# ENERGY POLICIES OF IEA COUNTRIES

# Estonia

## 2019 Review

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# INTERNATIONAL ENERGY AGENCY

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# Foreword

The International Energy Agency (IEA) has conducted in-depth peer reviews of its member countries' energy policies since 1976. This process not only supports energy policy development, but also encourages the exchange of international best practices and experiences. In short, by seeing what has worked – or not – in the "real world", these reviews identify policies that achieve their objectives and bring concrete results. Recently, the IEA has moved to modernise the reviews by focusing on some of the key energy challenges in today's rapidly changing energy markets.

This is the first in-depth review of Estonia's energy policies since it joined the IEA in 2014. Estonia has a unique energy mix among IEA member countries. Domestically produced oil shale dominates energy supply and is the main fuel input to electricity generation. This gives the country a high degree of energy independence but also the highest carbon intensity among all IEA countries. As the country seeks to decarbonise its energy supply, Estonia is now on the brink of a major energy transformation that will require a substantial change in the role of oil shale in its energy mix. This transformation represents a major economic and social challenge, and we recommend that it be supported by defining least-cost pathways for decarbonisation. I am pleased to see that Estonia has already achieved its EU-mandatory emission reduction and renewable energy targets for 2020. Looking forward, reaching its targets for 2030 will require determined and timely action.

As with most IEA countries, Estonia's main challenge as it moves to a lower carbon energy future is the decarbonisation of its transport sector, which is currently not on track to meet its short-term emission and energy efficiency targets. In this report, we recommend that the government review energy taxation of all fuels to better reflect externalities, including carbon and particulate emissions, to accelerate the switch to low-emission technologies, notably in the transport sector.

It is my hope that this in-depth review will further guide Estonia in its energy transition and help it achieve the energy policy goals of providing affordable, secure and clean energy to its population, while adapting to a fast-changing, international energy landscape.

Dr. Fatih Birol

Executive Director

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# 1. Executive summary

## Overview

This is the first In-depth Review of Estonia's energy policies since it became the 29th member of the International Energy Agency (IEA) on 9 May 2014. Estonia's energy supply is unique among IEA member countries, with its strong reliance on domestically produced oil shale, an energy-rich sedimentary rock that can be either burned for heat and power generation or used for producing liquid fuels. This provides Estonia with a strong degree of energy self-sufficiency, but it also results in the country having the highest carbon intensity of all IEA countries also due to Estonia's position as a net electricity exporter. In 2018, oil shale accounted for 72% of Estonia's total domestic energy production, 73% of total primary energy supply and 76% of electricity generation, which is a significant drop over the past 10 years.

Estonia has already achieved its mandatory emissions reduction and renewable energy targets for 2020. However, total final energy consumption started increasing again in 2016 and there is a possibility that Estonia might miss its 2020 efficiency target. In most IEA countries, energy consumption is decoupled from economic growth and population, but this is not yet the case for final energy consumption in Estonia.

The IEA In-depth Review (IDR) comes at a very interesting time for Estonia. Looking to 2030, for the first time Estonia is required to reduce its emissions instead of merely containing their growth. Domestic discussion about how to reach the 2030 targets has begun but no specific policy measures have been agreed upon yet.

## Energy sector transformation

The 2017 "*General Principles of Climate Policy until 2050*" outline the vision of the government for transforming Estonia into a low-carbon economy and society. The 2017 *National Development Plan of the Energy Sector until 2030* sets out the government's policy objectives and framework to 2030 and its ambition to 2050. It commits Estonia to reduce greenhouse gas emissions (GHG) in the energy sector by at least 70% by 2030 and by over 80% by 2050, compared to the 1990 level, while maintaining final energy consumption in 2030 at the same level as in 2010 and increasing the share of renewable energy in final consumption to 50%. Reaching these targets will require determined and timely action to decarbonise the electricity and transport sectors.

Estonia is on the brink of a major energy transition that will see a substantial change in the role of oil shale in the future energy mix, moving towards extracting a higher value of oil shale resources. The future of the Estonian oil shale industry will largely depend on the cost of emitting $CO_2$ in the power sector that is set to increase strongly in the period after 2020. This will make liquefaction into shale oil more competitive than direct use for electricity generation. Balancing social, environmental, economic and energy security considerations will guide the gradual transformation of the Estonian oil shale industry in the coming decades.

Electricity production from oil shale is the most $CO_2$-intensive among all combustion technologies, which is why Estonia’s power and heat production has the second-highest $CO_2$ intensity of all IEA countries after Australia. The liquefaction of oil shale has a significantly smaller environmental footprint than electricity production as it emits less $CO_2$ and uses almost double the energy content of the resource compared to electricity production. In addition, retort gas is a high-value by-product of the liquefaction of oil shale, creating additional value to the energy sector, increasing the efficiency of the primary resource use, and further improving the economics for liquefaction of oil shale.

Looking forward to 2030, Estonia has established goals for renewable energy shares of up to 50% in both gross final energy consumption and electricity generation, and renewable energy shares of 80% in heat production and 14% in transport. These goals appear to be attainable, but require the government to further develop strategic plans with clearly defined deployment pathways that address the challenges of an accelerated renewable energy deployment.

Biomass from domestic forestry continues to be the main source of renewable energy in Estonia, covering almost all renewable heat production. Biomass is also co-fired to produce electricity in combined heat and power plants. The anticipated growth of the biomass contribution raises concerns from some stakeholders and an environmental perspective, although in the last decade the annual use of forest resources has remained below the required regrowth of the forest resources. These concerns warrant an analysis to confirm what level of biomass supply is sustainable and clearly establish the role that biomass can play in least-cost renewable energy deployment.

Significant administrative barriers for wind power deployment have emerged since 2015. Wind power development is now in conflict with national defence concerns and environmental protection rules have started to constrain permitting of new projects. Wind power is likely the lowest cost technology for large-scale renewable energy projects in Estonia and a strong and sustained deployment of wind power projects could be necessary to achieve the 2030 targets. As such, there is need to quickly resolve the barriers to wind power deployment in a manner that clearly addresses all national security and environmental concerns.

As in most IEA countries, Estonia is struggling to increase the share of renewables in transport, which in 2017 remained essentially unchanged since the last IDR at around 0.5%. The government is addressing these issues with biofuel blending obligations and the promotion of indigenous production of biomethane as cost-effective means to increase the share of renewables in the transport sector. The government is positive that it will meet the 2020 target of 10% and reach a 14% share in 2030, as the share of renewables had already increased to 3.7% in 2018 as a result of the biofuel blending mandate.

However, these measures may not be enough to reach the targets and the government should consider increasing the electrification of transport as a complementary strategy. Until 2015, the government provided support to promote electric vehicles and investments in charging infrastructures, which now cover all of Estonia. However, since late 2015, the government has shifted its priorities and is now subsidising the introduction of biomethane instead.

Estonia still has a good chance to reach its 2020 target to limit total final consumption to the 2010 level despite a resurge of consumption since 2016. However, the 2030 energy efficiency targets will be harder to reach without further energy efficiency measures and funding. This is especially important in light of the future decrease of $CO_2$ allowances in the power sector, the revenues of which are used for the green investment schemes.

The residential sector is the single largest energy-consuming sector in Estonia. Although the energy efficiency of buildings has improved in recent decades, the building stock is nevertheless old and inefficient. Renovating the housing stock can reduce heating demand of buildings by up to 50%, but complex renovation procedures are a barrier for energy efficiency improvements in the residential sector. Estonia is a small market and the traditional energy service company (ESCO) business model might not be sustainable on its own. However, with adequate support from the government, there is a large scope to make the ESCO concept attractive. A more targeted offer by ESCOs could help unlock the significant potential for energy savings throughout the economy and could also offer additional financing possibilities.

The vast majority of Estonia's population is connected to a district heating (DH) system and DH accounts for one-third of total energy consumption in the residential and commercial sectors. At around 50%, biomass is the largest energy source for DH production. The DH systems are in need of substantial rehabilitations to reduce heat losses in transmission and in the boilers. However, the current price regulation requires that any efficiency savings be directly passed on to consumers. This limits the incentive for DH companies to invest in efficiency measures. Introducing a mechanism by which the potential savings of such efficiency measures could be shared between consumers and producers could lead to more energy efficiency investments.

## Taxation

Estonia's energy tax system is not designed to take into account the negative externalities of energy production and consumption. Excise duties are not linked to carbon content or emissions of particles, but are the result of political compromises. A flat rate – regardless of the source of energy – taxes electricity output. Estonia does not have a carbon tax on transport fuels and does not plan to introduce one in the near future. Similarly, there is also no vehicle registration tax, or any other tax based on carbon emissions of vehicles. The government should consider increasing the effective cost of $CO_2$ emissions across the board, including in sectors where $CO_2$ emissions are currently not priced, and regularly review the actual energy and emissions savings obtained by granting tax exemptions for energy efficiency investments.

## Energy market reform

Since the last IDR, Estonia has made notable progress in opening up its electricity and gas markets to increase competition. The Estonian electricity retail market has been fully open to competition since 2013 and 16 electricity retailers were active in 2017. The state-owned incumbent supplier still has by far the largest market share at nearly 60%, down by over 20% since 2011. Switching rates are relatively low, typically around 3-5% per year, as cost savings from switching suppliers are not high enough to incentivise consumers, because retail market margins are among the lowest in Europe. A milestone achievement in the electricity sector is the installation of 100% smart metres completed on 1 January 2017. More accurate metre readings have resulted in significant improvement of network management, with cost savings of around 30% that are passed on to consumers through reduced network tariffs.

The natural gas market was fully liberalised in 2007, and at the time of the last IDR in 2013, a single vertically integrated company still dominated Estonia's natural gas market. The 2012 amendment of the Natural Gas Act initiated the complete unbundling of the natural gas market, which was achieved in 2016. Ownership of the transmission system was transferred to Elering, the publicly owned transmission system operator. In 2017, 6 wholesalers and 27 retailers were operating in Estonia and the market share of the former incumbent is falling quickly, underlining the enhanced competitiveness of the natural gas sector.

Estonia is committed to an open market economy and is aware of the innovative strength of the private sector. Yet, government-owned companies still occupy strategic positions throughout the energy sector. The government could leverage this to actively guide the energy sector along its transition to a low-carbon economy in line with the targets set in the low-carbon strategy and the national development plan.

## Energy security and regional integration

Estonia has habitually equated energy security with energy independence. While the concept of energy independency may have had its merit in the initial years after regaining independence in 1991, Estonia is now firmly established in the European energy markets. Instead of pursuing energy independence, together with its European Union neighbours, Estonia should prioritise the identification of market-based solutions to diversify supply and to enhance the security of supply.

Estonia has taken significant steps to integrate its electricity network with the Nordic region and Eastern Europe. The completion of the EstLink 2 interconnection with Finland in 2014 tripled the electricity transmission capacity between the Baltic and Nordic countries. The operationalisation of a third transmission line with Latvia in 2020 will further strengthen electricity interconnection. This allows Estonia to trade electricity and serve as a transit country for electricity. In 2017, Estonia's interconnection level was 63%, substantially higher than the 10% target for all European Union countries. Estonia seeks to further increase its security of electricity supply by desynchronising from the Russian integrated electricity system, and synchronising with the continental Europe grid, by 2025.

At the time of the last IDR, the gas market of Estonia and its two Baltic neighbours was isolated from the European market and relied 100% on Russian gas. The commissioning of a liquefied natural gas terminal in Lithuania in late 2014 has changed the situation. Ongoing interconnection projects to develop a regional gas market will make Estonia an integral part of a gas transit corridor. The two most important projects are the Balticconnector between Estonia and Finland, due for commissioning in 2020, and the gas interconnection between Poland and Lithuania, due for completion in 2021, which will connect the gas systems of the Baltic states with Central Europe. Estonia and its neighbouring EU countries are pursuing the establishment of common rules for a competitive, integrated and liquid regional gas market.

Based on IEA methodology for net imports, Estonia's oil stockholding obligation is relatively low due to the volumes of shale oil exports. However, as a member of the European Union, its relevant stockholding obligation is 61 days of consumption of main oil products. This level of stocks is well above the 90-day net-import level required for IEA countries. Since Estonia does not have a refinery, all stocks are held as refined products. Estonia neither owns nor operates any public storage facilities; all stocks are held under storage contracts, with a significant share of the mandatory stocks held in neighbouring countries.

## Key recommendations

***The government of Estonia should:***

- Clarify energy and climate targets for 2030 and 2050 and implement a regular monitoring system of progress achieved towards reaching these targets.
- Undertake a robust analysis of least-cost renewable energy deployment pathways with a comprehensive scope covering: domestic renewable resource potential; the role of all viable renewable energy technologies and supporting infrastructure; and an examination of policy, regulatory and market barriers to renewables deployment, including pre-developing potential wind farm sites.
- Review energy taxation of all fuels to reflect their external costs, including carbon content and particles, and accelerate the switch to low-emission technologies, notably in transport.
- Increase the financial support for the renovation of the existing building stock, in particular residential buildings, and develop an ESCO market.
- Encourage energy efficiency investments by district heating companies, for instance by amending the tariff regulation methodology in the District Heating Act so that savings can be shared between consumers and the companies.

# 2. General energy policy

## Key data

(2018 provisional)

**TPES:** 5.6 Mtoe (oil shale 72.7%, natural gas 7.3%, bioenergy and waste 19.3%, oil 1.8%, wind 1.0%, coal and peat 0.7%, hydro 0.02%, electricity -2.9%*), +2.7% since 2008

**TPES per capita:** 4.3 toe/cap (IEA average: 4.1 toe [2017])

**TPES per unit of GDP:** 145 toe/USD million PPP (IEA average: 105 toe USD million PPP [2017])

**Energy production:** 5.9 Mtoe (oil shale 71.8%, bioenergy and waste 26.9%, wind 0.9%, peat 0.4%, hydro 0.02%), +38.9% since 2008

* Electricity exports are counted as negative in TPES

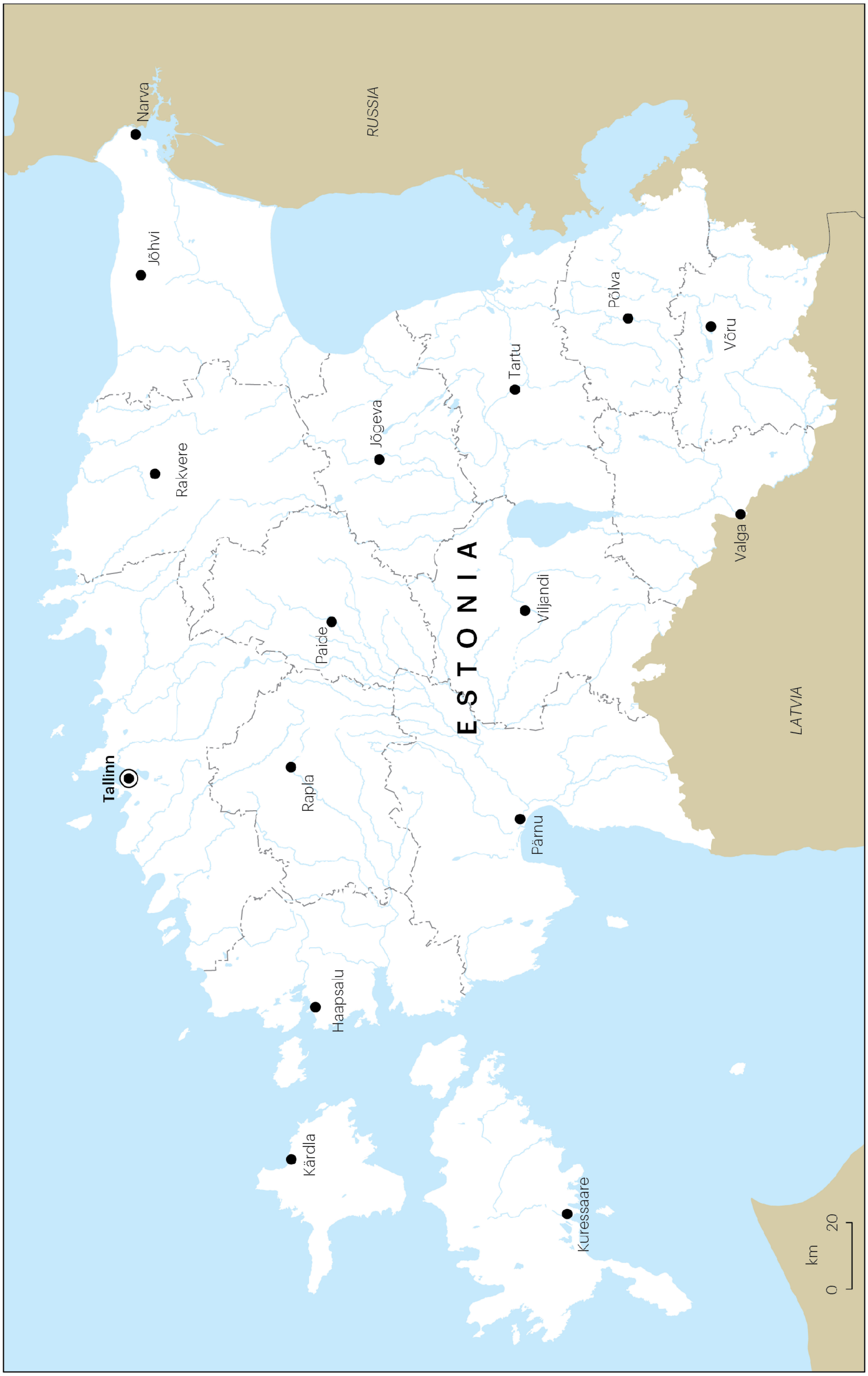
## Country overview

The Republic of Estonia (hereafter Estonia) is located in northeast Europe, bordering the Baltic Sea and the Gulf of Finland, between Latvia and the Russian Federation (Figure 2.1). The country has an area of 45 227 square kilometres and is divided into 15 counties and 79 municipalities, with Tallinn as its capital city. Estonia has a population of 1.3 million, of which ethnic Estonians account for 69%, Russians 25%, Ukrainians 2%, Belarussians 1%, Finns 1% and other groups 2%. The official language is Estonian and the second most spoken language is Russian.

Estonia restored its independence in 1991, 51 years after being annexed by the Soviet Union. Since then, Estonia has moved rapidly to reorient itself to the west, has adopted market reforms and has become a stable multi-party democracy under its 1992 Constitution. It joined both the European Union (EU) and the North Atlantic Treaty Organization in 2004, and became a member of the Organisation for Economic Co-operation and Development in 2010. Estonia became the 29th member of the International Energy Agency (IEA) on 9 May 2014. This is the first In-depth Review of Estonia’s energy policies since it became an IEA member country.

Estonia is a parliamentary republic with a single-chamber parliament (the Riigikogu), elected every four years by proportional representation. The president of Estonia is elected by the parliament for a five-year term and the prime minister, appointed by the president, heads the government. The most recent parliamentary election was in March 2019. The incumbent Prime Minister Jüri Ratas was re-installed, and is now leading a new coalition government consisting of his Centre Party, and the conservative Pro Patria and EKRE parties.

## Figure 2.1 Map of Estonia




This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Estonia is an open, market-based economy that has a well-skilled workforce and a business-friendly environment. In 2017, the industry sector, including construction, accounted for just over 28% of gross domestic product (GDP), while the service sector accounted for just over 69% and the primary sector for only 3% (OECD, 2019). Estonia's per capita GDP at USD 30 895 in 2016 is 27% lower than the OECD average. Estonia's economy is highly integrated in global trade. In 2017, total trade (imports plus exports) accounted for 152% of GDP, compared to the EU average of 86% (World Bank, 2019a). Its main exported goods are electrical machinery and equipment, oil shale products, wood products, and miscellaneous industrial goods. Overall, low and medium value-added products dominate exports (OECD, 2017). Around 70% of exports go to EU countries, with the main exporting destinations being Sweden, Finland, Latvia and Germany.

Estonia is notable for its pioneering digitalisation of public services; an area in which it is more advanced than most OECD countries (OECD, 2017). The rate of Internet use (79.5%) and the number of mobile broadband subscriptions (145.9 per 100 habitants) are among the highest in the world, and are the key reasons behind the fast development of e-governance in Estonia (EC, 2018). The dissemination of electronic identification cards (ID) to the entire population allows for convenient and secure access to e-governance services. Estonia installed 100% smart metering in the electricity sector by the end of 2016, allowing for more accurate metre readings that significantly improved network management and generated cost savings of around 30%. The savings have been passed back to customers through decreased network tariffs.

Unlike most IEA member countries, Estonia's population has been declining in recent decades. Population fell from just over 1.56 million in 1991 to 1.32 million in 2015 (World Bank, 2019). The decline was due to falling birth rates and increasing net emigration. In the past few years, the trend has halted, and the population has increased slightly since 2015, as the government has facilitated the hiring of highly qualified foreign workers. Unlike in many other IEA member countries, energy demand in Estonia has not yet shown a clear decoupling from population. Although energy demand and emissions have shown some decoupling from economic growth, both demand and emissions have been rising since 2015.

## Energy supply and demand

Estonia's energy supply is unique among IEA member countries, with its strong reliance on domestically produced oil shale that can be either burned for heat and power generation or used for producing liquid fuels (Box 2.1). In 2018, oil shale accounted for 72% of Estonia's total domestic energy production, 73% of total primary energy supply (TPES)[1] and 76% of electricity generation. Estonia also has large domestic biomass resources. Bioenergy and waste accounted for 27% of domestic energy production and 19% of TPES in 2018 (Figure 2.2).

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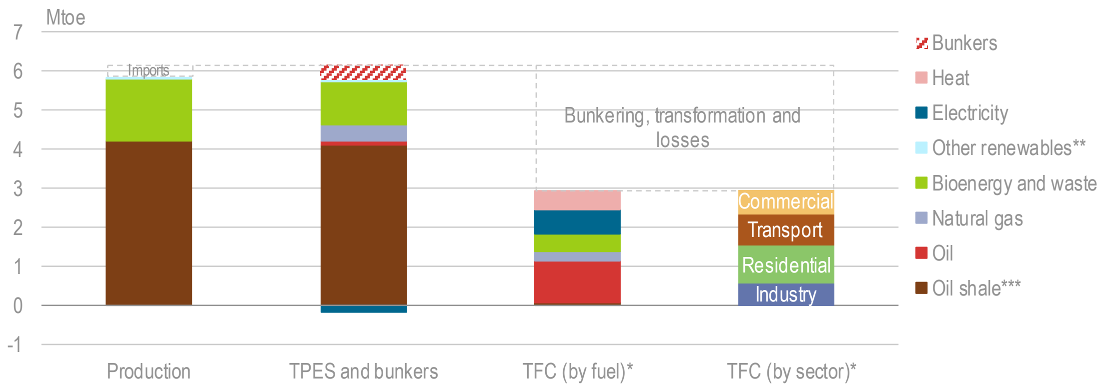
[1] TPES is made up of: production + imports – exports – international marine and aviation bunkers ± stock changes. This equals the total supply of energy that is consumed domestically, either in transformation (e.g. power generation and refining) or in final use.

The large oil shale and bioenergy production gives Estonia a higher domestic energy production than its TPES (not including international bunkers). The country is a net exporter of several energy sources, notably primary solid biofuels, electricity and shale oil produced from oil shale. However, the country fully relies on imports for the provision of liquid transport fuels, such as diesel and gasoline, and natural gas.

The residential sector was the largest energy-consuming sector in 2017, accounting for 32% of total final consumption (TFC)[2], followed by the transport, commercial and industry sectors. Oil and electricity are the main energy sources, with a total share of 58% of TFC. Oil dominates consumption in the transport sector, whereas electricity is the most important fuel in the industry and commercial sectors. Bioenergy accounts for the largest share of energy consumed in the residential sector.

### Figure 2.2 Overview of energy production, supply and consumption by fuel and sector, 2018






Estonia's energy production is higher than TPES, not counting bunker fuels, and the country is a net exporter of energy. Oil shale and bioenergy dominate energy supply.

* 2017 data.

** Other renewables includes wind and hydro.

*** Oil shale includes minor shares of coal and peat.

Notes: TPES: total primary energy supply; TFC: total final consumption; Mtoe: million tonnes of oil-equivalent. Supply data for 2018 are provisional. TPES does not include international bunkering fuel.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

### Box 2.1 Oil shale and shale oil

Oil shale is an energy-rich sedimentary rock which contains organic matter in the form of kerogen, a waxy hydrocarbon-rich material regarded as a precursor of petroleum. In IEA statistics, oil shale is aggregated with coal when measuring primary energy supply. In solid form, it contains more inert matter than coal. Once extracted from the ground, oil shale can be used directly in a power plant (pulverised or in a fluidised bed boiler) or processed to produce shale oil (also known as kerogen oil or oil-shale oil).

[2] TFC is the final consumption of energy (electricity, heat and fuels, such as natural gas and oil products) by end users, not including the transformation sector (e.g. power generation and refining).

Shale oil is unconventional oil produced from oil shale by pyrolysis, hydrogenation or thermal dissolution. In IEA statistics, shale oil is categorised under primary oil as "other hydrocarbons". Shale oil can be used directly as a fuel or upgraded to meet refinery feedstock specifications by adding hydrogen and removing impurities such as sulphur and nitrogen. The refined products can be used for the same purposes as those derived from crude oil. Estonia does not have refineries to produce refined oil products, and all its produced shale oil is exported.

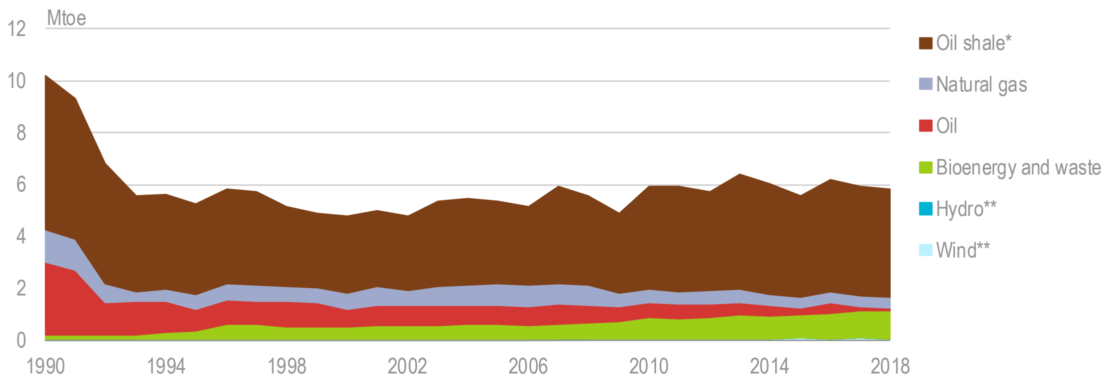
Oil shale and the shale oil produced from it should not be confused with light tight oil (sometimes also referred to as shale oil), which is produced from shale formations, often together with shale gas in hydraulic fracturing. This is not done in Estonia.

Source: Based on IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics; IEA (2013), *World Energy Outlook 2013*, https://www.iea.org/publications/freepublications/publication/WEO2013.pdf.

## Energy production and self-sufficiency

In line with the domestic energy demand, Estonia's TPES dropped rapidly in the early 1990s, and has since varied around 5-6 million tonnes of oil-equivalent (Mtoe). In 2017, TPES was 5.7 Mtoe, roughly the same as a decade earlier (Figure 2.3). However, annual fluctuations have increased significantly because of more electricity trading with other countries in the region. Regional electricity prices have strongly been influencing Estonia's supply of oil shale for power generation since it joined the Nordic-Baltic power market in 2013.

### Figure 2.3 TPES by source, 1990-2018






After a big decline in the early 1990s, TPES in Estonia has been generally stable, with bioenergy and waste steadily increasing and oil shale fluctuating due to electricity trade.

* Oil shale includes minor shares of coal and peat.

** Not visible on this scale.

Notes: Mtoe = million tonnes of oil-equivalent. Supply data for 2018 are provisional. Electricity trade is not included in the chart.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

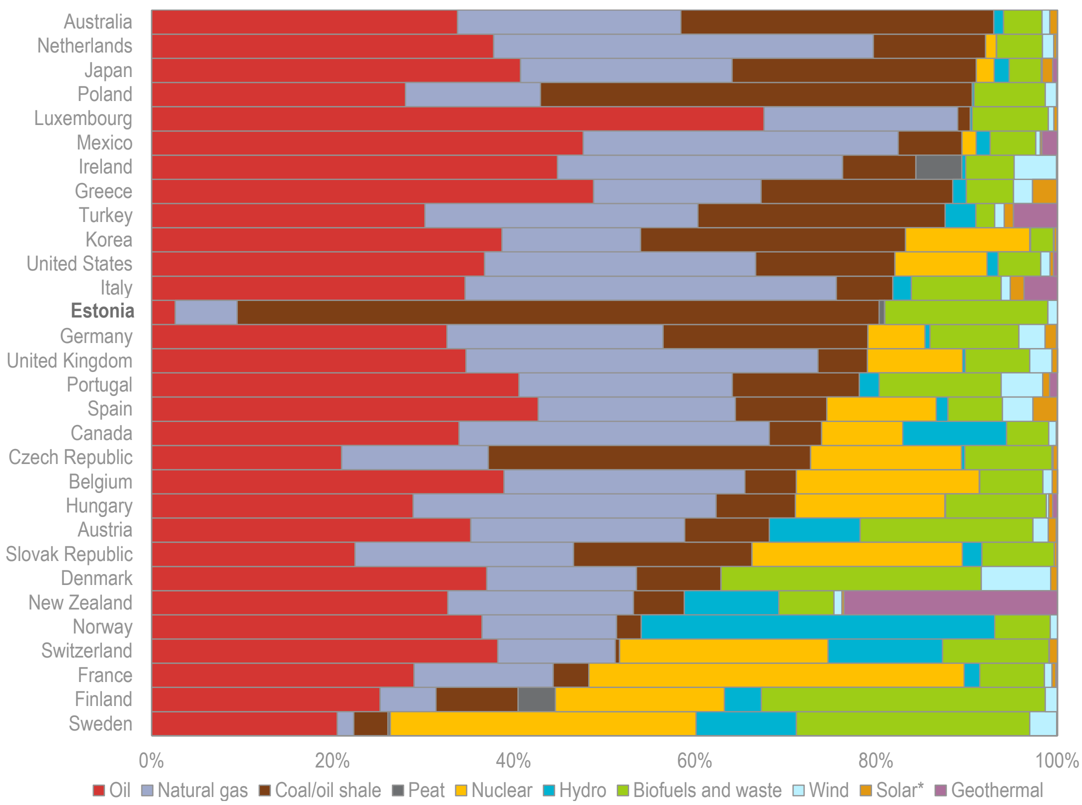
In 2018, domestic oil shale (including a small share of hard coal and peat) accounted for 73% of TPES. Bioenergy and waste are the second-largest energy source and have grown by 72% in the last decade. Natural gas, on the other hand, has dropped by half in a decade, accounting for 7% of TPES in 2018. In addition, oil supply has significantly declined over the past decade, falling to 2% of TPES in 2018 from 13% in 2008. However, this is not reflected in the final consumption of oil fuels, as shale oil exports are counted negative to the oil in TPES. Oil in TFC has been quite stable over the last decade.

In 2018, the share of fossil fuels in Estonia's TPES was 82%, the thirteenth-highest share among IEA member countries (Figure 2.4, 2017 ranking). Estonia also had the fifth-largest share of bioenergy and waste in comparison.

Energy production in Estonia increased steadily from the late 1990s, although with annual variations in oil shale production. In 2018, its total domestic energy production was 5.9 Mtoe, which was a 39% increase in a decade.

Oil shale production increased from 3.4 Mtoe in 2008 to 4.2 Mtoe in 2018. Yet, the share of oil shale in the country's domestic energy production has generally been decreasing due to more rapid growth in bioenergy and waste production. Over the past ten years, bioenergy and waste production has more than doubled: from 0.7 Mtoe in 2008 to 1.6 Mtoe in 2018.

### Figure 2.4 Breakdown of TPES in IEA member countries, 2017






Estonia has the thirteenth-highest share of fossil fuels in TPES in the IEA, but also has a high share of bioenergy and waste.

* Includes solar PV, solar thermal, wave and ocean power, and other power generation (e.g. from fuel cells).

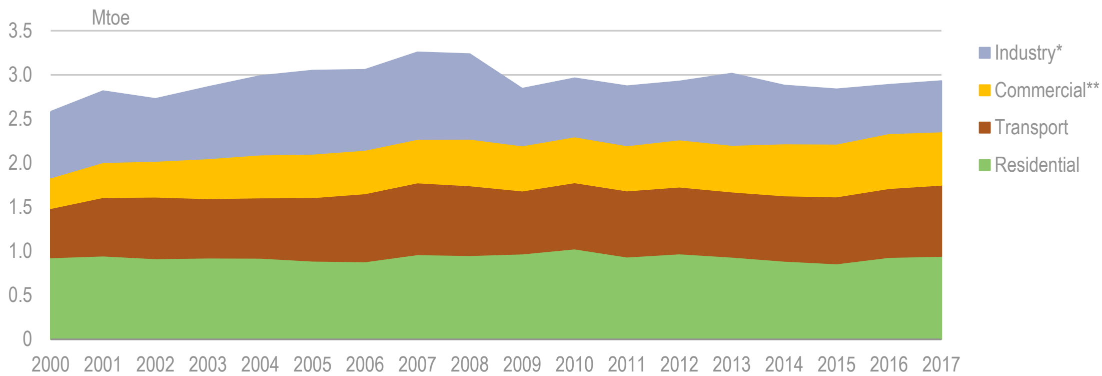
Note: Electricity trade not included.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

## *Energy consumption*

In the five years following the restauration of the country's independence in 1991, Estonia's TFC dropped by 52%. Since then, energy consumption has been quite stable at around 3.0 Mtoe per year, with only small annual variations (Figure 2.5). In 2017, Estonia's TFC was 2.9 Mtoe. The residential sector has been the largest consumer of energy since 2009, and accounted for 32% of TFC in 2017. The transport sector has a 27% share of TFC, followed by the commercial sector (21%) and the industry sector (20%). Consumption in the industry sector has been falling since 1990, with a 42% drop in the last decade. Meanwhile in the commercial sector, energy demand increased by 26% in the last ten years. This reflects a shift in Estonia's economy from manufacturing to more service-based companies. Consumption in the transport and residential sectors has remained quite stable over the last decade.

**Figure 2.5 TFC by sector, 2000-17**






Total energy consumption has been stable in recent years, with the residential sector continuing to be the largest energy consumer at around a third of TFC.

* Industry includes non-energy consumption.

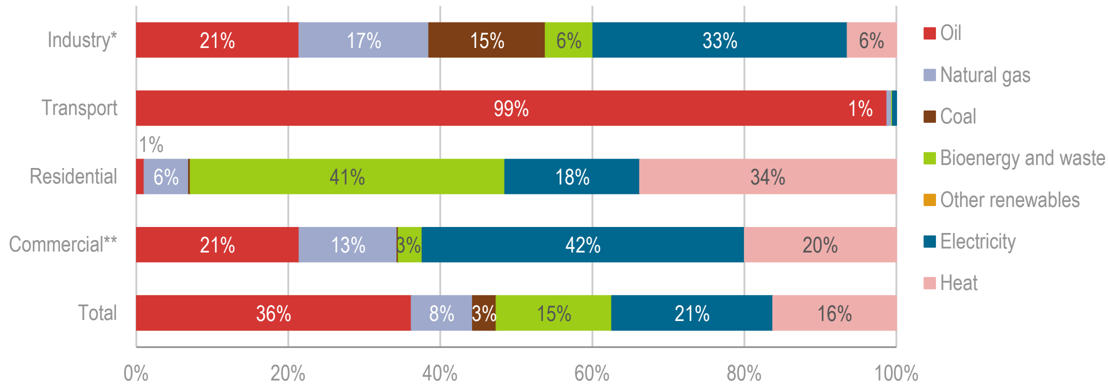
** Commercial includes commercial and public services, agriculture and forestry.

Note: Mtoe = million tonnes of oil-equivalent.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

Oil is the largest energy source in Estonia's energy consumption, accounting for 36% of TFC in 2017 (Figure 2.6). Most oil is consumed in the transport sector. Electricity is the second-largest source at 21% of TFC, followed by district heat (16%), and bioenergy and waste (15%). Electricity accounts for a considerable share in the commercial sector, whereas bioenergy and district heat have high shares in the residential sector. The industry sector consumes a mix of electricity, oil, natural gas, oil shale and heat.

**Figure 2.6 TFC by source and sector, 2017**






Oil has the largest share in Estonia's TFC, especially dominating the transport sector, whereas electricity and heat account for considerable shares in all other sectors.

* Industry includes non-energy consumption.

** Commercial includes commercial and public services, agriculture and forestry.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

## Key institutions

The **Ministry of Economic Affairs and Communications** drafts and implements the state's energy policy. The Energy Department has the main responsibility for energy while the Building and Housing Department is responsible for the energy efficiency of the housing stock, and the Transport Department and the Energy Department are co-responsible for fuel issues.

The **Ministry of the Environment** organises and co-ordinates environmental policy, including the management of the use, protection, recycling and registration of natural resources.

The **Ministry of Finance** is responsible for state budget and tax policies.

The Estonian **Competition Authority** is the regulator for gas and electricity network tariffs and sets prices for district heating.

**Elering AS** is the state-owned electricity and gas transmission system operator (TSO) and electricity network service provider.

Annex A provides more detailed information about institutions and organisations with responsibilities related to the energy sector.

## Policy and targets

Estonia's energy policy is set out in national energy and climate strategies in support of domestic energy goals and European Union targets. The 2017 *National Development Plan of the Energy Sector until 2030* (NDPES 2030) is the guiding policy document of the Estonian energy sector (MEAC, 2017).

The NDPES 2030 integrated six policies that had been adopted earlier; those for the electricity, energy efficiency, renewable energy, housing and buildings sectors, and the energy technology programme, with the aim to ensure that comprehensive planning of the energy sector is guided by a single development plan. Reducing the number of strategy documents also allows for better integration with national budget preparation. This will facilitate the planning and funding of policy measures to 2030. The IEA commends Estonia for implementing this strategic planning framework.

The NDPES 2030 describes the objectives of Estonia's energy policy to 2030 and lays out the vision for the energy sector until 2050 as follows (MEAC, 2017):

- reducing the energy intensity of the economy by 66% in 2030 compared to 2012
- maintaining the final energy consumption in 2030 at the same level as in 2010 (3 Mtoe), with renewable energy accounting for at least 50%
- reducing primary energy consumption by 10% compared to 2012
- not exceeding 57.7 TWh of primary energy supply by 2030
- imported fuels will not account for more than 25% of domestic primary energy consumption in 2030
- making Estonia a net exporter of energy by 2030
- limiting the share of the largest gas supply source to 70%
- reducing greenhouse gas (GHG) emissions in the energy sector by at least 70% by 2030 and by over 80% by 2050, compared to the 1990 level
- reducing emissions from outside the EU Energy Trading System (ETS) by 13% below the 2005 level.

The NDPES 2030 also integrated the targets and objectives of the NDPES 2020 as well as the targets to 2020 that were set in line with EU requirements. The targets for 2020 are:

- emissions outside the EU-ETS will not increase by more than 11% compared to the 2005 level
- final energy consumption in 2020 will not exceed the level of 2010 (3 Mtoe)
- renewable energy will account for at least 25% of gross final consumption.

Estonia has already exceeded the 2020 renewable energy target in 2017 and in the same year non-ETS emissions were actually below their 2005 level. However, since 2017, total final energy consumption and total GHG emissions have been increasing. There is a possibility that Estonia may miss its 2020 target of keeping final energy consumption at the 2010 level. Moreover, while Estonia has made impressive progress to increase the share of renewable energy in the electricity and heating sectors, it is far from meeting the mandatory 10% target in the transport sector, with renewables accounting for less than 0.5% in 2017. Initial government data for 2018 show a 3.7% renewable share in transport, indicating that the biofuel mandate has been successful. The government is positive about meeting 10% target in 2020.

Reaching the energy and climate targets to 2030 requires substantially greater efforts, as for the first time Estonia needs to reduce its emissions instead of merely containing their growth. This necessitates a substantial transformation of the energy sector and in particular of the role of oil shale. Domestic discussions about how to reach the 2030 targets have begun but no specific policy has been agreed upon yet.

The Estonian government defines itself as a firm believer in open markets and low state involvement, with energy supply driven by market prices. Yet, the state remains the owner of a number of key companies and institutions in the energy sector, including the country's largest energy company, the vertically integrated Eesti Energy, that has, among others, interests in oil shale mining, electricity generation and supply, and oil shale liquefaction. The state also owns Elering, the electricity and gas transmission system operator.

The government is aware that market forces alone will not deliver the long-term energy and climate targets and that state intervention is needed in sectors where the market-based approach is not viable, or where there are barriers that need to be overcome. The NDPES 2030 clearly sets out the objectives of diversifying the energy mix and more specifically of moving to more environment-friendly electricity production. However, detailed measures and programmes have not yet been determined and there appears to be a general lack of urgency to tackle the large challenges lying ahead. In addition, there is scope to launch more targeted initiatives to encourage pollution mitigation and resource efficiency in the oil shale sector (OECD, 2017).

## Energy sector transformation and independence

The NDPES 2030 also elaborates the "*General Principles of Climate Policy until 2050*" (GPCP 2050), that outline the vision for the transformation of Estonia into a low-carbon economy and society. The key focus of the GPCP 2050 is the decoupling of economic growth from the use of primary raw materials through a more efficient use of primary energy (Riigikogu, 2017).

Estonia's use of primary raw material is largely determined by the heavy reliance on oil shale in the energy sector. Reaching the goal of a low-carbon economy therefore requires a transformation of the role oil shale plays in Estonia's energy sector. This transformation will be propelled by the increasing $CO_2$ price in the EU-ETS that will make production of electricity from oil shale increasingly financially unattractive.

Estonia is on the brink of a major energy transition that will see an increasing share of renewable electricity and a continuously declining share of oil shale in electricity production, in favour of liquefaction of oil shale. The liquefaction of oil shale has a smaller environmental footprint than electricity production as the process emits less $CO_2$ and is more efficient. The liquefaction process uses up to 85% of the energy content of the resource compared to 30-40% for electricity production. The production of shale oil is already increasing. In 2017, 35% of total oil shale production was converted to shale oil, up from 31% in 2016.

Paradoxically, the shift towards liquefaction of oil shale will accelerate the decreasing role of oil shale in the power sector beyond the immediate substitution. This is due to the retort gas or shale gas, a high-value by-product of liquefaction of oil shale into shale oil, which offers substantial benefits to the Estonian energy sector and overall economy, and also increases the overall efficiency of the primary resource use, further improving the economics for liquefaction of oil shale.

Estonia places a high value on energy independence, which is one of the objectives of the NDPES 2030. This is largely the result of the country's history. Estonia's energy policy since the country regained its independence in 1991 sees energy independence as a requirement for energy security. Estonia has the highest energy independence in the EU due to the dominance of oil shale and the large share of renewables in the energy mix.

However, energy independence is increasingly less relevant for a country that is as well integrated with neighbouring EU member countries as Estonia is and that is promoting additional electricity and gas interconnectivity projects to further increase this integration. Estonia's interconnection with neighbouring Baltic and Nordic countries in the electricity market already exceeds the EU target and completion of the Baltic gas connector will further increase security of supply. The government should now shift focus towards energy security and resilience, to prepare for possible external shocks and adapt to climate change.

According to Eurostat, Estonia had the lowest energy import dependency of all EU countries measured as the share of total energy needs met by imports from other countries (Eurostat, 2018). However, using an index with a single indicator to judge energy independence can be misleading, as total energy exports and imports are balanced out, and Estonia's dependence on imported oil products is not properly reflected. Estonia also is promoting the increased liquefaction of oil shale for reaching the objective of energy independence in liquid fuels, as synthetic petroleum can also be used to produce motor fuels (MEAC, 2017). A sustained shift towards liquefaction of oil shale could eventually produce sufficiently large volumes to justify the operation of a refinery in Estonia (see Chapter 4). This would not only enlarge the value chain of oil shale, but also increase security of supply and potentially position Estonia as an oil product exporter.

Estonia has significant renewable energy sources, with great unexplored potential. As most other IEA member countries, there are delays in administrative approval for construction of wind farms and transmission lines. However, in the case of Estonia, the delays are due to spatial planning issues and objection by the Ministry of Defence, as wind turbines interfere with radar capabilities and potentially undermine national security. There is a technically straightforward but expensive solution: the installation of additional radar systems. This solution has already been deployed in other IEA member countries, notably the United Kingdom, which might offer some best practice experiences. However, the larger issue to be assessed relates to the overall procedures for spatial planning requirements that project developers need to comply with. This will become increasingly relevant also for expanding grid infrastructure with the expected increase in decentralised generation.

## Taxation

Estonia's commitment to an open market economy with minimal state intervention is also reflected in its tax structure. Estonia has no domestic carbon-pricing system as around two-thirds of total emissions fall under the EU-ETS. There is a marginal domestic carbon tax instrument in the form of a EUR 2 per tonne of $CO_2$ surcharge to the ambient air pollution charge for all facilities larger than 2 megawatts (MW), regardless of whether it is within the EU-ETS or not. However, major electricity producers are exempt from this charge if they invest in retrofitting. There is also no carbon-related tax for other sectors, including the transport sector. The government has no plans to introduce a market-based $CO_2$ emission pricing system for the non-ETS sector.

The 2017 OECD *Economic Survey of Estonia* found that financial incentives to prevent or reduce environmental damage are too low and recommended to set tax rates on oil shale, vehicle and energy use at a level that better reflects the environmental damage they generate (OECD, 2017), despite the fact that environmental taxes already account for a relatively large share of tax revenues. But the negative externalities of fossil fuels are currently not sufficiently reflected in the existing tax rates and there is a significant number of tax exemptions and reduced tax rates which are counterproductive for meeting the climate targets.

The 2016 reform of the oil shale extraction tax has even further reduced the impact of taxation in the oil shale sector, questioning even more whether Estonia could reach its targets for an energy transition as per the NDPES 2030 (see Chapter 3) (OECD, 2017).

However, the oil shale sector is not the only sector that could benefit from a more strategic use of taxation to steer behaviour. As Estonia grows richer, demand for mobility increases and is largely satisfied through individual motorised transport. Individual vehicle ownership is now higher than the EU average. Estonia does not levy an outright carbon tax on transport fuels, nor does it levy a vehicle registration or road use tax for private vehicles. Estonia therefore has one of the oldest and heaviest vehicle fleets in Europe. Innovative pilot projects like the provision of free public transport for Estonian citizens in Tallinn (see Box 7.1 in Chapter 7) and efforts to introduce smart mobility in Tallinn need to be supplemented by clear tax incentives and other price signals to steer behaviour in the desired direction.

## Assessment

This review comes at a very interesting time for Estonia, as the country enters a period in which it has to start reducing GHG emissions in non-ETS sectors and where quickly rising $CO_2$ prices drive the transformation of the power sector, which relies for 76% of electricity production on burning of oil shale. Other emerging challenges are the need to increase the share of renewables in transport fuels and improving energy efficiency across the economy.

The country has a unique energy history. The shift to a market economy after regaining independence in 1991 resulted in a significant decrease in gross inland consumption, from 9.8 Mtoe in 1990 to 5.5 Mtoe in 2016, and GHG emissions droppd by roughly 50% in the same time period. But in recent years energy consumption and emissions have grown again, despite a decreasing population. In most IEA member countries, economic growth is decoupled from energy consumption and emissions, but this is not the case yet in Estonia. There does not appear to be any specific cause for this other than higher electricity exports. However, there appears to be a general lack of urgency to act on efficiency and climate-related issues as demonstrated by the fact that concrete planning for reaching the 2030 targets has not yet commenced.

Security of supply seems of greater public and political importance, reflected in the strong desire for energy independence, and large infrastructure-related projects like the Baltic gas connector and the desynchronisation of the electricity system from Russia. As these projects are now on track, the IEA encourages the government to shift gears and focus on the sustainability of the energy system.

A key and unique characteristic of the Estonian energy sector is the use of the domestically sourced oil shale, which accounted for 73% of total energy supply in 2018. The second-largest primary energy source is biomass, which is also mostly of domestic origin. Estonia is fortunate to currently be a net exporter of energy, mainly shale oil, solid biofuels and electricity. However, it fully relies on imports for the provision of liquid transport fuels and natural gas.

Estonia actively supports a liberalised free and open energy market. Nevertheless, several strategically important energy companies are owned by the state. As the energy sector is faced with a massive transformation with uncertain results, it is perhaps not the best time to contemplate privatisation. On the other hand, the government is conscious of the innovative strengths that the private sector can bring to such a transformative process.

Estonia is highly interconnected with the Baltic and Nordic countries, and is part of the Baltic-Nordic electricity market. Interconnection capacity exceeds Estonia's peak demand. The Baltic gas interconnector with Finland is expected to be operational in 2020. Together with imports of liquefied natural gas from Lithuania, this Baltic connector will further reduce Estonia's dependence on direct gas imports from Russia, one of the government's declared policy priorities. Despite these good results, there is room to achieve mutual progress in other parts of the energy sector, like harmonisation of bio-blending requirements or a common reserve market for electricity.

The extensive use of oil shale allows for a low import dependency, but at the same time Estonia's carbon intensity is the highest among IEA member countries. The energy transformation of the electricity sector represents thus a major economic and social challenge that can be supported by defining pathways for decarbonising the sector.

Heating makes the residential sector the largest energy consumer, followed by the transport sector. Industrial energy consumption has fallen sharply following the regaining of independence in 1991 and Estonia's decision to focus on creating a competitive service sector. Energy consumption in the service sector is growing in line with economic growth and the move towards a digitalised economy.

Estonia has already exceeded the 2020 renewable energy target in 2017 and is expected to also meet its binding non-ETS targets for GHG emissions. However, overall energy-related emissions are increasing again. Moreover, Estonia will most likely miss the mandatory 10% renewable target in the transport sector by a large margin. The 2030 targets are much more stringent, requiring for instance for the first time a decrease in GHG emissions, and other considerable efforts in all energy sectors. Detailed planning of policy measures, monitoring their implementation and evaluating their outcomes should be expedited to steer the country back on track to reach the 2030 targets and the ambition for 2050.

The GPCP 2050, Estonia's low-carbon strategy, and the NDPES 2030, Estonia's comprehensive energy strategy, were both adopted in 2017. The NDPES 2030 sets out a broad range of energy targets. The decarbonisation depicted in the NDPES 2030 requires significant investment.

Coherent policy measures have to be developed and monitored to ensure that the targets are achieved. Removing regulatory barriers (i.e. geographical restrictions due to defence requirements, access to balancing market) can help trigger investments and comply with energy and climate targets. In line with EU regulation, Estonia submitted its draft national Energy and Climate Plan to the European Commission in December 2018; the final plan will be submitted by the end of 2019.

Finally, a word on the steering power of taxation. Taxation for revenue is well understood, and in some cases revenues can be used to influence behavioural change, like insulation of houses and encouraging a modal shift by providing free public transport. The government could also make better use of taxation itself to steer behaviour. Currently, the energy tax system hardly takes into account negative externalities of energy production and consumption. For instance, excise duties are not linked to carbon content or emissions of particles, but are the result of political compromises. A flat rate – regardless of the source of energy – taxes electricity output. As of January 2019, excise tax reductions of up to 90% for electricity-intensive industries apply, which are paired with substantial energy efficiency efforts of these industries, when such reductions are granted. The government should consider increasing the effective cost of $CO_2$ emissions across the board, include sectors where $CO_2$ emissions are currently not priced, and regularly review the actual energy and emission savings obtained by granting tax exemptions for investing in energy efficiency.

## Recommendations

***The government of Estonia should:***

- ☐ Clarify energy and climate targets for 2030 and 2050 and implement a regular monitoring system of progress achieved towards these targets.
- ☐ Further develop concrete policy measures in line with 2030 and 2050 targets.
- ☐ Co-ordinate the design and implementation of climate and energy policies with its Nordic and Baltic neighbours.
- ☐ Develop pathways for decarbonising electricity production and phase out oil shale in a socially and economically viable manner.
- ☐ Review energy taxation of all fuels to reflect their external costs, including carbon content, and to accelerate the switch to low-emission technologies, notably in the transport sector.
- ☐ Continue to remove regulatory barriers to investment in low-carbon energy production and energy infrastructure, notably restrictions.

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# 3. Oil shale

## Key data

(2018 provisional)

**Production of oil shale:** 22.0 Mt/4.2 Mtoe, +36% (by volume) since 2008

**Share of oil shale:** 71.8% of energy production, 72.7% of TPES and 75.9% of electricity generation

**Consumption by sector (2017):** 4.2 Mtoe (heat and power generation 59.0%, liquefaction 34.4%, other energy and industry 6.5%)

## Overview

Estonia's energy supply is unique among International Energy Agency (IEA) member countries, as it strongly relies on domestically produced oil shale, an energy-rich sedimentary rock that is burned for heat and power generation, or used for producing liquid fuels. Oil shale is the dominant fuel in domestic energy production, total primary energy supply (TPES) and electricity generation in Estonia (Figure 3.1). With its significant reserves of oil shale, Estonia's oil shale industry is the biggest in the world.

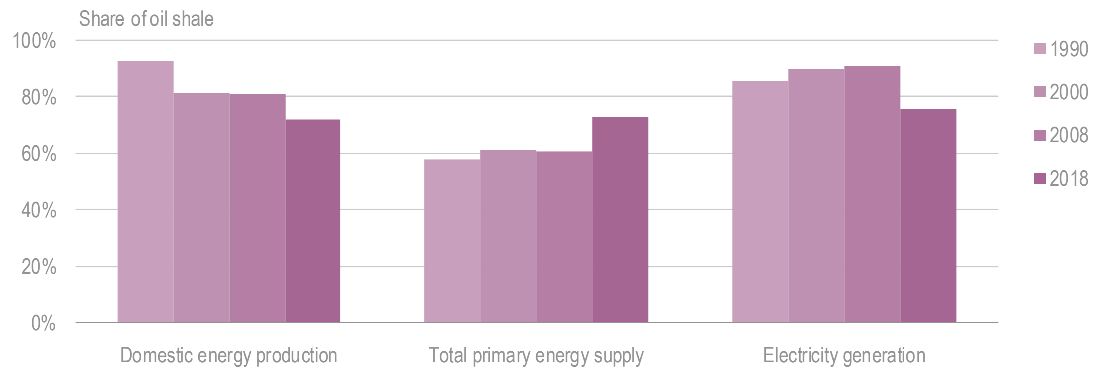
The year 2016 marked the 100th anniversary of the industrialisation of oil shale in Estonia and the country has been generating electricity from oil shale since 1924. The oil shale industry continues to be of strategic importance in the Estonian economy ensuring energy security, accounting for a considerable part of Estonian exports and offering significant employment in a structurally weak region of the country (MoE, 2016).

Oil shale mining and uses come with considerable environmental impacts. The future of the Estonian oil shale industry will largely depend on the cost of emitting $CO_2$ in the power sector under the European Union (EU) Energy Trading System (ETS) that is set to increase strongly in the period after 2020. This will affect the business case for Estonia's oil shale industry and will make liquefaction into shale oil more competitive than direct use for electricity generation. Balancing social, environmental, economic and energy security considerations will guide the transformation of the Estonian oil shale industry in the coming decades.

## Supply and demand

In 2018, Estonia produced 4.2 million tonnes of oil-equivalent (Mtoe) of oil shale, which accounted for 72% of total domestic energy production, 73% of TPES and 76% of electricity generation (Figure 3.1). Oil shale is a sedimentary rock, which contains organic matter in the form of kerogen (see Box 2.1 in Chapter 2). Like coal production, it is mined in solid form, and has slightly higher energy density than lignite (EE, 2019). In addition to oil shale, Estonia also uses small shares of coal, coal products and peat, which account for around 1% of TPES.

### Figure 3.1 Share of oil shale in Estonia's energy system, 1990-2018





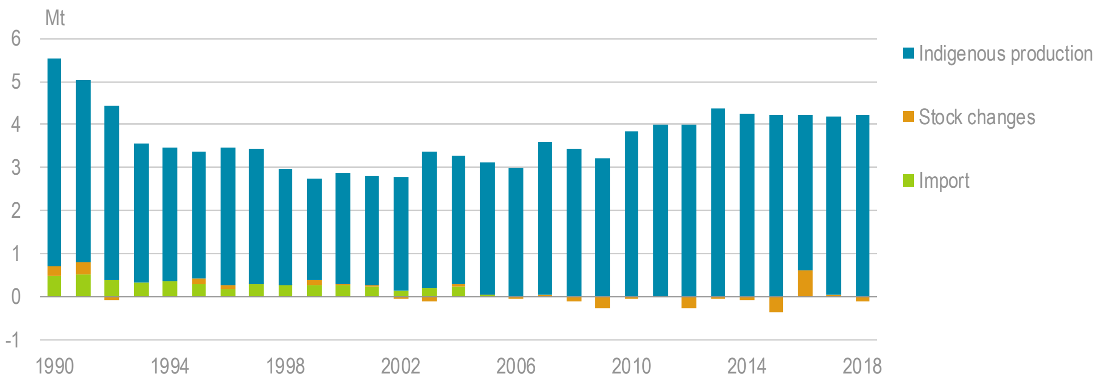

Oil shale is the dominant energy source in Estonia, although its shares in domestic energy production and electricity generation have decreased in the last decade.

Note: Supply data for 2018 are provisional.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

Estonia's oil shale production varies slightly from year to year, but in general total domestic supply has been around 4 Mtoe since 2010. This is an increase from around 3 Mtoe in the early 2000s. Stocks are used to balance supply and demand between years, as was the case for instance in 2016 (Figure 3.2). Although domestic oil shale production has increased, its share in domestic energy production has declined due to a rapid increase in bioenergy production.

### Figure 3.2 Oil shale supply by source, Estonia, 1990-2018






Estonia's oil shale production has been around 4 Mtoe per year since 2010, covering around 70% of TPES.

Notes: Mt = million tonnes. Supply data for 2018 are provisional.

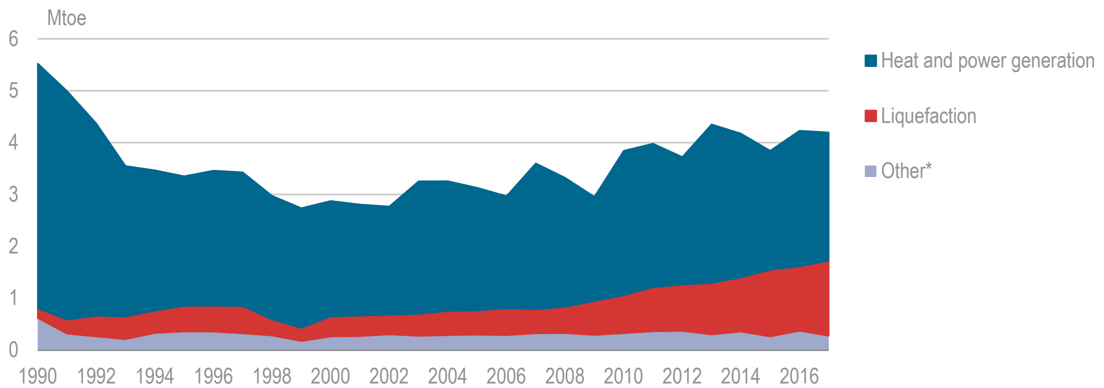
Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

Oil shale used in liquefaction plants has slowly replaced consumption in the heat and power generation over the last decade, and the trend is likely to continue. Heat and power generation remain the largest oil shale consuming sectors, accounting for 59% of total oil shale consumption in Estonia in 2017. Nearly all of this is pure power generation, with only a few per cent used in co-generation with heat. Around 34% was liquefied to produce shale oil. The remainder (just below 7%) is used in other energy transformation processes and the energy sector's own use, and in final consumption in the industry sector (Figure 3.3).

Oil shale liquefaction has tripled in the last ten years, as most of the increase in oil shale production has been for liquefaction. Over 90% of the annual shale oil production is exported (see Chapter 4).

Correspondingly, the share of oil shale used in heat and power generation has fallen, from 78% in 2007 to 59% in 2017. However, electricity generation from oil shale has remained around 10 terawatt hours (TWh) per year, although with large annual variations due to regional power trading. The growth in renewable power has led to a fall in the share of oil shale in total power generation, but there is no clear trend yet showing a decline in electricity generated from oil shale.

**Figure 3.3 Oil shale consumption by sector, 1990-2017**






Oil shale used in liquefaction plants has slowly replaced consumption in the heat and power generation over the last decade, and the trend is likely to continue.

* "Other" includes other energy processes, the energy sector's own use and final consumption in the industry sector.

Notes: Mtoe = million tonnes of oil-equivalent. Oil shale in total primary energy supply by sector.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

## Policy and regulatory framework

The *National Development Plan for the Use of Oil Shale 2016-2030* (hereafter "Oil shale development plan") (MoE, 2016) is the guiding policy document for the oil shale sector. The plan has three strategic objectives:

- increase the efficiency and reduce the environmental impact of oil shale mining
- increase the efficiency and reduce the environmental impact of oil shale use
- develop education and research activities related to oil shale.

The plan includes financial means for the years 2016-19 and is accompanied by an action plan for implementing the strategic aims and measures.

The need for an oil shale development plan follows from the "Earth's Crust Act" (Riigi Teataja, 2017), which states that no oil shale mining permit will be granted in the absence of a national development plan for mining and all usages of oil shale. The latest revision of the act entered into force in 2017 to ensure the sustainable and economical use of natural resources, including oil shale, while reducing adverse effects for the environment. The Ministry of Environment[1], based on the Earth's Crust Act, regulates oil shale mining. The oil shale resources belong to the state and the Ministry of Environment, through the Environmental Board, issues exploration and mining permits. The revised act requires all companies applying for mining permits to provide an *ex ante* analysis of the socio-economic impact of its activities related to oil shale.

The Earth Crust Act sets the total annual maximum mining limit at 20 million tonnes (Mt). Oil shale reserves are around 5 000 Mt, and the economic proven reserve is estimated to be 1 000 Mt. With an annual production of roughly 15-20 Mt, the proven reserves would suffice for approximately 50 years at the current mining rate (MoE, 2016). The purpose of the annual mining limit is to ensure the sustainable use of the reserves, and to eventually reduce the annual use of oil shale due to the negative environmental and social impacts of oil shale mining and use (MoE, 2016).

The earlier oil shale development plan ran from 2008 to 2015. The National Audit Office's 2014 evaluation of the implementation of that plan found that two of the plan's primary goals were not met: reducing the environmental impact of oil shale mining and the use of oil shale; and increasing the efficiency of mining and use. The audit further found that the existing environmental charges were ineffective in influencing behaviour in the shale industry (Riigicontrol, 2014).

The oil shale development plan has close linkages with other strategic documents, including the *National Development Plan of the Energy Sector 2030* (NDPES 2030) (MEAC, 2017). The NDPES 2030 discusses the oil shale industry as a part of the country's overall energy policy and focuses on issues related to the production of energy from oil shale within the larger security of supply context. The focus of the oil shale development plan is on identifying new technologies to improve the sustainability of oil shale extraction, and on the environmental impact of extracting and processing oil shale.

The government aims to find a balance between energy security, environmental concerns and state revenues when setting the level of fees charged for the exploitation of oil shale resources. It is increasingly aware of the need to better reflect the external costs associated with the mining and use of oil shale when setting environmental fees and taxes.

The oil shale industry is subject to the Environmental Charges Act. Until 2016, each tonne of shale oil produced from oil shale was taxed at EUR 1.58, the so-called resource or mining tax. In 2016, the government reduced the tax to EUR 0.275 per tonne to maintain the competitiveness of the Estonian liquid shale oil industry in light of low world crude prices. The level of the resource tax is further linked to the average crude oil price in the

[1] Annex A provides detailed information about institutions and organisations with responsibilities related to the energy sector.

past quarter, thereby assuring that the tax as such is not an impediment for oil shale mining, as the revenues of the mining companies are also roughly correlated with the crude oil price. Water use is charged EUR 19.48 per 1 000 cubic metres ($m^3$) of water pumped out of the quarries and EUR 54.32 per 1 000 $m^3$ for pumping water out of mines.

In 2017, oil shale mining companies paid around EUR 62 million in environmental charges. Of this, pollution charges for emissions and landfilling waste related to mining and processing of oil shale accounted for EUR 42 million. Fees for special use of water totalled EUR 7.2 million. The resource tax accounted for the rest. In the same year, the industry invested over EUR 30 million for environmental causes, mainly for measures to modernise the production process and improve the quality of the ambient air (EE et al., 2018).

In 2017, the government commissioned a study to review the principles of the environmental fees related to oil shale mining and use, and to provide suggestions how the government should structure taxes and fees for the oil shale industry in the period 2018-50. On the basis of the suggestions made, the government will develop a new model for taxes and fees by the end of 2019 (EE et al., 2018).

## Industry structure

Four companies hold oil shale mining permits in Estonia. State-owned Eesti Energia is the largest oil shale mining and processing company in the world and holds the largest number of mining permits, representing roughly 75% of total annual allowances, through its subsidiary EE Kaevandused AS. VKG Kaevanduesed OÛ (VKG) holds 18%, Kivioli Keemiatööstuse Varad (KKV) 10% and AS Kunda Nordic Tsement the remaining share of the annual mining allowances. In 2009, the Ministry of Environment established a maximum annual mining limit for each licence holder (Table 3.1).

**Table 3.1 Oil shale mining and allowances, 2013-17**

| | Annual allowed volumes (kt) | Actual mined volumes (kt) | | | | | Average of allowed volumes used 2013-17 |
|---|---|---|---|---|---|---|---|
| | | 2013 | 2014 | 2015 | 2016 | 2017 | |
| **Eesti Energia** | 15 010 | 11 830 | 11 614 | 11 083 | 9 732 | 11 157 | 74% |
| **Viru Keemia Grupp** | 2 772 | 2 344 | 2 483 | 2 637 | 1 791 | 3 239 | 90% |
| **Kivioli Keemaitööstus** | 1 980 | 755 | 1 058 | 1 350 | 1 581 | 1 164 | 60% |
| **AS Kunda Nordic Tsement** | 238 | 98 | 103 | 117 | 0 | 74 | 33% |
| **Total** | **20 000** | **15 027** | **15 258** | **15 187** | **13 104** | **15 634** | **74%** |

Source: EE et al. (2018), *Estonian Oil Shale Industry Yearbook 2017*.

Up to 2017, none of the four licence holders had mined their maximum annual limit. The Earth Crust Act was thus amended in 2015, providing the four companies with a seven-year period during which they can mine the outstanding amount of their annual limit since 2009. In 2017, VKG was the first and only company to mine oil shale based on the allowances carried forward (EE et al., 2018). The total annual mining limit remained, however, at 20 Mt (MoE, 2016).

The allocation of permits is independent from actual mining, as companies can trade their mining rights. There is no formal procedure for companies to relinquish unused rights to other companies. There are instead one-off informal agreements between companies to trade mining rights if a company in a given year does not fully use its allowances. The ad hoc nature of these arrangements creates uncertainty in the industry and prevents forward-looking planning.

The use of oil shale in power and heat production still dominates, but shale oil production is growing quickly (see Chapter 4). The full liberalisation of the Estonian electricity sector in 2013 abolished administered electricity prices and hence made the use of oil shale for electricity production less attractive. The NDPES 2030 sets a goal to maximise the added value of oil shale and to maintain the competitiveness and investment capacity of the oil shale sector to ensure continuous energy security.

## Environmental impact from oil shale production and use

Oil shale mining and use has a large number of environmental impacts. Oil shale is mined either through opencast or underground mining. In both cases, it’s excavated and transported to a processing plant where it is crushed, sometimes enriched, and then heated to produce shale oil or put into ovens for heat or power generation.

Mining of oil shale suffers from high losses during the mining process, especially when using the underground mining technique. Losses average roughly 23% of the total amount of oil shale mined in a given year, but are close to 30% for underground mining (MoE, 2016). Mining losses will likely increase in the future as more accessible reserves are exhausted. Increasing the efficiency of underground oil shale mining allows a better exploitation of the resources. Research is underway to develop new technologies, bearing in mind environmental protection, but apart from promising pilot initiatives, a conclusive solution has not yet been found.

Another environmental concern of oil shale mining is waste management. The current recovery level of waste rock is 40% and in 2017, 6.26 Mt of waste was produced from mining (EE et al., 2018). The industry is looking for new applications for the by-products of oil shale mining. Parts of the waste rock are crushed and used to manufacture low-class concrete. Waste rock can also be added to power plant boilers or to purify flue gasses. The new circulating fluidised bed boilers that are replacing the old pulverised firing boilers in the power sector and the solid heat carrier oil manufacturing equipment replacing the gaseous heat carrier (GHC) equipment can work with a lower calorific value of raw material. This can reduce the amount of waste rock deposited in extractive waste depositories that is qualified as non-hazardous waste (MoE, 2016). In addition, for every tonne of oil shale mined, 450 kg of slag is produced. Some portion of the slag is used by the buildings industry, but the largest part must be deposited. This is mainly done by depositing the slag in the landscape, which has contributed to creating hills and mountains (KAS, 2018).

In 2017, 56% of mine waste was reused (EE et al., 2018). Despite the progress made, the Estonian oil shale industry is aware that there remains scope for substantial improvement in recovering by-products and is therefore involved in and financing substantial research activities for the period to 2030.

Oil shale mining also requires large amounts of water, which cannot easily be cleared and reused due to the chemicals used in the mining process, and must be disposed of in a secure way. This has a negative impact on the groundwater quality in mining areas, and technical solutions have yet to emerge to mitigate these negative effects. For each tonne of oil shale extracted, 15 $m^3$ of water is pumped out. The target set in the oil shale development plan for 2020 is to reduce this to 14 $m^3$. However, in order to reach this level, mining intensity must be increased. The target levels for water use in 2025 and 2030 will be determined in 2020 (MoE, 2016).

In addition, oil shale mining also affects the local air quality and produces other residual pollution. The oil shale development plan sets out a number of measures to address these issues; however, it does not seem possible to eliminate all of the negative impacts with the given technology. Estonia has set ambient air pollution limits for 2030 (MoE, 2016); the majority of its medium-sized combustion facilities will require substantial investments for retrofitting after 2025 to comply with these limits.

Oil shale is used either for heat and power generation, or for producing liquid fuels. Both uses come with a different set of environmental concerns. When used for electricity generation, oil shale emits more carbon dioxide ($CO_2$) than any other primary fuel in Estonia. Its emission factor is 1 110 grammes $CO_2$ per kilowatt-hour ($CO_2$/kWh), which is 30% higher than that of burning coal and more than four times higher than that of natural gas. The new circulating fluidised bed boilers are more efficient than the old pulverised boilers and extract a higher calorific value when burning oil shale. The circulating fluidised bed also reduces other pollutants like sulphur dioxide ($SO_2$) emissions and nitrogen compounds ($NO_x$), but in total, electricity production from oil shale remains the most polluting among all combustion technologies. Electricity generation from oil shale also produces substantial amounts of fly ash. Unlike for mine waste, there is currently limited potential to use fly ash as raw material. Only 1.6% of the fly ash produced during electricity production in 2017 was reused (EE et al., 2018).

Two technologies are used in Estonia to process oil shale to obtain shale oil. Four plants use the older upright retorts GHC technology. The newer solid heat carrier horizontal retorts technology is used in three Petroter technology plants and the Enefit plant. The Petroter and Enefit plants have much lower $CO_2$ emissions and a much higher energy performance than the old GHC technology plants. However, even the GHC technology has a lower environmental impact than the use of oil shale for power generation.

## Future of oil shale

The gradual transformation of the Estonian oil shale industry is moving towards extracting a higher value of oil shale resources. Historically, the use of oil shale focused on electricity and heat production, with only small portions used to produce oil. While in 2017, heat and power generation still accounted for 66% of oil shale consumption, the shift away from using oil shale in solid form towards liquefaction is noticeable. The share of electricity production from renewable sources is steadily increasing and oil shale liquefaction had doubled since 2007, absorbing most of the additional oil shale production. In 2017, Estonia produced 1.02 million tonnes of shale oil (EE et al., 2018).

The future of Estonia's oil shale industry will largely be determined by the different markets in which oil shale products compete. The electricity and heat sectors are subject to the EU's regulatory framework and oil shale-based electricity competes in the open electricity market of Northern Europe and the Baltic states. Greenhouse gas emissions from power and heat production are part of the EU ETS (see Chapter 7). The price for emitting $CO_2$ under the ETS has increased sharply over the last two years, from around EUR 5 per tonne to EUR 20 per tonne in 2018. As the cap for emissions under the ETS will continue to drop, the cost of emitting $CO_2$ will increase further.

Shale oil competes in the world market with other liquid fuels. Increasing $CO_2$ prices in the EU-ETS market will make liquefaction of oil shale more competitive than electricity generation. The move from solid to liquid use and, as a by-product, to gaseous form, brings substantial benefits to the Estonian energy sector and its economy.

The oil shale development plan recognises the dynamics in European electricity markets. It explicitly commits to ensure enabling conditions for switching to a more complex use of the oil shale resource that provides more added value, while decreasing its negative environmental impact. To ensure continuous security of Estonia's energy supply, the oil shale development plan defines as a strategic objective to combine the production of oil shale-based energy with renewable and other energy sources (MoE, 2016).

Oil production technologies allow for 40-45% of the organic matter contained in oil shale to be used. One tonne of oil shale yields 0.8 barrels or 0.112 tonnes of shale oil, equivalent to 1.53 megawatt-hours (MWh). Using oil shale directly for power generation generates less than half the output at 0.7 MWh of electricity for every tonne of oil shale used (EE, 2019).

Synthetic petroleum can be produced from oil shale that can then be used for the production of motor fuels. A study undertaken for the preparation of the oil shale development plan found that the annual production of shale oil could reach over 2.5 mt, subject to all investment plans actually being implemented (MEAC, 2017). Such a level of annual production could justify the construction of a refinery in Estonia (see Chapter 4). This could provide around 6% of total value created in the Estonian economy and secure approximately 12 000 jobs directly or indirectly connected to the sector (MEAC, 2017).

Retort, or shale gas, is a high-value by-product of oil shale liquefaction. In 2017, 893.5 gigawatt hours (GWh) were generated from shale gas, equivalent to 9% of the total volume of power generated by oil shale companies. Eesti Energia has invested EUR 14.7 million in the renovation of energy unit no. 8 of its Eesti Power Plant to install a new fluidised bed boiler, which became operational in 2018. The boiler is capable of using up to 50% of shale gas, compared to 13% previously. This will contribute to decreasing the environmental impact of power generation from oil shale. Since the gas is a by-product of the liquid fuel production process, the overall efficiency of the use of a given quantity of oil shale is improved, making liquefaction of oil shale economically more attractive.

If all investment plans in oil shale liquefaction were to materialise, the by-products of oil production could generate over 5 TWh of electricity per year. The low marginal cost of the electricity production would enhance the competitiveness of Estonian electricity exports (MEAC, 2017).

Beyond its role in securing energy security of supply, the oil shale sector delivers important employment and social outcomes. It employs over 7 300 people directly and is the largest employer in the country's second-largest county, Ida-Viru, a region that does not offer many alternative employment opportunities. Revenues from the oil shale sector constitute significant revenues for the local governments. Moving along the value chain of oil shale is therefore an important contribution to maintain employment and social cohesion in a structurally weak region, once oil shale-based electricity generation is phased out.

## Assessment

Estonia's energy supply relies mainly on domestically produced oil shale, which gives the country a unique position among IEA members. In 2018, oil shale accounted for 72% of Estonia's total domestic energy production, 73% of total TPES and 76% of electricity generation.

Oil shale is the most important mineral of Estonia and oil shale resources belong to the state. Oil shale mining comes with considerable environmental impact, both in above-ground and underground mining. A lot of water is used or pumped away, dust and other emissions occur, and recovery rock is piled up in the flat landscape, while alternative uses are possible.

The Ministry of the Environment through the Environmental Board provides permits to mine oil shale. For environmental reasons, the production of oil shale is capped at 20 Mt per year. Four companies hold permits. The permits reflect historical rights of the holders. If a company in a given year does not fully use its allowance, the remainder can be used by another permit holder via informal agreements. As this system can create uncertainties over future quantities to mine, it would be preferable to rearrange the quantities under the license, based on a use-it-or-lose it principle.

A comprehensive review of the current taxation and fee system levied on the oil shale sector is ongoing and should be completed in 2019. The government is considering a modification to the fundamental principles of taxation of mineral resources to more clearly distinguish between fees for the use of the resource and environmental charges that address the externalities of the extractive activity and compensate for the environmental damages caused by the oil shale sector.

The policy framework for the oil shale sector is set by the *National Development Plan for the Use of Oil Shale 2016-2030*, which focuses on the mining side of the oil shale sector, paying less attention to the use of oil shale in electricity and conversion into shale oil. This leaves a gap for the future development of the sector as a whole.

Once extracted from the ground, oil shale can be used directly in a power plant (pulverised or in a fluidised bed boiler) or processed to produce shale oil. In 2017, heat and power generation accounted for 59% of total oil shale consumption in Estonia, while one-third was used for shale oil production. Remarkably, oil shale accounts for around 76% of electricity generation.

Oil shale has by far the highest $CO_2$ intensity in Estonia's heat and power generation. The emission factor for oil shale in heat and power generation is 1 110 $gCO_2/kWh$, this compares to Estonia's average emission factor of 660 $gCO_2/kWh$.

The power and heat sectors in Estonia are covered by the European ETS. The $CO_2$ price under the ETS has risen sharply over the last two years, from EUR 5 to EUR 20 per tonne in 2018. The high $CO_2$ emission factor of burning oil shale for power and heat implies that using oil shale for power and heat is becoming less competitive; this may become more urgent if the $CO_2$ price were to rise further. This provides opportunities for market penetration of renewables, and indeed, where possible, biomass is co-fired with oil shale in power generation.

As the use of oil shale in power and heat is becoming less attractive, the government is looking to transform the oil shale sector, shifting from power generation towards liquid shale oil production. Since the previous In-depth Review in 2013, four new shale oil liquefaction plants have been commissioned, and in 2017, Estonia produced 1.2 Mt of shale oil. As a by-product, some retort gas is produced, that is used on-site for power or heat generation and has a positive impact on emissions reductions and resource efficiency.

The further transformation of the Estonian oil shale industry will happen gradually. But the government is cognisant that market forces and $CO_2$ reduction policies will make the use of oil shale in power generation increasingly unattractive. This will make an increasing share of oil shale available for alternative uses and could eventually be sufficient to justify the construction of an oil refinery in Estonia with a positive impact on security of supply.

Given the substantial negative environmental impact of oil shale mining and use and the current lack of adequate technologies to mitigate those impacts, it is prudent that the government maintains the current annual mining limits.

## Recommendations

***The government of Estonia should:***

- Further reduce the environmental impact of oil shale mining, by designing and enforcing stricter regulations on water use, emissions and recovery waste rock.
- Review the role of oil shale in future power generation, as $CO_2$ prices are set to further increase, and together with the power sector design a pathway to a low-carbon electricity generation system while maintaining electricity security.
- Regularly assess the allocation of mining rights on a use-it-or-lose it basis, to align them with the actual needs of (potential) licence holders.

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# 4. Oil

## Key data

(2018)

**Domestic oil* production:** 21.6 kb/d of shale oil from oil shale, +157% since 2008

**Net-imports of oil*: -**21.4 kb/d, +266% since 2008

**Domestic oil products:** no refining in the country

**Net imports of oil products:** 26.4 kb/d, +21% since 2008

**Share of oil (2017):** 4.0% of TPES and 0% electricity generation

**Total oil demand**: 29.0 kb/d, 3% since 2008

**Consumption by sector (2017)**:** 1.2 Mt (transport 72.4%, commercial 11.1%, industry 10.8%, transformation/energy 4.9%, residential 0.8%)

* Includes conventional crude oil, condensates, natural gas liquids (NGLs) and unconventional oil.
** Consumption by sector data are presented in million tonnes (Mt) and exclude international marine bunkers.

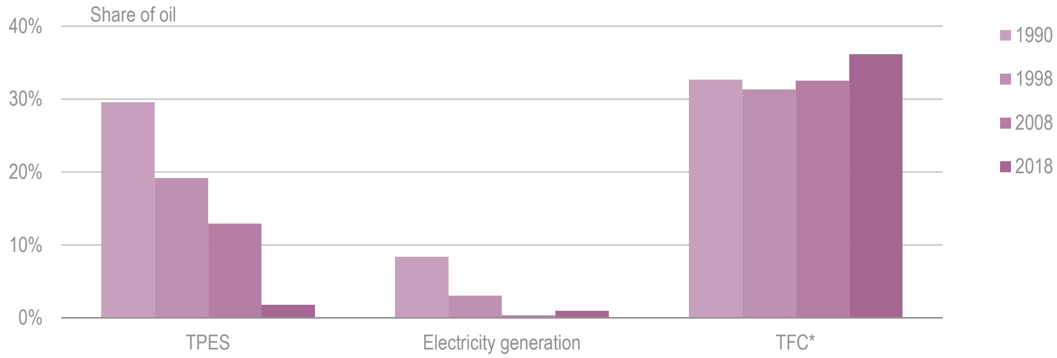
## Overview

In Estonia, in 2017, the share of oil in total primary energy supply (TPES) was 4%, down from 14% in 2007, which is the lowest share of oil in TPES among International Energy Agency (IEA) countries (the IEA average is 34%). However, oil accounts for over one-third of total final consumption (TFC) in Estonia. The level of oil consumption has been stable at around 1.1 million tonnes (Mt) over the last decade, mainly for the transport sector. The gap between TPES and TFC reflects the fact that Estonia's production of unconventional crude oil is derived from the liquefaction of oil shale, which is accounted for in TPES as "coal and oil shale" (Figure 4.1).

Estonia has no conventional crude oil production, but does produce unconventional oil – shale oil from domestic oil shale liquefaction, with the production level more than doubling over the last decade. As there are no refineries in the country, Estonia exports the vast majority of this shale oil production and fully relies on imports to meet its oil product demand. Estonia has not only nominally reduced its oil import dependency by exporting more shale oil, but has also successfully diversified its oil product import sources. Estonia does not have indigenous biofuel production and is therefore reliant on imports.

With successful market reform, the Estonian oil market has become fully liberalised and competitive, albeit with some large players still dominating the market. Fuel prices in Estonia have remained almost the same since the last In-depth Review in 2013, with regular increases in tax rates since 2016; Estonia's fuel prices have shifted from being among the lowest to being within the median levels of countries in the IEA oil price comparison.

**Figure 4.1 Share of oil in different energy metrics, 1990-2018**






Estonia's production of unconventional oil comes from the liquefaction of oil shale.

* The latest data available for total final energy consumption are for 2017.

Notes: TPES = total primary energy supply; TFC = total final consumption. Estonia's production of oil shale, from which its unconventional oil is produced, is accounted for as "coal and oil shale" in the IEA's TPES metrics, and is the reason for the apparent discrepancy in the share of oil between TPES and TFC. Data for 2018 are provisional.

Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

Estonia fully meets its IEA and EU emergency oil stockholding by holding public stocks of refined products, a substantial portion of which is held in other countries under bilateral agreements.

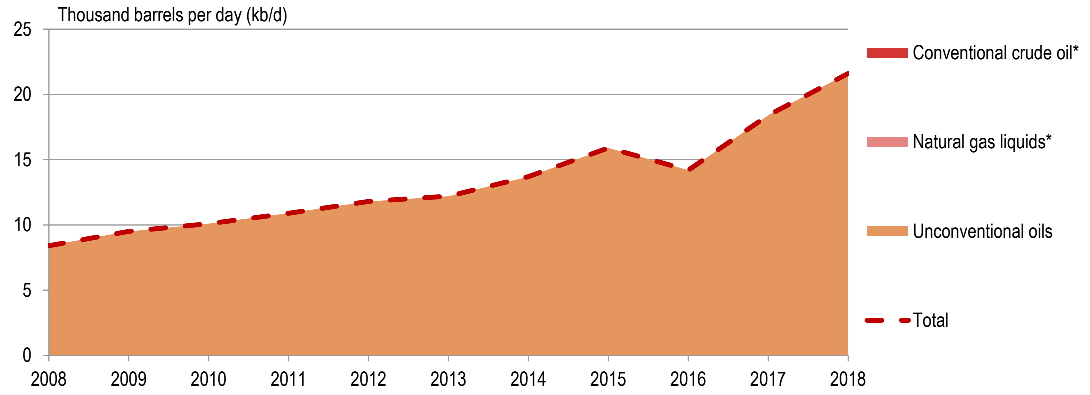
## Supply and demand

### *Oil production*

Estonia has unconventional oil production in the form of shale oil from domestically produced oil shale. The liquefaction of oil shale, an energy-rich sedimentary rock, into shale oil accounts for all domestic oil production. Liquid shale oil is essentially a synthetic crude oil, with a lower viscosity and lower sulphur content than heavy fuel oil derived from refining of conventional crudes. It is primarily used as a blending component in heating or bunker fuel oil to lower sulphur content, and as refinery feedstock.

In the period 2008-18, Estonia's domestic oil production increased by 157%, reaching 21.6 thousand barrels per day (kb/d) in 2018 (Figure 4.2), the equivalent of 1.12 Mt annually. The amount of shale oil production in a given year is directly linked to changes in the supply of domestic oil shale, global crude oil prices and electricity demand, as oil shale is also used for power generation. Sharp annual changes in 2015-17 were mainly due to changes in global oil market fundamentals, where falling crude oil prices led to a steep decline in production for the first half of 2016 followed thereafter by more stable growth. The longer term trend of rising shale oil production reflects the growing economic advantage of producing liquid fuels rather than electricity from the oil shale (see Chapter 3).

**Figure 4.2 Domestic oil production, 2008-18**






Estonia's oil production is entirely unconventional oil – shale oil from oil shale.

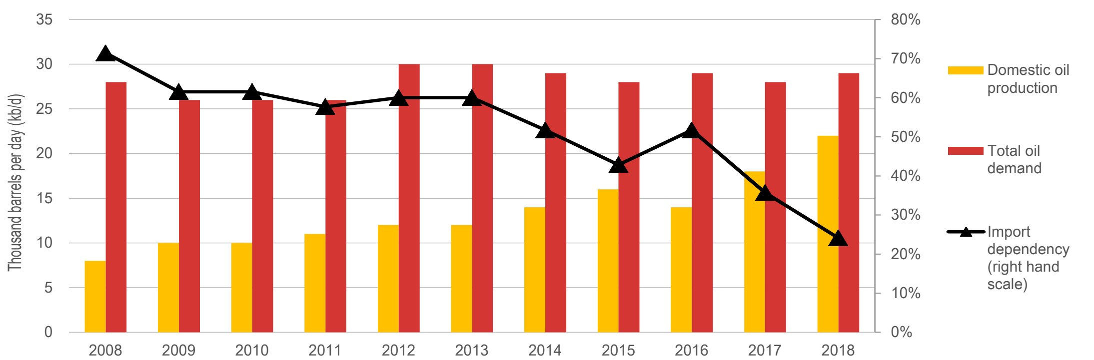
* Non-existent.

Source: IEA (2019b), *Oil Information 2019*, www.iea.org/statistics.

## *Trade: Imports and exports*

As there are no refeneries in the country, Estonia does not import crude oil and relies entirely on imports, mostly diesel oil and motor gasoline, to meet its oil product demand. At the same time, the vast majority of shale oil production of Estonia is exported. In 2018, 99% of total shale oil produced in the country was exported, an increase on the 93% share in 2017, accounting for three-fifths of total oil exports. With the production level of shale oil soaring over the last decade, the country's total oil import dependency[1] fell from 73% to 24% in 2018 (Figure 4.3).

**Figure 4.3 Estonia's oil supply, demand and import dependency, 2008-18**






Estonia's rising production and exports of shale oil over the past decade have reduced oil import dependency by half.

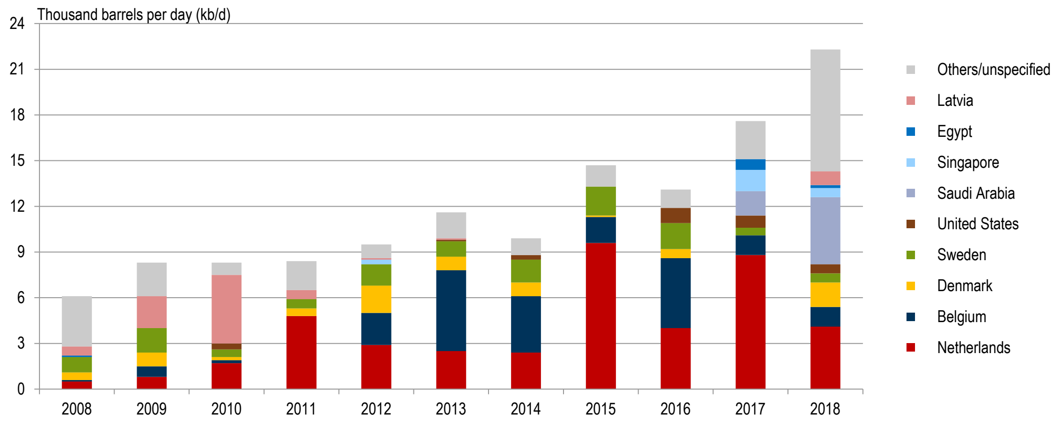
Source: IEA (2019b), *Oil Information 2019*, www.iea.org/statistics.

[1] Import dependency = net imports ÷ total demand.

## Shale oil

Over the last decade, Estonia's shale oil exports have increased by more than 250%, to reach 21.4 kb/d in 2018 (Figure 4.4). Estonia exports the majority of its shale oil to European countries, such as the Netherlands, Belgium and Latvia. Export destinations have become more diverse in recent years; in 2018, Saudi Arabia became the largest recipient of Estonian shale oil and accounted for 20% of the total, followed by the Netherlands with 18%, a sharp fall from 50% previously. The rest was exported to Denmark (7%); Belgium (6%); Latvia (4%); Singapore, Sweden and the United States (3% respectively); and others/unspecified (36%).

### Figure 4.4 Estonia's net shale oil exports per country, 2008-18






Estonia's shale oil exports have increased in volumes and diversified in destination.

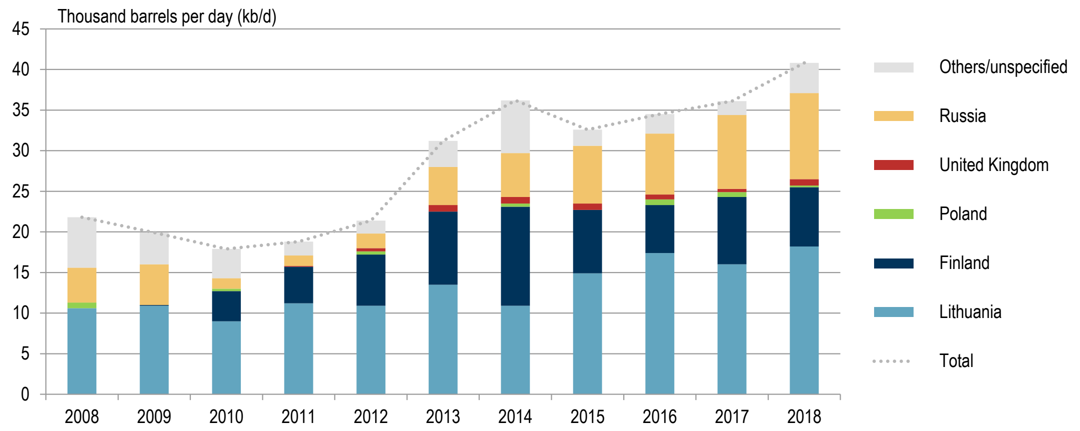
Source: IEA (2019b), *Oil Information 2019*, www.iea.org/statistics.

## Oil products

Estonia is fully reliant on imports for refined oil products. Over the last decade, the level of its net imports of oil products has increased by 21%, to reach 26.4 kb/d in 2018. In the same year, the total volume of oil products imported to Estonia was 40.8 kb/d (Figure 4.5). While the total volume of imports has increased by 87% over the last decade, the import sources are still mostly confined to its neighbouring countries, like Lithuania, accounting for 45% of the total share in 2018, followed by the Russian Federation (26%), Finland (18%), the United Kingdom (2%) and others. By product type, gas/diesel oil accounts for the largest share of oil products imported, with a 42% share in 2018, followed by 29% for motor gasoline and 25% for fuel oil. Lithuania is the largest supplier of transport fuels, whereas fuel oil comes almost entirely from Russia.

Oil product imports have increased significantly since 2012, when Estonia began to re-export oil products; in 2018, Estonia re-exported 35% of the imported oil products (Figures 4.6). The United States and Canada have been major destination countries, with the Netherlands and Saudi Arabia becoming important trading countries in recent years. Similar to shale oil export trends, the increased variety of export destinations is notable; in 2017, Saudi Arabia and Singapore were added to the destination list for the first time and the portions of oil products delivered to Argentina and Nigeria increased visibly in 2018.

### Figure 4.5 Estonia's oil products imports per country, 2008-18



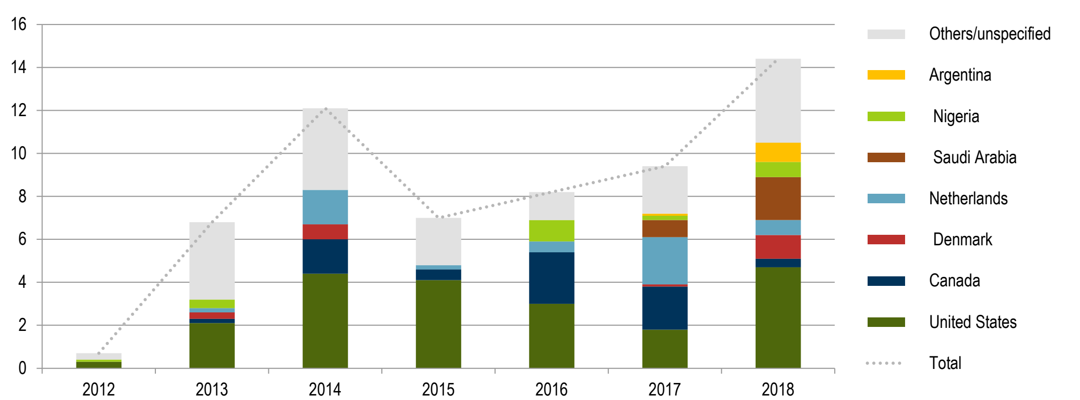



Although Estonia's oil product imports continue to increase, the import sources are still largely limited to the Baltic region.

Note: Imports of final oil products are reported as coming from the country of last consignment.
Source: IEA (2019b), *Oil Information 2019*, www.iea.org/statistics.

By fuel type, fuel oil exports accounted for about 48% of Estonia's total oil products exports in 2018, and motor gasoline around 43%. Canada and the United States buy almost all of Estonia's gasoline exports, whereas the Netherlands is the predominant recipient of its fuel oil, with some increasing volumes headed to Saudi Arabia and Singapore.

### Figure 4.6 Estonia's oil products exports per country, 2012-18





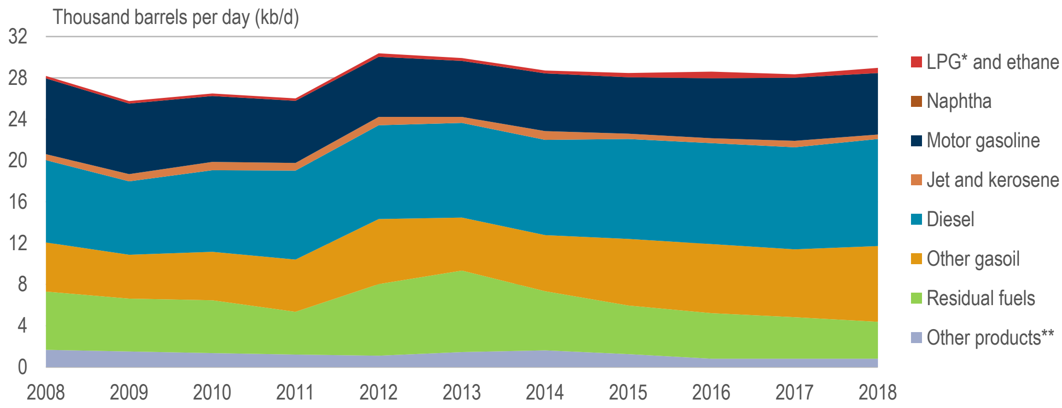

Estonia began re-exporting oil products in 2012 and their destinations have been greatly diversified since.

Source: IEA (2019b), *Oil Information 2019*, www.iea.org/statistics.

## Oil demand

Estonian oil demand remained relatively flat in the wake of the 2008 financial crisis, averaging around 26 kb/d in the period 2009-11. In 2018, Estonia's total oil consumption was 29 kb/d, which is almost on par with the pre-crisis level, but still below its peak in 2012 at 30.4 kb/d (Figure 4.7).

### Figure 4.7 Estonia's total oil consumption by product, 2008-18






Demand for diesel in the transport sector accounts for a growing share of total Estonian oil demand.

* Liquified Petroleum Gas

*******Other products* refer to crude oil, "other" natural gas liquids, shale oil, synthetic fuels, Orimulsion, hydrogen, synthetic crude, refinery gas, aviation gasoline, naphtha-type jet fuel, white spirit, industrial spirit, lubricants, bitumen, paraffin waxes, petroleum coke, tar, sulphur, aromatics and olefins.

Note: Total consumption includes refinery fuels and bunkers, and excludes backflows from the petrochemical sector and international marine bunkers.

Source: IEA (2019b), *Oil Information 2019*, www.iea.org/statistics.

Diesel for transportation is the most-consumed oil product in Estonia, accounting for nearly half of the total share in 2018. Demand for heating and bunkering oils accounted for 28% of total oil demand. There has been a substantial shift in the Estonian transport sector from gasoline to diesel and the share of gasoline in total oil demand has dropped from over 30% in the early 2000s to 19% in 2018. By sector,[2] transport, mostly road transport from diesel, remained by far the largest oil-consuming sector, at around 72% of the total share.

Oil demand in the commercial sector[3] has increased by around 34% over the past decade to become the second-largest oil-consuming sector in Estonia, at 11%. As for other sectors, oil consumption in the industry sector saw the largest decrease – 33% over the last decade – to account for 11% of the total share in 2017. Oil usage for transformation (heat and power generation) is rather minor in Estonia with around a 5% share in total on average.

[2] Information on oil consumption by sector is based on latest available data of 2017.
[3] Commercial sector includes agriculture, fishing and forestry.

**Box 4.1 Biofuels in Estonia's transport sector**

Based on the target set for the transport sector in the EU Renewable Energy Directive (2009/28/EC), Estonia will have to ensure that 10% of energy used in the transport sector comes from renewable sources by 2020. The target is to be met primarily by imposing an obligation on oil product suppliers to blend biofuel components into the transport fuels supplied to the Estonian market. Initially intended to be effective in 2017, implementation was delayed a year due to the difficulty for fuel suppliers in meeting the blending level.

Revised legislation requires the total share of biofuels blended into diesel and gasoline sold as transport fuels to be at least 3.1% (in energy content) as of May 2018, 6.4% from April 2019 and 10% from January 2020.

Suppliers are responsible for meeting the blending level at the warehouse terminal exits; however, industry standards will need to be developed regarding the specifications of bio component blending stocks to be used, as well as logistical aspects such as whether blending can be done with each tanker truck (i.e. rack blending) or if stocks of blended fuels are to be maintained (i.e. in-tank blending), and at what point sampling or quality testing is to be conducted. In the case of diesel, given Estonia's colder climate, hydro vegetable oil (HVO) is likely to be the more appropriate blending stock; however, no technical specifications or testing standards yet exist for HVO use in Estonia. In addition to setting a biofuel blending requirement on oil product suppliers, Estonia is also promoting the use of biomethane in vehicles (see Chapters 6, 7 and 8).

As of November 2018, the share of renewable energy in the Estonian transport sector was 4.85%, of which 3.1% is the first generation of biofuels, 1.35% second-generation biofuels or domestic biomethane and 0.4% electric mobility.

Source: Government of Estonia (2018), *Estonian National Energy and Climate Plan (NECP 2030)*, https://ec.europa.eu/energy/sites/ener/files/documents/ec_courtesy_translation_ee_necp.pdf.

## Market structure

The Estonian oil market is regulated by the Liquid Fuel Act (LFA), which determines the basis and procedures for ensuring fuel quality. All companies that import, export, sell or store fuels in Estonia must be registered with the Ministry of Economic Affairs and Communications (MEAC)[4].

There are three companies in Estonia that produce shale oil: Viru Keemia Grupp (VKG Oil), Kiviõli Keemiatööstus (KKT Oil) and Eesti Energia. VKG Oil is the largest producer of shale oil, accounting from some 52% of total production in 2017, followed by the state-owned company Eesti Energia (39%) and the privately owned KKT Oil (9%) (EE et al., 2018).

[4] Annex A provides more detailed information about institutions and organisations with responsibilities related to the energy sector.

The downstream wholesale oil market in Estonia is dominated by three main importers: Orlen Eesti (part of the Polish PKN Orlen group), which accounts for roughly 70% of product imports (primarily from its refinery in Lithuania), followed by Neste Eesti with 22% (from its refinery in Finland), with Equinor (formerly Statoil) importing the bulk of the remaining volumes.

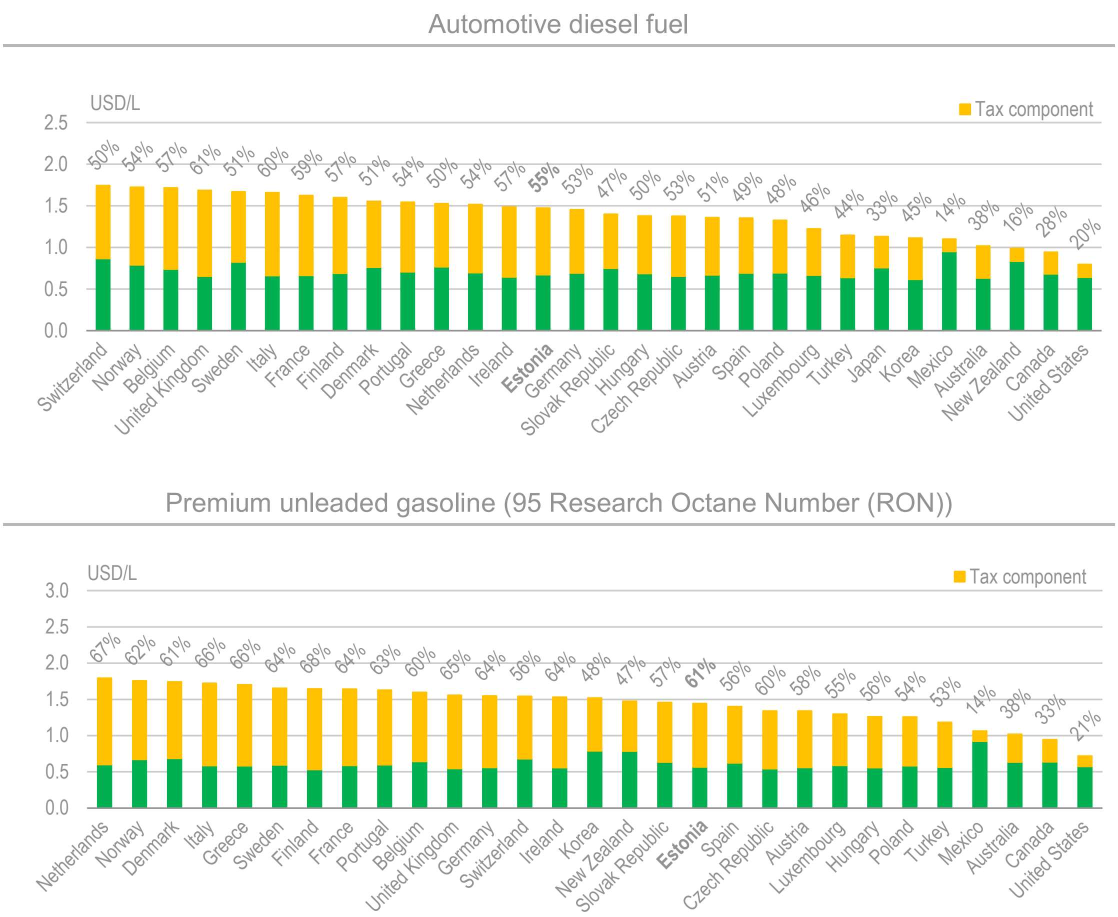
The retail market is largely dominated by four companies: Olerex (27%), Circle K (previously Statoil) (26%), Neste (18%) and Alexela (18%). There has been a reshuffling of the retail market since the last In-depth Review in 2013, with Olerex becoming the dominant player, up from fourth place, with 14% of market share; and the shares of Circle K, Neste and Alexela decreasing slightly. In addition to these four main companies, there are a number of companies with smaller volumes of retail sales, together representing 18% of the market in 2017, an increase from 12% in 2013. There were 500 filling stations operating in Estonia in 2017, a significant number compared to the country's market size. Of all transport fuel consumption, 77% was consumed by retail customers and the rest was wholesale purchases by companies with vehicle fleets.

## Prices and taxes

With the oil market fully liberalised, there is no regulation on either wholesale or retail prices. In the first quarter of 2019 (Q1 2019), the price of diesel was 1.47 USD/L. The tax rate has increased from 35% to 55% over the last five years. Estonia used to have the cheapest price among European IEA countries and the fourth-lowest in total IEA countries, but is now located at the median in IEA comparison (Figure 4.8).

In Q1 2019, the price of gasoline was 1.44 USD/L. The tax rate has increased from 48% to 61% over the last five years. Similar to diesel, the price of Estonian gasoline has moved up from being the fifth-lowest to being slightly lower than the IEA median in 2019. In Estonia, the level of tax applied on gasoline is by far the highest among all taxes on energy use, followed by the one on diesel.

**Figure 4.8 Oil fuel prices in IEA member countries, Q1 2019**






Estonia has progressively raised the rate of its fuel excise duties since 2016.

Notes: Premium unleaded gasoline data are not available for Japan; light fuel oil data are not available for Australia, Hungary, Mexico, New Zealand, the Slovak Republic and Sweden.

Source: IEA (2019c), *Energy Prices and Taxes: First Quarter 2019*, www.iea.org/statistics.

## Upstream – Oil shale liquefaction

There are ten oil shale liquefaction units in Estonia. Three of these have been commissioned since 2013, reflecting the growth in shale oil production over the past decade as a greater share of total oil shale production is used for liquefaction (see Chapter 3).

According to the *National Development Plan of the Energy Sector 2030* (NDPES 2030), growth in shale oil production is expected to continue, with additional liquefaction plants under development by Estonia's largest miner of oil shale, Eesti Energia, and further anticipated investment decisions in 2019 by shale oil producers regarding new facilities. Based on shale oil producers' investment plans, liquefaction capacity is expected to reach a level where, by 2035, the total amount of permissibly extracted oil shale each year could be used for shale oil production. This would equate to total domestic shale oil production reaching nearly 48 kb/d, more than twice the 2018 production level (MEAC, 2017).

# Infrastructure

## *Refining*

There are no oil refineries in Estonia. Past considerations, by Eesti Energia and VKG, to build domestic refining capacity to produce transportation quality fuels from shale oil have not been developed to date. As a consequence, shale oil production is either exported for further processing or used as a bunker fuel. However, with the growing volumes of shale oil, both in recent and coming years, the economic case could become stronger for building a refinery capable of supplying both the domestic and export markets. Moreover, changes to maximum levels of sulphur content of bunker fuels, starting in 2020 under the International Maritime Organization (IMO) standards, will mean that shale oil can no longer be used directly as shipping fuel, bolstering the case for developing the ability to refine this into higher value oil products.

## *Ports and road network*

Estonia does not have an oil pipeline network. It relies on its numerous seaports and rail to import oil products; fuels are distributed throughout the country by tanker trucks. Most liquid fuels are imported by rail from the Mažeikiu refinery in Lithuania (Orlen Lietuva), which is the only refinery in the Baltics, or by ship from Finland (Neste refinery in Porvoo) and from other countries.

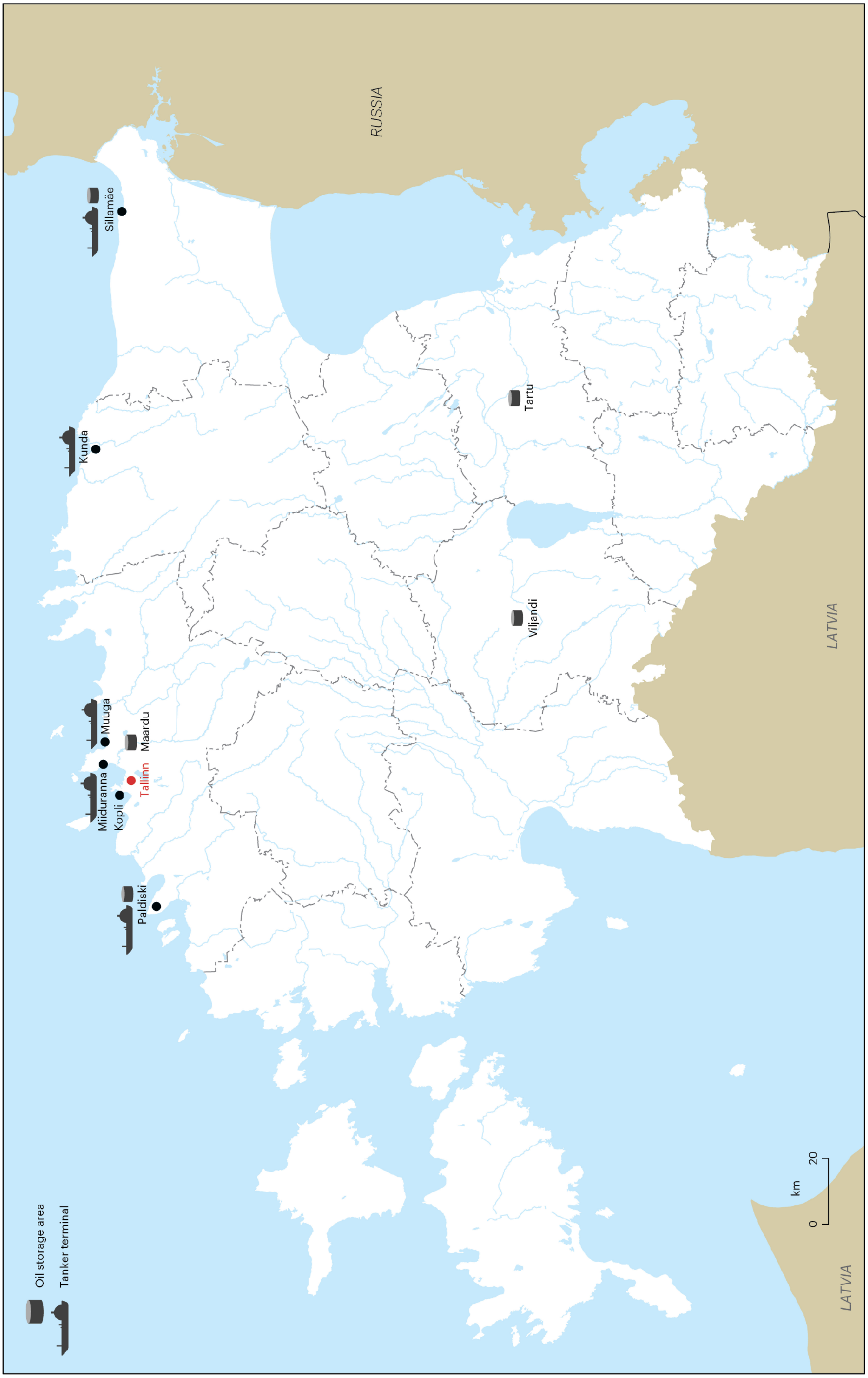
There are 19 commercially operating oil terminals in Estonia, consisting of 12 sea terminals and 7 inland terminals. The most important seaports handling oil products are: the port of Tallinn-Muuga Harbour (Estonia's largest port); the port of Sillamäe, which is the eastern-most port in the European Union; the Paldiski harbour; and the port of Kopli (Tallinn). All of these oil terminals are equipped with loading and storage capacity for oil products, and while some have also developed rail infrastructure connected to the backbone of the Estonian rail network for further distribution of goods, rail is not used for the distribution of oil products from ports.

## *Storage*

There is extensive storage capacity in Estonia, enough to store roughly twice the level of annual demand in 2018, due to the fact that the country has historically had a very active oil transit business. There has, however, been a considerable decline in transit cargoes from exporting countries such as Russia since 2007.

In total, Estonia has over 3.2 million cubic metres (mcm) of oil storage capacity (20.3 million barrels [mb]), primarily concentrated along the coast. The bulk of this capacity is at the Port of Tallinn's Muuga Harbour, which has a total storage capacity for oil products, mainly diesel and gasoline, amounting to 2 mcm (12.6 mb). The Port of Sillamäe has the largest capacity (0.5 mcm or 3 mb) for the storage of oil products. Estonia's inland storage facilities – Maardu (close to Tallinn), Viljandi and Tartu – have a combined total capacity of about 130 000 $m^3$ (roughly 820 kb), mostly dedicated to the storage of gasoline and diesel.

## Figure 4.9 Map of Estonia's oil infrastructure




This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

## Emergency response policy

The Liquid Fuel Stocks Act (LFSA) is the key piece of legislation relevant to emergency oil stocks and other emergency measures for liquid fuels. The LFSA places responsibility for emergency response with the MEAC.

In the event of an oil supply disruption, Estonia would release emergency oil stocks from its public stockholding. Based on a proposal of the Minister of Economic Affairs and Communications, the Estonian government would decide on the drawdown of emergency oil stocks. The government decision to draw stocks would specify, according to Article 7 of the LFSA: 1) the reason for the release of the stocks; 2) the estimated duration of the period during which the stocks are to be used; 3) the conditions for the release of the stocks (i.e. terms of sales agreements); 4) the activities necessary for replenishment of the stocks; and 5) the quantity of the stocks to be released.

The LFSA also provides the statutory authority to use o short-term measures to reduce oil demand in a crisis. These would be based on Estonia's *Handbook for Demand Restraint Measures*, which lays out the plans and the operational procedures of emergency measures that could be initiated in the event of oil supply disruption. Possible demand restraint measures include actions such as reducing speed limits, and campaigns such as ecodriving, car sharing, better use of public transport, and working from home. According to the handbook, if all of the measures examined are implemented, a total savings of over 8% of oil consumption used for road transport could be achieved, or roughly 1.54 kb/d.

A 2018 regulation under the Emergency Act mandates providers of vital services to take specific steps to ensure supplies during blackouts. Under this regulation and starting in 2022, fuel service stations which are defined as providers of vital services must install stand-alone power, hold back-up reserves, be able to prioritise emergency vehicles and be able to operate within 30 minutes of the beginning of a blackout. Eight of the existing filling station networks fall under this regulation and are each required to designate three stations as vital service providers. The regulation also requires partners of vital service providers, such as oil terminals, to develop emergency plans for continuity of service and to evaluate and choose business partners based on their ability to provide services in emergency situations.

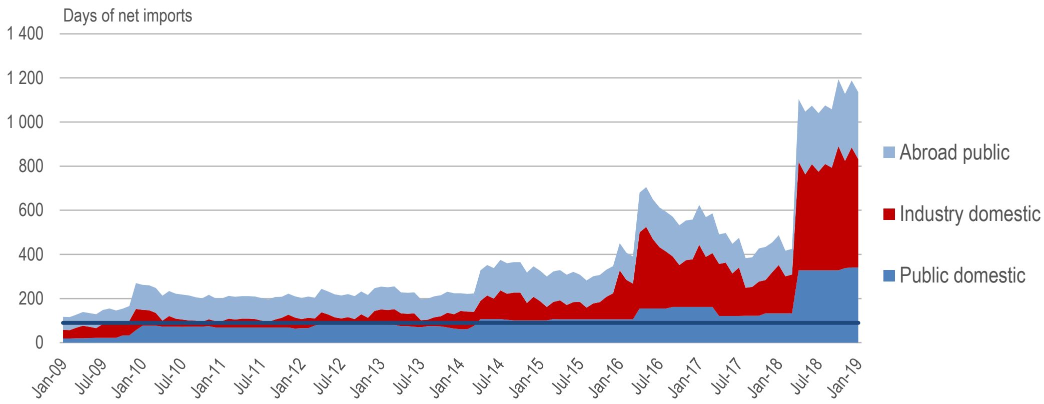
### *Oil emergency reserves*

The Estonian Oil Stockpiling Agency (OSPA), established in 2005, is tasked with establishing and maintaining compulsory oil stocks to fulfil Estonia's international obligations. The agency's operational and administration costs are covered through a stockpiling fee paid directly to OSPA by oil companies, which pass the cost of this fee on to consumers through the price paid at the pump.

Based on IEA methodology for net imports, Estonia's stockholding obligation is relatively low due to the volumes of shale oil exports. As OSPA emergency stockholding must also cover Estonia's obligation as a member of the European Union, its relevant stockholding obligation is 61 days of consumption of main oil products under the EU Oil Directive. The level of OSPA stocks is thus well above the 90-day net import level required as a member of the IEA.

At the end of 2018, OSPA oil stocks totalled 234 000 tonnes (1.8 mb), nearly three-quarters of this in the form of diesel, with the rest in the form of motor gasoline (22%) and jet kerosene (5%), while fuel oil stocks only account for a fraction of the total (<1%). For each product, the stock levels equated to more than the 61 days of consumption that OSPA is required cover, with a day's coverage of jet kerosene (130 days) and fuel oil (175 days) greater than that of diesel (88 days) and gasoline (69 days). In terms of net import coverage, total OSPA stocks equated to over 600 days of 2017 daily net imports. When counting all oil stocks as according to IEA methodology, Estonia's net import coverage is well in excess of 1 000 days.

### Figure 4.10 Oil stocks in days of net imports and 90-day IEA obligation, 2009-19



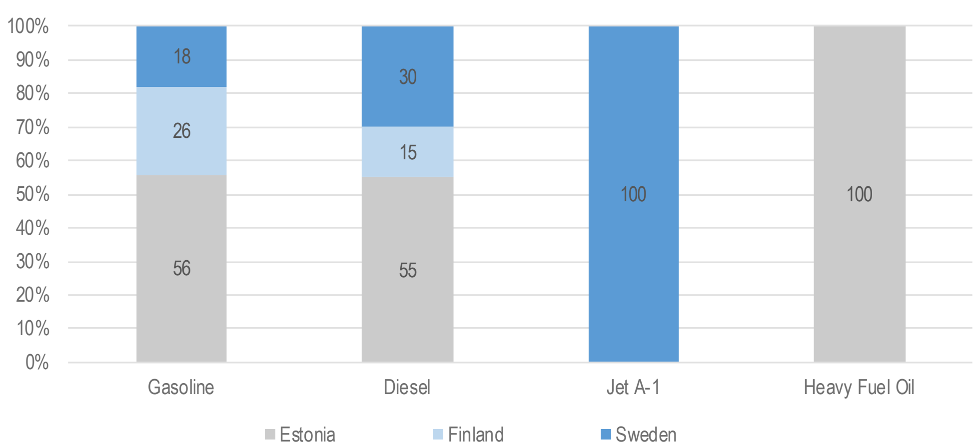



Estonian oil stocks are significantly above the 90-day requirement as net oil imports are low compared to the 61 days of oil consumption covered by OSPA stocks.

Source: IEA (2019d), *Monthly Oil Data Service*, https://www.iea.org/statistics/mods/.

All OSPA stocks are in the form of refined products and are held under storage contracts. OSPA does not own or operate any storage facilities. A significant share of OSPA's stocks are held in storage facilities in neighbouring countries, while a maximum of 20% of OSPA's stockholding needs are eligible to be held as delegated (ticketed) stocks.

### Figure 4.11 Locations of Oil Stockpiling Agency stocks, 2018






Source: IEA based on information provided by the Estonian Oil Stockpiling Agency.

In the case of a government decision to release emergency oil stocks, OSPA would offer to sell the stocks at prevailing market price to eligible oil companies, on a pro rata basis based on companies' sales data from the four preceding quarters. In the case of gasoline and diesel, this pertains to registered fuel wholesalers; offers for jet kerosene sales are made to aviation fuel suppliers and fuel oil offers to heat producers.

The stocks are to be sold at the market price at the time of delivery. The time estimated for delivery from overseas is estimated to be no more than 27 days. The transportation of the stocks to Estonia would be arranged by OSPA. In the case of ticket agreements, the stocks are to be sold to the market players in the same way as the stocks owned by OSPA. The only difference is that in the case of tickets, OSPA would buy the stocks from the ticket seller then sell these stocks to market players. If the market player is the ticket seller, then it has the right to use the volume of stocks indicated in the sales offer.

# Assessment

## *Oil markets*

Estonia's production of unconventional crude oil is derived from the liquefaction of oil shale which is accounted for in TPES, as "coal and oil shale". Thus, while Estonia's primary energy balance seemingly indicates a small role for oil, demand for oil products, principally in the transport sector, is an important component of Estonia's final energy consumption at over one third of TFC.

Estonia's substantial and growing production and export of shale oil result in it being only a marginal net oil importer. However, with no domestic refinery, Estonia is fully reliant on imports of refined products to meet its oil needs. Until now, the economic case for building a refinery in Estonia to convert its shale oil into oil products has not been strong enough, but as less and less oil shale is needed for power and heat generation, more quantities become available for processing into shale oil. If the entire mining quota were to be used for shale oil production, the shale oil production could increase to some 48,000 barrels per day. Although such a transformation is not likely to happen overnight, one should note that such a quantity of shale oil could justify the operation of a refinery in Estonia and thereby enlarge the value chain and increase security of supply. Of note: domestic petroleum product consumption in Estonia (diesel, gasoline, kerosene) is some 25 kb/d. Estonia could thus become a relatively large exporter of refined products.

Moreover, the new IMO standards for bunker fuels starting in 2020 will likely change the role of shale oil for bunker fuels, making it no longer possible to use directly for fuelling ships, thus adding further incentive to build capacity for refining shale oil into higher value oil products.

The relatively high level of storage capacity at Estonia's oil terminals, totalling over 20 mb compared to oil demand of around 10 mb per year, reflects the role it played in previous decades as a transit country for Russian oil exports. The ample storage capacity in Estonia, primarily for gasoline and transport diesel, has no doubt facilitated the growing practice since 2012 of (re-)exporting refined products.

The biofuel blending requirement set on oil product suppliers as of May 2018, of 3.1% into transport fuels, appears to have been successfully met. However, the steep ramp-up in the mandate, to 6.4% in April 2019 and 10% by 2020, will be challenging for industry to meet, particularly with respect to second-generation biofuels. There is no biofuel production in Estonia and the absence of an agreed standard for an HVO and the weather constraints on the use of FAME cause uncertainty about the availability of appropriate blending stock. Similarly, the preparation of local (national) technical standards for blending, uncoordinated with neighbouring Baltic countries, appears to create an unnecessary fragmentation of standards, blending practices and markets. The creation of such "boutique biofuels" adds to the cost of fuels in Estonia, which risks affecting the Estonian transport industry, and the freight industry in particular. Procedures for fuel blending and quality sampling can also add to the cost of fuels, which may be minimised by allowing industry some flexibility, such as allowing in-line or rack blending (at the loading of each tanker truck), to more cost effectively meet the biofuel mandate.

## *Oil security*

The LFSA, amended in 2013 to align with IEA requirements (Estonia became the 29th member of the IEA in May 2014), regulates emergency response in the case of an oil crisis. The release of publicly held emergency oil stocks is the most prominent emergency response measure available to the Estonian government.

Emergency preparedness was also enhanced in 2018 with legislation regarding vital services, which mandates that by January 2022, all filling stations defined as providers of vital services be able to operate within 30 minutes of a blackout.

OSPA is responsible for managing Estonia's emergency oil stocks. There is no stockholding obligation set on industry and OSPA's stockholding fully covers Estonia's stockholding commitments to both the IEA and the EU. Nearly half of OSPA's stocks are held outside of Estonia, in either Finland or Sweden, under bilateral agreements. This includes just under half of OSPA stocks of gasoline and diesel, and all of the kerosene jet fuel stocks.

# Recommendations

***The Estonian government should:***

- ☐ Explore, together with industry, the opportunity of having refinery to process shale oil in the country, and facilitate such an installation if deemed economically feasible.
- ☐ Monitor the availability of biofuel blending components for market suppliers for meeting the blending mandate, which is set to rise sharply, and facilitate access to the supply of appropriate blending components by quickly establishing, in co-ordination with neighbouring countries, technical standards for HVO.
- ☐ Consider flexible mechanisms for fuel retailers in how they meet the blending mandate, such as allowing in-line or rack blending and streamlining quality verification procedures.
- ☐ Investigate the need for lifting the biofuel blending requirement in a crisis, allowing fuel suppliers greater flexibility in meeting fuel demand in times of disruption.

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# 5. Electricity

## Key data

(2018 provisional)

**Total electricity generation:** 12.3 TWh, +16.3% since 2008

**Electricity generation mix:** oil shale 75.9%, bioenergy and waste 11.2%, coal and peat 6.2%, wind 5.2%, oil 1.0%, natural gas 0.5%, hydro 0.1%

**Electricity net exports:** 1.9 TWh (imports 3.1 TWh, exports 4.9 TWh)

**Installed capacity (2017):** 2.53 GW

**Electricity consumption (2017):** 7.7 TWh (commercial 38.8%, industry 29.0%, residential 25.1%, other energy 6.5%, transport 0.6%)

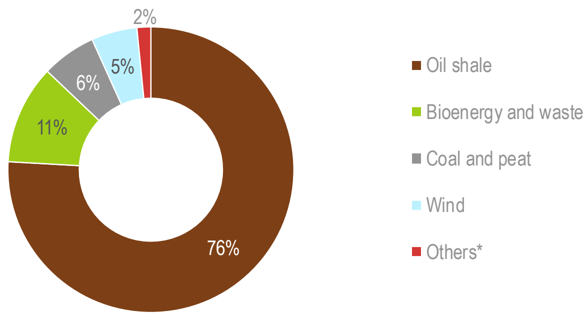
**Exchange rate (2017)**: EUR 1 = USD 1.13

## Overview

Oil shale is by far the most important energy source in electricity generation in Estonia. In 2018, the share of oil shale in electricity generation was 76% (Figure 5.1). However, the share has been gradually decreasing due to the continuous growth of renewables over the last decade. According to the *National Development Plan of the Energy Sector until 2030* (MEAC, 2017), Estonia has set a target of 50% renewable electricity in domestic final electricity consumption by 2030. The government considers increasing the target to 80% if the right conditions are met.

Estonia has taken significant steps to integrate its electricitynetwork with the Nordic region and Europe, including joining Nordpool in 2013 and participating in the European Market Coupling (PCR) since its launch in February 2014. Interconnections with Finland, reinforced in 2014 with EstLink 2, and Latvia, soon to be further expanded with a third interconnection, have allowed Estonia to trade electricity and serve as a transit country for electricity flowing from the north to the south. Estonia seeks to further increase its security of electricity supply by desynchronising from the Russian Integrated Energy system, and synchronising with the synchronous grid of continental Europe, by 2025.

**Figure 5.1 Electricity generation by source, 2018**






Oil shale dominates Estonia's electricity supply.

* *Others* include gas works gas, natural gas, oil and hydro.

Note: Data are provisional.

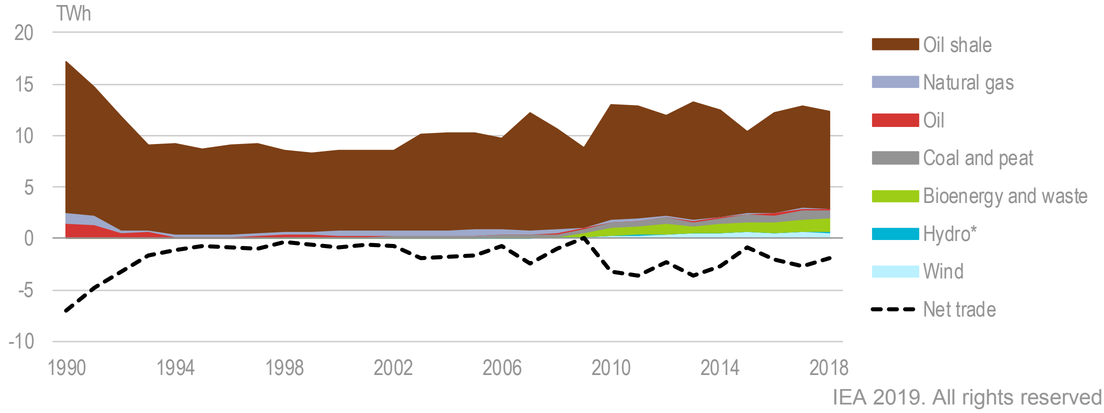
Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

# Supply and demand

## *Electricity generation*

Estonia's electricity generation is mainly from thermal power plants. Estonia has a large excess of installed capacity compared to domestic consumption. Regional market integration and interconnections have enabled Estonia to trade electricity with its neighbours more effectively, which has led to more fluctuations in power generation, corresponding to net exports in response to price variations on the neighbouring power markets (Figure 5.2). In 2018, Estonia generated 12.3 terawatt hours (TWh), of which 1.9 TWh was exported (net exports).

**Figure 5.2 Electricity generation by source, 1990-2018**






Estonia remains a net exporter of electricity while the share of renewable energy sources is rapidly increasing.

* Not visible on this scale.

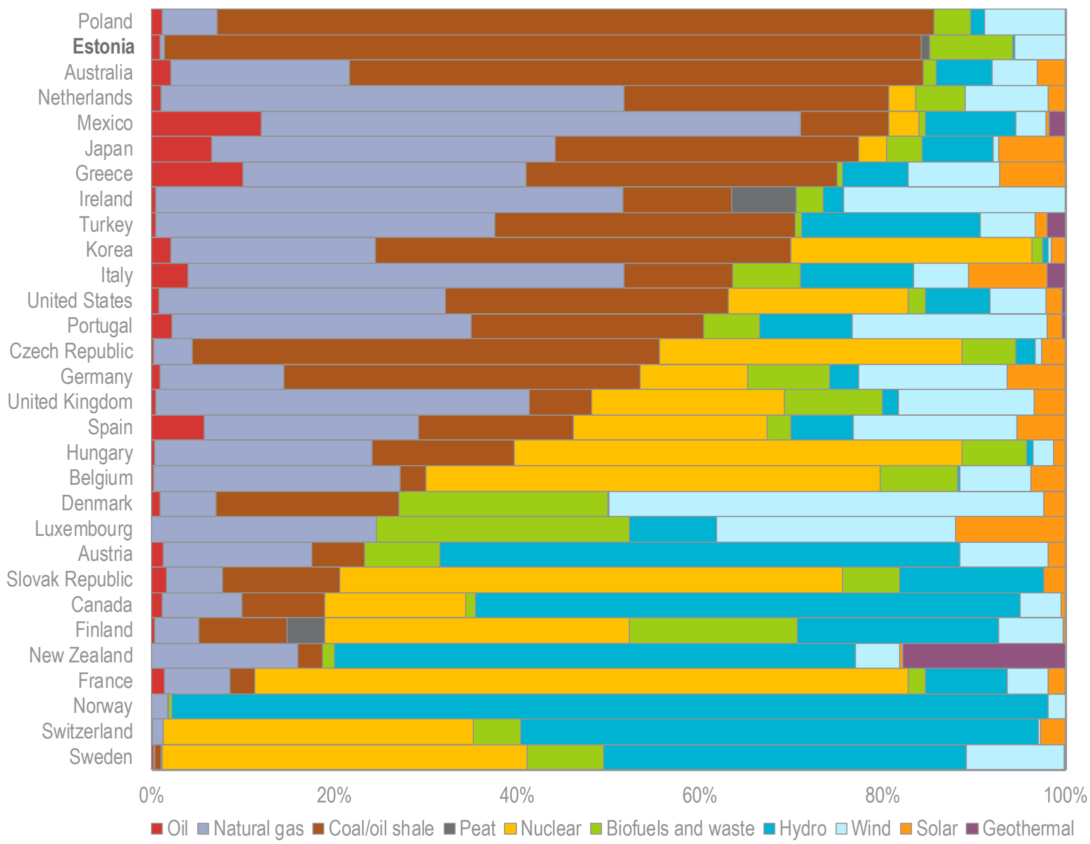
Note: Data for 2018 are provisional.

Sources: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics; IEA (2019b), *Electricity Information 2019*, www.iea.org/statistics.

As mentioned above, oil shale is the dominating source of power generation in Estonia, accounting for 76% of total electricity generated in 2018. However, the share of oil shale has declined in the last decade, down from 91% in 2008, due to the introduction of more renewable energy sources. Thanks to subsidies for renewable electricity generation, notably the feed-in premium system (see Chapter 8), the share of renewables in power generation increased from 1.9% in 2008 to 15.5% in 2018, or 16.5% when including non-renewable waste. The largest renewable source is bioenergy, which together with waste accounted for 11.2% of total electricity generation, followed by wind power with 5.2% and a minor share of hydropower.

Despite a recent increase in renewable energy sources, Estonia has the second-highest share of fossil fuels in electricity generation among IEA member countries (Figure 5.3), reflecting the dominant role of oil shale and electricity exports. The share of oil and natural gas, on the other hand, are tenth and second-lowest in the IEA comparison, respectively.

### Figure 5.3 Electricity generation by source in IEA member countries, 2017






Estonia's power generation has the highest share of coal/oil shale and the second-highest share of fossil fuels among IEA countries.

Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

Estonia's installed generation capacity stands at 2.53 gigawatts (GW). Combustible fuels account for the largest share, before wind and hydro (Table 5.1). Most of the installed capacities for combustible fuels are multi-fired power plants that burn mainly oil shale. In 2016, the average capacity factor for combustible fuel plants was 58.6%, compared with 21.6% for installed wind power and 66.6% for hydro-powered plants (IEA, 2019b).

Total installed capacity of various renewable electricity producers has been increasing. A majority of district heating networks with suitable heating load have made investments to switch to combined heat and power (CHP) plants in recent years. The main fuel in such power plants is typically forest residues. The electrical output of such small-scale CHPs is typically between 1-3 megawatts (MW), with a thermal output of around 10 MW. In addition to CHP plants serving district heating networks, around 40 MW of electricity is being produced in recently opened industrial CHPs providing heat to on-site industries (mainly timber or pulp).

**Table 5.1 Installed electricity-generating capacity on 31 December, 2000-17 (GW)**

| **Energy source** | **2000** | **2005** | **2010** | **2014** | **2015** | **2016** | **2017** |
|---|---|---|---|---|---|---|---|
| Hydro | - | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Wind | - | 0.03 | 0.11 | 0.28 | 0.30 | 0.31 | 0.31 |
| Combustible fuels | 2.80 | 2.52 | 2.64 | 2.75 | 2.55 | 2.25 | 2.21 |
| *of which:* | | | | | | | |
| *Single-fired:* | | | | | | | |
| Oil shale, coal and peat | - | 0.01 | - | - | - | - | - |
| Gas | 0.01 | 0.01 | - | 0.25 | 0.26 | 0.26 | 0.26 |
| Biofuels and waste | - | - | - | 0.02 | 0.02 | 0.02 | 0.02 |
| *Multi-fired:* | | | | | | | |
| Solid/liquid | - | - | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 |
| Solid/natural gas | 0.18 | 0.17 | 0.33 | 0.05 | 0.06 | 0.05 | 0.05 |
| Solid/liquid/gas | 2.61 | 2.33 | 2.30 | 2.41 | 2.20 | 1.91 | 1.86 |
| **Total capacity** | **2.80** | **2.56** | **2.75** | **3.03** | **2.86** | **2.57** | **2.53** |

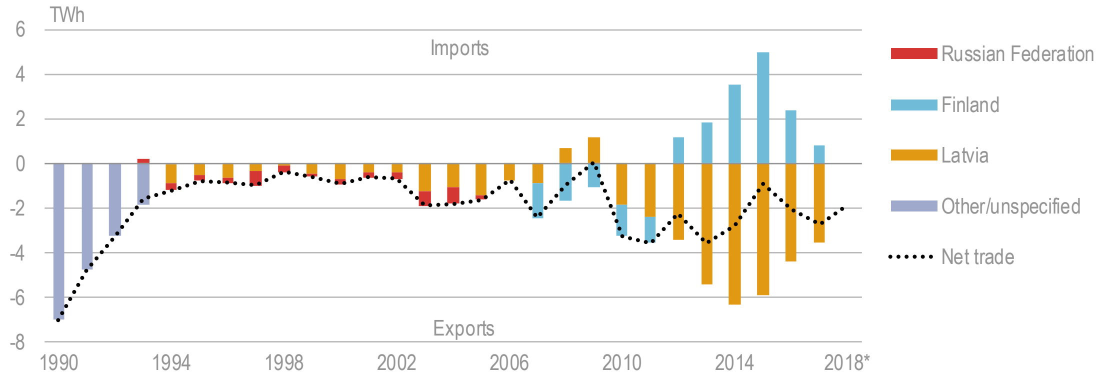
Note: Net maximum generating capacities on 31 December of each year.

Source: IEA (2019b), *Electricity Information 2019*, www.iea.org/statistics.

## *Imports and exports*

Estonia is well interconnected and trades electricity with Finland and Latvia via the European market coupling (Figure 5.4). In 2018, Estonia imported 3.1 TWh and exported 4.9 TWh, resulting in net exports of 1.9 TWh. Most imports come from Finland and most exports go to Latvia. Through the interconnections, Estonia can also serve as a transit country for power flowing from the north to the south. Estonia also has interconnections with the Russian Federation, but there has not been any electricity trade between the two countries since 2005, as other trading options have been more attractive and trade between the Baltic countries and third countries has been allocated to Lithuania.

**Figure 5.4 Estonia's electricity trade by country, 1990-2018**






Estonia is a net exporter in the regional transit of electricity from north to south.

* Data on electricity trade by country are not available for 2018.
Notes: TWh = terawatt hour. Supply data for 2018 are provisional.
Source: IEA (2019b), *Electricity Information 2019*, www.iea.org/statistics.

## *Electricity consumption*

Electricity consumption has gradually increased over the last decade, although with some fluctuations, mainly in the industry sector after the financial crisis in 2008. In 2017, total consumption was 7.7 TWh, 8% more than in 2007 but 1% less than in 2016 (Figure 5.5).

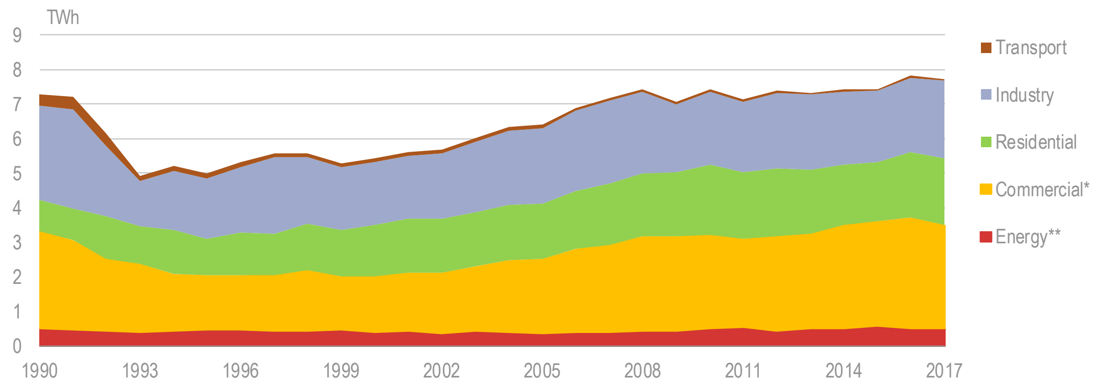
The commercial sector is the largest electricity consumer, at nearly 40% of total electricity demand. The industry and residential sectors consume most of the rest. In the industry sector, the largest subsectors are wood and wood products, paper, food, and machinery. The energy sector consumes a few per cent of the total, used in coal mines and coal liquefaction plants, and a minor share is consumed in the transport sector, including rail and road transport.

Estonia's electricity consumption varies annually from around 500 GWh/month during the summer period to around 800 GWh/month during winter peaks (Figure 5.6). Production shows more irregular variations, which is related to the regional electricity trade.

Elering[1], the Estonian transmission system operator (TSO), in its *Security of Supply Report 2018* estimates annual electricity demand to maintain a steady growth trend over the coming decade, of around 1% per year, reaching 8.7 TWh by 2028. Forecasted peak demand for 2028 is 1.68 GW, compared to 1.47 GW in 2017 (Elering, 2018a).

[1] Annex A provides more detailed information about institutions and organisations with responsibilities related to the energy sector.

**Figure 5.5 Electricity consumption by sector, 1990-2017**






Estonia's commercial sector accounts for the largest share of electricity use.

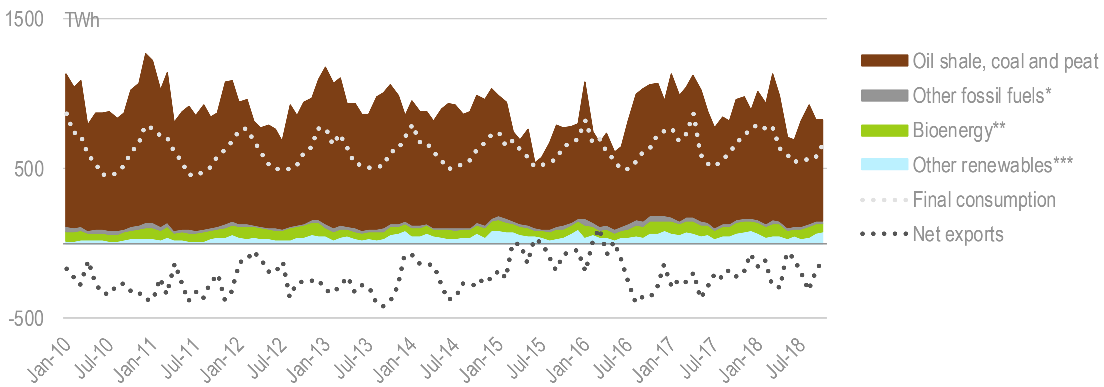
* Commercial includes commercial and public services, agriculture, and forestry.

** Energy includes petroleum refineries, coal mines, oil and gas extraction, and other energy sectors.

Note: TWh = terawatt hour.

Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

**Figure 5.6 Monthly electricity generation, consumption and trade, January 2010-October 2018**






Power generation from oil shale covers seasonal demand variations.

* *Other fossil fuels* include natural gas, oil and non-renewable waste.

** *Bioenergy* includes renewable waste.

*** *Other renewables* includes wind and hydro.

Note: TWh = terawatt hour.

Source: IEA (2018), *Monthly Electricity Statistics*, www.iea.org/statistics.

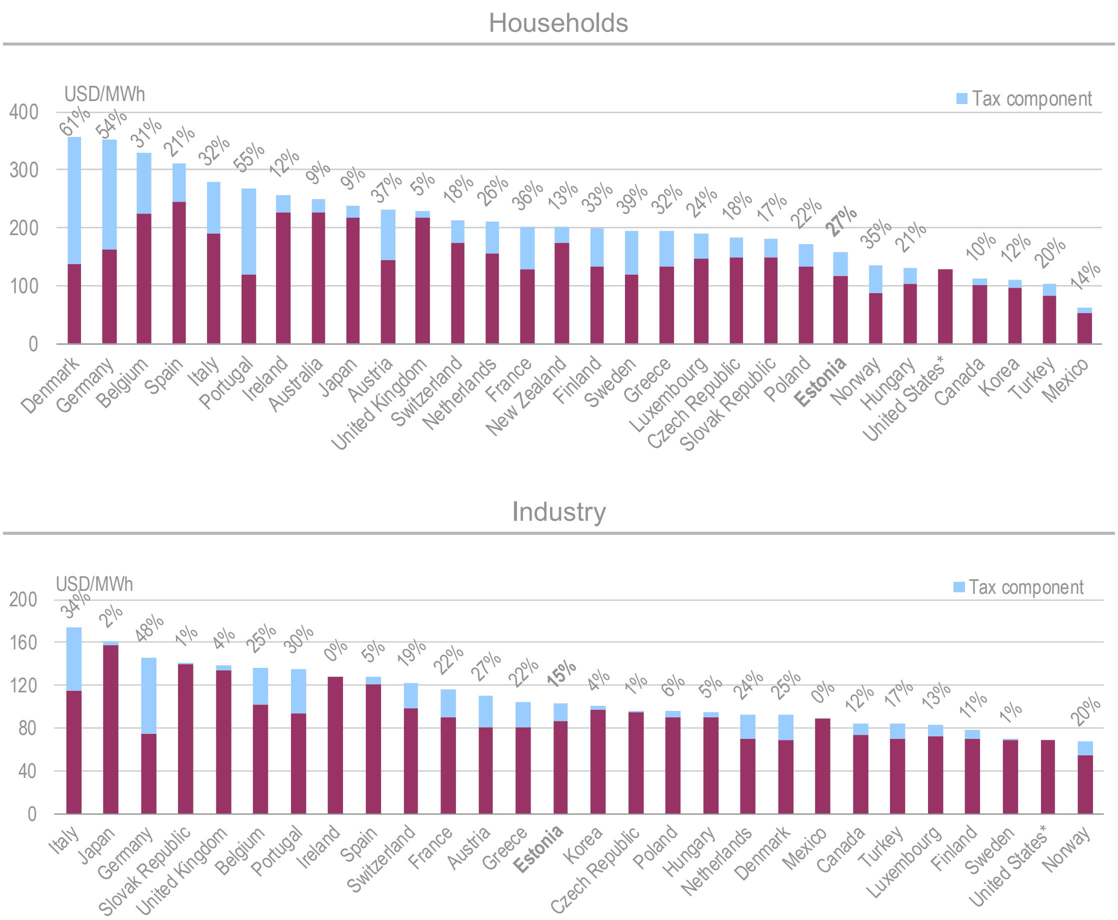
# Electricity prices and taxes

The Electricity Market Act ended the sale of electricity at a regulated price as of 1 January 2013, giving all consumers the opportunity to buy electricity from competing suppliers. Electricity sellers offer consumers packages that fix the price of electricity for a period of up to three years, using the spot prices of the Nord Pool as a basis. In 2017, 92% of Estonia's electricity was traded on the Nord Pool spot price power exchange.

The Estonian Competition Authority approves annual network service prices for both the transmission network operator and for distribution network operators. In 2017, the annual average transmission tariff was USD 0.012/kWh (1.05 euro cent), while the average distribution tariff was USD 0.06/kWh (5.28 euro cent) (both without value-added tax).

Estonian households paid USD 159/MWh on average for electricity in 2018, of which taxes accounted for 27% (Figure 5.7). This was in the lower half in an IEA comparison. Electricity prices for industrial users were USD 103/MWh, of which taxes accounted for 15%. This was among the median in the IEA. Compared to neighbouring countries, Estonia has higher prices for industries but lower ones for households (Figure 5.8).

### Figure 5.7 Electricity prices and taxes in IEA member countries, 2018



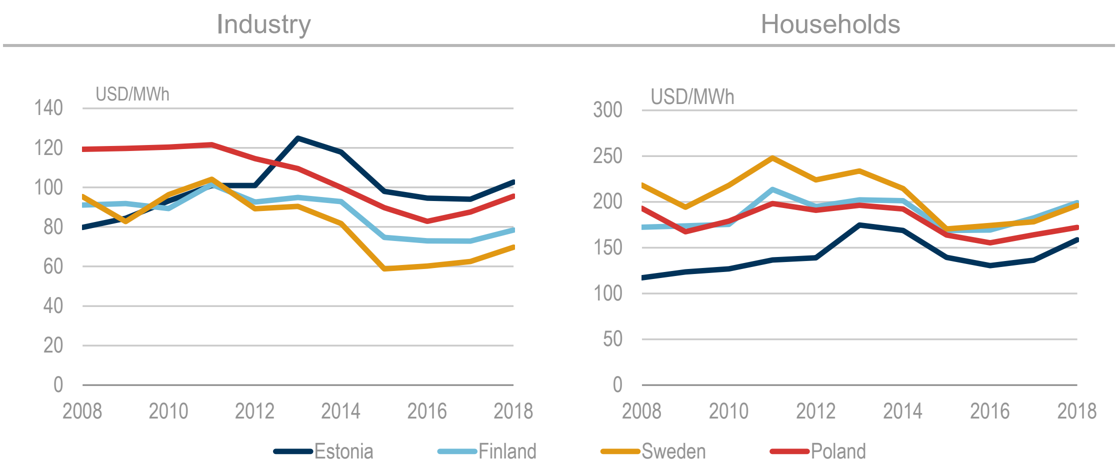



* Tax information for the United States is not available.

Note: Data not available for industry in Australia and New Zealand.

Source: IEA (2019c), *Prices and Taxes 2019*, www.iea.org/statistics.

**Figure 5.8 Electricity prices in Estonia and in selected IEA countries, 2008-17**






Source: IEA (2019c), *Prices and Taxes 2019*, www.iea.org/statistics.

## Market structure

As mentioned above, the Estonian electricity market was fully opened to all consumers in the beginning of 2013, creating the preconditions for the entry of new sellers into the market. Since 2013, household and commercial customers have been able to buy their electricity, either through a contract made directly with a supplier or from the distribution system operator under the framework of a universal service (when the consumer has not sellected a seller). Consumers are able to switch suppliers with a 21-day notice, and this will be shortened to 7 days in the second half of 2019. In 2017, 84% of Estonia's consumers had supply contracts; however, only 3% of consumers switched suppliers during that year (Competition Authority, 2018).

### *Wholesale and distribution market*

There were 16 companies selling electricity on the Estonian wholesale market in 2017. Eesti Energia AS is the biggest electricity seller, with nearly 60% of the wholesale market in 2017, compared to around 72% in 2013. The other major wholesalers are Elektrum Eesti OÜ (10.6%) and Scener OÜ (9.6%), with the remaining market share divided among the 13 other wholesalers.

In 2017, there were 34 distribution network operators in Estonia, with Elektrilevi having the largest customer base (87%), followed by VKG Elektrivõrgud OÜ (3%) and Imatra Elekter AS (3%). Estonia has a rather large number of small network operators, as evidenced by the remaining 7% covered by the 31 other companies. Network operators are responsible for maintaining and expanding their networks, measuring the electricity consumed, maintaining metering equipment, and repairing breakdowns.

Starting in 2016, Elering AS launched an IT platform allowing electricity sellers to submit their invoices jointly with the network service provider, further promoting competition through transparent pricing.

All electricity consumers have smart metres since 1 January 2017, allowing consumers to choose a dynamic electricity tariff linked to the wholesale market price. Estonia has made progress in making information available through digitalisation (Box 5.1). However, no significant demand-side response has yet appeared as a result of the mass deployment of smart metres and the potential for variable pricing that they offer.

**Box 5.1 Digitalisation in Estonia's electricity market**

Since the deregulation of the electricity market in 2013, Estonia has developed a digital environment. An important feature is the Data Hub, a web portal where all producers and suppliers have access to their own consumption volume measurement data (remotely readable in hourly data). The Data Hub information system, administered by Elering AS, ensures principles of equal access to electricity consumption volumes and quick supplier exchange procedures. Moreover, by adopting both smart and remotely read metres, Estonian consumers are able to access hour-based, real-time price signals.

Substantial improvements in efficiency and customer satisfaction have already been noted by distribution system operators. Elektrilevi, the largest distribution system operator in Estonia, reports that network losses in 2017 were 4.73%, a 30% decline from 2010, and customer inquiries reduced by ten-fold, from over 305 000 in 2012 to some 31 000 in 2017, with surveys showing a significant increase in customer satisfaction.

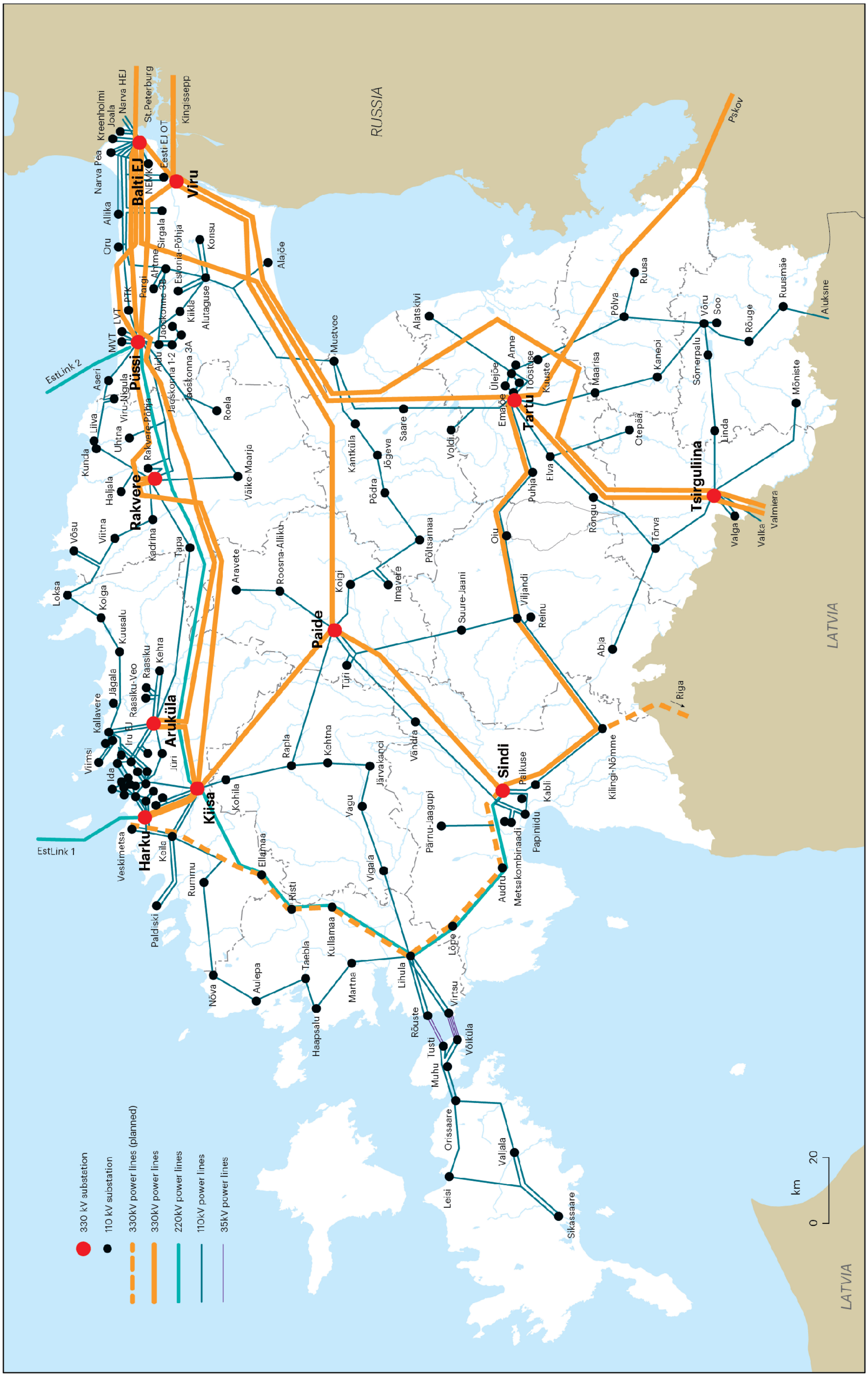
The digitalisation of the energy system has not only led to a consumer-centred system in the electricity market, but has also made it possible to cut down on any unnecessary costs for exchanging information between energy sellers and consumers. For instance, renewable energy producers can follow production data and submit applications for renewable subsidies. Ongoing developments from smart metres include measuring voltage quality, allowing for better investment decisions and the possibility to avoid electricity interruptions by renovating devices based on precise data.

Sources: Elering (n.d.), *Data Exchange*, https://elering.ee/en/data-exchange; Elering (n.d.), *Smart Grid Development*, https://elering.ee/en/smart-grid-development#tab1; Elering (2018a), *Security of Supply Report 2018*, https://elering.ee/sites/default/files/public/Infokeskus/elering_vka_2018_web_trc_ENG_v4.pdf; Elektrilevi website, https://www.elektrilevi.ee/en/avaleht; Agan, K. (2017), *Digitalization of the Energy Sector: The Case of Estonia*, www.wec-france.org/DocumentsPDF/Evenements/6-Forum-Europeen-Energie/K.Agan.pdf.

## Interconnections

The Estonian electricity system belongs to the large synchronously operating joint system BRELL (Belarus, Russia, Estonia, Latvia and Lithuania), comprising the neighbouring countries Latvia and Russia, connected with Estonia through alternating current (AC) lines. They, in turn, are connected to their neighbours Lithuania and Belarus. The connection with Russia is through three 330 kV overhead lines (two lines go from Narva to St. Petersburg and Kingissepp, and one line from Tartu to Pskov) and with Latvia through two 330 kV lines (one between Tartu and Valmiera, the other one between Tsirguliina and Valmiera). Estonia is connected with Finland through two direct current (DC) submarine cables (EstLink 1 and EstLink 2). Transfer capacities for meeting peak load on these lines are 1.02 GW to Russia, 0.82 GW to Latvia and 1.05 GW to Finland.

## Figure 5.9 Electricity infrastructure in Estonia




This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

A third AC line between Estonia and Latvia is being developed and is expected to be completed in 2020. This will be a continutation of the 330 kV overhead transmission line of Harku-Lihula-Sindi, linking from Kilingi-Nõmme to Riga (Latvia). After completion of this line, the entire mainland of Estonia will be covered with a 330 kV network and the western (Pärnu) consumption region in particular will have a better connection to the electricity transmission system (MEAC, 2017).

In 2017, Estonia had an interconnection level of 63%, substantially higher than the 10% target for 2020 set for all European Union member states (EC, 2017). The completion of EstLink 2, in 2014 substantialy suplemented the high-voltage DC interconnection between Estonia and Finland. This tripled the electricity transmission capacity between the Baltic and Nordic countries (to 1 GW), eliminating the trade bottleneck that had previously existed between the two power markets, and effectively transforming Estonia and Finland into a single market region where the day-ahead price of electricity was the same over 95% of the time in 2018.

Additionally, the NordBalt interconnection between Lithuania and Sweden that became operational in 2016, and the Litpol Link between Lithuanina and Poland, in operation since 2015, have effectively ended the isolation of the Baltic countries and integrated them with the rest of Europe (EC, 2017). The Baltic electricity system is now integrated with the Nordic countries' power exchange, Nord Pool (EC, 2017).

## *Synchronisation with continental Europe*

The long-term goal of the Estonian system operator is to achieve greater independence from the Russian integrated energy system, by disconnecting the Baltic electric nework from the north-east Russian grid and synchronising it with the continental Europe synchronous grid, in 2025.

The synchronisation of the Baltic states with continental Europe has been under preparation since 2009, starting with the signature of a joint declaration of principles. In June 2018, the Prime Ministers of Estonia, Latvia and Poland and the Presidents of Lithuania and the European Commission signed a joint political roadmap, which is to connect the Baltic states to the continental European network through Poland by 2025. The countries agreed to analyse options for synchronisation which would result in a high level of security while being carried out in a cost-efficient manner, taking into account both capital and operating expenditures. On 21 September 2018, a formal merger procedure was initiated; the Polish transmission network operator submitted to the relevant regional group of the European Network of Transmission System Operators (ENTSO-E) an application for extension of the continental European networks to the Baltic states. The agreement entered into force on 27 May 2019. The Baltic states also jointly submitted an application to the Connecting Europe Facility for co-financing of the investments made during the first phase (EU, 2018).

The synchronisation project is part of the wider Baltic Energy Market Interconnection Plan (BEMIP), whose primary objective is to achieve an open and integrated regional electricity (and gas) market between EU countries in the Baltic Sea region, ending the energy isolation of the Baltic countries. The initiative's members are the European Commission, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden. The Estlink, Nordbalt and LitPol links are key electricity infrastructure projects under the BEMIP.

### *Network balancing*

As the nation's TSO and network service provider, Elering AS is responsible for ensuring the operation of the Estonian electricity system. Pursuant to the Electricity Market Act and the Electricity Market Network Code, every market participant is responsible for its balance, either through contract with a supplier or a balance provider, while Elering AS is responsible for the overall balancing of the national network. In 2018, there were eight balance providers in Estonia, the biggest of which was Eesti Energia AS. The methodology for calculating the price for balance energy and standard terms and conditions for balance contracts concluded by Elering AS are approved by the Competition Authority *ex ante*. In the formation of the balance energy price, Elering AS is obliged to buy or sell balance energy at the most favourable price possible, with prices published on its public website. Looking to the future, the 2017 EU regulation on establishing a guideline on electricity balancing (EU 2017/2195) will eventually result in an integrated European balancing market.

The balance of the Estonian power system is ensured through co-ordination with other transmission system operators' control centres that belong to the BRELL system, as well as with the Finnish transmission system operator's control centre due to DC interconnectors between Estonia and Finland.

Elering AS activates balancing reserves and emergency reserves in real time and can use reserve capacity to compensate for any intra-hour deviations from the balance caused by network disruption or changes in planned generation or consumption. Emergency reserves and regulation agreements are agreed upon between Elering AS and power plants and neighboring TSOs; however, as a rule, Elering AS only buys balancing reserves in cases where the reserve capacity from Elering's Kiisa emergency reserve power stations are not sufficient (Elering, 2018b).

On 1 January 2018, the three Baltic TSOs launched a common Baltic balancing market for Estonia, Latvia and Lithuania. These three systems are viewed as a common balance area and one of the Baltic TSOs is responsible for balancing the summarised balance (rotated on a quarterly basis). The objective of the co-ordinated balance area is to improve the cost efficiency of the electricity system management, and particularly to reduce the imbalance of the Baltic system. Additionaly, all three Balctic TSOs are members of the Manually Activated Reserves Initiative (MARI), a European implementation project for the creation of a European platform for the exchange of balancing energy from frequency restoration reserves with manual activation. Under MARI, 19 European TSOs are collaborating on finding technical solutions to pending issues related to the establishment of such a platform as soon as possible (ENTOS-E, 2019).

## Electricity security

The Electricity Market Act provides the statutory powers for the Estonian government to implement emergency measures necessary to maintain the security of supply. These measures may include imposing an obligation to procure and store reserves of primary energy sources required for power generation, placing restrictions on all market participants, limiting or interrupting electricity supply to individual market participants, and modifying the obligation to provide network services. In a crisis, a supervisory committee under the direction of the minister, and including the TSO (Elering AS) and the largest electricity supplier (Eesti Energia AS), would be formed to co-ordinate crisis response and communications.

Pursuant to the Electricity Market Act, Elering AS, as the system operator, is required to submit annual security of supply reports to the European Commission, the Competition Authority, and the Ministry of Economic Affairs and Communications (MEAC). The reports forecast the electricity network's capacity requirements for the coming 15-year period, and are based on distribution grid operators' projections for consumption, transmission and generation capacity expansions on their grids.

The Electricity Market Act authorises the Competition Authority to impose an obligation on Elering AS to invite tenders for the creation of new production capacities, energy storage devices or energy efficiency/demand-side management measures, if the outlook provided in the annual security of supply report requires action to be taken (Riigi Teataja, 2014). The network tarrif would be used to finance the activities undertaken to meet the obligation set by the Competition Authority.

Elering AS also owns two emergency reserve power plants in Kiisa, with a total nominal capacity of 250 MW. The first was completed in 2013 (110 MW) and the second in mid-2014 (140 MW) and are designed to run on dual fuel, either natural gas or fuel oil. These emergency plants act as a last reserve in situations where there is lack of available power capacities to meet the system needs (MEAC, 2017); however, Elering AS also uses these plants in maintaining the Estonian power system's balance. This occurs only when the bids from market participants have been exhausted or if they fail to activate their bids. Elering's deployment of these plants for balancing may be an obstacle for integrating with other balancing markets, either in the Nordic region or the future European balancing markets.

## *Generation adequacy*

Estonia has sufficient production capacity to cover domestic electricity demand and to export electricity, mainly to Latvia and Lithuania. The load in the Estonian electricity system peaked on 5 January 2017 at 1.47 GW, when installed usable generation net capacity was 2.06 GW.

The Estonian electricity portfolio is independent from an energy point of view as most electricity is produced from domestic oil shale (see Chapter 3). Oil shale is used in three Estonian power plants: the Eesti Thermal Power Plant and the Balti Thermal Power Plant, both part of the Narva Power Plant complex; and the Sillamäe Thermal Power Plant.

Nevertheless, the situation for domestic power generation is changing. A large part of the existing units of the Narva Power Plant is planned to be closed by 2024, including capacity closures at the Eesti (489 MW) and Balti (130 MW) Power Plants. At the same time, power generation from renewable sources, mainly wind farms, will add to net capacity.

Projections for Estonia's generation capacities and peak demand are included in Elering's *Security of Supply Report 2018*. The report forecasts peak demand for 2028 to reach 1.68 GW during the winter, when usable generation capacity is projected to be 2.55 GW (Table 5.2). Elering assesses the future ability to ensure coverage of peak consumption and deal with additional increases in demand due to emergency circumstances, using the production reserve metric (defined as the usable capacity minus peak demand), according to the Electricity System Network Code.

**Table 5.2 Projected electricity-generating capacity and peak load (GW)**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2028 |
|---|---|---|---|---|---|---|---|
| **Installed net capacity** | **3.55** | **3.77** | **4.03** | **4.24** | **3.76** | **3.88** | **3.77** |
| *Thermal power plants* | *2.33* | *2.33* | *2.33* | *2.33* | *1.71* | *1.71* | *1.70* |
| *Renewable energy sources* | *0.96* | *1.18* | *1.44* | *1.66* | *1.79* | *1.91* | *1.81* |
| **Utilisable capacity for peak** | **2.22** | **2.34** | **2.35** | **2.34** | **2.56** | **2.56** | **2.55** |
| *Peak load (assumed scenario)* | *1.56* | *1.59* | *1.61* | *1.62* | *1.64* | *1.65* | *1.68* |
| Reserve (utilisable - peak load) | 0.65 | 0.75 | 0.74 | 0.72 | 0.92 | 0.91 | 0.87 |
| Reserve (with 10% factor) | 0.50 | 0.59 | 0.58 | 0.55 | 0.76 | 0.75 | 0.71 |

Notes: *Installed net capacity* includes all power plants connected to the system, including micro producers and emergency reserve power plants. *Utilisable capacity* includes import capacity and excludes capacities mothballed, in maintenance/scheduled repair, and under other limitations for meeting peak load.

Source: Competition Authority (2018), *Electricity and Gas Markets in Estonia*, p.50.

According to Elering's report, the generation reserve is sufficient for statisfying domestic electricity consumption over the period to 2028 – even factoring in an additional 10% margin on peak demand for extraordinarily cold winters. This takes into account not only domestic generation capacity, but also the ability to import electricity. The report notes that from 2024 there could be a shortage of domestic capacity to cover peak load. The report concludes that, considering the investments in the interconnections with neighbouring countries' electricity systems and the production capacity in the regional electricity market, the production capacity is sufficient to cover peak load. In addition to the capacities available in emergency situations, it is also possible to use Elering AS' 250 MW emergency reserve power station (Competition Authority, 2018). From 2023, the security of supply will thus be ensured by the concurrence of the production and transmission capacity.

Estonia's policy is for new electricity generation capacities to be developed in line with the conditions of the electricity market: where the government intervenes only to ensure fulfilment of the generation capacity criterion or to help innovative new technologies enter the market. The new electricity generation capacities in Estonia must be competitive in the open electricity market without additional subsidies from the state or consumers. The support schemes for the establishment of new generation capacities are specified in the Electricity Market Act and are directed primarily towards renewable energy and co-generation, as well as towards satisfying the criterion of available local generation capacities. Upon application, the need for support is assessed in light of the trends in the electricity market and in comparison to other measures for reducing greenhouse gas emissions (MEAC, 2017).

## *Reliability of electricity supplies*

Estonia has improved the reliability of its transmission network in recent years through upgrades of its transmission lines and interconnections. According to Elering, there were 86 outages in 2018, compared to 117 in 2017, and a 10-year average of 174, with 18.5 MWh of electricity not served, compared to a 145 MWh average (Elering, 2018c).

Nevertheless, one of Estonia's main challenges associated with its distribution grids is reducing the number of failures. Given its climate, weather-proofing grids is a substantial part of reducing outages. According to the largest distribution network operator, Elektrilevi OÜ, 35% of faults in its grid in 2016 were caused by weather conditions. Estonia plans to weather-proof up to 75-80% of all distribution grids by 2030, compared to 37% in 2016.

An additional challenge for distribution grids is the connection of an increasing number of distributed and micro generators, which need to be accommodated in the planning and development of grids, ideally through smart grid solutions. In order to facilitate the development of distributed and micro generation, technical solutions are needed that enable generators to operate without being disconnected from the grid, particularly in regions where development of distribution grids is impractical due to low or seasonal consumption.

The reliability indicators (see Box 5.2) of distribution grids in Estonia are affected by the nature of its population dispersment, with areas of high and very low population densities. According to the Estonian government, the required target reliability values should differ depending on consumption density and potential interruption damage, and emphasis on regional density of supply should be brought into a sharper focus in the context of developing the distribution grids, as this has the largest potential for damage in case of interruptions (MEAC, 2017).

### Box 5.2 Electricity reliability indicators for Estonia

There are two main indicators for assessing an electricity distribution network's reliability: SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index). In 2016, Estonia's SAIDI was 222.23 minutes per customer, a 13% improvement compared to 2012. Over the same period, Estonia's SAIDI also improved, by 16%, to settle at 1.96 interruptions per customer. However, they were still higher than the 2016 EU average, of 1.75 interruptions per customer for SAIFI and 169.56 minutes per customer for SAIDI.*

#### Table 5.3 Estonia's electricity distribution reliability indexes: SAIDI and SAIFI, 2012-16

| | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|
| **SAIFI (interruptions per customer)** | 2.32 | 3.06 | 1.13 | 1.73 | 1.96 |
| **SAIDI (minutes per customer)** | 255.79 | 465.32 | 182.82 | 237.74 | 222.23 |

Notes: All figures include both planned and unplanned, including exceptional events. SAIDI: System Average Interruption Duration Index; SAIFI: System Average Interruption Frequency Index.

On electricity transmission reliability, energy not supplied (ENS) and average interruption time (AIT) are the principal indicators assessed. The ENS refers to the total amount of energy that would have been supplied to interrupted users had there not been an interruption; the AIT is calculated as 60 times the ENS (MWh) divided by the average power supplied by the system (MW) and expressed in minutes per year.

For 2016, Estonia's unplanned ENS (excluding exceptional events) was 67.54 MWh, and unplanned AIT (excluding exceptional events) was 1 404.66 minutes per year. Between 2012 and 2014, both the ENS and the AIT significantly improved in Estonia; however, performance has been poor since mainly due to weather events. Particularly for the AIT, Estonia had the highest figure in 2016, at 1 406.66 minutes per year, which was well above the EU average of 91.44 minutes per year.** Portugal and Greece were the only two other countries whose AIT figures were higher than 20 minutes per year, at 84.44 and 20.93 minutes respectively.

**Table 5.4 Estonia's electricity transmission reliability indexes: ENS and AIT, 2012-16**

| | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|
| **ENS (MWh)** | 148.21 | 58.41 | 27.56 | 11.93 | 67.54 |
| **AIT (minutes per year)** | 1 756.00 | 2 719.00 | 410.30 | 552.00 | 1 404.66 |

Note: ENS = energy not supplied; AIT = average interruption time.

* SAIFI 2016 average is based on 27 EU countries that submitted data to the Council of European Energy Regulators; SAIDI 2016 average is based on 28 EU countries.

** AIT 2016 average is based on 17 EU countries that submitted data to the Council of European Energy Regulators.

Source: CEER (2018), *CEER Benchmarking Report 6.1 on the Continuity of Electricity and Gas Supply*, https://www.ceer.eu/documents/104400/-/-/963153e6-2f42-78eb-22a4-06f1552dd34c.

# Assessment

Estonia is a net exporter of electricity with generation exceeding demand and installed capacity in excess of peak demand. The Estonian electricity system remains heavily dependent on oil shale, which accounts for over 75% of generation. The Estonian government recognises that the carbon intensity of oil shale will not enable sustainable generation of low-carbon electricity in the long term. The government expects that the direct combustion of oil shale will be significantly reduced by 2030 due to expectations of an increasing $CO_2$ market price through the EU-ETS. The older generation of oil shale plants are expected to close in the near term, starting in 2019. However, co-generation of biomass (mostly wood chips) with oil shale will remain an important part of the generation mix through the 2020s.

Estonia is part of the European Market Coupling (PCR) through its participation in the Nordic-Baltic wholesale market and its electricity system is now one of the most interconnected in Europe. Interconnected capacity (around 1.8 GW with European countries and nearly 3 GW including Russia) well exceeds peak demand (around 1.5 GW) and work on additional interconnection capacity is ongoing. Although the TSO has forecast that there is sufficient domestic generation until 2024, it is clear that as oil shale plants retire, and more variable renewable generating capacity comes on line (mostly wind), the role of interconnection, dispatchable generation and storage will become more important in providing security of supply.

Estonia's immediate neighbours (the other Baltic states, Finland and Poland) have been net importers of electricity. The long-term trend with respect to other regional exporters (Norway and Sweden) is uncertain. The proposed interconnections between Norway and Great Britain and also Germany, and the retirement of nuclear power plants in Sweden, may reduce the availability of generation in the Nordic region. The Estonian government's expressed preference for resolving potential capacity shortfalls is to focus in the first instance on initiatives from market participants. If these prove to be insufficient, it would prefer regional solutions before as the last resort attempting a national capacity mechanism. However, the legal framework is in place should a national capacity mechanism be required, which could result in strategic behaviour of market participants to invest not, but to wait for the mechanism to be deployed. Any capacity mechanism would mandatorily require approval from the EU, which, while being a lengthy and complicated process, would reduce the risk of such strategic behaviour of the market participants.

The ongoing dialogue between the Nordic and Baltic states to establish a joint adequacy assessment of long-term generation capacity is important and necessary. However, the pace of change in Estonian and neighbouring countries' electricity systems suggests that these talks should proceed with some urgency to allow for the most cost-effective and appropriate interventions to take place if required. Also, they need to take into consideration the new requirements of the European Union's clean energy package.

The TSO should work towards integration in the European balancing markets, either via the Nordic balancing market or via the European balancing platforms that will be established under the guideline for electricity balancing. It is already an observer to the MARI project, and should keep following this work, with the aim of joining it in the future. The role of the state-owned TSO in Estonia's balancing and reserve market is unclear. It appears to deploy its own gas-fired emergency reserve generating capacity (250 MW) on a regular basis (once or twice a month). However, there is a lack of transparency over the operation of this reserve, as it sometimes seems to be deployed to keep prices in check, and it is unclear if it is restricting the opportunity for other, potentially more cost-effective, solutions. Moreover, the deployment of these plants for balancing may restrict the possibilities to integrate into the European balancing markets.

Significant progress has been made in efforts to synchronise Estonia's and other Baltic states' electricity networks with the Continental European Network via Poland by 2025. Estonia, Latvia, Lithuania, Poland and the European Commission published a joint Political Roadmap in June 2018. Considerable analysis and research have been undertaken in order to determine the most cost-effective approach. However, it is not clear yet what the impact will be on participants in the electricity sector. The Estonian government should share analysis and information, and organise meetings on the likely impacts of the Baltic-central European synchronisation project with relevant stakeholders throughout the process to ensure a smooth transition.

The Estonian retail market has been fully opened to competition since 2013 and there are now 16 electricity retailers. However, the state-owned supplier Eesti Energi has by far the largest market share at nearly 60%. The next two largest providers have a combined share of around 20%. Most consumers (84%) have a power contract, but some 16% remain on universal service provision, suggesting that they have yet to choose a retail supplier.

Estonian electricity bills can be split between retail and distribution suppliers, potentially improving transparency, although consumers may opt to receive just one bill. Around 40% of customers have dynamic, hourly, pricing. Although two price comparison websites are available, switching rates appear relatively low, typically around 3-5% per year. The Competition Authority has conducted research into consumer attitudes and has found that consumers lack a strong incentive to switch. This is because the overall cost savings from switching suppliers are not perceived to be high enough, especially when compared with the cost of other services such as heat.

The price of electricity for Estonian business consumers appears close to the median for IEA countries, and below the IEA median for residential consumers. However, Estonia's prices appear to be above the regional (Baltic and Nordic) average for business customers in particular, and this may potentially affect Estonian competitiveness.

The rollout of smart metres appears to have been a success, with 100% deployment. Significant network cost savings (~30%) have been reported by the industry, in large part due to the benefits of more accurate readings. No significant demand-side response potential has yet appeared as a result of the mass deployment of smart metres and the variable pricing that they offer. This is maybe due to a general lack of volatility in (relatively low) Estonian electricity prices. Future deployment of variable wind and solar power and increased reliance on imported electricity may result in stronger price fluctuations. This may provide opportunities to deploy demand response mechanisms, aggregation or storage to optimise system stability. However, it is important that consumers share in this benefit, with transparency in pricing and policy approaches key.

## *Security of supply*

Security of supply is regulated by the Electricity Market Act, which describes the obligations and responsibilities of the TSO. Within the MEAC, a supervisory committee under the direction of the minister, and including the TSO and Eesti Energia AS, is responsible for crisis response and communications.

Estonia's current production capacity remains sufficient to cover domestic electricity demand as well as exporting electricity, mainly to Latvia and Lithuania. The security of supply in Estonia has also been improved through the construction, by the TSO, of two emergency reserve power plants, located at Kiisa, with a total capacity of 250 MW and including blackstart capability.

However, Eesti Energia recently announced that at least three of its aging oil shale power units (with a total capacity of over 600 MW) will begin shutting down in 2019. Further expected and planned closures of oil shale generation capacity without a clear indication of replacement by domestic production will likely lead to Estonia becoming reliant on electricity imports in the mid-2020s.

Estonia's goal to synchronise its electricity system with the Nordic or continental Europe synchronous grid, starting in 2025, as well as ambitions to significantly increase wind generation, should guide investment in the transmission network. Estonia's TSO is taking steps in this regard, adapting the country's electrical system control centre, including adding a fully functional back-up control centre, reconstructing most of the critical 330 kV voltage nodal substations and reconstructing the Tsirguliina-Valmiera line to the Latvian border. In the Tallinn area, the TSO is replacing overhead lines with underground ones as well as existing oil-filled cable lines with modern plastic insulated ground cables. As the western and island regions of Estonia are the focus for most of the wind capacity development, network improvements are necessary to be able to deal with associated variable production. This includes the current construction of the 330 kW Harku-Ligula-Sindi and the Tartu-Viljandi-Sindi power lines. Once construction of the two lines is completed, the entire mainland of Estonia will be covered by a 330 kW network.

Reliablility of electicity supplies in Estonia will continue to improve through efforts to renovate the network. The availability of smart metres able to measure voltage quality will improve investment decisions and avoid disruptions by using precise data to make preventative renovations. Weather-proofing the network in Estonia is also an important element of security of supply, given the country's geographic location. In 2016, 35% of the faults in the grid of

Elektrilevi, the country's largest distribution grid operator, were caused by weather conditions. Just under one-third of the country's medium voltage grid was considered weather-proofed in 2016, compared to the 75-80% that the Estonian government considers to be the optimum share of all distribution grids to be weather-proofed by 2030.

## Recommendations

***The government of Estonia should:***

- ☐ Accelerate dialogue with Nordic and Baltic partners to understand regional trends with respect to adequacy of generation capacity beyond the mid-2020s, and design common responses to shortages, where needed.
- ☐ Improve transparency in, and access to, balancing and reserve market mechanisms, in part through continued work in the MARI project.
- ☐ Share analysis and information and organise meetings on the likely impacts of the Baltic-Central European synchronisation project with relevant stakeholders throughout the process to ensure a smooth transition.
- ☐ Assess experience in neighbouring countries, in particular Finland, regarding emergency response to blackouts and the role of blackstart capability within the network.
- ☐ Continue efforts to improve the transmission network, including weather-proofing and line upgrades, to ensure that security of supply is maintained.
- ☐ Further develop the use of smart metres as a means for enhancing security of supply through preventative maintenance and system balancing.

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# 6. Natural gas

## Key data

(2018 provisional)

**Domestic production:** none

**Net imports:** 0.50 bcm, -48% since 2008

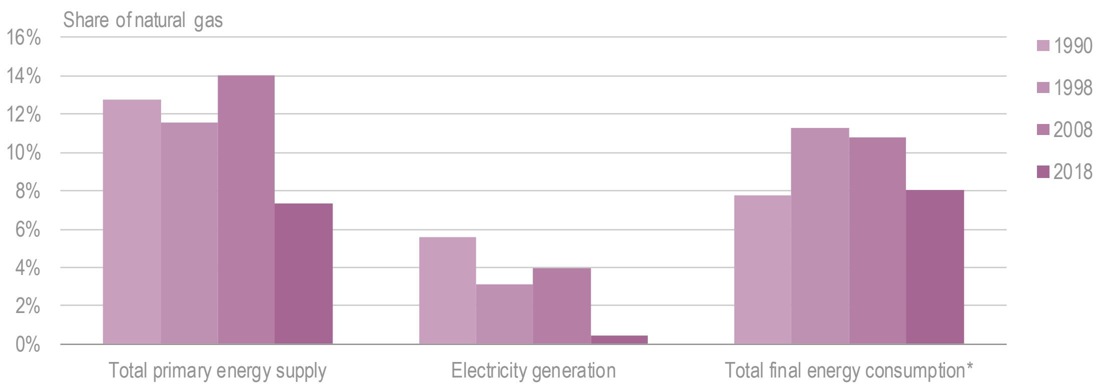
**Share of natural gas:** 7.3% of TPES, 0.5% of electricity generation, 8.1% of TFC (2017)

**Gas consumption by sector (2017):** 0.49 bcm (power and heat generation 40.8%, industry 24.2%, commercial 19.1%, residential 13.6%, transport 1.2%, other energy 1.1%)

## Overview

Natural gas is not a major energy source in Estonia. In 2018, total supply of natural gas was 0.50 billion cubic metres (bcm), equivalent to 7% of total primary energy supply (TPES), which was the third-lowest share of natural gas in TPES among International Energy Agency (IEA) countries (the IEA average is 23%). Over the last decade, the share of natural gas has fallen sharply in both TPES and total final consumption (TFC) (Figure 6.1). The drop in Estonia's natural gas consumption is mainly due to declining gas demand in heating and industry, due to switching to renewable energy sources.

### Figure 6.1 Share of natural gas in different energy metrics, 1990-2018






The share of natural gas in Estonia's energy mix has declined sharply over the last decade, primarily the consequence of switching to renewable energy sources.

* Latest total final consumption data are for 2017.

Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

With no domestic gas production, Estonia has until recently been fully dependent on imports of Russian gas, either directly through interconnections with the Russian Federation, or from its connection to the Inčukalns storage facility in neighbouring Latvia, where Russian gas is typically stored in the summer for use in the winter. With the connection to the Klaipeda liquefied natural gas (LNG) terminal in Lithuania via Latvia at the end of 2014, Estonia has opened the possibility to diversify its gas supply sources. In 2017, 88% of Estonia's gas imports came from Russia, while the remaining 12% was gas sourced on the GET Baltic gas exchange in Lithuania.

In efforts to improve its natural gas security, Estonia promotes indigenous production of biogas/biomethane, in line with the country's low-carbon energy transition, and is developing cross-border gas projects with neighbouring Baltic countries, such as the Balticconnector with Finland. Improved market competition followed by the complete unbundling of the natural gas market in 2016 is commendable achievement that has contributed to enhancing the competitiveness of the natural gas sector in Estonia.

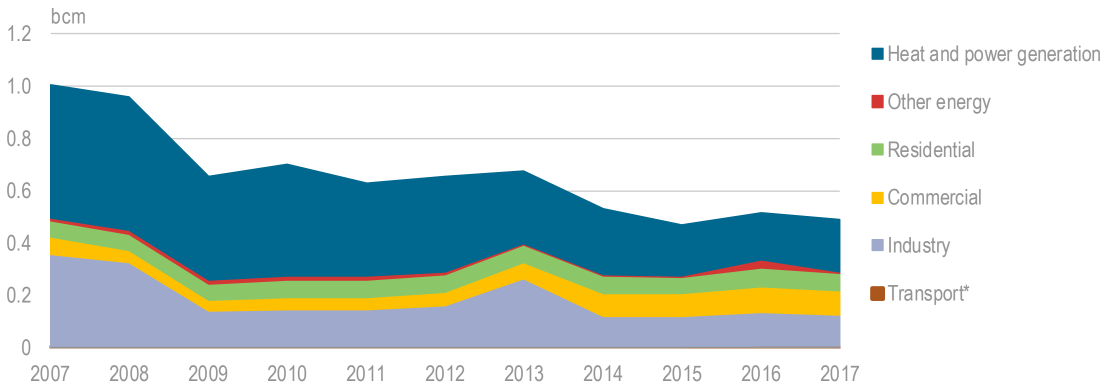
## Supply and demand

### *Consumption of natural gas*

Over the last decade, Estonia's total gas consumption has halved, to 0.50 bcm in 2018. The country's declining gas demand is due to a combination of factors, including the economic crisis of 2008, perceptions of gas as an at-risk fuel due to geopolitics, and increasing fuel-switching from gas to renewable fuels for district heating, the largest gas-consuming sector in Estonia.

Power and heat generation, mostly heating, accounted for 41% of the total gas consumption in 2017, which although still the largest by share, has been declining sharply since 2007 (Figure 6.2). By absolute volume, gas demand for power and heat generation has fallen by 60% in the last decade. In 2014, several district heat suppliers, including major ones like Kiviõli Soojus AS and Kuusalu Soojus OÜ, converted to biofuels, which are estimated to have reduced annual gas consumption by about 10 million cubic metres (mcm) per year. Tallinna Küte, the main operator of district heating in Tallinn, committed to decrease its share of gas consumption to 20%, from 65% in 2013, equivalent to a reduction of 60 mcm gas consumption per year (Competition Authority, 2016). A new biomass fired combined heat and power plant, coming on-line in 2020, will help to meet this commitment by reducing its gas consumption by 20 mcm per year.

### Figure 6.2 Natural gas consumption by sector, 2007-17






The decline in total gas consumption over the last decade has been driven by reductions in gas use in power and heat generation and the industry sector.

* Not visible on this scale.

Notes: bcm = billion cubic metres. *Other energy* includes the energy sector's own consumption and losses in oil and gas production and refineries. *Commercial* includes commercial and public services, agriculture and forestry. *Industry* includes non-energy consumption.

Source: IEA (2019b), *Natural Gas Information 2019*, www.iea.org/statistics.

Industry is the second-largest gas-consuming sector, accounting for 24% of total consumption in 2017. Similar to the decline in gas use for heat generation, industry's gas consumption has fallen by 67% over the last decade. A substantial reason for this decline is the role of Nitrofert AS, a major fertiliser producer that accounted for nearly 40% of industrial gas consumption in Estonia prior to the 2008 financial crisis. Nitrofert AS suspended production of fertilisers, and thus its gas use, in 2015. The share of gas demand in the commercial sector grew strongly (by 47%) over the same period, accounting for 19% of the total in 2017. Gas demand for the residential sector was relatively modest with 10% growth, accounting for 14% of the total gas demand in 2017.

Gas consumption in the energy industry and transport sectors is minor in Estonia, each with around a 1% share of the total. Natural gas was first used for transportation in 2012 at less than 1 mcm. Over the last five years, gas consumption in the sector has jumped to 5.7 mcm, which is a rapid growth rate, but remains very marginal in the total share of both gas consumption and transportation fuels. The increase is due to the development of compressed natural gas (CNG), which is seen in Estonia as a potential area for growth in gas use, particularly with respect to biomethane.

Estonia is seeking to promote the use of biomethane in vehicles as a cost-effective means for meeting the target set for the transport sector under the EU Renewable Energy Directive (2009/28/EC). Estonia established a 10% biofuel blending requirement by 2020 for oil products (see Box 4.1 in Chapter 4 and Chapter 8).

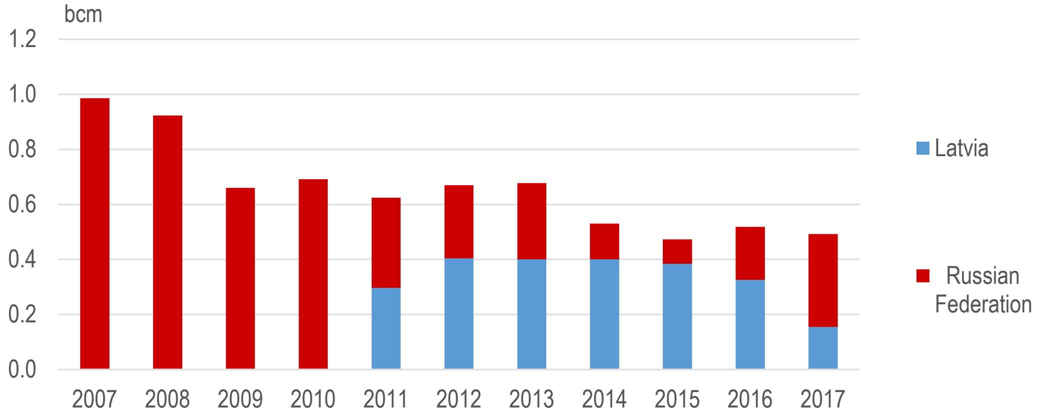
Nevertheless, the Estonian Competition Authority foresees a continuous drop in gas demand in the coming years, as the reductions due to converting to renewable energy sources for heating and more efficient use of heat by consumers will outweigh any demand growth for gas in the transport sector. The ten-year development plan of Estonia's transmission system operator (TSO), Elering[1], projects overall gas demand to decline to 0.47 bcm by 2027 (Competition Authority, 2018).

## Trade

In 2017, Estonia's total gas imports were 0.49 bcm (Figure 6.3). In line with the declining gas demand in the country, the volume of gas imports has fallen by 51% over the last decade.

Prior to 2014, only gas imports of Russian origin were possible, either directly imported from Russia or from the Inčukalns gas storage facility in Latvia. Estonia's connection with the Klaipeda LNG terminal in Lithuania, commissioned in 2014, has made it possible for Estonia to develop more diversified import sources. However, gas from Lithuania is purchased on the gas exchange GET Baltic, and as deliveries from this exchange come either from Klaipeda LNG or from Russian gas delivered to Lithuania, gas imports via this route do not necessarily indicate diversification from Russian gas. Thus, while 31% of Estonia's 2017 gas imports came through the connection with Latvia, including 12% from Lithuania, the predominant share of Estonia's gas imports are still of Russian origin (Competition Authority, 2018).

**Figure 6.3 Estonia's natural gas imports by entry point, 2007-17**






Estonia's gas imports are predominately of Russian origin, either imported directly or through the interconnection with Latvia.

Source: IEA (2019b), *Natural Gas Information 2019*, www.iea.org/statistics.

### *Production of biomethane*

Estonia has no domestic production of natural gas. However, the government has been supporting indigenous production of biomethane to promote both the security of natural

[1] Annex A provides more detailed information about institutions and organisations with responsibilities related to the energy sector.

gas supply and the low-carbon energy transition. The Estonian government recognises that biomethane has substantial energy potential in Estonia, particularly in the transport sector, and estimates that there is a total production potential of up to 370 mcm a year (mcm/y). Estonia has a set a goal to reach 15 mcm/y of biomethane production by 2020, and further increase the production level to 40 mcm/y by 2030 (MEAC, 2018a).

To meet these targets, Estonia has been promoting domestic biomethane production, mainly through measures such as subsidies (see section below on prices and tariffs). In 2018, two biomethane production units were established in Estonia, with a total capacity of around 62.5 gigawatt hours per year (6.5 mcm/y) (see section below on infrastructure). The total output of domestic biomethane production was around 4.5 mcm in 2018, only a fraction of the total gas consumption level and less than one-third of the goal set for biomethane production in 2020.

## Market structure

### *Unbundling of the gas network*

Estonia underpins liquidity and competition of the domestic gas market as the primary measure to sustain security of gas supply. The Competition Authority oversees the market, including transmission and distribution regulations and pricing. The Estonian gas market has been fully liberalised since 2007 and Estonia made amendments to the Natural Gas Act in June 2012, which underpinned the unbundling of the transmission system from the producer and/or seller via complete ownership unbundling, to comply with the EU's third energy package of 2009.

The Estonian gas market used to be dominated by a single vertically integrated company, Eesti Gaas, whose biggest shareholder was Gazprom.[2] At the time of the last IDR in 2013, Eesti Gaas was still the only gas importer and trader in the country, although legislation had encouraged open competition. The 2012 amendment to the Natural Gas Act obliged AS Eesti Gaas to separate its gas distribution utility by January 2013 and divest its ownership of transmission services by 2015. The ownership unbundling was finalised in March 2016 and the current Estonian TSO is publicly owned via Elering (formerly EG Võrguteenus AS before 2015[3]).

### *Wholesale*

Eesti Gaas AS was the only wholesaler on the Estonian gas market until 2015, when other companies began to compete on the wholesale market. The availability of competitive gas supply from the Lithuanian GET Baltic exchange, which added the possibility of virtual gas trading in Estonia in 2017, has facilitated the emergence of new gas suppliers.

In 2017, three companies imported gas into the Estonian market: Eesti Gaas AS (still the dominant importer, representing 88% of total 2017 imports), Elektrum Eesti OÜ (8% of imports) and Eesti Energia AS (4%). Following the expiration of its long-term contract

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[2] Others included Germany's E.ON, Finnish utility firm Fortum and Latvia's Itera.

[3] Before 2015, EG Vorguteenus AS was an independent system operator (both transmission and distribution) that leased Eesti Gaas' assets for providing transmission services.

with Gazprom at the end of 2015, Eesti Gaas AS entered into a new three-year contract with Gazprom in March 2016. Eesti Gaas AS remains the biggest wholesaler on the market (with a wholesale market share of 67.4% in 2017), followed by Eesti Energia AS (11%), and the remaining market share spread over four other companies, each with less than 10% (Baltic Energy Partners OÜ, Scener OÜ, Alexela Energia AS and 220 Energia OÜ) (Competition Authority, 2018).

### *Retail*

With new gas importers entering the market, the dominance of Eesti Gaas AS in the retail sector has decreased. Gaasivõrgud AS, a subsidiary of Eesti Gaas, has the biggest market share and uses the 1 486 km long distribution network owned by Eesti Gaas under a commercial lease contract. In 2017, 27 companies were active on the Estonian retail gas market, compared to 23 the previous year. Eesti Gaas remains the dominant supplier in the retail sector, with 55% of the market in 2017. However, this is substantially lower than before, and compares to 93% in 2016 (Competition Authority, 2018). To promote further market competition, the obligatory supply licence was replaced with a simple registration as a supplier in mid-2017.

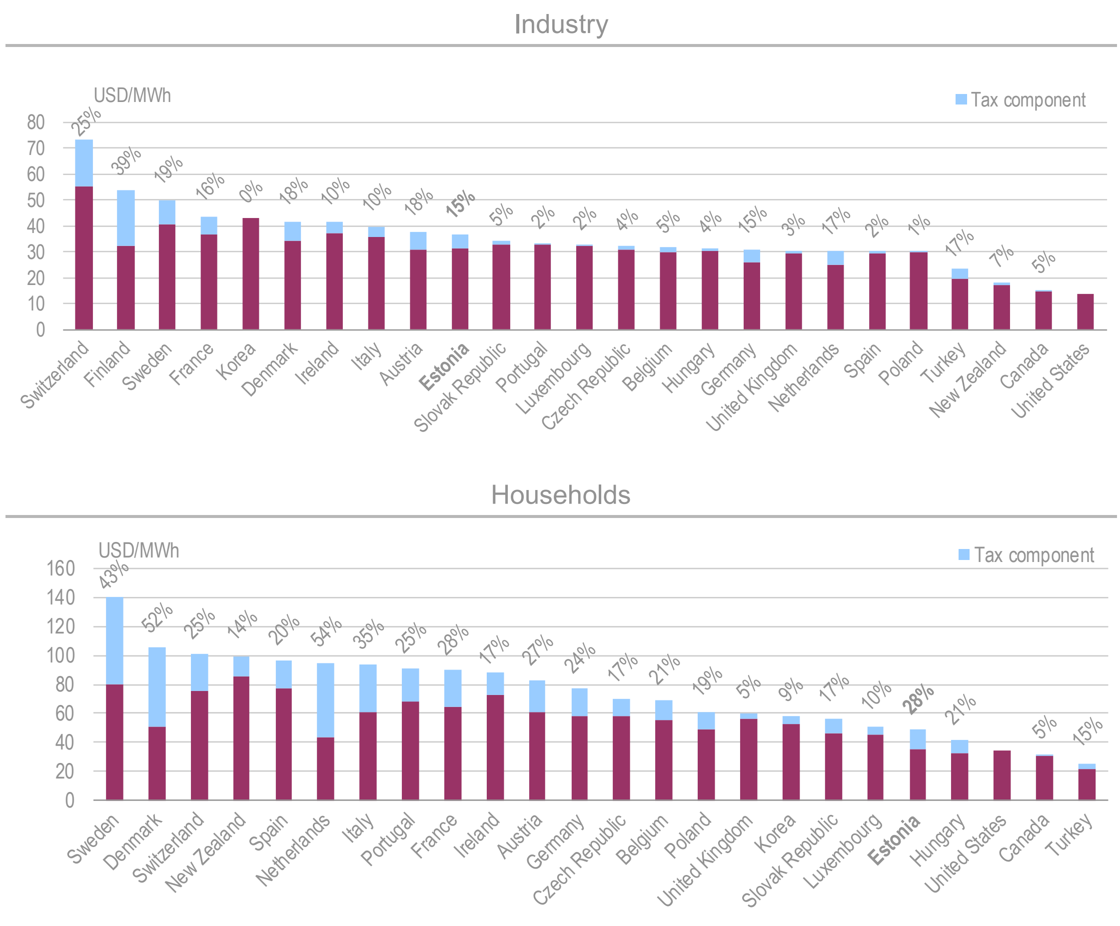
## Price and tariffs

The Estonian Competition Authority is responsible for network tariffs and methodologies for calculating connection fees, which it approves in accordance with the Natural Gas Act. Eesti Gaas AS, as the predominant market player, must get approval from the Competition Authority on the sales margin to be included in the price of gas sold to household consumers. Other gas sellers add the approved sales margin to the import price of gas. The Competition Authority verifies annually that the weighted average price of gas sold in a calendar year does not exceed the weighted average purchase price in the same period, otherwise the company must settle the balance with its customers.

Pursuant to the Natural Gas Act, household consumers must be notified 30 days in advance of any change in price. The retail sale prices of the gas sold to final consumers are disclosed on the gas suppliers' websites. Consumers can then decide whether they wish to switch gas suppliers. The price of natural gas was responsible for 68% of the total gas bill for the household consumer in 2017 (Competition Authority, 2018).

The continuous fall in gas demand is driving down the price of gas in Estonia. Estonia's gas price for industry dropped significantly between 2013 and 2018, from USD 47.2/MWh to USD 36.9/MWh, despite a sharp increase in the tax rate (from 3% to 15%; see Figure 6.4). In the IEA comparison, Estonia is now a little closer to the IEA median, from the 11th lowest to the 14th lowest.

**Figure 6.4 Natural gas prices in IEA member countries, 2018**






In the IEA comparison, Estonia's industry gas price stands close to the median while the household gas price is relatively low.

Notes: MWh = megawatt hour. Tax information is not available for the United States. Data not avabilable for Australia, Finland (households), Greece, Japan, Mexico and Norway.

Source: IEA (2019c), *Energy Prices and Taxes 2019*, www.iea.org/statistics.

Over the same period, the gas price for households fell by 27%, to USD 48.7/MWh. Unlike the industry gas price, there was only a small increase in the tax rate, from 21% to 28%, as it was from a higher basis. Estonia still has one of the lowest gas prices for households among European IEA member countries.

## *Financial support for biomethane*

In 2018, the government set up a scheme to provide financial support for domestic biomethane production (see Chapters 7 and 8).  Under the scheme, companies may request state subsidies for their biomethane production by submitting applications on a rolling basis from 2018 to 30 November 2020. Elering, the state-owned TSO, manages the direct payment of the subsidies based on the level of production and consumption. For its first year 2018, the government allocated around EUR 4 million for the scheme, including promoting the usage of biomethane in public transport, with an objective of making biomethane more price-competitive against other liquid fuels. As of April 2018, upon the first commercial sales of biomethane in Tehnika st gas station, the price of biomethane was EUR 0.82/kg, slightly higher than EUR 0.81/kg of CNG (Eesti Gaas, 2018). The Environment Investment Center also supported around EUR 2.23 million for the construction of 12 gas stations providing biomethane fuels (see next section).

According to *National Development Plan of the Energy Sector 2030* (MEAC, 2017), the Estonian government has not confirmed the feasibility of promoting biomethane through a feed-in tariffs system.

# Infrastructure

## *Gas network*

The TSO owns a network of 10 gas pipelines (885 km, 43 of which transit pipelines), 3 gas metering stations and 36 gas distribution stations. The Estonian gas transmission system is connected with Russia and Latvia through three interconnectors, all one directional (flowing into Estonia). Two transit pipelines go through the southern part of Estonia (Izborsk-Inčukalns and Valdai-Pskov-Riga) to transport gas from Russia to Latvia in the summer and inversely in winter, but these are not connected to Estonia's network.

Gaasivõrgud, a subsidiary of Eesti Gaas, is the major distribution system operator in Estonia. It operates the 1 486 km long distribution network owned by Eesti Gaas under a commercial lease contract. There are 23 other small companies running 648 km of natural gas distribution network (Competition Authority, 2018).

The Estonian gas system does not have compressor stations and is dependent on pressure being maintained from the network in neighbouring countries. Typically, the network's pressure is maintained by the Russian system's compressor stations in summer and by the output pressure of the Inčukalns gas storage facility in winter.

**Table 6.1 Major gas network infrastructure in Estonia**

| Interconnector | Maximum technical capacity | Delivery pressure | Utilisation rate (average 2018) | Comment |
|---|---|---|---|---|
| **Karksi (Latvia-Estonia)** | 7 mcm/d (73.5 GWh/d) | 24-42 bar | 15% | Capacity will be increased to 10 mcm/d (105 GWh/d) from January 2020 |
| **Värska (Russia-Estonia)** | 4 mcm/d (42.0 GWh/d) | 24-42 bar | 46% | |
| **Narva (Russia-Estonia)** | 3 mcm/d (31.5 GWh/d) | 18-30 bar | 9% | |
| **Balticconnector (Finland-Estonia)** | 7.7 mcm/d (81.2 GWh/d) | 31-80 bar | – | Will start operation in January 2020 |

Note: mcm/d = million cubic metres per day; GWH/d = gigawatt hours per day.

Sources: Elering (2018), *Estonian Gas Transmission Network Development Plan 2018-2027*, https://elering.ee/sites/default/files/attachments/Estonian_gas_transmission_network_development_plan_2018_2027.pdf; MEAC (2018b), *Regional Risk Assessment of Security of Gas Supply of Finland, Estonia, Latvia, Lithuania 2018*.

### Recent changes in network

Traditionally, winter gas has been supplied from the Inčukalns underground storage facilities via the connection at Karksi (which has a technical entry-point capacity of 7.0 mcm/day), with gas supplies in the remainder of the year (May to October) coming directly from Russia through the Värska and Narva connections (with capacities of 4 mcm/d and 3 mcm/d, respectively). However, starting in the second half of 2016, gas import flows changed considerably, as the gas supplied directly from Russia became cheaper relative to gas supplied via Latvia (including Lithuania), due to higher transmission tariffs. This resulted in the Värska connection becoming the main route of supply, with the Karksi connection providing additional capacity when needed. Moreover, starting from 1 January 2019, the Narva interconnector became technically no longer able to serve as an entry point for gas supply to Estonia due to changes made to the line within the Russian territory (Elering, 2018). However, this situation is set to change significantly with the development of a regional gas market under the Balticconnector project with Finland (see section on "Infrastructure developments: Regional network interconnections" below).

## *LNG terminal*

Estonia does not have an LNG terminal; however, it is connected to the Klaipeda LNG terminal in Lithuania. Commissioned at the end of 2014, the Klaipeda LNG terminal consists of a floating storage and regasification unit with a total capacity of up to 10.25 mcm/d and has LNG storage for 170 000 $m^3$. Owned by Leigh Höegh LNG (Norway), Klaipeda has primarily been supplied by the Norwegian LNG, but began to diversify its sources, including receiving its first cargo from the United States in late 2017.

Estonia is also studying the possibility of establishing an on-shore LNG terminal in Paldiski, the location of Estonia's planned Balticconnector compressor station. Planned to be commissioned by the first half of 2021, the project would have a regasification capacity of 4 mcm/d in a first stage, and could potentially be extended to 14 mcm/d in a second stage, depending on market conditions.

### Figure 6.5 Map of the Baltic region's gas infrastructure


This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Elering (2018), *Estonian Gas Transmission Network Development Plan 2018-2027*, https://elering.ee/sites/default/files/attachments/Estonian_gas_transmission_network_development_plan_2018_2027.pdf.

## Storage

There are no gas storage facilities in the country. Estonia uses the Inčukalns underground gas storage facility in Latvia, which supplies gas to major consumers in Estonia, Latvia, Lithuania and north-western Russia (Pskov). Traditionally, the Inčukalns reserve is filled in summer with Russian gas, using compressor injection, and used in winter using natural withdrawal, primarily for heat generation.

The only functioning natural gas underground storage facility in the Baltic states, Inčukalns has a total technical capacity of 4.47 bcm, of which 2.32 bcm was active in 2018. According to the owner of the Inčukalns underground gas storage facility, JSC Conexus Baltic Grid, it is possible to increase the active capacity to 3.2 bcm to ensure the Baltic region's needs for natural gas, or to expand it even further to store natural gas volumes required by Finland in a future regional market. The company made an investment request with the Latvian authorities in 2018 to enhance the operations of the storage facility to allow the Inčukalns to maintain its functionality in a regional transmission system following the Balticonnector project completion. The upgrade would install compressors to raise the storage pressure and allow, for the first time, compressor extraction, raising the gas extraction capacity from 30 mcm/d to 32 mcm/d (Conexus, 2018).

## Infrastructure developments

### *Biomethane infrastructure*

In 2018, two biomethane stations were started operations in Estonia, with a total capacity of 6.5 mcm/y. The plant in Kunda is capable of injecting a total volume of up to 48 gigawatt hours per year (GWh/y, or 5 mcm/y) of produced biomethane into the local distribution grid. The plant in Paide is an off-grid unit that delivers biomethane to an off-grid system. The Estonian government has indicated that at least three more biomethane production units are expected to start operating in the coming years (IEA, 2018).

The Estonian government is committed to injecting the locally produced biomethane into the natural gas network and targets to have 3-4% of the total gas in the network from biomethane by 2020, the equivalent of around 12-15 mcm/y.

The Estonian government is also committed to supporting the development of fueling stations for biomethane and CNG, with the goal of having 30 stations nationwide by 2020. In April 2018, Eesti Gaas opened Estonia's first gas station to sell green gas, supplied from the country's first biomethane production in Kunda. The gas station is in the centre of Tallinn. Eesti Gaas plans to expand biomethane sales across its network of stations selling CNG, which in 2018 consisted of eight stations – four in Tallinn, two in Pärnu, one in Tartu and one in Narva – and plans to open additional stations in Viljandi, Rakvere and Jõhvi (Eesti Gaas, 2018).

### *Regional network interconnections*

Projects underway to develop and improve regional interconnections will transform the Estonian gas network into an important part of a transit corridor. The most important of these is the Balticconnector project, including enhancements to the Karksi (Estonia-Latvia) interconnection, which will connect the gas systems of Finland and the Baltic states. Another important project in the region is the construction of the Gas Interconnection Poland-Lithuania (GIPL), which will connect the gas systems of the Baltic states with Central Europe. The three Baltic countries agreed to develop a common tariff methodology for transmission services in 2019 for their common input-output zone. The zone will be expanded to include Finland starting in 2020, following the completion of the Balticconnector (Figure 6.5).

The **Balticconnector** project is being jointly developed by Elering and the Finnish state-owned company Baltic Connector Oy. It will link the Klaipeda LNG regasification storage terminal in Lithuania and the Inčukalns gas storage in Latvia with Finland via the Estonian network. The pipeline's bi-directional transmission capacity will be 7.2 mcm/d, and include two compressor stations, in Inkoo, Finland and Paldiski, Estonia. The project also includes the renovation of the Karksi interconnection between Latvia and Estonia, expanding its capacity (to 10 mcm/d from the current 7 mcm/d), allowing bi-directional flow, and including a compressor station at Puiatu. As one of the European Commission's declared projects of common interest towards improving gas supply security and creating an integrated European energy market, the project is co-funded to the extent of 72% of the total investment costs, estimated at EUR 285 million. Renovation to the Karksi interconnection is to be completed in 2019 while the connection between Estonia and Finland will be completed in 2020 (Elering, 2018).

The **GIPL project**, connecting Lithuania and Poland, will integrate the Baltic states and Finland (after the completion of the Balticconnector) with the unified Central European gas market. This will provide access to alternative supply sources for the Baltic region via Poland's LNG connections, in addition to Russia and the Klaipeda LNG terminal, and create the conditions for competition in an open gas market. The GIPL will also enable Polish market participants to use the Inčukalns storage facility in Latvia. It was originally planned to be completed in 2019, but as the gas route in Poland was changed, completion is now planned in 2021.

# Gas emergency response

## *Gas emergency policy and organisation*

Overall responsibility for security of gas supply is divided between the TSO – Elering, the Competition Authority, and Ministry of Economic Affairs and Comunications (MEAC). According to the Estonian Natural Gas Act, gas supply to household customers may not be interrupted or restricted during the period from 1 October to 1 May. The obligation for supplying protected customers is imposed on Elering, which would draw the required volumes from its stocks held in Inčukalns. Gas supply to entities producing heat for heating of residential spaces and that do not have the possibility to use another fuel other than gas may not be interrupted or restricted during the same period either. The only exception to this rule is in cases of danger to the life, health or property of persons, or to the environment, or by agreement of the parties.

In order to reduce possible risks to the security of gas supply and to cope with any gas supply disruptions, the Competition Authority prepares a risk assessment, preventive action plan and emergency plan, in accordance with the Natural Gas Act and EU Regulation No. 2017/1938. The plan is updated and approved by the minister every two years. According to the latest (2018) plan, the once in 20 years peak demand (January 2006) was equal to 6.7 mcm/d, of which the highest daily consumption of protected consumers was 1.0 mcm.

Based on these figures, Estonia's security of supply standards are the ability to guarantee supply volumes of 7 mcm (for supplying protected consumers over 7 consecutive peak demand days) and 30.4 mcm (to cover 30 days).

## Network resilience

Estonia, is required to meet the infrastructure standard detailed in Article 5 of the EU Gas Security of Supply Regulation No. 2017/1938, which relates to the ability to satisfy total gas demand in the event of a disruption of the single largest gas infrastructure, during a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years. The EU infrastructure standard is met where the N-1 value is greater than or equal to 100%.

Estonia met this infrastructure standard in 2017, with 104.5%, based on the peak demand and the 7 mcm/d capacity of the Karksi connection being the single largest infrastructure within a total transmission network capacity (incoming) of 14.0 mcm/d (Competition Authority, 2018). With the closure of the Narva interconnection starting in 2019, the infrastructure standard is no longer being met. However, with the completion of the Balticconnector (the interconnection at Paldiski will have a capacity of 7.2 mcm/d) and the Karksi interconnection modifications (the capacity expansion to 10 mcm/d), Estonia will once again meet the standard in 2020.

## Emergency response measures

The obligation of supplying protected customers is imposed on the TSO Elering, which would draw from stocks held in the Inčukalns storage facility in Latvia. Elering secures the required volumes by signing purchase option agreements with winners of public procurements, which it launches following updates to the Emergency Plan.

The TSO is responsible for reporting to MEAC on any event which has, or could have, a significant adverse effect on the supply situation, and on any market measures being applied by the system operator to mitigate the disruption. MEAC, together with the Competition Authority, would analyse the situation and determine whether any of the measures of compulsory reduction of gas demand listed in the Natural Gas Act are necessary. If so, the ministry would make a proposal to the government, including the specific measures to be used, the reasons for implementing these measures and the expected number of days the measures are to be in effect.

According to the Natural Gas Act, the emergency response plan could include actions to:

- reduce the supply of gas to persons who use gas for purposes other than for producing heat
- authorise a reduction in the supply of gas to entities producing heat
- authorise a reduction in the temperature of the water used for heating residential buildings
- obligate entities producing heat to switch to alternative fuels.

The TSO has signed co-operation agreements with its key counterparts (i.e. industrial customers, distribution system operators, system operators of neighbouring countries) to facilitate activation of crisis measures. In the event of a government decision to introduce mandatory measures to reduce gas demand, the TSO will inform its key counterparts and the Competition Board about the decision and its planned steps to implement the decision. Industrial users, including electricity generators, would then fulfil their role in the TSO's emergency response plan by reducing gas consumption by up to 80%, with measures which:

- prioritise the use of available gas supplies to ensure the security of supply of households
- impose compulsory use of alternative fuels and compulsory transfer to other fuels
- impose compulsory use of electricity from sources other than gas.

Gas distributors and industrial gas consumers subject to compulsory demand reduction measures are required to inform the Competition Authority of steps they are taking to minimise the damage caused by the proposed measures.

## Assessment

Natural gas is not a major energy source in Estonia. Gas consumption has halved over the last decade, primarily due to the switching away from gas towards renewable energy sources in the heat and industry sectors, which nevertheless remain the largest sectors for gas use in Estonia. The rising demand for gas in transportation over the coming decade, related to increased biomethane use to meet the goal of 10% of renewables in transportation, will not offset Estonia's overall trend of declining gas consumption.

As Estonia does not have any domestic natural gas production, it is fully dependent on imports. At the same time, the Estonian government has been supporting indigenous production of biomethane to promote both gas supply security and the low-carbon energy transition. The potential for biomethane production in Estonia is quite substantial. The government estimates that this has the possibility of reaching 0.37 bcm/y. However, Estonia has set much more modest goals, using state subsidies to reach 5 mcm/y in 2020 and 40 mcm/y by 2030, compared to the 2018 level of 4.4 mcm.

Connection to the Klaipeda LNG terminal in Lithuania, since 2014, has created the possibility for Estonia to develop more diversified import sources. However, higher transmission costs for gas transiting Lithuania and Latvia have made gas imported directly from Russia more attractive.

Estonia has made good progress in opening up its market since liberalisation in 2007. The complete unbundling of the transmission system was finalised in 2016, and reduced the dominance of Eesti Gaas AS, formerly the only wholesaler and main retailer in the country. To promote further market competition, starting in mid-2017, obligatory licensing was replaced with a simple registration as a supplier and Estonian companies were given access to the GET Baltic gas exchange.

The development of a regional gas market, including the connection with Finland via the Balticconnector and improvements to the interconnection with Latvia, will fundamentally transform Estonia's gas market. Currently a "dead-end" system for gas supplies, Estonia will become an important part of a transit corridor, connecting not only the Baltic region with Finland, starting in 2020, but also to the rest of Europe with the completion, in 2021, of the GIPL project linking the network with Poland. However, in order to create an effective regional gas market, mutually agreed network rules and pricing methodology for a common entry-exit system need to be finalised. Regionally applied tariffs will help to diversify Estonia's supply sources by removing uneven transmission costs, which currently make imports from the Klaipeda LNG uncompetitive. Moreover, a more competitive regional market will be critical for attracting additional suppliers to the existing network and for making further investments in LNG infrastructure on the network commercially viable.

Responsibilities for security of gas supply, regulated under the Natural Gas Act, are divided between the TSO, the Competition Authority, and the Ministry of Economic Affairs and Communications. The TSO is responsible for assuring the reserves of stock necessary to meet security standards for protected customers, and for notifying the Ministry of any event having a significant adverse effect on gas supplies. The Ministry and the Competition Authority determine whether any of the measures of compulsory reduction of gas demand listed in the Natural Gas Act are necessary, and make a specific proposal to the Government.

The TSO, Elering, has developed co-operation agreements with its key counterparts, such as its industrial customers and gas distributors, to facilitate the activation of crisis measures. However, effective implementation of emergency response requires clear procedures and communication protocols throughout the process of identifying and assessing a situation, formulating a response plan, reaching and implementing a governmental decision, and monitoring its effect. A crisis handbook to formalise these procedures would be useful in Estonia and should be improved through regular emergency excercises.

## Recommendations

***The government of Estonia should:***

- Together with Finland, Latvia and Lithuania finalise the establishment of common rules for a competitive, integrated and liquid regional market for natural gas.
- Together with neighbouring countries, find a market-based solution to diversify supply into the region and enhance the security of supply.
- Establish a working group consisting of Elering, the Competition Authority, and the Ministry of Economic Affairs and Communications, and other relevant stakeholders to develop a handbook that clearly defines responsibilities, operational procedures and communications channels for rapid decision making in case of a gas emergency.
- Conduct regular exercises, in order to test operational procedures to be taken during a gas emergency.

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# 7. Energy, environment and climate change

## Key data

(2017)

**GHG emissions without LULUCF*:** 20.9 $MtCO_2$-eq, +8.7% since 2005, -48.4% since 1990

**GHG emissions with LULUCF*:** 19.1 $MtCO_2$-eq, +17.3% since 2005, -51.0% since 1990

**Energy-related $CO_2$ emissions (2017):**

**$CO_2$ emissions from fuel combustion:** 16.0 $MtCO_2$ (-4.6% since 2005, -54.4% since 1990)

**$CO_2$ emissions by fuel:** oil shale 69.1%, oil 19.9%, natural gas 6.0%, other (coal, peat and non-renewable waste) 5.0%

**$CO_2$ emissions by sector:** power and heat generation 75.8%, transport 15.2%, industry 3.9%, commercial 3.7%, residential 1.0%, other energy 0.4%

**$CO_2$ intensity (TPES per GDP)**: 0.43 $kgCO_2$/USD GDP PPP (IEA average 0.24)

* Land use, land-use change and forestry.

## Overview

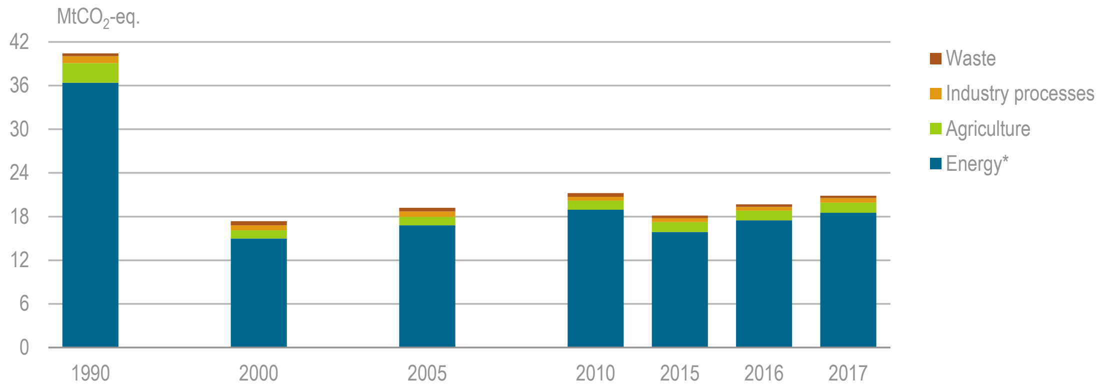
Estonia is well on its way to meet its target for emissions outside the European Union (EU) Emission Trading system (ETS) for 2020 of limiting the increase of emissions by 11% compared to the 2005 level. In 2017, non-ETS emissions were 1.1% below the 2005 level. For 2030, Estonia is obligated for the first time to reduce its emissions, by 13% below the 2005 level, a much larger challenge that requires proactive and determined government policy.

In 2017, energy-related emissions accounted for 89% of Estonia's total greenhouse gas (GHG) emissions (not including effects from land use), the highest share among IEA member countries. This is mostly due to its reliance on oil shale for much of its power and heat production.

Estonia's emissions fell sharply in the early 1990s with the transition from a planned economy to a market economy. Since 1995, however, emissions have remained relatively stable at around 20 million tonnes of carbon dioxide-equivalent ($MtCO_2$-eq.) (Figure 7.1).

Heat and power generation accounts for three-quarters of energy-related emissions. The future use of oil shale will therefore determine how Estonia's total emissions will develop (see Chapter 3). The transport sector is the second-largest emitting sector.

**Figure 7.1 Greenhouse gas emissions by sector, 1990-2017**






Estonia's greenhouse gas emissions fell sharply in the 1990s, but have been relatively stable since, at around 20 $MtCO_2$-eq. Energy-related emissions account for nearly 90% of the total.

* Energy includes power and heat generation, commercial, households, industrial energy consumption, and transport.

Note: $MtCO_2$-eq = million tonnes of carbon dioxide-equivalent.

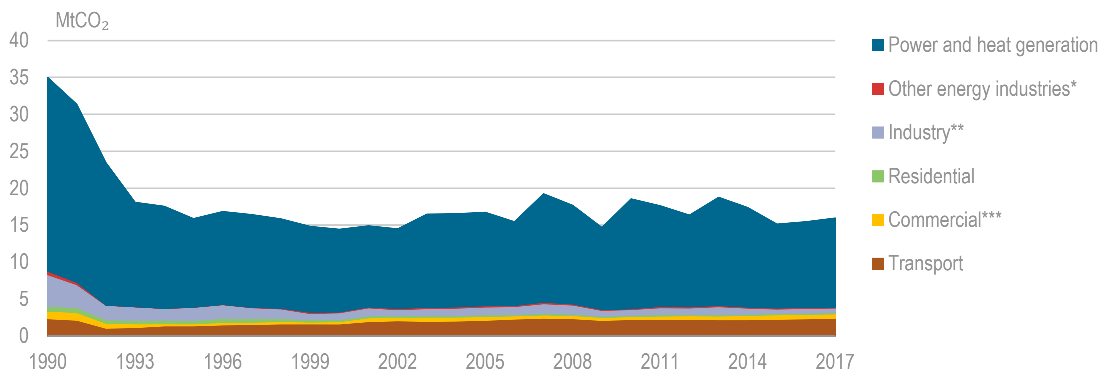
Source: EPA (2018a), *Inventory of Greenhouse Gas Emissions and Sinks 1990-2016*, https://unfccc.int/documents/65674.

# Energy-related $CO_2$ emissions and carbon intensity

Estonia has the highest carbon intensity of all IEA countries due to the dominant role of oil shale in electricity and heating, and the country's position as a net electricity exporter (see Chapter 5). In 2017, Estonia's energy-related $CO_2$ emissions were 16.0 $MtCO_2$. Heat and power generation accounted for 76% of these emissions. The rest were mostly from the transport sector, which accounted for 15%, followed by small shares in industry (4%), the commercial sector (4%) and the residential sector (1%).

Estonia's share of residential emissions in total $CO_2$ emissions was the second-lowest among IEA countries after Sweden, and can be explained by the large use of district heating and bioenergy for heating. Emissions from the production of district heat are not counted under the residential sector, but under heat and power generation. If including indirect emissions from heat and power generation to the end-use sectors, residential emissions account for a third of the total. Emissions from power generation fluctuate greatly with annual variations in the volume of exported electricity that is mainly produced from oil shale (Figure 7.2). Apart from those fluctuations, total energy-related $CO_2$ emissions have remained stable at around 16 $MtCO_2$ for over two decades.

### Figure 7.2 Energy-related $CO_2$ emissions by sector, 1990-2017






Power and heat generation, heavily reliant on oil shale combustion, represents three-quarters of total energy-related $CO_2$ emissions, and varies annually with electricity trade.

* *Other energy* includes emissions from coal mines and oil and gas extraction.

** *Industry* includes $CO_2$ emissions from combustion at construction and manufacturing industries.

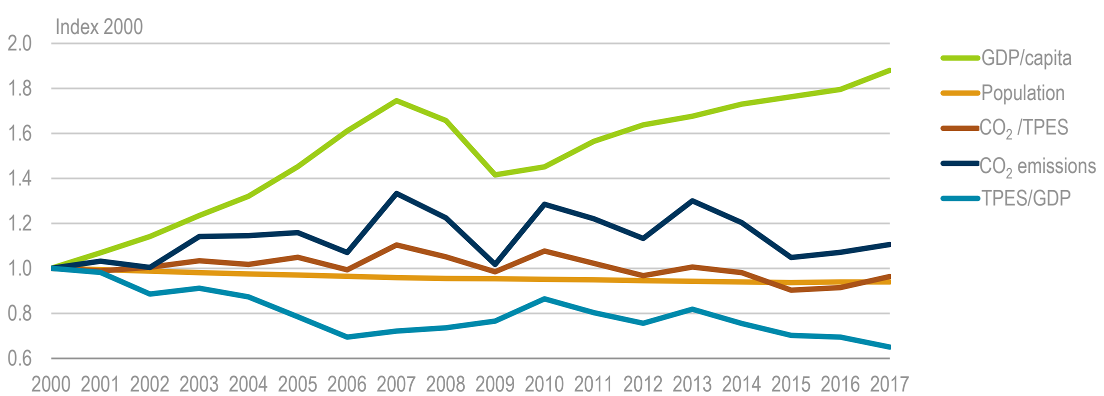
*** *Commercial* includes commercial and public services, agriculture/forestry, and fishing.

Note: $MtCO_2$ = million tonnes of carbon dioxide.

Source: IEA (2019), *$CO_2$ Emissions from Fuel Combustion 2019*, www.iea.org/statistics.

Total $CO_2$ emissions in a country are driven by population changes and economic development, measured as gross domestic product (GDP) per capita. Emissions are also affected by the energy intensity of the economy and carbon intensity of the energy supply. In Estonia, the effect from growth in the economy is partially offset by a slowly declining population and the energy intensity of the economy (Figure 7.3). From 2000 to 2017, GDP (in purchase power parity [PPP]) increased by 88%. Meanwhile, energy-related $CO_2$ emissions increased by 11%, although with large annual fluctuations.

### Figure 7.3 Energy-related $CO_2$ emissions and main drivers in Estonia, 2000-17





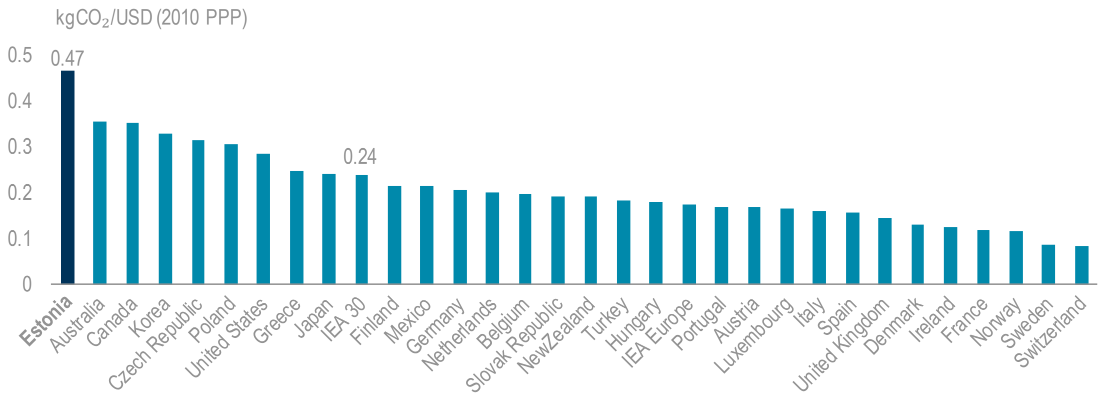

Despite substantial economic growth per capita, energy-related $CO_2$ emissions have been stable, thanks to reduced energy intensity of the economy and a slightly declining population.

Notes: GDP = gross domestic product; TPES: total primary energy supply. Real GDP in USD 2010 prices and purchase power parity.

Source: IEA (2019), *$CO_2$ Emissions from Fuel Combustion 2019*, www.iea.org/statistics.

Despite some improvements in energy and carbon intensities, Estonia has the highest $CO_2$ emissions per GDP among IEA member countries, by a large margin (Figure 7.4). Furthermore, where many countries have reduced their carbon intensities, Estonia's has remained relatively stable at a high level (Figure 7.5).

### Figure 7.4 $CO_2$ intensity in IEA member countries, 2016

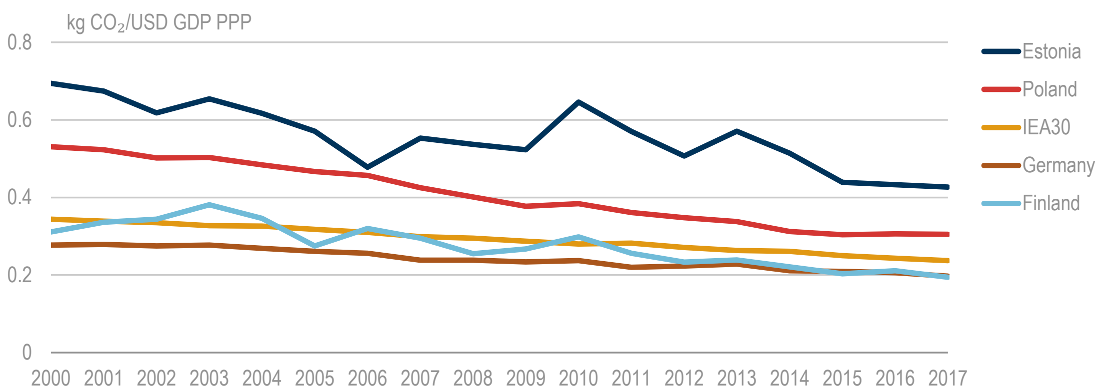





Estonia's economy is by far the most $CO_2$ intensive among IEA member countries.

Source: IEA (2019), *$CO_2$ Emissions from Fuel Combustion 2019*, www.iea.org/statistics.

### Figure 7.5 $CO_2$ intensity in Estonia and selected IEA member countries, 2000-17



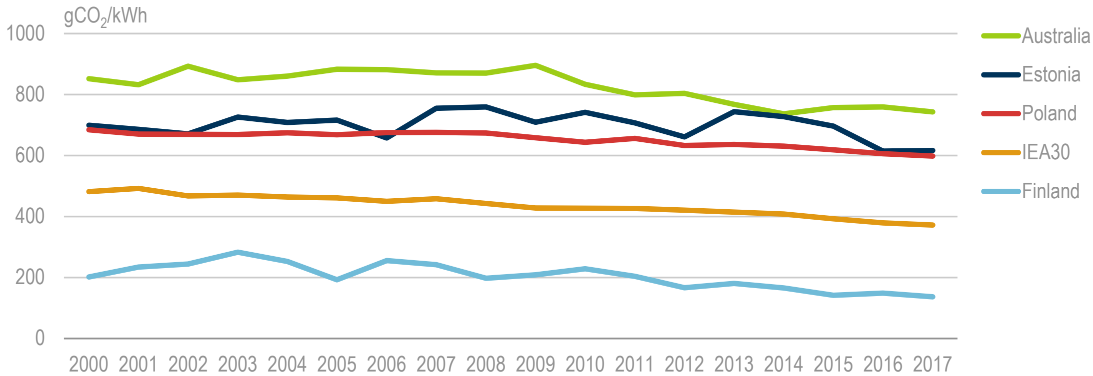



Estonia's $CO_2$ intensity declined rapidly in the 1990s, but has stabilised at a level significantly above all other IEA member countries.

Source: IEA (2019), *$CO_2$ Emissions from Fuel Combustion 2019*, www.iea.org/statistics.

The high carbon intensity comes from Estonia's dependence on oil shale in the power sector (see Chapter 3). Estonia has the second-highest $CO_2$ intensity of heat and power generation among IEA countries, after only Australia. In 2017, Estonia's heat and power generation emitted on average 617 $gCO_2$ per kWh, 66% above the IEA average of 372 $gCO_2$ per kWh (Figure 7.6).

**Figure 7.6 $CO_2$ intensity of power and heat generation in selected IEA member countries, 2000-17**






$CO_2$ intensity in heat and power generation has been stable at a high level, due to the large reliance on oil shale, which is the main reason for Estonia's high carbon intensity overall.

Source: IEA (2019), $CO_2$ Emissions from Fuel Combustion 2019, www.iea.org/statistics.

## Climate policy framework

### *The EU climate framework*

As an EU member state, Estonia's climate policy is guided by the climate policies of the European Union, the 2020 climate package and the 2030 climate framework. Member states are jointly committed to reducing EU-wide GHG emissions by 20% below 1990 levels by 2020 and by at least 40% by 2030 compared to 1990. Specific targets exist for the Emission Trading System (ETS) and the non-ETS sector.

The ETS is a cap-and-trade system for large power and heat plants (at least 20 thermal megawatt [$MW_{th}$]) and heavy industry. It covers around 45% of the EU's total emissions. By law, the ETS sector must reduce emissions by 21% below the 2005 level by 2020 and by 43% from 2005 to 2030 (EC, 2018a). This is an EU-wide target, without national sub-targets. The ETS sector emissions are thus mainly subject to the EU policy framework.

The non-ETS sector includes transport, residential and commercial sectors, non-ETS industry, agriculture, and waste management. They are covered under the EU Effort Sharing Decision (ESD). The EU-level targets for GHG reductions in the non-ETS sectors are 10% by 2020 and 30% by 2030, compared with 2005 levels. While the EU-ETS target applies for the EU as a whole, the EU-level target for the non-ETS sector is translated into binding targets for each member country.

Estonia will very likely achieve its non-ETS target for 2020 to limit emission growth to 11% above the 2005 level (EEA, 2018) as emissions were 2% below the 2005 level in 2017. Estonia's non-ETS target for 2030 is a reduction of 13% compared to 2005 (EC, 2018b).

In 2016, 68% of Estonia's total GHG emissions and 75% of its energy-related $CO_2$ emissions were in the ETS (MoE, 2019a). This is a substantially larger share than the EU average due to the importance of oil shale in Estonia's energy sector. As such, emission mitigation in Estonia is largely determined by EU policy and the $CO_2$ prices set under the ETS.

## Domestic climate policies

The IEA commends Estonia for the approval of its first climate strategy. In April 2017, the Estonian parliament, the Riigikogu, approved the "General Principles of Climate Policy until 2050" (GPCP 2050), outlining the vision for the transformation of Estonia into a low-carbon economy and society. The key focus of the GPCP 2050 is the decoupling of economic growth from the use of primary raw materials (Riigikogu, 2017).

The GPCP 2050 sets the country's first domestic emission targets: reducing GHG emissions by 80% by 2050, compared to 1990 levels, in line with the EU's 2050 climate roadmap. Sub-targets towards 2050 are reaching a 70% reduction of GHG emissions by 2030 and a 72% reduction by 2040, both compared to the 1990 level (Riigikogu, 2017). In 2017, total GHG emissions were 51% below the 1990 level (MoE, 2019a).

The GPCP 2050 replaced several other policies and guidelines in an effort to make climate policy more coherent. The principles and guidelines in the GPCP 2050 are taken into account when preparing and implementing cross-sectoral and sectoral strategies and national development plans. Sectoral policy guidelines are provided for: 1) energy and industry; 2) transportation; 3) agriculture; and 4) forestry and land use. In addition, the GPCP 2050 also includes general guidelines for adapting to climate change which are further elaborated on in the 2017 Climate Change Adaptation Development Plan until 2030.

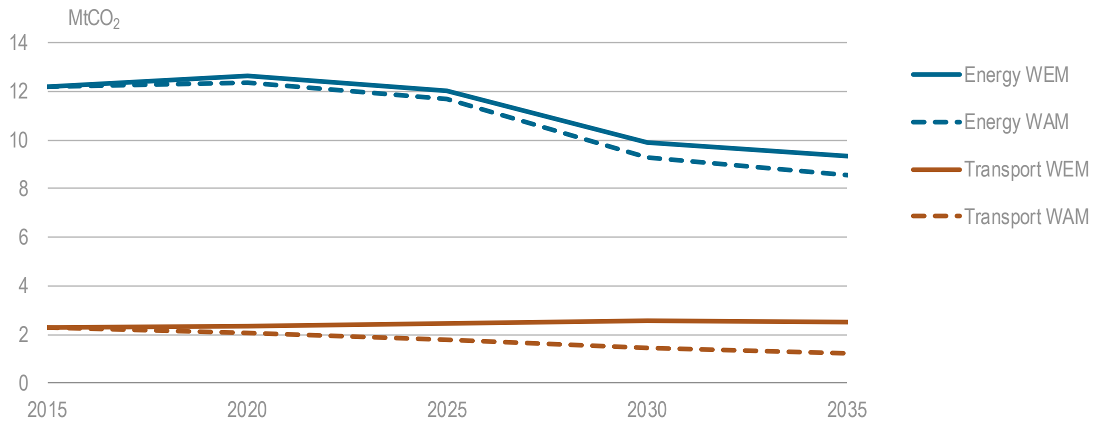
While the GPCP 2050 sets out the general guidelines and policy principles, it falls short of specifying a detailed plan of action and funding support. The discussion on how to reach 2030 and 2050 climate targets is in the early stages and specific measures and programmes have not yet been determined; the government expects them to be in place at the beginning of 2021.

The targets and principles of the GPCP 2050 are further elaborated on in the 2017 *National Development Plan of the Energy Sector until 2030* (NDPES 2030) that replaced the earlier NDPES 2020 (MEAC, 2017). The NDPES is based on studies that developed two emission scenarios, "with existing measures (WEM)" and "with additional measures (WAM)".

In the WEM scenario, total $CO_2$ emissions from the energy sector decrease by 15% to 13.2 mt/$CO_2$ in 2035 compared to 2015. This is mainly driven by the 23% projected decrease of $CO_2$ emissions from the energy industries sector; emissions in the transport sector are expected to increase. In the WAM scenario, total $CO_2$ emissions from the energy sector fall by 28% over the same timeframe. In the WAM scenario, emissions from the transport sector fall by 45% and emissions from the energy industries by 30% (MoE, 2017) (Figure 7.7).

The industry, service and residential sectors account for less than 10% of total emissions. Emissions in the industry sector are expected to increase under both the WEM and WAM scenarios. Under the WEM scenario, emissions from the service and residential sectors will increase marginally and under the WAM scenario they will decrease by about 10%. Reductions in these sectors are mainly the by-product of energy efficiency and renewable policies. The GPCP 2050 also highlights the role of economic policies aimed at transforming the economy towards higher value addition as a contributing factor for emissions reductions.

**Figure 7.7 Emission development to 2035, Estonia**






Note: $MtCO_2$ = million tonnes of carbon dioxide; WEM: with existing measures; WAM: with additional measures. Source: MoE (2017), *Estonia's Third Biennial Report under the United Nations Framework Convention on Climate Change*, https://unfccc.int/sites/default/files/resource/5806321_Estonia-BR3-2-BR3_EST_resubmission.pdf.

Heat producers in the district heating sector must pay a pollution charge for emitting $CO_2$. Since 2009, the rate is EUR 2/$tCO_2$. Companies can avoid the charge by investing in environmental protection measures which reduce pollutants or waste by 15% from their initial value. The charge also used to apply to electricity generators, but since January 2008, these are instead subject to an excise duty of EUR 4.47 per megawatt hour. The excise duty has not increased since 1 March 2011. There are currently no plans to introduce market-based $CO_2$ emission pricing outside of the ETS. The government will, however, consider reforming the domestic $CO_2$ pricing if the country is not on track for reaching its 2030 targets.

## *Policies to reduce emissions from the electricity sector*

Estonia's oil shale electricity plants are covered under the ETS. The future of oil shale electricity generation therefore depends mainly on $CO_2$ price developments within the ETS and EU environmental directives with regard to other emissions besides $CO_2$. The Estonian government sees the eventual phase-out of oil shale-based electricity production as inevitable and has no plans to introduce additional policies beyond the EU framework to accelerate this development.

In August 2018, the country's largest power producer, Eesti Energia[1], announced the closure of four old and inefficient oil shale generation units at its Narva power station during 2019. The units have a combined capacity of 619 MW. The closure is required to comply with the EU Industrial Emissions Directive (2011). Under the directive, combustion power plants either had to invest in environmental upgrades, or could opt for "limited lifetime derogation" for an additional 17 500 operating hours, or until 2023, whichever comes first (ICIS, 2018). Eesti Energia's unit has now reached the additional operating hours ceiling.

[1] Annex A provides more detailed information about institutions and organisations with responsibilities related to the energy sector.

The new 300 MW Auvere plant partly compensates for the capacity of the units closing down in 2019. The Auvere plant uses circulating fluidised bed generating units that are less emission-intensive. The plant was officially commissioned in 2018, though it has been connected to the grid since 2015 and operated with a reduced capacity factor during the trial operation. The Auvere plant can operate using multiple fuels and can either operate on 100% oil shale or can use up to 50% of biomass, up to 20% of peat and up to 10% oil shale gas. In February 2014 Eesti Energia announced that it cancelled earlier plans to build a second 300 MW unit. This is in line with the company's strategy to focus more on shale oil production that produces electricity as a by-product instead of using oil shale outright for electricity production (ERR Media, 2014) (see Chapter 3).

Phase III of the EU-ETS for the period 2013-20 has set a single, EU-wide limit on emissions. The number of $CO_2$ allowances for power stations and other fixed installations is reduced by 1.74% annually. Under Phase IV of the ETS (2021-30), the rate of decline is higher, at 2.2% annually. Estonia falls under the scope of Article 10c of the EU-ETS Directive (2009/29EC) that provides derogation from the requirement to auction all $CO_2$ allowances for power plants which was introduced under Phase III of the ETS (2013-19). Instead, Estonia is provided 18 million of transitional free $CO_2$ allowances for power plants under the ETS for the period 2013-19. The free allowances are deducted from the quantity that the respective member state would otherwise auction. The objective of the derogation is to encourage investments in the modernisation of the electricity sector, diversification of the fuel mix and to achieve carbon reductions. The value of the investment must be at least as high as the value of the free allowances received (MoE, 2017).

Eesti Energia receives a certain amount of free transitional allowances. For example, the Auvere plant received around 17.7 million tonnes of free $CO_2$ emission allowances for the period to 2019. However, the free allowances are not sufficient to cover all emissions from oil shale electricity generation. Eesti Energia must therefore buy additional certificates. The EU-ETS price increased significantly in the second half of 2018 to around EUR 20/tonne $CO_2$, up from an average of about EUR 7/tonne $CO_2$ from 2012 to 2017. With the new rules for Phase IV of the ETS, prices are expected to reach over EUR 30/tonne $CO_2$ by the early 2020s. Fewer carbon allowances will need to be purchased once Eesti Energia reduces the share of its oil shale generation, making electricity more competitive.

The government anticipates that the average $CO_2$ intensity of electricity generation will decline to 400-450 g/kWh by 2030 as a result of the shift from oil shale fired generation (NDPES 2030). This compares to a $CO_2$ intensity of 660 g/kWh for heat and electricity production in 2016.

## Policies to reduce emissions from the transport sector

Transport accounts for 39.3% of emissions in the non-ETS sector. In 2017, the share of transport in Estonia's total emissions was 11.7%, and 13.2% of energy-related emissions. Emissions in the transport sector have been rising steadily; in 2017, they reached their highest level since 2007, and were just 1.4% below their peak level of 1990 (MoE, 2019a).

Within the transport sector, emissions from road transport (passenger and freight) accounted for 96% of total emissions in 2017. Road transport emissions were 4% higher in 2017 than they were in 1990 (MoE, 2019a). Ownership of passenger cars continues to rise, reaching just over 700 000 in 2016, up by 17% over a five-year period (Eurostat, 2018). The number of passenger cars per 1 000 inhabitants was 534 in the same year, the ninth-highest share in the EU, and exceeding the EU average of 505. This is a remarkable change since the last IDR. At that time Estonia had 407 cars per 1 000 inhabitants compared to 503 for the EU-15 average at the time (IEA, 2013). Halting the trend of ever-increasing emissions from passenger cars requires swift implementation of ambitious policy measures to keep the transport sector on track for the country's 2030 non-ETS emissions reduction targets.

Railways only account for a marginal share of transport emissions, at 2.3% in 2017, as the rail network density is among the lowest in Europe (MoE, 2019b). The share of freight being transported by rail has been continuously decreasing in favour of road transport.

The National Transport Development Plan 2014-2020 is the guiding transport policy. The government is in the process of updating the plan, which is expected to be completed by the end of 2020 and to be introduced to parliament in the beginning of 2021. Transport is also a special topic in the NDPES 2030 and the GCPC 2050, and is an integral part of Estonia's spatial development plan to 2050. Planning and spatial development will reduce transport needs by ensuring that people can access their daily needs (school, shops, medical services, entertainment) by either walking or using public transport. In addition, the government expects that continuous technological development will improve the conditions for teleworking and therefore reduce commuting.

The government anticipates that in order to meet the 2030 emission target in the non-ETS sector, the majority of efforts and policies should concentrate on the transport sector. The government has identified four priority areas: 1) energy efficiency of the vehicle fleet; 2) alternative fuels and technologies; 3) public transport and mode shifting; and 4) taxation.

## Improving the energy efficiency of the vehicle fleet

In 2016, Estonia's passenger car fleet was the second-oldest in the EU (after Poland), with 28% of the vehicle stock 20 years old or older (Eurostat, 2018). Over 62% of the passenger car fleet has a petrol engine. Estonia has the highest share of large petrol-fired engines (above 2 000 $cm^3$) among all EU countries, at 11.5% of its total passenger car fleet. The situation is similar for diesel-powered engines; here the share of diesel engines exceeding 2 000 $cm^3$ is 16.6%, second only to Latvia. As a consequence, Estonia was the only country in the EU in 2016 were the average $CO_2$-specific emissions from newly registered cars at 134 $gCO_2$/km were higher than the EU's target of 130 $gCO_2$/km. However, the average $CO_2$ emissions from new passenger cars in Estonia has significantly dropped from its peak of 183.7 $gCO_2$/km in 2005 (EEA, 2017).

While the government is aware of these trends, it has not yet specified a detailed action plan to address them beyond introducing the compulsory EU energy-labelling scheme for new passenger cars in 2016. The public sector will be acting as a role model through its procurement policies (Riigikogu, 2017). The government is also considering introducing a smart tax environment to improve the energy efficiency of the vehicle stock, although no details have yet been specified (MEAC, 2017).

## Alternative fuels and technologies

Alternative fuel vehicles, like electric vehicles, compressed natural gas (CNG) and biomethane are only slowly making inroads. In 2016, Estonia's passenger vehicle fleet had the fifth-lowest share of alternative energy engines among all EU countries, at 0.23%. When it comes to newly registered passenger cars with alternative fuels, Estonia has the second-lowest share at 0.15% in 2016, behind Cyprus (Eurostat, 2018).

The government has provided investment support and fiscal incentives to promote electric vehicles. From July 2011 to July 2014, the Estonian Electromobility programme (ELMO) installed 167 quick-charging stations throughout the country and provided grants for the purchase of around 1 000 electric vehicles (EV). The public sector acquired 500 EVs under the programme for its social service workers in the countryside. The programme also provided grants for the purchase of plug-in hybrid vehicles. In addition, 197 normal-charging stations were installed in the country under the programme, mainly in private residences. The government plans to sell the existing quick-charging infrastructure to the private sector. Since the support programme ended in 2015, the growth of EVs and charging points has slowed down. In 2018, there were 1 258 EVs and 395 publicly available charging stations (EAFO, 2019).

The government may need to take a more active role in supporting E deployment. The IEA thefore welcomes the proposed launch of a new EV support scheme for heaviliy used vehicles such as taxis as a step in the right direction.

Since late 2015, the government has been providing subsidies for the establishment of biomethane filling stations and grants to public bus operators that use biomethane as a fuel. Since 2018, biomethane is locally produced, which also helps address emissions from the agricultural sector. The target for 2020 is a share of 3-4% of biomethane use in the transport sector, including for public sector bus services. Biomethane will supplement the use of CNG. Currently, about 15 CNG stations are operational and the use of CNG in transport is growing strongly, albeit from a low base, tripling between 2017 and 2018 to reach 60 gigawatt hours (GWh), or 6 mcm (see Chapter 6).

Biomethane would further the country's objective of reducing the use of imported energy to the maximum possible. And it would also support Estonia's obligation to reach 10% of renewable energy in transport fuels. Policy emphasis is also placed on increasing the obligation for biofuel blending in the liquid fuels market, where Estonia has made limited progress towards the 10% blending target by 2020 (see Chapters 4 and 8).

## Public transport and mode shifting

The number of railway passengers increased by 90%, from 4.2 million in 2013, the year the railway reconstruction was completed, to 7.8 million in 2018 (Statistics Estonia, 2019). This is a result of the government's investment in the upgrading and extension of the public transport network, the introduction of new inter-city and suburban services, and the modernisation of the rolling stock. Electrification of rail presents a notable opportunity to increase the share of renewables in transport as the Estonia rail network currently relies heavily on diesel fuel (EC, 2019).

A tram line linking the city centre of Tallinn to the international airport was opened in 2017. An extension to connect with the old city harbour is under construction and expected to be operational by the latest in 2022. Under a multimodal transport programme, public parking has been created next to the train stations to address issues of last-mile connectivity that might prevent passengers from shifting to public transport.

Experience from the provision of free public transport in Tallinn since 2013 (Box 7.1) shows that it needs to be combined with other measures to be effective in encouraging a modal shift. One such measure is the creation of dedicated bus lanes. Other measures make private car use more expensive at the municipal level by, for example, increasing parking fees and reducing the availability of parking places. The government is also encouraging the shift from motorised traffic to walking and cycling by increasing the number of sidewalks and bike lanes and providing more bike racks.

## Taxation

Estonia does not have a carbon tax on transport fuels and does not plan to introduce one in the near future. The government has indicated that it would consider the introduction of a carbon tax if the country is not on path towards meeting its emissions reduction targets for 2030 and beyond.

There is also no vehicle registration tax, or any other tax based on carbon emissions of vehicles. An excise duty is levied on gasoline and diesel. In 2015, the Estonian parliament decided to increase the fuel excise duty by 10% annually over the following three years. The excise tax on petrol was last increased in January 2018 and is now EUR 563 for 1 000 litres. The excise tax for diesel was last increased in February 2017 and stands at EUR 493 per 1 000 litres.

Estonia also does not levy any user charges for private vehicles, neither at the country or the city level. The city of Tallinn has considered introducing user charges as one option to reduce congestion and encourage a modal shift, albeit without any specific timeline.

However, since 1 January 2019, a road toll applies to all heavy goods vehicles (HGV) weighing above 3.5 tonnes. All HGVs that use the Estonian public road network have to pay the toll independent of the country of their registration. HGVs are categorised by their weight, emission class and number of axles. In addition, the toll rate varies with the number of days the vehicle is using the roads in Estonia. The toll ranges from EUR 9/day for HGVs up to 12 tonnes to EUR 1 300 annually for an HGV above 12 tonnes, with 4 or more axles and EUR 0 to II emission class (Road Administration, 2019a; Road Administsration, 2019b).

### Box 7.1 Estonia pioneering free public transport

Estonia is a pioneer in the provision of free public transport. On New Year's Day 2013, Tallinn became the first capital city in the European Union to provide free public transport for all permanent city residents. Free travel is offered on all buses, trams, trolley buses and trains in Tallinn as well as on the ferries connecting Tallinn to outlying islands. Eligible users identify themselves and validate their journey through the use of a smartcard, the so-called green card.

The funding of the scheme is linked to the number of residents in Tallinn. For each registered resident, the Tallinn municipality receives a portion of the national income tax paid by the resident. Tallinn had 419 820 residents when the scheme was launched in 2013 and their number had risen to 450 850 in August 2018. According to the Tallinn city government, the increased municipal tax collection has more than compensated the foregone revenues from ticket sales. Tallinn's gain in revenues comes at the loss of revenues of other counties and municipalities that have seen the number of their residents decline.

A verdict on the success of the scheme largely depends against which objectives it is judged. Early evaluations of the scheme showed that within the first year, the use of public transport increased by 14%. Vehicle traffic congestion increased by roughly the same amount due to a one-third increase of the total vehicle-kilometres despite a 5% decrease in the share of car users. Further evaluation showed that at the end of 2016, public transit use had declined since 2014 and the use of private cars had further increased. Free public transit also has a negative effect on people walking and cycling, as shorter trips are now made more frequently by free public transit. Use of public transport by low-income and unemployed residents increased measurably, but a direct link to improved employment opportunities could not be established. Evidence hence indicates that the provision of free public transport on its own is not sufficient to encourage a large-scale modal shift, but should ideally be combined with other policy measures, primarily by making individual car use more expensive.

In July 2018, the provision of free public transport was extended to bus travel within 11 of Estonia's 15 counties, the so-called counties lines. The central government is providing a subsidy of EUR 34.8 million for this initiative. Travel within the municipalities of the 11 participating counties and between counties is not included and users continue to pay for their fare. Unlike in Tallinn, the provision of free transport on the intra-counties bus lines is not limited to the place of residence. Users must, however, validate their travel by using the green card, primarily for data collection purposes needed to evaluate the impact of the scheme and to facilitate the planning of future bus services. An early evaluation of the programme shows that the free provision of county bus transport had an immediate impact. By November 2018, passenger numbers had increased by 27% compared to 2017 and there was also a 5% increase in line kilometres offered.

Sources: Cats, O., Y.O. Susilo and T. Reimal (2016), "The prospects of fare-free public transport: Evidence from Tallinn", https://link.springer.com/content/pdf/10.1007%2Fs11116-016-9695-5.pdf; Country submission; Turay, A. (2018), "A free ticket to ride: How Estonia is leading the world in a free transit revolution", http://estonianworld.com/opinion/a-free-ticket-to-ride-how-estonia-is-leading-the-world-in-a-free-transit-revolution/?fbclid=IwAR0dtuPaZVCUladVg7RnEZGMklEq1HUnuloIMSQTXzuB9S8z04PP7AlvcOE; Tallinn (2017), *The Right of Free Travel and Documents Evidencing the Right*, https://www.tallinn.ee/eng/pilet/The-Right-of-Free-Travel.

## Assessment

Reliance on oil shale gives Estonia the highest carbon intensity of GDP among all IEA member countries. In 2017, energy-related $CO_2$ emissions were less than half of their 1990 level due to the restructuring of the country's economy away from heavy industry towards the service sector. However, emissions have stabilised, largely due to the increased production and consumption of oil shale.

Power and heat generation accounted for three-quarters of total emissions in 2017 due to the high reliance on oil shale for power generation. The $CO_2$ intensity of Estonia's heat and power generation is significantly higher than the IEA average and is second only to Australia. The future emissions reduction path must therefore come from the oil shale sector.

Emissions from Estonia's power and large industry sectors participate in the EU-ETS. The price in the ETS is therefore the key determinant for the future of oil shale electricity generation, especially since the government does not have any plans to put in place additional domestic policies to expedite the exit from oil shale electricity.

Eesti Energia is preparing to gradually phase-out oil shale power generation towards 2030, driven largely by anticipated ETS price developments that will render oil shale-based power increasingly uncompetitive. As a first step, about 30% of the oil shale generation capacity, mainly old and outdated plants that have reached the end of their technical lifetime, will be decommissioned by 2020. Given the important economic and social dimensions of the oil shale sector, especially in eastern Estonia, the country has implemented a comprehensive programme to modernise the remaining oil shale generation fleet so it can be co-fired with up to 50% of domestically produced biofuels. This will help reduce the $CO_2$ intensity of power generation. However, plans to partially substitute oil shale with locally sourced peat in the same plants will somewhat negate the positive emission impact of reducing oil shale generation. The carbon content of peat is 4.44 $ktCO_2$/ktoe while that for oil shale is 4.47 $ktCO_2$/ktoe.

Estonia will continue exploiting its large oil shale resources, but will focus on production of liquid fuels instead of electricity. Compared to oil shale electricity, the production of shale oil is more than twice as efficient and has lower $CO_2$ emissions.

Emissions from non-ETS sectors are subject to the EU's ESD. The transport sector dominates non-ETS emissions, followed by the commercial sector then the residential sector. The ESD allows Estonia to increase its non-ETS emissions by 11% by 2020 compared to 2005 levels. In 2017, non-ETS emissions were 1% below the 2005 level, implying that Estonia will most likely meet its 2020 target. The IEA congratulates Estonia for this achievement.

The EU has set new targets for the non ETS sector for 2030, and for the first time Estonia will be required to reduce its non-ETS emissions, by 13% from 2005 to 2030. This is an ambitious target as the bulk of future emissions reductions will likely need to be delivered by the transport sector. The current policy measures targeting the transport sector appear unlikely to deliver the required savings to meet the 2030 non-ETS emission targets, and the domestic targets set by Estonia under the GPCP 2050.

Emissions in the transport sector have steadily increased and have almost reached their peak level of 1990 again, driven by increasing incomes and demand for mobility. Ownership of passenger cars is higher than the EU average, and the cars are also older and larger than the EU average. There is currently no sign that this trend will reverse in the short- to medium-term future. Arguably the introduction of biomethane and pilot electro-mobility schemes, in combination with investments in public transport infrastructure, has limited an even stronger increase in transport emissions. Until now, the lack of progress in decarbonising the transport sector has been compensated by the excellent progress made in promoting renewable fuels in heating and the upgrading and renovation of installations in the district heating system.

However, with the progress already made, the scope for further improvements in the heating sector is narrowing. As other sectors reach their limit in contributing to Estonia's renewable energy and climate targets, the government will have to take a more dedicated and focused approach on the transport sector. Estonia is promoting a modal shift and has heavily invested in upgrading and expanding the railway and local rail system. Railway passenger kilometres have significantly increased since the work was completed in 2013.

Estonia was among the global leaders in supporting electric mobility and has a country-wide fast-charging network. Yet, the future of the electric mobility programme is uncertain as the government is now shifting policy and financial support towards the promotion of biomethane. It is important to ensure that the existing EV infrastructure remains relevant to avoid users shifting back to combustion engine cars.  Electrification of transport would also support the government's goal to switch from imported to domestic energy sources and would substantially contribute to lower local air pollution.

Estonia has a large and unexplored potential to use taxes as an instrument to steer behaviour in the transport sector. Currently, there are no vehicle registration or road-use taxes levied on private vehicles in Estonia. Studies show that such taxes, differentiated to $CO_2$ emissions of cars, could have the strongest impact on reducing emissions from the transport sector. Most IEA member countries tax private combustion vehicles in one way or another, while supporting electric vehicles, and have seen positive impacts on buying and usage behaviour. The IEA encourages the Estonian government to closely study those examples with a view to their applicability in Estonia. The IEA also encourages the government to develop a dedicated strategy and roadmap for addressing transport sector emissions to 2030 and beyond, which will be critical if Estonia is to meet its long-term emission targets.

In April 2017 the parliament of Estonia adopted the country's first low-carbon strategy, the "General Principles of Climate Policy until 2050", that sets a target to reduce greenhouse gas emissions by 80% in 2050 compared to the 1990 level. Intermediate targets aim at a reduction of 70% in 2030 and by 72% in 2040. Reaching these targets will require determined and timely action to decarbonise the electricity and transport sectors. Currently, there is neither a specific action plan with programmes and measures in place to ensure meeting the targets of the GPCP, nor has a detailed monitoring and evaluation system been developed. The IEA encourages the government to prioritise the development of both of these tools.

## Recommendations

***The government of Estonia should:***

- ☐ Regularly monitor progress towards climate goals, take action to rebalance sectoral targets, and strengthen policies and measures to best manage meeting those targets, if necessary.
- ☐ Commit to not facilitate any new oil shale fired power generation plants to avoid a carbon lock-in.
- ☐ Introduce a taxation system and/or expand road-use charges for all vehicle types to introduce price signals to reflect externalities. Consider different options available, e.g. vehicle registration taxes, following the examples set in other IEA member countries.
- ☐ Develop a comprehensive set of emissions reduction pathways for the transport sector towards 2030 and beyond, and review them on a regular basis to take corrective measures as required.

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# 8. Renewable energy

## Key data

(2018 provisional)

**Renewable energy:** 1.1 Mtoe (20.3% of TPES) and 2.0 TWh (16.5% of electricity generation)

**IEA total renewables shares (2017):** 9.9% of TPES and 24.6% of electricity generation

**Bioenergy:** 1.0 Mtoe (18.2% of TPES) and 1.3 TWh (10.2% of electricity generation)

**Wind:** 0.06 Mtoe (1.0% of TPES) and 0.6 TWh (5.2% of electricity generation)

**Hydro:** 0.001 Mtoe (0.02% of TPES) and 0.02 TWh (0.1% of electricity generation)

## Overview

Since the 2013 In-depth Review, the share of renewable energy sources in total primary energy supply (TPES) has risen slightly, from 15.6% in 2012 to 19.2% in 2018. The share of renewables in electricity generation experienced limited growth over this period, increasing from 12.3% to 16.5%.

Biomass from domestic forestry continues to be the main source of renewable energy in Estonia. In 2018, bioenergy (mostly primary solid biofuels, but also a minor share of biogas and biogasoline) accounted for 95% of the renewable energy share in TPES. Bioenergy also remains the dominant source of renewable heat production. In contrast, 2018 renewable electricity generation was more evenly divided between bioenergy (66%) and wind generation (33%), with small contributions from hydropower.

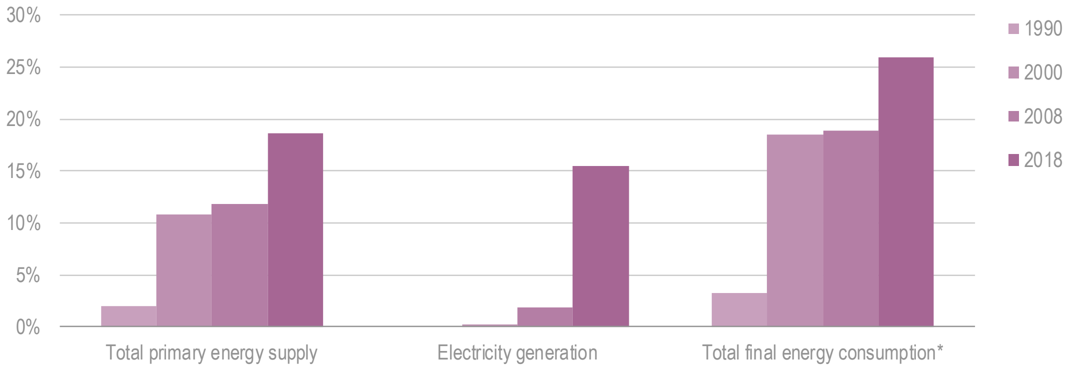
Estonia's renewable energy share of gross final energy consumption was 29.2% in 2017, well above the country's mandatory EU 2020 target of 25% (EC, 2019). Little progress has been made towards the mandatory EU 2020 target of 10% renewables in transport, which in 2017 was only 0.32%, essentially unchanged since the last In-depth Review.

Looking to 2030, Estonia has established goals for renewable energy shares of up to 50% in both gross final energy consumption and electricity generation and renewable energy shares of 80% in heat production and 14% in transport. These goals appear to be achievable, but require the government to develop strategic plans with clearly defined deployment pathways that address the challenges to an accelerated renewable energy deployment.

# Renewable energy supply and consumption

Figure 8.1 gives the evolution of renewable energy shares in the key metrics of TPES, electricity generation and total final consumption (TFC) and shows that in the last decade, the shares of renewables have increased at a rapid pace in all three metrics. Since 2010, the increase of renewables in TPES and TFC has slowed, indicating that Estonia has entered a new era were strong growth in renewables requires a more co-ordinated renewable energy policy to identify and address key barriers.

**Figure 8.1 Share of renewable energy in TPES, electricity and TFC, 1990-2018**






* Includes direct use in total final consumption and indirect use through electricity and heat consumption. Latest data are from 2017.

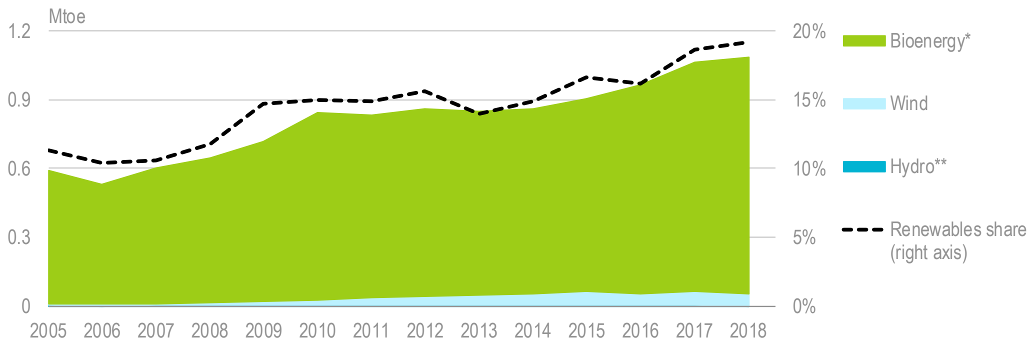
Note: Data for 2018 are provisional.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

## *Renewable energy in total primary energy supply*

Figure 8.2 gives the renewable energy contribution to TPES, which grew from 11.7% to 19.2% between 2008 and 2018. Bioenergy was the dominant source of renewable energy, accounting for 95% of renewables in TPES in 2018, down from 98% in 2008. The growth in wind power helped bring some diversification to the mix of renewables. From 2008 to 2018, wind power experienced a seven-fold growth, and increased from 0.2% to 1.0% of TPES.

**Figure 8.2 Renewable energy in TPES, 2005-18**





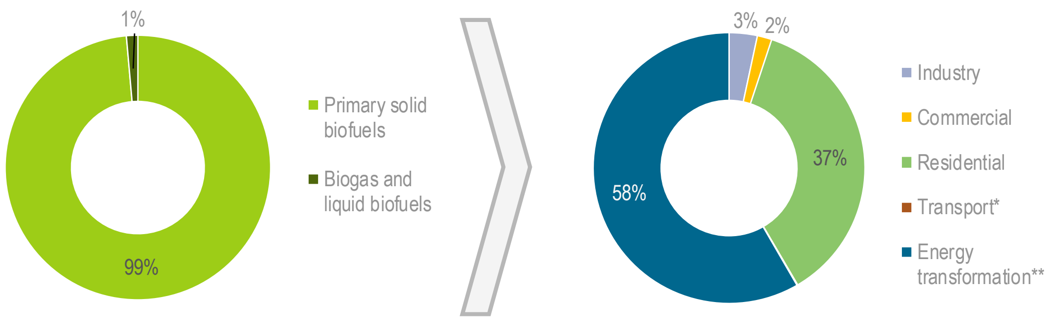

* *Bioenergy* includes solid primary biofuels, liquid biofuels, biogases and renewable municipal waste.

Notes: Mtoe = million tonnes of oil-equivalent. Supply data for 2018 are provisional. Total primary energy supply includes conversion losses for bioenergy fuels in heat and power generation, which is not the case for hydro, wind or solar.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

Figure 8.3 shows the resources mix of Estonia's bioenergy supply, which totalled 1.0 Mtoe in 2018. Primary solid biofuels sourced from domestic forestry account for 99% of the supply. In addition to the domestic supply, Estonia produces solid biofuels for export, which account for around one-third of total domestic bioenergy production.

### Figure 8.3 Bioenergy supply by source and use by sector, 2017






* Not visible on this scale.

** Energy transformation is mainly electricity and heat generation from primary solid biofuels and waste.

Notes: Mtoe= million tonnes of oil-equivalent. Percentages of bioenergy supply by source in 2018 are the same as 2017. Total supply of bioenergy in 2018 was 1.03 Mtoe. In addition, there was 0.06 Mtoe of non-renewable municipal waste in Estonia's total primary energy supply in 2018.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

The share of the bioenergy supply consumed to produce heat and electricity is 58%. District heating accounted for 97.1% of biomass consumption for heat and electricity, with a relatively even split between combined heat and power (CHP) plants and heat-only boilers (Table 8.1). Co-firing of biomass with shale oil in electricity-only plants accounted for just 2.9% of biomass consumed for heat and electricity.

### Table 8.1 Biomass consumption for heat and electricity by plant type, 2017

| Plant type | Consumption (ktoe) | Share of biomass use in heat and power |
|---|---|---|
| Combined power and heat (district heating) | 276 | 53% |
| Heat only (district heating) | 230 | 44% |
| Electricity only | 16 | 3% |
| **Total** | **522** | |

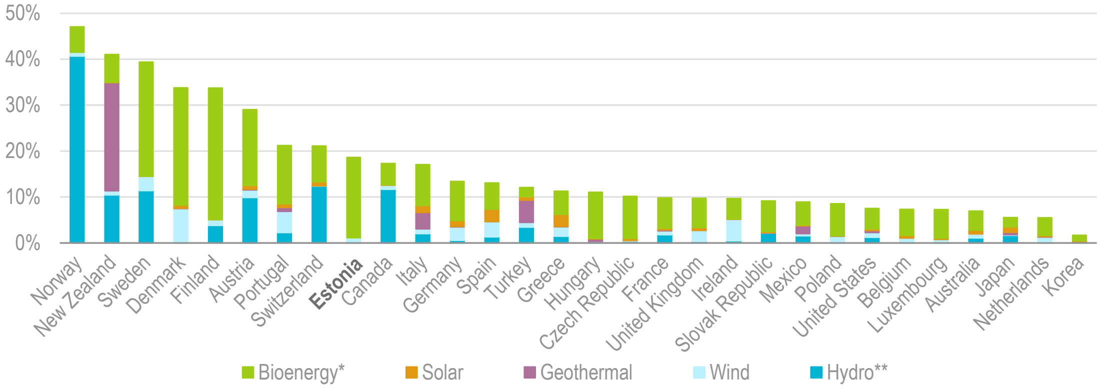
Note = ktoe: kilotonne of oil equivalent.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

In 2017, 37% of the total biomass supply was burned in smaller distributed systems that provide heat to residential sector consumers that do not use district heating. These smaller systems play a key role in meeting Estonia's heat demand, covering about half of residential heat demand in 2017 (IEA, 2018b).

Estonia ranked ninth among IEA countries in the share of TPES from renewables in 2017 (Figure 8.4). Among the countries approaching or exceeding 20% renewables in TPES, Estonia has the highest share of bioenergy in its renewable energy mix. A diversification of renewable energy sources could help Estonia maintain its strong position in the share of renewables in TPES.

**Figure 8.4 Renewable energy share of TPES in IEA countries, 2017**






* *Bioenergy* includes solid biofuels, renewable waste, liquid biofuels and biogases.

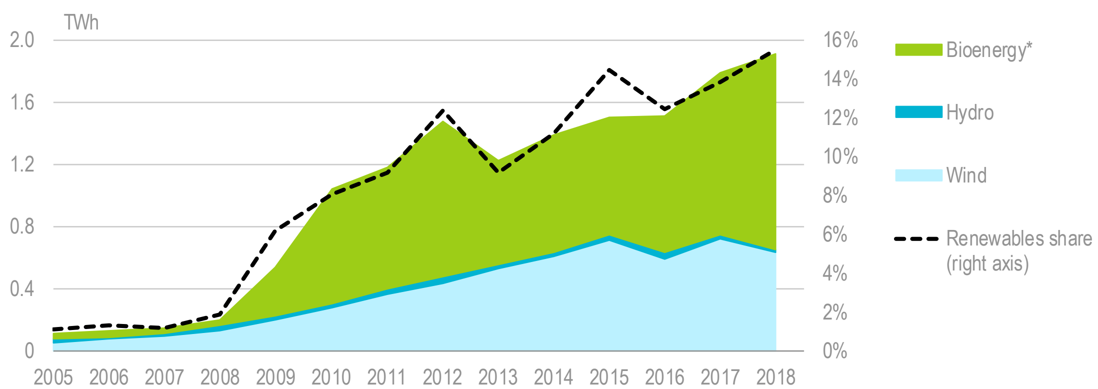
** *Hydro* includes hydro power (excluding pumped storage), and tidal, wave and ocean energy.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

## Renewable electricity generation

From 2008 to 2018, renewables expanded from just 1.9% to 15.5% of total electricity generation (Figure 8.5). This twelve-fold increase in renewable electricity was driven by increasing use of biomass and wind power deployment. Hydropower has provided a small, but consistent, contribution.

**Figure 8.5 Renewable energy in electricity generation, 2005-18**






* *Bioenergy* includes solid primary biofuels, liquid biofuels, biogases and renewable municipal waste.

Note: TWh = terawatt hour.

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

The role of bioenergy in renewable electricity generation shifted significantly from 2008 to 2018. In 2008, bioenergy accounted for just 18% of renewable electricity. In 2018, bioenergy power generation was 1.3 terawatt hours (TWh), accounting for a 66% share of renewable electricity.

Biomass CHP plants covered 86% of the bioenergy contribution to renewable electricity generation (Table 8.2). The remaining 14% came from the co-firing of biomass with shale oil in electricity-only plants.

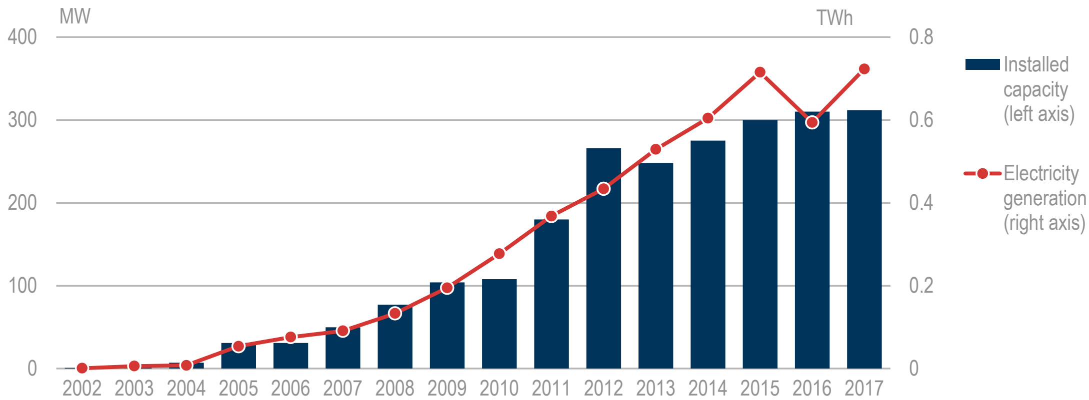
### Table 8.2 Renewable electricity from bioenergy by plant type, 2017

| Plant type | Biomass electricity | |
|---|---|---|
| | TWh | Share |
| Combined heat and power | 0.86 | 85.9% |
| Electricity only | 0.14 | 14.1% |
| Total | 1.0 | 100% |

Note: TWh = terawatt hour.
Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

From 2007-17, wind power capacity increased from 50 megawatts (MW) to 312 MW, while wind generation grew from just 0.7% to 5.6% of total electricity generation (Figure 8.6).

### Figure 8.6 Wind power capacity and generation, 2002-17





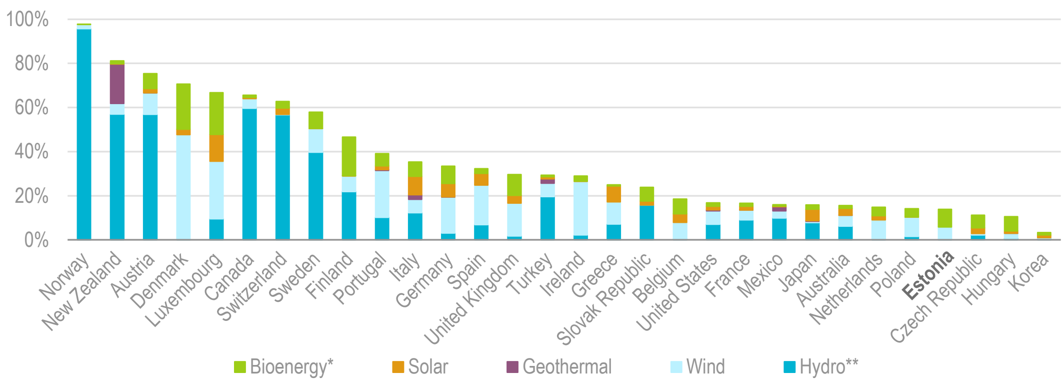

Notes: MW = megawatt. Decreased generation in 2016 resulted from a sustained period of unusually low winds.
Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

Rapid growth in wind turbine deployment has helped wind generation become a key source of renewable electricity. In 2018, wind generation accounted for 33% of Estonia's renewable electricity generation. However, since 2015, wind deployment has slowed down significantly, with only 10 MW of new capacity added in 2016 and no new capacity deployed in 2017. Estonia should rapidly identify and address the causes of the slowdown in wind power deployment.

Hydropower is the third-largest renewable electricity source in Estonia, with 6 MW of installed capacity generating 0.03 TWh in 2018 to cover 0.1% of national electricity generation. Despite its small size, hydropower still contributes to Estonia's renewable energy goals.

In 2017, Estonia's share of renewables in electricity ranked 27th among IEA countries (Figure 8.7). The experiences of other IEA countries can offer insights on the pathways to achieving the 50% share of renewable electricity laid out in the *National Development Plan of the Energy Sector until 2030* (NDPS 2030), (MEAC, 2017a).

**Figure 8.7 Share of renewables in electricity generation in IEA countries, 2017**





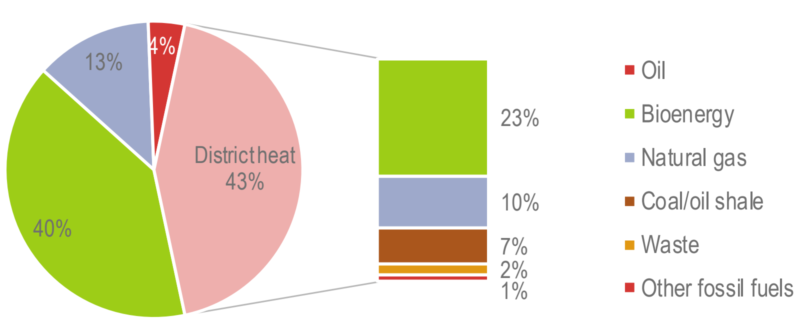

* *Bioenergy* includes solid biofuels, renewable waste, liquid biofuels and biogases.
** *Hydro* includes hydro power (excluding pumped storage), and tidal, wave and ocean energy.
Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

## Renewables in heat production

In 2017, renewable energy covered 51.6% of Estonia's heat consumption, with over 95% coming from bioenergy and 4.6% covered by heat pumps using renewable energy (Eurostat, 2018). The 2017 share of renewables in heat exceeded Estonia's 2020 target of 38.4%, but significant progress is still needed to reach the 2030 target of 80% renewables in heat consumption.

Figure 8.8 shows the breakdown by type of fuel in heat consumption in the residential and commercial sectors (excluding heat from electricity), where bioenergy covered 63% (23% from use of biomass in district heating systems plus 40% from direct use of biomass is smaller systems outside of district heating networks).

**Figure 8.8 Residential and commercial heat consumption by fuel, 2017**






Note: Excludes heat from electricity.
Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

Table 8.3 gives the breakdown of renewable heat production by plant type and shows that almost half of renewable heat production came from biomass CHP plants. CHP plants create a direct linkage between the heat and electricity sectors that allows biomass CHP to be a major driver of renewable energy in Estonia. In 2017, biomass CHP plants accounted for 48% of the renewable electricity and 44% renewable district heat.

**Table 8.3 Renewable heat production in district heat systems by plant type, 2017**

| Plant type | Heat from biomass | |
|---|---|---|
| | Terajoule | Share |
| Combined heat and power | 5 520 | 44.5% |
| Heat only | 6 892 | 55.5% |
| Total | 12 412 | 100% |

Source: IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

## *Renewables in transport*

In 2017, oil-based fuels covered 99% of transport demand in Estonia. Renewable biofuels accounted for just 0.32% of total fuel consumption. The share of biofuels has remained essentially unchanged since 2013. The government has introduced a biofuels blending mandate to meet the 2020 target of 10% renewable energy in transport (see Chapters 4 and 7).

# Targets, policy and regulation

The Ministry of Economic Affairs and Communications, the Ministry of Environment, and the Ministry of Agriculture share responsibility for the overall legal framework, policies and measures related to renewable energy[1].

Obligations established under EU Renewable Energy Directives drive Estonia's renewable energy targets and policy. The first Renewable Energy Directive (RED I) was approved in 2009 and set binding renewable energy targets for each EU member country up to 2020 (EU, 2009). Under RED I requirements, Estonia submitted a National Renewable Energy Action Plan (NREAP), detailing the plans and measures to achieve its 2020 targets.

The second Renewable Energy Directive (RED II) was approved in 2018 and covers renewable energy deployment through 2030. RED II does not include country-specific targets; instead countries are obliged to make national contributions towards the following 2030 targets for the EU as a whole:

- 32% renewables share in EU gross final energy consumption
- 14% renewables share in EU transport sector gross final energy consumption.

[1] Annex A provides more detailed information about institutions and organisations with responsibilities related to the energy sector.

Under RED II requirements, Estonia developed a draft National Energy and Climate Plan (NECP), proposing the 2030 renewable energy targets and detailing the plans and measures to achieve those targets. The draft NECP draws from and is supported by Estonia's NDPES 2030. The draft NECP was submitted to the European Commission in December 2018 and Estonia must submit the final NECP before the end of 2019.

Table 8.4 gives Estonia's 2020 and 2030 renewable energy targets (Red I and II) and the status towards achieving these targets as of 2017. In addition, Estonia set a 2030 target of 10% "fuel-free" electricity from wind, solar or hydropower sources. Looking to 2050, Estonia indicates wind energy could cover up to a third of electricity demand.

**Table 8.4 Renewable energy shares by sector, 2017 status and targets 2020-30**

| Sector | 2017 | Targets | |
|---|---|---|---|
| | | 2020 | 2030 |
| Heating and cooling | 57% | 38.4% | 80% |
| Electricity | 13.2% | 17.3% | 30% (50%)* |
| Transport | 0.32% | 10% | 14% |
| Gross final consumption | 29.2% | 25% | 42% (50%)* |

* Goal if flexible collaboration mechanisms are implemented (see Box 8.1).

Sources: EC (2019), *Country Report Estonia 2019*, https://ec.europa.eu/info/sites/info/files/file_import/2019-european-semester-country-report-estonia_en.pdf; Government of Estonia (2018a), *Estonian National Energy and Climate Plan (NECP 2030)*, https://ec.europa.eu/energy/sites/ener/files/documents/ec_courtesy_translation_ee_necp.pdf; Government of Estonia (2010), *National Renewable Energy Action Plan until 2020 (NREAP 2020)*, https://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans; IEA (2019), *World Energy Balances 2019*, www.iea.org/statistics.

The draft NECP notes that flexible collaboration mechanisms with other EU member states could drive a more aggressive renewables deployment and help increase Estonia's 2030 renewable energy targets for electricity and gross final consumption to 50%. Box 8.1 provides details on Estonia's current and planned use of flexible collaboration mechanisms.

The IEA encourages Estonia to undertake a robust analysis of least-cost pathways for renewable energy deployment with a comprehensive scope covering domestic renewable resource potential; the role of all viable renewable energy technologies and supporting infrastructure; and an examination of policy, regulatory and market barriers to renewables deployment.

Such an analysis would greatly assist Estonia in setting ambitious but achievable renewable energy targets and would provide needed clarity to energy sector stakeholders developing the plans, policies, regulations and projects required to achieve the 2030 targets. Policy clarity is critical as the NECP and the NDPES lack many of the details needed to ensure a robust and sustained renewable energy deployment. In addition, while Estonia's "General Principles of Climate Policy until 2050" set greenhouse gas (GHG) reduction goals for 2040 and 2050, they do not define renewable energy targets for these years or specify how renewables will support the GHG emissions reductions goals.

**Box 8.1 Flexible collaboration mechanisms to support renewables**

Flexible collaboration mechanisms were established under the Renewable Energy Directive I (RED) (EU, 2009) and extended through 2030 under RED II (EU, 2018). The mechanisms Estonia is interested in implementing can be summarised as follows:

Statistical transfers allow one EU member state that has exceeded its renewable target to sell a portion of the statistical surplus to help another member state achieve its renewable energy target. Statistical transfers do not require the physical transmission of renewable electricity, heat or cooling between the member states.

Joint projects allow two or more member states to co-operate on projects producing renewable electricity, heating or cooling. Each participating state can then count an agreed-upon proportion of the produced renewable electricity, heating or cooling towards the achievement of their renewable energy targets.

In 2017, Estonia reached 29.2% renewable energy in gross final consumption, well above its 2020 target of 25% (EC, 2019). In November 2017, Estonia became one of the first EU member states to use the statistical transfer mechanism, signing an agreement with Luxembourg to sell 300 gigawatt hours (GWh) of statistical renewable electricity in 2018 and 400 GWh in 2020 for EUR 10.5 million (EC, 2017). Revenue from statistical transfers has been allocated to reduce the renewable energy charge paid by all Estonian electricity customers to fund Estonia's renewable support scheme. Building on this successful transfer, Estonia is working to expand the use of collaboration mechanisms to boost domestic renewable energy deployment.

In 2018, Estonia established an expert group of government and industry stakeholders to: 1) identify EU member states interested in collaborating with Estonia; 2) prepare a list of possible statistical transfers and joint projects; and 3) create offers for interested countries (MEAC, 2017b). The MEAC notes there are 600 GWh of statistical renewable energy available for transfers in both 2019 and 2020. Estonia amended its Electricity Market Act in 2018 to allow the government to issue tenders for renewable energy projects specifically to support statistical transfers (Government of Estonia, 2018c).

The draft National Energy and Climate Plan notes a strong potential for joint projects to increase deployment of renewable energy projects in Estonia. It cites 4 GW of wind power projects and a 500 MW pumped hydro project that could benefit from co-operation on funding and deployment with other EU member states (Government of Estonia, 2018c).

If properly implemented, collaboration mechanisms could accelerate the deployment of renewables in Estonia through increased foreign investment and additional money for Estonia's renewable support schemes. This could allow Estonia to raise its 2030 renewable energy targets and contribution to the overall EU 2030 renewable target. Successful implementation of the collaboration mechanisms will require Estonia to present a favourable environment for renewable project deployment and ensure markets are in place to support increased levels of renewables production. This will likely require significant expansion of both domestic consumption of renewables and increased interconnection capacity to export renewable electricity.

## *Measures supporting renewable electricity*

Estonia's current renewable energy support scheme is based on a floating market feed-in premium that is automatically given to qualifying suppliers of electricity from renewable energy. This system was established in 2007 and Estonia is in the process of replacing it with competitive auctions, which are planned to start in 2019.[2]

Amendments to the Electricity Market Act, which passed by parliament in June 2018, mandate a reverse auction process in which the government issues tenders for a certain amount of renewable generation. Project developers then compete in a reverse auction where the lowest cost renewable energy projects that meet qualifying standards are selected to receive a feed-in premium subsidy (Government of Estonia, 2018b). The 2018 Electricity Market Act amendments define the process for the government to organise public tenders with the following objectives:

- tenders to increase renewable generation to meet the 2020 target of 17.6% renewable electricity, limited to projects of over 1 MW
- tenders to increase renewable generation by 5 GWh per year from 2019 to 2021, limited to projects of 50 kW to 1 MW
- tenders for renewable generation to meet obligations stemming from any statistical transfers of renewable energy established under the EU flexible collaboration mechanism
- tenders for renewable generation to meet to any targets established by the government beyond 2020.

The government is planning for technology-neutral auctions that allow bids from wind, solar, geothermal, hydropower, biogas and biomass projects.[3] Qualifying projects selected through the auction process receive monthly payments for generating electricity from renewable sources, which are calculated as a sliding premium on top of the market price for electricity.

The premium is equal to EUR 0.0537 per kWh, which is paid on top of the average electricity market price of the last month. The premium is reduced if the average price rises above EUR 0.0393/kWh and reaches zero once the average price is above EUR 0.093/kWh. The sliding premium is guaranteed for 12 years if the project generates the agreed amount of renewable electricity (Government of Estonia, 2018b).

This subsidy scheme encourages project developers to bid by guaranteeing auction winners a minimum payment of EUR 0.0537 per kWh even if the average market price for electricity is very low, or even zero. But it also exposes producers to some market signals as the premium decreases when market prices go up, and the risk of overpayment is eliminated as the premium is gradually reduced to zero if electricity prices increase.

The renewable support scheme established under the 2018 Electricity Market Act amendments maintains a non-competitive feed-in premium for wind, solar, geothermal, hydropower, biogas or biomass projects with a capacity of less than 50 kW. Qualifying projects do not have to participate in auctions, but automatically receive a payment

[2] The introduction of auctions is driven by mandates in the European Commission *Guidelines on State Aid for Environmental Protection and Energy 2014-2020*, which required that by 1 January 2017, aid for renewables is granted as a premium to the market price in a competitive bidding process on the basis of clear, transparent and non-discriminatory criteria (EC, 2014).

[3] Plants co-firing biomass with non-renewable fuels are eligible to receive subsidies for the portion of electricity coming from renewables.

calculated as a sliding premium on top of the market price for electricity delivered to the grid. Payments are calculated using the same floating market premium formula described above, but projects qualifying for the non-competitive feed-in premium are not required to generate any set amount of electricity.

Funding for the renewable support scheme continues to come from a renewable energy charge that supported the previous feed-in premium system. Every electricity customer in Estonia pays this charge, which is collected by Elering, the transmission system operator. There are no exemptions or reductions. In 2019, the charge was EUR 0.0104/kWh (Elering, 2019a).

It should be noted that renewable projects that were operational before the 2018 amendments to the Electricity Market Act came into force and which qualified for the feed-in premium under the previous support scheme continue to receive payments as agreed to under that scheme.

The previous feed-in premium subsidy scheme appears to have been a key driver in the renewable deployment seen since the last In-depth Review. The IEA welcomes Estonia's transition to competitive auctions, which can be an effective mechanism to support continuing growth of renewables. Tenders and the auction process need to be well designed and implemented. Clarity on the timing and size for future tenders, transparent selection criteria, and an efficient bidding process will help project developers prepare relevant and cost-effective project bids that support a least-cost pathway to achieving renewable energy targets.

Technology-neutral competition based solely on project cost can cause a single technology to dominate renewables deployment and may not result in the most efficient technical and financial operation of the electricity system as a whole. The IEA recommends that Estonia consider the merits of allocating some funds to technology-specific auctions to ensure a diversified renewable generation portfolio that takes full advantage of all renewable resources in Estonia.

The following sections examine policy impacts on renewable electricity generation from specific renewable resources in Estonia.

## *Wind*

The previous feed-in premium support scheme helped to drive strong wind power deployment, which reached 5.2% of electricity generation in 2018. Estonia's transition to competitive auctions should support accelerated wind power deployment as wind power is already one of the lowest cost technologies and the cost of both onshore and offshore wind projects continue to decline (IEA, 2018b). However, wind power deployment in Estonia has slowed significantly, with only 10 MW of new capacity in 2016 and no new projects deployed in 2017 or 2018 (see Box 8.2).

### Box 8.2 Wind power and national security

Wind turbines can affect the ability of radar to detect and track airplanes, resulting in negative impacts on national security capabilities. However, turbine impacts on radar can be mitigated by adjusting the siting of the wind turbines and through upgrading or expanding radar capabilities (Miller, 2016). Estonia's small land area and geopolitical location present specific challenges for balancing wind power deployment and national security interests and since 2008, the Ministry of Defence has objected to over 500 megawatts (MW) of planned or permitted wind projects (EWPA, 2019). This represents a significant capacity of potential projects being blocked, as total wind power capacity was 310 MW in 2017. Objections from the Ministry of Defence also appear to be part of the reason that no new wind projects have been deployed since 2016 (EWPA, 2018a).

In 2018, the government created a working group including the Ministry of Defence and wind power developers to clarify national security restrictions on wind project deployment. The working group examined existing restrictions and national security issues related to wind power in Estonia and presented findings, indicating that wind power developers should cover the full cost of any additional radar units needed to compensate for the impacts from wind power projects (EWPA, 2018b). While these findings clarify the responsibility of wind project developers, the government has yet to offer a clearly defined planning and permitting process that will allow developers to understand the full range of national security restrictions and open a pathway for projects to proceed in a manner that does not excessively impact radar and other national security assets.

Given the critical role that wind power could play in meeting renewable energy targets for 2020 and 2030, the IEA recommends that the Estonian government quickly clarify the procedures for project developers to comply with all spatial planning requirements. National security, environmental and other spatial planning restrictions that can affect wind projects should be transparently presented as early as possible in the planning and permitting process, so that wind project developers know in advance what is required to bring a project to successful operation. A complete review and presentation of all spatial planning restrictions would also help policy makers understand the full impact of these restrictions on wind deployment potential and whether or not current restrictions are compatible with Estonia's medium- and long-term renewable energy targets.

A proactive approach to quickly identify sites with strong wind resource and access to adequate transmission capacity and with minimal impacts on defence capabilities could help restart the sustained growth of wind power Estonia experienced up to 2016. Looking forward, a potential solution would be to establish a database of all relevant data needed to plan wind projects while respecting national security and other restrictions. This would allow project developers to modify projects before they are submitted and help policy makers to identify areas where additional investment in defence capabilities would be warranted and most effective to support significant increases in wind power deployment.

Current electricity market regulations guarantee network access for all generators, but require that the project developer pay the cost of any improvements to the transmission and distribution system required to connect the project to the electricity grid. This policy treats all technologies equally, does not appear to have limited the impressive renewable energy growth seen from 2007 to 2017, and has the advantage of encouraging project developers to build on sites that have the lowest grid connection costs, thereby reducing the overall cost of the electricity generated. However, requiring project developers to pay grid connection costs could represent a barrier to deployment of offshore wind projects due the high cost of connection versus other technologies. In Denmark, one the largest offshore wind markets, connections costs have fallen but can still be up to EUR 0.4 million per MW (Energinet, 2018).

Notable offshore wind capacity has been installed in countries that require projects to pay the full cost of grid connection. However, other countries have moved away from this system to regimes that require the transmission system operator to cover the cost while giving them greater control over the siting of offshore wind projects (Schittekatte, 2016). The IEA recommends that Estonia examine how connection costs are regulated in the major offshore wind markets to determine which system of allocating connection costs best matches Estonia's electricity market and the government's desire for notable offshore wind power deployment.

In addition, the IEA notes that the higher connection costs for offshore wind could make it difficult for offshore wind projects to compete in technology-neutral auctions based solely on lowest project costs.

## Solar

Elering indicates that solar photovoltaic (PV) capacity experienced a ten-fold increase in 2018, growing to 110 MW from just 11 MW in 2017. This development appears to result from a drop in PV installation costs coinciding with the expiration of the guaranteed feed-in premium on 31 December 2018, which encouraged developers to quickly bring PV projects to market (Elering, 2019b). PV has now surpassed hydropower to become the third-largest source of renewable electricity in Estonia and will likely continue to grow.

Estonia's updated renewable support scheme will most likely drive additional PV deployment. PV is among the lowest cost renewable technologies and continues to experience rapid cost reductions (IEA, 2018b). These low costs mean PV projects will be competitive players in Estonia's reverse auction process and could result in the first deployment of multi-MW PV systems in Estonia before 2020. PV could also have a substantial advantage in the upcoming renewable electricity auctions as wind power developers may be reluctant to submit bids until a clear solution for siting issues is reached (see previous section).

PV is also well positioned to take advantage of the continuation of the guaranteed feed-in premium for systems of less than 50 kW. PV is one of the few technologies that can be easily deployed at this scale and at a cost competitive price (IEA, 2018b). This subsidy could support a rapid growth of distributed PV on residential and commercial properties.

In addition, the government-owned utility Eesti Energia has plans to deploy 50 MW of PV by 2022 (EE, 2018). The utility will pursue this goal through PV projects on utility-owned land and development of PV projects on customer properties, which will be built, owned and operated by the utility and funded through power purchase agreements with property owners (Bellini, 2018).

Taken together, these factors indicate that PV has a notable role in renewable electricity generation that could grow substantially in the future. However, Estonia's current energy sector planning documents lack a clear strategy on the desired role of PV. The only direct mention is an aspirational 2050 target for 100 MW of PV in the 2017 "General Principles of Climate Policy until 2050", but this level of deployment has already been achieved, in 2018. The IEA recommends that Estonia re-examine the role that PV can play in meeting renewable energy targets and the potential impact that substantial PV deployment could have on the electricity system and market.

This includes a need to reconsider technology-neutral auctions where wind and PV generation compete solely on the basis of price. PV and wind offer complementary generation profiles and simultaneous development of both resources could support an increase in renewable energy that is more cost effective and easier to manage from an operational electricity system perspective, versus trying to reach the renewable energy target by relying primarily on just one of these technologies.

## Hydropower

Hydropower plays a small role in renewable energy generation in Estonia, covering 0.1% of generation in 2018. Estonia indicates that hydropower generation resources are fully utilised. The draft NECP makes note of a potential 500 MW pumped storage hydro project that would be a valuable asset to support system integration of variable renewable energy (VRE) from PV and wind. The IEA recommends that Estonia identify opportunities for pumped hydro storage to support VRE integration. Additional VRE integration issues are discussed below.

## System integration of renewables

The current level of generation from variable wind and PV in Estonia does not present any notable issues for stable operation of the electricity system. However, the draft NECP indicates 4 GW of planned wind power projects and the NDPES 2030 has an aspirational goal for wind power to cover one-third of Estonia's electricity generation in 2050. In addition, PV generation has expanded much faster than government predictions. System integration measures could be needed in the medium to long term to ensure that the full potential of VRE can be harnessed in a secure and economic manner. The IEA has identified several strategies supporting VRE integration:

- adequate transmission and distribution infrastructure
- efficient utilisation of cross-border interconnectors
- system-friendly VRE deployment
- maximising the flexibility of the non-VRE generating fleet
- leveraging demand-side flexibility
- increased electrification of the energy sector.

Estonia is already making upgrades to its transmission network to help to integrate a higher share of wind and PV generation. These include expanding the reach of the domestic high-voltage network, which will provide grid access to a larger number of wind projects and utility-scale PV projects. However, the scale of wind and PV deployment required to achieve the 2030 target of up to 50% renewable electricity could require additional investment in the transmission system to ensure that the grid reaches the best sites for wind and PV generation and that there is adequate transmission capacity.

Transmission adequacy could be a concern for offshore wind as the current system does not reach many coastal areas and may lack the capacity needed to securely integrate the multi-hundred MW- to GW-scale projects envisioned in government planning documents (Government of Estonia, 2018a). The rapid and unanticipated growth in PV generation means that the adequacy of the distribution network may also need to be re-examined, especially given the potential growth of the distributed PV system taking advantage of the feed-in premium for systems under 50 kW.

The rapidly falling cost of battery storage should also be considered. Batteries can provide a wide range of capabilities that support VRE integration and if properly deployed can reduce the need for investment in traditional transmission and distribution infrastructure. For example, batteries allow for self-consumption of renewables at the site of the end user, reducing the need for additional distribution capacity. Estonia should examine the wide range of services that can be provided by batteries and where relevant consider policy and regulatory changes that would allow batteries to participate in the electricity system. Estonia may also wish to examine the inclusion of aid for batteries in its support scheme.

Cross-border electrical interconnectors assist with VRE integration through regional balancing, which helps the electricity system react to wind and PV generation variability and by allowing export of wind and PV generation to avoid curtailment and lost revenue when VRE generation exceeds local demand. Estonia already has notable interconnection capacity with Finland and Lativa (Elering, 2019c). A third interconnector with Latvia is under construction and there are plans to increase interconnections further so that Estonia can become part of the synchronous European grid system by 2030.

System-friendly VRE deployment means that wind and PV assets are deployed in locations and configurations that make it easier for the electricity grid to integrate the generated electricity. One means to encourage system-friendly deployment is the inclusion of specific locational or performance requirements within auctions as has been done in Denmark and Mexico, for example. Locational requirements allow auctions to promote renewable energy projects in areas with a good balance of renewable resource quality, grid access, and reduced concerns over national security or environmental restrictions. Technology-specific performance requirements could be included in the auction process to steer project developers to design projects that are easier to integrate into the existing grid in a secure manner. Examples included requiring larger blades on wind turbines to reduce the variability of their generation and/or setting the orientation of PV systems so that their generation is better aligned with the daily electricity demand.

Another key factor affecting VRE integration is the flexibility of the existing fleet of generation assets. This includes both the technical ability of power plants to rapidly change their output or run efficiently at low levels of generation and the ability of the market to financially support flexible operation. Estonia should examine its current fleet of thermal power plants to see what limits they place on VRE integration and determine if there are any operational or market changes needed to allow for more flexible operation of thermal generators. Looking to future investments in thermal generation, Estonia should consider prioritising technologies and plant configurations that allow for greater flexibility in responding to the significant anticipated growth in VRE generation.

Demand-side flexibility can support VRE integration by allowing electricity demand to be intentionally adjusted to compensate for the variable generation of wind and PV. A simple option for introducing demand-side flexibility is financial agreements between utilities and large industrial and commercial customers that provide incentives to decrease or increase electricity consumption at the request of the utility to help balance VRE generation. Estonia could also leverage the national deployment of smart metres, which in combination with time-of-day pricing can be used to encourage patterns of electricity demand that better align with VRE generation.

Electrification can support VRE integration by creating additional demand for generation from wind and PV. It can also be one of the more effective options for introducing renewable energy into the transport and heating sectors. Electrification also creates additional opportunities for demand-side flexibility. The sections on renewables in heat and transport provide additional insights on how electrification could support achieving Estonia's renewable energy targets.

## *Bioenergy*

Electricity from bioenergy increased from 0.3% to 10.2% of total electricity generation between 2008 and 2018. This growth was driven by deployment of CHP plants using domestic forestry biomass. In 2017, biomass CHP covered 85.9% of the electricity from bioenergy. CHP plants are among the most efficient means to capture the useful energy in biomass as they produce both heat and electricity. However, this also creates complications as these plants operate in two separately regulated markets. Despite being one of the largest contributors to renewable electricity, CHP plants in Estonia are designed primarily to provide heat to district heating networks with electricity generation a secondary revenue source. As such, electricity incentives alone may not be adequate to drive additional biomass CHP deployment.

The feed-in premium of the previous support scheme seems to have helped to drive significant growth in bioenergy as it guaranteed an additional payment on all electricity sales. The transition to technology-neutral auctions could remove this incentive as it is not clear that biomass CHP or other bioenergy electricity technologies can compete on a cost-only basis with wind and solar. Estonia should examine whether or not targeted subsidies for electricity from bioenergy are needed, especially in the context of CHP, and if so whether or not the planned auction process will allow bioenergy projects to make competitive bids.

It is also critical to note that well over 90% of the growth in bioenergy from 2008-18 was based on consumption of biomass from domestic forestry (IEA, 2018a). For bioenergy to support continued expansion of renewables, and achievement of the 2020 and 2030 targets, Estonia will need a sustainable supply of low-cost biomass.

EU regulations on land use, land-use change and forestry (LULUCF), and national sustainable land-use and forestry plans place significant limits on annual biomass production (Government of Estonia, 2018d). The government has stated that the sustainability requirements allow for significant increases in biomass production (Government of Estonia, 2017a). However, while biomass production in Estonia doubled in the period 2007-17, the quantity of biomass available for domestic consumption remained essentially flat, at around 0.8-0.9 Mtoe due a steady increase in biomass exports, which reached a third of total production in 2018 (IEA, 2019).

The draft NECP and the NDPES reflect Estonia's clear understanding of the challenges and importance of maintaining a sustainable supply of biomass for renewable energy projects. Current laws and regulations give the government numerous tools to monitor and regulate the level of biomass production (Government of Estonia, 2017a). However, national plans do not discuss the impact of a growing share of biomass exports, or clearly establish the quantity of domestic biomass production that will be needed to support a sustained expansion of renewable electricity generation in line with the 2020 or 2030 targets.

A comprehensive review including an examination of biomass sustainability, the potential of other bioenergy resources, and a detailed technical analysis of the most economic and secure manner to increase the bioenergy share in renewable electricity would help to determine how bioenergy can best support the achievement of Estonia's 2020 and 2030 goals. Such a review should also examine how the design and operation of CHP plants and the functioning of electricity and heat markets could be adjusted to allow CHP to play a greater and more flexible role in electricity generation. For example, adding heat storage to existing CHP plants or requiring heat storage on newly constructed plants would reduce the need to closely follow heat demand and allow for more flexibility in electricity generation.

The potential role of waste in renewable energy should also be examined. Non-renewable waste makes a small contribution in meeting Estonia's energy demand, covering 2% of TPES (0.11 Mtoe) and 1.1% of electricity generation (0.14 terwatt hour [TWh]). However, the reported data show no renewable energy contribution from waste-to-energy. It is recommended that Estonia review its waste-to-energy data and practices to determine if this resource is making a contribution to its renewable energy targets.

Waste-to-energy contributions to TPES and electricity appear to come from a single 17 $MW_e$ (megawatts of electricity) CHP unit at the Iru Power Plant. This unit has operated since 2013 and burns municipal solid waste to generate electricity and to produce heat for the district heating network serving Tallinn and the surrounding area. This dedicated waste-to-energy unit has reduced the amount of waste sent to landfills, but the requirement to keep the unit operating at a minimal level combined with a reduction of municipal waste in Estonia has resulted in a need to import waste from other countries (ERR, 2016).

## *Measures supporting renewable heat*

The NDPES sets a target for 2030 of an 80% renewable energy share in heat consumption. In 2017, the share in residential and commercial heating was 57%. However, there is no coherent national support scheme that clearly drives achievement towards the 80% target. Most heat-related policy is set on a regional or municipal level; however, the government has periodically introduced small support schemes for renewable heat, often in relation to the renovation of buildings or heating systems.

A national support scheme encourages increased use of high-efficiency renewable energy in small residential heating systems. The scheme provides a direct payment to owners of small residential buildings to replace a liquid fuel heating system with equipment using renewable energy. The scheme covers 40% of the cost of the new system, with a maximum payment of EUR 4 000. National planning documents do not reference this plan, nor note what level of contribution it is expected to provide towards renewable targets.

The government may review existing heat policy, including local and municipal regulations, to determine if any additional support mechanisms are needed to ensure that the 80% target can be achieved. Such a review could also examine the heavy reliance on biomass, which covers essentially all renewable heat production in Estonia. It would be good to determine what share of the 80% target can be sustainably covered with biomass and to examine options to diversify the mix of renewable energy in heat production. These options could include high efficiency heat pumps powered with renewable electricity for space heating and solar thermal water heaters to meet residential and commercial hot water. Solar water heaters are a well-established technology with one of the lower cost options for hot water and have been shown to work effectively even in colder climates (Mussard, 2017).

## *Measures supporting renewables in transport*

Estonia has struggled to make progress on the 2020 target of 10% renewable energy in the final consumption of the transport sector. In 2017, the share of renewables in transport was only 0.32%, not much higher than it was a decade earlier. In response to the slow uptake of renewables in transport, the government amended the Liquid Fuel Act in 2018, mandating that biofuels cover an increasing percentage of the energy content of petrol and diesel that is imported, stored or sold in Estonia. The amendment requires biofuel shares of 3.1% in 2018, 6.4% in 2019 and 10% in 2020 (Government of Estonia, 2019). Moreover, starting in 2019, second-generation biofuels (produced from waste and residues) must account for at least 0.5% and first-generation biofuels (produced from agriculture) must not exceed 7% of total energy.

Government data for 2018 show a 3.7% renewable share in transport, indicating that the biofuel mandate has been successful. This rapid increase in the share of renewable energy in transport is a significant achievement, but still leaves a large gap to achieve the 2020 target. Fuel sector stakeholders have expressed concerns that the industry may have difficulties in achieving the target by 2020 (see Chapter 4, specifically Box 4.1). In addition, the biofuel mandate may not ensure achievement of the target, as it is not clear if it applies to all transport fuels consumed in Estonia (EC, 2019).

As there is currently no biofuel production in Estonia, the biofuel mandate does not address the government's goal of using local renewable energy sources, as expressed in the NECP. The biofuels mandate will require the sustained import of significant quantities of biofuels to maintain the 10% share of renewables in transport. To address this concern, the government passed the Act on Biomethane Market Development Support in 2015, which created support schemes for domestic production and consumption of biomethane, with the aim to have biomethane cover 3% of transport energy demand by 2020 and 10 fuelling stations in operation in 2020 (Government of Estonia, 2015). The support scheme is managed by the Estonian Environmental Investments Centre and provides the following subsidies:

- EUR 3 million for deployment of biomethane fuelling stations, with the subsidy for each station limited to EUR 350 000 based on 35% of project construction costs
- EUR 6 million for public transit systems to purchase biomethane vehicles, with the subsidy limited to EUR 4 million per transit system based on 30% of the total cost of all vehicles purchased.

To ensure a domestic supply of biomethane for these fuelling stations and vehicles, the government passed the Act on Biomethane Market Development Support in the same year creating the following subsidies for domestic biomethane production (Government of Estonia, 2017b):

- EUR 100 per MWh, minus the average market price of natural gas from the previous month, for biomethane delivered to the final consumer as transport fuel
- EUR 93 per MWh, minus the average market price of natural gas from the previous month, for biomethane delivered to the final consumer in the natural gas system.

This multipronged approach addresses demand, logistics and supply of biomethane, and could increase the renewable share in transport based on domestic fuels. However, it requires building and maintaining an efficient biomethane supply chain and a market demand for biomethane that is large enough to displace a significant percentage of transportation fuel consumption. The government should track the progress of biomethane development closely and determine if the existing subsidies are effective in promoting the growth of biomethane in transport.

There are no clear plans for electrification of transport in Estonia's renewable energy policy documents. Given the conditional 2030 target for up to 50% renewable electricity, electrification of transport presents an attractive path to cover a significant share of transport demand with renewable energy (see Chapter 7).

## Assessment

Estonia has already exceeded the 2020 target of 25% renewable energy in gross final consumption. The share of renewable energy in heat production also exceeded the 2020 target in 2017. However, achieving the targets for renewables in electricity and especially in transport will require additional efforts. Initial data for 2018 show an increase due to the introduction of a biofuel mandate and subsidies to launch the market for biomethane in transport.

The limited share of renewables in transport can be attributed to the lack of a government incentive regime, very limited domestic renewable fuel production and the high costs of imported biofuels. The government is attempting to address these issues with biofuel blending obligations and a support scheme for domestic production and consumption of biomethane in transport. There are concerns, however, that these measures may not be enough to achieve the 2020 targets. The government should examine options to increase electrification of transport as a complementary strategy to accelerate the growth of renewables in transport.

The government is confident that ongoing strong growth of renewable energy is feasible and has established a 2030 target of 42% renewables in gross final consumption in the draft NECP, noting that EU flexible collaboration mechanisms could support a 50% renewables target as set in the NEDP 2030.

However, these targets appear to be based on general expectations or political judgements, rather than on a robust assessment of least-cost renewable deployment pathways and resource potential. Given the relatively and deliberately low ambition of the 2020 targets, and the apparently extensive wind (onshore and offshore) and biomass resources, further assessment of the renewable energy targets based on a detailed and comprehensive analysis of deployment potential and barriers is warranted.

The renewable deployment achieved from 2007-17 was supported by a feed-in premium guaranteed to qualifying projects for 12 years. In line with an EU requirement and reflecting the declining cost of renewable energy technologies, Estonia is preparing a post-2020 feed-in premium auction regime. Auctions have proven to be successful in other countries, but require a transparent and well-designed process that needs to be effectively managed to ensure renewable deployment is on track to meet targets. Current planning documents do not adequately define the auction support scheme. The government should clearly set out auction parameters such as budget, timing and technology mix in advance.

There is also a concern that a strict focus on technology-neutral auctions could result in suboptimal renewables deployment dominated by a single technology with the lowest per project cost. Such a deployment could fail to leverage the advantages of a diverse mix of renewable generation, might not result in the lowest overall system cost and could create operational concerns for the electricity grid. The government could consider an auction process that allows locational or performance requirements or some level of technology-specific tenders. The design of an effective auction process would be greatly assisted by the recommended analysis of least-cost renewable deployment pathways.

The deployment of wind from 2007-15 seemsed to have been relatively smoothly. However, significant and widely acknowledged administrative barriers have emerged. Further, onshore and offshore wind power development is now in conflict with national defence radar effectiveness, which has triggered bans on wind deployment in multiple zones. Environmental protection rules (e.g. Habitat Directive, Natura 2000 zones) have also started to constrain permitting of new projects. Wind power is likely the lowest cost technology for large-scale renewable energy projects in Estonia and a strong and sustained deployment of wind power projects could be necessary to achieve 2030 targets. As such, there is need to quickly resolve the barrier to wind power deployment in a manner that clearly addresses all national security and environmental concerns.

Neither the transmission system operator nor the dominant distribution system operator indicate that there are any technical constraints in the near future to an open-ended integration of wind and PV into the grid. However, the plans for up to 4 GW of wind projects by 2030 and the unexpected and rapid growth of PV call for development of a clear medium- to long-term strategy for securely integrating growing shares of variable renewable generation.

Despite the significant use of biomass in CHP and district heating systems today, the government believes that the biomass contribution to renewable heat and electricity can continue to grow. This raises concerns from both an industry and an environmental perspective. Industry is worried that LULUCF rules and national sustainable land-use and forestry plans will constrain the supply of biomass for energy. In contrast, environmental groups believe that current forestry and biomass harvesting activities are excessive and unsustainable and that the new LULUCF rules must be thoroughly and properly enforced. These concerns warrant an analysis confirming what level of biomass supply is sustainable and clearly establishing the role that biomass can play in least-cost renewable energy deployment. An interesting subject for this analysis would be diversification of the renewable energy mix in heating, which currently relies almost exclusively on biomass.

## Recommendations

***The government of Estonia should:***

- Undertake a robust analysis of least-cost renewable energy deployment pathways with a comprehensive scope covering: domestic renewable resource potential; the role of all viable renewable energy technologies and supporting infrastructure; and an examination of policy, regulatory and market barriers to renewables deployment, including pre-developing potential wind farm sites.
- Set transparent requirements and a clear timetable and parameters for future tenders and the auction process. Consider the merits of locational and performance requirements and technology-specific tenders to ensure an optimal mix of renewable energy generation.
- Co-ordinate spatial planning and support for wind energy, in particular with neighbouring countries, in view of efforts to jointly develop grid connectivity to reduce costs.
- Urgently clarify with relevant parties, including the Ministry of Defence, how to resolve the current impasse of developing wind energy sites related to the issue of radar interference.
- Provide clearer guidance on the procedures for verifying the compliance of wind (and other) energy sites with all necessary environmental legislative and planning requirements (including LULUCF assessment and rules).

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# 9. Energy efficiency

## Key data

(2017)

**Total final consumption (TFC):** 2.9 Mtoe (oil 36.2%, electricity 21.2%, heat 16.2%, bioenergy and waste 15.2%, natural gas 8.1%, coal 3.1%), -10% since 2007, -1% since 2010

**Consumption by sector:** residential 32.2%, transport 27.5%, commercial 20.6%, industry 19.7%

**Energy consumption (TFC) per capita:** 2.2 toe (IEA average 2.9 toe), -8% since 2007, +0.1% since 2010

**Energy intensity (TFC/GDP):** 78 toe/USD million PPP (IEA average: 74 toe/USD million PPP), -16% since 2007, -24% since 2010

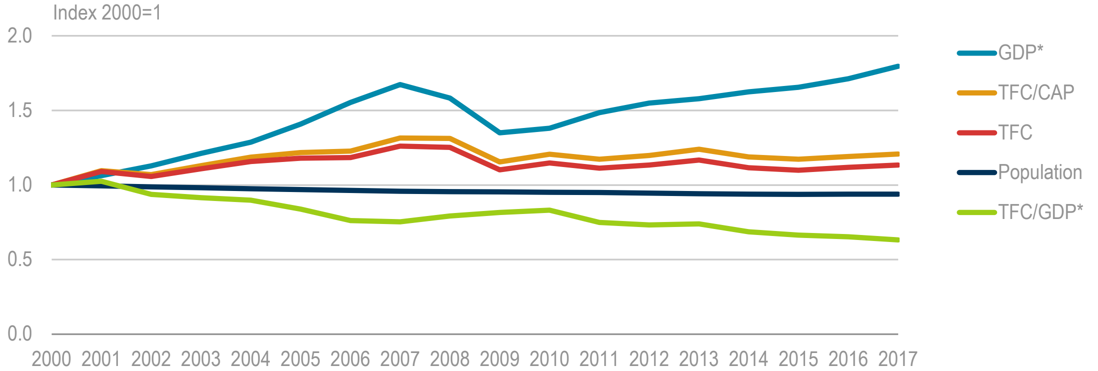
## Overview

Estonia has set a national energy efficiency target to maintain its final energy consumption in 2020 at the same level as in 2010, when it was 3 million tonnes of oil-equivalent (Mtoe). The target was set in response to the European Union (EU) Energy Efficiency Directive. Until 2015, Estonia was well on track to meet the target, but in 2016 and 2017, final energy consumption increased and reaching the 2020 target will now be more challenging.

The financial crises of 2008 severely affected Estonia's economy, but it has recovered in recent years. In 2015, Estonia's gross domestic product (GDP) exceeded the pre-crisis level of 2007 and has been growing strongly since. This economic recovery has happened with relatively stable total final consumption (TFC), showing signs of a decoupling between economic growth and energy demand. Energy demand is largely driven by the size of the population and economic development. In Estonia, these two parameters are on opposite trajectories. Unlike most IEA member countries, Estonia's population is slightly declining. Between 2000 and 2017, the population fell by 6%, and the energy consumption per capita remained stable (Figure 9.1).

Energy intensity can be measured as TFC per capita and as TFC per GDP. Compared to other IEA member countries, Estonia has relatively high energy intensity per unit of GDP expressed in purchasing power parity. In 2017, Estonia's TFC per GDP was 78 tonnes of oil equivalent (toe) per million USD, the ninth-highest in the IEA. Estonia's TFC per capita was 2.2 toe in the same year, which was among the lower half in an IEA comparison, although just above the average European IEA countries (Figure 9.2).

## Figure 9.1 Energy supply and drivers, 2000-17





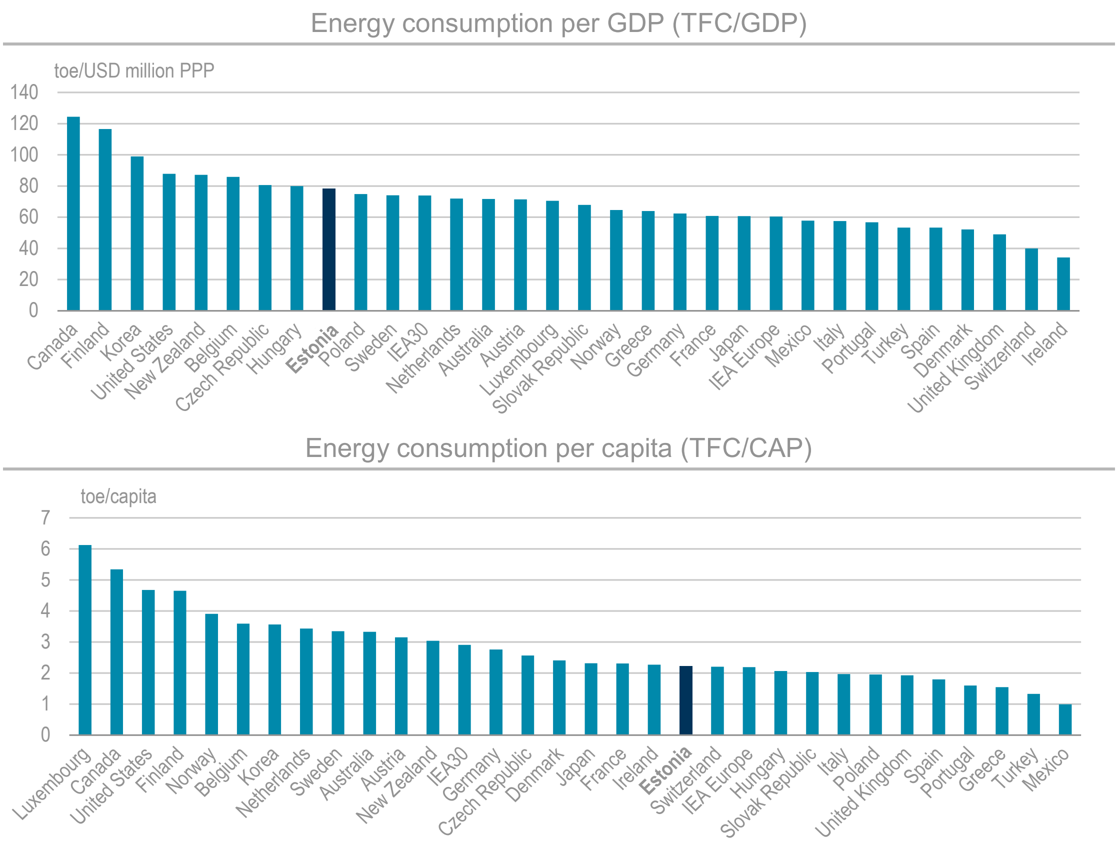

Estonia's TFC remains stable despite strong economic growth since the financial crisis, but there has been no visible decoupling between energy demand and population.

* GDP data are in billion USD 2010 prices and PPPs (purchase power parity).

Note: GDP = gross domestic product; TFC = total final consumption; CAP = per capita.

Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

## Figure 9.2 Energy intensity in IEA member countries, 2017






Estonia's total final consumption over GDP is among the highest in the IEA, while total final consumption per capita is in the lower half.

Notes: TFC = total final consumption; GDP = gross domestic product; CAP = capita; toe = tonne of oil equivalent. Energy intensity in total final energy consumption, not including the energy transformation sector. GDP data are in billion USD 2010 prices and PPPs (purchase power parity).

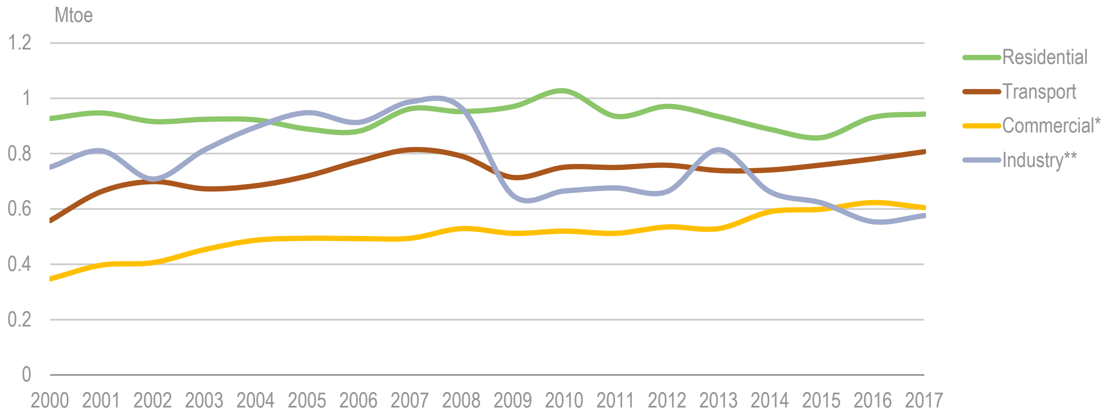
Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

A country's energy intensity can be explained by the structure of the economy. Since regaining independence in 1991, Estonia's economy has shifted continuously out of heavy industry and more towards the service and commercial sectors. These sectors are less energy intensive and tend to have a different fuel mix, typically consuming more electricity and space heating, than traditional industry sectors.

## Energy consumption by sector

Since a decline after the financial crisis in 2008, Estonia's TFC has been relatively stable at around 2.8-3.0 Mtoe. Energy consumption, however, has varied on a sector level (Figure 9.3). The commercial sector's energy consumption has increased steadily while industrial consumption has declined, corresponding to a shift towards a more service sector-based economy in Estonia. Transport energy demand has also continuously been increasing, while residential sector consumption has remained relatively flat.

**Figure 9.3 Final energy consumption by sector, 2000-17**






* Includes commercial and public services, agriculture, forestry, and fishing.

** Includes non-energy use.

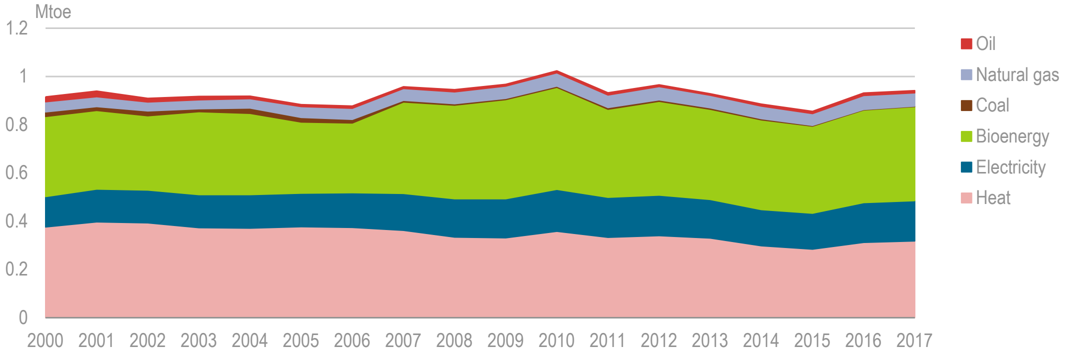
Note: Mtoe = million tonnes of oil-equivalent.

Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

### *Residential sector*

The residential sector is the largest energy consumer in Estonia, with nearly one-third of TFC in 2017. Energy demand has been stable in the last decades, despite the decline in population. Weather conditions, especially winter temperatures, cause annual variations in demand; during 2000-17, energy demand varied between 0.9 Mtoe and 1.0 Mtoe (Figure 9.4).

**Figure 9.4 TFC in the residential sector by source, 2000-17**






Residential energy consumption shows annual variations, but the long-term trend is stable, despite a declining population.

Note: Mtoe = million tonnes of oil-equivalent.

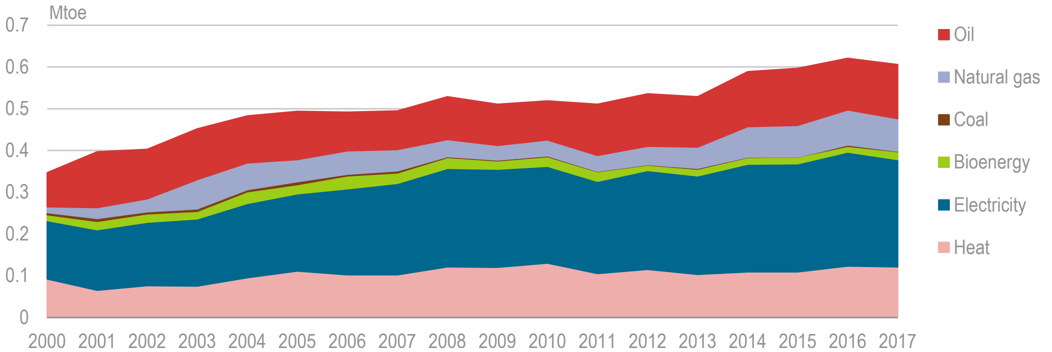
Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

Bioenergy and district heating together account for 75% of residential energy consumption, mainly used for space and water heating. Electricity accounts for 18% of demand in the sector, consumed mostly by household appliances. Fossil fuels account for only 7% of the direct consumption (Figure 9.4). However, they also make up around half of the district heating supply and 86% of the electricity generation, which gives a total share of fossil energy of over 40%.

## *Industry and commercial sectors*

Estonia's economy is becoming more oriented towards services, and energy consumption in the commercial sector has steadily increased over the last decades. In 2017, the commercial sector consumed 0.61 Mtoe, a 22% increase compared to 2007 (Figure 9.5). Agriculture and forestry account for around 20% of total commercial energy demand, mostly diesel oil. The rest is consumed in public and commercial services, which mostly use electricity in appliances and district heating or natural gas for heating.

**Figure 9.5 TFC in the commercial sector by source, 2000-17**






The commercial sector has the fastest growing energy demand in Estonia, largely met by electricity, which accounts for nearly half of total consumption in the sector.

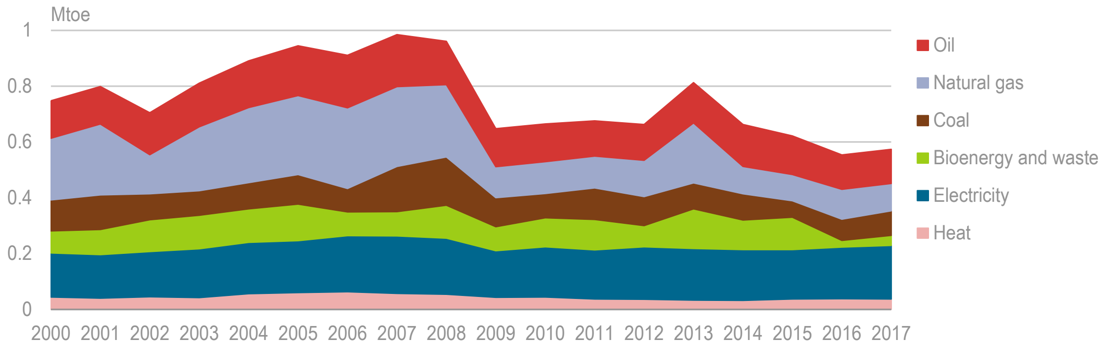
Notes: Mtoe = million tonnes of oil-equivalent. Includes commercial and public services, agriculture, forestry, and fishing.

Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

The industry sector is on the opposite trajectory, with a 42% decline in energy consumption in the last decade (Figure 9.6). Consumption fell by a third in one year after the financial crisis in 2008 and has not picked up since. In 2017, the industry sector consumed 0.58 Mtoe, or 20% of TFC. Electricity accounts for one-third of total energy use in industry, and the share has increased as consumption of other energy sources has fallen. In particular, bioenergy consumption, mainly in wood industries, has declined significantly in recent years.

Construction is the largest energy-consuming industry, with 22% of total industry consumption. This includes a large share of bitumen and lubricants used for non-energy purposes (mainly asphalt). Other large industry sectors are non-metallic minerals, food and tobacco, paper and pulp, and wood product industries (Figure 9.7).

**Figure 9.6 TFC in industry by source, 2000-17**

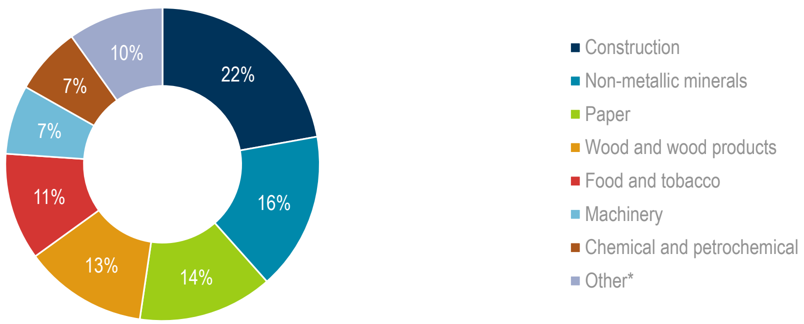





Industrial energy consumption has not recovered from the large decline after the financial crisis, and has fallen by 42% in the last decade.

Notes: Mtoe = million tonnes of oil-equivalent. Includes non-energy consumption.
Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

**Figure 9.7 Energy consumption in manufacturing industry sectors, 2017**






Estonia has several industry sectors with similar shares of total energy consumption, but construction is the biggest when including oil products used for non-energy purposes.

* Includes consumption of bitumen and lubricants for non-energy use in construction.

** *Other* includes mining and quarrying, textile and leather, transport equipment, non-ferrous metals, iron and steel, and unspecified industrial consumption.

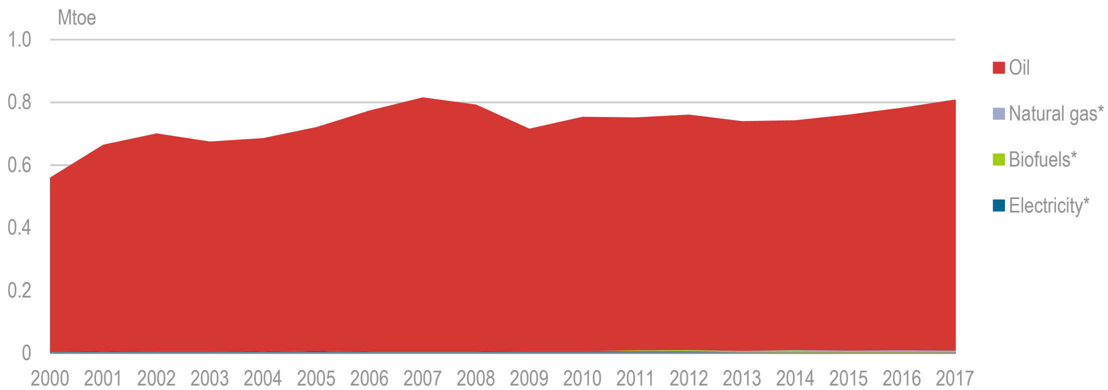
Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

### Transport

Transport sector energy consumption was affected by the overall decline in energy demand after the financial crisis. From 2007 to 2009, transport consumption fell by 12%. Since then, however, demand has increased again and in 2017 stood at 0.81 Mtoe, only 1% below the 2007 peak (Figure 9.8).

Nearly all transport energy consumption is covered by oil fuels. In 2017, diesel accounted for 65% and gasoline for 33% of transport energy consumption. The rest was minor shares of biofuels, natural gas and electricity.

**Figure 9.8 TFC in transport by source, 2000-17**






Domestic transport energy demand is increasing, and nearly entirely dependent on oil fuels.

* Not visible on this scale.

Notes: Mtoe = million tonnes of oil-equivalent. The transport sector demand excludes international aviation and navigation.

Source: IEA (2019a), *World Energy Balances 2019*, www.iea.org/statistics.

## Energy efficiency policy framework and targets

Estonia's energy efficiency policy is guided by the EU Energy Efficiency Directives (EED), the EU's 2030 Framework for Climate and Energy, and the EU's international energy and climate commitments. Estonia's obligations under the EU's EEDs include the preparation of national energy efficiency action plans. The latest plan was in 2017 and will be the last as energy efficiency reporting will be subsumed into the National Energy & Climate Plan 2021-2030 as from 2021. In addition to the national level plan, 113 public bodies at Estonia's municipal and city levels also had to prepare energy efficiency action plans by 2017 (MEAC, 2017a).

The *National Development Plan of the Energy Sector* (NDPES) set the main policy framework for energy efficiency in Estonia and guides the preparation of the national energy efficiency action plans. The NDPES to 2030 became effective in 2017 and replaced the NDPES 2020 (MEAC, 2017b).

The 2016 Energy Sector Organisation Act (ESOA) transposes the 2012 EU EED (2012/27/EU) into Estonian law. The ESOA provides the foundation for the establishment of an energy efficiency obligation scheme. The 2012 EED requires energy companies in each member state to achieve yearly savings of 1.5% of annual sales to final consumers. The introduction of an energy efficiency obligation scheme is one of the options provided in the EED on how to meet the target. Estonia has an energy efficiency obligation to reach 7 101 gigawat hours (GWh) in the period from 1 January 2014 to 31 December 2020 (MEAC, 2017b).

The ESOA also establishes the legal foundation for the performance of energy audits, the exemplary role of public sector buildings and the promotion of green public procurement (Riigikogu, 2016). The ESOA regulates the energy services market and includes measures to ensure energy efficiency in the entire value chain of the electricity sector (MEAC, 2017b).

### *Targets for 2020 and 2030*

The government of Estonia has set a 2020 target to maintain final energy consumption at the 2010 level, equivalent to 119 petajoules (PJ) (2.84 Mtoe[1]). This target established the basis for energy efficiency policies and measures across the Estonian economy for the period to 2020. The base scenario forecast for Estonia's final energy consumption in 2020 is 137 PJ (3.27 Mtoe), meaning that in 2020 Estonia should save 18 PJ (0.43 Mtoe), or 13.1%, as a result of implementing energy efficiency measures.

According to IEA statistics, Estonia's TFC was 2.96 Mtoe in 2010, and was 1.1% lower in 2017 at 2.93 Mtoe. This was on track to meet the 2020 target. However, TFC increased by 1.4% in 2017 from 2016, so the most recent development of energy consumption in Estonia is not on track. A 2019 EU report also noted that in 2017 Estonia was not on track to meet the 2020 target, as its final energy consumption was above the required 2020 trajectory (EC, 2019).

The NDPES 2030 sets the following energy efficiency targets for 2030:

- reducing the energy intensity of the economy by 66% compared to 2012
- maintaining final energy consumption at the same level as in 2010
- primary energy consumption will be 10% less than in 2012.

Energy intensity measured as TFC/GDP was 78 toe/USD million (PPP) in 2017, a decline of 14% from 2012. Estonia is thus already making progress towards its 2030 targets, but further energy efficiency improvements will be required to be able to have a growing economy without increasing energy demand. Estonia has potential to improve its energy efficiency across all sectors, but notably in the existing building stock, which accounts for a large share of the energy consumption.

## Energy efficiency in buildings

Estonia's building stock is rather old, with 86% of all buildings constructed before 1991 and only about 7% built after 2006 (Figure 9.9). The building stock is characterised by

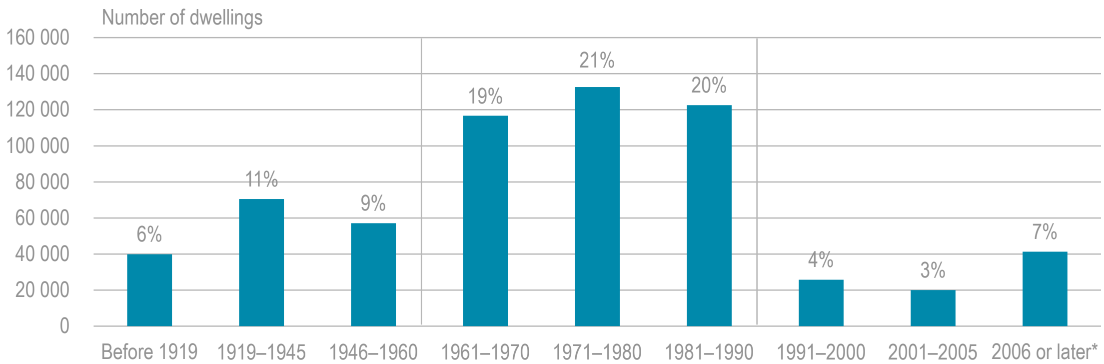
[1] The definition of final energy consumption is slightly different from IEA data, where TFC was 2.96 Mtoe in 2010.

poor energy efficiency and studies commissioned by the government estimate that the technical energy savings potential of buildings is up to 80% of the current energy consumption of the building stock (MEAC, 2017c). With stricter energy performance standards and developments in building techniques, new buildings are generally much more energy efficient than in the past. Improving the energy efficiency standards of the old buildings through renovation and retrofits could have a significant impact on Estonia's total energy demand.

The NDPES 2030 sets the following targets for the building sector[2]:

- renovation efforts have improved the energy efficiency of buildings (40% of small residential buildings have an energy efficiency class of C or D, 50% of apartment buildings are Class C, 20% of non-residential buildings are Class C)
- new buildings will have a Class A energy performance indicator, which conforms to the requirement for nearly zero-energy buildings
- 37% of the total net area of the buildings used by the central government is located in buildings that satisfy at least the minimum energy efficiency requirements enforced in 2013.

**Figure 9.9 Number of dwellings by time of construction, 2012**






In 2012, only 14% of dwellings had been constructed since 1991, indicating a large energy efficiency potential through renovations and retrofits.

* Includes dwellings that were uncompleted in 2012.

Notes: Conventional dwellings by time of construction as of 31 December 2011. Does not include dwellings of unknown age, which accounted for 4% of total dwellings in the statistics.

Source: Statistics Estonia (2013), *Conventional Dwellings by Time of Construction and County, 31 December 2011*, https://www.stat.ee/68514.

The new building code of 2013 sets out the requirements for nearly zero-energy buildings. It does not include requirements for zero carbon, passive architecture or material reuse. All new public sector buildings from 2019 and all new private buildings from 2021 onward must comply with the requirements for nearly zero-energy buildings. The government is aware that this is a challenging target and that it requires upgrading the skills and competence levels of architects and builders as well as construction supervisors.

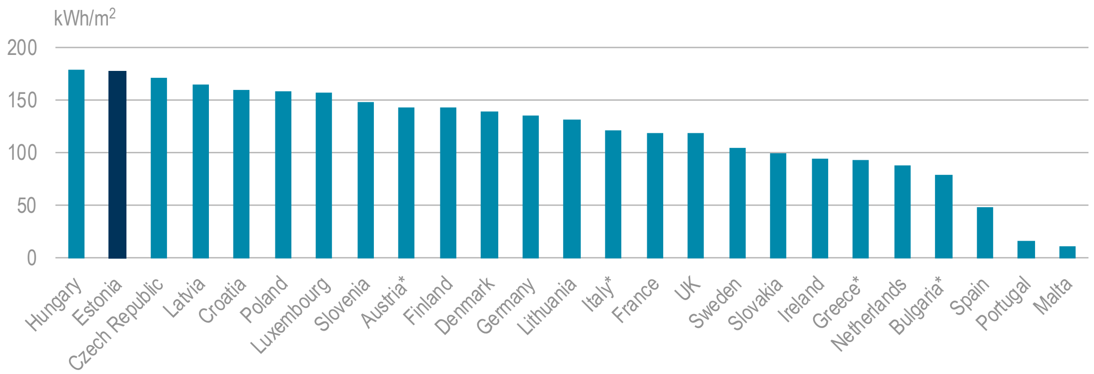
[2] See next section for a discussion of energy efficiency classes of buildings.

The construction of new nearly zero-energy buildings in the public sector is contributing to meeting the overall energy efficiency targets for 2030. The government plans to commission pilot projects for the design and construction of nearly zero-energy buildings that can easily be replicated and that would include innovative technical solutions (MEAC, 2017c). The government plans to share the pilot designs with private developers to introduce best construction practices more widely in the construction industry (MEAC, 2017b).

## Residential building sector

The potential for energy efficiency improvements is especially large for residential buildings as they account for over 60% of the net build area (MEAC, 2017c). The energy consumption of Estonia's residential sector at over 32% of TFC in 2017 is the highest share of all IEA countries. Within the residential sector, heating accounts for the largest share of energy consumption at around 75%. The energy demand for space heating per surface area in residential buildings is among the highest in the European Union. This is partly due to the cold climate, with an average yearly temperature of 6.7°C, which translates into a high heating demand. However, Estonia's consumption is significantly higher than in many of the neighbouring Nordic and Baltic countries with a similar climate (Figure 9.10), pointing to other factors that influence heating demand more strongly, including the age of the building stock and large potential for renovation. Studies undertaken for the preparation of the NDPES 2030 show retrofitting of buildings can reduce total heating demand by 50% (MEAC, 2017b).

**Figure 9.10 Energy use in residential space heating for 25 EU countries, 2016**






Estonian dwellings require among the highest levels of space heating per square metre in the EU.

* Data from 2015.

Note: Energy consumption in residential space heating per dwelling in a normalised climate.

Source: Odyssee-Mure (2018), *Consumption per Dwelling for Space Heating*, www.indicators.odyssee-mure.eu/energy-indicators/household-heating-consumption.html.

To reach the targets of the NDPES 2030, the annual renewal rate in the residential building stock would need to be 1% of new construction and 2% of renovation; however, the actual renewal rate is, on average, only 0.5% annually (MEAC, 2017b). This is partly explained by the ownership profile in Estonia's residential sector. Almost 96% of all residential units (individual houses and apartment buildings) are owner-occupied and the share of rented accommodation is only slowly increasing. The public sector owns less than 4% of the residential housing stock and social housing accounts for less than 1% (MEAC, 2017b). About 60% of the Estonian population lives in owner-occupied apartments that are organised into housing associations, either for each building or for a group of buildings, depending on the exact type of development. Policies and support schemes to improve the energy efficiency of residential buildings must specifically target the ownership structure and age profile of the building stock.

The government has designed sample energy efficiency renovation packages for five energy performance levels of buildings to determine the economic and technical potential for renovations. The lowest energy performance level is considered Class F and describes only minor improvements compared to the existing situation, while the highest level is performance Class B, equivalent to low-energy buildings (MEAC, 2017c). The renovation package that offers the best economic value is achieved by aiming for performance Classes D and E; however, this would not result in Estonia meeting the energy efficiency targets set in the NDPES 2030. The package solutions focusing on more substantial renovation and retrofitting represent the technical potential and would be realised by aiming for performance Classes B and C (MEAC, 2017c).

Renovating apartment buildings to energy performance Classes B and C would realise approximately 2 TWh/year of energy savings and would bring Estonia closer to meeting the targets set in the NDPES 2030. However, achieving energy performance Classes B and C is only economically attractive if housing associations receive grants from the government. In the absence of financial support schemes, the majority of renovations would only target reaching energy performance Classes D and E with substantially lower energy savings (MEAC, 2017c). The government therefore offers financial support for energy efficiency improvements of residential buildings of up to 30% in Tallinn and Tartu and up to 40% in other locations of the total renovation cost.

The situation is more complicated for single-occupancy houses as they tend to be older. Therefore, the investment required to achieve a comparable energy performance level is substantially higher than for apartment buildings. The cost of upgrading a standard old individual house to performance Class C would be EUR 300/m$^2$, which is twice the amount as for an apartment building (MEAC, 2017c). Individual house owners would therefore require substantial financial support from the government. An additional challenge is that individual house owners usually undertake renovations in incremental steps when a specific need arises and without regard to improving the overall energy efficiency performance of the dwelling. Overcoming this barrier requires the provision of non-financial support services to assist owners with the planning and financing of the complex reconstruction work.

## *Public sector buildings*

The ESOA lays down the obligation for the renovation of the public sector building stock. According to the ESOA, the government must renovate 3% of the total surface area of the central government building stock annually. The Ministry of Finance[3] is responsible for implementing the obligation as the energy conservation co-ordinator for the central government buildings stock. This legal obligation is not applicable to the building stock of regional and local authorities; however, the ESOA obliges the Ministry of Finance to

[3] Annex A provides more detailed information about institutions and organisations with responsibilities related to the energy sector.

share best practices with regional and local authorities, to encourage them to adopt energy efficiency plans for their building stock, and to implement energy management systems and commission energy audits (MEAC, 2017b).

At the beginning of 2018, the total floor area of buildings over 250 square metres used by public bodies was just over 1.35 million m$^2$. As of January 2019, the area of buildings meeting the minimum energy performance requirements adopted in 2013 was 572 000 m$^2$. Reaching the 2030 target of the NDPES implies that at least 240 000 m$^2$ will need to be renovated by 2030. The average annual renovation rate for the period 2014-20 is estimated at 30 000 m$^2$, which leaves 170 000 m$^2$ for the period 2021-30. The target for 2020 is a renovation rate of 20% and Estonia is well on its way to reach this if the current annual renovation of 30 000 m$^2$ is maintained (MEAC, 2018). The IEA congratulates Estonia for this achievement.

A key challenge for the renovation and reconstruction of public buildings are small public units, like pre-schools and primary healthcare centres. They are eligible for renovation grants but often lack the technical competencies to undertake complex renovation works. To overcome this barrier, the government plans to develop a green label and green public procurement system and to offer technical support services for the small units. The example of Ireland in consolidating small individual renovation projects into larger ones to bring down procurement costs and to help with more standardised renovation solutions should be considered by the Estonian government. The IEA encourages the government to expedite the issuance of both the label and procurement systems to facilitate the renovation of the public building stock.

## *Support measures*

Subsidies are the main support measure for improving the energy efficiency of residential buildings. Housing associations can apply for grant support to the Credit and Export Guarantee Fund (SA KredEx). Depending on the complexity of the renovation to be undertaken and the location of the building, financial support is equal to 15-40% of the total cost. In addition, up to 50% of the cost of a technical consultant or for the renovation supervisor can be reimbursed. Apartment associations that apply for a grant of 15% of the total cost must achieve 20% energy savings. Applying for 25% support requires the reconstruction of the heating system, the insulation of the façade and roof, and the installation of new windows. If, in addition, the new windows are insulated and a ventilation system with heat recovery is installed, the renovation work can receive 40% grant support (MEAC, 2017c).

Housing associations often finance their share of the renovation work through loans. However, there are instances where the banking sector considers these applications to have higher than average risks, e.g. due to the location of the building or to the large number of association members that results in poor payment discipline. In response, the government has launched a loan guarantee scheme for housing associations. The loan guarantee can cover up to 75% of the total loan amount and is also administered by SA KredEx.

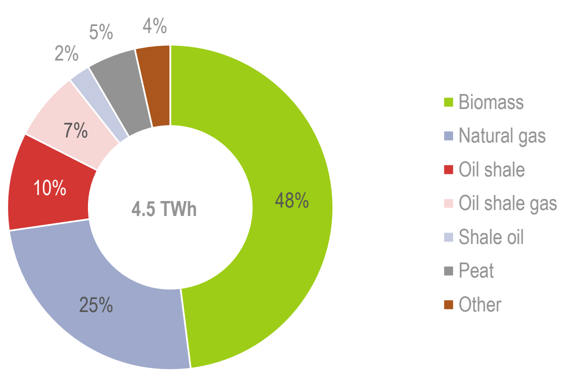
Since late 2016, individual house owners can apply for a grant of up to EUR 15 000, but the grant cannot exceed 30% of the total eligible renovation cost. In addition, the government offers tax incentives for individual owners to encourage the insulation of owner-occupied private houses or apartments. In 2015, 18% of income tax declarations requested a deduction for their residential housing loans (MEAC, 2017c).

The green investment schemes that are funded from the sale of $CO_2$ allowances are the largest financing source for energy efficiency improvements (MEAC, 2017b). EU structural funds and government funding complement the funding sources of SA KredEx. The State Budget Strategy for the period 2013-30 defines the priority measures to be funded through the green investment schemes. One of these measures is the promotion of energy efficiency and the use of renewable energy in public sector buildings. Within this measure, 54% of the allocated $CO_2$ auction revenues is provided to local governments and 46% to the central government (MEAC, 2017b). The investments primarily target the building sector, renovation of the district heating systems and of street lighting, the creation of co-generation plants, and the development of public transport. Estonia also benefits from the EU cohesion policy funds to support cross-cutting energy efficiency measures.

## District heating

Estonia has a large district heating (DH) sector, supplying 60% of the residential sector with heat. DH accounts for around one-third of total energy consumption in the residential and commercial sectors. Biomass is the largest energy source for DH production, accounting for nearly half of total DH generation (Figure 9.11). Natural gas accounts for 25% and oil shale-related fuels for 19% of total DH generation. Around half of DH is produced in combined heat and power (CHP) plants, often using biofuels and waste or oil shale. The share of CHP generated heat has increased in recent years (see Chapters 6 and 8 for a more detailed discussion on the fuel mix).

**Figure 9.11 District heating generation by fuel, 2017**






Nearly half of district heating in Estonia is generated from biomass, the rest is a mix of different fossil fuels including natural gas, oil shale and peat.

Source: Country submission.

### *District heating market and regulation*

Estonia has 230 district heating systems, the majority of which is operated by private companies at the municipal level. The DH market is regulated through the District Heating Act, which requires that all municipalities that use DH prepare a local heating infrastructure development plan. The plan not only focuses on investment needs in energy production and distribution, but must also assess the energy efficiency measures implemented in buildings connected to the DH. If the annual volume of a DH system is greater than 50 000 MWh, the municipality is authorised to take decisions concerning investment proposals in the sector (MEAC, 2017a).

The DH Act allows local governments in areas that have DH systems, or that plan to establish DH systems, to give a monopoly status to the DH operator under certain conditions (MEAC, 2017a). While the granting of monopoly status makes investments in DH more attractive, it might result in suboptimal solutions from an energy perspective and prevent the installation of more efficient and renewable heating solutions. In recognition of this risk, the government is encouraging the creation of local heating solutions using biomass and other locally available fuels where possible, instead of the rehabilitation of inefficient district heating solutions.

The Estonian Competition Authority regulates DH prices on a cost-plus basis. This means that the maximum price of heat should reflect the operating costs including production, distribution and necessary infrastructure investments, while environmental targets and quality and safety requirements are met. The cost-plus regulation also allows a justified profit for the company. In April 2017, the price of DH varied from EUR 35.33 MWh to EUR 86.96 MWh, excluding taxes. The weighted average DH price in 2017 was EUR 50.58 MWh excluding taxes. Prices are typically higher in smaller network regions with an annual sales volume below 10 GWh.

## *District heating energy efficiency potential and barriers*

Estonia's DH systems are rather old and have substantial potential to improve efficiency. The NDPES 2030 sets a target to preserve DH in areas where they are sustainable and capable of providing consumers with reasonably priced energy solutions in line with long-term environmental and energy targets.

A study undertaken by the Estonia Development Fund revealed that losses along the heating pipelines average 21%. The complete renovation of the heating pipelines could result in energy savings of up to 542 GWh in the period 2014-20 (MEAC, 2017a). Most of the functioning boilers are rather old and their renovation and replacement could also result in substantial energy savings, estimated at around 23 GWh (MEAC, 2017a). Older boilers using shale oil are replaced with more affordable biomass.

As per the NEAAP, Estonia is promoting the implementation of high efficiency CHP and nine new plants are already operating with more under construction. These efficient plants reduce the price of heat. However, this also means that energy efficiency investments at the consumer end become less attractive as lower consumer prices result in longer payback periods for energy efficiency improvements in the building stock.

The current price regulation for DH is one of the key factors limiting investments in energy efficiency improvements and the implementation of other cost-effective DH solutions for internal efficiency improvements. All benefits from the investments made have to be transferred to customers and do not improve the financial results of the investing companies. DH companies have also expressed concern that the regulatory environment is not sufficiently stable to promote long-term investments; the price regulation criteria change frequently.

DH operators in certain regions are also concerned about the long-term sustainability of their business model and hesitant to embark on substantial investments in improving efficiency, which they may not be able to recover. The government plans as set out in the NDPES 2030 to facilitate competition in heat supply, and allow local heat production infrastructure, reduce the long-term viability and efficiency of parts of the district heating network. Involving local authorities in the long-term planning of the heating infrastructure and in undertaking heating sector audits is therefore a welcome initiative.

Estonia supports the development of efficient DH through the “effective production and transmission of thermal energy” programme, with the goal to increase the share of renewable energy in heating and reduce emissions. The programme is funded through EU structural funds and administered by the Foundation Environmental Investments Centre, with a total budget of around EUR 60 million for 2014-20. The NDPES targets that in 2030 80% of heat demand will be generated from renewable energy sources. Substantial progress has already been made towards this target and the IEA commends Estonia for this.

## Industry

The share of industry in TFC is continuously declining; however, potential for energy savings exists, especially in the wood, paper and food sectors; in mining; and in the construction material sector. The government has identified a savings potential of 36 GWh annually in the manufacturing sector. Energy intensity in industry decreased by 6% from 2015-17 (EC, 2019).

The EU Energy Efficiency Directive imposes a requirement for non-small and medium-sized enterprises to undertake regular energy audits. This was transposed into Estonian law in 2016 with the ESOA. Since 2017, the government supports energy audits and investments in energy efficiency in the industrial sector through the EU structural funds, with a total budget of EUR 433 million for the period 2014-20. Government support is focused on interventions that would not be realised under market conditions only, as their pay-back period would be too long. In addition, the government is also implementing non-monetary support schemes to raise awareness and improve the energy efficiency competence level of experts to assist with project implementation. Since 2017, 85 audits have been conducted, with a target of 270 audits by 2020. However, there is no obligation to implement the energy efficiency measures following an energy audit.

The Environmental Investment Centre manages the funding for energy and resource audits and energy efficiency investments in the industry sector. Thirty investment projects recommended by the audits are ongoing, a large proportion in the wood industry. Funding for investments is made available separately for small and large projects. Small projects need to achieve at least a 1% energy efficiency or resource use improvement and can apply for up to EUR 100 000 of support. Large improvement projects need to achieve at least a 5% improvement in their energy use and can apply for a minimum of EUR 201 000 and up to EUR 2 million of funding.

The government is also offering tax exemptions for industry. Industry is only taxed on distributed profits, but not on those that they retain. This has stimulated the willingness of businesses to reinvest their profits, including on more energy-efficient machinery and equipment and the renovation of existing buildings, or the construction of new ones.

In addition, energy intensive companies in the manufacturing or IT sector can apply for a 90% reduction of the excise tax on electricity from 2019 onwards if they implement an ISO 50001 energy management system. This measure could concern up to 240 companies. The Tax and Customs Board has published the implementation guidelines for the scheme. Among them is a requirement that the energy management system covers the electricity consumption of the energy company and not just of one subsidiary. It will be important that the tax exemption only be provided after the ISO 50001 certification has been obtained. Alternatively, the government can consider offering an increasing proportion of tax reduction throughout the process of complying with the ISO 50001 requirements. In both cases, strict monitoring and verification that the measures are indeed implemented and producing savings need to be ensured to verify that the desired outcomes are achieved.

The market for energy service companies (ESCOs) is not yet well developed in Estonia. ESCO solutions have penetrated mainly among large commercial and industrial energy users, notably in the food production industry. The small commercial, public and residential sectors are much slower in taking up ESCO services (MEAC, 2017b). The government is actively working towards changing this in light of the many benefits ESCOs can offer in realising the energy efficiency potential in Estonia. In 2018, the Ministry of Economic Affairs and Communications organised a roundtable to discuss how the government could better support this nascent sector and what type of barriers need to be overcome. Barriers identified include high transaction costs and the complexity of establishing a mutually accepted baseline for contracts. The lack of a sufficient number of trained professionals is another barrier for the development of the ESCO market.

## Transport

The share of transport in TFC rose from 22% in 2000 to 28% in 2017, primarily driven by strong economic growth that propelled the ownership of private cars and encouraged freight transport by road, and urban sprawl. Estonia is among the top ten most transport energy intensive IEA countries (defined as transport energy use per GDP PPP; see Chapter 7). Vehicles on local roads and streets outside of urban areas account for over 40% of total vehicle fuel consumption (BSERC, 2017).

The NDPES 2030 sets a target for 2030 that the fuel consumption of vehicles should not exceed the level of 2012 (8.3 TWh) and that the energy demand from individual passenger cars should not be more than 5% higher than in 2010, measured in passenger kilometres (km). In 2010, demand was 6 100 passenger-km. This would imply either a reduced demand for travel through, for example, increased teleworking, or a modal shift. The NDPES 2030 does indeed aim that 25% of the working population will use public transport to travel to and from work (MEAC, 2017b).

The targets were set on the basis of extensive background studies undertaken for the preparation of the NDPES 2030. The studies assessed the energy savings potential of 24 potential measures and concluded that if all potential measures were implemented, up to 40% of transport energy consumption could be saved compared to the base scenario. Around 20% of the potential savings would come from more efficient conventional combustion engine vehicles and hybrid electric cars. However, the contribution of electric vehicles would remain small despite the progress made with the government support programme (BSERC, 2017; MEAC, 2017b). The remaining share would be achieved through a combination of:

- taxation of cars and car use
- expanding public transport infrastructure

- ecodriving
- parking management and pricing
- integrated spatial planning
- congestion charges and other measures.

The main barriers to reach the energy efficiency targets in the transport sector are the lack of comprehensive fiscal measures to improve the fuel efficiency of vehicles and to provide incentives for a modal shift, and the lack of long-term funding schemes for developing public transport, cycling infrastructure and pedestrian zones. The IEA encourages the Estonian government to rapidly finalise the new transport sector development plan for the period to 2030 and to accelerate the introduction of a smart tax environment to improve the fuel efficiency of the vehicle fleet. Estonia should explore how best to leverage its leadership in the area of digitalisation for the introduction of country-wide shared mobility services and "mobility as a service" schemes, for instance by exchanging best practices with neighbouring Finland. See Chapter 7 for a more detailed discussion of the transport sector.

## Assessment

The TFC of Estonia has nearly halved since 1990. It decreased mostly in the immediate years after the restoration of independence of Estonia in 1991 and was relatively stable from the mid-1990s until the financial crises in 2008. In 2017, Estonia's TFC was 2.9 Mtoe (3.4 TWh), in line with the 2020 target to limit TFC at the 2010 level (3.0 Mtoe).

The residential sector accounts for the largest share of TFC, followed by transport, the commercial sector and the industry sector. The current national energy efficiency measures have mostly focused on improving the energy performance of buildings, as this is the sector responsible for the highest energy consumption rates and has a large unexplored efficiency potential.

Traditionally, the Estonian government favours market-based solutions and aims to limit government interventions to the minimum degree required. However, the NDPES 2030 acknowledges that meeting the country's 2030 energy efficiency targets in the transport and building sectors will largely depend on extensive public intervention. Relying on markets only to implement the required energy efficiency measures in these sectors would likely result in increasing energy consumption.

Reaching the primary energy consumption target for 2030 will largely be determined by future developments in the oil shale industry that is subject to the National Oil Shale Development Plan to 2030 (see Chapter 3).

### *Buildings and demand for heating and cooling*

The residential sector is the single largest energy-consuming sector in Estonia. This is largely due to the country's cold climate with an average yearly temperature of 6.7°C. Estonia's building stock is old and inefficient, although building energy efficiency has improved in recent decades. Renovation of the housing stock could reduce the heating demand of buildings substantially according to the NDPES 2030.

The government has only limited possibilities to lead by example in the residential housing sector, as the public sector owns less than 4% of residential buildings. It is therefore important to encourage private owners to undertake the complex renovation work required. Due to the high proportion of owner-occupied residential units, Estonia has less of a principal-agent problem than most other IEA countries. The hurdle facing Estonia is the need of the housing associations to reach agreement on efficiency upgrades. There is a general distrust in Estonia to embark on collective solutions, explained by the country's history. Identifying project champions that can convince the association members and explain the benefits of the renovation is therefore critical for increasing the rate of residential renewal rates (CO2mmunity, 2018).

The main measure implemented for improving the energy performance of residential buildings are subsidies for the renovation of the existing building stock financed by EU structural funds and the revenues of the Emissions Trading System. Between 2014 and 2017, the measure allowed 1 000 apartment buildings to be renovated with higher efficiency standards (out of a stock of 22 000 buildings), for a corresponding energy savings of 57 GWh. However, a large share of private house owners did not apply for the energy efficiency grant, due to a complicated application process.

The government's plan to develop sample designs and renovation packages as part of its commitment to undertake extensive renovation of public sector buildings could also boost private sector investments. However, a key requirement for a higher uptake of energy efficiency investments in the public and private sector is the availability of qualified professionals to undertake the energy improvement works.

Recent years have seen an increase of temperature in summer, leading to a growing need for cooling. The use of air conditioning is regulated in the new minimum efficiency standards of 2013. In the Tallinn region, for example, it would be possible to introduce district cooling. While cooling does not have the same priority as heating, it would still be advisable to explore the technical potential of district cooling to pre-empt any move towards inefficient individual cooling solutions.

## *District heating*

The vast majority of Estonia's population is connected to a DH system. DH accounts for one-third of total energy consumption in the residential and commercial sectors. Biomass is the largest energy source for DH production, accounting for around half of total DH generation, followed by natural gas and oil shale related fuels. Around half of DH is produced in CHP plants, often using biofuels and waste or oil shale. The share of CHP generated heat has increased strongly in recent years.

Estonia has 230 DH networks, the majority of which are operated by small private companies at the local level. The DH system is old and in need of substantial rehabilitations to reduce heat losses in the transmission and in the boilers. Until 2016, the regulatory framework gave most DH systems monopoly status and prevented the emergence of alternative heating solutions in these regions. The prices of DH services are regulated on a cost-plus basis and differ markedly throughout the country depending on the fuel used.

The price regulation requires that any efficiency savings be directly passed on in lower prices for consumers, with little benefit for the investor. This limits the incentive for DH companies to invest in efficiency measures. The introduction of a mechanism by which the potential benefits of such efficiency measures could be shared between consumer and producer could lead to more energy efficiency investments.

The DH sector in Estonia is undergoing a transition in light of decreasing heat demand due to building upgrades, the introduction of more local solutions for supplying heat, and the gradual emergence of energy associations that produce heat and electricity for their own needs (prosumers). DH regulation should not prevent the introduction of cost-effective and environment-friendly solutions from competing with DH. At the same time, it is a challenge for the government to ensure continuous investments in improving the efficiency of DH while simultaneously encouraging alternative policy approaches.

The revised DH Act of 2017 aims to strike a balance between the two objectives. It aims to create a favourable investment environment for the implementation of sustainable solutions, either as DH or through local solutions. It sets the framework for the government to continue providing investment support for the rehabilitation for DH systems that have a long-term perspective. But it also paves the way for the gradual transition away from unsustainable DH solutions towards localised solutions.

## *Industry*

The industry sector is the third major final consumption sector after housing and transport. The Ministry of Environment anticipates that the greatest potential for saving energy in Estonia arises from mining, food, wood and paper sectors. The oil shale industry has large efficiency potential and is already undertaking extensive investments to reduce the energy intensity of the mining and processing of oil shale, as this will directly improve their profits (see Chapter 3).

Estonia transposed the EU EED that imposes regular energy audits for non-small and medium-sized enterprises into national law in 2016. The number of energy audits is growing gradually and it is uncertain if the target of 270 audits by 2020 can be met. There is no obligation to implement energy efficiency measures following an energy audit and only about one-third of the energy audits undertaken have resulted in follow-on investment projects. It would be important to understand why companies are opting not to undertake energy efficiency investments and what kind of incentive structures and policy framework could change this. The IEA encourages the government to launch a study in this regard.

At the moment, the findings of the individual energy audits are not used for further research or to inform policy making. There is no monitoring system in place to collect information on energy savings potential from the energy audits. This is a great loss of information for the country and hampers further understanding of the potential for and the best way to better exploit the energy efficiency potential with a view to meeting the 2030 targets. The systematic collection and analysis of data would also contribute to gathering evidence of the actual energy savings achieved through specific energy efficiency measures; data which are currently also not available on a systematic basis. While international benchmarking might not be feasible for all industries in Estonia, it would still be worthwhile to explore to the extent possible how the energy performance of industry in Estonia compares to that in other countries.

## *Challenges*

Estonia has a good chance to reach its 2020 target to limit total final consumption to the level of 2010. The 2030 energy efficiency targets will be harder to reach without further energy efficiency measures and funding. Accelerating the uptake of energy efficiency investment across the economy requires a comprehensive campaign to increase the awareness of households and industry about the benefits and support schemes available to them. Facilitating access to planning and management support for complex rehabilitation works is another important barrier to overcome.

The application process for government grants is considered complex and lengthy and has proven to be a barrier for energy efficiency improvements in the residential sector. In the industry sector, and specifically in the small industry segment, the provision of technology-specific information for energy efficiency solutions will be helpful to further unlock the potential. Both of these barriers could be addressed through the development of a broader ESCO market that could also offer energy audits, energy managers, and supervisory and building services for the construction process. The lack of qualified builders and supervisors that can ensure that quality work is being undertaken has been a hindrance for potential investors to embark on technically complex renovation projects.

The ESCO market in Estonia is in the nascent stage. This is partly due to the relatively recent requirement for energy audits, as the energy efficiency obligations were only transposed into national law in 2016. Another reason for the slow growth is the limited pool of qualified professionals that have the required certifications.

The government is in the process of developing an integrated professional qualification system in close co-operation with the education system and by making necessary changes to the curricula. The objective is to create a network of qualified specialists offering energy services in Estonia. This is a welcome initiative and applauded by the IEA.

However, there is a limited pool of interested candidates to train as energy services professionals and raising awareness about the possible career paths in this area will be important. The energy services career path could be of particular interest in the structurally weaker sections of Estonia that offer limited alternative employment opportunities. Establishing a nationwide register of qualified companies will also facilitate the uptake of ESCO solutions.

Estonia is a small market and the traditional ESCO business model might not be sustainable on its own. However, with adequate support from the government, there is a large scope to make the ESCO concept attractive. A more targeted offer by ESCOs could help unlock the significant potential for energy savings in both industrial processes and industrial buildings, and the residential sector. A functioning ESCO market would also offer additional financing possibilities for projects in those sectors.

Finally, if Estonia wants to realise its potential annual energy efficiency investment, it will need to assure continued provision of sufficient public grant schemes and to allocate additional public funds to complement funds received through the EU structural funds. This is especially important with a view to the reduced $CO_2$ allowances for the period to 2030 that will reduce the revenues available for the green investment schemes.

## Recommendations

***The government of Estonia should:***

- ☐ Increase the financial support for the renovation of the existing building stock, in particular residential buildings, ensure continuity in available budget and develop an ESCO market.
- ☐ Facilitate and simplify the grant application process for the renovation of private houses.
- ☐ Improve the understanding of the energy efficiency potential of the industrial sectors by aggregating existing audit data and by international benchmarking.
- ☐ Increase requirements on industry to implement the findings of the energy audits.
- ☐ Encourage energy efficiency investments by district heating companies, for instance by amending the tariff regulation methodology in the District Heating Act so that benefits can be shared by consumers and the companies.

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# 10. Energy technology research, development and demonstration

## Key data
(2017)

**Government energy RD&D spending:** EUR 21.9 million

**Share of GDP:** 0.94 per 1 000 GDP units (IEA* median: 0.30)

**RD&D per capita:** USD 18.7 (IEA* median: USD 13.8)

* Median of 19 IEA member countries for which 2017 data are available.

## Overview

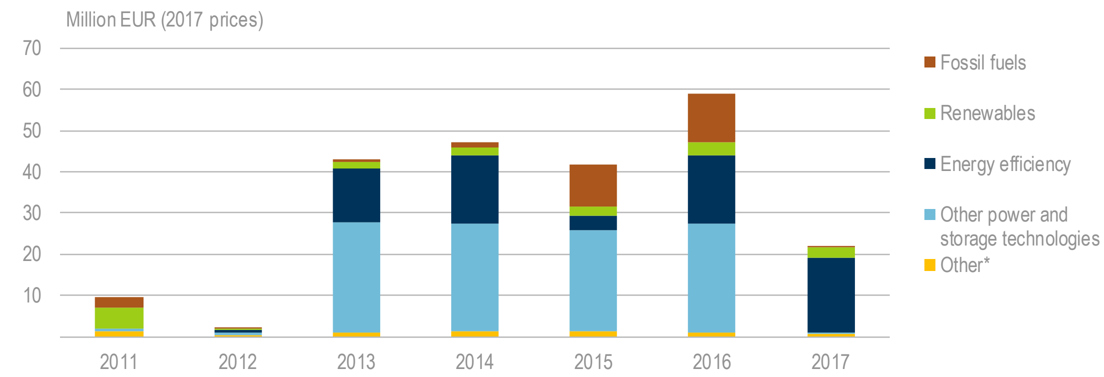
In 2017, Estonia had the second-highest share of spending on research, development and deployment (RD&D) per unit of gross domestic product (GDP) of all International Energy Agency (IEA) member countries. In line with the *National Development Plan of the Energy Sector 2030* (NDPES 2030) Estonia has realigned its priorities for energy RD&D, by including the transport and the building sectors among its priority areas (MEAC, 2017).

## Public spending on energy RD&D

In 2017, the government spent EUR 22 million on energy-related RD&D. Energy efficiency accounted for 83% of total spending, followed by renewables (13%) and other technologies (3%). Energy efficiency funding was directed at various sectors, including industry and buildings. Public spending on energy RD&D in Estonia has shifted significantly in recent years, away from fossil fuels towards energy efficiency and renewable energy (Figure 10.1).

From 2013 to 2016, Estonia had the highest public spending on energy-related RD&D among all IEA countries. In 2017, Estonia's public spending on energy-related RD&D decreased by more than half compared to EUR 59 million in 2016. Despite this, Estonia still had the second-highest share of spending among IEA member countries, at 0.094% of GDP (Figure 10.2). The decrease in 2017 was a result of reduced funding for RD&D related to fossil fuels and some power and energy storage technologies. On the other hand, funding of RD&D related to energy efficiency increased to EUR 18 million, from EUR 16 million in 2016.

**Figure 10.1 Government energy RD&D spending by category, 2011-17**



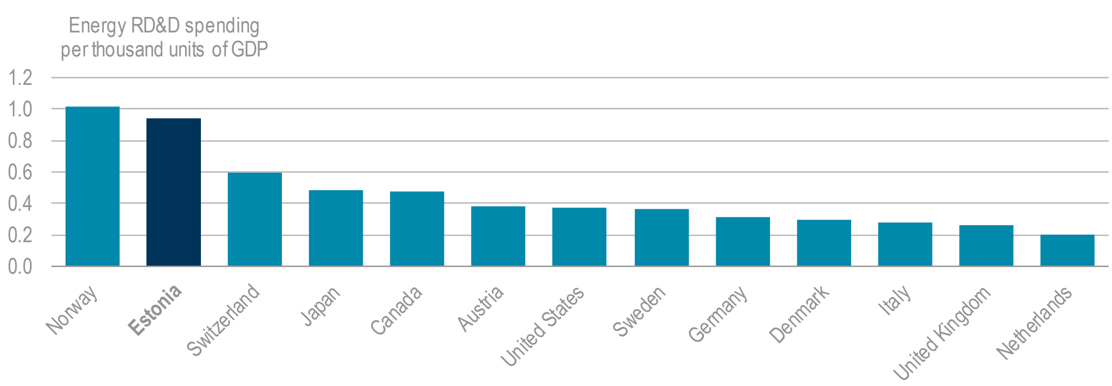



The government spent EUR 22 million on energy-related RD&D in 2017; energy efficiency received the largest share.

* *Other* includes nuclear, hydrogen and fuel cells and cross-cutting technology and research.

Source: IEA (2018), *Energy Technology RD&D Budgets 2018*, www.iea.org/statistics.

**Figure 10.2 Government energy RD&D spending per GDP in IEA countries, 2017**






As in 2016, Estonia continues to rank high in RD&D spending per unit of GDP among IEA countries for 2017.

Note: Data are not available for Belgium, the Czech Republic, Finland, France, Greece, Hungary, Ireland, Korea, Luxembourg, Portugal or Spain.

Source: IEA (2018), *Energy Technology RD&D Budgets 2018*, www.iea.org/statistics.

# General RD&D strategy and organisational structure

The Research and Development Council advises the government on all matters relating to Estonia's RD&D strategies and innovation policies. Its approval is required before policy documents are passed forward to the government. The government then submits the national RD&D policies to the national parliament (Riigikogu) for approval. The Estonian Research Council, established in 2012, is the main RD&D funding body and co-ordinates external RD&D co-operation (MER, 2018a).

The Ministry of Education and Research and the Ministry of Economic Affairs and Communications[1] jointly developed the third Estonian Research and Development and Innovation Strategy (RDI) for 2014-2020 entitled "Knowledge-based Estonia" (MER, 2014), through extensive consultations with researchers, the business sector, policy makers and implementing agencies. The RDI 2014-20 reduced the number of national RDI programmes to make them more efficient. RD&D funding is focused on a limited number of areas under the so-called smart specialisation concept that aligns priorities for economic, RD&D and education policies with the aim to support knowledge-based economic development. One of the smart specialisation areas is targeting the more effective use of resources, including in the energy sector. The RDI aims to enhance co-operation between RD&D institutions and the private sector and to make research more relevant to the business sector (MER, 2018b).

The RDI consolidates the financing mechanisms for RD&D which are rather fragmented. The RDI sets out a number of performance indicators, including increasing the overall RD&D investment to 3% of GDP by 2020, of which the private sector would account for 2% of GDP, and to reach at least tenth position in the EU Innovation Union Scoreboard. Meeting the indicators requires an effective reorganisation of the statistics and monitoring system for financing RD&D (MER, 2014).

## Energy RD&D priorities, funding and implementation

The NDPES 2030 is the guiding policy for Estonia's energy research, development and deployment. The RD&D priorities in the NDPES 2030 are aligned with the five key areas necessary for the transition of the energy sector and focus specifically on demonstration and application:

- electricity supply
- development of local fuels (oil shale, biofuels, biomass, other fossil fuels)
- transport and mobility
- energy efficiency of buildings
- heat supply (generation, transmission, storage and district heating).

The NDPES 2030 redefined the earlier priority areas of energy RD&D to include transport and buildings based on the lessons learnt from the Energy Technology Programme (ETP) that ran from 2008 to 2013. RD&D activities in the transport sector will focus on the development and commercialisation of alternative fuels, specifically the use of methane fuels (biomethane) and biogas. This is expected to help meet the 2020 renewable energy targets in the transport sector (see Chapters 4, 7 and 8). The priorities in the buildings sector are: developing new energy efficiency technologies for upgrading the existing building stock and developing affordable technology solutions for new nearly zero-energy buildings. The buildings sector RD&D is closely linked to activities in the area of heat supply.

[1] Annex A provides more detailed information about institutions and organisations with responsibilities related to the energy sector.

Oil shale remains a central part of Estonian energy RD&D activities given its importance in the Estonian energy sector (see Chapter 3). Among other projects, the Tallinn University of Technology (TalTech) undertook a project on the cogeneration of shale oil for heat and electricity and developed a cogeneration model. TalTech is also the key player in offering university curricula related to oil shale. The *National Development Plan for the Use of Oil Shale 2016-2030* sets out the RD&D activities for the period to 2030 with an emphasis on the linkage between basic and applied research (MoE, 2016).

The NDPES 2030 includes a provision for the creation of a dedicated long-term investment fund sourced from the state budget. This proposal is a response to the findings from the evaluation of the ETP, which identified the need to address the fragmented nature of Estonia's RD&D in order to increase its effectiveness in delivering results and to make the most efficient use of the existing funds. The fund was expected to become operational in 2019. However, currently no details on the structure, size or decision-making process of the fund are available. Among other activities, the fund will finance R&D institutions in the energy field, e.g. universities, for research areas identified through stakeholder consultations. Overall, Estonia relies heavily on funding from various EU programmes, the future of which is uncertain beyond 2020.

The Ministry of Economic Affairs and Commuications' policy is implemented primarily through the Enterprise Estonia Foundation that manages support for the private sector, and innovation and technology programmes; through the KredEx foundation that assists business in accessing finance and has a special focus on supporting energy efficiency in the buildings sector; and the Environmental Investment Centre that funds renewable energy and energy efficiency projects (see Chapter 9).

Estonia does not systematically collect information on RD&D spending by the private sector. Instead, the data are contained in different databases and are collected and analysed through different methodologies. For example, the Ministry of Economic Affairs and Commuications collects data from the Estonian Research Information System, the Estonian Environmental Investment Centre, KredEx and the annual government budget manually. The responsible unit also directly contacts large energy companies and manually analyses the financial reports of smaller companies to compile private sector RD&D data.

## Industry collaboration

Industry is particularly engaged in RD&D related to the exploitation of oil shale. The largest RD&D investment is undertaken by Eesti Energia, the country's dominant company in the oil shale and oil shale electricity generation sector. The magnitude of Eesti Energia's RD&D investments is such that it strongly influences the annual total of Estonian energy RD&D spending. In 2013, when Eesti Energia ended its RD&D investment in an oil shale refinery, Estonia's overall RD&D investments for the year dropped below the EU average (Kattel and Stamenov, 2017).

One of the challenges the Estonian RD&D programme is facing is its small size and the dominance of small and medium-sized enterprises in its economy. Estonia is addressing these challenges by supporting the development of clusters, i.e. co-operation networks in the same area of specialisation, to leverage the available resources and help small and medium-sized companies gain competitiveness. For the period 2014-20, energy sector-related clusters selected for funding support include the EstonianWind Technology Cluster and the Estonian Smart City Cluster, as well as the real estate and energy cluster KEN. The cluster programme is implemented by the Enterprise Estonia Foundation (EAS, 2019).

# International collaboration

## *IEA technology collaboration programmes*

Estonia is not a very active contributor to the technology collaboration programmes (TCPs) organised by the IEA. It only participates in 2 of the 38 TCPs. In 2018, Estonia joined the Bioenergy TCP that undertakes analysis on the potential of biomethane in transport applications, a priority RD&D area for Estonia. In April 2019, Estonia completed formalities to join the Heat Pump Technologies TCP, which supports deployment of heat pumps by quantifying the energy savings and emissions reduction potentials of heat pumps in different applications.

## *Other engagements*

Estonia focuses its international RD&D collaboration primarily on programmes within the EU framework and within the context of the Baltic and Baltic-Nordic regional co-operation.

### Horizon 2020

Estonia participates in Horizon 2020, the largest research and innovation programme in the EU. One of Horizon 2020's priority areas is energy, and particularly energy efficiency, low-carbon energy and smart cities, all of which are priority areas for Estonia's RD&D. By early 2017, Estonia had received 0.8% of the EU funding devoted to programmes related to "secure, clean and efficient energy" (EC, 2017).

As of January 2019, 61 Estonian organisations had received approximately EUR 18.5 million for Horizon 2020 energy projects. This includes nine grants for a total of EUR 5.4 million to the city of Tartu, the Estonian participant in the SmartEnCity project (smart zero emissions cities) (Kattel and Stamenov, 2017). The funds will be used to undertake large-scale renovation of 20 Soviet apartment buildings in Tartu in line with the standards of zero-energy buildings. Solar panels will be installed on the participating buildings and they will be equipped with smart energy-efficient home management systems that will help monitor energy consumption (Tark Tartu, 2019).

Estonia was a partner of a Horizon 2020 programme dedicated to cleaning up oil spills in the Artic (GRACE oil project). In February 2019, Estonia became the first Baltic country to receive support under the European Commission's InnovFin Programme (Box 10.1).

### Baltic collaboration

At the regional level, Estonia participates in the Baltic Sea Region Energy Cooperation (BASREC), the energy committee of the Baltic Council of Ministers and the Baltic Energy Market Interconnection Plan (BEMIP). With these commitments, Estonia aims to strengthen its energy security, promote more research and development, and increase intellectual property from domestic resources.

BEMIP projects are funded through the EU's structural funds, including the European Regional Development Fund and the Cohesion Fund. Under the framework of the Horizon 2020 programme, EUR 16.9 million have been allocated to participants from the Baltic region to stimulate research and innovation on secure, clean and efficient energy source (EC, 2017). The three Baltic countries and Finland are collaborating on the preparation of a joint Preventive Action Plan and an Emergency Plan for the region (EC, 2018a).

**Box 10.1 InnovFin programme**

The European Investment Bank awarded a EUR 12 million loan under the InnovFin programme to the Estonian company Elcogen to bring its highly efficient fuel cell technology to the market. This is the first InnovFin support for a Baltic country. InnovFin is the European Commission's innovators financing programme that is part of the Horizon 2020 research and innovation programme. The financing awarded to Elcogen falls under the InnovFin's Energy Demonstration Projects facility. The European Investment Bank loan supplements EUR 18 million that Elcogen had raised earlier from private investors and public funds.

The loan allows for further research and development of fuel cells and the creation of a demonstration manufacturing plant that would eventually allow mass manufacturing at affordable costs. Once completed, Elcogen plans to manufacture approximately 2 million cells per year, equivalent to an electrical capacity of 50 megawatts.

The fuel cell technology that Elcogen has developed and patented converts a range of fuels, mainly hydrogen and biogas, into electrical energy with a very high electrical efficiency compared to other commercially available fuel cells. Elcongen's fuel cell technology specifically targets residential power generation systems, industrial power generation units and off-grid power generation.

Source: EIB (2019), *Estonia: #InnovFin: EUR 12 Million Loan from EU to Clean Tech Company Elcogen*, https://www.eib.org/en/infocentre/press/releases/all/2019/2019-041-innovfin-eur-12-million-loan-from-eu-to-estonian-clean-tech-company-elcogen.

## Nordic-Baltic Memorandum of Understanding (MOU) on Energy Research Programme

In October 2018, Estonia signed the "Memorandum of Understanding between the Baltic States and the Nordic Energy Research on Energy Research Programme" (Nordic Energy Research, 2018). The MOU will establish a collaborative energy research programme across the two regions.

The total funding for the programme is EUR 2.4 million for the years 2019-22, half of which will be funded by the Nordic Energy Research, an organisation under the Nordic Council of Ministers. The other half will be funded by the Baltic governments. Estonia has pledged an annual contribution of EUR 110 000 that will be sourced from the budget provisions made under the NDPES 2030 for the years 2019-22. The joint research programme has three central objectives:

- to promote intra-Baltic and Baltic-Nordic energy research projects with the participation of Baltic researchers
- to create a Baltic-Nordic PhD collaboration programme
- to foster an exchange of energy research between the Baltic and Nordic countries.

The MOU builds on the successful co-operation between researchers from the three Baltic countries and the Nordic Energy Research, in the preparation of the "Baltic Energy Technology Scenarios 2018" (BENTE). BENTE analysed several scenarios to explore the drivers and their impacts on possible changes in the energy systems in the three Baltic countries, including which path would lead them towards the 2°C scenario. The key findings of BENTE include that their national renewable energy targets can be achieved using domestic resources and that this would reduce their import dependency and provide an effective hedge against high electricity prices. However, even in the 4°C scenario, the three Baltic countries would not be reaching their 2030 non-ETS sector targets, although Estonia will be close (Nordic Council of Ministers, 2018). Reaching the 2030 non-ETS targets largely depends on the early adoption of additional energy policy and climate measures, especially increasing the share of renewable energy. The report also indicated further areas of joint technology co-operation that are reflected in the MOU.

Estonia is a member of the International Renewable Energy Agency, through which it is exploring ways to meet its commitments under the EU Renewable Energy Directive. Areas of common interest include sectoral policy implementations and renewable energy development, such as the use of liquid biofuels in transport. Estonia does not participate in the Clean Energy Ministerial, nor in Mission Innovation.

## Monitoring and evaluation

Estonia does not have a specific monitoring and evaluation system in place for its energy RD&D activities. There is also no plan to create and implement such a system. The evaluation of the ETP in 2012 identified several issues, including the need to increase co-operation between research institutions and the private sector to direct RD&D towards areas with more direct application and economic impacts, and the insufficient supply of qualified energy sector experts.

The Ministry of Education and Research evaluates the outcomes of the country's overall RD&D programme. An analysis undertaken in 2017 showed that a large number of RD&D goals set in the RDI for 2020 will not be met. Investments in total R&D have declined, from 2.31% of GDP in 2011 to 1.28% in 2016. Estonian scholars' publications are on path to meet the targets set in the RDI; however, these do not necessarily translate into more output-oriented research (ERR Media, 2018). However, Estonia has been successfully applying for funds under the EU Horizon 2020 programme and has received above EU average funding in terms of funding per population.

The European Innovation Scoreboard 2018, which assesses relative strengths and weaknesses of national innovation systems, considers Estonia a moderate innovator with a performance below the European Union average (EC, 2018b). Estonia's innovation performance improved until 2015, but due to a strong decline in 2016, the level in 2017 was 3.2% below the level in 2010. This is despite an above EU average score in the innovation-friendly environment, human resources and intellectual assets categories. However, this could not compensate for a below-average performance in the finance and support category that declined by almost 34% between 2016 and 2017, and the weak performance in the sales impact assessment (EC, 2018b).

An ongoing challenge for Estonian RD&D is the continuous disparity between the type of research supported by public funds, mainly basic research and academic publications, and the requirements of industry for more applied research, which can translate into economic opportunities (Kattel and Stamenov, 2017). This was also a key finding of the 2012 review of the ETP and the 2017 evaluation report of the Ministry of Education and Research and was also recognised in the 2013 In-depth Review of Estonia (IEA, 2013). This is partly due to the emphasis put on the number of publications and citations in the assessment of research institutions.

## Assessment

The NDPES 2030 sets out Estonia's plans for energy-related research and development activities. This includes trying to simplify and better co-ordinate R&D activities.

Estonia has identified key areas of energy importance to focus its R&D efforts on. These include areas of comparative advantage, such as transitioning to alternative uses of oil shale and the development of biomethane in the transport sector. There is also a focus on areas of significant energy consumption, such as heating. Given that Estonia is a relatively small country, the IEA thinks this is a sensible approach.

Funding for energy R&D in Estonia comes from EU funds like Horizon 2020, and Estonian state budget programmes. Some of these funds and programmes appear to have overlapping objectives and there may be an opportunity to better use the funding to more effect. As an example, the R&D funding from the national budget under the national development plan (EUR 1.6 million over four years) appears too small to have a meaningful impact. This is especially so when spread across seven R&D programme areas, the Nordic-Baltic energy research programme and participation in the IEA's technology collaboration programmes.

The government has recognised the importance of international and regional co-operation on areas of common interest. The IEA commends this approach as it could help build scale, speed up developments and leverage additional private investment.

Estonia has well-established institutions, such as Kredex and the Environmental Investment Centre, that help to finance research, development, demonstration and commercialisation projects related to environment and energy. For example, the Environmental Investment Centre channels funding from state budget funds and EU funds for the implementation of projects, including in priority R&D areas such as biomethane production and efficiency improvements in district heating. These appear to be working effectively and have the support of market participants.

R&D statistics do not appear to be collected in an efficient and systematic way. Given the efforts made in Estonia to move towards digitalisation and the range of different R&D funding sources and programmes, there is opportunity to improve the system of R&D data collection, its transparency and reporting, to the benefit of systematic evaluation, which seems to be lacking.

The government's review of the previous Energy Technology Programme found that there was too much emphasis on research publications and citations in universities, rather than in helping to solve real world problems with industry. The NDPES 2030 recognised the need to realign funding away from theoretical academia to RD&D demonstration projects. A 2017 analysis undertaken by the European Union suggests that there is still significant potential to improve in this area.

## Recommendations

***The government of Estonia should:***

- Focus its energy R&D efforts on areas of most relevance to Estonia, such as alternative uses for oil shale, biomethane for transport, improvements to heating and digital solutions.
- Explore ways to better collaborate regionally and internationally on areas of common interest in energy R&D, including leveraging private sector investment.
- Systematically evaluate research programmes, notably to see whether they contribute to practical innovations.

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## ANNEX A: Institutions and organisations with energy sector responsibilities



The **Ministry of Economic Affairs and Communications (MEAC)** has overall responsibility for energy policies and is responsible for co-ordinating the implementation of the National Development Plan for the Energy Sector. Within the ministry, the Energy Department has the main responsibility for energy and co-operates with the Building and Housing Departments on matters related to the energy efficiency of the housing stock and district heating. The Transport Department and the Energy Department are both responsible for fuel issues.

MEAC is responsible for the Electricity Market Act, and the Electricity Network Codes. MEAC is also responsible for the implementation of the EU Renewable Energy Directive and other related EU legislation. It drafts legislation proposals related to renewable energy, in consultation with other stakeholders. The ministry has two subordinate bodies that support the implementation of renewables and energy efficiency policies. The first one, the **Credit and Export Guarantee Fund (KredEx Fund)**, works on measures targeted to the residential sector and electromobility. KredEx Fund provides guarantees for loans, mainly for reconstruction of houses and improving their energy efficiency, but also provides grants for installing renewable energy generation installations for private households (solar panels, wind generators). The second subordinate body, the **Environmental Investment Centre (EIC)**, implements measures targeting public infrastructure, particularly heat and electricity generation, reconstructing combined heat and power plants, district heating systems, street lighting, and wind parks. The EIC also manages funding for energy investments in the industrial sector and provides support schemes for increasing the share of renewable heat.

MEAC, the **Ministry of Environment (MoE)** and the **Ministry of Agriculture (MoA**) share responsibility for the overall legal framework, policies and measures related to renewable energy. MEAC deals directly with energy and electricity-related issues and is responsible for preparing legislative changes and presenting them to the relevant authority. The MoE and the MoA are responsible for biomass sustainability and biodiversity-related issues, which are highly relevant to renewable energy given the important role of biomass. The MoA also deals with land-use issues related to agricultural biomass.

MEAC has the responsibility for oil emergency preparedness, emergency oil stocks and other emergency measures for liquid fuels. The **Estonian Oil Stockpiling Agency (OSPA**), established in 2005 under the Liquid Fuel Stocks Act, is tasked with establishing and maintaining compulsory oil stocks to fulfil Estonia's international obligations for emergency oil stocks. The agency's operational and administration costs are covered through a stockpiling fee paid directly to OSPA by oil companies, which pass the cost of this fee on to consumers through the price paid at the pump. OPSA is a 100% state-owned enterprise. MEAC has overall supervisory functions for security of electricity and gas supply and coordinates electricity and gas security of supply crises response and communications. It undertakes these responsibilities in close coordination with the transmission system operator and the competition authority.

MEAC oversees all activities related to planning, co-ordinating and executing technological development and innovation policy, including for energy, with a special focus on liaising with the private sector. National support measures for innovation policy are implemented by **Enterprise Estonia**, which provides financing products, advice and partnership opportunities, as well as training for entrepreneurs, R&D institutions and the public. The **Ministry of Education and Research** has overall responsibility for planning, co-ordinating, implementing, and monitoring research and education policies, including those related to energy. It also co- ordinates international RD&D co-operation at the national level.

The MoE organises and co-ordinates environmental policy, including the management of the use, protection, recycling and registration of natural resources and emissions from the energy sector. Among others, the MoE regulates is responsible for the implementation and co-ordination of the National Development Plan for the Use of Shale Oil. The MoE, through the **Environmental Board**, issues exploration and mining licenses for oil shale. The MoE and MEAC share responsibility for climate policy which in Estonia is closely linked to the oil shale sector. The MoE is responsible for the development of green public procurement.

The **Ministry of Finance (MOF)** is responsible for state budget and tax policies. The MOF is the energy conservation co-ordinator for the central government buildings stock and as such responsible for implementing the renovation obligation for the public building stock. Though the obligation is not applicable to regional and local authorities; the MOF is obliged to share best practices with regional and local authorities.

The Estonian **Competition Authority** is the main regulatory body in the energy sector and controls and ensures the compliance of energy market participants with the market rules and regulations. The Competition Authority is independent and has a legal obligation to exercise its powers impartially. It exercises state control, supervision and monitoring in accordance with the Electricity Market Act and the Competition Act in the electricity sector and in accordance with the Natural Gas Act and the Competition Act in the gas sector.

The Competition Authority approves the methodology for the European network codes, determines gas and electricity network tariffs, and sets prices for district heating. Its responsibilities include ensuring fair competition on the renewable energy market. It also supervises the maintenance of long-term gas and electricity security of supply in cooperation with the transmission system operator and the MEAC. It prepares risk assessment, preventive action and emergency plans in the gas sector.

Some aspects of energy regulation fall under the jurisdiction of the **Estonian Consumer Protection Board**, which also has a supervisory role under the Electricity Market Act in areas related to safety. The **Technical Surveillance Authority** supervises the commissioning, use, operation and maintenance of gas installations, and monitors compliance with requirements for energy efficiency, energy performance labels and ecological design.

**Elering AS** is the state-owned electricity and gas transmission system operator (TSO) and electricity network service provider. Elering owns Estonia's entire electricity transmission network and is joint owner, with neighbouring TSOs, of the respective interconnections. Elering also owns the entire Estonian gas transmission network.

Elering is a member of the European Network of Transmission System Operators for Electricity (ENTSO-E) and an associated partner for gas (ENTSO-G). The company's shareholder rights are exercised by MEAC. Elering undertakes regular assessment of medium-term security of supply in the electricity sector and is also responsible for the overall balancing of the national electricity network and approves the methodology for calculating the price of balance energy and the terms and conditions for balance contracts ex ante. Elering shares responsibility for security of supply in the electricity and gas sectors with MEAC and the Competition Authority. It is also manages subsidy payment for bio-methane production.

**Eesti Energia** is a state-owned company with interests in oil shale mining and processing (electricity and liquefaction), renewable electricity generation, and gas imports and retail. Esti Energia also owns the majority of Estonia's gas distribution network through its subsidiary Eesti Gas. Eesti Gas in turn has handed the operation of the distribution network to another subsidiary, **Gaasivõrgud AS.**

# ANNEX B: Organisations visited

## *Review criteria*

The Shared Goals (see Annex D), which were adopted by the International Energy Agency (IEA) Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews conducted by the IEA.

## *Review team*

The In-Depth Review team visited Estonia from 5-9 November 2018. The review team met with government officials, energy suppliers, market participants, interest groups, consumer representative associations, research institutions, and other organisations and stakeholders. The report was drafted on the basis of the information obtained during these meetings, the team's preliminary assessment of Estonia's energy policy, the Estonian government's response to the IEA energy policy questionnaire, and information on subsequent policy developments from the government and private sector sources. The members of the team were:

### IEA member countries

Mr. Jürgen Streitner, Austria (team leader)

Mr. Martin Jones, Australia

Mr. Risto Leukkunen, Finland

Ms. Manuela Fonseca, Portugal

Ms. Paule Anderegg, Switzerland

Mr. Alex Campbell, United Kingdom

Mr. Tom Howes, European Union

### International Energy Agency

Mr. Aad van Bohemen

Mr. Jason Elliott

Ms. Dagmar Graczyk (Senior Country Analyst)

The team is grateful for the co-operation and assistance of the many people it met with during the visit. Thanks to their kind hospitality, openness and willingness to share information, the visit was highly informative, productive and enjoyable.

The team wishes to express its gratitude to Mr. Ando Leppiman, Secretary General, Ministry of Economic Affairs and Communications for his personal engagement in the meetings and for hosting our visit. The team is also grateful to Mr. Timo Tatar, Deputy Secretary General for Energy, and Mr. Jako Reinaste, Manager of Energy Markets, both from the Ministry of Economic Affairs and Communications, for their tireless efforts and professionalism in planning and organising the review visit and their patience and diligence in supporting the team throughout the review process. Special thanks also to all of the staff of the ministry who participated in and contributed to the review, notably Mr. Madis Laaniste, Mr. Jaanus Uiga and Mr. Rein Vaks as well as Mr. Peter Gornischeff, Counsellor at the Estonian Permanent Representation to the Organisation for Economic Co-operation and Development (OECD) for their input and support throughout the review.

The review was prepared under the guidance of Mr. Aad van Bohemen, Head of the Energy Policy and Security Division, IEA. Ms. Dagmar Graczyk managed the review and is the author of the report, with the exceptions of Chapters 4, 5, 6 and 8. Mr. Jason Elliott and Ms. Selena Jihyun Lee wrote Chapters 4, 5 and 6. Mr. Peter Journeay-Kaler wrote Chapter 8. Mr. Oskar Kvarnstrom, Ms. Selena Jihyun Lee, Ms. Lilli Lee and Mr. Deayong Kim prepared and drafted the sections relating to energy data contained in each chapter. Helpful comments, chapter reviews and updates were provided by the following IEA staff: Ms. Maxine Jordan, Ms. Randi Kristiansen, Mr. Kevin Lane, Mr. Joe Ritchie and Mr. Sacha Scheffer. Special thanks to the IEA Secretariat with regard to the data, publication and editing. Mr. Oskar Kvarnstrom, Ms. Selena Jihyun Lee and Ms. Lilli Lee ensured the preparation of the design of the report with figures, tables and maps. Ms. Roberta Quadrelli and Mr. Jungyu Park provided support on statistics. Ms. Therese Walsh managed the editing process and Ms. Astrid Dumond managed the production process.

## *Organisations visited*

- Alexela Energy (electricity/natural gas/oil)
- AU Energiateenus (electricity efficiency)
- Circle K (oil)
- Competition Authority (independent statuary body to regulate the energy sector and enforce consumer protection law)
- Eesti Energia (mining, electricity and oil shale liquefaction)
- Eesti Erametsaliit (RES)
- Eesti Pank (central bank of Estonia)
- Elektrilevi (distribution system operator)
- Elektrum Eesti (renewable energy company)
- Elering (electricity and gas transmission system operator)
- Enefit Green (power)
- Environmental Board
- Environmental Investment Centre (energy efficinecy)
- Estonian Academy of Sciences
- Estonian Employers' Confederation
- Estonian Fund for Nature
- Estonian Green Movement
- Estonian Power and Heat Association, Utilitas OÜ

- Estonian Private Forest Centre
- Estonian Renewable Energy Association
- Estoniain Union of Co-operative Housing Associations (energy efficiency)
- Estonian Wind Power Association
- Kiviõli Keemiatööstus (oil shale)
- Kredex (financial institution)
- Kroodi Terminal (oil)
- Ministry of Economic Affairs and Communications
- Ministry of Education
- Ministry of Environment
- Ministry of Finance
- Ministry of Interior
- Neste Eesti (oil)
- NordicEnergy Solutions (Energy Services Company)
- OLEREX (oil sector)
- OPSA (Estonian Oil Stockpiling Agency)
- Orlen Eesti (oil)
- State Forest Management Centre
- Statistics Estonia
- Stockholm Environment Institute (SEI) Tallinn
- Tallinn University of Technology
- Technical Regulatory Authority (energy efficiency)
- Union of Electricity Industry of Estonia
- Viru Keemia Grupp (oil shale)

# ANNEX C: Energy balances and key statistical data

## Energy balances and key statistical data

Unit: Mtoe

| SUPPLY | | 1990 | 2000 | 2010 | 2015 | 2016 | 2017 | 2018P |
|---|---|---|---|---|---|---|---|---|
| **TOTAL PRODUCTION** | | **5.23** | **3.18** | **4.93** | **5.60** | **5.19** | **5.79** | **5.87** |
| Coal | | 4.83 | 2.59 | 3.86 | 4.22 | 3.63 | 4.15 | 4.21 |
| Peat | | 0.20 | 0.08 | 0.09 | 0.03 | 0.03 | 0.01 | 0.02 |
| Oil | | - | - | - | - | - | - | - |
| Natural gas | | - | - | - | - | - | - | - |
| Biofuels and waste[1] | | 0.19 | 0.51 | 0.96 | 1.29 | 1.48 | 1.57 | 1.58 |
| Nuclear | | - | - | - | - | - | - | - |
| Hydro | | - | - | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wind | | - | - | 0.02 | 0.06 | 0.05 | 0.06 | 0.06 |
| Geothermal | | - | - | - | - | - | - | - |
| Solar/other | | - | - | - | - | - | - | - |
| **TOTAL NET IMPORTS[2]** | | **4.24** | **1.51** | **0.66** | **0.22** | **0.19** | **-0.12** | **-0.13** |
| Coal | Exports | 0.04 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | Imports | 0.73 | 0.33 | 0.05 | 0.01 | 0.02 | 0.02 | 0.02 |
| | Net imports | 0.68 | 0.31 | 0.03 | - | 0.01 | 0.01 | 0.01 |
| Oil | Exports | 0.01 | 0.13 | 0.37 | 1.06 | 1.08 | 1.30 | 1.58 |
| | Imports | 3.16 | 0.92 | 1.16 | 1.70 | 1.83 | 1.90 | 2.08 |
| | Int'l marine and aviation bunkers | -0.21 | -0.13 | -0.25 | -0.34 | -0.32 | -0.37 | -0.40 |
| | Net imports | 2.94 | 0.66 | 0.54 | 0.29 | 0.43 | 0.23 | 0.10 |
| Natural gas | Exports | - | - | - | - | - | - | - |
| | Imports | 1.22 | 0.66 | 0.56 | 0.39 | 0.43 | 0.41 | 0.41 |
| | Net imports | 1.22 | 0.66 | 0.56 | 0.39 | 0.43 | 0.41 | 0.41 |
| Electricity | Exports | 0.73 | 0.11 | 0.37 | 0.55 | 0.48 | 0.43 | 0.43 |
| | Imports | 0.13 | 0.03 | 0.10 | 0.47 | 0.31 | 0.20 | 0.26 |
| | Net imports | -0.60 | -0.08 | -0.28 | -0.08 | -0.18 | -0.24 | -0.16 |
| **TOTAL STOCK CHANGES** | | **0.12** | **0.02** | **0.05** | **-0.36** | **0.61** | **0.03** | **-0.10** |
| **TOTAL SUPPLY (TPES)[3]** | | **9.59** | **4.72** | **5.63** | **5.46** | **5.98** | **5.71** | **5.64** |
| Coal | | 5.75 | 2.92 | 3.87 | 3.86 | 4.24 | 4.21 | 4.12 |
| Peat | | 0.20 | 0.05 | 0.06 | 0.03 | 0.04 | 0.04 | 0.03 |
| Oil | | 2.84 | 0.65 | 0.58 | 0.28 | 0.42 | 0.16 | 0.10 |
| Natural gas | | 1.22 | 0.66 | 0.56 | 0.39 | 0.43 | 0.41 | 0.41 |
| Biofuels and waste[1] | | 0.19 | 0.51 | 0.82 | 0.91 | 0.98 | 1.07 | 1.09 |
| Nuclear | | - | - | - | - | - | - | - |
| Hydro | | - | - | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wind | | - | - | 0.02 | 0.06 | 0.05 | 0.06 | 0.06 |
| Geothermal | | - | - | - | - | - | - | - |
| Solar/other | | - | - | - | - | - | - | - |
| Electricity trade[4] | | -0.60 | -0.08 | -0.28 | -0.08 | -0.18 | -0.24 | -0.16 |
| ***Shares in TPES (%)*** | | | | | | | | |
| *Coal* | | *59.9* | *61.9* | *68.7* | *70.7* | *70.9* | *73.8* | *73.0* |
| *Peat* | | *2.1* | *1.1* | *1.0* | *0.6* | *0.6* | *0.6* | *0.5* |
| *Oil* | | *29.6* | *13.7* | *10.2* | *5.2* | *7.0* | *2.7* | *1.8* |
| *Natural gas* | | *12.7* | *14.0* | *10.0* | *7.2* | *7.2* | *7.1* | *7.3* |
| *Biofuels and waste[1]* | | *2.0* | *10.9* | *14.6* | *16.6* | *16.4* | *18.7* | *19.3* |
| *Nuclear* | | - | - | - | - | - | - | - |
| *Hydro* | | - | - | *0.0* | *0.0* | *0.1* | *0.0* | *0.0* |
| *Wind* | | - | - | *0.4* | *1.1* | *0.9* | *1.1* | *1.0* |
| *Geothermal* | | - | - | - | - | - | - | - |
| *Solar/other* | | - | - | - | - | - | - | - |
| *Electricity trade[4]* | | *-6.3* | *-1.7* | *-5.0* | *-1.4* | *-2.9* | *-4.1* | *-2.9* |

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elements.

Unit: Mtoe

| DEMAND | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FINAL CONSUMPTION** | **1990** | **2000** | **2010** | **2015** | **2016** | **2017** | **2018P** |
| **TFC** | **5.67** | **2.58** | **2.96** | **2.84** | **2.89** | **2.93** | **..** |
| Coal | 0.44 | 0.14 | 0.09 | 0.06 | 0.08 | 0.09 | .. |
| Peat | 0.08 | 0.01 | 0.00 | 0.00 | 0.00 | - | .. |
| Oil | 1.85 | 0.79 | 0.98 | 1.04 | 1.03 | 1.06 | .. |
| Natural gas | 0.44 | 0.28 | 0.21 | 0.22 | 0.25 | 0.24 | .. |
| Biofuels and waste[1] | 0.19 | 0.43 | 0.55 | 0.50 | 0.42 | 0.45 | .. |
| Geothermal | - | - | - | - | - | - | .. |
| Solar/other | - | - | - | - | - | - | .. |
| Electricity | 0.59 | 0.43 | 0.59 | 0.59 | 0.63 | 0.62 | .. |
| Heat | 2.09 | 0.51 | 0.53 | 0.43 | 0.47 | 0.48 | .. |
| ***Shares in TFC (%)*** | | | | | | | |
| *Coal* | *7.8* | *5.3* | *3.2* | *2.1* | *2.8* | *3.1* | .. |
| *Peat* | *1.4* | *0.5* | *0.1* | *0.1* | *0.1* | - | .. |
| *Oil* | *32.7* | *30.6* | *33.2* | *36.5* | *35.6* | *36.2* | .. |
| *Natural gas* | *7.7* | *10.7* | *7.0* | *7.8* | *8.7* | *8.1* | .. |
| *Biofuels and waste[1]* | *3.3* | *16.5* | *18.6* | *17.5* | *14.7* | *15.2* | .. |
| *Geothermal* | - | - | - | - | - | - | .. |
| *Solar/other* | - | - | - | - | - | - | .. |
| *Electricity* | *10.3* | *16.7* | *20.0* | *20.8* | *21.7* | *21.2* | .. |
| *Heat* | *36.8* | *19.8* | *17.9* | *15.2* | *16.3* | *16.2* | .. |
| **TOTAL INDUSTRY[5]** | **2.78** | **0.75** | **0.67** | **0.62** | **0.55** | **0.58** | **..** |
| Coal | 0.37 | 0.11 | 0.09 | 0.06 | 0.08 | 0.09 | .. |
| Peat | 0.00 | 0.00 | - | - | - | - | .. |
| Oil | 0.78 | 0.14 | 0.14 | 0.14 | 0.12 | 0.12 | .. |
| Natural gas | 0.37 | 0.22 | 0.11 | 0.09 | 0.11 | 0.10 | .. |
| Biofuels and waste[1] | 0.01 | 0.08 | 0.10 | 0.12 | 0.02 | 0.04 | .. |
| Geothermal | - | - | - | - | - | - | .. |
| Solar/other | - | - | - | - | - | - | .. |
| Electricity | 0.24 | 0.16 | 0.18 | 0.18 | 0.19 | 0.19 | .. |
| Heat | 1.02 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | .. |
| ***Shares in total industry (%)*** | | | | | | | |
| *Coal* | *13.1* | *14.8* | *13.1* | *9.5* | *13.7* | *15.3* | .. |
| *Peat* | *0.1* | *0.3* | - | - | - | - | .. |
| *Oil* | *27.9* | *18.0* | *20.5* | *22.3* | *22.4* | *21.4* | .. |
| *Natural gas* | *13.4* | *29.4* | *17.1* | *15.1* | *19.3* | *17.0* | .. |
| *Biofuels and waste[1]* | *0.2* | *10.5* | *15.6* | *18.6* | *4.3* | *6.2* | .. |
| *Geothermal* | - | - | - | - | - | - | .. |
| *Solar/other* | - | - | - | - | - | - | .. |
| *Electricity* | *8.5* | *21.0* | *27.1* | *28.5* | *33.4* | *33.3* | .. |
| *Heat* | *36.8* | *5.9* | *6.6* | *5.9* | *6.9* | *6.4* | .. |
| **TRANSPORT[3]** | **0.82** | **0.56** | **0.75** | **0.76** | **0.78** | **0.81** | **..** |
| **OTHER[6]** | **2.07** | **1.27** | **1.55** | **1.46** | **1.55** | **1.55** | **..** |
| Coal | 0.07 | 0.02 | 0.01 | 0.00 | 0.01 | 0.00 | .. |
| Peat | 0.08 | 0.01 | 0.00 | 0.00 | 0.00 | - | .. |
| Oil | 0.29 | 0.10 | 0.10 | 0.15 | 0.14 | 0.14 | .. |
| Natural gas | 0.07 | 0.06 | 0.09 | 0.13 | 0.14 | 0.13 | .. |
| Biofuels and waste[1] | 0.18 | 0.35 | 0.45 | 0.38 | 0.40 | 0.41 | .. |
| Geothermal | - | - | - | - | - | - | .. |
| Solar/other | - | - | - | - | - | - | .. |
| Electricity | 0.32 | 0.27 | 0.41 | 0.41 | 0.44 | 0.42 | .. |
| Heat | 1.07 | 0.47 | 0.49 | 0.39 | 0.44 | 0.44 | .. |
| ***Shares in other (%)*** | | | | | | | |
| *Coal* | *3.5* | *1.9* | *0.5* | *0.2* | *0.3* | *0.2* | .. |
| *Peat* | *3.8* | *0.9* | *0.3* | *0.2* | *0.1* | - | .. |
| *Oil* | *13.9* | *8.1* | *6.7* | *10.1* | *8.7* | *9.0* | .. |
| *Natural gas* | *3.2* | *4.4* | *6.0* | *8.6* | *9.1* | *8.6* | .. |
| *Biofuels and waste[1]* | *8.8* | *27.2* | *28.8* | *25.9* | *25.6* | *26.4* | .. |
| *Geothermal* | - | - | - | - | - | - | .. |
| *Solar/other* | - | - | - | - | - | - | .. |
| *Electricity* | *15.5* | *20.9* | *26.2* | *28.0* | *28.2* | *27.4* | .. |
| *Heat* | *51.4* | *36.7* | *31.5* | *27.0* | *28.0* | *28.4* | .. |

Unit: Mtoe

| DEMAND | | | | | | | |
|---|---|---|---|---|---|---|---|
| **ENERGY TRANSFORMATION AND LOSSES** | **1990** | **2000** | **2010** | **2015** | **2016** | **2017** | **2018P** |
| **ELECTRICITY GENERATION**[7] | | | | | | | |
| Input (Mtoe) | 6.63 | 2.86 | 3.91 | 3.14 | 3.31 | 3.50 | .. |
| Output (Mtoe) | 1.48 | 0.73 | 1.11 | 0.89 | 1.05 | 1.11 | 1.06 |
| Output (TWh) | 17.18 | 8.51 | 12.96 | 10.40 | 12.18 | 12.90 | 12.30 |
| ***Output shares (%)*** | | | | | | | |
| *Coal* | *86.0* | *91.9* | *88.4* | *82.7* | *83.4* | *82.8* | *81.7* |
| *Peat* | *-* | *0.2* | *0.9* | *0.5* | *0.4* | *0.8* | *0.4* |
| *Oil* | *8.4* | *0.7* | *0.3* | *0.5* | *2.1* | *0.9* | *1.0* |
| *Natural gas* | *5.6* | *7.0* | *2.3* | *0.6* | *0.6* | *0.5* | *0.5* |
| *Biofuels and waste* [1] | *-* | *0.2* | *5.7* | *8.5* | *8.3* | *9.1* | *11.2* |
| *Nuclear* | *-* | *-* | *-* | *-* | *-* | *-* | *-* |
| *Hydro* | *-* | *0.1* | *0.2* | *0.3* | *0.3* | *0.2* | *0.1* |
| *Wind* | *-* | *-* | *2.1* | *6.9* | *4.9* | *5.6* | *5.2* |
| *Geothermal* | *-* | *-* | *-* | *-* | *-* | *-* | *-* |
| *Solar/other* | *-* | *-* | *-* | *-* | *-* | *-* | *-* |
| **TOTAL LOSSES** | **3.38** | **2.09** | **2.96** | **2.63** | **2.68** | **2.70** | **..** |
| of which: | | | | | | | |
| Electricity and heat generation[8] | 2.67 | 1.48 | 2.19 | 1.74 | 1.69 | 1.81 | .. |
| Other transformation | 0.17 | 0.22 | 0.42 | 0.53 | 0.58 | 0.53 | .. |
| Own use and transmission/distribution losses | 0.54 | 0.39 | 0.36 | 0.36 | 0.41 | 0.37 | .. |
| **Statistical differences** | **0.54** | **0.04** | **-0.29** | **-0.01** | **0.42** | **0.07** | **..** |
| **INDICATORS** | **1990** | **2000** | **2010** | **2015** | **2016** | **2017** | **2018P** |
| GDP (billion 2010 USD) | 14.96 | 14.13 | 19.50 | 23.39 | 24.21 | 25.39 | 26.37 |
| Population (millions) | 1.59 | 1.40 | 1.33 | 1.31 | 1.32 | 1.32 | 1.32 |
| TPES/GDP (toe/USD 1 000)[9] | 0.64 | 0.33 | 0.29 | 0.23 | 0.25 | 0.22 | 0.21 |
| Energy production/TPES | 0.54 | 0.67 | 0.88 | 1.03 | 0.87 | 1.01 | 1.04 |
| Per capita TPES (toe/capita) | 6.04 | 3.37 | 4.22 | 4.16 | 4.55 | 4.34 | 4.28 |
| Oil supply/GDP (toe/USD 1 000)[9] | 0.19 | 0.05 | 0.03 | 0.01 | 0.02 | 0.01 | 0.00 |
| TFC/GDP (toe/USD 1 000)[10] | 0.38 | 0.18 | 0.15 | 0.12 | 0.12 | 0.12 | .. |
| Per capita TFC (toe/capita) | 3.57 | 1.84 | 2.22 | 2.16 | 2.19 | 2.23 | .. |
| $CO_2$ emissions from fuel combustion ($MtCO_2$)[10] | 35.0 | 14.5 | 18.6 | 15.2 | 15.5 | 16.0 | .. |
| $CO_2$ emissions from bunkers ($MtCO_2$)[10] | 0.7 | 0.4 | 0.8 | 1.1 | 1.0 | 1.2 | .. |
| **GROWTH RATES (% per year)** | **90-00** | **00-10** | **10-14** | **14-15** | **15-16** | **16-17** | **17-18** |
| TPES | -6.9 | 1.8 | 0.7 | -5.6 | 9.6 | -4.6 | -1.1 |
| Coal | -6.5 | 2.9 | 2.1 | -8.3 | 9.8 | -0.7 | -2.3 |
| Peat | -12.6 | 0.6 | -8.8 | -13.2 | 6.1 | 2.9 | -25.0 |
| Oil | -13.7 | -1.2 | -8.4 | -30.3 | 47.7 | -62.9 | -34.8 |
| Natural gas | -5.9 | -1.6 | -6.2 | -10.3 | 9.5 | -5.1 | 2.0 |
| Biofuels and waste[1] | 10.5 | 4.8 | 1.6 | 4.1 | 8.0 | 9.0 | 1.9 |
| Nuclear | - | - | - | - | - | - | - |
| Hydro | - | - | - | - | 50.0 | -33.3 | -50.0 |
| Wind | - | - | 21.3 | 19.2 | -17.7 | 21.6 | -11.3 |
| Geothermal | - | - | - | - | - | - | - |
| Solar/other | - | - | - | - | - | - | - |
| TFC | -7.6 | 1.4 | -0.7 | -1.5 | 1.8 | 1.5 | .. |
| Electricity consumption | -3.0 | 3.3 | - | -0.8 | 6.6 | -1.1 | .. |
| Energy production | -4.8 | 4.5 | 3.1 | 0.5 | -7.4 | 11.7 | 1.3 |
| Net oil imports | -13.9 | -2.0 | -6.1 | -30.6 | 47.1 | -45.9 | -56.2 |
| GDP | -0.6 | 3.3 | 4.2 | 1.9 | 3.5 | 4.9 | 3.9 |
| TPES/GDP | -6.3 | -1.4 | -3.4 | -7.3 | 5.9 | -9.1 | -4.8 |
| TFC/GDP | -7.0 | -1.8 | -4.7 | -3.3 | -1.6 | -3.3 | .. |

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elements.

## *Notes*

1. Biofuels and waste in Estonia are comprised of solid biofuels, liquid biofuels and biogases. Data are often based on partial surveys and may not be comparable between countries.
2. In addition to coal, oil, natural gas and electricity, total net imports also include peat and biofuels.
3. Excludes international marine bunkers and international aviation bunkers.
4. Total supply of electricity represents net trade. A negative number in the share of TPES indicates that exports are greater than imports.
5. Industry includes non-energy use.
6. Other includes residential, commercial and public services, agriculture/forestry, fishing, and other unspecified.
7. Inputs to electricity generation include inputs to electricity, combined heat and power, and heat plants. Output refers only to electricity generation.
8. Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil fuel electricity generation, theoretical losses are shown based on a 100% primary equivalent for hydro and wind.
9. Toe per thousand USD at 2010 prices and exchange rates.
10. "$CO_2$ emissions from fuel combustion" have been estimated using the IPCC Tier I Sectoral Approach methodology from the *2006 IPCC Guidelines.* Emissions from international marine and aviation bunkers are not included in national totals.

## ANNEX D: International Energy Agency "Shared Goals"



The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

**1. Diversity, efficiency and flexibility within the energy sector** are basic conditions for longer term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydropower, make a substantial contribution to the energy supply diversity of IEA countries as a group.

**2.** Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases, this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

**3. The environmentally sustainable provision and use of energy** are central to the achievement of these shared goals. Decision makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the polluter pays principle where practicable.

**4. More environmentally acceptable energy sources** need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

**5. Improved energy efficiency** can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle, from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

**6.** Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

**7. Undistorted energy prices** enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

**8. Free and open trade** and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

**9. Co-operation among all energy market participants** helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at the meeting of 4 June 1993 in Paris, France.)

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

# ANNEX E: List of abbreviations



In this report, abbreviations and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for the abbreviations used.

## Acronyms and abbreviations

| | |
|---|---|
| AC | Alternating current |
| AIT | Average interruption time |
| BEMIP | Baltic Energy Market Interconnection Plan |
| BENTE | Baltic Energy Technology Scenarios |
| BRELL | Belarus, Russia, Estonia, Latvia and Lithuania |
| CHP | Combined heat and power |
| CNG | Compressed natural gas |
| DH | District heating |
| EC | European Commission |
| EED | Energy Efficiency Directive |
| ENS | Energy not supplied |
| ENTSO-E | European Network of Transmission System Operators for Electricity |
| ESCO | Energy service company |
| ESD | Effort Sharing Decision |
| ESOA | Energy Sector Organisation Act |
| ETP | Energy Technology Programme |
| ETS | Energy Trading System |
| EU | European Union |
| EV | Electric vehicle |
| GDP | Gross domestic product |
| GHC | Gaseous heat carrier |
| GHG | Greenhouse gas |
| GIPL | Gas Interconnection Poland-Lithuania |
| GPCP | General Principles of Climate Policy |
| HGV | Heavy goods vehicle |
| HVO | Hydro vegetable oil |
| IDR | In-depth Review |
| IEA | International Energy Agency |
| IMO | International Maritime Organization |
| LFA | Liquid Fuel Act |
| LFSA | Liquid Fuel Stocks Act |
| LNG | Liquefied natural gas |
| LULUCF | Land use, land-use change and forestry |
| MARI | Manually Activated Reserves Initiative |

| | |
|---|---|
| MEAC | Ministry of Economic Affairs and Communications |
| MER | Ministry of Education and Research |
| MOU | Memorandum of Understanding |
| NDPES | National Development Plan of the Energy Sector |
| NECP | National Energy and Climate Plan |
| NGL | Natural gas liquid |
| OECD | Organisation for Economic Co-operation and Development |
| OSPA | Oil Stockpiling Agency |
| PPP | Purchase power parity |
| PV | Photovoltaic |
| RD&D | Research, development and deployment |
| RDI | Research and Development and Innovation Strategy |
| SAIDI | System Average Interruption Duration Index |
| SAIFI | System Average Interruption Frequency Index |
| TCP | Technology collaboration programme |
| TFC | Total final consumption |
| TPES | Total primary energy supply |
| TSO | Transmission system operator |
| USD | United States dollar |
| VRE | Variable renewable energy |
| WAM | With additional measures |
| WEM | With existing measures |

## *Units of measure*

| | |
|---|---|
| bcm | billion cubic metre |
| $CO_2$ | carbon dioxide |
| $CO_2$-eq | carbon dioxide equivalent |
| g | gramme |
| $gCO_2$ | grammes of carbon dioxide |
| GW | gigawatt |
| GWh | gigawatt hour |
| kb/d | thousand barrels per day |
| $kgCO_2$ | kilogrammes of carbon dioxide |
| km | kilometre |
| ktoe | kilotonnes of oil equivalent |
| kV | kilovolts |
| kWh | kilowatt hour |
| $kWh/m^2$ | kilowatt hours per square metre |
| m | metre |
| $m^3$ | cubic metre |

| | |
|---|---|
| mb | million barrels |
| mcm | million cubic metres |
| mcm/d | million cubic metres per day |
| Mt | million tonnes |
| $MtCO_2$ | million tonnes of carbon dioxide |
| $MtCO_2$-eq | million tonnes of carbon dioxide equivalent |
| Mtoe | million tonnes of oil-equivalent |
| MW | megawatt |
| $MW_e$ | megawatts of electricity |
| MWh | megawatt hours |
| $MW_{th}$ | thermal megawatt |
| PJ | petajoule |
| $tCO_2$-eq | tonne of $CO_2$ equivalent |
| toe | tonnes of oil equivalent |
| TWh | terawatt hour |
| USD/L | US dollar/litre |

# ENERGY POLICIES OF IEA COUNTRIES

## Estonia

### 2019 Review

The International Energy Agency (IEA) regularly conducts in-depth peer reviews of the energy policies of its member countries. This process supports energy policy development and encourages the exchange of international best practices and experiences.

This report on Estonia is the first since the country became the 29th member of the IEA in 2014. It discusses the energy challenges the country faces and recommends possible solutions to help it achieve a secure and sustainable energy future.

Estonia is on the brink of a major energy transition that will involve a substantial change in the role of domestically produced oil shale in the country's future energy mix. The transition will require Estonia to carefully balance social, environmental, economic, and energy security considerations.

Estonia has already achieved its emissions reduction and renewable energy targets for 2020, but the country still has the highest carbon intensity of all IEA countries because of the dominant role of oil shale in its energy sector. Reaching Estonia's ambitious targets for 2030 is possible but requires determined and timely action to decarbonise the country's electricity and transport sectors.

Estonia also has considerable scope to review energy taxation of all fuels to better reflect their carbon content with a view to accelerating the switch to low-emission technologies, notably in transport.

In this report, the IEA provides recommendations for further improvements of Estonia's policies to help the country guide the transformation of its energy sector.