Co-funded by the Horizon 2020 programme of the European Union

Energy Efficiency Trends and Policies in Estonia

Monitoring of EU and national energy efficiency targets

Report prepared by

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Tallinn, October 2021

Co-funded by the Horizon 2020 programme of the European Union

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1 CONTENT OF THE REPORT

This report is dedicated to the development of energy efficiency indicators in Estonia between 2014 and 2019. It analyses the main trends in energy consumption and energy efficiency since 2014 based on data and indicators from the ODYSSEE database.

The report also gives an overview of the main national energy efficiency policies and measures in Estonia by end-use sectors.

The main focus is on the policies which were reported in the second Estonian Energy Efficiency Action Plan 2014-2020 (NEAP 2) [1] but also some of the policies reported in the new Estonian National Energy and Climate Plan 2030 (NECP 2030) [5].

Estonia's goal for 2020 was to maintain the level of final energy consumption at the level of 2010. The renewed "Estonia 2020 Competitiveness Plan" approved by the Government of the Republic in April 2013 also provides the same energy efficiency target, according to which the final energy consumption in 2020 must not exceed the 2010 level [2]. 2020.

According to Statistics Estonia, the final energy consumption in Estonia in 2010 was 119 PJ. As a result of the implementation of Estonia's energy saving policy, savings in final energy consumption of 18 PJ/a or 13.1% had to be achieved in 2020 [2].

According to Article 7 of the Energy Efficiency Directive, for the period from 1.01.2014 to 31.12.2020, the annual energy savings must be 1.5% of the annual energy sales to final customers. Estonia's general energy efficiency obligation in the period 2014–2020 is 7101 GWh, which is provided by the Energy Management Organization Act [8].

2 ECONOMIC AND ENERGY EFFICIENCY CONTEXT

2.1 The ODYSSEE and MURE database

The background data for this study are from the two databases: the ODYSSEE database for energy efficiency indicators and the MURE database for energy efficiency policies and measures. Both databases are regularly updated by the network of national experts from all EU Member States. The databases are managed by a technical coordination, namely by Enerdata for ODYSSEE and Fraunhofer-ISI for MURE. The two databases can be accessed at http:/www.odyssee-mure.eu/.

2.2 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 surprised positively, averaging almost 5% over the last three years. Despite the rapid growth, there should be no significant internal imbalances in the Estonian economy.

In addition to actual economic growth, Table 1 also shows the change in the volume indices of industrial production, development in producer and consumer prices compared to the previous year.

Table 1. Key annual development indices of economy, 2014–2019, %

Annual index	2014	2015	2016	2017	2018	2019
GDP (CLV)	3.0%	1.8%	3.2%	5.5%	4.4%	5.4%
Industrial production volume (2015=100)	100%	100%	112%	126%	150%	145%
Producer prices	-1.6%	-2.0%	-0.7%	3.6%	2.6%	-0.2%
Consumer prices	-0.1%	-0.5%	0.1%	3.4%	3.4%	2.3%

In 2019, Estonia's GDP at current prices amounted to 28.04 thousand million euros. The average growth rate of the GDP over the period 2014-2019 has been 39% and annual growth per year about 6.8% (Figure 1).

Throughout the year, value added was driven mainly by activities focused on domestic consumption, in particular information and communication, trade, and professional and technical activities, contributing a total of 2.6 percentage points. Manufacturing still had a strong impact, although its value-added growth declined in the last quarter as exports decreased. Economic growth was also supported by a sharp increase in the value added of the agricultural sector. The biggest negative impact was in the energy sector due to the declining competitiveness of oil shale based energy.

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 external demand has weakened significantly and export growth has remained low.

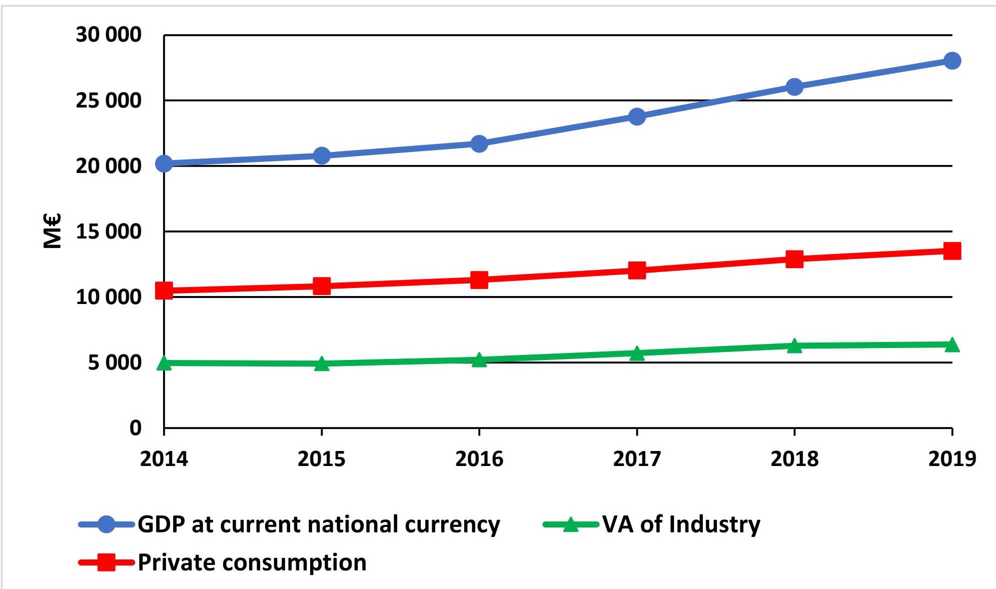


Figure 1. Macroeconomic development (M€ 2019)

Due to the more volatile developments in the global economy, the contribution of external factors decreased in 2019 and inflation slowed to 2.3% in Estonia and 1.2% in the euro area. The rise in prices of services accelerated during the year, while the rise in energy prices slowed down and alcohol prices fell in the second half of the year due to the fall of excise duties.

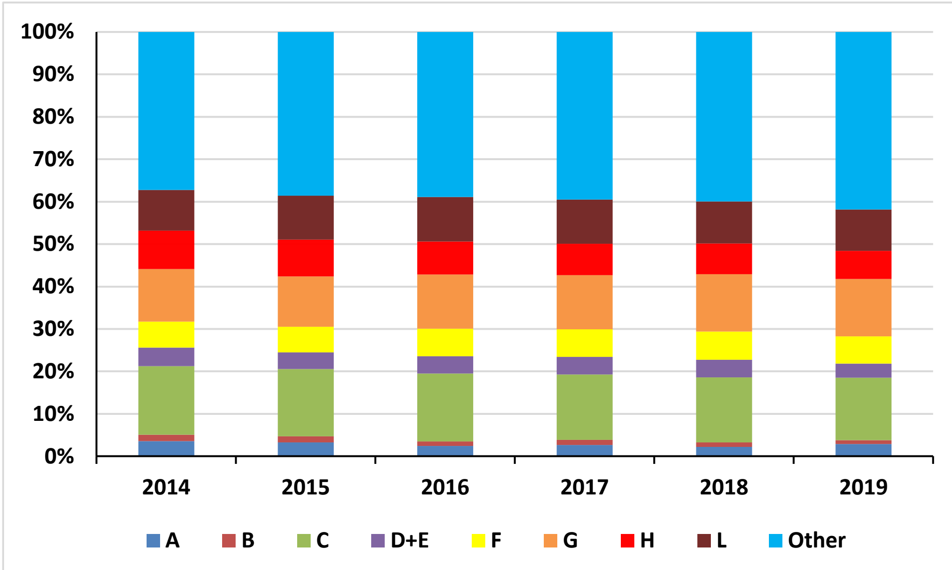
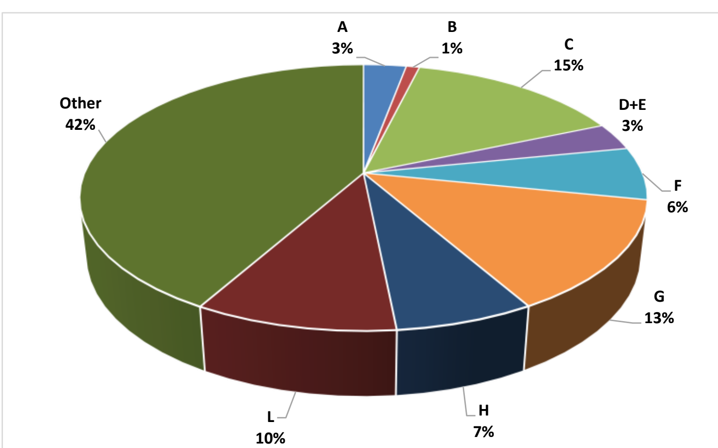


Figure 2. Structure of value added, 2014–2019

The structure of value added in the observed period 2014-2019 is quite stable (see Figure 2). In 2019, the share of real estate activities, wholesale and retail trade in value added has increased (1.4% and 2.3% respectively) and the share of other sectors has decreased compared to 2014 (manufacturing 1.4% and transport / storage 2.3%, respectively).

Regarding the current (2019) structure of the VA, manufacturing has the largest share in VA (14.7%, NACE code C), followed by wholesale and retail trade (13.5%, NACE code G) and real estate (9.7%, NACE code H). The structure of VA in 2019 is shown in Figure 3.



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

Figure 3. Structure of the value added in 2019

The development of some macro level indicators during the period 2014–2019 as relative to 2014 is presented in Figure 4.

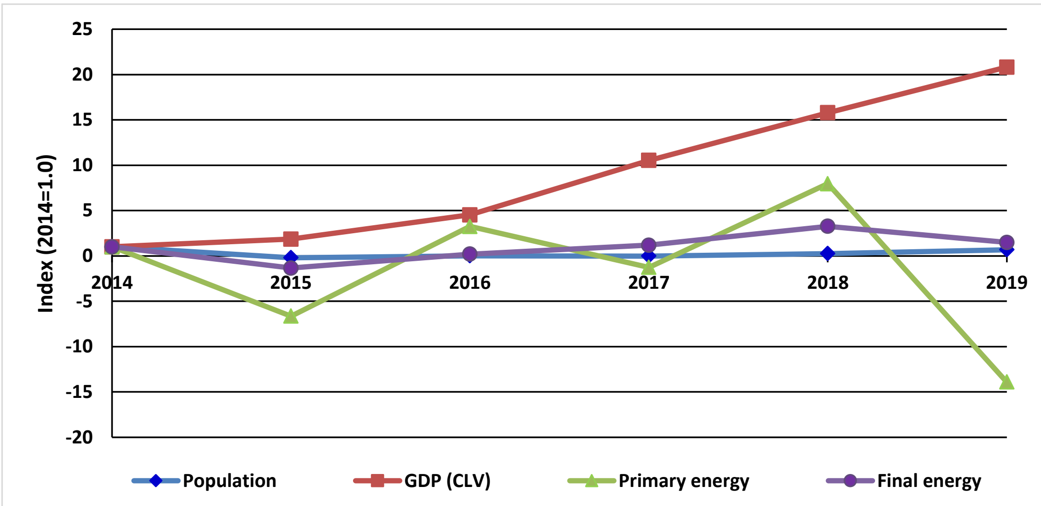


Figure 4. Development relative to 2014

2.3 Energy consumption trends by fuel and by sector

In Estonia, security situation in energy supply is quite good as the total import dependency is low. For years 1995-2010, 25-30% of the energy consumed has been imported. However, since 2014, the share of imports has increased significantly, now reaching an average of 50% of total energy consumption. The share of 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 proved to be more expensive than imported electricity due to high CO_2 taxes.

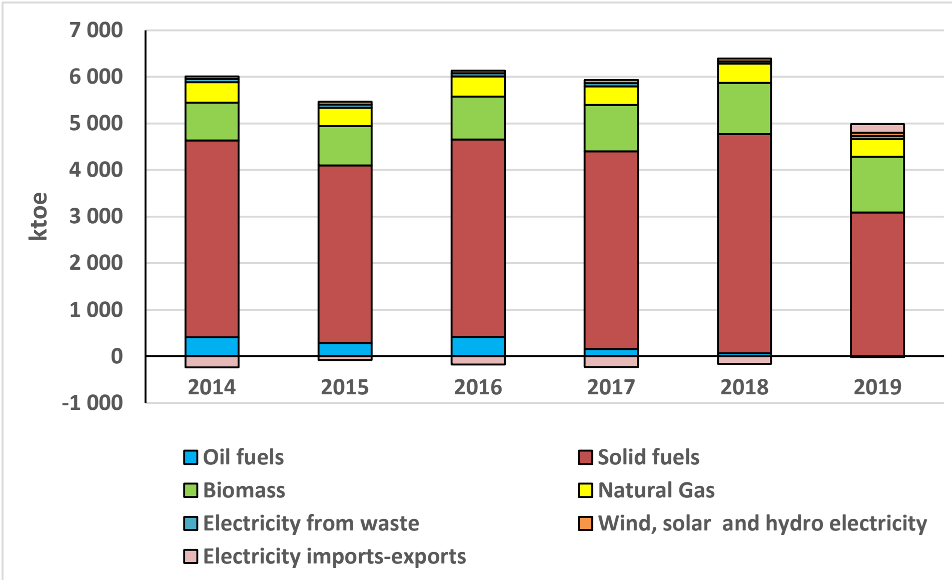


Figure 5. Primary energy use, 2014–2019

The structure of primary energy supply sources (see Figure 5) has been fairly stable however, changes can be seen in 2019. Solid fossil fuels (mainly local oil shale), which consistently accounted for 71–76%, have fallen to 62% in 2019. The share of oil-based fuels, as well as their absolute volume, has been steadily declining as they have been gradually replaced mainly by biomass. The share of biomass is relatively high and has grown from 14% in 2014 to 24% in 2019. As for other renewable energy sources, the share of wind energy has been constantly growing, but its share in the structure of primary energy supply is still small (about 1%). The share of natural gas has remained the same – 7-8%.

Final energy consumption has been fairly stable throughout the period 2014-2019, ranging from 2.7-2.9 Mtoe per year. The sectoral structure of final consumption is shown in Figure 6.

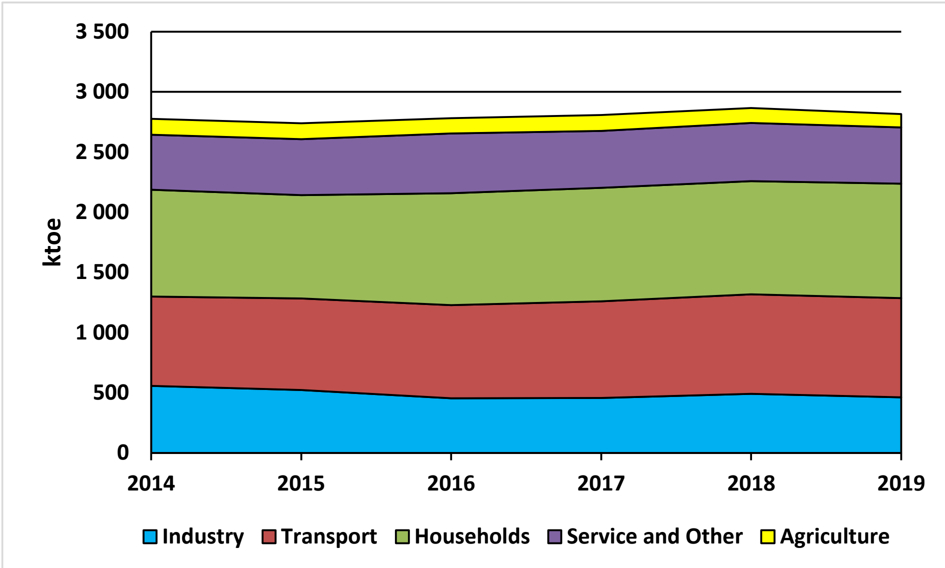


Figure 6. Final energy use by sector, 2014-2019

Most of the final energy consumption is consumed by households, but its share has slightly increased. The second largest share of final consumption goes to transport, and the share of this sector is also growing. In 2014-2019, energy use in the tertiary sector has remained practically the same, both in absolute and relative terms. However, energy consumption in the industrial and agricultural sectors is on a declining trend.

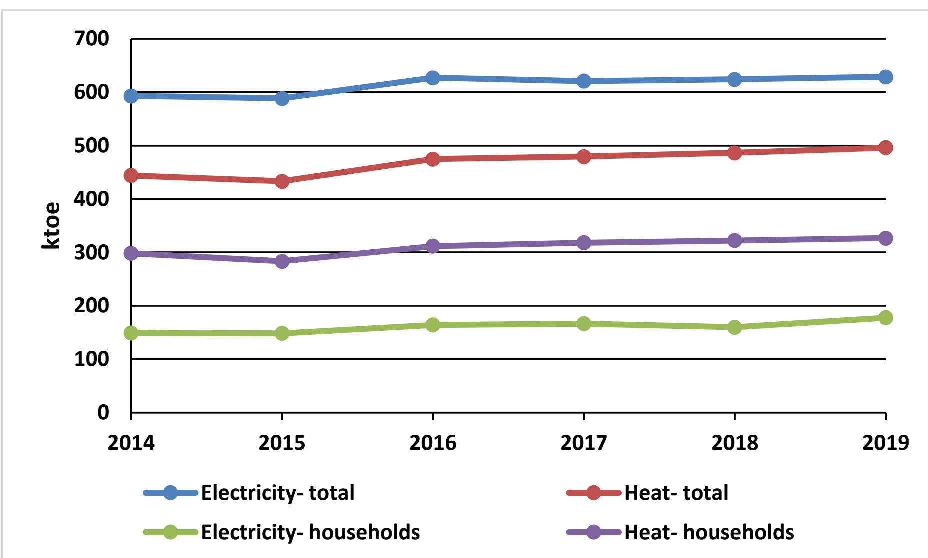


Figure 7. Electricity and heat consumption, 2014–2019

The dynamics of final electricity and heat consumption since 2014 is presented in Figure 7. In the period 2014-2019, electricity and heat consumption have increased by 6% and 12%, respectively. Household electricity consumption has increased by 19% and heat consumption by 10%.

2.4 The policy background to energy efficiency

The *Estonian National Strategy on Sustainable Development – Sustainable Estonia 21*[1], is the most general national strategy document aimed at developing Estonia until the year 2030 and integrating economic factors with the principles of sustainable development. The national strategy is based on the *Sustainable Development Act*, adopted by the Parliament in 1995. The act established the principles for the sustainable use of the natural environment and resources.

Several essential development documents have been adopted during last years. The *National Reform Programme 'Estonia 2020'*[2] (approved by the Government in 2011) established two major priorities of the Government for moving towards environmentally sustainable economy and energy sector:

- implementing long-term structural changes in the energy sector in harmony with Estonia's energy security and energy efficiency objectives;
- reducing the general resource-intensity, including energy intensity, of the economy, through increasing energy efficiency. In the Programme of the Government an ambitious goal has been set for making final energy consumption more efficient in Estonia – to keep the final energy consumption in 2020 at the level of 2010, i.e. reducing final consumption of energy by approx. 11% compared to the forecast for 2020. Keeping final consumption of energy at the 2010 level will require decreased energy use combined with the increase in energy efficiency. This will result in reduced emission of GHG related to production and consumption of energy. Regarding GHG emission the National Reform Programme 'Estonia 2020' provides that according to the EU goals Estonia's emissions from the non-ETS sectors should not increase more than 11% by 2020 compared to the 2005 level.

[1] https://www.riigiteataja.ee/akt/940717

[2] https://vv.riigikantselei.ee/sites/default/files/content-editors/Failid/eesti2020/ee2020_2019-2020_30.05.2019.pdf

The National Renewable Energy Action Plan up to 2020 (NREAP)[3] was approved by the Government in November 2010. The national goals for Estonia in the EU 20-20-20-package require 25% share of energy from renewable sources in gross final energy consumption by 2020 and allow 11% increase of the greenhouse gas emissions outside the emission trading directive scope by 2020, if compared to the 2005 level. The 10% share of renewable energy sources in the road transport fuels by 2020 is an EU-wide common goal. The NREAP presents estimations, planned policies and measures for achieving the national targets. Implementation plan for years 2010-2013 of "National Renewable Energy Action Plan up to 2020" is also adopted.

It has to be noted that the Plan predicted the share of renewable energy in final consumption to be 20.9% in 2010, but, actually, the indicator reached to 24.0%.

Estonia's energy development plan to 2030 (ENMAK 2030)[4].

ENMAK 2030 describes the vision of the development of the Estonian energy economy and selects the most optimal solutions by sector based on the overall goal of ensuring energy supply to consumers at market-based prices and availability, in line with the EU's long-term energy and climate policy goals.

The fulfilment of the general objective of the Estonian Energy Economy Development Plan in 2030 can be characterized by the following results:

- there is a free, subsidized and open fuel and electricity market;
- electricity generation capacity in Estonia is sufficient if the N-1-1 criterion is met (in terms of generation equipment);
- the Estonian electricity system is synchronized with the synchronous area controlled in the European Union;
- electricity production from renewable energy sources accounts for 50% of final domestic electricity consumption, and the construction of new renewable electricity generation facilities takes place under open electricity market conditions without

[3] https://www.mkm.ee/sites/default/files/taastuvenergia_tegevuskava.pdf

[4] https://www.mkm.ee/sites/default/files/enmak_2030.pdf

additional domestic subsidies;

- the share of the largest source of supply in the Estonian gas market does not exceed 70%;
- the share of the largest gas seller in the Estonian gas market does not exceed 32%;
- there has been a significant decrease in market concentration in the gas market and the level of gas market concentration HHI is below 2000;
- district heating systems have been maintained in areas where they are sustainable and able to provide consumers with affordable and environmentally friendly energy solutions;
- 80% of the heat produced in Estonia is based on the renewable energy sources, the importance of local energy sources in heat production is further increased by peat. The goal is largely market-based;
- the average total duration of interruptions in the distribution network per place of consumption per year does not exceed 90 minutes, which is achieved without additional burden on the consumer tariff;
- energy efficiency of buildings has increased through reconstruction activities (40% of small dwellings – C or D energy efficiency class; 50% of apartment buildings – C; 20% of non-residential buildings – C);
- the new buildings correspond to the value of the energy efficiency number of the nearly zero energy building;
- 37% of the total net floor area of buildings used by the central government is located in buildings that meet at least the minimum energy efficiency requirements that came into force in 2013;
- the fuel consumption of the vehicle fleet in 2030 will not exceed the level of 2012 (8.3 TWh).

The objectives of the *Estonian Energy Sector Development Plan* are achieved primarily through this development plan, but agreements concluded in the EU (incl. Directives, regulations, etc.)

or with other countries can also make an important contribution to their fulfilment.

Estonia's 2030 National Energy and Climate Plan ('NECP 2030')

NECP 2030 has been drawn up on the basis of the applicable development documents, which in turn had been drafted taking into consideration EU and international environmental, energy and climate aims.

The key objectives of Estonia's NCEP 2030 are:

• Achieve of an 80% reduction in GHG emissions by 2050 (including 70% by 2030); In 1990, greenhouse gas (GHG) emissions were 40.4 Mt CO_{2ekv} (excl. LULUCF) and in 2019 13.98 Mt CO_{2ekv} (incl. 12.3 Mt CO_{2ekv} from the energy sector). The projected GHG emissions for 2030, when the existing and additional measures under the NCEP 2030 are applied, are 10.7-12.5 Mt CO_{2ekv} (excl. LULUCF);

• Achieve a 13% reduction of GHG emissions by 2030 compared to 2005 levels in the sectors falling under the scope of the Shared Effort Regulation (transport, small-scale power, agriculture, waste management, forestry, industry). According to the 2019 GHG inventory, in 2005 GHG emissions in the sectors covered by the Shared Effort Regulation totalled 6.3 Mt CO_{2ekv}, i.e. in 2030 emissions from the sector might total 5.5 Mt CO_{2ekv} (the exact target for 2030 had to be clear in 2020, when the national emission levels for the period 2021-2030 will be determined for the sectors under the Regulation);

• The share of renewable energy in total final consumption must be at least 42% by the year 2030: In 2030, production of renewable energy will be 16 TWh, which is 50% of final energy consumption, including 4.3 TWh renewable electricity (2018: 1.8 TWh), renewable heat 11 TWh (2018: 9.5 TWh) and transport 0.7 TWh (2018: 0.3 TWh);

• In 2030, final energy consumption must remain at 32-33 TWh: 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 Energy Efficiency Directive) will help keep final energy consumption at the same level. Making primary energy consumption more efficient will help reduce energy consumption.

• Reduction of primary energy consumption 14% (compared to the peak of recent years). In the period 2020-2030, Estonia is capable of reducing primary energy consumption by modernizing the shale industry.

• Ensuring energy security by keeping the rate of dependency on imported energy as low as possible: Use of local fuels is kept as high as possible (including increasing the use of fuel-free energy sources), developing biomethane production and potential uses.

• Meeting the minimum criteria for interconnectivity of electricity grids: Increasing capacity towards Latvia and synchronizing the power grid with the Central European frequency band by 2025.

• Use of research and development and innovation in measures to retain the competitiveness of the economy.

3 Overall assessment of energy efficiency trends

3.1 Overall trends in energy intensity

In the analysis of energy intensity developments at the macro level the growth of GDP in 2014–2019 has to be considered. Throughout the period, the growth of value added was mainly driven by activities focused on domestic consumption, especially information and communication, trade, professional and technical activities. The manufacturing industry still had a strong impact. Economic growth was also supported by a sharp increase in the value added of the agricultural sector. In 2019, domestic demand grew at the fastest pace in the last seven years, 5.2%, and the share of domestic demand in GDP rose to 97.6%[5]. The biggest negative impact was in the energy sector due to the decrease of oil shale energy competitiveness. It should be noted that in 2014–2019, the GDP trend has been on a steady upward trend and the trend of primary energy consumption has been steadily declining (see also Figure 4), therefore the GDP growth rate can be considered as the main factor influencing the overall energy intensity of the economy.

As a result of this GDP growing trend, both the primary and final intensity of Estonian economy have been falling during the whole period of 2014–2019 (see Figure 8). The primary energy intensity of economy has fallen by 28% (5.6% per year in average) from 0.34 koe/EUR2015 in 2014 to 0.24 koe/EUR2015. The decrease of final energy intensity during the same period has been almost at the same level – by 15% (2.9%/a).

The outdoor temperature directly affects energy consumption for space heating, primarily within the domestic and tertiary sectors. Therefore, a part of annual energy consumption, the space heating of buildings in particular, depends on severity of the cold during the heating period. To ignore the impact of annual changes of climate on the energy consumption the adjustment of data on climate are used. Both the primary and final intensity data in Figure 8 have been adjusted for annual climate changes.

The ratio of final energy use to the supply of primary energy can be treated as the most general indicator of energy efficiency at macro level. Over the period 2014–2019 the annual value of

[5]Review of the economy 2019. Ministry of Finance (in Estonian). https://www.mkm.ee/sites/default/files/majandusulevaade_2019_0.pdf /

final to primary energy ratio was fairly stable but still had a growing trend (see Figure 8), indicating the efficiency growth of fuel and energy conversion at the level of whole economy. Nevertheless, the average thermal efficiency of power plants in Estonia (38.6% in 2019) is still significantly lower than the corresponding average indicator in the EU (49.5%)[6].

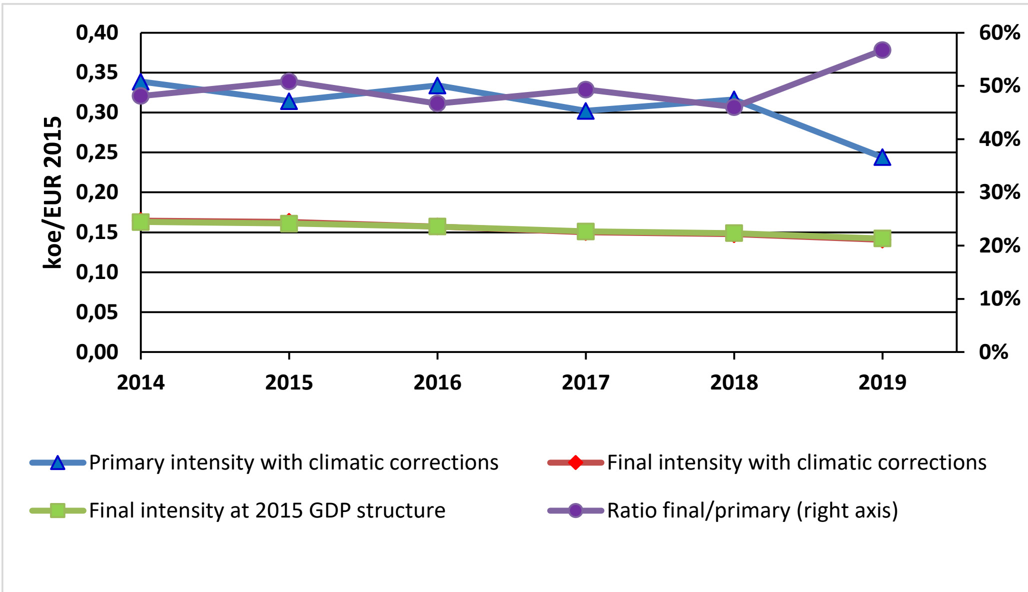


Figure 8. Macro level energy intensity indicators, 2014–2019

To enable more detailed analysis of changes in intensity and also international comparisons, some adjustments have to be made. The adjustment to annual climate enables eliminate the energy consumption differences between years. Another adjustment considers the differences between nominal and real purchasing power (adjustment to PPP) of EURO in Estonia enables more fare comparison of countries using indicators that include economic elements. Table 2 tabulates the observed and adjusted values of primary and final intensity to demonstrate the impact of adjustments to climate and particularly to purchasing power parity. The PPP adjustment reduces the difference between average intensity indicators for Estonia and EU significantly. These differences together with the impact of adjustments are presented in Table 2.

[6] Data by Eurostat

Table 2. Primary and final energy intensity in Estonia and in EU; koe/EUR2015

Indicator, country	**2010**	**2015**	**2019**
Primary energy intensity, observed – Estonia	0.38	0.31	0.24
Primary energy intensity, adjusted to climate – Estonia	0.37	0.31	0.24
Primary energy intensity, adjusted to climate and PPP – Estonia	0.26	0.21	0.16
Primary energy intensity, adjusted to climate and PPP – EU	0.13	0.11	0.11
Final energy intensity, observed – Estonia	0.19	0.16	0.14
Final energy intensity, adjusted to climate – Estonia	0.19	0.16	0.14
Final energy intensity, adjusted to climate and PPP – Estonia	0.13	0.11	0.11
Final energy intensity at constant structure, adjusted to climate and PPP – Estonia	0.19	0.16	0.15
Final energy intensity at constant structure, adjusted to climate and PPP – EU	0.09	0.08	0.08

Source: Odyssee database

The efficiency of energy use in all major branches of economy has increased too, as a declining trend can be observed in energy intensities of major sectors (see Figure 9).

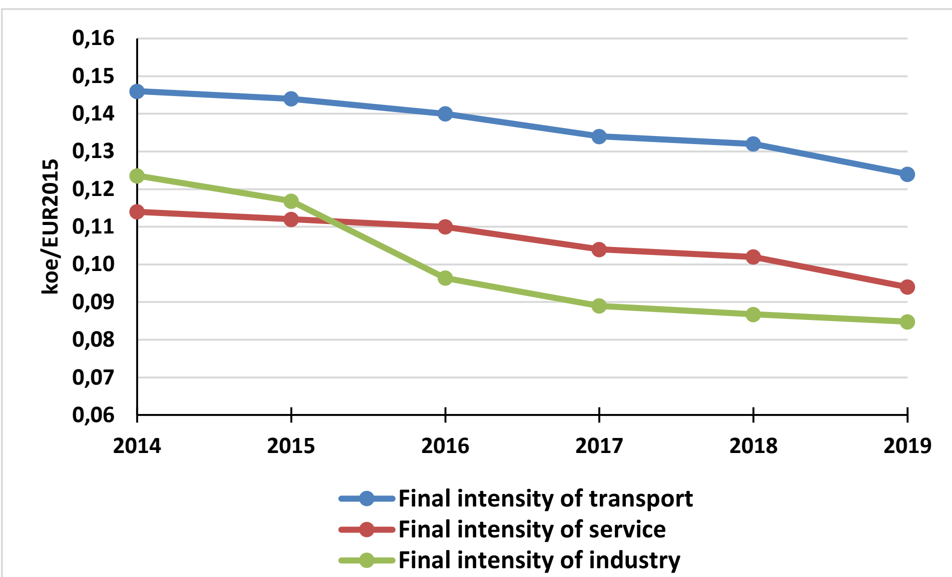


Figure 9. Final energy intensity in major sectors, 2014–2019

Still, in transport and tertiary sectors, where the intensity is very similar, the change in intensity during last five years is insignificant.

3.2 Industry

Several significant changes in the structure of energy use in industry have taken place between 2014 and 2019 (Figure 10). The use of fuel oils has slightly increased both in relative (from 11% to 14%) and absolute (by 3%) terms. The share of natural gas has grown (from 17% to 22%), the increase in absolute terms has been 2%. Consumption of coal has decreased both in relative and absolute terms and the share of oil shale has remained the same. At the same time, the use of wood fuels has decreased from 19% to 5%. The share of electricity has increased from 33% to 40%, but in absolute terms the electricity consumption has increased only by 1%. The share and amount of purchased heat have been both quite stable.

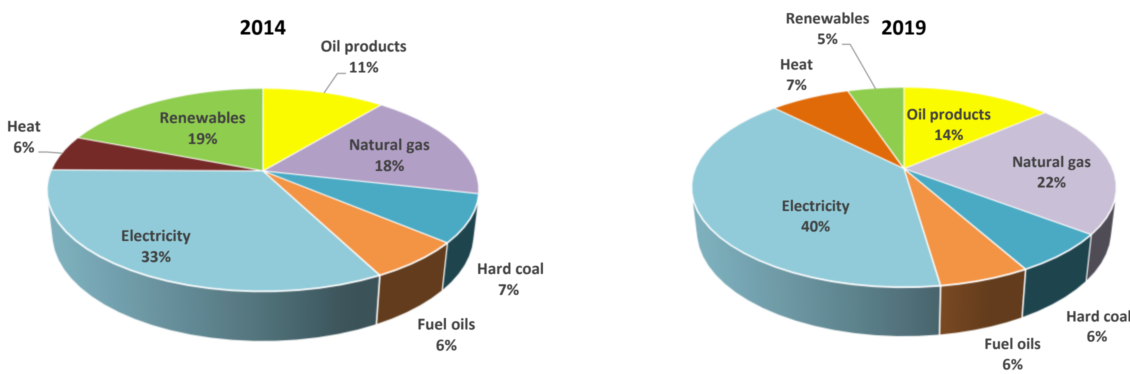


Figure 10. Structure of final energy use of industry

The absolute level of final energy consumption in industry has been fairly stable throughout the period 2014-2019, ranging from 2.7-2.9 Mtoe per (see Figure 6). In 2019, energy consumption in industry was 15.6% less than in 2014. At the same time, the value added (CLV) in industry has grown by 21.8%. Implemented energy efficiency measures and structural changes in final energy have led to lower energy intensity (see Figure 10 and Figure 11). A comparison using PPPs shows that in both industry and manufacturing, Estonia's energy intensity indicators are lower than the EU average (see Figure 11).

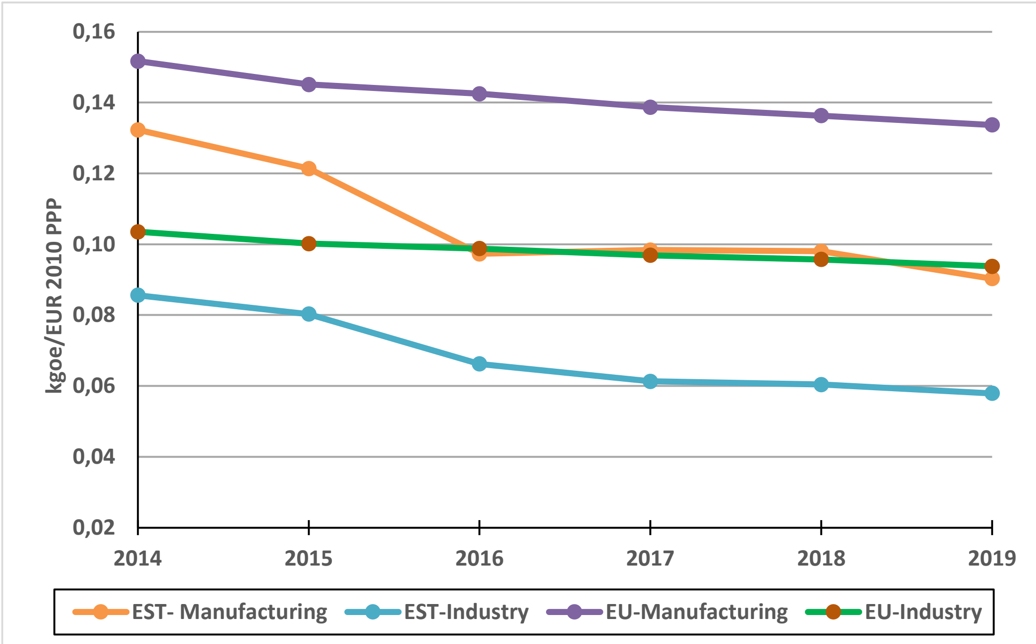


Figure 11. Energy intensity in manufacturing and industry, 2014–2019

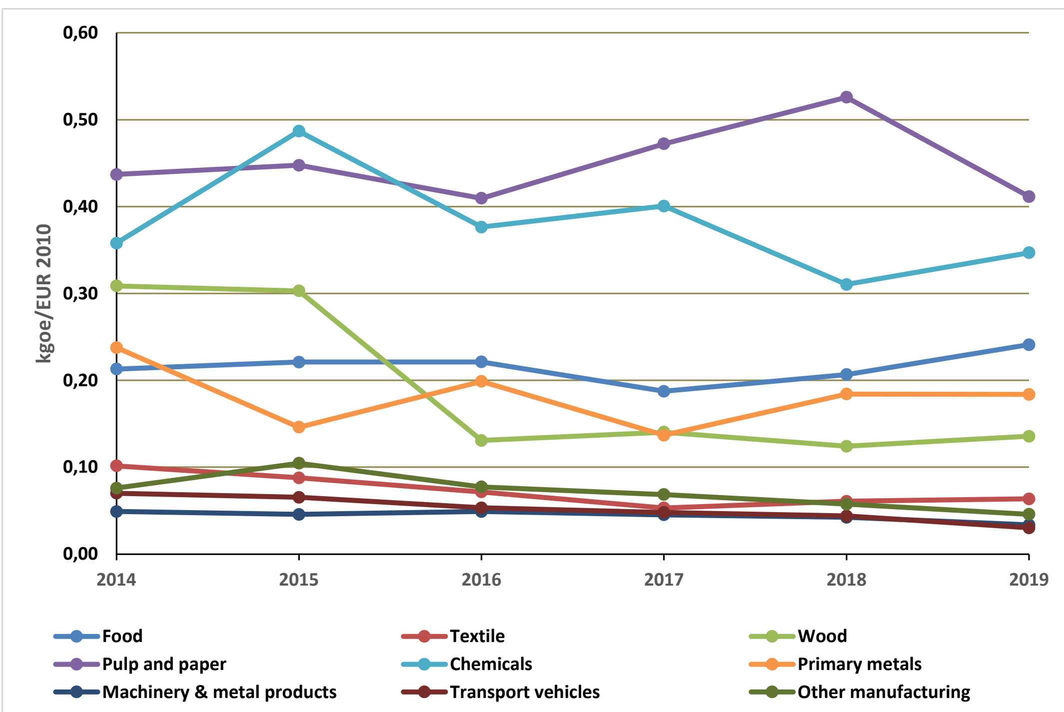


Figure 12. Energy intensity in branches of industry, 2014–2019

In all branches, except for the food industry, the energy intensity has a general tendency towards reduction. Still, there are relatively large annual variations in some branches (pulp and paper as well as in food sector). To find out the reasons for such fluctuations more detailed analyses should be carried out.

The share of energy-intensive industries in the European Union, such as cement, metal and paper, and as a provider of added value in Estonia is small or non-existent, as cement and clinker production was discontinued in Estonia in the second half of 2019.

Thus, we can say that Estonia has a larger share of the so-called non-energy-intensive industries (food industry, wood processing, mineral industry, etc.). The comparison of average specific industrial energy use in the EU and in Estonia indicates that when considering the purchasing parities of currencies, the level in Estonia (0.06 koe/EUR2010 PPP) in 2019 was by 38% lower than in the EU (0.09 koe/EUR2010 PPP).

The intensity of energy use of Estonian manufacturing sector was ca 32.5% lower than the EU average, being 0.9 koe/EUR2010 PPP and in EU 0.13 koe/EUR2010 PPP in 2019 (Figure 11).

3.3 Households

Between 2014 and 2017 the demographic tendencies, which have been in progress for a long period already, continued – the population continued to decline. From 2018 onwards, however, the population trend turned upwards and in 2019 this increase continued.
The population is an important factor to be considered when analysing the households' energy consumption. As at 1 January 2019, the estimated population of Estonia was 1.325 million persons. Since 2014, the increase has been 0.7%.

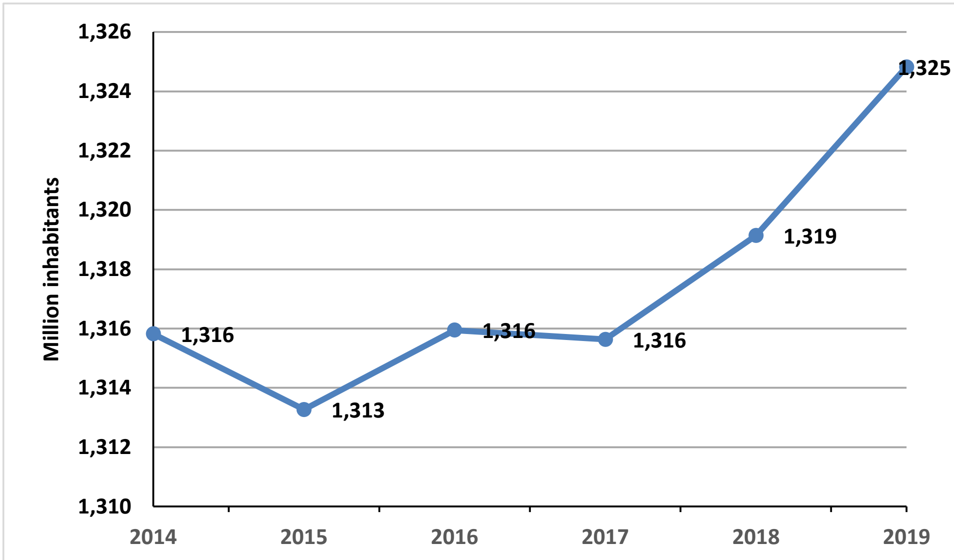


Figure 13. Population in Estonia in 2014-2019

According to the official statistics in 2019 the number of dwellings was 729 thousand. The estimated number of households was 617 thousand. The share of single-family houses in the housing stock has increased over the last nine years and the share of apartments has decreased. Back in 2010, the respective figures were 70% and 30%.[7]

In 2014–2019, the total energy consumption of households was quite stable, in 2019 electricity consumption increased slightly. (Figure 14).

[7] Source: ODYSSEE database

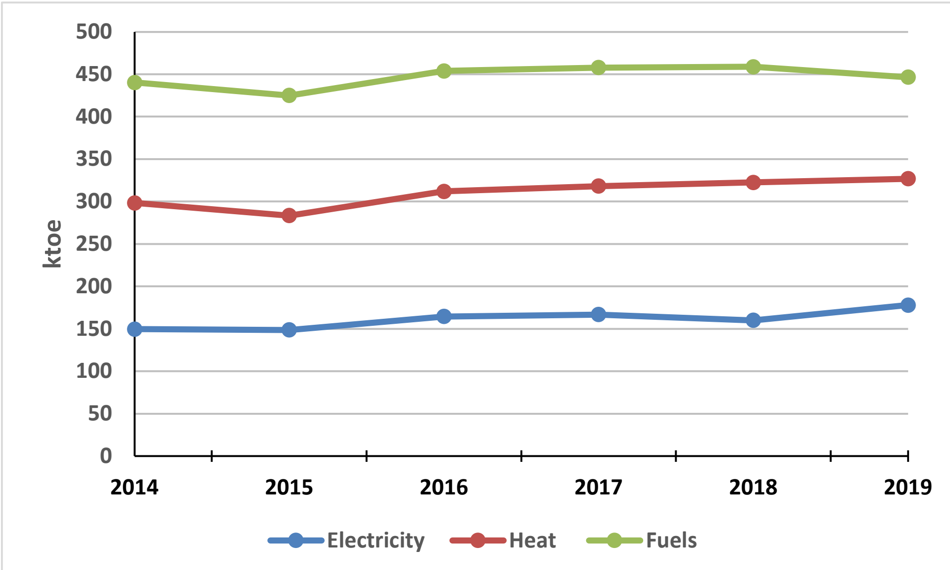


Figure 14. Households' energy consumption, 2014–2019

Several significant changes have taken place in the structure of the energy supply. The most important is the increase in electricity consumption: the use of electricity by households has increased by almost 19% - from 298 ktoe in 2014 to 327 ktoe in 2019 (average 3.8% per year).

The share of electricity in the total energy consumption of households has also increased from 17% in 2014 to 19% in 2019 (see Figure 14). Annual heat consumption (DH) has decreased only in relative terms (from 42% to 40%) but has risen slightly in absolute terms (from 298 ktoe to 327 ktoe). The use of oil fuels and natural gas in households has remained practically at the same level and their share in energy consumption has also remained the same (1% and 6%, respectively).

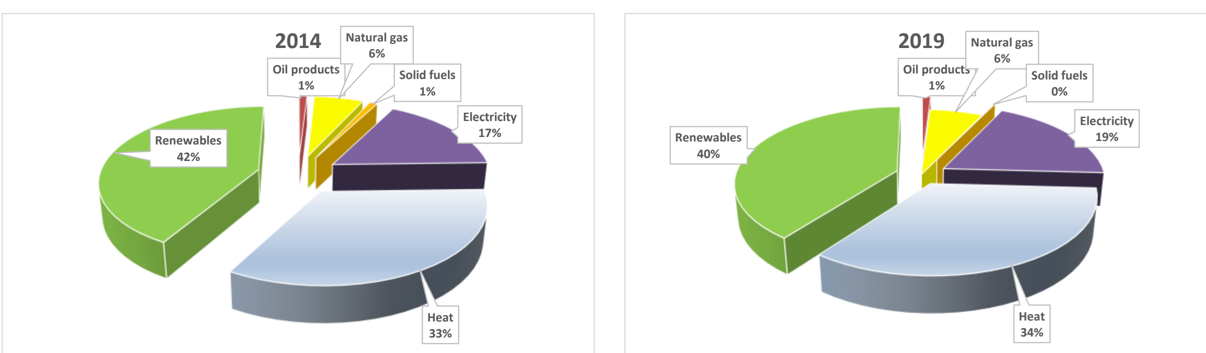


Figure 15. Structure of households' energy use, 2014-2019

The estimated share of space heating in households' total energy consumption is approximately

60–70%. The annual amount of energy used for space heating depends on the outdoor temperature during the heating season. Therefore, to find the actual changes in energy use efficiency for space heating there is a need to eliminate the annual climate changes. This can be made using heating degree days (HDD), which express the severity of the cold in a specific time period taking into consideration both the outdoor temperature and room temperature.

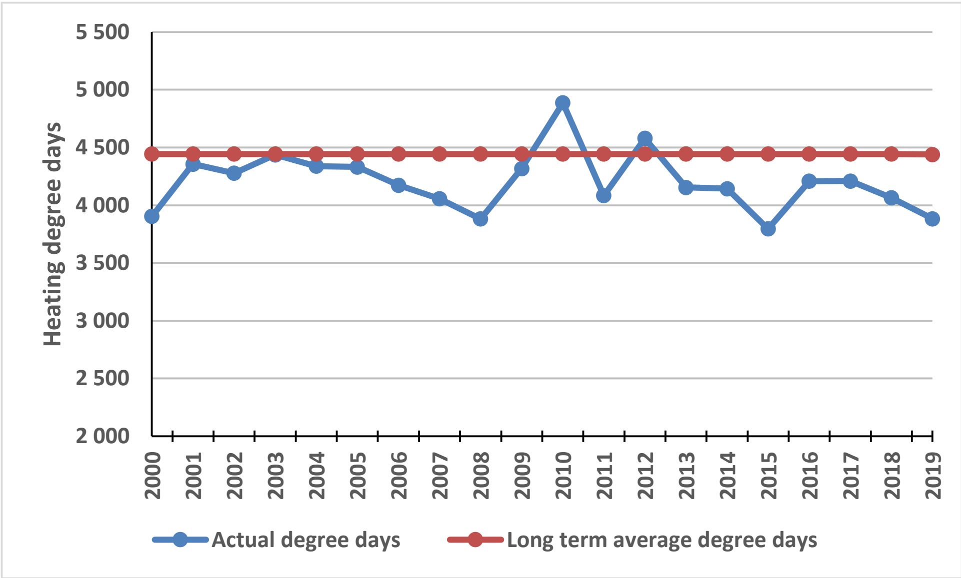


Figure 16. Heating degree days, 1995–2010

The long-term average and actual degree days values for Estonia are presented in Figure 16 (source: Eurostat). As a well-known fact, the climate is getting warmer, i.e. the annual number of actual heating degree days (HDD) has been declining. Still, there are some variations in the opposite direction, as it was in 2010 and 2012. Relevant coefficient (actual HDD divided by the mean of HDD) is used to adjust annual values of energy consumption for space heating according to climate changes.

The development of households' energy consumption including the use for space heating is presented in Figure 17.

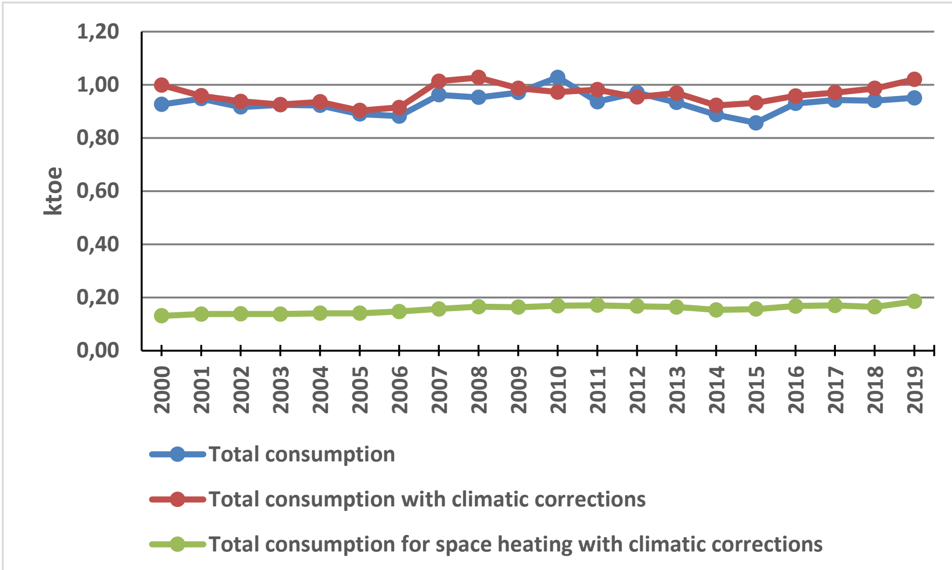


Figure 17. Households' energy consumption, actual and climate-adjusted, 2000–2019

Specific energy consumption (climate corrected) calculated per dwelling has been declining, still with some exceptions (Figure 18).

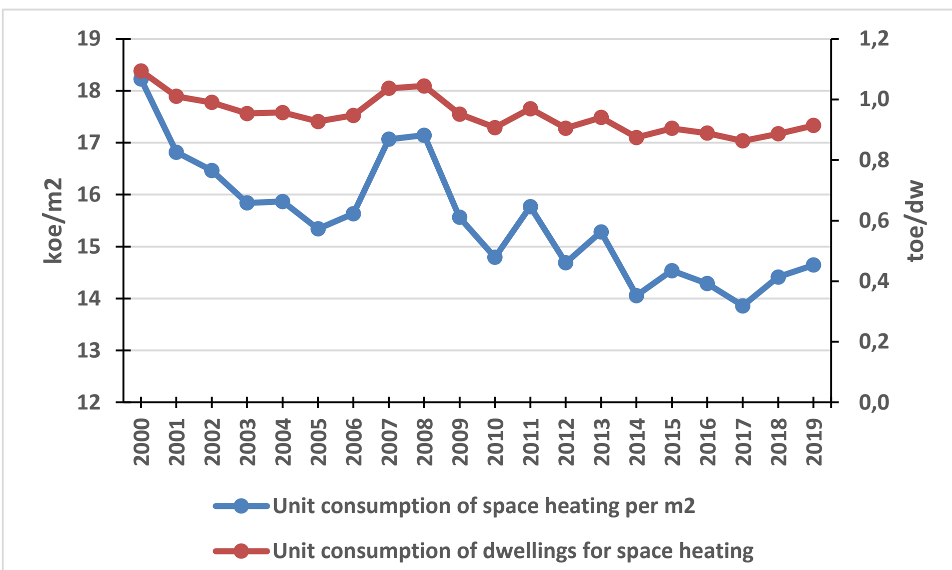


Figure 18. Specific energy use for space heating by households, 2000–2019

It has to be considered that the average area of dwellings has increased year by year: from 60 m^2 in 2000, to 62 m^2 in 2019. The size of new dwellings is growing: the average living area of new dwellings in 2019 was 94 m^2. Of course, there are great area differences between various types of dwellings. For example, in 2019 the average living area of a new single-family house was 153 m^2 and of the new apartment 62.1 m^2. Therefore, the specific consumption per area unit (m^2) should be considered as the more representative one (see climate corrected use in Figure 18).

Space heating needs take the major share of households' energy consumption. The Figure 18 shows that the efficiency of energy use for space heating has been improved significantly, reflected by indicators of consumption per unit (per dwelling and/or per m^2).

For making fair comparison of households' specific energy consumption between EU member states, the difference in climate conditions in countries should be considered. Also, in frames of the current Odyssee project a methodology was elaborated for scaling the households' energy consumption to the EU average climate. The annual specific space heating energy calculated per heating degree day is an informative comparison option as well. These and some other indicators for enabling to compare the energy use efficiency in dwelling sector in Estonia and in the EU as average are presented in Table 3.

Table 3. Key indicators of households' annual specific energy consumption, 2019

Indicator	Unit	Estonia	EU
Energy consumption (all purposes)	toe/dwelling	1.39	1.27
	koe/m^2	23.76	14.47
Energy consumption (all purposes) scaled to EU average climate	toe/dwelling	1.30	1.48
	koe/m^2	19.98	14.47
Energy consumption for space heating scaled to EU average climate	toe/dwelling	0.67	n. a.
	koe/m^2	10.76	n. a.
Energy consumption for space heating per heating degree day	toe/dwelling	0.17	0.01
	koe/m^2	2.65	0.17
Electricity consumption	kWh/dwelling	3029	3744

Hence, considering climate conditions, the energy consumption per dwelling (and per m^2) in Estonia seems to be at quite good level.

In Estonia, the electricity consumption has continued to grow during many years. It has to be noted that the increase of electricity consumption per household does not always mean that households do not save electricity. The electricity use is growing primarily due to increasing number of appliances owned by households.

3.4 Services

In tertiary sector, the number of enterprises, persons employed and net sales have grown faster than Estonian enterprises in average. The rapid growth of economic activity in the service sector has also led to a slight increase in energy consumption (Figure 19). Still, during the period 2014–2019 the total energy consumption in tertiary sectors has decreased by 2.1%. At the same time, the electricity use grew by 4.5% and fuel consumption by 3.3%. In 2019, the electricity consumption constitutes more than a half of the energy use in the service sector.

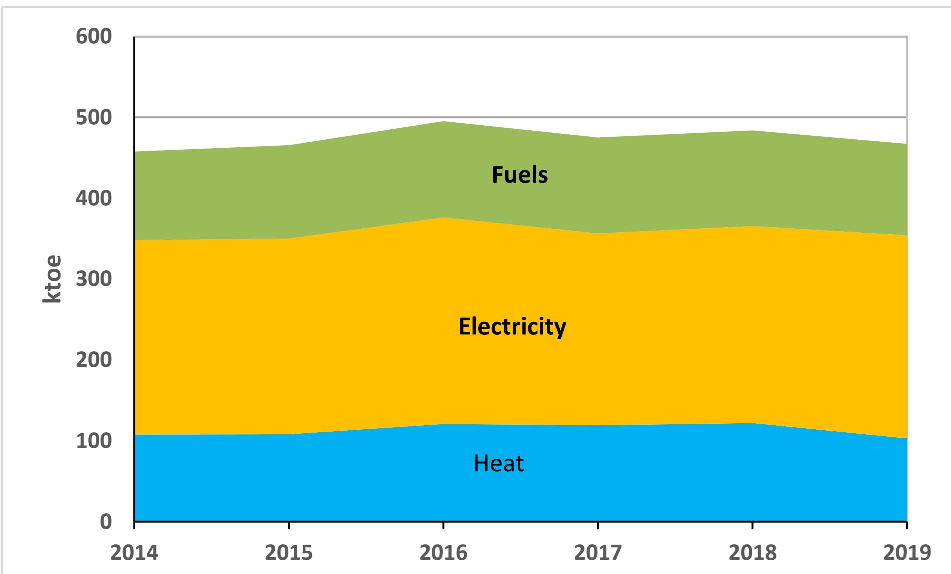


Figure 19. Structure of final energy use in service sector, 2014–2019

Regarding energy efficiency in service sector, it has to be pointed out that the increase of labour productivity has been accompanied by a decrease in energy and electricity intensity over the period considered: 1.15 koe/EUR2015 in 2014 and 1.10 koe/EUR2015 in 2019. (see Figure 20).

Only a small increase in electricity consumption per employee has taken place in recent years (2018-2019).

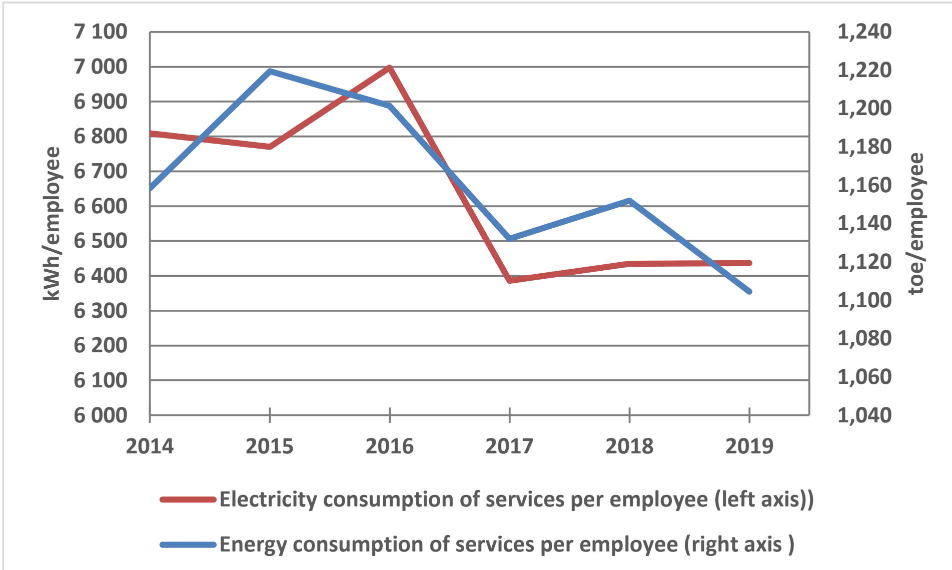


Figure 20. Specific energy consumption in service sector, 2014–2019

The indicator of general energy intensity in service sector has decreased in Estonia. In the EU the trend of improvement has been quite stable (see Figure 21). So, the difference between Estonia and the EU has decreased from 96% in 2014 to 86% in 2019.

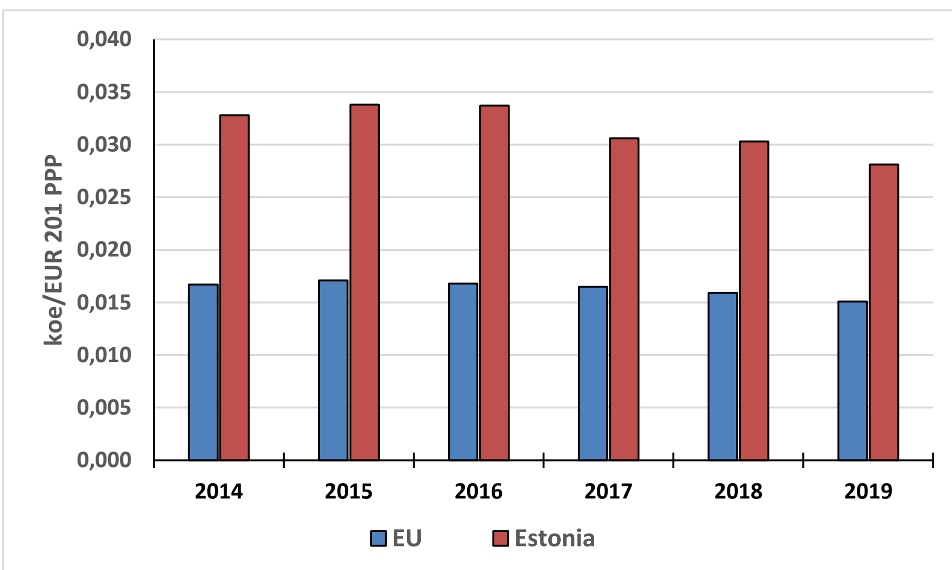


Figure 21. Specific energy consumption in service sector (EU and Estonia), 2014–2019

As to specific electricity consumption, since 2003 the amount of electricity consumed per employee in Estonia has been larger than the EU average. In 2014, the difference was 33.9%:

6 798 kWh and 4 724 kWh, respectively, and in 2019 the difference was 32.8% (6 436 kWh and 4 846 kWh, respectively), and in both cases, there is a downward trend.

3.5 Transport

The activity of transport largely influences all the remaining branches of economy as well as the service sector, being at the same time strongly influenced by these sectors. The transport sector of Estonia is influenced not only by the domestic factors but also by the economic situation outside Estonia. In 2019 the economic results of Estonian transport enterprises improved as compared to 2014.

Passenger transport increased by 9% in 2019 compared to 2014 - Estonian transport companies carried almost 170 million passengers (156 million in 2014, respectively). Most of them were transported by domestic traffic. Nearly 162 million passengers used bus transport, which was 8% more than in 2014. The number of other domestic road passengers increased by 4.9% and 38% in rail and inland waterways, respectively. The number of passengers on domestic flights doubled, amounting to 10 000 passengers in 2019.

The passenger traffic volume of transport enterprises increased 2% during the year, thereby in the international passenger traffic the increase was 11%. The domestic passenger traffic volume decreased 7%.

The freight volume in tonne-kilometres of Estonian transport enterprises decreased by 7% in 2019 compared to the 2014. The freight turnover in international transport comprised 85% of the total freight turnover and increased by a tenth during the year. In domestic traffic, the freight turnover increased 1%. In 2009 the freight turnover of transport enterprises had fallen but in 2010 the demand for transport services recovered and the freight turnover was 14.5 billion tonne-kilometres. The increase in the freight turnover of Estonia was mainly influenced by an growth in the international sea and railway transport – by 62% and 12%, respectively. The total freight turnover of road transport enterprises decreased 5%, while the domestic transport freight turnover increased 7%. The turnover of road freight transport increased by almost 25% in the period 2014-2019, while the turnover of rail freight decreased by about 43%.

In 2019, transport enterprises carried around 87.4 million tonnes of goods, which is 18.4% less than in 2014, 21.3 million tonnes of goods or 4% more than in 2014 were transported on roads. Nearly 21.3 million tonnes of cargo or 41% less than in 2014 were transported on public railways.

International rail transport decreased by 30% during the observed period and domestic transport by about 52%. In 2019, transit goods accounted for 44% of goods transported by rail. Transit freight transport by rail decreased by 34% in the period 2014–2019. Inland transport of public rail in tonnes decreased by about 50% during the observed period. In 2019, maritime transport companies transported 14% less goods than in 2014. The cargo volume was only 37.7 million tonnes.

As at the end of 2019, 794 926 passenger cars, 131 10 trucks, 5 221 buses and 57 867 motorcycles were registered in the Estonian Road Administration Traffic Register (ERATR). In 2019 the number of first registration of passenger cars in Estonia was 27 584, this is 6 484cars more than in 2014. Also, the share of new motor vehicle registrations increased in 2019 compared to the previous year – about 5% more new cars were registered. In 2019, the estimated motorisation rate was 600 passenger cars per 1 000 inhabitants in Estonia.

During 2014–2019 the final energy consumption in transport has increased by 11.5% (see Figure 22). The consumption of fuels has increased in road transport, where in 2019, 13.3% more fuels were consumed than in 2014. At the same time fuel consumption in railway transportation has decreased by 42.3%, in domestic air transport 3.4% and in domestic water transport about 11.7%.

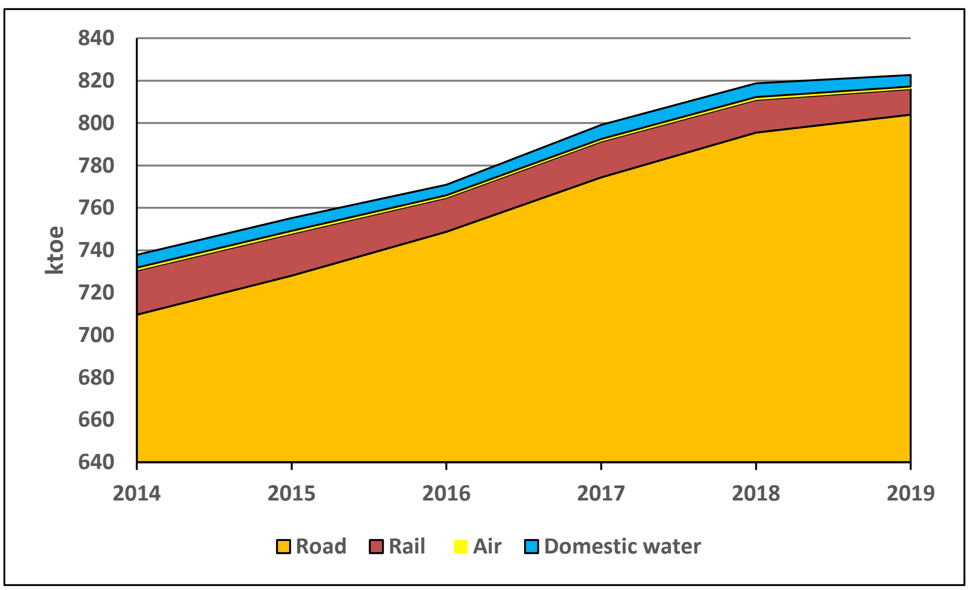


Figure 22. Energy use by type of transport, 2014–2019

There have been only slight changes in the structure of energy consumption by type of transport during 2014–2019: the shares of road transport and to some extent also of air transport have increased, the share of rail transport is declining. The structures in 2014 and 2019 are shown in Figure 23.

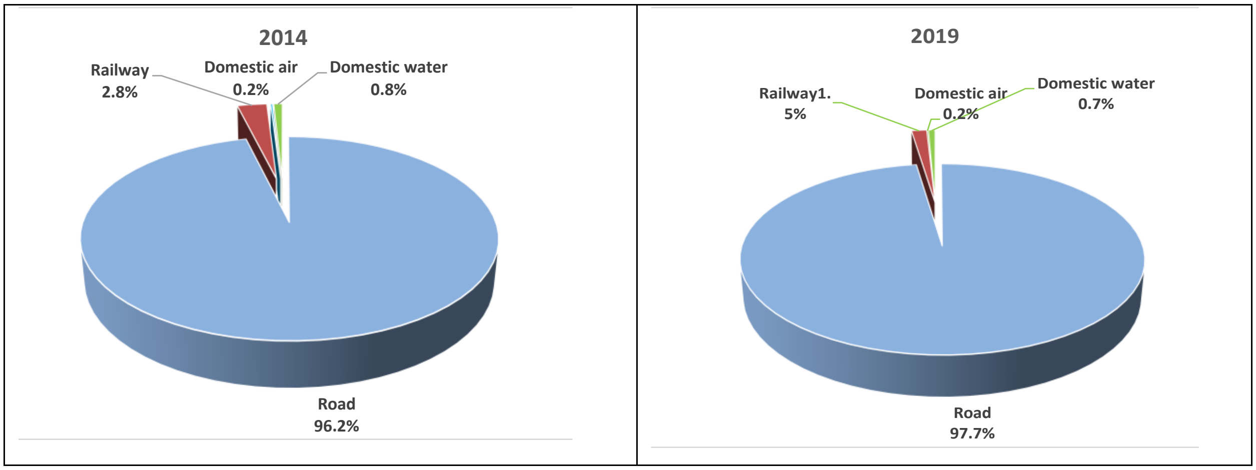


Figure 23. Structure of fuel use by type of transport, 2014 and 2019

In road transport, consumption of both fuels – petrol and diesel – has been increasing (see Figure 24).

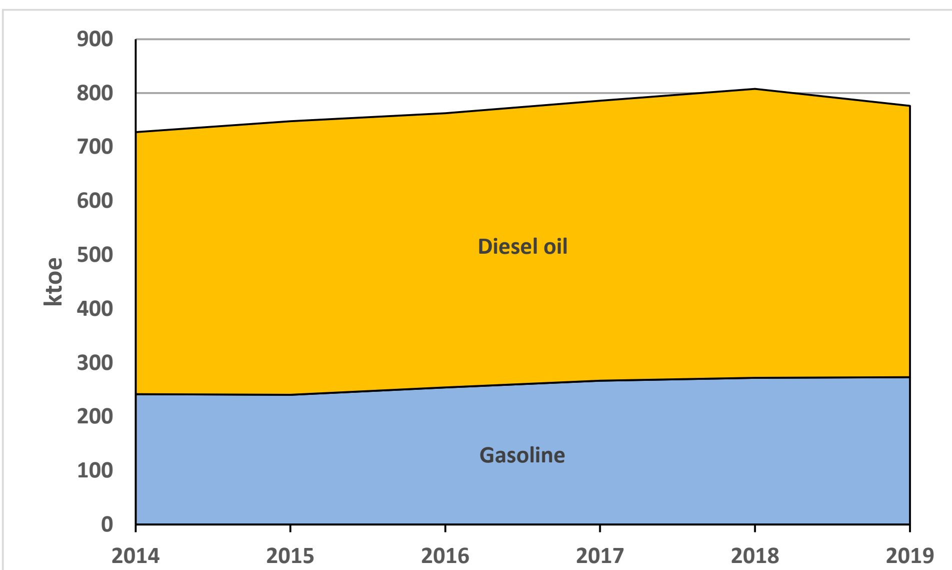


Figure 24. Fuel use in road transport, 2014-2019

In the period 2014-2019, the share of diesel fuel use by cars and trucks has increased. In the case of buses, however, the trend is opposite, i.e. the number of buses consuming diesel fuel has decreased (see Figure 25).

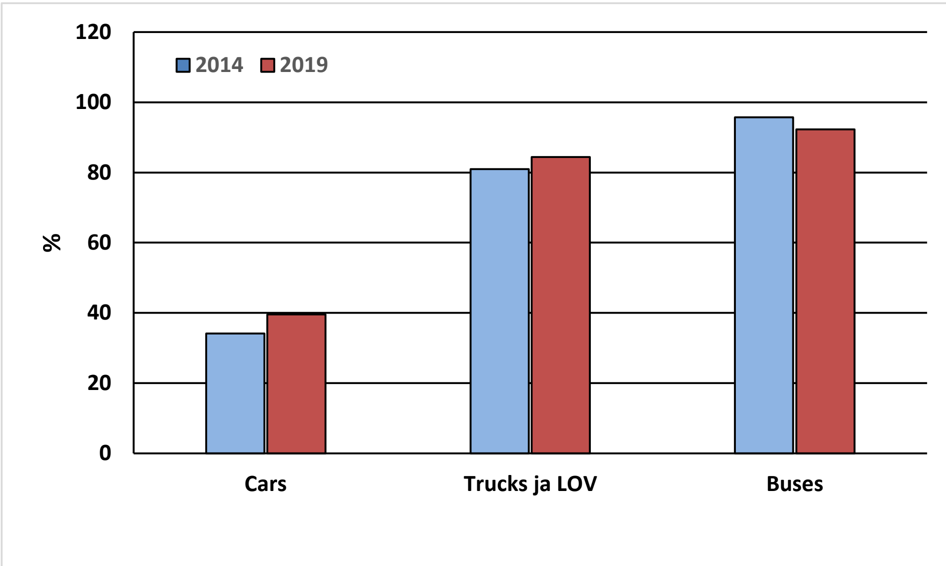


Figure 25. Share of diesel fuel vehicles in road transport, in 2014 and 2019

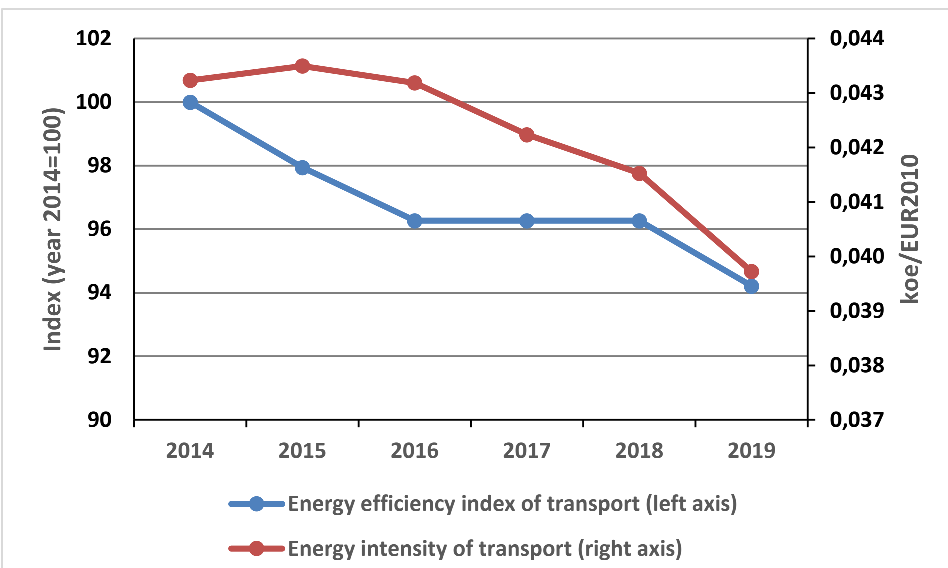


Figure 26. Energy intensity and efficiency in transport sector, 2014–2019

Based on general available data, it can be concluded that the energy efficiency index ODEX for transport in Estonia has decreased by 6% (from 2014 to 2019) meaning that the energy intensity has decreased. The development of the index and the natural values of the transport sector energy intensity (koe/EUR2000) are presented in Figure 26.

The energy efficiency of transport depends on many factors. The age of the vehicles, in road transport in particular, is an important one among these factors. According to Statistics Estonia, in 2019, 52% of first-registered vehicles were new, including 52% of passenger cars, 54% of lorries, 25% of buses and 43% of motorcycles.

3.6 Assessment of energy efficiency/savings through ODEX: total and by sector

For assessing energy efficiency in several sectors in an aggregated way, a special energy efficiency index (ODEX) has been elaborated and introduced in ODYSSEE-MURE projects. The methodology for calculating ODEX enables to aggregate trends in the different unit consumptions by sub-sector or by end-use into one index by sector based on the weight of each sub-sector/end-use in the total energy consumption of the sector. ODEX can be seen as an alternative to the energy intensities usually calculated to assess energy efficiency changes at the sectoral level or at the level of the whole country because they are corrected for various factors that are not linked to energy efficiency, such as climate fluctuations, changes in economic and industry structures, lifestyle changes (increase in dwelling size, appliance ownership), etc.

ODEX is defined and can be calculated at the level of sectors (industry, transport, households) or of the whole economy, i.e. for all final consumers. This index is obtained by aggregating the unit consumption changes at detailed levels, by sub-sector or end-use, observed over a given period. The unit consumption variation is measured in terms of index, which enables to combine various units for the detailed indicator. Using relevant physical parameters, the ODEX indicator provides a good “proxy” of the energy efficiency progress from a policy evaluation viewpoint. In the period 2000–2019, the energy efficiency improvement of the general (global) ODEX, which covers all sectors, was 20.4% and in the period 2014-2019 8.1% (Figure 27).

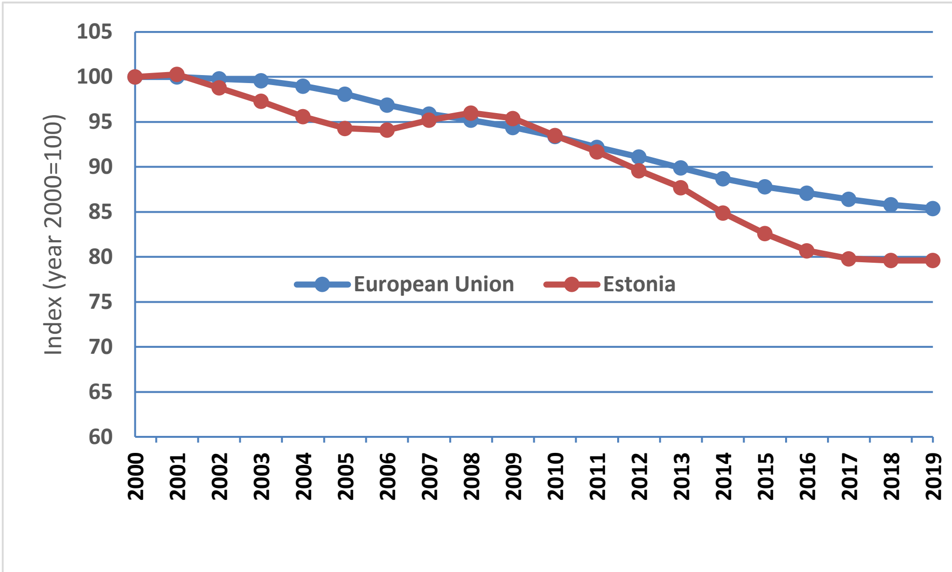


Figure 27. Dynamics of energy efficiency index ODEX, 2000–2019

The development of ODEX indices for sectors of economy during 2000–2010 is given in Figure 28. As to industry, the value of ODEX for 2010 is 42% (compared to the 100.0% in year 2000) indicating 58% increase of the energy efficiency during the period. One of the important reasons for the increase in energy efficiency in industry is the closure of large energy-intensive companies.

The index for the manufacturing industry has decreased in a very similar way indicating the major share of manufacturing in total industry. This is mainly due to the closure of large and energy-intensive industries.

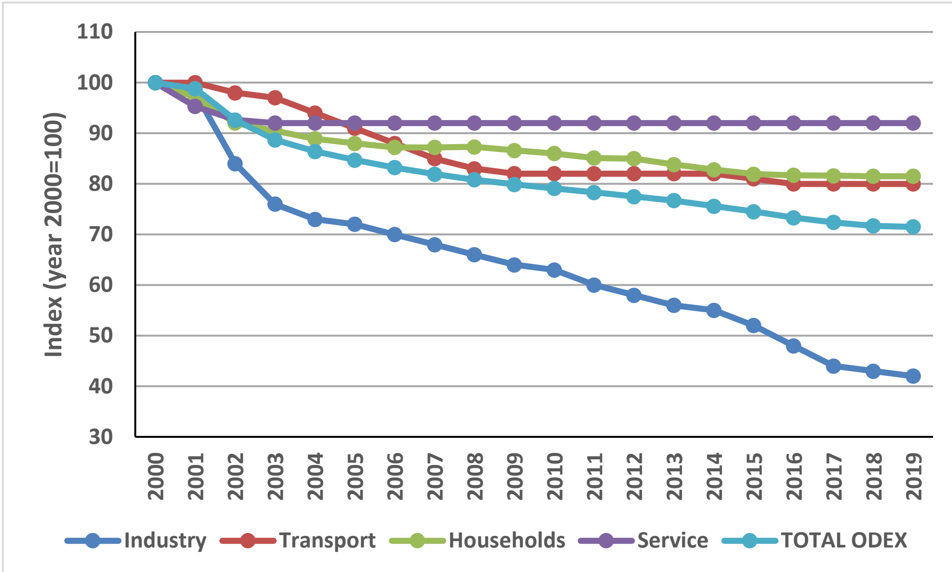


Figure 28. Dynamics of ODEX by sector, 2000–2010

In households sector, the ODEX has decreased by 18.5% from 2000 to 2019. Due to poor statistics on energy consumption in households, the efficiency analysis has to be based mainly on some case studies and expert estimations. It can be assumed that the efficiency improvement is to a great extent a result of renovation of building envelopes – additional thermal insulation of outer walls, replacing windows, etc. The specific heat consumption in new dwelling houses is lower due to more strict thermal standards in building codes. At the same time, there is an opposite tendency – new dwellings are larger and higher living standards need more energy.

Between 2000 and 2019, the ODEX index for transport has decreased, indicating that the aggregated energy efficiency in transport has a general declining trend. Due to the lack of detailed data, it is difficult to evaluate the reasons for the improvement in energy efficiency in road transport. One of the reasons is certainly the increase in the number of new cars in the whole car stock, the reduction in diesel consumption, better road maintenance, etc.

The energy efficiency of the service sector increased by about 8% between 2000 and 2009, which is the most modest of the final consumption sectors.

3.7 CO_2 emission trends

For evaluating the impact of improving the efficiency of energy use on environment both the

Co-funded by the Horizon 2020 programme
of the European Union

reduction of primary energy use and emissions have to be considered.

In 2019, the total emissions of GHGs (with indirect CO_2), measured as CO_2 eq., were 13 983.50 kt, and without LULUCF 14 699.12 kt. From 1990 to 2019 emissions with LULUCF decreased by 63%. The energy sector is the main source of greenhouse gas emissions in Estonia. In 2019, the energy sector contributed about 83.5% of total emissions, totalling 12 277.72 kt of CO_2 equivalent. A substantial amount of energy-related emissions is caused by an extensive consumption of fossil fuels for power and heat production. Emissions from the energy sector by subcategory in 2000–2019 are presented in Figure 29.

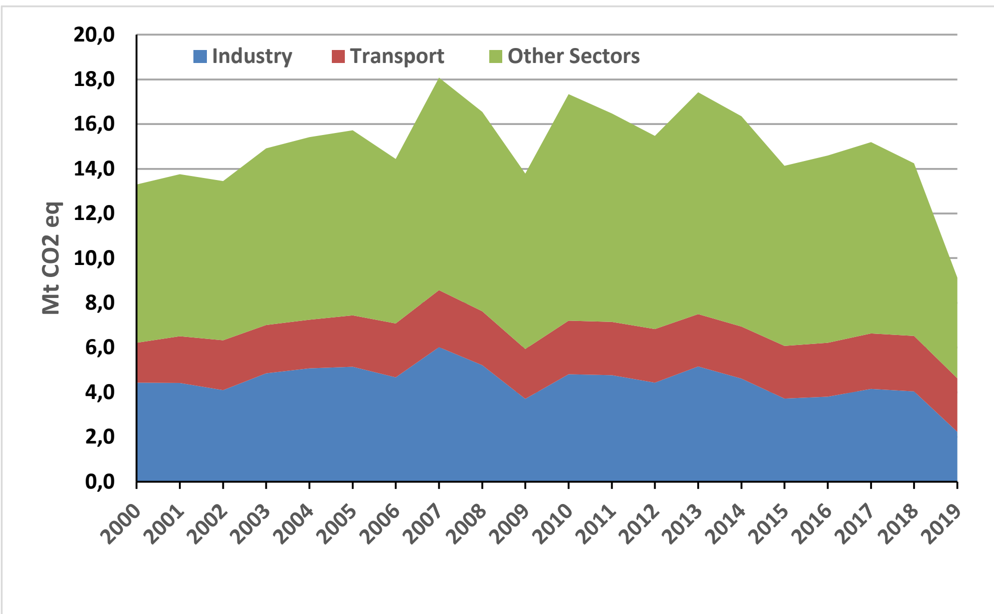


Figure 29. Emissions from the energy sector by subcategory in 2000–2019, kt $CO_{2\ eq}$

Since 2017, CO_2 emission has been on a declining trend, mainly due to the decline in electricity production from oil shale as a result of the increase of the EU ETS emission allowance price. Thus, the share of electricity imports has increased in recent years and the share of domestic electricity production has decreased.

In 2019, 7 354 GWh of electricity was produced in Estonia, of which 58.4% was produced from oil shale, 12.2% from oil shale gas, 26.6% from renewable energy sources (biomass, wind and hydro), 0.5% from natural gas and 0.3% from other fuels (peat, waste).

4 Energy efficiency measures

4.1 Energy efficiency policy in Estonia

Estonia is mostly planning its activities in the area of development of energy efficiency with the European Union energy efficiency directive adopted in 2012. The Directive has been transposed into Estonian legislation by the Energy Management Organization Act and its by-laws [6, 7, 8].

A common framework has been established for the Member States to promote energy efficiency in order to achieve the EU energy efficiency targets for 2020 and 2030:

The goal of energy efficiency by 2020 was to reduce consumption in the European Union by 20 percent, i.e. the final energy consumption had to be a maximum of 1086 Mtoe and the primary energy consumption 1483 Mtoe.

The goal for 2030 is to reduce the European Union's consumption by 32.5 percent, i.e. the maximum level in final energy consumption in 2030 is 956 Mtoe and the primary energy consumption is 1 273 Mtoe.

Estonia's National Energy and Climate Plan sets a goal for 2030 to keep final energy consumption at 32 to 33 TWh / a and to reduce primary energy consumption by up to 14% compared to the peak of recent years [5].

Within the framework of the implementation of the state energy policy, the focus is on the organization 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 energy consumption and prices are 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 [5].

4.2 Recent energy efficiency measures

4.2.1 Residential sector

Regarding the efficient use of energy in residential sector, *the Development Plan of the Energy Sector until 2030* (approved by the Government in October 2017) which replaces an earlier document (*National Development Plan for Housing Sector 2008–2013*[8]) has a key importance. Among main objectives of the plan, there is one targeted to improvement of quality and sustainability of the housing stock in Estonia. There are several measures presented in the plan. 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 a high potential for energy savings - the energy costs of buildings account for about 25.96% of the total energy consumption in the EU. In Estonia, household's energy consumption accounted in 2019 for 33.77% of the total energy final consumption.

By reconstructing the housing stock, it is possible to reduce the need for heating energy in buildings by up to 50% and thereby achieve, among other things, a reduction in the volume of imported fossil fuels and CO_2 emissions. At the same time, it is 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.

All energy efficiency improving measures entered into MURE database are accompanied by three level (high, medium, low) semi-quantitative impact estimations.

Most measures implemented in residential sector have the medium impact (Table 4).

[8] https://www.mkm.ee/sites/default/files/eluasemevaldkonna_arengukava_2008_2013.pdf

Table 4. Measures for residential sector

	Measure	Semi-quantitative impact	Energy savings, PJ	CO_2 savings, $ktCO_2$
1.	Renovation of apartment buildings (2014-2020)	Medium	1.10	6.86
2.	Minimum energy performance requirements for buildings	Medium	0.19	15.68
3.	Renovation of district heating boilers	Medium	0.09	6.36
4.	Replacement and reconstruction of pumping stations, water treatment equipment, water pipelines and sewerage facilities	Low	0.01	0.08
5.	Demolition aid for local authorities	Low	0.01	0.81
	Total		**1.04**	**29.79**

4.2.2 Transport sector

Regarding the public transport, in Estonia one of the main problems is the poor condition of rolling stock. The average age of buses in public transport is more than 12 years [12]. Currently, public transport subsidies are used to compensate up to 70% of the costs connected with the providing public transport services on local bus lines [13]. Compensation payments are paid in accordance with the regulation No. 1370/2007 of the European Parliament and of the Council [14]. However, the compensation mechanism has not stimulated public transport service providers to make sufficient investments into the rolling stock.

In March 2011, the Government decided to launch the Electric Mobility Programme (EMP) for Estonia combining the extensive introduction of electric vehicles with the financing available in frames of the Kyoto Protocol mechanisms. KredEx supported the acquisition of electric vehicles in the period 2011-2014 (657 vehicles, the total amount of support was 10.5 million euros). The average annual mileage of vehicles is 11.6 million km and the reduction of CO_2 emissions is 1.96 thousand tons. No reduction in energy consumption was measured.

In 2019, the Government of the Republic adopted a new regulation: *Conditions and procedure for granting aid for the purchase of electric vehicles* [15]. The aim of the regulation is to reduce CO_2 emissions in the Estonian transport sector through the 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 a new fully electric M1 or N1 category vehicle, which will be used mainly in Estonia. An electric vehicle must cover at least 80 000 kilometres and at least 80% of it in Estonia within four years during the payment of the support. The company can apply for support for the purchase of vehicles for its main or secondary activity.

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

According to the Traffic Act, the Road Transport Act and the Taxation Act, a time-based fee is valid in Estonia, the payment of which gives you the right to use road for a certain period of time [16, 17, 18]. The fee does not depend on the mileage. The fee be paid before driving. You can pay 24 hours a day, 7 days a week. The payment 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. In addition to trucks registered in Estonia, trucks registered abroad must also pay fees. The rate of the charge depends on the gross weights 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.

The regulation *Conditions and Procedure for the Preparation of a Motor Vehicle Driver and Curricula for the Preparation of a Motor Vehicle Driver* [19] regulates the preparation and after-training of a motor vehicle driver. Sustainable driving training is also part of driver training, including a theory course and a practical driving course. Course content: Practical driving in traffic before the theoretical lecture, where the fuel consumption of a specific driver is measured with a special device. Practical driving after the theory lecture. In this part, the knowledge gained in the theoretical lecture is applied in practice. Fuel consumption is remeasured and the driver's driving style and behaviour are assessed.

Table 5. Measures for transport sector

	Measure	Semi-quantitative impact	Energy savings, PJ	CO_2 savings, $ktCO_2$
1.	Compulsory training in sustainable driving	Medium	0.33	24.51
2.	Time-based road use fee	Medium	0.12	11.88
3.	Support for the purchase of electric vehicles	Low	0.08	5.94
	Total		**0.53**	**42.33**

4.2.3 Service sector

1. Support for energy and resource audits of fisheries and aquaculture product businesses, energy efficiency of fishing and coastal fishing vessels.

The aim of the European Maritime and Fisheries Fund measure 2014-2020 *"Support for energy and resource audits of enterprises handling fishery and aquaculture products"* is to support the fish and enterprise in conducting energy and resource audits. The energy and resource audit identifies those investments in the processing of fishery and aquaculture products that help to save energy or reduce the impact on the environment, including investments in the processing of waste.

A corresponding regulation has been adopted in Estonia: 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*, establishing the procedure for granting subsidies for energy and resource audits in enterprises handling fishery and aquaculture products [20].

2. Modernization of health centres

According to Government of the Republic Order No. 297 of 4 July 2014, The Ministry of Social Affairs is the implementing agency and the Ministry of Finance is the implementing unit for the measure 2.4 "Available and high-quality Ensuring health services to increase employment retention and return to employment" for activity 2.4.2 "Supporting investments in the centres of attraction of primary health care centres by ensuring accessible and diverse primary care services".

The Regulation No. 5 of the Minister of Health and Laboure, *Modernisation of health centres* lays down the conditions for granting support [22]. Within the framework of the activity of the measure, the following will be built or reconstructed:

1) at least 35 primary health care centres and 2) one modernized general hospital networked with 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.

3. Modernisation of street lighting

In order to increase the efficiency of electricity use, the Ministry of Economic Affairs and Communications initiated the measure *Renovation of the Street Lighting Infrastructure*. Support for the financing of this activity is paid from the resources of the European Union Cohesion Fund. The aim of the measure is to renovate obsolete street lighting infrastructure, as a result of which the use of modern lighting and control technology 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. 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. 5 of the Ministry of Economic Affairs and Communications "*Conditions for supporting the renovation of street lighting infrastructure*" [21].

4. Support for improving the energy efficiency of welfare institutions.

According to the regulation of the Public Administration No: 40 *Conditions and procedure for the use of support provided for the conversion of local government care institutions into energy-efficient buildings and the construction of energy-efficient buildings of care institutions*, support is provided to local governments to improve the energy efficiency and use of renewable energy within the meaning of subsection 20 (1) of the Regulation [23].

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.

4. Modernization and renovation of schools in the process of reorganizing the school network.

Regulations No. 50 of the Minister of Education and Research *Organizing of the basic school network in the period 2014-2020* and No. 22, *Organization of the Gymnasium Network in the Period 2014-2020* establish the procedure for awarding grants to the measure [24, 35]. Support is provided for investments in basic school buildings with the aim of supporting the reorganization 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.

As an expected result of the grants given to the projects:
1) the buildings of the basic schools that received the grant are modern;
2) the school network of the local governments that received support has been reorganized and the study space of the schools under their maintenance has been optimized;
3) the project must contribute to the achievement of the output indicator of the measure (modernized area in square meters).

A total of 12 basic schools will be renovated or built in Kohtla-Järve, Narva, Kärdla, Tartu, Tallinn, Haapsalu, Jõhvi, Pärnu, Türi, Kuressaare, Sillamäe and Rakvere. The activities are supported by the European Regional Development Fund in the amount of 85%.

5. Institutional development program (energy efficiency investments in universities).

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*

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 modernization of infrastructure, the creation of new curricula and the improvement of the quality of doctoral studies.

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 must be from 1 January 2014 to 31 August 2023. The energy savings achieved by 2020 are shown in the

Table 6.

Table 6. Measures for service sector

	Measure	Semi-quantitative impact	Energy savings, PJ	CO_2 savings, $ktCO_2$
1.	Support for energy and resource audits of fisheries and aquaculture product businesses, energy efficiency of fishing and coastal fishing vessels	Low	0.07	15.1
2.	Modernization of health centres	Low	0.03	7.1
3.	Modernisation of street lighting	Low	0.03	7.3
4.	Support for improving the energy efficiency of welfare institutions	Low	0.07	15.1
5.	Modernization and renovation of schools in the process of reorganizing the school network	Low	0.03	5.6
6.	Institutional development program (energy efficiency investments in universities)	Low	0.04	8.6
	Total		**0.28**	**58,8**

4.2.4 Industry sector

1. Resource efficiency measure to promote investments in work processes.

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 as a whole. The central goal of the energy and resource efficiency measure for companies is to make more efficient use of resources.

Increasing competition for natural resources is creating scarcity and raising prices, which is affecting the world economy. At the same time, however, a large number of 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, 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 111 million euros. The bulk of the budget, 109 million €, is for investment in businesses. For example, support is provided for activities related to the transformation of the production process, which reduce the amount of resources used in production. Innovative solutions play an important role in this, as innovative solutions need to be found to reduce resources in production. 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.

In order to receive money for innovations, companies must first prepare a detailed analysis of resource use or audit. The grant of 1.5 million euros is planned. The analysis evaluates the company's use of resources comprehensively and offers solutions for making activities more efficient.

The conditions and procedure for receiving support for the measure are provided by the regulation No. 27 of the Minister 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* [26].

2. Implementation of the ISO50001 standard in electricity-intensive companies

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 01.01.2019, 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. [27].

Electricity forms a significant part of the costs of the Estonian manufacturing sector compared to, for example, neighbouring countries. 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 megawatt-hour. The standard rate of excise duty is 4.47 € per megawatts-hour, which means that the change in the law will allow electricity-intensive companies to actually save € 3.97 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, incl. establishes and certifies its energy management system.

3. Investment in the best available technique; support to resource management systems combined with IT applications

The objective of the measure is to accomplish greater energy and resource savings in industry mainly through the introduction of novel solutions. Using the best available equipment, including technology, will enable resource productivity to be increased in all areas of production.

The Operational Programme for Cohesion Policy Funding in frames of the European Commission – Estonia Partnership Agreement for European Structural and Investment Funds 2014–2020 includes, under Priority issue 4 (Growth-capable entrepreneurship and internationally competitive RD&I), providing support for investments in the best available technique (BAT) and also support to resource management systems combined with IT applications (measure 4.3.1) with the support budget of 109.5 M€ considering 219.0 M€ as the total cost of taken measures. The support rate per project is foreseen up to 50%. For awarding the grants the intermediate bodies are the Ministry of the Environment (the 1st level) and the Centre of Environmental Investments (the 2nd level).

The conditions and procedure for receiving support for the measure are provided by the regulation No. 22 of the Minister of the Environment *Conditions for granting the measure "Investments in the best possible resource-efficient technology; Support for Resource Management Systems and Supporting IT Applications*" [28].

The Estonian Ministry of Economic Affairs and Communication commissioned Ernst & Young Baltic AS (E&Y) to carry out a study on the impact of measures financed from EU structural funds on achieving Estonia's energy economy targets. The study was completed in March 2017. The main objectives of the engagement were to identify measures included in the 2014–2020 Operational Programme for Cohesion Policy Funds that produce direct energy savings or increase the production of renewable energy; and to assess the energy savings and/or renewable energy production achieved and projected in relation to these measures for the period 2014–2020.

The ex-ante expected energy savings estimations presented in the E&Y study are to a certain extent approximate and subjective, depending on the quality of available information. In accordance with the point 1 of annex V to Directive 2012/27/EU, the scaled savings method has been chosen for calculating energy savings, whereby engineering estimates of savings have been used as well. Estimated energy savings from the measure is approximately 0.62 PJ.

Table 7. Measures for industry sector

	Measure	Semi-quantitative impact	Energy savings, PJ	CO_2 savings, $ktCO_2$
1.	Resource efficiency measure to promote investments in work processes	High	0.77	n. a.
2.	Implementation of the ISO 50001 standard in electricity-intensive companies	High	0.4	n. a.
3.	Investment in best available technique; support to resource management systems combined with IT applications	High	0.62	n. a.
	Total		**1.79**	

4.2.5 General Cross-Cutting measures

1. 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 has to 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 [27]. The current tax rates stipulated in the Alcohol, Tobacco, Fuel and Electricity Excise Duty Act are presented in Table 8.

Table 8. Excise tax on fuels and energy (as on 1 January 2021)

Fuel/energy	Unit	Rate, € /unit	EU minimum	Published
Unleaded petrol	1000 l	565	359	RT I, 30.06.2015, 1 01.01.2018

Fuel/energy	Unit	Rate, € /unit	EU minimum	Published
Diesel oil	1000 l	493	330	RT I, 30.06.2015, 1 01.02.2017
Kerosene	1000 l	330	330	RT I 2010, 22, 108 - 01.01.2011
LPG (as motor fuel)	t	193	125	RT I, 24.12.2016, 1- 01.07.2017
Heavy fuel oil	t	559	15	RT I, 24.12.2016, 1 -. 01.07.2017
Shale oil heating oil	t	540	15	RT I, 24.12.2016, 1 - 01.07.2017
Light fuel oil	1000 l	493	21	RT I, 30.06.2015, 1 - 01.02.2017]
Coal, coke	GJ	0.93	0.30	RT I, 30.06.2015, 1 - 01.02.2016
Oil shale	GJ	0.93	0.30	RT I, 30.06.2015, 1 - 01.02.2016
Natural gas for heating	1000 m^3	79.14	5.0/10.0	RT I, 24.12.2016, 1 - 01.01.2020
Electricity	MWh	4.47	0.50/1.00	RT I 2010, 22, 108 - 01.01.2011

In 2016, the revenues from energy related excise duties into state budget were 529.0 M€, in 2015 the relevant income had been 466.2 M€. For estimating the potential energy savings of the final energy consumption, a study was performed by the ÅF-Consulting AS. Applying a number of 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.

2. Requirement for remotely readable electricity meters.

According to the EU Energy Efficiency Directive (EED), which entered into force in 2018, the water, heating, gas and electricity meters of all end-users must be remotely readable to the end of the year 2026.

According to the Electricity Market Act, remotely readable electricity meters have been mandatory in Estonia since 2017 [29]. The EU Energy Efficiency Directive, 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 directive, which is the basis for the requirement to read meters remotely, is designed in particular to help achieve the 2030 energy savings targets. The Directive stipulates that meter readings must also be provided to the final customer so that the consumer 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 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, for example, it may turn out to be more economical to plan some activities with higher electricity costs for 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.

3. Requirement to install remotely readable gas meters

In order to achieve energy saving target set for the European Member States for 2030, it is necessary to make all building and apartment-based water, electricity, gas and heating meters remotely readable by 2026.

Due to the network rules for the operation of the gas market, from 2021 onwards, each customer must be able to see, in addition to electricity, their gas consumption on an hourly or daily basis.

This means that all data must be read remotely and old gas meters must be replaced.

Today, every consumer can see their electricity consumption in real time, a similar possibility should arise for remotely readable gas meters. Instead of monthly accounting, not only daily, but even hourly accounting is created. This gives the consumer the opportunity to monitor the price of gas and direct their consumption accordingly. It is helpful for those who have several heat sources at home. Then, according to the price visible in real time, you can choose to use electricity, gas or, for example, wood as a heating source.

On 1 January 2020, Regulation No. 41 of the Minister of Economic Affairs and Communications, *Network code for the functioning of the gas market,* entered into force, which obliged gas network operators to ensure the operation of remotely readable gas meters by 1 January 2021 at the latest [31].

4. Trainings and events to promote more sustainable use of energy and resources

Trainings and events promoting the more sustainable use of energy and resources are part of a larger measure *Resource Efficiency for Businesses*. The aim is to train specialists for resource audits and investments.

From the structural support funds of the European Union budget for the period 2014-2020, the Ministry of the Environment implements the measure “Resource efficiency of enterprises” with a total volume of 162 million euros, of which 81 million euros are European Union funds.

Regulation No. 27 of the Minister 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”* [32].

The measure includes four activities: raising awareness, training specialists, conducting audits or analyses of resource use and investing. Within the framework of the activities of the measure, trainings, conferences, seminars and information days on topics related to resource efficiency will be organized in 2016-2023. The objectives of the measure for more sustainable use of business resources are expected to be achieved by 2023.

The budget of the training measure popularizing the more sustainable use of energy and resources was: 800 thousand €, of which grants amounted to 400 thousand €. The rest had to be paid by the participants.

Results so far (by 2020)

52 energy and resource management specialists have been trained under the enterprise resource efficiency measure. The training of specialists took place through two training cycles. The trainings were organized and conducted by Tallinn University of Technology, in the case of the first training cycle it was done in cooperation with the ÅF-Consulting.

The training plan was divided into 3 modules, the total volume of which was 6 ECTS or 156 academic hours. The training lasted 12 working days. The first training cycle took place in the spring of 2017. The second training cycle started on November 28, 2017 and the last training day was March 20, 2018. The in-service training took place in 2019-2020. The training included visits to companies in special sectors, which added a practical dimension to the training. Those who completed the second training cycle also prepared simplified resource audits as a group work. The specialists who have completed the training were issued a TUT certificate, which certifies that they are competent to perform resource use analyses in industrial companies that meet the requirements set by the Ministry of the Environment.

5. Modernization of heating systems and connection to district heating

The measure is based on the Atmospheric Air Protection Act [33] and the Regulation No. 10 of the Minister of the Environment [34]. The law stipulates the system for collecting environmental charges and establishes the rates of charges. Environmental charges are channelled into Atmospheric Air Protection Programs (Environmental Program), 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.

The Environment Program is a set of sectoral programs funded through supported and implemented projects.

In connection with the reduction of the negative environmental impact of energy, housing associations, local government units, companies, environmental protection institutions, non-profit associations, foundations, legal persons in public law and self-employed persons can apply for support from the Environment Program. Grants can be requested for buildings built before 1 January 2010.

In the period 2014-2020, a total of 82 projects have been funded, including:

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
Modernization of boiler houses and heating systems	15

Table 9 summarises the energy savings achieved through the implementation of General cross-cutting measures.

Table 9. General cross-cutting measures

	Measure	**Semi-quantitative impact**	**Energy savings, PJ**	**CO_2 savings, $ktCO_2$**
1.	Fuel and energy excise taxes	High	26.04	n. a.
2.	Requirement for remotely readable electricity meters	Medium	1.55	n. a.
3.	Requirement for remotely readable gas meters	Low	0.10	12.3
4.	Trainings and events to promote more sustainable use of energy and resources	Medium	0.47	33.2
5.	Modernization of heating systems and connection to district heating	Medium	0.34	43.0
	Total		**27.59**	**88,5**

4.3 Summary

Estonia's overall energy efficiency obligation in the period 2014–2020 was 7 101 GWh, which is provided in the Energy Management Organization Act [8].

In the period 2014-2020, a total of 41 energy efficiency measures have been implemented in Estonia. Although the energy savings from the implementation of all measures have not yet been calculated (deadline April 2022) it can be stated with certainty that Estonia has fulfilled its task of saving energy. The total energy savings of 22 measures amounted to 8775 GWh (31.59 PJ) as of 1.08.2021 (see also Table 10 of the ANNEX 1).

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ANNEX 1

Table 10. Summary of Energy Efficiency Measures 2014-2020

	Measure	Semi-quantitative impact	Type of measure	Energy savings, PJ
	RESIDENTAL SECTOR			
1.	Renovation of apartment buildings (2014-2020)	Medium	Economic	1.10
2.	Minimum energy performance requirements for buildings	Medium	Regulatory	0.19
3.	Renovation of district heating boilers	Medium	Economic	0.09
4.	Replacement and reconstruction of pumping stations, water treatment equipment, water pipelines and sewerage facilities	Low	Economic	0.01
5.	Demolition aid for local authorities	Low	Economic	0.01
	TRANSPORT SECTOR			
6.	Compulsory training in sustainable driving	Medium	Economic	0.33
7.	Time-based road use fee	Medium	Financial	0.12
8.	Support for the purchase of electric vehicles	Low	Economic	0.08
	SERVICE SECTOR			
9.	Support for energy and resource audits of fisheries and aquaculture product businesses, energy efficiency of fishing and coastal fishing vessels	Low	Economic	0.07
10.	Modernization of health centres	Low	Economic	0.033
11.	Modernisation of street lighting	Low	Economic	0.034
12.	Support for improving the energy efficiency of welfare institutions	Low	Economic	0.07
13.	Modernization and renovation of schools in the process of reorganizing the school network	Low	Economic	0.03
14.	Institutional development program (energy efficiency investments in universities)	Low	Economic	0.04
	INDUSTRY SECTOR			
15.	Resource efficiency measure to promote investments in work processes	High	Economic	0.77
16.	Implementation of the ISO50001 standard in	High	Regulatory	0.4

	electric-intensive companies			
17.	Investment in best available technique; support to resource management systems combined with IT applications	High		0.62
	GENERAL CROSS–CUTTING			
18.	Fuel and energy excise taxes	High	Financial	26.04
19.	Requirement for remotely readable electricity meters	Medium	Regulatory	1.55
20.	Requirement for remotely readable gas meters	Low	Regulatory	0.1
21.	Trainings and events to promote more sustainable use of energy and resources	Medium	Information	0.47
22.	Modernization of heating systems and connection to district heating	Medium	Economic	0.34
	TOTAL			**31.59**

Table 11. Additional Energy Efficiency Measures 2014-2020

	Measure
	RESIDENTAL SECTOR
1.	Renovation of small houses
	TRANSPORT SECTOR
2.	Developing sustainable urban mobility and a human and environmentally friendly public urban space
3.	Light traffic support schemes
4.	Reconstruction of railways and increase of speed limits
5.	Improving connectivity at public transport stops including new stops and routes
6.	Development of shipping (ferries, port management, etc.)
7.	Railway electrification (incl. new electric trains)
8.	Automatic motor insurance payment rate
9.	Free public transport
10.	Speed cameras and speed limits on roads
11.	Vehicle registration fee
	SERVICE SECTOR
12.	Support for energy efficiency in kindergarten buildings
13.	Renovation of inefficient heating pipelines and/or construction of new heating pipelines
14.	Renovation of central government buildings (CO_2 measure)
15.	Renovation of local government buildings (CO_2 measure)
16.	Energy efficiency investments in the hospital network
17.	Improving energy efficiency in agriculture
	INDUSTRY SECTOR
18.	Special use fee for water
	GENERAL CROSS–CUTTING
19.	Investments of electricity distribution network companies in energy efficiency

Calculations of the energy savings achieved through the implementation of the measures are in progress.