fulfilled for obtaining a subsidy arises from the regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021 establishing the Recovery and Resilience Facility.[96] According to Article 5, Horizontal principles, the Facility shall only support measures respecting the principle of 'do no significant harm'. In practice, this means that every subsidy application supported by the Facility needs to have a thorough assessment to comply with the principle regardless of the size or nature of the project planned. Therefore, for example when applying for a reconstruction grant for a detached house, hiring an expert to carry out the 'do no significant harm' assessment as a prerequisite for the application poses an additional time and financial burden. Applicants, especially, when it comes to private individuals, generally do not have experience with subsidies and their requirements which makes it difficult for them to manage those processes and they need external support. For the reconstruction of apartment buildings, there are technical consultants to help apartment associations in the process; however, the number of those consultants is limited, and they also need to adapt to changing regulations. **Therefore, any additional requirements would slow down administrative processes which in effect results in a slower pace moving towards energy efficiency targets.**

Whereas the previous paragraph describes an additional barrier in the application phase, which can inhibit a project or prevent it from being realised, procurement regulations are a major concern in the implementation phase. Projects receiving state aid generally need to comply with § 3. General principles of public procurement of the Public Procurement Act.[97] In the past years, the control of procurements carried out by non-procurers has been tightened and in principle they are treated as procurers. This means that the Public Procurement Act needs to be strictly followed by both the contracting authority and the contractor as any deviations from the tender requirements or the contract can result in a partial or full subsidy refund claim.

For example, the guarantee, insurance, and performance bond required in the contract must be submitted for the required time with the required content and issued by a person who meets the requirements. Contractual payments must be made on exactly the agreed terms. If there are competence requirements for persons in the contract, they must be checked. The contracts must be fulfilled, and the other parties must be required to fulfil it exactly. When there is deviation from the requirements that

[95] Chancellor of Justice. 15.12.2022. Operational continuity of the building register, Ülle Madise. Available at: https://www.oiguskantsler.ee/sites/default/files/field_document2/Ehitisregistri%20toimepidevus.pdf
[96] Official Journal of the European Union Regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021 establishing the Recovery and Resilience Facility. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0241&from=ET
[97] State Procurement Act. Available at: https://www.riigiteataja.ee/akt/104082022011

has not been previously approved by the unit administering the application process and signed by both parties in accordance with § 123. Modification of public contract of the Public Procurement Act, it is considered as violation of the contract signed and therefore the conditions of § 3 are not met. This can lead to a partial or full reclaim of funds allocated for the project. Subsidy reclaims are a remarkable threat for private individuals and apartment associations that have limited resources and lack the ability to cover potential shortcomings in funding. **Therefore, due to the risk of placing themselves in an economically difficult situation, the plans of applying for a subsidy are reassessed and the risk can outweigh the benefits of reconstruction.**

A major issue preventing new developments supporting energy efficiency targets from being realised is the speed or the lack of it of planning and permitting procedures. New planned projects need to go through lengthy procedures. For example, the strategic environmental assessment procedure is a long-lasting and complex procedure.[98] While it has the purpose of contributing to the integration of environmental considerations into the preparation and adoption of strategic planning documents, provide a high level of protection of the environment and promote sustainable development, it also reduces certainty about the possibility implementing the planned project. **The extensive and increasing bureaucratic processes and time needed to handle planning and permitting applications have reduced the competitiveness of Estonia and are preventing amongst other investments with the purpose of increasing energy efficiency from being realised.**

Another barrier of planning and permitting that needs to be handled is to provide clarity about the opportunities available. For example, in Ida-Viru County, there are a lot of interests towards building PV solar farms. However, the Ministry of Defence has been disapproving applications for national defence purposes. Currently, there is a lack of transparency regarding the opportunities available, therefore, the situation should be regulated to provide information for all interested stakeholders about the requirements for the PV solar farms and define the possible areas for development with their respective allowed capacities. This could avoid unnecessary application and administration procedures.[99]

4.5.6 *Energy efficiency not being the focus area*

Key takeaways

- The majority of Estonia's industrial companies are not energy intensive, leading to a lighter focus placed on energy efficiency, although this has also changed due to the energy crisis and the high energy costs.
- Investment decisions taken by industries are based on the payback period, i.e. lower energy prices prevent some enterprises from making energy efficiency investments.

Energy efficiency is not the primary problem for industries that are not energy intensive, which forms the majority of Estonia's industrial companies. Electricity and heat make up a small fraction of resource costs for many production facilities and the primary focus is placed on the efficient use of other resources. Many representatives of industries have only started to also focus on energy efficiency because of the energy crisis and high energy costs.

[98] Environmental Impact Assessment and Environmental Management System Act – Subchapter 2: Strategic Environmental Assessment of Strategic Planning Document. Available at: https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/521012022001/consolide#para31

[99] Ärigeenius. 21.06.2022. Real estate companies: problems with the building register crippled economic activity. Available at: https://ari.geenius.ee/rubriik/uudis/kinnisvarafirmad-probleemid-ehitisregistriga-halvasid-majandustegevust/

The industries that were interviewed were energy intensive industries (Estonian Cell, A. Le Coq, Enefit Power) that have a considerable energy cost. These enterprises have already invested into energy efficiency and continue to do so in the future. The table below presents the energy costs and revenue incurred in 2021 by the interviewed enterprises.

Table 4-4 Overview of 2021 revenue and energy costs of interviewed enterprises

Enterprise	Revenue, k€	Energy costs, k€	% of revenue
Estonian Cell AS	90 859	25 287	27.83%
A. Le Coq AS*	77 113	2 827	3.67%
Enefit Power AS	626 004	63 158	10.09%
Average	**264 659**	**30 424**	**13.86%**

*Energy costs also include water.

A list of 10 top enterprises in the manufacturing sector by revenue were analysed by the same indicators. The list is compiled based on the estimated revenues in IV quarter of 2022. The revenues in the table are compiled based on financial reports of 2021. The cost of energy was taken from the respective financial reports of those companies. As annual financial reports do not provide a comprehensive overview of energy consumption and costs, some of the costs might be included in other operating costs of the companies observed. As seen in the table below, the energy cost to revenue ratio varies between enterprises and the field of activity a lot. Many of the industries had energy costs that were smaller than 1% of their revenue and therefore it might be not a primary concern for such enterprises. The average percentage of energy costs to revenue of the enterprises interviewed was 13.9% while the top manufacturers based on 2022 IV quarter data had an average of 4.6%.

Table 4-5 Revenue and energy costs of manufacturing enterprises

Enterprise	Industry	Revenue, k€	Energy costs, k€	% of revenue
Ericsson Eesti AS	Electronics	534 482.00	65.00	0.01%
Stora Enso Eesti AS	Wood	289 884.28	3 286.27	1.13%
GPV Estonia AS	Electronics	134 968.75	498.94	0.37%
Prysmian Group Baltics AS*	Electrical	119 563.84	5 342.81	4.47%
AS HKScan Estonia	Food	156 445.00	7 344.00	4.69%
Scandagra Eesti AS	Fodder	128 988.00	935.00	0.72%
ABB AS	Electrical	131 081.00	1 469.00	1.12%
Valio Eesti AS	Food	130 676.00	3 828.00	2.93%
AS VNK	Chemicals	131 681.17	3 585.34	2.72%
AS Estonian Cell	Pulp and paper	90 859.00	25 287.00	27.83%
Average		**184 862.91**	**5164.14**	**4.60%**

*Includes costs for maintenance and other costs related to production
Source: Revenue costs based on Teatmik and energy costs from E-business register[100]

The main problem with investments in energy efficiency in non-energy intensive industries is, that it is not seen as a priority. Energy costs make up a small percentage of overall costs and generally there are

[100] Teatmik. Available at https://www.teatmik.ee/et/statistics/legal/eyJhcyI6WyJDIl0sImFzcCI6dHJ1ZX0=; Teatmik. Available at https://www.teatmik.ee/et/statistics/legal/eyJhcyI6WyJDIl0sImFzcCI6dHJ1ZX0=; E-business register. Available at: https://www.rik.ee/et/e-ariregister

other more lucrative opportunities of optimising resource costs. The primary focus, however, lies on increasing profits through larger sales revenues rather than minimising costs. Nevertheless, higher and less predictable energy prices have created the need for finding ways to reduce energy costs. During the interviews conducted, representatives from industries and energy efficiency experts pointed out that the energy crisis has motivated non-energy intensive industries to invest in local power generation or more efficient solutions as even though energy costs do not form a significant share of their overall resource costs, the payback period for some energy efficiency investments comply with the expected standard payback period in the industry of 3-5 years. As these investment decisions are taken based on the payback period, lower energy prices prevent some enterprises from dealing with energy efficiency measures.

4.5.7 Unwillingness of residents in apartment buildings to invest in renovation

Key takeaways

- There is need to develop an effective communications strategy to educate and create awareness on the need and benefits to carry out building renovations across the population.
- The willingness of the younger population to renovate buildings is greater than that of the older population due to the longer payback required for investing in energy efficiency measures.
- The current high cost of materials and increasing interests rates make building renovations a relatively high-risk decision not only for residents but also for the banks.
- There is less incentive for apartments with lower-value property prices to carry out building renovations as it does not significant increase the property prices. It also does not decrease the direct costs to be incurred by residents as loan payments exceed savings from reduced energy costs.

Several interviews conducted pointed out that there is a significant gap in apartment associations in terms of willingness to renovate. The renovation of apartment buildings requires either self-financing or taking a loan from a bank. In order to renovate apartment buildings, 51% of the residents need to agree to this decision, in case of smaller apartment buildings, all residents need to agree.

Even though there are other benefits of renovation of the building then lower energy bills, for e.g., better indoor climate and extended lifetime of the building, the lack of information and barrier of inefficient communication poses a major issue. The overall objective of reducing energy consumption and greenhouse gas emissions related to energy remains a distant issue for people. Interviews with KredEx and Consumer Protection and Technical Regulatory Authority highlighted the communication issues. Some residents do not really understand the necessity of renovation, nor are there enough good examples in the media about the need and benefits for renovation to motivate residents taking this financial burden. There is significant need of consultants to convince and clarify the aspects of renovation for the residents of apartment building. Another communication issue is related to citizens from other cultures – there is lack of communication material about renovation benefits and possibilities tailored to the Russian speaking residents, where resistance to renovation are often found.

Another big aspect of decision making is the variation of generations living in the building. Younger people are often more open for renovating the building, whereas older generations might be more sceptical and against renovations. While renovation lowers the expenses of energy for a household, the renovation loan might significantly raise the monthly expenses. In case of taking a loan for 20 or 30 years, the effect of lower monthly expenses might not be seen until the loan is paid off. This in turn does not appeal to older

generations, who do not see it being their problem and question the need to pay a loan for 30 years when they might not experience the full effect after the loan is paid as loan payback usually exceeds savings from renovation.

Making the decision to carry out renovation is not only affected by the timeframe but also by the lack of understanding what co-ownership of the apartment building means. Residents lack the understanding why they need to pay their part for certain things. For example, a person living on the third floor might be resentful about paying their part for thermal insulation of the exterior basement walls, since in their understanding it only affects the ones that live on the first floor.

A major cause slowing down the apartment associations from taking a loan for renovation can be attributed to the increase of prices due to economic situation that has occurred over the recent months. Since the cost of construction materials have significantly increased, the total cost of renovation has also grown remarkably. Another factor influencing the cost is the increase of interest rates. The Euro Interbank Offered Rate was negative at the beginning of 2022, whereas at the beginning of 2023, the six-month average has increased to nearly 3%. The current high cost of materials as well as increasing cost of loan interests make renovation a relatively high-risk decision in financial aspect for residents as well as for the banks.

The residents of apartment associations might also be unwilling to invest in renovation due to the low value of property. Most of the apartment buildings that have been renovated are located in bigger cities and have 30-40 apartments.[101] Such apartments generally have a higher property value also before renovation, while renovation will further increase their value. Increased value of real estate makes renovation more supported by residents even if their direct monthly payments increase. In areas where the value of properties is lower, residents might oppose renovation as renovation has a significantly lower impact on increasing the price of properties. In addition, such apartment buildings might not qualify for a loan from a bank. The long term strategy for building renovation brought out that even with a 40% grant, the total costs for apartment buildings increase on average by 20%.[102] As renovation will not usually decrease direct costs for residents due to loan payments exceeding the savings from reduced energy costs, then factors like property price and the impact that renovation has on the property price are of significant importance.

4.5.8 Car orientated infrastructure and legislation

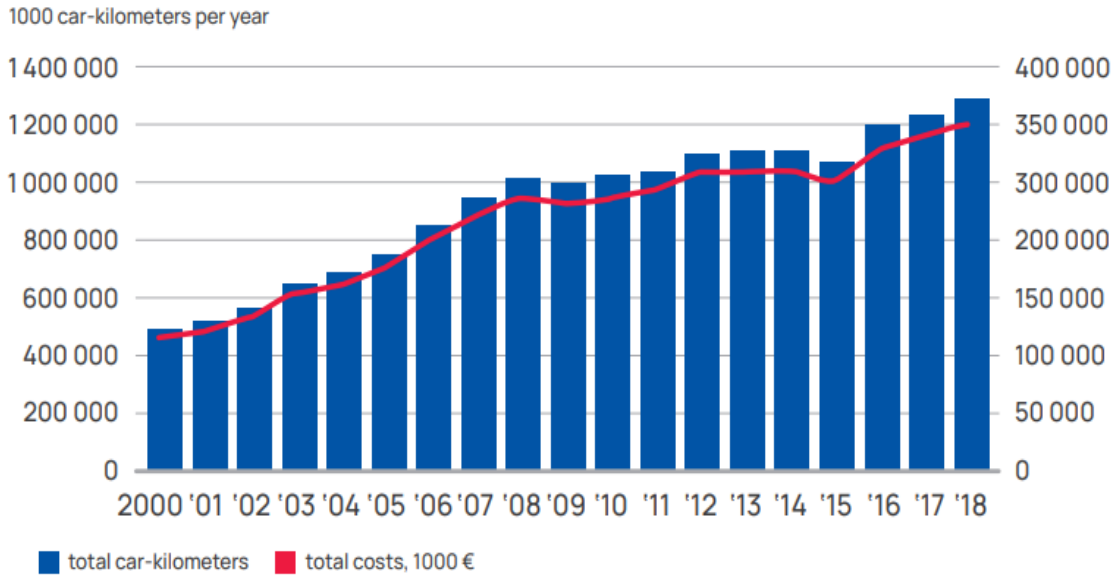
Key takeaways

- The potential to reduce transportation footprint is very high as most of the transport mileage from cars comes from urban areas where it is possible to develop efficient public transport.
- The barriers to reduce car dependency include the lack of city planning to promote sustainable mobility, the absence of convenient public transport and bicycle paths, and the good affordability of personal cars.

[101] TalTech. 2020. Long-term strategy for building renovations. Available at: https://www.mkm.ee/media/155/downloadhttps://www.mkm.ee/media/155/download
[102] TalTech. 2020. Long-term strategy for building renovations. Available at: https://www.mkm.ee/media/155/downloadhttps://www.mkm.ee/media/155/download

Transport Administration raised a point that most of the traffic in Estonia occurs in Harju County, which contributes to nearly 50% of all mileage in Estonia. Achieving the objectives in the transport and mobility development plan for 2035 requires dramatic changes in the mobility of the population. The figure below shows that both the distance travelled with cars and the cost of traveling with cars have risen sharply between 2000 and 2018.[103]

Figure 4-2 Distance travelled and costs of travelling by car during the period of 2000-2018

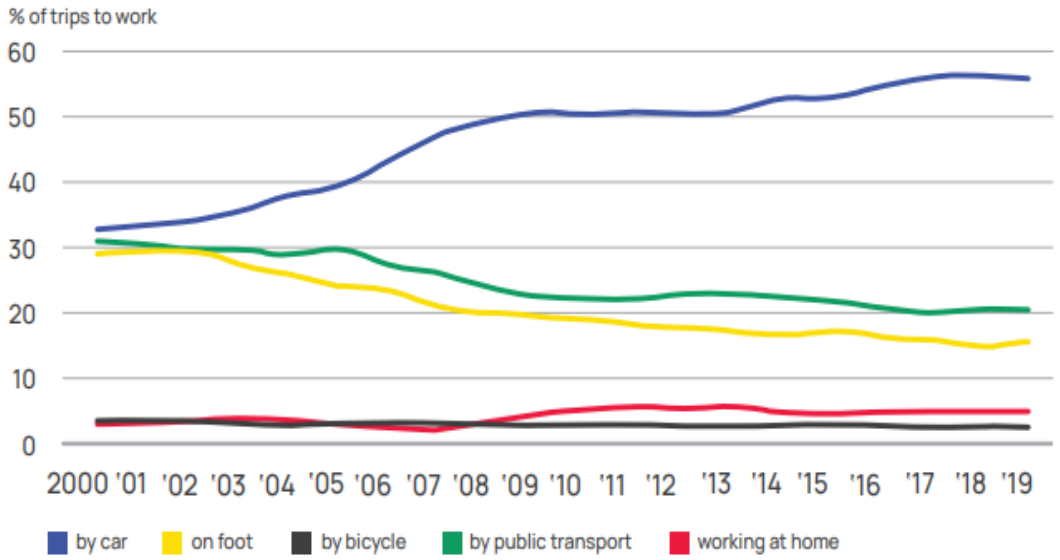


Source: Statistics Estonia[104]

For example, with the 120,000 daily commuters in Harju County, the environmental impact is very different depending on whether people are driving alone in their cars or whether they are using public transport or cycling. The potential to reduce transportation footprint is very high as most of the transport mileage from cars comes from urban areas where it is possible to develop efficient public transport. Unfortunately, so far, most of the city planning in Estonia has been car orientated. With the affordability of cars increasing, this has encouraged a growing trend for residents to use cars. The figure below shows that the use of public transport and walking have decreased significantly in Estonia.[105]

[103] Foresight Centre. 29.04.2022.The sustainability of Estonia's transport system mostly depends on Harju County, https://arenguseire.ee/en/news/the-sustainability-of-estonias-transport-system-mostly-depends-on-harju-county/
[104] See figure 19 of "The Future of Mobility" report by Foresight Centre. 2021. Available at: https://arenguseire.ee/wp-content/uploads/2022/03/2021_the_future_of_mobility_report_web.pdf
[105] Foresight Centre. 2021. The Future of Mobility. Available at: https://arenguseire.ee/wp-content/uploads/2022/03/2021_the_future_of_mobility_report_web.pdf

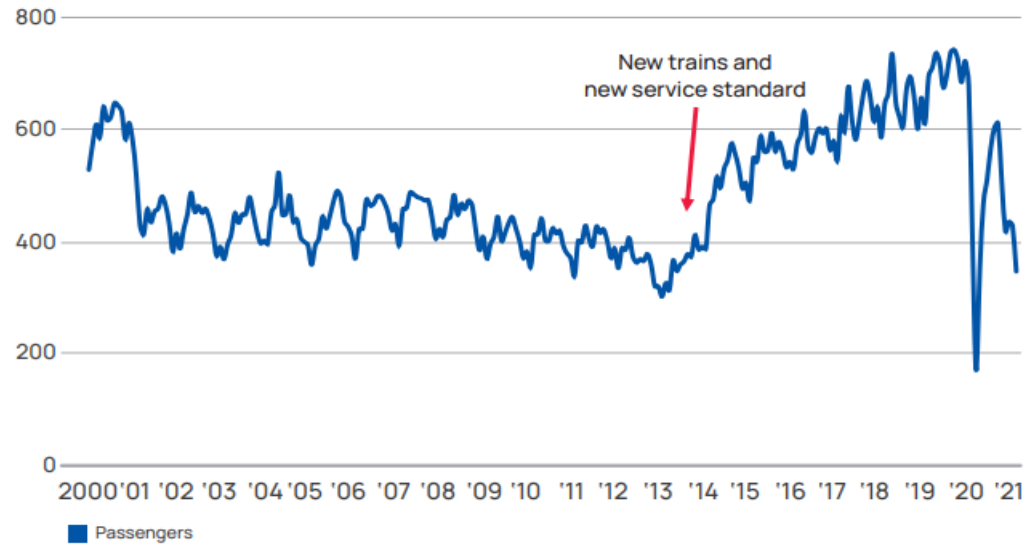
Figure 4-3 Transportation to work in 2000-2019



Source: Statistics Estonia

The figure below shows that investments made in public transport have a significant effect on the user volumes of public transport. Therefore, reliability on cars depends highly on the actions of state and municipal authorities. Usage of domestic trains doubled during 2013–2020 as new passenger trains were introduced by national operator Elron. The success of rail transport did not, however, result in a significant increase in the total number of users of public transport. This implies that users of public transport started using trains instead of other public transport modes, although the better infrastructure public transport also attracted new users.[106]

Figure 4-4 Train journeys, passengers per month in 2000-2021



Source: Statistics Estonia, Table TS1421

According to the mobility report of Estonia, despite the continuing rise in the number of workers living in urban areas, which has increased by 9% since 2013, the number of passengers on city transport,

[106] Foresight Centre. 2021. The Future of Mobility. Available at: https://arenguseire.ee/wp-content/uploads/2022/03/2021_the_future_of_mobility_report_web.pdf

including the free city transport in Tallinn, was largely unchanged in Estonia during the period of 2014–2019.[106]

Transport Administration saw the biggest potential to reduce car dependency in Tallinn and its suburbs. Three main problems were highlighted, with the biggest barrier to reduce car dependency being the lack of city planning. The second barrier is the absence of convenient public transport and bicycle roads, and third barrier would be the good affordability of personal cars.

City planning was brought out as the biggest problem as it cannot be easily changed. Urban sprawl and the structure of suburbs make it difficult to implement efficient public transport as the distances are long and the population density is low. The design and low population density of suburbs results in residents in these areas to be car dependent. The addition of bus routes or bicycle tracks is not thought to make a significant impact as schedules (frequency) of public transport and longer travel distances make travelling by public transport, i.e. buses or bicycles, a less attractive and viable option. In addition, city planning has not been proactive in limiting car use; rather, the opposite has been true in many cases. For example, car orientated infrastructure is enforced in Tallinn, with parking regulations such as having a minimum number of parking spaces for cars for every new building. On the contrary, minimum requirements for bicycle parking spots, light traffic roads or accessibility to public transportation is not required. Such legislation further encourages spatial development that prioritises the needs of car users and discourages the use of public transportation. With regards to city planning, the lack of legislation to prevent urban sprawl means that developments are often far away in large areas which are difficult to access on foot, bicycle, or with public transport.

The second barrier of transport is the development of public transport. Investments into public transport should be increased to make public transport more efficient. Based on the responses received from the energy efficiency opinion study of residents, enterprises and local authorities, it was considered more important to focus on establishing a convenient and fast public transport network, rather than the cost of travelling. The first and second barrier in transportation, i.e. lack of city planning and a lack of a good public transport network, are connected as urban sprawl makes it difficult to develop a fast and reliable public transport infrastructure with reasonable costs.[107]

The third issue is the high affordability of a personal car. Transport Administration implied that additional taxes might be necessary to further encourage people to change their personal car to more environmentally friendly alternatives. Salaries in Estonia have grown historically faster than the cost of buying and maintaining a car, making ownership of personal cars more affordable in relation to average salaries. Either a car tax or tax based on the energy use or emissions of the car could be implemented to reduce energy use in transport sector. Discussions regarding the implementation of such taxes have been problem politically and is therefore unlikely to be implemented in the near future.

According to the Transport Administration, raising awareness of citizens can help but is not seen as a primary factor to influence commuters to use public transport instead of personal cars. The energy efficiency opinion study of residents, enterprises, and local authorities indicated that two-thirds of residents use gasoline or diesel car for every daily commuting. On average, residents in North-Estonia and families with children use personal car more than on average, as well as residents who live in private

[107] Kantar. 2022. Opinion survey on energy efficiency of residents, entrepreneurs and local governments. Available at: https://www.mkm.ee/media/7853/download

households. Estonians do not see that they will change the way they commute in the next five years. Car users think that energy use of transport sector should be decreased with more efficient cars; users of public transport think that energy efficiency of transport sector should be increased by developing better public transportation networks.[107]

4.5.9 Low requirements for the energy audit

Key takeaways

- The current minimum requirement for companies to carry out energy audits has led to a less than desired impact to increase energy efficiency.
- A more demanding regulation / requirement for energy audits will increase its potential to achieve higher energy savings.

In accordance with Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, energy audits for large enterprises in Estonia are mandatory as a measure that can lead to significant energy savings.[108] This obligation has been set by § 28 of the Energy Sector Organisation Act.[109] § 27 section 5 states that in order to ensure the quality of the energy audits, the minister in charge of the policy sector makes regulations to establish the minimum requirements for energy audits. Paragraphs 5 and 6 of the corresponding regulation define the activities and the contents of the energy audit.[110] § 5 section 1 states that while collecting the source data of the energy audit, the following are mapped by month for at least one year and if possible, a longer time period:

1. energy use in terms of electricity, thermal energy, gas, liquid fuel and solid fuel;
2. energy production in terms of different types of energy;
3. renewable energy production and its use.

During the energy audit analysis:

1. an energy balance is drawn up according to the company's various types of energy;
2. an assessment of the current state of energy use and production;
3. the base scenario of energy use and production is determined, which expresses the situation if no efficiency measures were implemented;
4. alternative development scenarios of energy use and production are determined;
5. an evaluation of the energy saving potential of energy use and production development scenarios is carried out;
6. a mutual comparison of the development scenarios of energy use and production will be carried out, as a result of which the priority and expediency of these scenarios will be determined.

When evaluating the energy saving potential of an alternative energy use and production development scenario, the following characteristics of the scenario are defined:

1. activities and measures necessary for implementation;
2. estimated cost of implementation;
3. estimated energy savings;

[108] Official Journal of the European Union Directive 2012/27/EU of the European Parliament and the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0027&from=EN
[109] Energy Management Organisation Act. Available at: https://www.riigiteataja.ee/en/eli/502092016001/consolide.
[110] Minimum requirements for energy audits. RT I, 23.12.2016, 3. Available at: https://www.riigiteataja.ee/akt/120112020005

4. estimated carbon dioxide reduction;
5. estimated impact on the revenues and costs of a large enterprise;
6. economic profitability;
7. risks and dangers;
8. feasibility analysis and recommendations for implementation.

Section 1 of § 6 defines the parts of the energy audit as follows:

1. Title page;
2. Preface;
3. Overview of the field of activity of a large enterprise;
4. Brief description of the activities most affecting energy consumption in the economic activities of the large enterprise;
5. Overview of the performed measurements;
6. Overview of energy audit results;
7. Appendices.

The overview of performed measurements is defined in section 5 as containing at least the data specified in § 5 section 1 of the regulation, i.e., generally not requiring additional on-site measurements during the audit process.

The current minimum requirement for the audit enables companies to fulfil the requirement without going into too much detail in their energy consumption, which in turn means that the results of the audits has had of less impact than desired. In the previous years, large enterprises have seen the requirement of conducting the energy audit as an additional burden and have been satisfied by meeting the minimum criteria set for the minimum price possible. Therefore, energy consumption and measures are not analysed in detail and large enterprises will not act on the results of the energy audit or get a good overview of their problems. However, with the increase in energy prices, the expectations from large enterprises have increased, although the requirements need to be raised to increase energy savings potentials.

DeltaE, a company active in the energy efficiency market sees the current regulation as an inhibitor to carrying out energy efficiency investments. The audits conducted cannot determine the root causes of excessive energy consumption as the division of energy use between different energy consumers is not properly determined. As a result, the measures developed do not map the full potential of energy efficiency. Due to open competition and the need to only fulfil the requirements of the energy audit, companies offering detailed analyses and providing technical solutions cannot compete with offers that are done merely for following the regulations set. As a result, large enterprises might get a less beneficial audit, but not be aware of it themselves, which means that they will not investigate further opportunities for increasing energy efficiency as they believe that there are none. This in turn does not enable companies to reach the highest standards of energy efficiency.

The proper energy audit process should start with thorough measurements to better understand the energy balance and the inner climate of the company that is audited. Measurement and validated data about every significant node form the basis for carrying out further assessments and for truly understanding where there is potential for energy savings. Measurements should be carried out over a longer period of time, and they need to continue after the implementation of energy savings measures to assess their performance. With sufficient data, it is possible to work out the energy savings measures

that are most suitable for each company. According to DeltaE, within the energy audit technical solutions should be proposed so that the audit would function as a term of reference for planning and design that can be started as the next step following the completion of the audit. **Overall, the feedback from market participants is that the regulation should be more demanding in order for it to have a greater effect and serve its purpose.**

4.5.10 High renewable energy tax

Key takeaways

- While high renewable energy taxes can encourage energy efficiency in industries, it can also backfire if it is set at such a high rate that results in a loss of competitiveness, which may result in a decrease in energy efficiency investments.

Energy-intensive industries appealed to the government to impose a tax ceiling of 15 percent of the normal rate on the fee for renewable energy, which is one component of the price of electricity. According to entrepreneurs, this would increase the competitiveness of Estonian companies, as electricity is significantly more expensive for large consumers in Estonia than in neighbouring countries. Expensive electricity for large consumers worsens the competitiveness of energy-intensive products produced in Estonia, both domestically and on export markets. The petition has been signed by Estonian Cell, Kunda Nordic Cement, Horizon Cellulose and Paper and Viru Keemia Grupp.

Renewable energy tax is used to support electricity production from renewable sources and efficient cogeneration. Renewable energy tax is paid by all electricity end consumers. VAT will be added to the renewable energy tax. High resource costs encourage energy efficiency but if resource costs are so high such that competitiveness suffers, then investments to energy efficiency and production facilities might stop all together which in turn has a negative effect on energy efficiency.

According to the current Electricity Market Act[111], renewable energy tax is calculated by Elering. Elering compiles and publishes every year before 1st December based on the submitted prognosis of producers and consumers a proposition for renewable tax rate for the following year. Consumers and producers send the prognosis before 1st November. The following table presents the renewable tax rates in Estonia during the period of 2012-2023.

Table 4-6 Renewable electricity tax rates from 2012-2023

Year	Rate without VAT, euro cent/kWh	VAT	Rate with VAT, euro cent /kWh
2023	1.24	20%	1.49
2022	1.13		1.36
2021	1.13		1.36
2020	1.13		1.36
2019	1.04		1.25
2018	0.89		1.07
2017	1.04		1.25
2016	0.96		1.15
2015	0.89		1.07
2014	0.77		0.92

[111] Available at: https://www.riigiteataja.ee/en/eli/528082014005/consolide

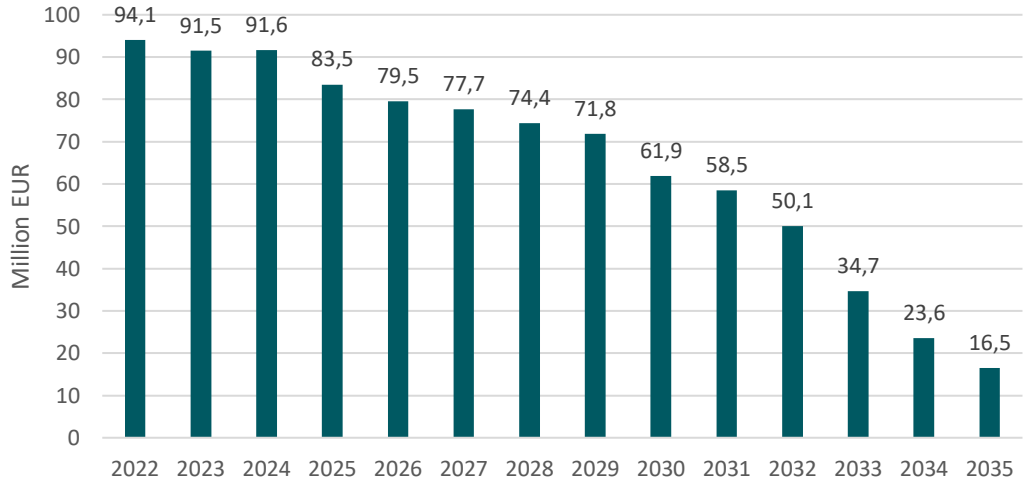
Year	Rate without VAT, euro cent/kWh	VAT	Rate with VAT, euro cent /kWh
2013	0.87		1.04
2012	0.97		1.16

Source: Elering. Renewable energy tax[112]

The largest part of the renewable energy tax funds, which amounts to over EUR 32 million, is directed towards solar energy producers, followed by power plants using biomass as energy (over EUR 30 million), and wind parks (EUR 24 million). Biogas and hydro energy power plants are funded by less than a million euros. The subsidy is granted for 12 years. The rate of renewable energy tax has varied depending on how many power generation units exceed 12 years of production, prognosis until 2035 is shown in Figure 4-5.

European Commission has allowed to make exceptions for large enterprises to keep competitiveness as the tax will prevent some producers to successfully compete in the global markets.
As of 01.01.2021, renewable energy subsidy is not paid to new production units for 12 consecutive years, instead, the aid will be paid with reverse auctions only for the best, i.e. lowest bidders.[113] This will significantly reduce the amount of renewable energy subsidy (see Figure 4-5) and the renewable energy tax as the tax rate depends on subsidies paid to producers and electricity consumption.

Figure 4-5 Renewable energy subsidy prognosis up to 2035[114]

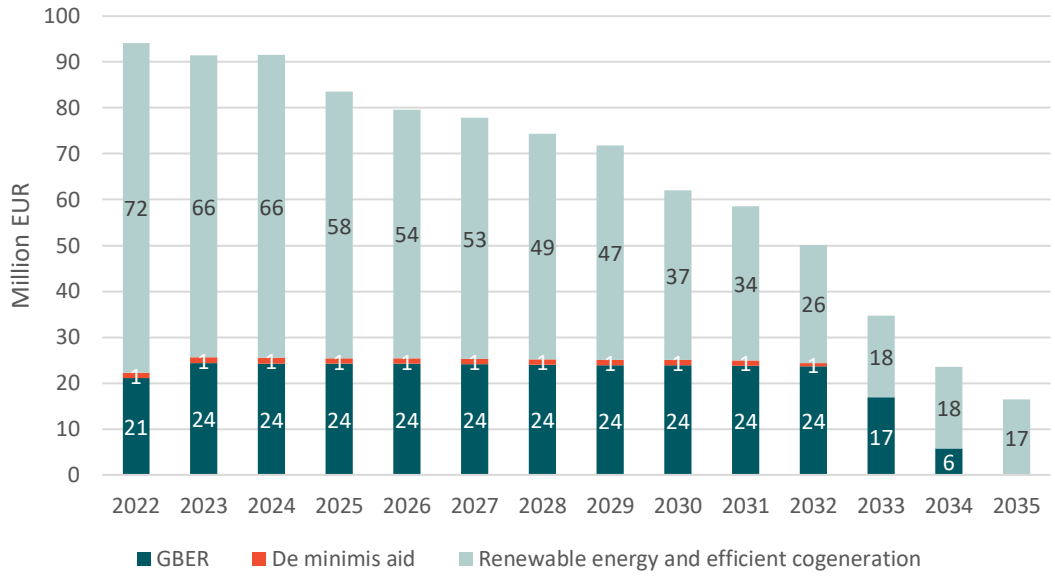


Source: This prognosis was made by Elering AS and shared with the project team by MEAC.

Not all the state aid for renewable energy is paid through renewable energy tax. Some of the investments are implemented with EU funds through General Block Exemption Regulation (GBER) or de minimis state aid (see Figure 4-6). Cost estimation of reverse auctions was not provided in the source material. State aid to renewable energy projects will not affect renewable energy tax as it is not paid directly by the consumers.

[112] Elering AS, renewable energy subsidy. Available at: https://elering.ee/taastuvenergia-toetus
[113] Elering AS, renewable energy subsidy. Available at: https://elering.ee/taastuvenergia-toetus
[114] This prognosis was made by Elering AS and shared with the project team by MEAC.

Figure 4-6 State aid for renewable energy by source



Source: This prognosis was made by Elering AS and shared with the project team by MEAC.

5 Forecast for Estonia's final energy consumption in the baseline scenario

The total volume of the energy saving obligation in Estonia in the period from 1 January 2021, to 31 December 2030, was 14 767 GWh, which has increased to 21 279 GWh (see Textbox 5-1).[115] The national energy efficiency goals are set in the '*National Development Plan of the Energy Sector until 2030*'.[116] To fulfill the general obligation to save energy, state taxes that contribute to more economical use of energy (fuel excise, electricity excise, VAT) are implemented in Estonia. In addition, renovations of residential buildings and buildings owned by local governments, modernisation of street lighting, activities aimed at increasing the resource efficiency of companies, electrification of the transport sector and other measures promoting energy saving are also implemented.

Textbox 5-1 New deal on the Energy Efficiency Directive

On 10 March 2023, the Council of the EU and the EU Parliament arrived at a provisional political agreement to reduce the final energy consumption at the EU level by 11.7% in 2030. This translates to an upper limit to EU's final energy consumption of 763 million tonnes of oil equivalent, which will be binding. The upper limit of primary energy consumption (993 million tonnes of oil equivalent) will only be indicative and non-binding.

Under this new agreement, it was also agreed to gradually increase the annual energy savings target for final energy consumption from 2024 to 2030. Member States will have to achieve new annual savings of 1.49% of the average final energy consumption during this period, and to achieve 1.9% by 31

[115] National energy saving obligation financial measures suitable for implementation development of calculation methodologies and assessment of energy saving potential: Final report. Available at: https://www.mkm.ee/media/443/download

[116] This is a document that is currently being updated based on the document "National Development Plan of the Energy Sector until 2030" that was prepared in 2017. The 2017 document is available at: https://faolex.fao.org/docs/pdf/est199996.pdf

December 2030. Energy savings realised through policy measures under the current and revised Energy Performance of Buildings Directive (EPBD), and measures stemming from the EU ET for installations and for buildings and transport; and from emergency energy measures may be used to count towards this target. In addition, it was agreed that the public sector would have to achieve an annual energy consumption reduction of 1.9% that can exclude public transport and armed forces. Further, at least 3% of the total floor area of buildings owned by public bodies would also be required to be renovated annually.

Following this new development, the revised volume of energy saving obligation to be fulfilled by Estonia from 2021 to 2030 has increased to 21 279 GWh instead.

In developing the baseline scenario, the final energy consumption is calculated based on a forecast of market economic improvement of energy efficiency which fulfils the EU rules to a minimum extent. It also accounts for the impact of measures implemented previously.

5.1 Energy consumption forecasts of the Households and Service sectors

Estonia has an active construction market and building stock that increases every year, where the construction of new buildings is more than the number of buildings that are demolished. The largest consumer of final energy in 2020 was the household sector (35%), as shown earlier in Figure 2-6.

Textbox 5-2 Key assumptions and other considerations taken when calculating the baseline scenario for households and service sectors

The baseline scenario is calculated with the following three key assumptions , which figures are presented in Table 5-2:

- Yearly energy weighted renovation rate;
- Yearly dropout rate of buildings;
- Yearly new construction rate of buildings.

Other considerations that are taken include the following:

- The energy weighted renovation rate describes the percentage of existing building stock that is renovated to the energy performance class C in Estonia which typically leads to an achievement of a final energy reduction of 50-60%.
- The baseline scenario calculated for the building stock considers energy that is used for providing indoor climate (empty buildings are not included).
- Industrial buildings are not included in this building stock because they belong to the industry sector.
- The new building rate is taken from the building statistics database from the past 20 years.
- Renovation rates are taken from the Estonian long-term renovation strategy (LTRS) and these values are considerably lower than the ones provided by building use permits. However, LTRS operates with deep renovation rates which are not straightforward to assess from building use permits.
- For dropout rates, a conservative estimate equaling 50% of rates reported in the long-term renovation strategy has been used.

The net floor area of the building stock is shown in Table 5-1 below. Detached houses and apartment buildings represent households and other building categories, i.e., 'Office', 'Commercial', 'Education' and 'Other' represents the service sector.

Table 5-1 Net floor area (m^2) of the building stock divided into main building categories in 2020

Data	Detached	Apartment	Office	Commercial	Education	Other	Sum
Constructed < 2000	18 800 000	22 900 000	4 200 000	4 000 000	3 700 000	4 800 000	**58 400 000**
Constructed ≥ 2000	3 600 000	8 100 000	1 600 000	2 600 000	550 000	1 200 000	**17 650 000**
Total	**22 400 000**	**31 000 000**	**5 800 000**	**6 600 000**	**4 250 000**	**6 000 000**	**76 050 000**

Source: EHR Building Registry database

The baseline scenario is calculated by applying the yearly energy weighted renovation, the dropout rate and new building rates following the current trendlines described above. Energy weighted renovation and dropout rates are taken from Estonian Long Term Renovation Strategy[117], where these parameters have been comprehensively analysed. New building rates represent an average of statistics from 2010-2021. The results for households and service sectors are summarised in Table 5-2 below.

Table 5-2 Yearly energy weighted renovation, dropout and new building rates in m^2 and percentage, that is used in the baseline scenario calculation in building categories

Yearly change	Detached	Apartment	Office	Commercial	Education	Other	Sum
Renovation	85 000	280 000	47 500	62 500	42 250	20 000	**537 250**
	0.38%	0.90%	0.82%	0.95%	0.99%	0.33%	**0.71%**
Dropout	95 000	110 000	20 000	20 000	10 000	20 000	**275 000**
	0.42%	0.35%	0.34%	0.30%	0.24%	0.33%	**0.36%**
New building	245 000	310 000	75 000	65 000	35 000	50 000	**780 000**
	1.09%	1.00%	1.29%	0.98%	0.82%	0.83%	**1.03%**

The baseline scenario results for the **final energy use in households and service sectors** are calculated with TalTech's building stock hourly energy model and assumptions are reported in the tables above (i.e. Table 5-1 and Table 5-2). Final energy use in the building stock from 2020 to 2050 are shown in Table 5-3 and Figure 5-1 below, which differentiates the different energy sources. The category of 'Heat' in the table and figure includes district heat and fuels. The "PV to Grid" figures refers to the surplus on-site electricity generation that is exported to the grid, and are presented as negative numbers in Table 5-3. This surplus of electricity exported to the grid almost compensates for the increase in electricity consumption in buildings.

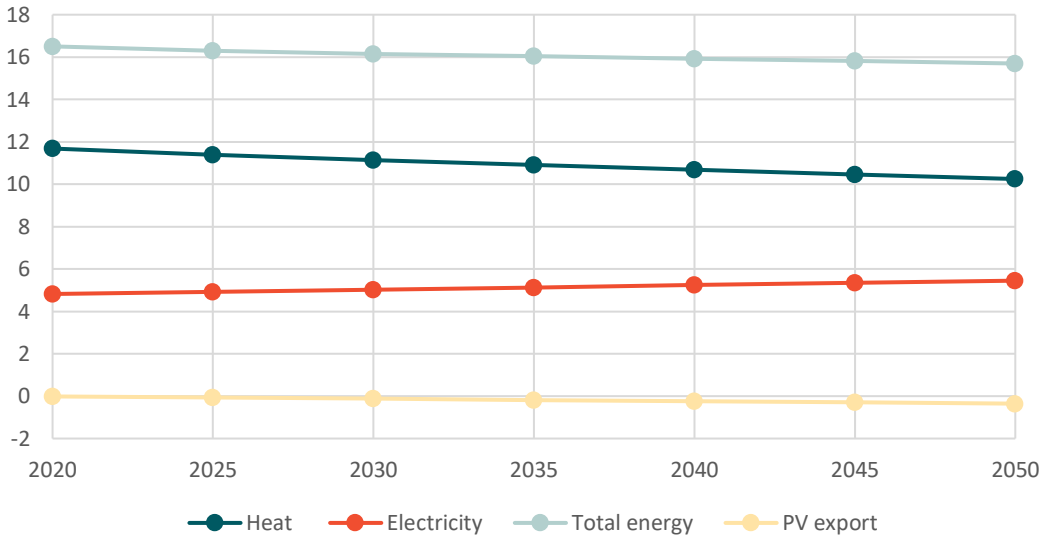
Final energy use of the building stock beyond 2020 decreases even with small renovation rates applied in the baseline scenario. This can be a result of the construction of new nearly zero energy buildings, which will slowly replace the existing building stock with high energy-performing buildings.

[117] Long-term strategy for building renovation (July 2020). Available at: https://energy.ec.europa.eu/system/files/2020-09/ee_2020_ltrs_official_translation_en_0.pdf

Table 5-3 Final energy use in households and service sectors in the baseline scenario, TWh

	2020	2025	2030	2035	2040	2045	2050
Heat	11.68	11.38	11.13	10.91	10.69	10.47	10.25
Electricity	4.82	4.92	5.03	5.13	5.24	5.34	5.45
Total energy	**16.50**	**16.30**	**16.16**	**16.04**	**15.93**	**15.81**	**15.70**
PV to Grid	-0.01	-0.06	-0.12	-0.19	-0.24	-0.29	-0.35

Figure 5-1 Final energy use in household and service sectors, and electricity export in the baseline scenario

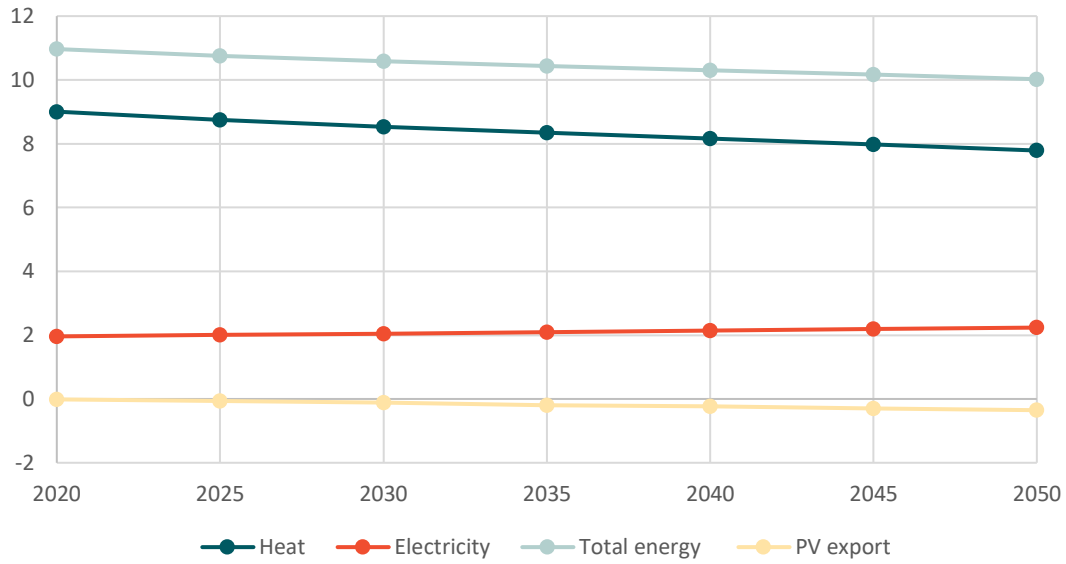


The baseline scenario results for the final energy use in households from 2020 to 2050 is shown in Table 5-4 and Figure 5-2 below. The energy consumption data for 2020 is taken from the statistics database, and the consumption for the following years is calculated with the building stock model.

Table 5-4 Final energy use in households in the baseline scenario, TWh

	2020	2025	2030	2035	2040	2045	2050
Heat	9.01	8.75	8.53	8.34	8.16	7.97	7.79
Electricity	1.96	2.00	2.05	2.10	2.14	2.19	2.24
Total energy	10.97	10.75	10.58	10.44	10.30	10.16	10.02
PV export	-0.01	-0.06	-0.12	-0.19	-0.24	-0.29	-0.35

Figure 5-2 Final energy use in households and electricity export in the baseline scenario

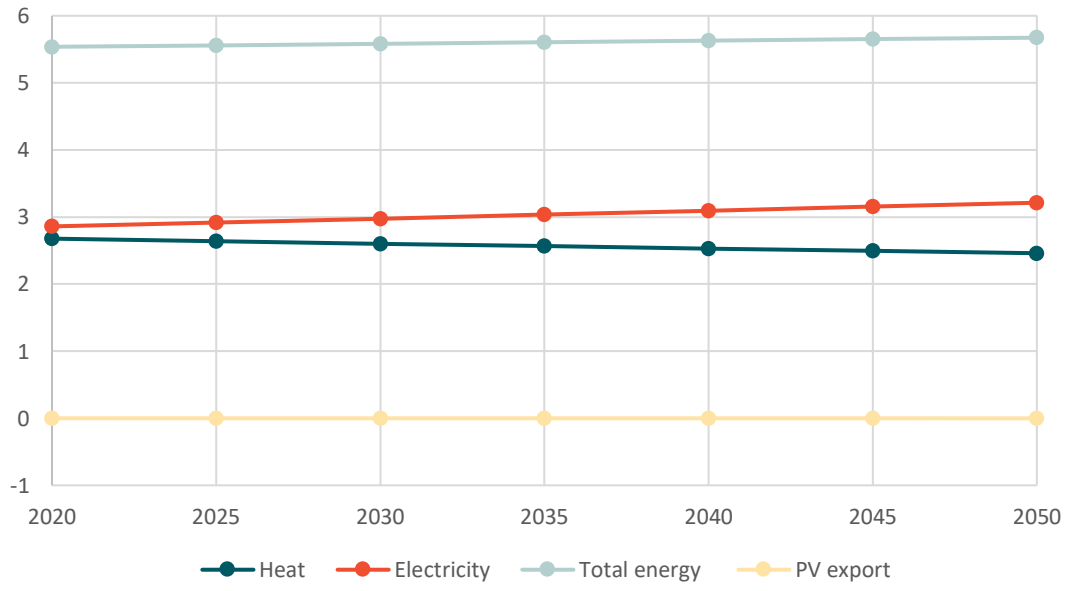


The baseline scenario results for the final energy use in the service sector from 2020 to 2050 is shown in Table 5-4 and Figure 5-3 below.

Table 5-5 Final energy use in service sector in the baseline scenario, TWh

	2020	2025	2030	2035	2040	2045	2050
Heat	2.68	2.64	2.60	2.57	2.53	2.50	2.46
Electricity	2.86	2.92	2.98	3.04	3.09	3.15	3.21
Total energy	5.54	5.56	5.58	5.60	5.63	5.65	5.67
PV export	0.000	0.000	0.000	-0.001	-0.001	-0.001	-0.001

Figure 5-3 Final energy use and energy export in service sector



The baseline scenario results for the **breakdown of heat in households and service sectors** from 2020 to 2050 is presented in Table 5-6 below. The main energy sources up to 2050 are district heating and wood, and to a smaller extent, gas. The overall trend shows a decrease in the use of wood, gas, oil and coal. District heating energy remains quite constant with only a slight decrease, while the share of biogas increases.

Table 5-6 District Heating and fuels for heat generation in household and service sectors, in GWh

	2020	2025	2030	2035	2040	2045	2050
District heating	5 203	5 172	5 164	5 169	5 175	5 181	5 186
Wood	4 666	4 465	4 285	4 118	3 952	3 785	3 618
Gas	1 351	1 305	1 263	1 224	1 185	1 145	1 106
Oil	389	366	345	324	303	282	261
Coal	53	50	47	45	42	40	38
Biogas	21	24	27	30	32	35	37

5.2 Energy consumption forecasts of the Transport sector

Energy consumption in the transport sector has increased from 8 736 GWh to 9 178 GWh in the period of 2010 to 2020. As shown earlier in Figure 2-6, the consumption of the transport sector accounted for 29% of the total final energy consumption in Estonia.

Textbox 5-3 Key assumptions and other considerations taken when calculating the baseline scenario for the transport sector

The baseline scenario in the transport sector is constructed as a **business-as-usual** scenario, where it is assumed that there will be no significant changes in people's attitudes and driving habits, or no major changes in technology, economy, or policies. This is a reference scenario used for benchmarking other scenarios. Baseline is a historical scenario showing the energy demand forecast in case current circumstances continue. Therefore, the impact of new policies (e.g., Fit-for-55) on energy demand is not included in this scenario.

In the baseline scenario for the transport sector, it is assumed that energy consumption will grow according to current trends, i.e., at 1% per year.

The calculation of the baseline scenario for the transport sector uses a consumption prognosis methodology, taking the approach as follows:

- Firstly, the total energy consumption in the sector is prognosed based on the statistical data for the period of 2010 to 2021;
- Secondly the share of each fuel is prognosed as a trendline of historical period;
- Finally, the consumption forecast of each fuel is calculated by multiplying the share with total consumption.

When looking at the share of fuels in total energy consumption, there is a clear trend of replacing vehicles with gasoline engines with diesel engines. This trend is also visible in stock changes, where the number of vehicles with diesel engines is increasing. Motor spirit consumption has dropped from 3,366 GWh in 2010 to 2 322 GWh in 2021; diesel oil consumption has risen from 5 210 GWh to 6 404 GWh. Consequently,

the share of motor spirit consumption in transportation energy consumption has decreased from 39% in 2010 to 24% in 2021 and share of diesel increased from 60% to 66%.

Table 5-7 below presents an overview of the expected share of fuels in the total energy consumption of the transport sector by 2050. The share of aviation gasoline, Liquefied Petroleum Gas (LPG) and Natural Gas for Vehicles (NGV) is expected to remain at the current level.

Table 5-7 Forecast of percentage share per fuel type in the transport sector by 2050, in percentages

Fuel type	% share in 2020	% share in 2021	% share in 2050
Gasoline	27	24	10
Diesel	63	66	76
Bioethanol	0.8	0.5	0.2
Biodiesel*	4.1	4.5	5.2
Biogas	1.1	1.4	1.9
Electricity	0.3	0.3	3.2

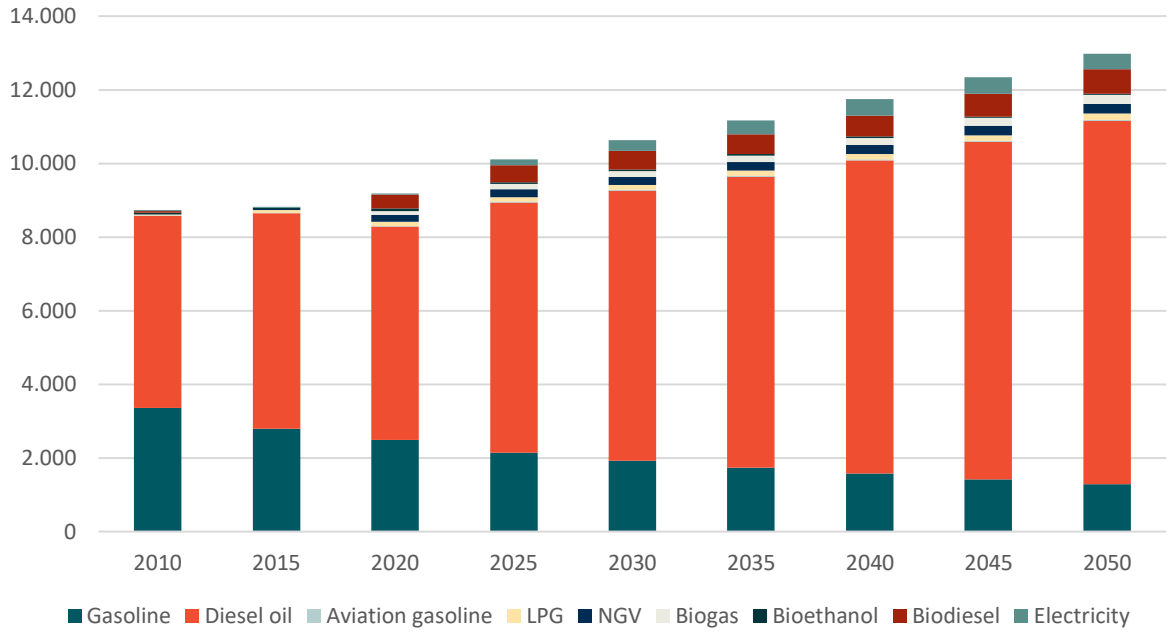
*Blending concentration will remain the same

The forecast for the fuel consumption in the transport sector up to 2050 is shown in Table 5-8 and Figure 5-4 below. By 2050, the total energy consumption of the transport sector increases to 12 972 GWh, of which diesel oil accounts for 9 877 GWh. The consumption of biofuels, i.e. biogas, bioethanol and biodiesel, increases to 942 GWh, accounting for 7.2% of the total consumption; where, if electricity is also included, will account for 10.5% of the total fuel consumption in the transport sector.

Table 5-8 Forecast of fuel consumption in transport sector up to 2050, in GWh

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Gasoline	3 366	2 799	2 493	2 139	1 931	1 743	1 573	1 420	1 281
Diesel oil	5 210	5 852	5 796	6 799	7 326	7 894	8 506	9 166	9 877
Aviation gasoline	11	17	14	23	24	25	26	28	29
LPG	26	63	118	126	133	140	147	154	162
NGV	1	32	181	208	219	230	242	254	267
Biogas	1	1	98	149	164	182	201	222	245
Bioethanol	47	35	72	45	41	37	33	30	27
Biodiesel	38	0	381	461	497	535	577	622	670
Electricity	37	23	26	165	297	389	439	448	415
Total	**8 736**	**8 821**	**9 178**	**10 116**	**10 632**	**11 174**	**11 744**	**12 343**	**12 972**

Figure 5-4 Energy consumption forecast of transportation up to 2050



5.3 Energy consumption forecasts of the Industry sector

In 2020, the consumption of the industry sector accounted for 15% of the total final energy consumption (see Figure 2-6). There is so much uncertainty in the future energy consumption of Estonian industry today that it is extremely difficult to forecast the level of energy consumption even for the next couple of years, let alone the end of the next EU energy saving reporting period (2021-2030) or even further into the future (2050). The uncertainty is further increased by political decisions and targeted subsidies, which do not favour market economic development.

Since the improvement of the energy efficiency of industrial enterprises and, consequently, the reduction of consumption, is dependent on the enterprises themselves, no state aid is foreseen here. The enterprises are only requesting for the government to maintain a normal business environment to survive in the intensifying competition. This includes the elimination of the renewable energy fee included in the electricity price, the establishment of a tax ceiling, or special features of the excise tax for energy-intensive productions etc.

Textbox 5-4 Key assumptions and other considerations taken when calculating the baseline scenario for the industry sector

The base scenario of the industry's future energy consumption has assumed that energy consumption will generally remain at the level of 2021 until 2030 and will increase slightly thereafter. Growth in the activity of the industry sector is assumed to increase by 1.5% per year. It is also assumed in the baseline scenario that a new bio products factory will be completed in Estonia by 2030, and that new electricity renewable energy production capacities would be continuously built starting in 2024. The given assumptions also align with the assumptions given in the update of the Energy Roadmap.[118]

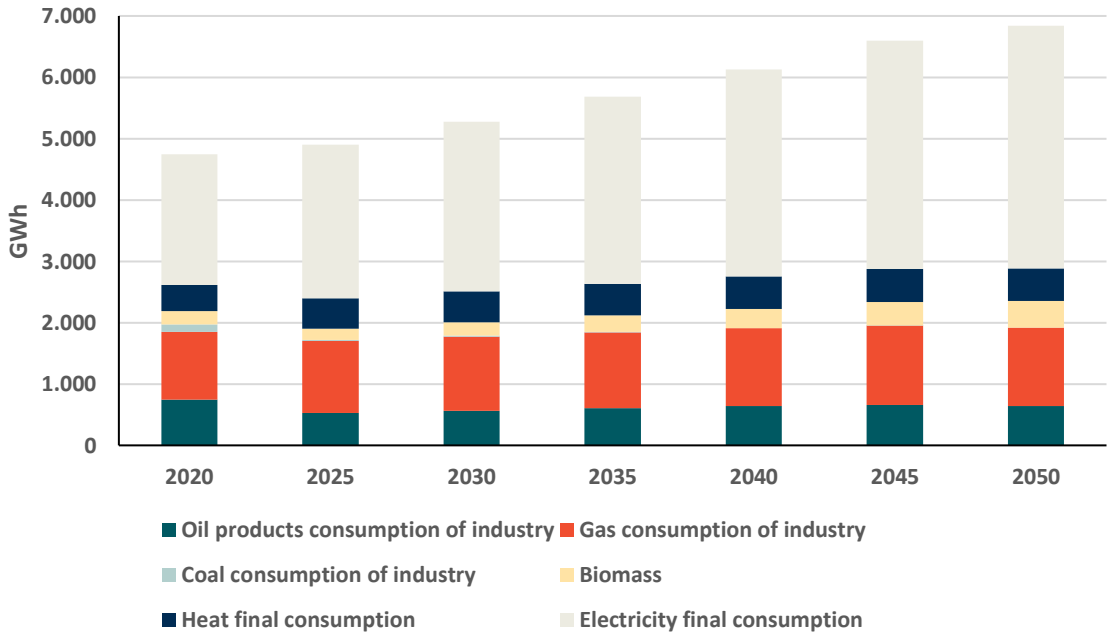
[118] Green Tiger. Energy roadmap update – roadmap 2023 (in Estonian). Available at: https://rohetiiger.ee/wp-content/uploads/2022/10/Teekaardilugu2023-1.pdf

The forecast for the **fuel, heat, electricity, and total energy consumption in the industry sector** in the baseline scenario up to 2050 is shown in Table 5-9 and Figure 5-5 below.

Table 5-9 Forecast of fuel, heat, electricity, and total energy consumption until 2050, in GWh

	2020	2025	2030	2035	2040	2045	2050
Electricity	2 129	2 503	2 764	3053	3372	3727	3958
Natural Gas	1 101	1 178	1207	1236	1267	1298	1279
Oil products	749	522	560	600	632	647	638
Heat	430	490	502	514	527	540	532
Biomass	218	189	225	267	318	378	430
Coal	118	16	18	13	9	11	0
Total energy	**4 745**	**4898**	**5276**	**5 684**	**6 124**	**6 598**	**6 836**

Figure 5-5 Final energy consumption forecast of industry (baseline scenario)



5.4 Final energy consumption forecast in the baseline scenario

The forecast for the **total final energy consumption by sector** up to 2050 is shown in Table 5-10, Figure 5-6, and Figure 5-7 below.

According to forecasts (see Figure 5-6 and Figure 5-7):

- The share of the transport sector will increase from 29% in 2020 to 33% in 2050;
- The share of the industrial sector increase from 15% in 2020 to 19% in 2050;
- The share of household energy consumption in final consumption will decrease from 35% in 2020 to 28% in 2050;
- The share of the service sector will decrease slightly from 17% in 2020 to 16% in 2050;
- The share of agriculture in the total final consumption was about 4% in 2020. It will decrease to about 3.3% in 2050. It has been assumed that the share of agriculture will remain practically at the same level in 2050 as it was in 2020.

Table 5-10 Final energy consumption forecast by sector until 2050 (baseline scenario)

	2020	2025	2030	2035	2040	2045	2050
Residential	10.99	10.78	10.62	10.46	10.31	10.15	9.99
Service	5.48	5.57	5.58	5.59	5.60	5.61	5.62
Transport	9.18	10.12	10.63	11.17	11.74	12.34	12.97
Industry	4.75	4.90	5.28	5.68	6.12	6.60	6.84
Agriculture	1.27	1.27	1.27	1.27	1.27	1.27	1.27
Total energy	**31.7**	**32.6**	**33.4**	**34.1**	**3 5,0**	**535.9**	**36.6**

Figure 5-6 Forecast of final energy consumption until 2050 (baseline scenario)

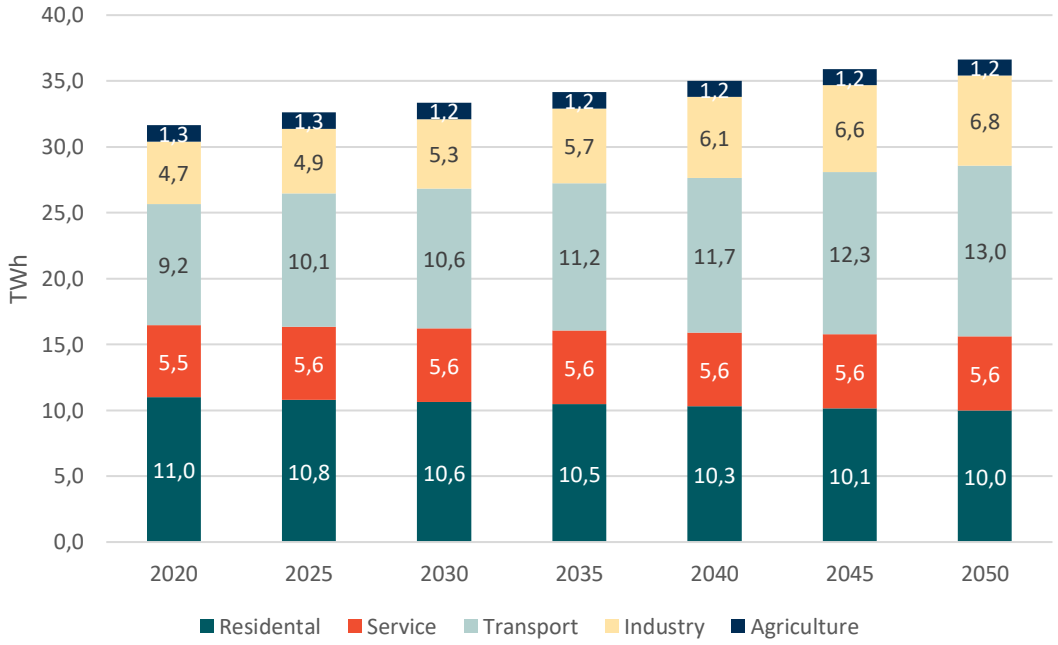
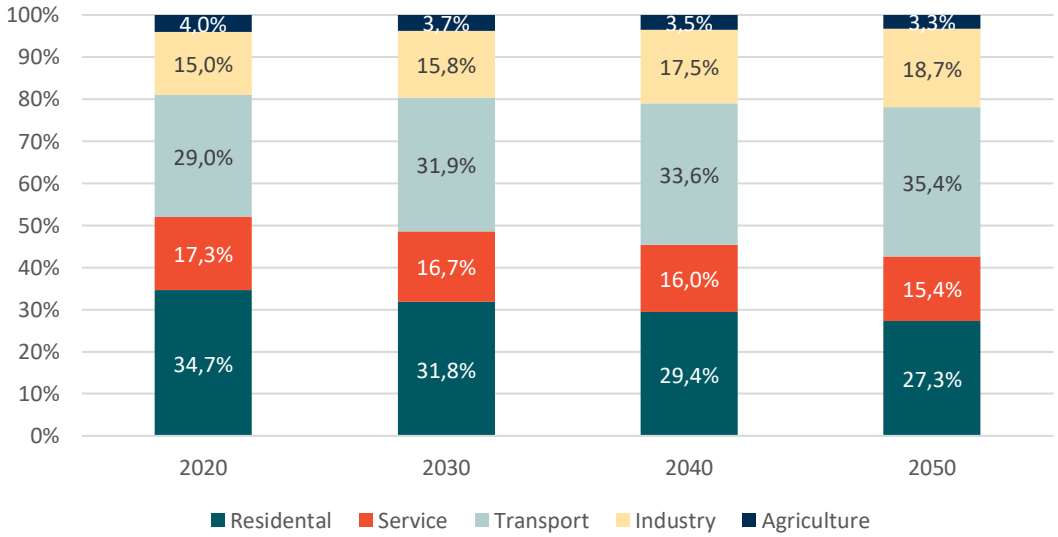


Figure 5-7 Share of sectors in final energy consumption



5.5 Conclusion and next steps

The previous subchapters in Chapter 5 have provided the energy consumption forecasts of the key sectors in the baseline scenario, and have also outlined the key assumptions and considerations that were taken. The submission of this report is also accompanied by an Excel document, which provides the raw data (and their sources) used to develop the tables and graphs in this report.

The information gathered in Deliverable 2 will also contribute to the analysis of the impacts of different energy efficiency pathways in Deliverable 3. Within this deliverable, the main energy indicators that are used to calculate energy savings of measures are:

- ✓ Final energy consumption;
- ✓ Electricity (part of final energy consumption);
- ✓ Heating energy, which includes fuels, district heating, and part of final energy consumption).

The main economic activity indicators that are used to track the baseline are related to sectoral growth:

- ✓ Industrial growth index;
- ✓ Residential square meters evolution;
- ✓ Service square meters evolution;
- ✓ Transport activity, including passenger transport (passenger-kilometer) and freight (tonne-kilometer).

In the next deliverable, the impacts of energy efficiency measures on climate and other socio-economic aspects will also be discussed using the following indicators:

- Primary energy consumption;
- Greenhouse gas emissions;
- Unit cost of savings (€/MWh);
- Size of government budget;
- Size of private investments;
- Revenue from taxes;
- No. of new jobs created;
- Other co-benefits.

Annex 1 - Summary of Energy Efficiency Measures from 2014 to 2020

Table 0-1 Summary table of energy efficiency measures implemented in the period 2014-2020

	Measure	Semi-quantitative impact	Type of measure	Energy savings	
				ktoe	GWh
RESIDENTAL SECTOR					
1.	Renovation of apartment buildings (2014-2020)	High	Fiscal	20.15	234.39
2.	Renovation of private buildings (2019-ongoing)	Medium	Fiscal	1.84	21.35
3.	Renovation of rental buildings (2016- ongoing)	Low	Fiscal	0.03	0.37
4.	Atmospheric air protection program, including heating equipment for apartment associations (2014-ongoing)	Low	Fiscal	0.71	8.28
	Sub-Total			**22.73**	**264.39**
TRANSPORT SECTOR					
5.	Eco-driving (2011-ongoing)	High	Regulatory	10.05	116.83
6.	Walking and cycling roads (2015-2018)	High	Fiscal	12.77	148.49
7.	Mobile speed cameras (2019-ongoing)	Low	Fiscal	0.04	0.47
8.	Time-based road use fee (2018-ongoing)	Medium	Economic	3.8	44.21
9.	Electric car purchase and rental programme (2019- ongoing)	Medium	Fiscal	1.19	13.84
	Sub-Total			**27.85**	**323.85**
SERVICE SECTOR					
10.	Aid for energy and resource-efficient processing of fishery and aquaculture products (2017-ongoing)	High	Fiscal	2.98	34.61
11.	Renovation of healthcare centres (2016- ongoing)	Low	Fiscal	0.13	1.53
12.	Modernisation of street lighting (2016-ongoing)	Medium	Fiscal	0.71	8.30
13.	Renovation of kindergarten (2017-ongoing)	Medium	Fiscal	0.93	10.79
14.	Renovation of social care homes	Low	Fiscal	0.09	1.02

	Measure	Semi-quantitative impact	Type of measure	Energy savings	
				ktoe	GWh
	(2017-ongoing)				
15.	Renovation of school buildings (2018-ongoing)	Medium	Fiscal	1.02	11.85
16.	Renovation of university and R&D institutions (2016ongoing)	Medium	Fiscal	0.60	6.99
17.	Support for improving the energy efficiency of coastal fishing vessels (2019- ongoing)	Low	Fiscal	0.05	0.56
19.	New childcare and pre-primary education infrastructure (2016- ongoing)	Low	Fiscal	0.24	2.77
	Sub-Total			**6.74**	**78.42**
INDUSTRY SECTOR					
20.	Energy and resource efficiency in industries (2016-ongoing)	High	Fiscal	12.62	146.75
21.	Electro intensive enterprises tax reduction (2018-ongoing)	High	Economic	4.49	57.41
	Sub-Total			**17.77**	**204.16**
GENERAL CROSS-CUTTING					
22.	Fuel and energy excise taxes and renewable energy fee (2012-ongoing)	High	Economic	623.55	7 251.86
23.	Electricity smart meters (2015-ongoing)	High	Regulatory	57.51	668.86
24.	Energy efficiency investments by electricity distribution companies (2020-ongoing)	Low	Economic	0.09	1.00
25.	Profit distribution based corporate income tax (1991-ongoing)	High	Fiscal	35.10	408.22
26.	Oil boiler replacement (2015-ongoing)	Low	Fiscal	0.84	9.77
	Sub-Total			**717.09**	**8 339.74**
	TOTAL			**792**	**9 211**

Source: Ministry of Economic Affairs and Communications (January, 2023)

Annex 2 – Interview questions

The following list is an overview of the main questions that were sent to most interviewed stakeholders. The wording of the main questions can differ from stakeholder to stakeholder, but the intention of the question was the same for all. Questions were submitted in Estonian; an English translation of these questions is provided in *italics*.

Millise sektori või valdkonna esindajate juures näete suurimat energiasäästupotentsiaali?
What sector or field has the biggest potential for energy efficiency?

Millised meetmed ja tegevused omavad suurimat energiatõhustamise potentsiaali ning milliste meetmete teostamine on kõige lihtsam või parima tasuvusega?
What measures and activities have the biggest energy efficiency potential and what measures are easiest to implement or with the best payback time?

Millistele meetmetele peaks riiklikult keskenduma energiasäästu ning renoveerimise vallas? Kui suurt rolli näete toetusmeetmetel energiatõhususe eesmärkide saavutamisel?
What measures should be focused on at the state level in the field of renovation and energy efficiency? How big a role does grants have in the energy efficiency goals?

Millised on energiasäästumeetmete ulatuslikumaks rakendamiseks vajalikud tegevused riigi poolt aastani 2050?
What are the activities necessary by the state to implement energy efficiency measures further until 2050?

Milline on (sektor sõltuvalt intervjuust) üldine perspektiiv 2050. aastani, kuidas prognoosite Eesti (sektor sõltuvalt intervjuust) energiaintensiivsust ja summaarset energiakasutust?
What is the outlook of (sector based on stakeholder) until 2050, how do you prognose energy intensity and absolute energy use?

Millised barjäärid takistavad ulatuslikumalt energiatõhususe meetmete elluviimist? Mida saaks teha paremini?
What are the barriers to further implementing energy efficiency measures? What could be done better?

Kas ja kuidas on (sektor sõltuvalt intervjuule) valmistunud energiakriisiks, kuidas on tegevust mõjutanud kõrged energiahinnad?
How have (sector based on stakeholder) prepared for the energy crisis, and how has high energy prices changed the activities of enterprise?

The following list is an overview of questions specific to interviewed stakeholders:

A.Le Coq AS

Kuidas olete rahul seni ellu viidud meetmetega? Millised on olnud ettevõtte rohepöörde elluviimise positiivsed/negatiivsed mõjud?

How have you been satisfied with the measures implemented to this day? What have been the positive and negative aspects of implementing green transition in the company?

Estonian Association of Construction Entrepreneurs

Kuidas hindate Eesti hoonefondi praegust energiakasutust? Millised on peamised probleemid, kus on kõige rohkem potentsiaali olukorda parandada?
How do you assess the current use of energy in apartment sector? What are the main problems, where is the biggest potential for energy efficiency.

Milline on ehitussektori võimekus hoonete energiatõhustamisele seatud eesmärkide saavutamiseks?
What is the construction sector's capacity to achieve building energy efficiency goals?
Kuidas hindate Eesti rekonstrueerimisstrateegia eesmärki jõuda hoonete ümberehitustega nii kaugele, et pea kõik täna olemasolevad hooned saavutaks aastaks 2050 vähemalt energiaklassi C?

How do you assess the goal to achieve a sufficient renovation rate that almost all existing buildings will reach energy class C by 2050?

Ministries

Milliseid muudatusi seadusandluses oleks vaja teostada ja, milliseid meetmeid tuleks luua, et Eesti energiatõhusust suurendada?
What changes in the legislature should be made, and what measures should be implemented to increase energy efficiency in Estonia?

Estonian Cell AS

Millist mõju omab energiatõhusus järgnevatel aastakümnetel ettevõtte tegevuse jätkusuutlikkusele?
What is the impact of energy efficiency on the sustainability of the enterprise in the following decades.

Täiendavad punktid: uus koostootmisjaam, lokaalsed lahendused, biogaas, elektrihind.
New planned CHP, local energy production, biogas, price of electricity.

Estonian Central Association of Property Owners

Kuidas hindate Eesti kodude energiatõhususe hetkeseisu ja kodude energiatõhusamaks muutmise tempot?
Assessment on Estonian homes energy efficiency and renovation pace.

Mida saaks edaspidi teha paremini, et suurendada kodude renoveerimise mahtu?
What can be done better to increase renovation volumes?

Kui suur osakaal Eesti kodudest saavutavad Teie hinnangul 2050. aastaks vähemalt energiaklassi C?
Assessment of the proportion of houses that will achieve energy class C by 2050.

Consumer Protection and Technical Regulatory Authority

Kuidas on seni energiaauditite süsteem end õigustanud, mida saaks teha paremini, tarbimispõhine kohustuse tekkimine, miinimumnõuded.
How has the energy audit obligation justified itself, and what can be done better?

IVIA

Millised tööstusettevõtted ja millises mahus tegutsevad Ida-Virumaal 10, 20, 30 aasta pärast?

What kind of industries and at what volumes will be active in Ida-Viru County after 10, 20, 30 years?

Kuidas muutub Ida-Virumaal tegutsevate ettevõtete energiamahukus?
How will the energy intensity of enterprises in Ida-Viru County change

Millist mõju omab tootmisüksuste rajamisele Õiglase Ülemineku protsess?
What is the impact of Just Transition Fund on production facilities?

Enefit Power

Kuidas hindate tööstusparkide mõju energiakasutusele?
How do you assess the impact of industrial parks to energy use?

Utilitas AS and EJKÜ

Kui suurt potentsiaali energiasäästuks näete soojuse tootmise perspektiivist (näiteks pikaajaline soojuse akumulatsioon, uudsed lahendused)?
How big potential is there in the perspective of producing heat energy (for example lõng term accumulation of heat, new solutions)?

Milliseid tehnoloogilisi lahendusi kasutatakse 2050. aastal kaugküttevõrkude soojusega varustamisel ja, millist mõju omavad need energiakasutusele?
What technological solutions will be used in 2050 for producing heat for DH networks and what is the impact of these solutions on energy use?

Kuidas hindate Eesti hoonefondi renoveerimise mõju kaugküttesoojuse tarbimisele pikemas perspektiivis? Millises ulatuses mõjutab kaugküttesoojuse tarbimist uute tarbijate lisandumine?
What is the assessment of renovation to DH use in the long term? How will new DH consumers affect the outcome?

Millist mõju omab kaugjahutuse jätkuv arendamine energiatõhususele?
Impact of district cooling on energy usage?

Konkurentsiamet, regulatiivsed probleemid – kas on takistanud innovatsiooni?
Has innovation been blocked by regulatory barriers?

Estonian Chamber of Commerce and Industry

Millised on ettevõtete pikaajalised probleemid energiatõhususega seonduvate investeeringute juurutamisel?
What are the long-term problems of implementing energy efficiency measures?

Millistes valdkondades on vaja energiatõhususe suurendamiseks riikliku abi?
What sectors would need state aid to increase energy efficiency?

Tööstussektorite elujõulisus ning prognoosid?
Competitiveness of industrial sector and prognosis.

Environmental Investment Centre

Energiasäästukohsutused, kas on realistlikud?

Energy saving obligations – how realistic are they?

Estonian Environmental Research Centre

Keskkonnajalajälg – kas peaks renoveerimise nõuetega siduma? Energiatõhususe nõuded on energia lõpptarbimise osas – kas metoodikat peaks muutma, et soosida keskkonnasõbralikke materjale?
Environmental impact – should it be tied to renovation requirements? Energy saving obligations is for the end use – should the methodology be changed to encourage the use of environmentally friendly materials.

Kaugjahutus, jahutusseadmed ning jahutusagensid.
District cooling, cooling agents, cooling equipment.

Agricultural Registers and Information Board

GBER, nõuded, hanked ning eelnimetatud tegevustega seonduvad bürokraatlikud probleemid.
GBER, obligations, tender process, and problems related to mentioned keywords