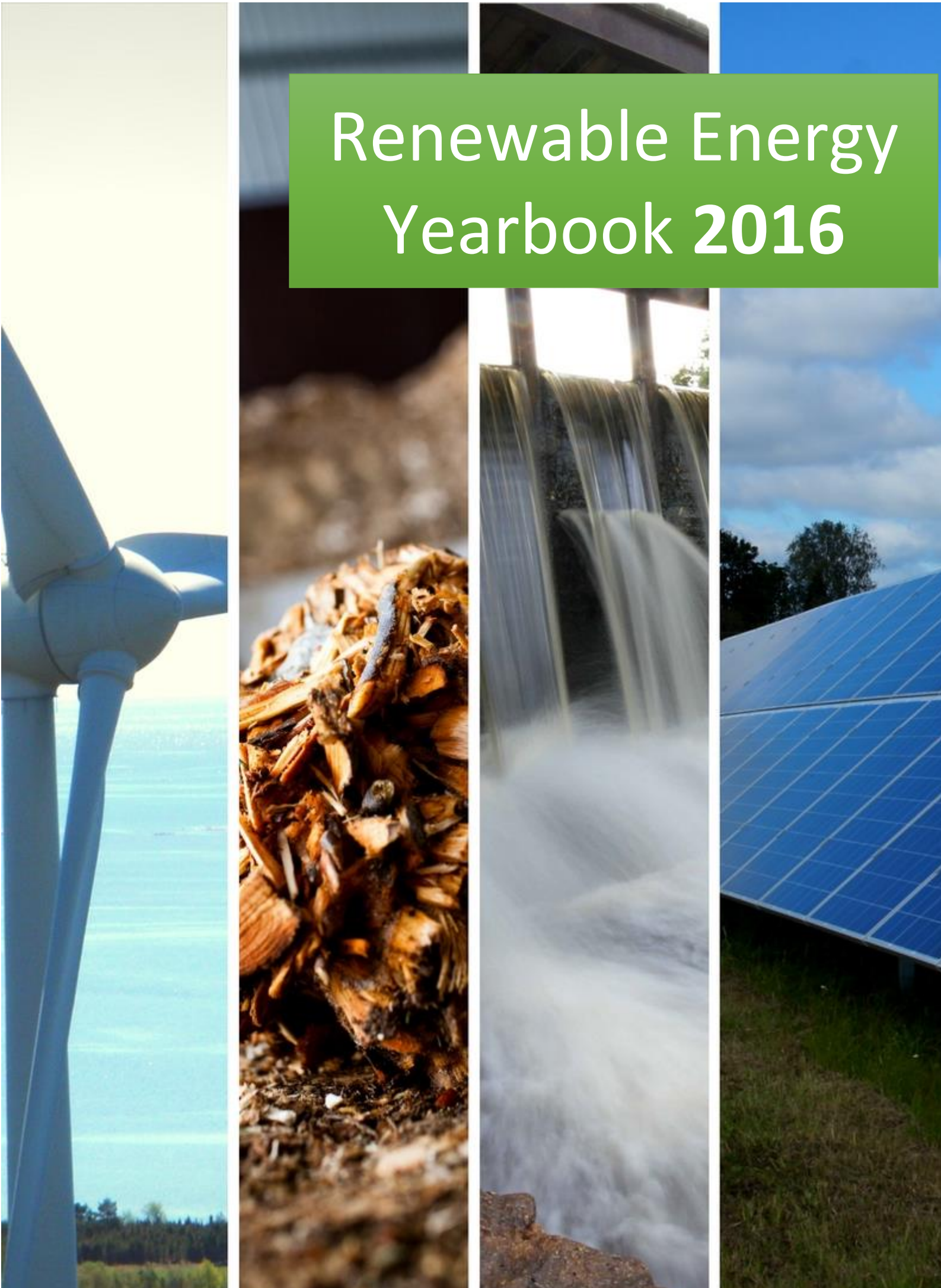

Renewable Energy Yearbook **2016**

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Photos used on the cover: Estonian Wind Energy Association, AS Utilitas Eesti, Estonian Hydroenergy Association, Estonian PV Energy Association.

Estonian Renewable Energy Association

The Estonian Renewable Energy Association (EREA) was founded on the 13th of May in 2011 with the aim to unite Estonian organisations active in the field of renewable energy under one roof with the missioon to advance and develop the field.

Estonian Renewable Energy Association currently has 10 members:

Energy producers:
AS Fortum Eesti
OÜ Graanul Energia
AS Nelja Energia
OÜ Utilitas Tallinna Elektrijaam

Associations:
Estonian Biogas Association
Estonian Power Plants and District Heating Association
Estonian Wind Energy Association
Estonian Hydro Power Association
Estonian PV Energy Association

Private person:
Toomas Koovit

EREA unites the major share of Estonian renewable energy producers and has set the long-term goal to 100% transition to renewable sources in energy economy.

The “Renewable Energy Yearbook 2016” is produced by: Erki Ani, Rene Tammist, Aivo Lokk

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Introduction

Estonian Renewable Energy Association publishes the Yearbook regularly in order to give an overview in current situation, updates and necessary changes in renewable energy field.

The Yearbook of 2016 gives a comprehensive overview of renewable energy sector in Estonia as well as in Europe and rest of the World. The Yearbook contains Estonian and European Union renewable energy statistics and overview in legislation for the period of up to 2017.

In 2016 alone the added investments and capacities in the sector formed nearly as much as during the last three years altogether. The higher rate of investments is stimulated by the perspective that the governmental support scheme in Electricity Market Act will be ceased. From these developments it can be assumed that the increasing rate of added capacity will continue in 2017. Although the governmental policies for investments in renewables is still unclear for the period after 2020 which definitely affects new investments in renewable sector for the coming years.

In the end of 2016 EREA published the scenario for 100% transition to renewable energy – “Renewable energy 100% - transition towards clean energy” (RE100), which is supported by research done under ENMAK (National Development Plan of the Energy Sector Until 2030) by the Estonian Development Fund. The RE100 allows Estonia to use it’s economical and geographical properties and to act as a role model for others, thereby ensuring another powerful engine for Estonian economy. In order to realize that vision strong political will and clear decisions are needed from the government.

The share of renewable energy among the energy economy has slowly grown and reached 56.1% in heating and cooling sector in 2015. Despite the great future potential of renewable energy, the goals have not yet been met in the electricity and transport sectors.

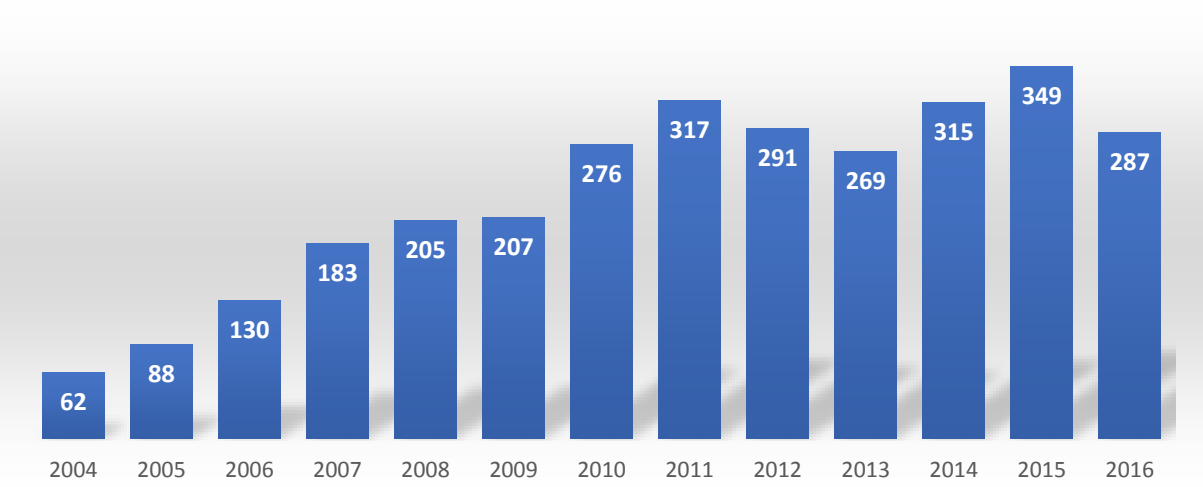
What is renewable energy?

Renewable energy uses resources (for example solar, wind, geothermal or wave energy etc.) consistently or so that they have the ability to recover themselves with the circulation of substances within the ecosystem (for example, biomass energy — wood, energy bush, straw etc.) without decreasing the amount of the resource as a result of human activity to the extent that would harm local ecosystems. To remain the ability to recover, the resources must be used sustainably, meaning the consumption does not exceed the pace of renewing. This way, these kind of resources can be used for thousands of years. Renewable energy can be used to produce electric energy, as well as thermal energy, engine fuel and giving electricity to areas not connected to the power grid.

Renewable Energy in the World

According to Bloomberg New Energy Finance, in comparison between 2015 and 2016, investments in renewable energy decreased globally by 18%, to 287 billion dollars (Graph 1).

Graph 1. Global investments in renewable energy (in billion dollars).
Source: Bloomberg New Energy Finance[1]



The decrease in investments is mainly caused by decline of two main markets. 26% in China and 43% in Japan. China is now more focused on investing in grids instead of increasing power within the grids, with the goal to increase the efficiency of renewable energy capacities already installed. In Japan, the main cause of decline in investments is monitoring the reliability of renewable energy capacities installed so far, as well as raising its efficiency. In the future, the increasing number of rooftop PV panels will have a growing role in increasing the share of renewable energy in Japan. It is also supported by upgraded support mechanisms.

Investments also somewhat decreased in the USA (7%). There, the developers were concentrating on developing tax-deductible projects for wind and solar PV.

In Asia and the Pacific Ocean area, the investments went down by 26%, to 134.5 billion dollars. In India, the number stayed almost the same (9.7 bln dollars) — the market was positively influenced by the construction of giant PV power plants.

In Europe, the investments increased by 3%, going up to 71.2 billion dollars. The rise was mostly influenced by offshore windfarm projects, as well as the so far biggest wind park project in Norway (1GW, with the investment of 1.3 billion dollars). Considering the volume of investments in Europe, the leading country was United Kingdom that had investments reach 26 billion dollars (a 2% increase compared to the year before).

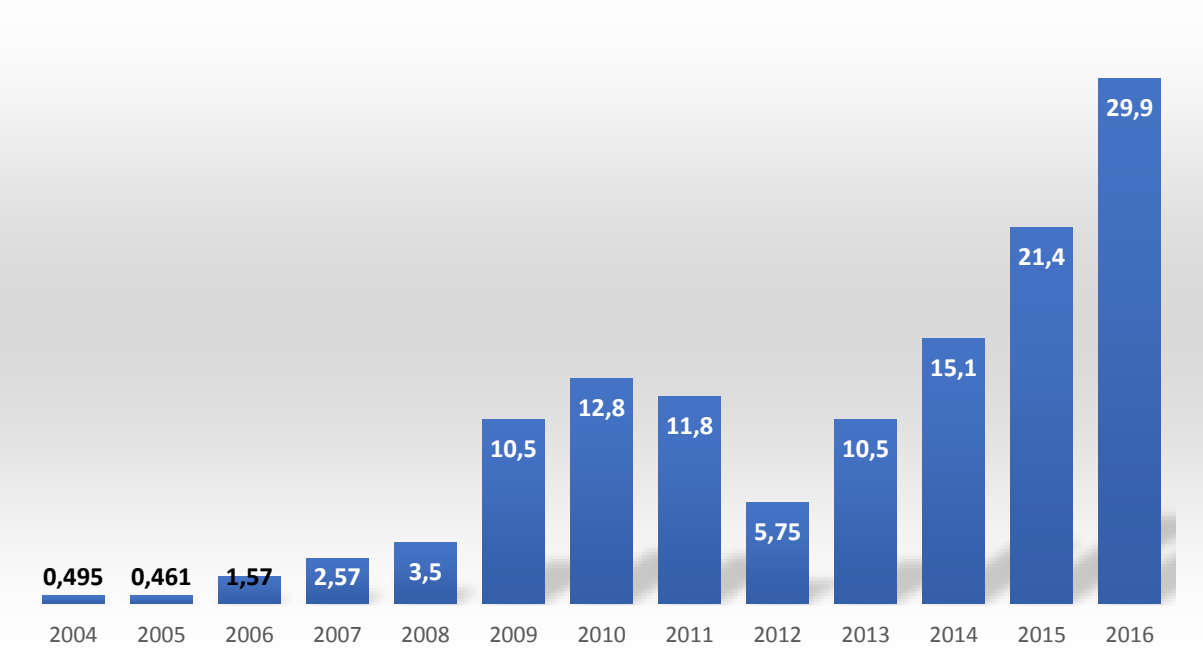
[1] https://about.bnef.com/blog/record-30bn-year-offshore-wind-overall-investment/

Investments in Germany that came in second, decreased by 16% and France is third with 5% decrease. Belgium is right behind them with renewable energy investments reaching up to 3 billion dollars (a remarkable, 179% rise) then Denmark with 2.7 billion dollars in investments (a 102% rise); Sweden with 2 billion dollars in investments (an 85% rise); and Italy with 2.3 billion dollars in investments (an 11% rise).

There was a bigger decrease in developing countries, because several projects that won renewable energy underbiddings with power in 2016, did not assure financing by the end of the year. In South Africa, investments decreased by 76%, to 919 million dollars; by 80% in Chile, to 826 million dollars; by 59% in Mexico, to 1 billion dollars; by 74% in Uruguay to 433 million dollars and by 4% in Brasil, to 6,9 billion dollars. Investments went up in Jordan, where the 1 billion dollar line was passed for the first time and compared to last year, the investment rate was 147% higher and eventually reached 1.2 billion dollars.

The most positive development in 2016 were the investments to offshore wind farms. Compared to last year, the volume of investments went up by 40% and reached 29.9 billion dollars (see Graph 2). Behind these increased investments are bigger and more powerful turbines as well as updated technology that, in turn, improve the profitability of the investments.

Graph 2. Global Investments to Offshore Wind Farms (in billion dollars).
Source: Bloomberg New Energy Finance[2]



Despite the decrease in investments on a global scale that was somewhat influenced by reduction in prices of renewable energy technologies, the global share of added capacities in the renewable energy sector increased. Wind energy capacities were increased by 56.5 GW — a smaller increase than last year (63 GW), but when comparing increases year-by-year, it is the second best result. Added capacities to solar PV set another record — 73 GW, a big increase compared to 56 GW that was added in 2015.

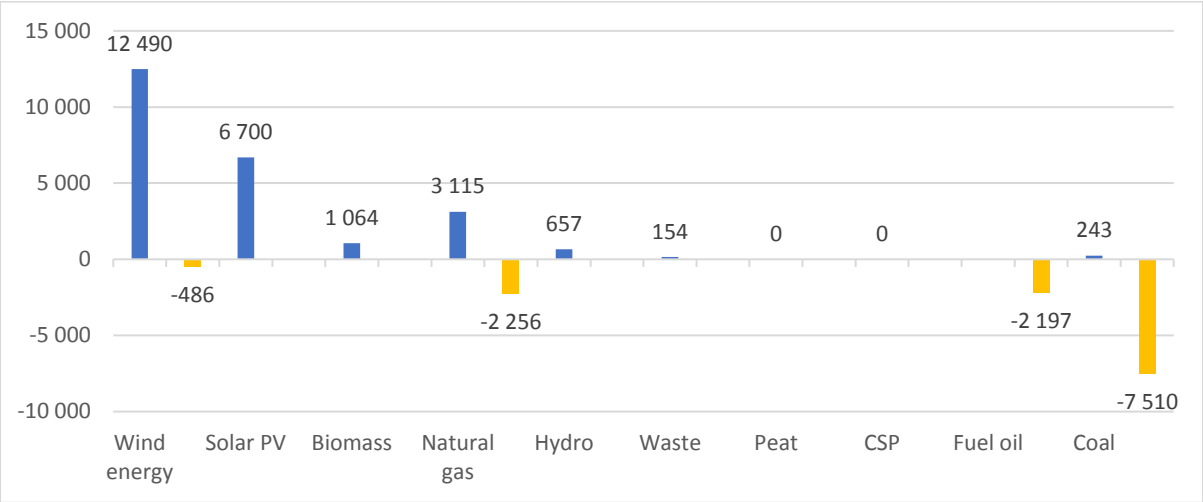
[2] https://about.bnef.com/blog/record-30bn-year-offshore-wind-overall-investment/

Renewable Energy in the European Union

Investments to renewable energy increased in the European Union thanks to the development of offshore wind farms. Compared to 2015, the investments increased by 3%, reaching 71.2 billion dollars in 2016. In Europe in 2016, the added capacities based on renewable energy made up 86% (21.1 GW) of all added electricity production capacities.

Compared to 2015, there was 6.3 GW less power generation capacity added in 2016 (24.5 GW, see Graph 3). Wind energy had the biggest share with 51% (12,5 GW) of all the added capacity. Solar PV came in second place with 6.7 GW and natural gas third with 3.1 GW. Capacities based on biomass were added by 1.1 GW (4% of all added volume). Hydro was added by 657 MW (3%) and power generation capacity based on waste was added by 154 MW (0.6%).

Graph 3. Newly Installed and Decommissioned Capacities in the EU in 2016 (in MW).
Source: WindEurope[3]



In 2016, 7.5 GW of coal production capacity was decommissioned, as well as 2.3 GW of natural gas production capacity and 2.2 GW of fuel oil production capacity.

Despite the ambitious goal formulated by the European Commission in the proposals of the Energy Union according to which the EU will become a world leader in the field of renewable energy, the investments for the renewable energy sector have decreased by more than a half, when compared to the best year so far — 2011. When comparing EU to its biggest competitors, China and USA are one step ahead when it comes to developing renewable energy. China's investments for renewable energy are bigger than the EU and USA are making combined. 5 out of 6 PV panel manufacturers as well as 4 out of 10 wind turbine manufacturers are from China. It is also the largest market for electric vehicles in the world. USA exceeds Europe in installed renewable energy capacities and is very close by total investment volume. Per capita, the investments made in the field of renewable energy in the USA are bigger than in Europe. If India reaches its goal set for 2022 — to install a total capacity of 175 GW in renewable energy — it will have bigger investments as well as bigger added capacities than the yearly volumes in Europe.

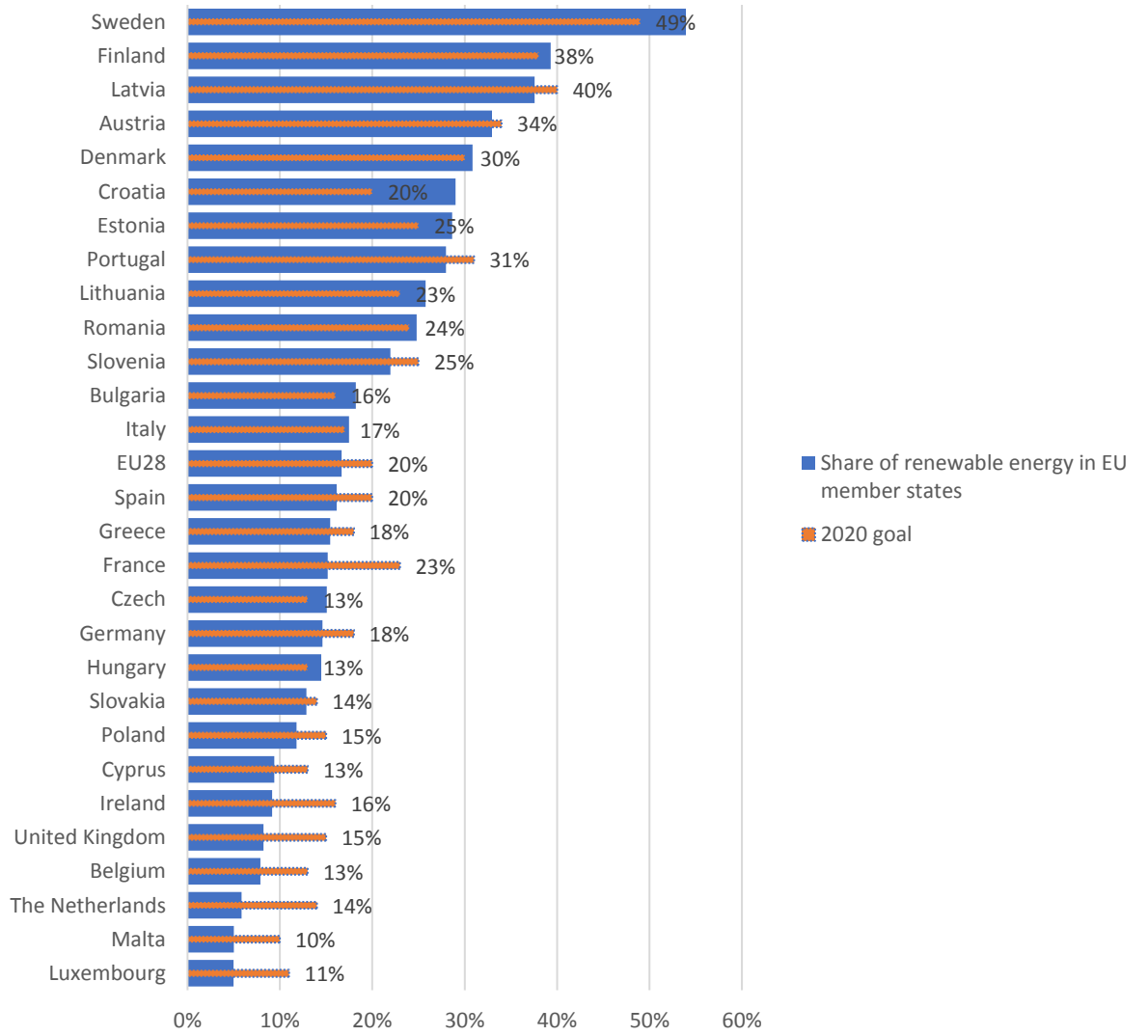
[3] WindEurope (2017). Wind in Power: 2016 European statistics.

To meet the ambitious goal of the Energy Union, Europe must try a lot harder, but the goals presented by the Commission for 2030 as well as the regulative framework for it give little hope for success.

The Share of Renewable Energy in the EU

In 2015, renewable energy made up 16.7% of the final consumption of energy in the EU. That means when compared to 2004, the rate has almost doubled. The goal set for renewable energy usage by 2020 is 20% and by 2030, at least 27% of the final consumption.[4]

Graph 4. Share of Renewable Energy in EU Member States (%).
Source: Eurostat[5]



[4] http://ec.europa.eu/eurostat/documents/2995521/7905983/8-14032017-BP-EN.pdf/af8b4671-fb2a-477b-

[5] http://ec.europa.eu/eurostat/web/energy/data/shares

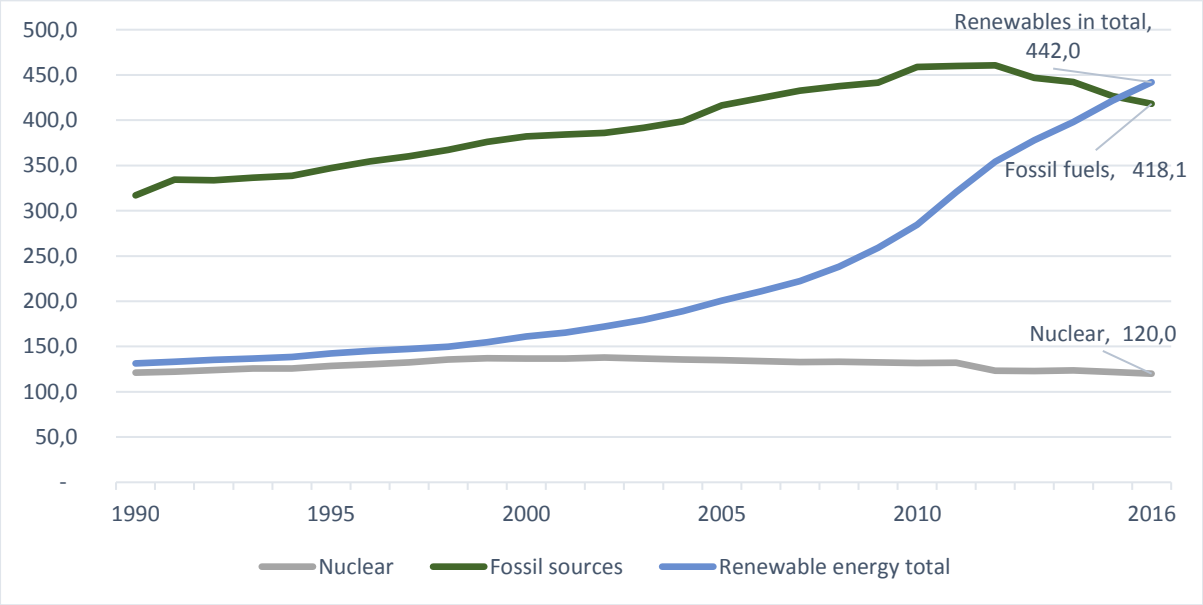
According to Eurostat, by 2015, 11 member states of the EU (9 in 2014) had met the 25% goal set in the Renewable Energy Directive for renewable energy share in the member states (see Graph 4): Bulgaria, Czech Republic, Denmark, Estonia, Croatia, Italy, Lithuania, Hungary, Romania, Finland and Sweden. Austria and Slovakia are 1% away from meeting the goal. At the other end of the scale, we find The Netherlands, France, Ireland, United Kingdom and Luxembourg that are further away from meeting the goal.[6]

In 2015, the share of renewable energy usage in Estonia was 28.6%, which means that we have fulfilled the goal set by the directive. It is mainly influenced by the transition from natural gas and oil shale to bio fuels in the heating and cooling sector. We still have not reached the sub-goals in electricity (17,6% by 2020) and transportation (10% by 2020) sectors.

Production Capacity in the European Union

The added renewable energy electricity production capacities of 2016 made up 86% of all added capacities and that breaks the former record of 79% set in 2014. The total capacities of renewable energy now exceed all other electricity production capacities in the EU (see Graph 5). For the first time, wind energy made up over half of the added capacities and took second place in the EU in electricity production, after natural gas. Compared to 2005, when solar PV only made up 0.3% (2 GW), wind energy 6% (41 GW) and coal 24.8% (167 GW) of total capacities installed, solar PV capacities have increased 50 times, to 101 GW by the end of 2016 (accounting for 11% of the total electricity production capacity in the EU), wind energy capacities have almost quadrupled, to 154 GW (16.7% of total capacities) and the percentage of coal has decreased to 16.5% (152 GW).[7]

Graph 5. Electricity Production Capacities in the EU (GW).
Source: Eurostat[8], WindEurope[9]

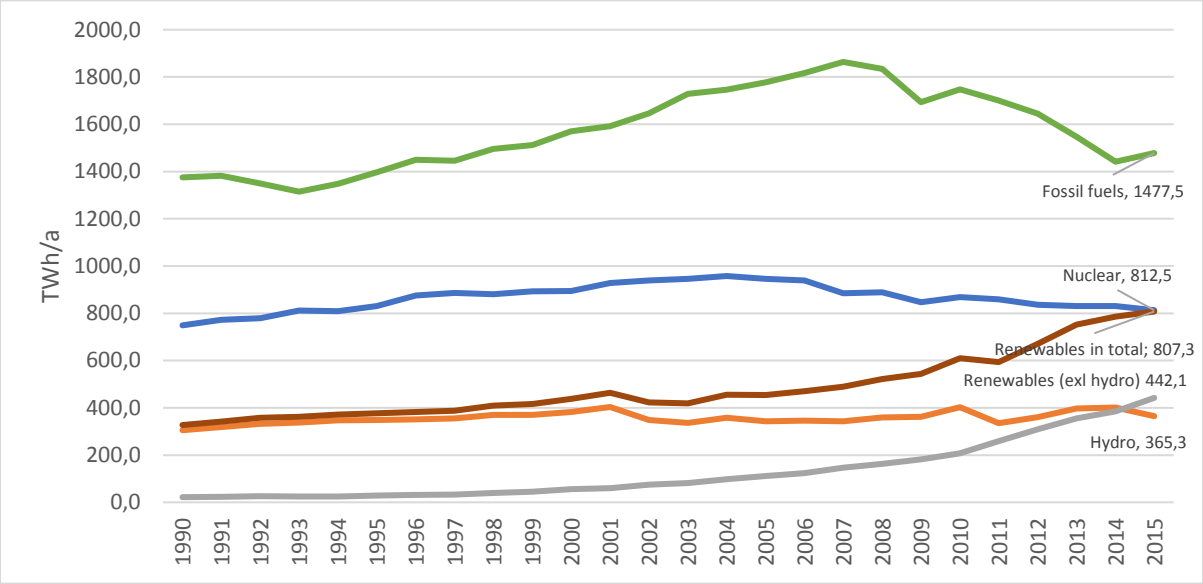


[6] http://ec.europa.eu/eurostat/documents/2995521/7905983/8-14032017-BP-EN.pdf/af8b4671-fb2a-477b-b7cf-
[7] WindEurope. 2016 European Statistics
[8] http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_from_renewable_sources
[9] WindEurope. 2016 European Statistics

The increasing share of renewable energy in power grids lowers the price of energy for consumers on the wholesale market, but also makes it more volatile. That is why it is important to take into account the fluctuation inherent to renewable resources and adapt consuming habits to their changes.

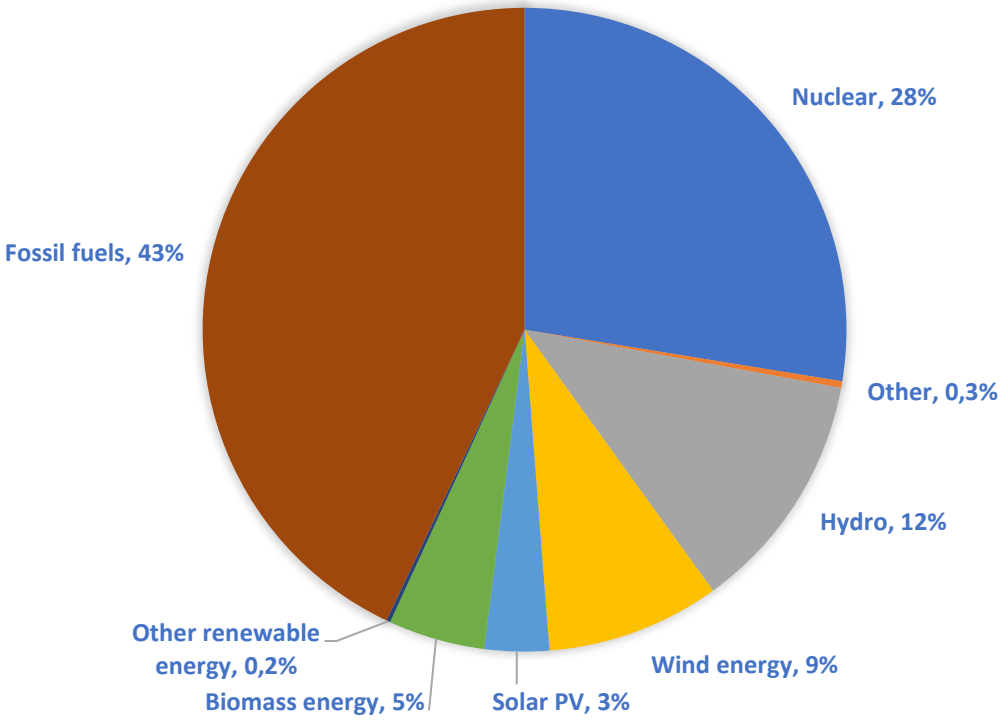
According to Eurostat, 3097 TWh of electricity was produced in the EU in 2015 (see Graph 6). Renewable power (807 TWh) had almost as big of a share than nuclear power (812 TWh). Most electricity is still produced from fossil fuels — 1477 TWh. The biggest increase in the last decade has been in producing electricity from renewable resources and the largest decrease in electricity production has appeared among the electricity produced from fossil fuels.

Graph 6. Net electricity production in the EU (TWh)
Source: Eurostat



At the end of 2016, the most important renewable energy source in the EU was hydro energy (see Graph 7) that manufactured 12% of all produced electricity. Wind energy was on second place and was used to produce 9% of overall electricity. Electricity produced from biomass made up 5% and PV 3%.

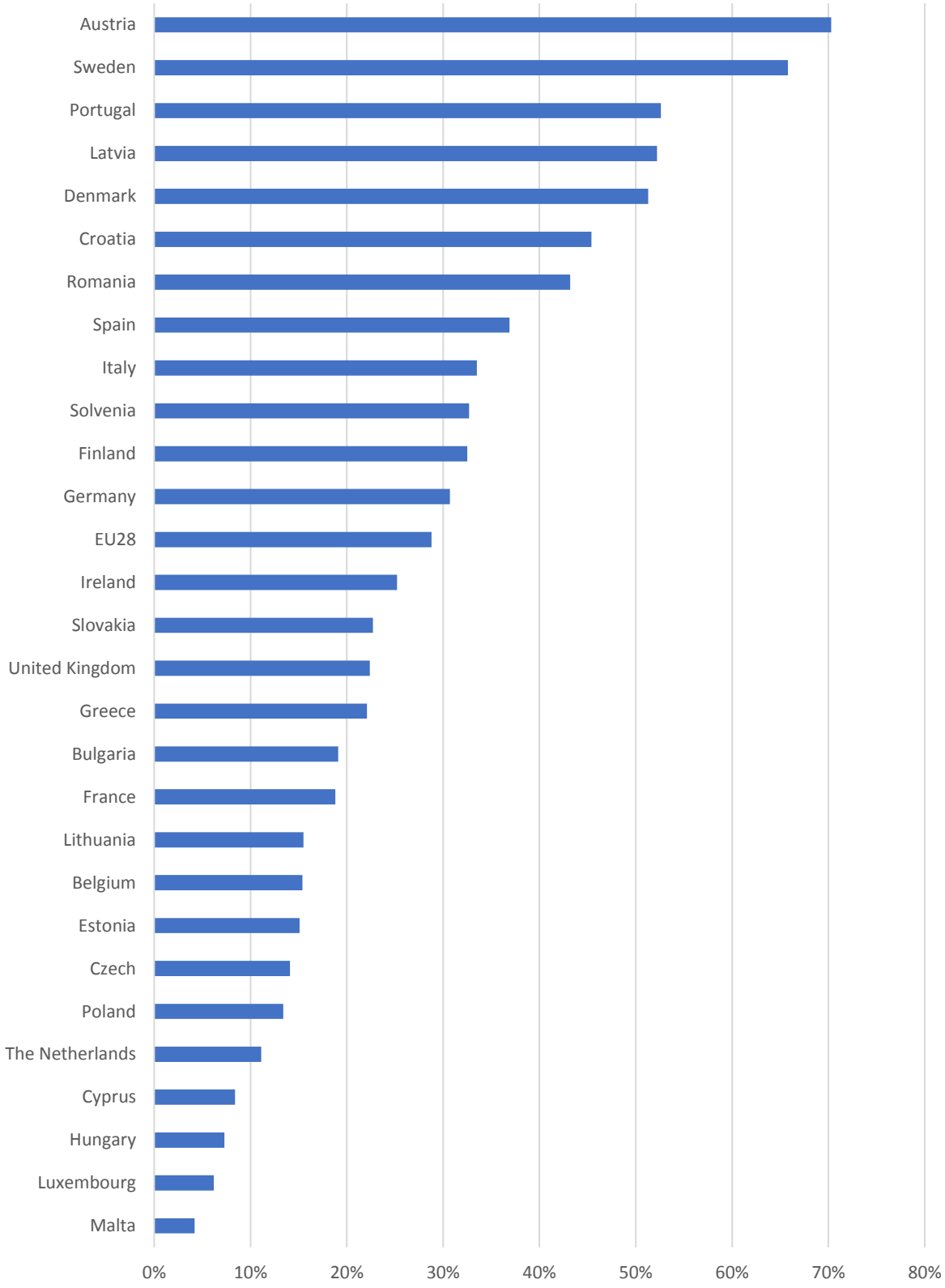
Graph 7. Electricity Production in the EU in 2016, by energy source (%).
Source: Initial data Entso-E[10], National Statistics[11]



When looking at the share of electricity production from renewable sources (Graph 8), the smallest renewable electricity production percentage is in Malta (4.2%), Luxembourg (6.2%) and Hungary (7.3%). The highest renewable electricity production percentages are in Austria (70.3%), Sweden (65.8%) and Portugal (52.6%). Thanks to hydroelectric power stations, our closest neighbour Latvia produces 52.5% of all consumed electricity from renewable sources. Among Estonian electricity manufacturing, in 2015, only 15.1% came from renewable sources. With this rate, we are very low on the list of comparison in the EU member states and have fallen back 2 places within the last year.

[10] https://www.entsoe.eu/data/statistics/Pages/default.aspx
[11] https://www.gov.uk/government/statistics/electricity-section-5-energy-trends

Graph 8. Share of Renewable Rlectricity in the EU Member States in 2015 (%).
Source: Eurostat[12]



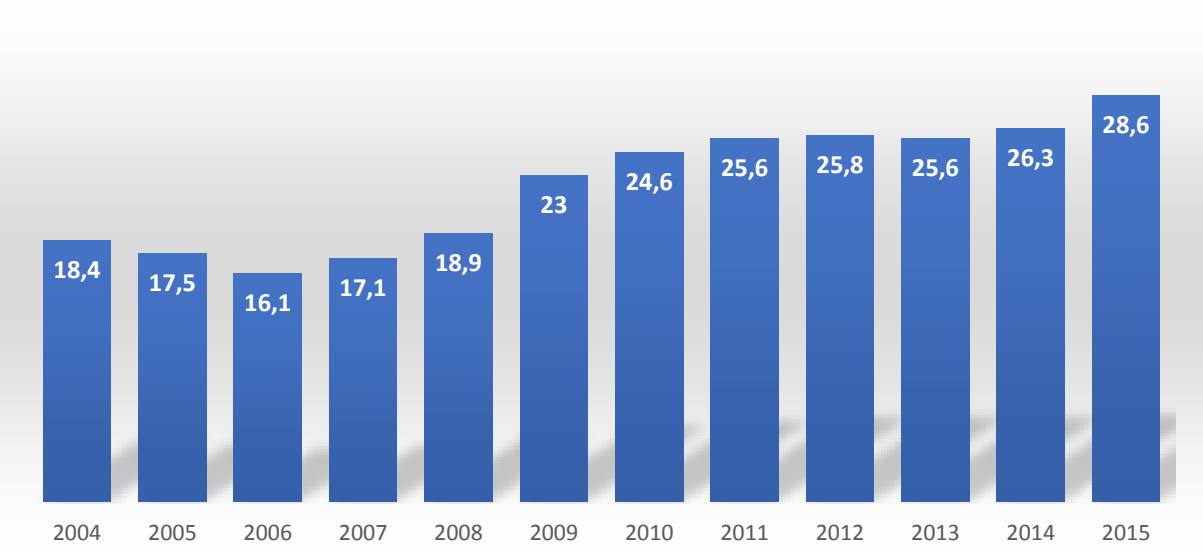
[12] http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_from_renewable_sources

Renewable Energy in Estonia

Investments and added renewable energy capacities made in 2016 are almost as large as they were in 2013-2015 combined. Investments have also been powered by the threat that the state's support scheme included in the Electricity Market Act that is in effect now, might be discontinued. That is why projects that have started before are being finished and an increase in production capacities can be predicted in 2017. The state policies for renewable energy investments after 2020 are still unclear and this kind of uncertainty will influence investments in the following years.

According to Eurostat, the share of renewable energy used in final consumption increased by 2.3% between 2014 and 2015 (from 26.3% to 28.6%, see Graph 9). In the heating sector on the same period, the share of renewable energy went up from 45.1% to 49.6%. In the electricity sector, the share of renewable energy in 2015 is 15.1% and in the transport sector, 0.4%.[13]

Graph 9. Share of Renewable Energy in Final Consumption (%).
Source: Eurostat[14]



[13] http://ec.europa.eu/eurostat/web/energy/data/shares
[14] Eurostat: Share of renewable energy in gross final energy consumption

Overview of Developments in the Estonian Renewable Energy Sector in 2016

According to Elering, 1414 GWh of electricity was produced from renewable energy sources in the power grid in 2016. It is 6% less than the year before and makes 15.1% of total electricity consumption. Most (55.6%) of the electricity based on renewable sources was produced from biomass, biogas and waste. The share of wind energy in 2016 was 41.7% (589 GWh) of electricity based on renewable sources. Unlike last year, the 600 GWh capacity triggered remuneration limit for wind energy set in the Electricity Market Act was not reached.

Prices for all renewable energy technologies have globally significantly decreased, especially for wind and solar PV. The biggest decrease in prices has been among offshore wind energy. In 2016, a capacity of 7.05 MW was added with one wind park, so Estonia has a total of 309.96 MW of wind energy capacities.

A cogeneration plant by AS Graanul Invest was completed in the second half of 2016 in Imavere. Its thermal energy capacity is 28 MW and electricity capacity 10 MW. In Tallinn, OÜ Utilitas Tallinna Elektrijaam finished another cogeneration station with a thermal energy capacity of 76.5 MW and electricity capacity of 21.4 MW.

3.74 MW of new solar PV production capacities were added to the power grid, the volume of produced electricity almost doubled in comparison to 2015 to a level of 3 GWh. The estimated total power of installed PV panels has reached to 10 MW and in 2016, almost 250 new solar PV producers started generating electricity, 243 of them were connected to the power grid. In addition, there are autonomous producers who have not connected the power grid. Compared to recent years, there has been a substantial increase in the number of PV parks with capacities over 200 kW. The number of autonomous solar PV stations has also increased, influenced by the erection of off-grid stations by Elektrilevi. The ongoing decline of technology prices has contributed to the rapid growth of PV usage, and the trend will continue in the future as well.

The production of hydroenergy increased by 30% within the last year, from 27 GWh in 2015 to 35 GWh in 2016. The larger productivity was brought on by better water conditions, there were no changes installed capacities.

The growth of microgeneration, that means production capacities of up to 15 kW, increased. In 2015, 220 new microgenerators started operating. According to the Estonian Renewable Energy Association, in 2016, another 254 microgenerators were added. The total number of microgenerators connected to the grid was 816 in the end of 2016. There is also a number of additional autonomous producers not connected to the power grid and in 2016 an estimated 30 kW of autonomous capacities were added.

Renewable Energy Highlights of 2016

March
Sillamäe Power station renovated a second one of its four oil shale units to use chipwood as fuel. The capacity of the unit is 26 MW.

May
AS Fortum Tartu opened an innovative district cooling station that is a first of its kind in both Estonia and the Baltic states. With the capacity of 13 MW, the district cooling station uses traditional industrial cooling devices as well as the water from river Emajõgi.

June
AS Eesti Energia created a separate company for renewable energy production, under the name Enefit Renewable energy that will operate all the renewable energy production units of the AS Eesti Energia.

October
Elektrilevi started piloting new autonomous power grid service in the areas where it is not reasonable to renew overhead lines and substations or where the construction proves to be too expensive. In these places, new local off-grid PV stations will be installed. The government approved the Estonian Energy Sector Development Plan.

December
The government approved the General Principles of Estonian Climate Policy and the Climate Change Adaptation Development Plan. The main goal of the General Principles of Estonian Climate Policy document initiated by the Ministry of Environment is bu 2050 to reduce the amount of greenhouse gas emissions by 80% compared to the levels in 1990. This means gradually transforming the economy and energy system to be more resource efficient, productive and green. Changes need to be made in energy, transport, industrial, agricultural and forestry sectors. It is an umbrella document that sets out the principles and policies that will be put into effect in future renewal of sectoral development plans.

April
Construction of wind parks is hindered by a restriction made by the Ministry of Defence about both the new and existing locations of the parks. The restriction cancels the planning of 9 parks currently in development stage.

June
The development of offshore wind energy doubled its pace, as the leading wind energy and wind turbine producers announced that offshore wind energy will become significantly more competitive. The European ministers of energy signed a programme to fulfill that promise. In practice, this means international cooperation in planning sea areas and power grids, also evening out different technical rules and standards. That would help bring down the price of offshore wind energy. Earlier research by the European Commission has shown that if the countries cooperated in that area, it would be possible to save 5.1 billion euros on offshore grids alone.

November
EREA presented the new renewable energy transition plan “Renewable Energy 100% — The Triumph of Clean Energy in Estonia” that stipulates the transition to renewable energy in both electricity and heating and cooling sectors. Compared to the earlier programme, the new one also has a vision for the transport sector. The total cost of investments has decreased by half during the last 5 years, solar PV capacity will continue to increase and a call to phase out oil shale by 2030 was added.

The 18th Conference on Research and Exploitation of Renewable Energies took place in Tartu. Among the topics discussed were EREA’s Renewable Energy 100 and its socio-economic influences, as well as the perspectives of energy policies in the coming decades, the long-term perspectives of wind energy and the smart city project of Tartu were introduced.

On 4th of November, a globally important milestone was passed — the Paris Climate Agreement that agreed to limit global temperature rise, keeping it below 2 degrees compared to pre-industrial levels, in order to prevent climate change from reaching a dangerous level, came into force.

Legislation

Electricity Market Act

In 2012, the Ministry of Economic Affairs and Communications initiated a legislative amendment aimed at changing the renewable energy subsidy scheme. In October 2014, the European Commission issued a state aid permit for the previously in force, current and revised renewable energy subsidy scheme. On September 19th of 2016, Riigikogu (The Parliament) started proceedings of the draft Electricity Market Act Amendment Act SE290. The draft regulates that if the production capacity of existing production equipment is not sufficient enough to meet the goal of electricity production from the state's renewable energy source or in the production of electricity in an efficient cogeneration mode, the government, on the proposal of the Minister for Economic Affairs and Infrastructure, arranges an underbidding to obtain additional production capacity. In addition, the existing producers will be distinguished and will receive support under the current grant rates for the 12-year support period. A regulation of international cooperation mechanisms transposing the relevant EU directive was added to the law. The directive encourages the use of energy from renewable sources.

District Heating Act

In 2016, amendments to the District Heating Act 8 years in the making were completed by the Ministry of Economic Affairs and Communications and given to Riigikogu and processing the draft law started on 13 June 2016. The aim of the amendment of the District Heating Act was to direct district heating providers to use more stable, environmentally friendly and cheaper fuels. The aim of the bill is to provide the district heating consumer with the lowest and most stable price of heat energy, hand in hand with a well-organized and efficiently arranged heat supply. Among other things, additions in the draft included mandate norms to establish regulations necessary for pricing regulation, and further clarifications were made that were proved necessary in practice.

The Estonian National Development Plan of the Energy Sector Until 2030

In 2016 the Estonian government approved a development plan named The Estonian National Development Plan of the Energy Sector Until 2030. At present, the draft has been forwarded to Riigikogu for an opinion. Upon receiving the opinion from Riigikogu, the government will make a final decision for the development plan. The new plan sets the direction of the energy sector until 2030, but also sets goals up to 2050.

General Principles of Estonian Climate Policy until 2050

In 2015, the Ministry of Environment started to develop General Principles of Estonian Climate Policy until 2050. The goal of the paper is to formulate and agree on a national level long-term climate policy vision, policy guidelines and greenhouse gas emission reduction targets until 2050. The development document will contain long-term policy orientations in the areas of energy, transport, industry, agriculture, forestry and waste management to move towards a vision of Estonia's long-term climate policy to reduce greenhouse gas emissions by at least 80% by 2050, compared to 1990 levels.

Amending the Grid Code

In 2016, the Ministry of Economic Affairs and Communications initiated the amendment of the Grid Code in connection to the implementation of the EU Grid Codes. EREA has put forward several dozen proposals for the new Grid Code, based on extensive analysis by consulting firm GL Garrad Hassan. The process of amending the code should end in 2018.

Draft Law for Energy Communites

In 2015, the Ministry of Economic Affairs and Communications published a plan for the elaboration of a draft law on energy communities. Although the draft was promised to be submitted for approval in the same year, it has not happened yet. Establishing operating conditions for energy communities is very important; at present, legislation does not even allow the establishment of energy cooperatives. In 2015, Arengufond implemented the Energy Communities Mentoring Program that mapped the potential of Estonian energy communities, and analyzed the socio-economic impacts and legal effects of energy associations.

Marine Spatial Planning

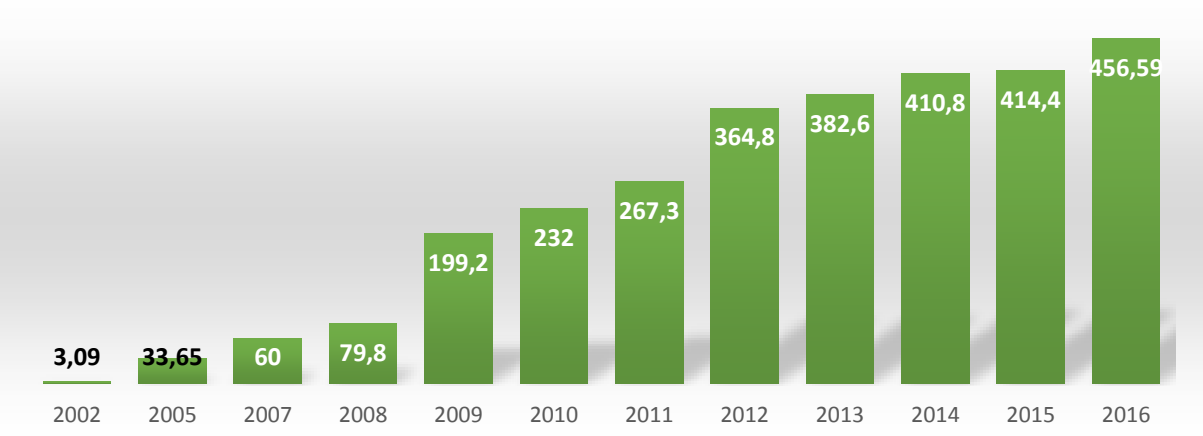
In 2015, the first marine plans of Estonia were prepared, which determine the areas and conditions for the use of marine resources, including for the introduction of offshore wind turbines. First plans were made for Pärnu and Hiiumaa counties, where both plans have been accepted and established by county governors. The state has indicated willingness to draw up a plan for all marine areas. The first draft of the marine area plans should reach the public no later than in November of 2017. The planning is expected to be completed by December 2019.

Electricity Production from Renewable Energy Sources

Investments and Added Capacities in Estonia

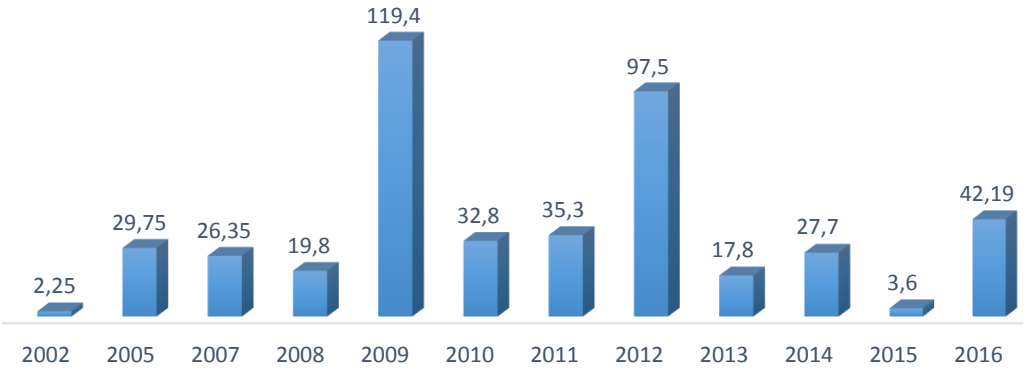
By the end of 2016, Estonia had installed 456.6 MW of renewable electricity capacities. When comparing the last four years, the increase in capacities in the renewable energy sector was the largest in 2016 (see Graph 10, Graph 11).

Graph 10. Renewable Electricity Capacities Over the Years (MW).
Source: EREA



According to EREA, 42.19 MW of new power production capacities were added to the grid in 2016 (see Graph 11). It is the third largest result over the years — in 2009, 119.4 MW of new capacities based on renewable energy were added, in 2012, it was 97.5 MW.

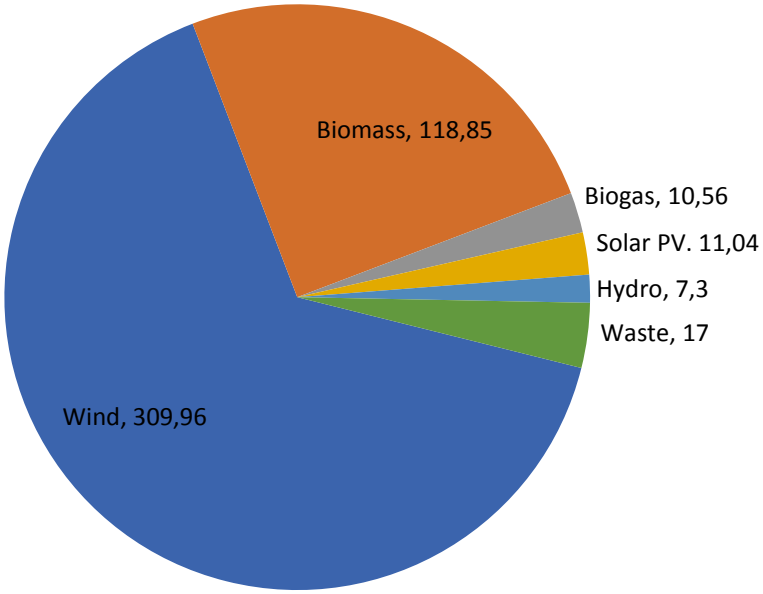
Graph 11. New Renewable Electricity Capacities Over the Years (MW).
Source: EREA



According to Graph 12, of the total electricity production capacity in Estonia wind and biomass are the most prominent. In 2016, the largest increase in renewable energy capacities was in electricity produced using biomass — in comparison to 2015, it went up by 31.45 MW.

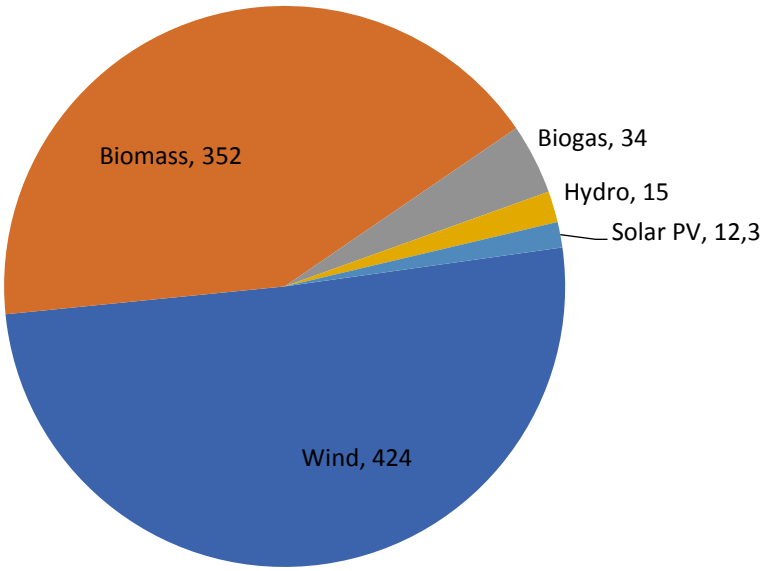
By the end of 2016, wind power capacity accounts for 65% of the installed capacity of renewable energy, meaning 309.96 MW, and the capacity for biomass is 25%, reaching 118.85 MW. The rest of the production capacities combined are ~ 8% of the installed capacity. Compared to 2015, the share of biomass production capacities has increased the most (20.3% in 2015). It is also important to note the increase in total capacities of solar PV, which exceeded the installed capacity of biogas in 2016, and is now ranked third among all renewable energy production capacities, after wind and biomass.

Graph 12. Renewable Energy Capacities by Electricity Generation (MW).
Source: EREA



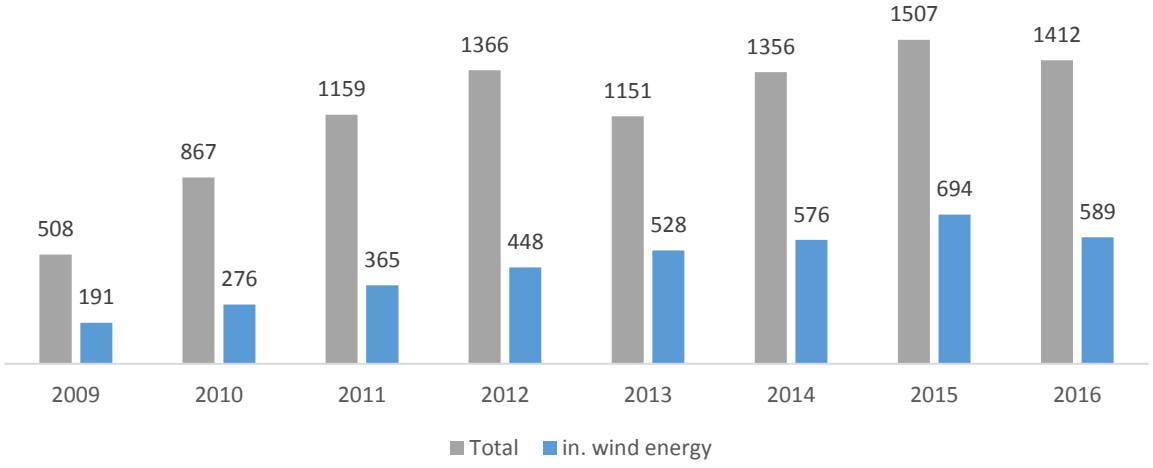
In Estonia, 837.3 million euros have been invested in the renewable energy production capacities (see Graph 13). Compared to investments added in 2015, in 2016, the investments significantly increased. In total renewable electricity production capacities attracted 69.3 million euros in investments.

Graph 13. Overall Investments to Renewable Electricity Sector (in millions of euros).
Source: EREA



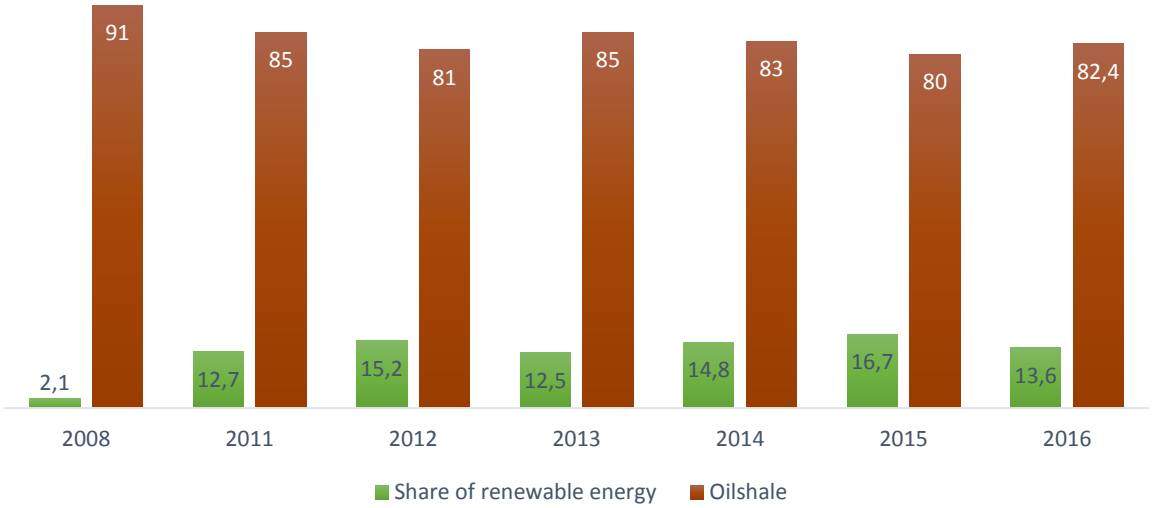
According to Elering, 1412 GWh of electricity was produced using renewable energy in 2016, which is 6.2% less than in 2015 due to the worse weather conditions for wind energy. In 2015, wind energy production reached 694 GWh and in 2016 589 GWh. Wind energy was the only one to decrease (by 15%), electricity production from hydro energy increased by 30% in 2016. Biomass and biogas was used to produce 789 GWh, hydro energy to produce 35 GWh and solar PV to produce 3 GWh of electricity.

Graph 14. Renewable Electricity Production (GWh).
Source: Elering



The ratio between electricity produced from renewable energy sources and electricity produced from oil shale has changed marginally in recent years, remaining essentially the same. In 2016, the share of electricity from renewable sources was 13.6% according to AS Elering. The share of oil shale has swayed very little, between 85% and 80% in recent years.

Graph 15. The Share of Renewable Energy and Oil Shale in Electricity Production (%).
Source: Elering



Electricity and Heat Cogeneration

Cogeneration of heat and electrical power is the simultaneous production of heat and electricity, using waste heat from electricity production. Cogeneration of heat and electricity allows electricity to be generated in areas where there is a sufficient heat load, thus increasing the efficiency of the energy system.

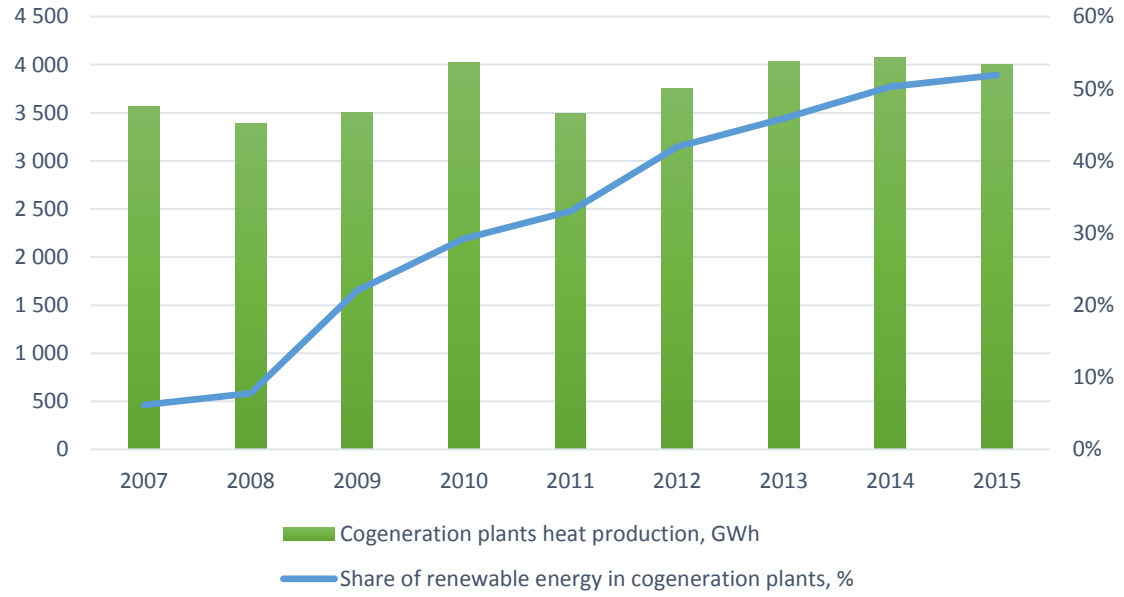
In Estonia, the largest investments in the heating industry have been made especially in the construction of new cogeneration capacities in Tallinn, Tartu, Pärnu, Paide, Kuressaare and Rakvere, but at the same time, the potential of cogeneration in Estonia is far from being exhausted. The potential is available for cogeneration plants in smaller settlements as well as, for example, in Tallinn.

The construction of new cogeneration capacities depends primarily on the legislator, since the cost of an additional investment in electricity generation per unit of electricity (investment per 1 MWel) is significantly higher than the cost of an investment per unit of heat output. That is why investors need to be sure that the legally guaranteed subsidy will not change in the future. The legislative uncertainty associated with the Electricity Market Act, due to the lengthy proceedings, does not increase the security of investments.

The use of renewable fuels for heat production in cogeneration plants has grown significantly, reaching 52% in 2015 (see Chart 16). In 2015, another oil shale unit in Sillamäe SEJ was transformed to work on biofuels. In 2016 AS Graanul Invest completed a 10 MW electric power cogeneration plant in Imavere, to satisfy the needs of a pellet industry. In the autumn 2016, the 21.4 MW electric power reserve boiler house/cogeneration plant by OÜ Utilitas Tallinna Elektrijaam started production.

Graph 16. Share of Heat From Renewable Fuels in the Production of Heat in Cogeneration Plants in 2007-2015 (GWh)

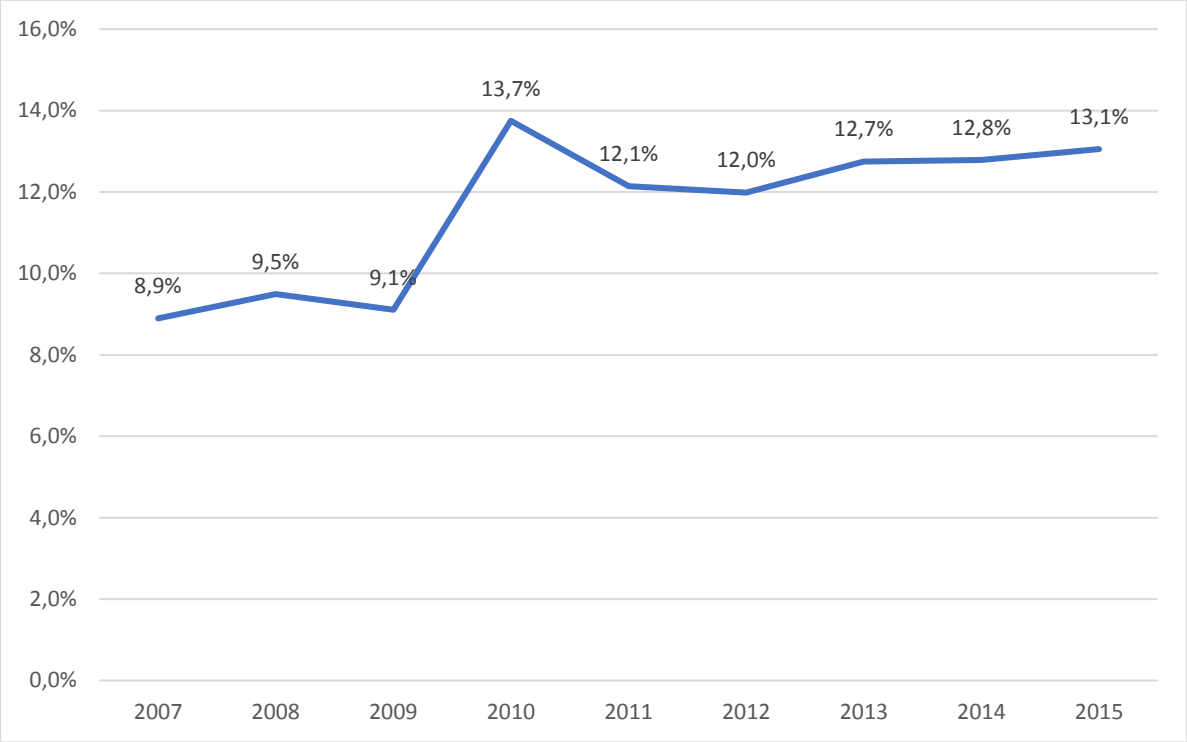
Source: EREA



Cogeneration is also used in Estonia by industrial users who need to use steam or heat in their industrial processes. While most of the existing industrial cogeneration plants used natural gas as fuel, new planned ones use local biofuels.

Estonia has not achieved the goal of cogeneration set for 2020, according to which the share of electricity produced in cogeneration plants should be 20% of gross consumption. Today it is over 13% (see Chart 17). A wider application of cogeneration would be an important source of primary energy savings to fulfill the goals set by the EU Energy Efficiency Directive.

Graph 17. Share of Co-generated Electricity Produced in Gross Electricity Consumption (including self consumption and losses) in 2007-2015 (%).
Source: EREA



OÜ Utilitas Tallinna Elektrijaam two cogeneration plants

Wind Energy

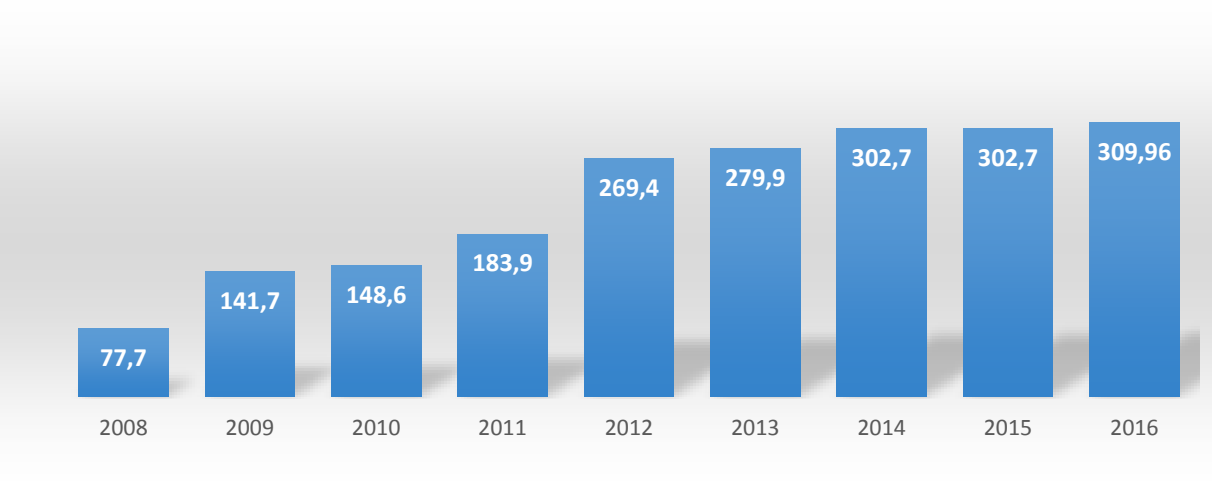
Last year, only one wind farm was opened in Estonia - the Tooma II wind farm, owned by AS Nelja Energia. It has three Enercon E-92 wind turbines of 2.45 MW, with a total power of 7.05 MW. The total investment of the second stage of the Tooma wind farm is 11.5 million euros and the estimated annual production is 19 GWh. By the end of 2016, there were 139 wind turbines with a total capacity of 309.96 MW in Estonia (see Graph 18).

Regarding the wind conditions, the year 2016 was not the best, which can also be seen by a 15% decrease compared to electricity generated by wind farms in 2015. If a year ago, the wind turbines generated 694 GWh during the 12 months, then in 2016 the electricity output was 589 GWh. That would be enough to supply electricity for approximately 238 500 households for the whole year. Due to the low wind speeds, the 600 GWh per calendar year capacity triggered remuneration limit for wind energy set in the Electricity Market Act was not reached. Unfortunately, the first 600 GWh crossing in 2015 was also a signal to investors that Estonian government does not expect for more wind turbines to be added to the country's electricity system.

In 2016, wind energy received renewable energy subsidies in the amount of 27.7 million euros, which is about 40% of the total amount of subsidies. Wind farms receive support during the first 12 years of operation. In 2016, this milestone was met by the first wind farm in Estonia, the eight wind turbines of Pakri peninsula (total capacity 18.4 MW). This means that the Pakri wind farm will no longer receive renewable energy subsidies.

In June 2016, Estonia's first marine area plan was established, which also found areas in the regions adjacent to the Hiiumaa county to be used for offshore wind energy. The Pärnu County Governor also adopted a plan for marine areas bordering Pärnu County, which was introduced in April 2017.

Graph 18. Wind Energy Capacities Established in Estonia (MW).
Source: Estonian Wind Energy Association



Tuuliki Kasonen, NGO Estonian Wind Energy Association:
"2016 surprised us with sudden decrease in offshore wind energy's prices. At the beginning of June, Europe's leading wind power and wind turbine manufacturers announced that offshore wind energy will become significantly more competitive over the next decade, and its price will drop below 80 euros per MWh by 2025. At the same time, EU energy ministers signed a plan to fulfill this promise. It was predicted that within the next decade, offshore wind turbine prices could successfully compete with new conventional power plants, when it comes to prices. But it happened much earlier than expected.

Already in the summer of 2016, Borssele wind park won an underbidding in the Netherlands at a price of 78 EUR per MWh, and in the autumn of the same year, Kriegers Flak Marine Park being built in the Denmark in the Baltic Sea also won with the price of 49.9 EUR / MWh. It must also be mentioned that Walney Offshore Wind Farm's Marine Park, which was decided to be built at the end of the last decade, produces energy at the price of 158 EUR per MWh, so the development has been explosively fast. However, surprises are not limited to this, as in April 2017 Germany's underbidding was won by three offshore wind farms with 0 financial support, which means that the renewable energy fees will not be paid for these power stations. This is the first time ever when offshore windfarms are built under market conditions."

Solar PV

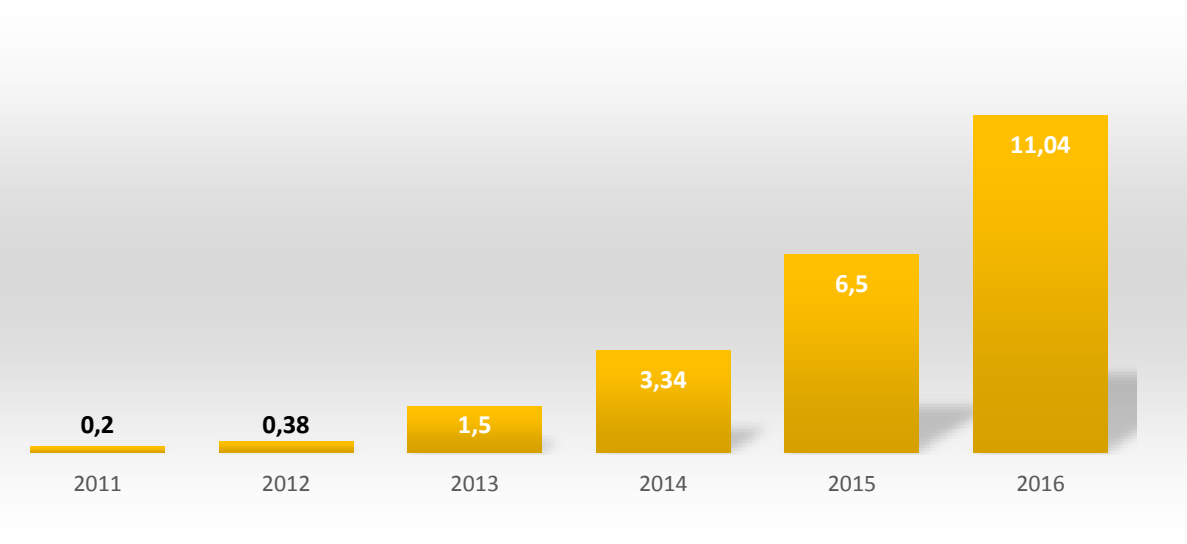
In Estonia, as of the end of 2016, 809 small producers of solar PV sell electricity to the grid and receive renewable energy subsidy, most them are microgenerators. To this number can be added the number of people who have installed PV panels, but have not notified the grid operator.

2016 was once again a record year in added PV capacities. There were 3.7 MW of added capacities, that is more than in 2011 to 2014 combined and 16% more than in 2015. According to AS Elering and Imatra AS, 11 MW of PV panels is connected to the grid in Estonia (see Graph 18). According to Elering, as of the end of 2016, net power production capacity of 2947

MW[15] has been installed in Estonia, of which the share of PV is 0.37%, but it is showing continuous growth, since in 2015 the number was 0.2%.

The amount of subsidy paid under the Electricity Market Act to PV producers was 143,162 euros in 2016, which is 51% higher than in 2015, but is a small percentage of the total paid grants — only 0.21%.

Graph 19. PV Capacities Combined (MW).
Source: EREA, based on Elektrilevi and Imatra



Andres Meesak, NGO Estonian PV Electricity Association

"2016 was once again a record year in added PV capacities. In addition to the fact that the capacities almost doubled (see Graph 18), there is also a significant increase among the average size of PV stations, as well as an increase in the number of autonomous, off-grid solutions compared to recent years. Thanks to the growing popularity of PV panels, these are becoming a new normality in the society and the image of PV panels as luxury goods is fading. Reduction in prices of technology, shorter pay-back periods and proven productivity have been pushing up the credibility and reliability of PV panels for more and more consumers.

Unfortunately, 2016 did not bring the long-awaited change in regulation that would allow communities to build PV power plants in co-operative form to reduce the energy costs of local government buildings or schools, or allocate energy costs between the members of community. The experience of many European countries has shown that PV plants are the first choice for communal energy communities and their favorite technology. On the positive side, one must place the creation of PV plants by many rural enterprises, farms and small-scale productions, with an intention to lower the energy consumption component in their finished products."

[15] https://elering.ee/elektrienergia-tarbimine-ja-tootmine-eestis/

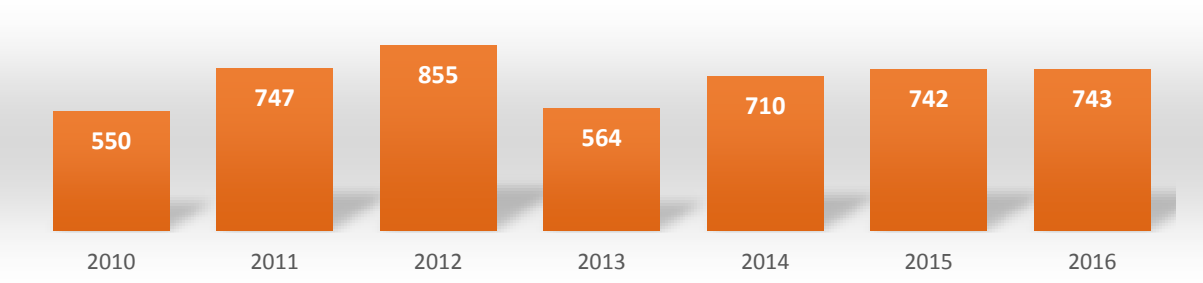
Bio Fuels

Biomass

According to Elering, biomass as the biggest renewable energy source in Estonia, was used to produce 743 GWh of electricity in 2016, accounting for 52% of all electricity produced from renewable energy sources. Compared to 2015, the production did not increase significantly, adding 10 GWh of produced electricity[16].

Renewable energy subsidies for biomass remained roughly at the same level as in 2015 — 32.4 million euros, accounting for 47.5% of total subsidy paid. In 2016, two larger biomass-fuelled heat and electricity cogeneration stations with a total combined heat capacity of 104.5 MW and a total electricity capacity of 31.4 MW were added. This sector also got the biggest added investment of 55 million euros.

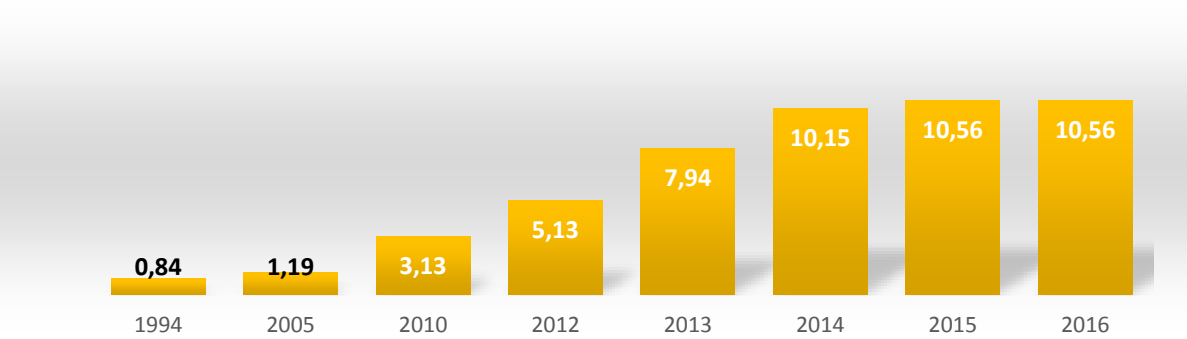
Graph 20. Electricity Produced from Biomass (GWh)
Source: Elering



Biogas

No new biogas plants were added in 2016, and according to EREA, there has been no new investments in this sector. The installed capacity of the biogas plants stayed at the level of 10.56 MW, and according to Elering, the biogas plants produced 46 GWh of electricity, which is slightly less compared to the production in 2015 (49 GWh). Biogas plants received 2.3 million euros of renewable energy subsidy to in 2016.

Graph 21. Biogas Capacities in Estonia (MW).
Source: Estonian Biogas Association



16 Elering's statistics does not include the power plant's self-consumption, which for cogeneration plants reaches 10%, so the total actual amount of electricity generated from biomass is higher. The power consumption of the power plants in particular concerns cogeneration plants that are fueled by wood chips, biogas and waste. Wind turbines, PV and hydro power plants have basically no self- consumption. Thus, according to data from the Statistical Office, the production of cogeneration plants accounts for a higher proportion of renewable energy than Elering data suggests and a lower proportion of wind energy from renewable energy sources. The calculation of electricity self-consumption is important because it will be taken into account in fulfilling the EU's renewable energy obligations.

Ahto Oja, NGO Estonian Biogas Association:
"To summarize, we can say that compared to the year before, in 2016, 4922 MWh (44 874 MWh) less electricity was generated to the grid from biogas. As far as we know, no biogas production units were added in 2016. Supposedly there are around 1000 natural gas vehicles and the consumption of natural gas in vehicles is presumably 2.5 million kg. Nowadays, buses in the town of Võru are running with compressed gas. The first LNG-CNG station in Estonia started operating in Võru in January 2017. In addition to the Võru station, CNG gas stations in Jüri and Tallinn are also envisaged. This spring, Tallinn's third CNG gas station was opened on Gaasi Street.

In the biomethane support scheme call by Environmental Investment Centre that ended on April 6th, station owners have asked for support for CNG stations in 31 locations all over Estonia. However, the second part of the same support measure for local governments to create the demand for biomethane consumption, has not activated and under the current conditions it is rather likely it will not activated at all. So the promotion of biomethane consumption in transport has not moved forward. All of the 18 existing biogas plants are known to be working and producing heat and electricity or only heat energy.

In the area of policy advancement, we can be happy about the Ministry of Environment's regulation that establishes requirements and raw materials, according to which a certified biofertilizer can be produced from the fermentation residue. There is still an accredited certification body missing for the implementation of this regulation.

This year, the policy makers have promised to propose a solution to the start-up support for price difference between biomethane and natural gas and the 4% biomethane blending requirement for each natural gas cubic meter, which presumably generates demand for 20 million Nm3 of biomethane annually. It is less than 5% of the overall biomethane potential. Therefore, it might be advisable to increase the share of supply obligation in the future to use the potential of domestic renewable transport fuel, biomethane, to the fullest. Looking back on the year, it can be said that the prerequisites for this for next year are many times better than a year ago."

Hydro Power

There were no added capacities for hydropower production and the installed capacity is 7.3 MW. However, the addition of hydropower to the grid increased thanks to the favourable conditions for hydro energy. According to Elering, 35 GWh of hydropower was produced to the grid, that is almost 30% more than in the year before.

Despite the increased production due to a increased levels of water, the state of hydro energy in Estonia is not too good. Stricter environmental objectives have led to the prospect that the share of hydropower might be reduced by dismantling the weirs.

Jan Niilo, NGO Eesti Veskivaramu

The year of 2016 in hydro energetics was quite variegated. Unfortunately, not because there would have been many new production units in this sector. There is rather a struggle for survival going on, in order to continue with the oldest means of electricity generation in Estonia. In 2016, the Chancellor of Justice started a scrutiny of a clause on Water Act, under which in the rivers of the so-called salmonids, the passage of fish should be ensured at all times, and if experts find that there isn't an ideal solution for this, river dams should be demolished.

To date, the future of three hydroelectric power plants in operation, which account for about a third of the production of hydropower in Estonia, is under question. Additionally, the question of restoration and reinstating of several largely preserved complexes is still open.

One of the potential projects to be launched is the first hydroelectric power plant in the Baltics and the former Western Russia, in Kunda. The station is a heritage conservation site and has been selected as one of the 100 treasures of Estonia for the republic's 100th anniversary. This status also entails a certain increased commitment. Therefore, regardless of the final fate of the station, plans are made to fix up the building and related facilities, and the works will start in 2017.

Considering the advancement of technology and technical capabilities in the sector over the last 5 years, it is likely that compromises can be reached between the environmental objectives and other interests.

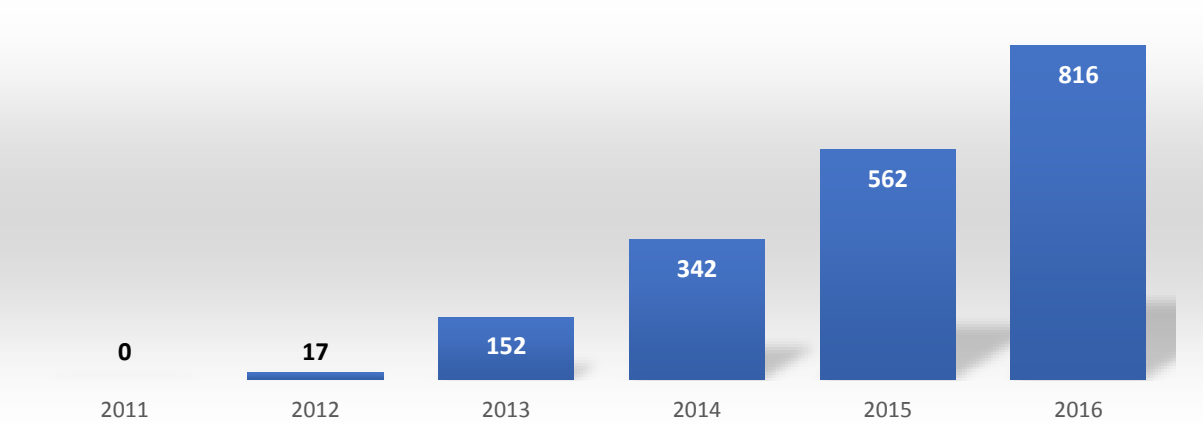
Microgeneration

Microgenerators are very small-scale electricity producers whose installed production capacity in Estonia does not exceed 15 kW. For example, microgenerators are households and small businesses for whom there have been established simplified power grid accession procedures.

There has been a rapid development in the sector of microgeneration over the last few years and every year, the number of new producers is larger than it was the year before. In 2016, a new record of 256 new microgenerators connected to the power grid was set and by the end of the year, the total number of microgenerators connected to the grid was 816 (see Graph 22). 97% of them have PV panels and the rest mostly operate small wind turbines. Compared to 2015, when the number of microgenerators was 562, the number grew by 32% in 2016.

At the end of 2015, the combined capacity of microgenerators was 4.5 MW. By the end of 2016, the capacity had gone up to 6.8 MW. To this, we can add the capacities from the producers who do not get subsidies and are not connected to the grid.

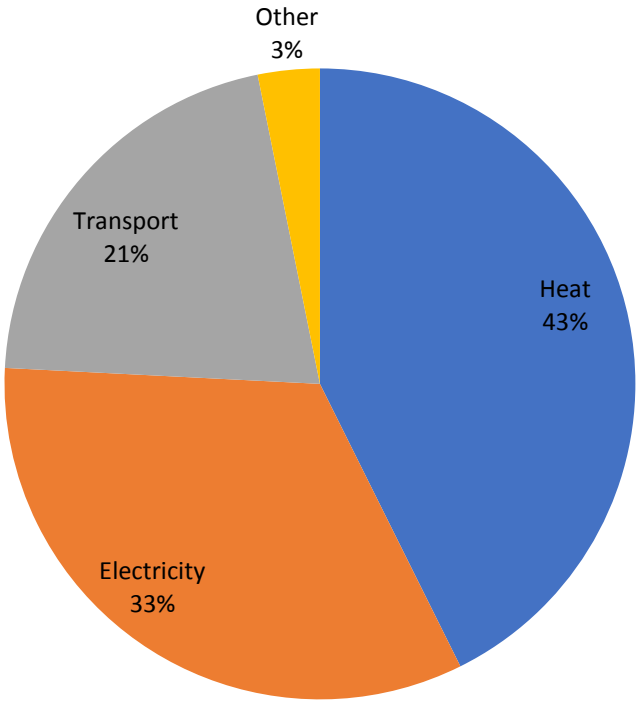
Graph 22. The Growth of Microgenerators Connected to the Power Grid by Year.
Source: EREA. Based on data by Elering and Imatra



Production of Heat Energy from Renewable Sources

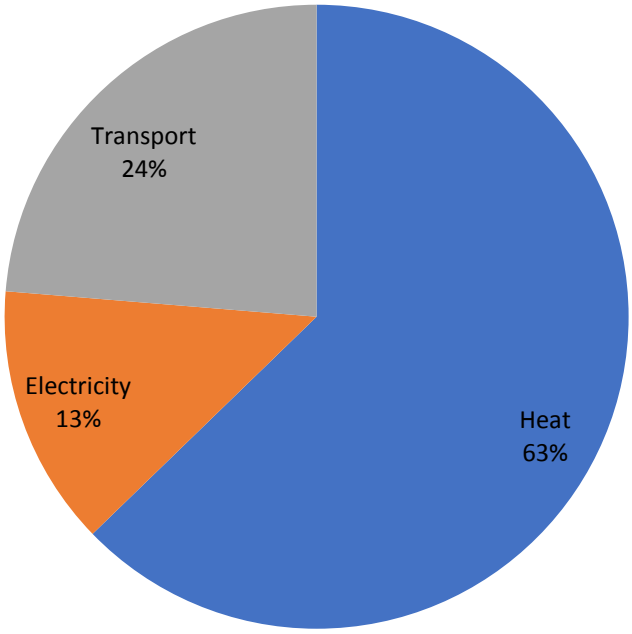
Estonia is in a climatic zone where buildings need to be heated for at least 7 months every year. Therefore, heat energy is consumption is greater than electricity consumption in Estonia. Heat consumption accounted for 43% of overall final energy consumption. Electricity and transport sector form 33% and 21% accordingly (see Graph 23 and Graph 24)[17]. When looking at households, the importance of heat is even bigger — 63% of consumed energy is in the form of heat.

Graph 23. Final Consumption of Energy in Estonia (%).
Source: EREA



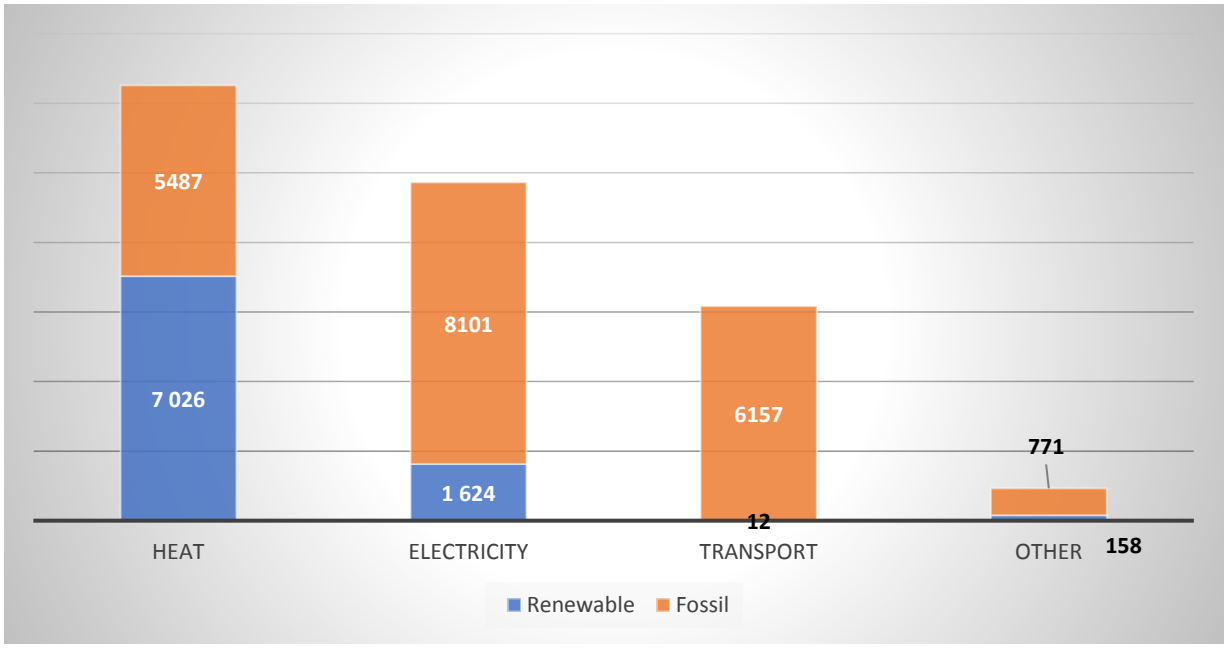
[17] Data by Statistics Estonia + local and domestic heating's fuel consumption and produced heat are taken into account.

Graph 24. Final Energy Consumption by Households (%).
Source: EREA



Renewable energy sources are used more in the heat production than electricity and transport production (see Chart 25).

Graph 25. Final Energy Consumption and the Share of Renewable Energy in 2015 (GW).
Source: EREA



The use of local fuels mostly means the use of renewable biomass. The share of renewable energy in heating sector has grown each year, reaching 56.1% in 2015[18].

District Heating

There are more than 200 district heating areas in Estonia. Around 60% of Estonian households are supplied by district heating. Close to 2/3 of the consumed heat is produced in district heating. District heating is mostly common in cities and densely populated areas, because it is a consumer-friendly type of heating solution that provides security of supply and is environmentally friendly.

District heating divides the heat produced in efficient central boiler houses through the district heating network. The generation and distribution of heat allows the application of the best technology available and the use of the district heating network that meets the needs, allows flexibility in the choice of fuel type and allows to use the benefits of cogeneration of heat and electricity.

The development of the district heating sector is characterized by a number of changes. Like electricity production, energy security is also important in heat production. The price of heat is also influenced by the price of energy carriers and their availability. Due to the need to increase energy security, Estonian producers should increase the consumption of domestic fuels.

The biggest change in the sector is in the change in the fuel used for heat generation. Several factors - the volatility of natural gas prices and the geopolitical tensions with Russia, who still supplies most of the natural gas we use, the country's desire to tax different fuels in a similar manner, based on their calorific value (which raises the price of local fuel oils) - are determining the increased use of local fuels. However, the prices of renewable fuels have remained at the same level in recent years. Also considering the aspect of energy security, it is reasonable to use indigenous renewable energy sources.

Regulatory changes are also expected in the district heating sector - in major district network areas, preparations are being made for a transition to a multi-tariff heat accounting system that would consist of a constant price of heat (capacity charge) and a consumption charge (charge for the heat consumed).

The reduction in heat consumption that stems from reconstruction of buildings has a greater impact in smaller district heating networks. It is probably not economically viable to offer district heating supply there and it is more reasonable to switch to on-site heating solutions. Meanwhile, district heating networks located in larger cities have sufficient development potential – district heating network areas are expanding and new customers are connecting with the district heating system.

One of the challenges is the implementation of the EU Energy Saving Directive in Estonia. By the end of 2020, the near-zero-energy buildings requirements will enter into force (for existing buildings owned by the state and local governments by the end of 2018). A research carried

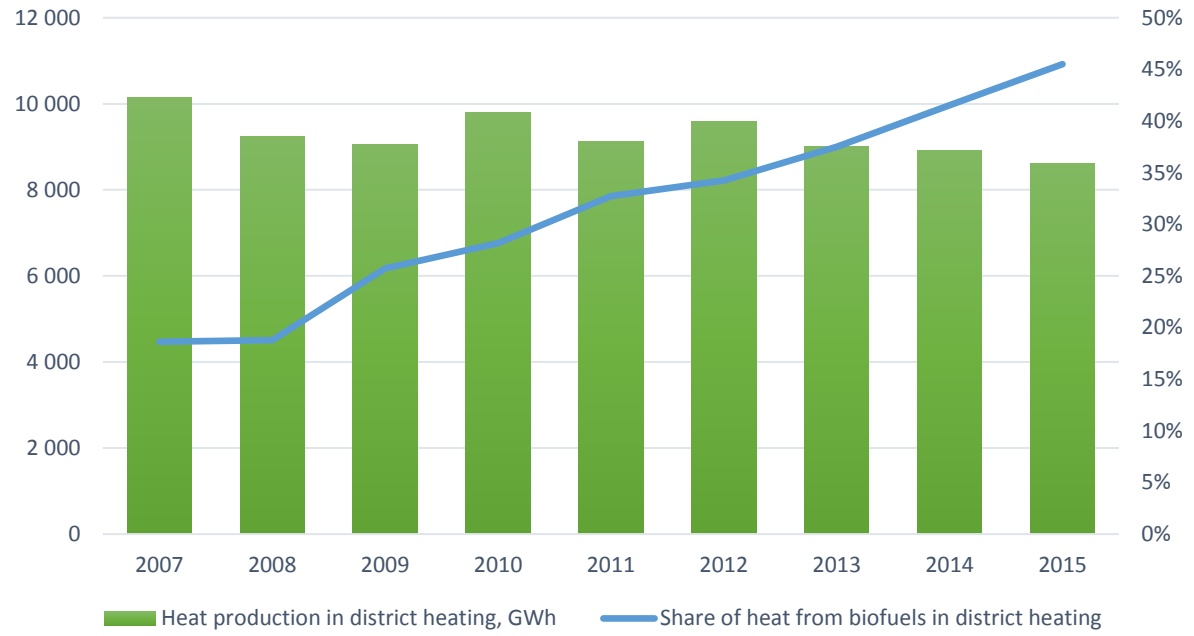
[18] Found in both fuels consumed for heat production in district heating and place heating plants, according to which the share of heat from renewable fuels in total heat produced is ~ 56.1%

out by Tallinn University of Technology in 2016 concludes that district heating based on renewable energy sources and cogeneration can meet the requirements for near-zero energy buildings[19].

In the district heating sector, more and more boiler houses and cogeneration plants are switching to renewable fuels. According to Statistics Estonia, the share of renewable energy in district heating in 2015 was 46%. This percentage has increased significantly over the years (see Chart 26). As statistics are published in the second half of the year, current yearbook does not reflect the data for 2016.

In 2016 several new boiler houses using renewable energy (Jõgeva, Kehtna, Märjamaa, Suure-Jaani, etc.) were opened. In total, with the support of the Environmental Investment Center, more than 40 energy projects were funded in 2016, in which fossil fuel was switched for fuels from renewable sources.

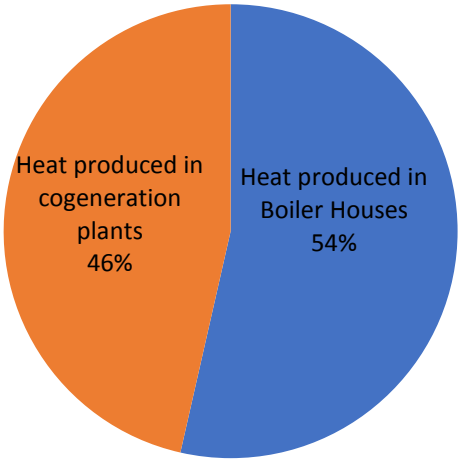
Graph 26. Share of Heat from Renewable Energy Sources in Heat Production in 2007-2015 (GWh).
Source: EREA



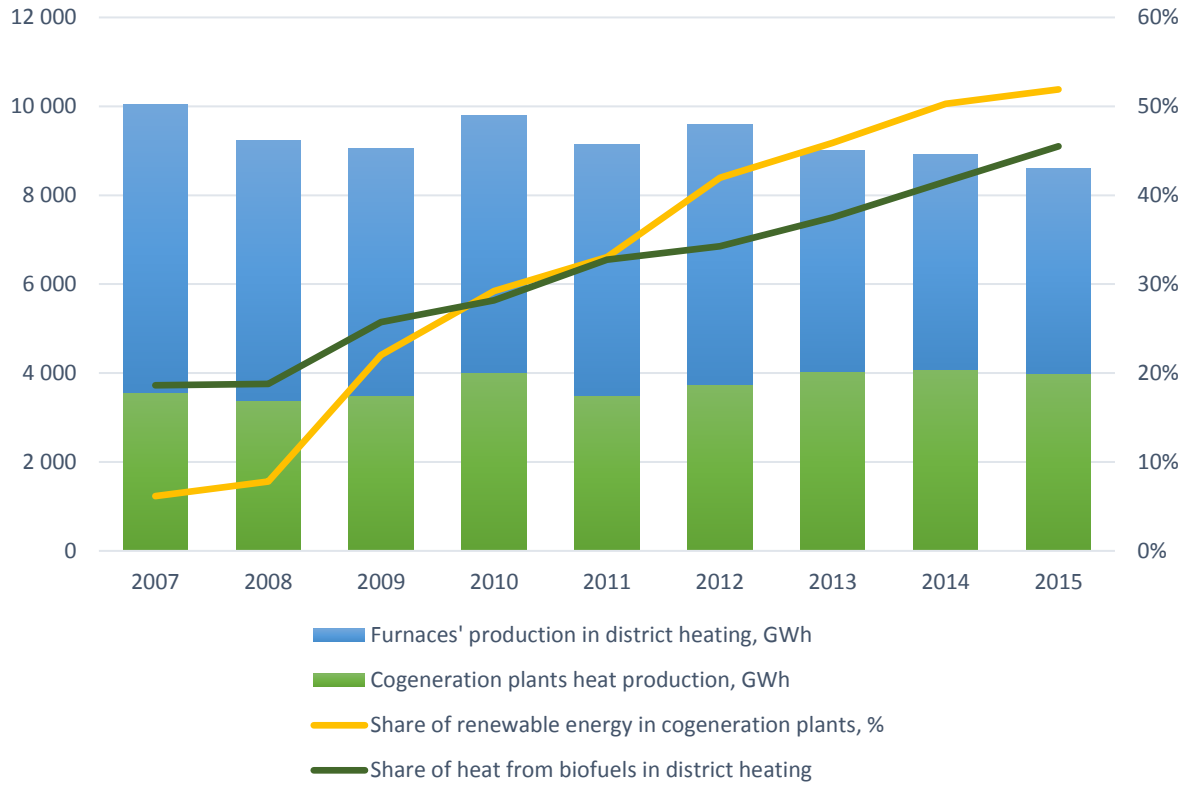
Considering the above, it is expected that the share of renewable energy will continue to increase. In 2015, boiler houses produced 54% of heat energy and 46% of heat energy was produced by cogeneration plants. The share of renewable energy sources has increased significantly in cogeneration plants specifically. In 2015, the share of renewable energy sources used in cogeneration plants exceeded 50% (see Chart 28).

[19] Weighing factors of district heating, TUT 2016

Graph 27. Heat Production in Cogeneration Plants and Boiler Houses in 2015 (%).
Source: EREA



Graph 28. Heat Produced in Cogeneration Plants and Boiler Houses and Share of Biofuels in 2007-2015 (GWh).
Source: EREA



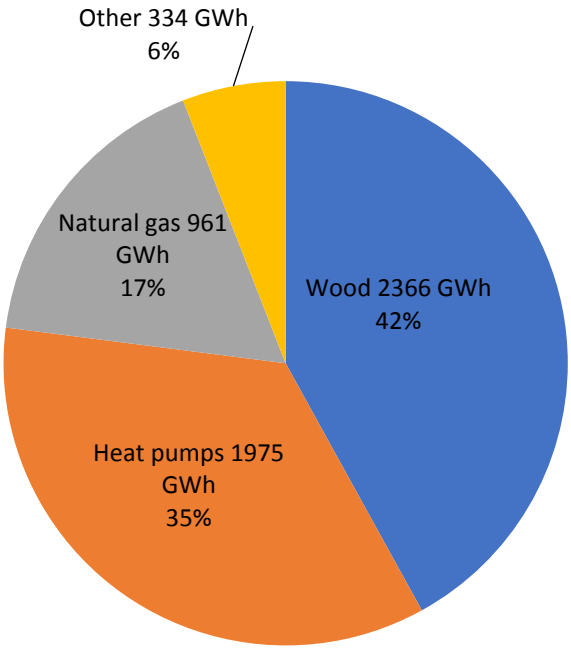
With the excise tax increase for specially marked fuel at the beginning of 2014 and the wider use of indigenous renewable energy sources, it can be assumed that in the coming years, we will see a bigger shift to renewable energy, especially in small boiler houses that have used fuel oil up to now. Out of the bigger boiler houses, Tallinn boiler houses are going to switch to wood chips as well.

Local and on-site heating

Local and on-site heating form a significant part of the heat supply of Estonian households. On-site heating is a heating mode that serves a private house or one part of a larger building, local heating means the complete heat supply of one building through a communal heating system[20].

Local and on-site heating are mostly used in smaller settlements or areas, where there is no option for district heating. To reduce environmental emissions and improve the quality of outdoor air, district heating should be preferred to local heating and on-site heating in densely populated areas, since, particularly in stove heated areas, the concentration of fine particles in the air increases during the heating season and, therefore, increases local air pollution. The official statistics on on-site heating are not yet available in Estonia, but according to EREA, based on Statistics Estonia's data on fuel consumption in various sectors and on the expert assessments of specialists of the sector, last year, close to 5600 GWh of heat was generated at local heating systems.

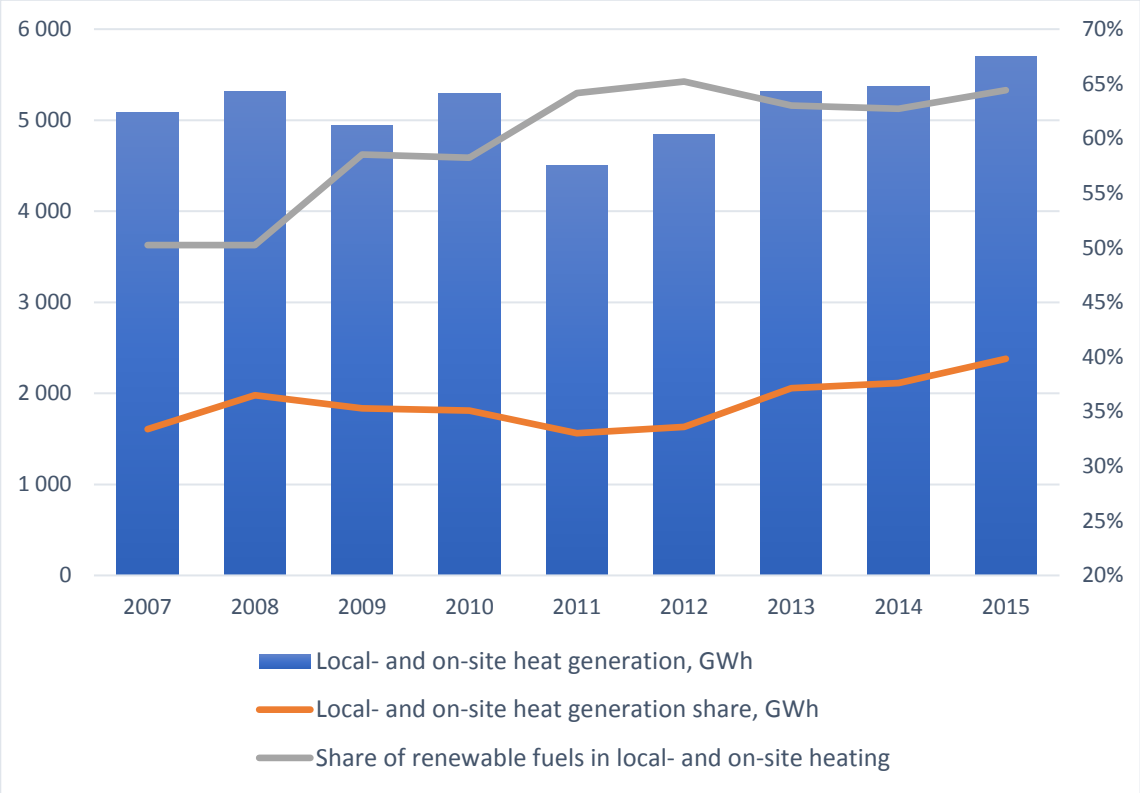
Graph 29. Production of Local Heating and On-site Heating by Energy Sources in 2015 (GWh).
Source: EREA



[20] www.energiatalgud.ee, communal heating system, in turn, means the heating source together with the heating network of the building.

Graph 30. Local and On-site Heat Production and the Share in Total Heat Production for 2007-2015 (GWh).

Source: EREA



In local and private heating, the most commonly used fuel is wood, which in turn is divided into: 96% is firewood and 4% wood briquettes, pellets, wood chips and waste. The production of heat pumps has grown year by year and exceeded the amount of one third of the total volume of local heating. The heat generated from natural gas accounts for only 17% of the heat produced as local and private heat. The share of light and heavy fuel oil, coal and other fuels will further marginalize in the coming years due to the state excise tax increase plan.

The share of renewable energy in local heating is estimated to be over 60%, depending on the use of electricity from renewable sources for the operation of heat pumps and electric heating (Graph 30).

Renewable Energy Sources in Transport sector

The objectives of the European Union's in the field of transport are to reduce greenhouse gas emissions and to provide a more specific sub-goal "to reduce the proportion of cars running on so-called conventional fuels by half by 2030 and completely eliminate them in city traffic by 2050."[21]

According to the "Transport Development Plan 2014-2020", prepared by the Ministry of Economic Affairs and Communications, the share of greenhouse gases from transport is second largest after electricity and heat production in Estonia. By 2020, the target level at EU for all member states for the share of renewable energy in final energy consumption in the transport sector is at least 10%. The level in 2017 must be at least 3%. At the end of 2015, the share of renewable energy in Estonian transport sector is 0.4%[22].

In 2012, Estonia became the first country to set up a nationwide electric car charging network. There are 167 electric car chargers in Estonia, of which 102 are in towns or settlements and 65 by highways. The high-speed chargers cover all the major high-traffic roads and the distance between the charging points is 40 to 60 km[23]. According to the Association of Automobile Sales and Service Companies, in the beginning of 2017, 1,165 of M1 electric vehicles were registered in the Estonian Traffic Register and only 32 new electric vehicles were registered in 2016.

Transport fuels are consumed in Estonia in the amount of 8.5 TWh. According to an Estonian biomethane resource study prepared by Arengufond in 2014, it is estimated that up to 4.7 TWh[24] of biomethane per year could be produced in Estonia, the raw material for which would be biomass in grasslands, agricultural production residues, as well as biodegradable waste from industries, landfill gas and municipal waste from water treatment plants[25]. At the beginning of 2017, there are 5 CNG stations in Estonia — in Tallinn, Tartu, Pärnu and Narva[26].

[21] https://www.mkm.ee/sites/default/files/transpordi_arengukava.pdf

[22] Eurostat: http://ec.europa.eu/eurostat/web/energy/data/shares

[23] http://elmo.ee/laadimispunktide-vorgustik/

[24] 4,7 TWh = 483 M m3 of biomethane

[25] Elering: http://gaas.elering.ee/wp-content/uploads/2016/03/Gaasiülekandev.rgu-arengukava-2016-2025.pdf

[26] http://www.ngva.eu/search-nearby-by-country

Renewable Energy Goals for Estonia

The European Union's Renewable Energy Targets for 2020 and 2030

By 2020, the European Union has set the following goals:
* Achieve 20% share for renewable energy in final energy consumption. To achieve this, the Directive sets targets for Member States have that take into account the relative wealth of countries, as well as past progress in the promotion of renewable energy. The targets may vary widely from one member state to another, for example, Malta has a target of 10% renewable energy as a share of final energy consumption, while Sweden a goal of 49%.
* Reduce carbon dioxide emissions by 20% compared to 1990.
* Reduce final energy consumption by at least 20% from the projected level.
* At least 10% of the fuel used in the transport sector should be from renewable energy sources.

In accordance with the Directive 2009/28/EÜ on the promotion of energy from renewable sources, Estonia has committed to increasing the share of renewable energy sources in total energy consumption by 25% by 2020 compared to 2005. The proportion of heat produced from renewable sources should be 38.4% by 2020, according to the national action plan with electricity at 17.6%, and the share of fuel from renewable energy sources consumed by transport 10%.

In 2014, the European Council agreed on a framework for the European Union's climate and energy policy until 2030:
* Reduce carbon dioxide emissions by 40% compared to 1990.
* The share of renewable energy must be 27% at the EU level.
* 27% energy savings target - reducing energy consumption compared to current energy consumption baseline scenarios.
* The reform of the Emission Trading Scheme to ensure higher prices for carbon dioxide in the emissions trading market, which will motivate companies to invest in low carbon technologies.

The European Commission has committed the member states to draw up and submit a national climate and energy plan for 2030 by 1 January 2018 at the latest. The template should describe the plan preparation process, the overall energy economy situation, the objectives of energy economy development and measures up to 2030 in all dimensions of the energy policy dimensions. In addition, countries are required to present a draft plan to the European Commission and other member states, who may, if necessary, propose amendments to the drafts of the national plans.

The Estonian National Development Plan of the Energy Sector (ENMAK)

The development of the Estonian National Development Plan of the Energy Sector until 2030 started in 2013. The development plan addresses future activities related to energy, heating and fuel economy, energy use of the transport sector and housing sector. In October 2016, the Estonian government approved the Development Plan and submitted it to Riigikogu.

According to ENMAK, the share of renewable energy in final consumption of energy in 2030 is 50%. The goal for the electricity production from renewable sources will be 50% of domestic electricity consumption, and the goal for the heat production from renewable sources will be 80% of the domestic final consumption of heat in 2030. The share of variable renewable technologies in final energy consumption should be 10%.

RE 100%

At the end of 2016, an updated “Renewable Energy 100” (RE100) plan was envisaged by the Estonian Renewable Energy Association for transitioning to 100% renewable energy in electricity and heating sector by 2030.

Compared to the first plan of RE100, completed in 2012, the situation in the global economy has changed. The prices of oil, other energy carriers and electricity have fallen sharply, Paris climate packages has entered into force, the prices of renewable energy technologies have significantly decreased, and the efficiency of improved renewable energy technologies has increased. Therefore, it was important to upgrade the RE100 plan, which is now titled “Renewable energy 100% - The Triumph of Clean Energy in Estonia” (RE100).

More important updates compared to the previous plan:

- a vision in the transport sector, with a proposal to ban the registration of fossil-based vehicles in Estonia from 2030;
- the total investment cost of RE100 has fallen by EUR 1.580 billion;
- more PV power capacities are added than before;
- the prognosis for electricity consumption has increased due to the electrification of transport;
- productivity of both wind turbines and PV panels has improved;
- the price of almost all renewable energy technologies has fallen;
- proposal for the elaboration of a plan for PÕXIT, or the termination of oil shale energy by 2030, was added to the policy recommendations.

Regional Goals

All over Estonia, several cities and local governments have set up renewable energy targets in development plans that would allow regional renewable energy resources to be used more effectively and more sustainably in the future. Major projects have also been initiated, focusing more on environmental awareness among local people. One good example is the 5-year international cooperation project SmartEnCity that begun in February 2016, aimed at creating a comprehensive solution for a smart and sustainable urban environment in Tartu. Within the

framework of the project, the city's ecological footprint and energy demand will be minimized, and local renewable energy solutions will be used, with the application of smart solutions.

The Covenant of Mayors, the pan-European and world's largest urban climate and energy initiative, brings together local and regional authorities that voluntarily commit to reducing CO2 emissions by at least 40% by 2030. Estonian cities Tallinn, Rakvere, Jõgeva and Tartu have joined the Covenant of Mayors and commited to reduce CO2 by 20% by 2020.[27]

[27] http://www.linnapeadepakt.eu/about/covenant-of-mayors_et.html

Summary

Over the past seven years, wind and PV prices have decreased by 66% and 85% respectively, and the efficiency and durability of equipment has increased[28], which encourages more and more consumers to use renewable energy resources. The decrease of global investments in renewable energy in 2016 is largely due to the reduction of the cost of renewable energy technologies. The cost of renewable energy is about to achieve grid parity and therefore a better competitive advantage in markets. However, a continued increase in investments is necessary to meet the Paris climate objectives as well as the growing global demand for energy.

Investments in Estonia in 2016 were spurred by the perspective that the subsidy scheme contained in the Electricity Market Act today will be abolished by the state. In Estonia, last year, once again, a record number of new microgenerators, who produced energy for their own households, started operating. The investors need a clearer perspective and legislative certainty from the government to foster further increases in renewable energy, both on a small and industrial scale. In particular, greater clarity is needed in determining the direction of sector development beyond 2020.

Despite the successful take-up of renewable energy in the heating industry, there are still challenges with the promotion of renewable energy in the electricity and transport sectors. It was also brought up in February 2017, in the OECD Environmental Performance Overview for Estonia[29]. The report notes that Estonia's electricity production from renewable energy sources, wind energy and biomass-based electricity production, are one of the lowest in the OECD. The share of fossil fuels in the energy production is 85%. Estonia is also the most carbon-intensive economy in the OECD countries. The OECD recommends reducing the share of oil shale among energy sources and encouraging the use of renewable energy sources and measures to promote energy efficiency. Renewable energy target in the transport sector needs vigorous steps by the state in the near future. Despite the well-developed charging network of electric cars, further measures are needed to encourage the take up of electric mobility.

[28] https://www.lazard.com/media/438038/levelized-cost-of-energy-v100.pdf
[29] http://www.oecd.org/env/country-reviews/OECD_Keskkonnatoime_ulevaated_Eesti2017.pdf

Share of renewable energy in final energy consumption in EU (%)[30]

	2004	2012	2013	2014	2015	2020 GOAL
EU28	8,5%	14,4%	15,2%	16,1%	16,7%	20%
BELGIUM	1,9%	7,2%	7,5%	8,0%	7,9%	13%
BULGARIA	9,4%	16,0%	19,0%	18,0%	18,2%	16%
CZECH REPUBLIC	6,8%	12,8%	13,8%	15,1%	15,1%	13%
DENMARK	14,9%	25,7%	27,4%	29,3%	30,8%	30%
GERMANY	5,8%	12,1%	12,4%	13,8%	14,6%	18%
ESTONIA	18,4%	25,8%	25,6%	26,3%	28,6%	25%
IRELAND	2,4%	7,2%	7,7%	8,7%	9,2%	16%
GREECE	6,9%	13,5%	15,0%	15,3%	15,4%	18%
SPAIN	8,3%	14,3%	15,3%	16,1%	16,2%	20%
FRANCE	9,4%	13,4%	14,1%	14,7%	15,2%	23%
CROATIA	23,5%	26,8%	28,0%	27,9%	29,0%	20%
ITALY	6,3%	15,4%	16,7%	17,1%	17,5%	17%
CYPRUS	3,1%	6,8%	8,1%	8,9%	9,4%	13%
LATVIA	32,8%	35,7%	37,1%	38,7%	37,6%	40%
LITHUANIA	17,2%	21,4%	22,7%	23,6%	25,8%	23%
LUXEMBOURG	0,9%	3,1%	3,5%	4,5%	5,0%	11%
HUNGARY	4,4%	15,5%	16,2%	14,6%	14,5%	13%
MALTA	0,1%	2,8%	3,7%	4,7%	5,0%	10%
NETHERLANDS	2,1%	4,7%	4,8%	5,5%	5,8%	14%
AUSTRIA	22,6%	31,4%	32,3%	32,8%	33,0%	34%
POLAND	6,9%	10,9%	11,4%	11,5%	11,8%	15%
PORTUGAL	19,2%	24,6%	25,7%	27,0%	28,0%	31%
ROMANIA	16,3%	22,8%	23,9%	24,8%	24,8%	24%
SLOVENIA	16,1%	20,8%	22,4%	21,5%	22,0%	25%
SLOVAK REPUBLIC	6,4%	10,4%	10,1%	11,7%	12,9%	14%
FINLAND	29,2%	34,4%	36,7%	38,7%	39,3%	38%
SWEDEN	38,7%	51,1%	52,0%	52,5%	53,9%	49%
UNITED KINGDOM	1,1%	4,6%	5,7%	7,1%	8,2%	15%

[30] http://ec.europa.eu/eurostat/web/energy/data/shares

Share of renewable energy in transport sector in EU[31]

	2012	2013	2014	2015	2020 GOAL
EU28	5,6%	5,9%	6,5%	6,7%	10,0%
BELGIUM	4,8%	5,0%	5,7%	3,8%	10,0%
BULGARIA	0,6%	6,0%	5,8%	6,5%	10,0%
CZECH REPUBLIC	6,1%	6,3%	6,9%	6,5%	10,0%
DENMARK	6,4%	6,6%	6,7%	6,7%	10,0%
GERMANY	7,5%	6,9%	7,3%	6,8%	10,0%
ESTONIA	0,4%	0,4%	0,4%	0,4%	10,0%
IRELAND	4,8%	5,7%	5,8%	6,5%	10,0%
GREECE	0,9%	1,0%	1,3%	1,4%	10,0%
SPAIN	0,7%	0,8%	0,8%	1,7%	10,0%
FRANCE	7,5%	7,7%	8,4%	8,5%	10,0%
CROATIA	1,0%	4,3%	4,1%	3,5%	10,0%
ITALY	6,0%	5,4%	5,0%	6,4%	10,0%
CYPRUS	0,0%	1,1%	2,7%	2,5%	10,0%
LATVIA	4,0%	4,0%	4,1%	3,9%	10,0%
LITHUANIA	4,9%	4,8%	4,3%	4,6%	10,0%
LUXEMBOURG	2,8%	4,0%	5,4%	6,5%	10,0%
HUNGARY	5,9%	6,2%	6,9%	6,2%	10,0%
MALTA	3,2%	3,4%	4,6%	4,7%	10,0%
NETHERLANDS	4,9%	5,1%	6,2%	5,3%	10,0%
AUSTRIA	9,9%	9,5%	10,9%	11,4%	10,0%
POLAND	6,5%	6,6%	6,2%	6,4%	10,0%
PORTUGAL	0,8%	0,9%	3,7%	7,4%	10,0%
ROMANIA	4,9%	5,4%	4,7%	5,5%	10,0%
SLOVENIA	3,3%	3,8%	2,9%	2,2%	10,0%
SLOVAK REPUBLIC	5,4%	6,0%	7,6%	8,5%	10,0%
FINLAND	1,1%	10,2%	22,0%	22,0%	10,0%
SWEDEN	14,8%	19,2%	21,1%	24,0%	10,0%
UNITED KINGDOM	3,9%	4,7%	5,3%	4,4%	10,0%

[31] http://ec.europa.eu/eurostat/web/energy/data/shares

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