# Estonia 2023

## Energy Policy Review

International Energy Agency

# INTERNATIONAL ENERGY AGENCY

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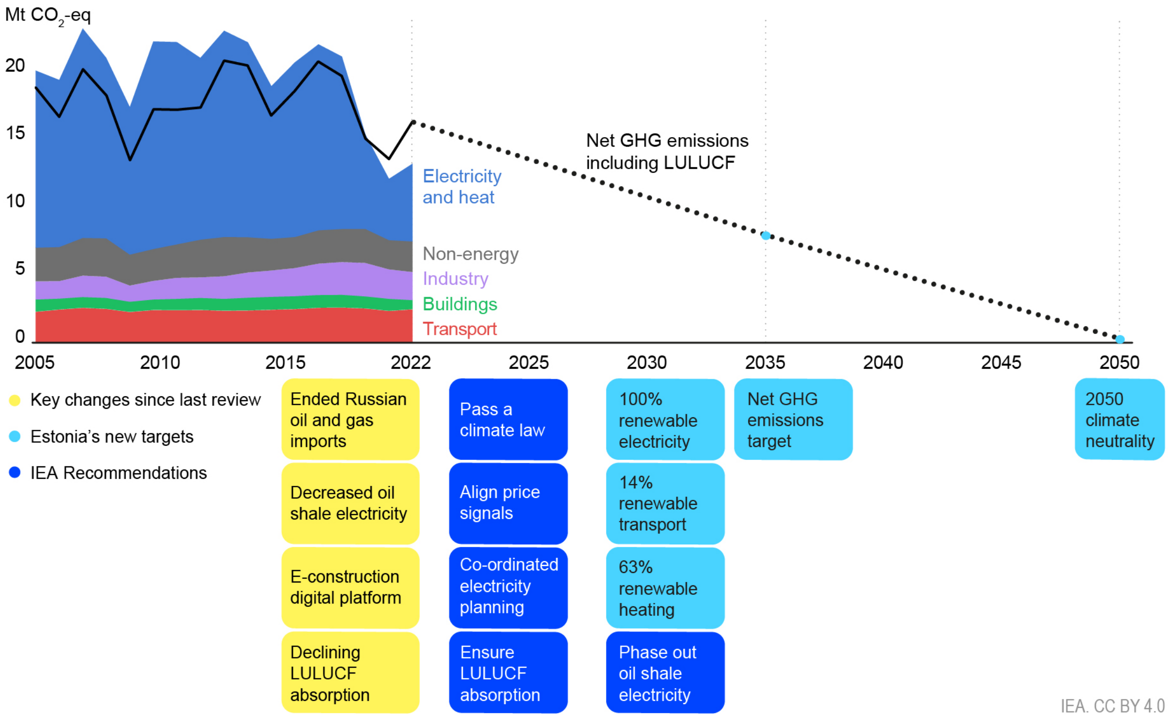
# Executive summary

This IEA Energy Policy Review comes at a critical moment for Estonia, which is facing notable challenges amid the climate and energy crises and the Russian Federation's invasion of Ukraine. The IEA commends Estonia for the steps it has taken to end all remaining energy trade with Russia while ensuring regional energy security, and for the work to accelerate the energy transition, including setting a 2050 carbon-neutrality target and a target for 100% of annual electricity demand to be covered by renewable energy by 2030. These targets require major investments across all sectors and improved energy sector planning.

Estonia has notably decreased its greenhouse gas emissions (GHG), mainly due to an overall reduction in electricity and heat generation from oil shale and growth in generation from wind, solar photovoltaics (PV) and domestic forestry biomass. However, starting in 2020 net GHG emissions have been increasing due to a rebound in electricity and heat generation from oil shale and to land use, land-use change and forestry (LULUCF) becoming a net emissions source, mainly due to increased emissions from forests.

**Major efforts required to reduce Estonia's emissions**

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This report provides policy recommendations to help Estonia address its energy sector challenges and drive a clean, secure and just energy transition. It highlights international best practices relevant to Estonia and details areas where Estonia's leadership can assist other countries with their energy sector challenges.

**Existing policies are insufficient to meet Esonia's ambitious targets, but new policies are being developed to support more robust emissions reductions.** Estonia's ambitious targets require accelerated renewables deployment, increased electrification and phasing out oil shale generation while ensuring a just transition that maintains energy affordability and supports economic development in the oil shale region. The IEA commends Estonia for establishing a Ministry of Climate with broad-ranging authority over the energy system and for starting work on a climate law. These steps will help provide the policy clarity and broad action needed to meet Estonia's climate and energy ambitions. The IEA recommends Estonia pass a climate law that sets legally binding targets for carbon neutrality and intermediate emissions reductions, allocates responsibilities for implementation, and sets clear targets for phasing out oil shale and other fossil fuels.

**Changes to fiscal and tax policy are needed to encourage consumers to move away from fossil fuels and support the uptake of low-emission, more efficient, renewable and innovative options.** Estonia's excise duty rates are not based on GHG emissions or other environmental factors. In addition, Estonia is the only IEA member country without taxation on private vehicles and has one of the oldest and least efficient vehicle fleets. IEA recommends a broad effort to align price signals with climate and energy goals by updating energy excise duties; increasing carbon prices; quickly introducing vehicle taxation to drive uptake of efficient vehicles, including electric vehicles (EVs); and ending support for fossil fuels. This should be done in a way that generates sufficient revenue to support a just clean energy transition.

**A major electricity system transformation is needed to achieve the 100% renewable electricity target and put Estonia on the path to climate neutrality.** The IEA commends Estonia for taking steps towards these targets but notes a lack of clarity on how they will be achieved and whether existing energy sector planning processes will effectively guide the country to a carbon-neutral energy system. The IEA recommends that the government ensure co-ordination between all components of electricity sector planning, including electrification, to clarify to energy sector stakeholders which pathways to climate-neutral electricity generation will be supported by policy, market regulations and incentives. It is also important that the government develop a streamlined and transparent system for spatial planning and permitting of renewable energy and supporting infrastructure to ensure projects can be deployed at the needed pace.

**Meeting climate targets will require stronger forestry and biomass policies.** To meet its climate targets, Estonia needs to increase LULUCF emissions removals. However, LULUCF has been a notable emissions source every year since 2018, driven mainly by changes to Estonia's forests, including increased logging. Forestry biomass plays a major role in Estonia's energy system, accounting for 23% of total energy supply in 2022 (compared to the IEA average of 3.5% in 2022) and is a key fuel for heating. The European Union ban on wood imports from Russia could increase demand for Estonia's forestry energy products (40% of which were exported in 2021), potentially increasing prices and reducing domestic availability. Measures to boost LULUCF carbon absorption could reduce the availability of biomass for energy. The IEA recommends that the government develop strong measures to ensure that LULUCF delivers net emissions reductions in line with climate and energy targets, including a robust forest inventory methodology, well-enforced biomass sustainability criteria and clear estimates on the environmentally sustainable level of biomass available. In addition, efforts to reduce emissions from heating should focus on heat pumps and thermal storage.

**Estonia has taken steps to ensure regional gas security while working to reduce its gas demand and decarbonise its gas supply.** Natural gas plays a relatively minor role in Estonia's energy system and is used mostly for heating. In 2021, natural gas accounted for just 8.6% of total energy supply (versus the IEA average of 30%) and came mostly from Russia. In 2022, Estonia took swift actions to end its reliance on Russian gas and secure regional gas supply and reduced gas demand to 5.8% of total energy supply. This included co-operation to open a new supply route from Finland's liquefied natural gas (LNG) terminal through the Balticconnector pipeline. Despite damage to this pipeline in October 2023, Estonia has a secure gas supply thanks to its emergency gas reserve in Latvia's storage facility and access to Lithuania's LNG terminal. At the same time, Estonia has successfully boosted biomethane production and, with further efforts, could decarbonise its entire gas supply. The IEA recommends the government swiftly decarbonise the gas sector by developing a comprehensive policy for boosting biomethane production and demand.

**Estonia is leveraging a high level of digitalisation to support innovative efforts in the energy sector that can serve as examples for other countries.** The online e-construction platform allows users to access information and documents related to most buildings, including building permits, energy demand and energy performance certificates (EPCs). Estonia is also developing a methodology to calculate dynamic EPCs based on metered energy demand, exploiting the country's 100% coverage of smart meters. These steps would help to address the strong need for increased data on and action to improve the energy efficiency of Estonia's old and relatively inefficient building stock.

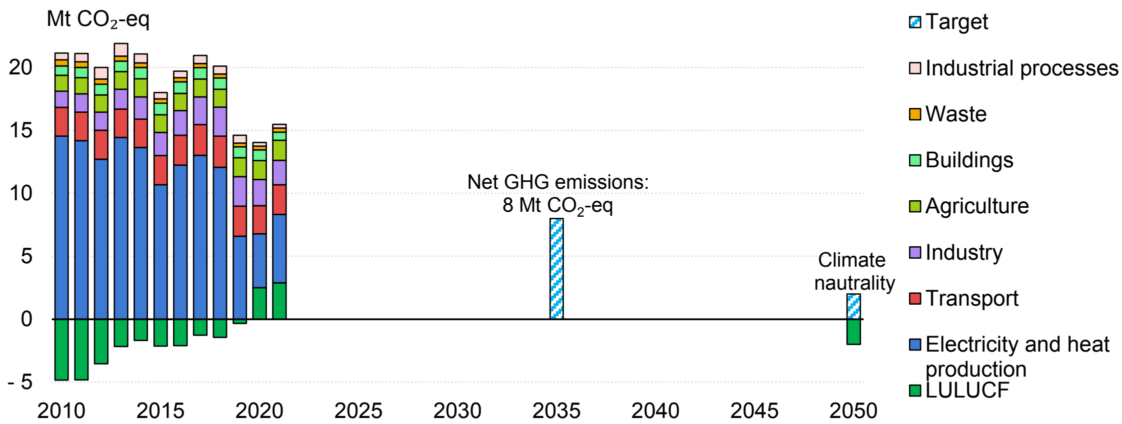
**Estonia is also a leader in boosting critical minerals supply, an essential element for the energy transition.** Estonia is home to one of the few rare earth elements processing facilities outside of the People's Republic of China. Construction has started on a factory that will produce rare earth permanent magnets used in EVs and wind turbines, with a goal to start production in 2025, making it the first rare earth magnet factory in Europe. Estonia also has large phosphate deposits that may contain other critical minerals and present an opportunity for Estonia to support the energy transition and expand its economy, with the potential to use skills and expertise from the oil shale industry. The IEA encourages Estonia to quickly determine its critical minerals production capacity and the investments needed to bring any such resource to market, and to explore other areas that can support a just and inclusive energy transition. The IEA emphasises that expansion of critical minerals production should avoid and mitigate adverse impacts on the environment and local communities.

# 1. Climate and energy policy

## Greenhouse gas emissions have declined but fossil fuels still dominate energy supply and demand

Estonia has noticeably reduced GHG emissions since 2010 and aims to continue this trajectory with a goal to achieve climate neutrality by 2050 and an interim emissions reduction target for 2035 (Figure 1.1). Emissions reductions from 2010 to 2021 were mainly driven by less use of oil shale for electricity generation.

**Figure 1.1 Greenhouse gas emissions by sector in Estonia, 2010-2021 and 2035 and 2050 targets**



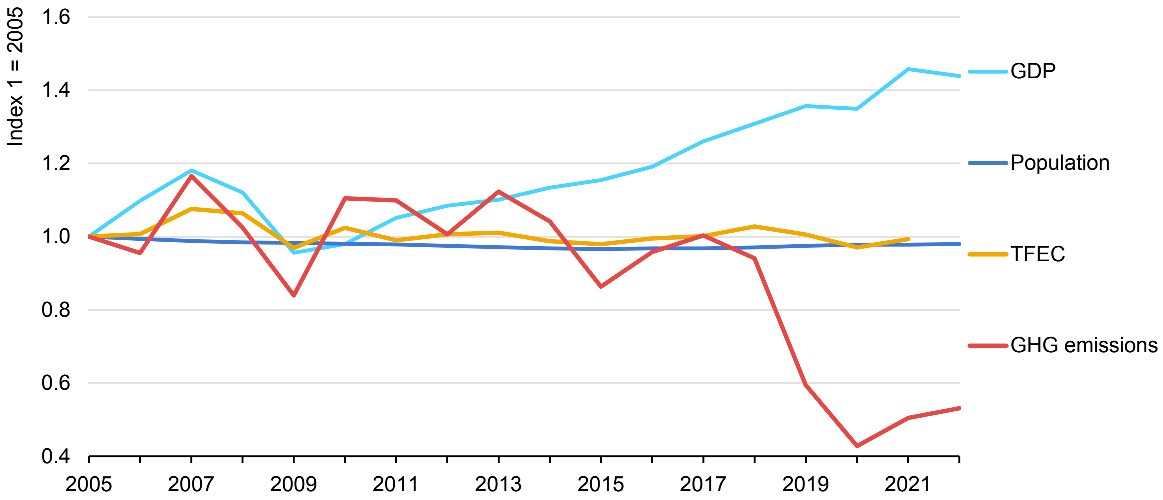



Source: IEA analysis based on UNFCCC (2023), Greenhouse gas inventory data.

While emissions have decreased, Estonia's gross domestic product (GDP) has been growing since 2010, with only a slight decline in 2020 from the impacts of the Covid-19 pandemic (Figure 1.2). At the same time, energy demand measured as total final energy consumption (TFEC) has been stable, showing a clear decoupling of economic activity from energy demand and reflecting a shift to an economy focused on services and non-intensive industry. Estonia's population has been relatively stable, with a slight increase from 1.31 million in 2015 to 1.33 million in 2021.

Estonia's energy system is still dominated by fossil fuels, but the share of fossil fuels in total energy supply (TES) declined from 90% in 2010 to 71% in 2022 (Figure 1.3). This was mainly driven by changes in electricity generation from oil shale, which dropped sharply in 2019 and 2020, but rebounded some in 2021 and 2022 as high electricity prices made oil shale generation economically competitive. The drop in oil shale generation has been offset by increased generation from bioenergy, wind and solar PV; and the switch from being a net exporter to a net importer of electricity (Figure 1.5).

**Figure 1.2 Trends of gross domestic product, population, total final energy consumption and greenhouse gas emissions in Estonia, 2005-2022**





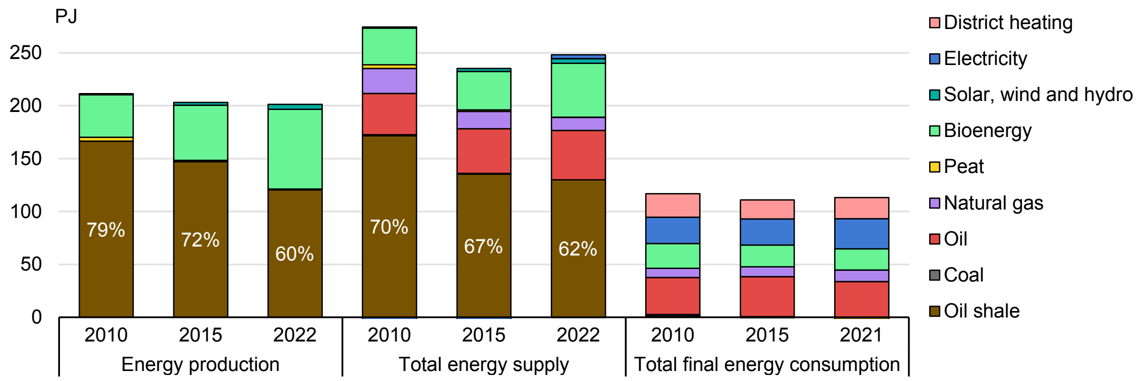

Source: IEA (2023), World Energy Balances.

Bioenergy plays a major and increasingly important role in Estonia's energy system. From 2010 to 2022, the share of bioenergy in TES increased from 14% to 24% (compared to the IEA average of 6% in 2021). Bioenergy comes mainly from domestic forestry biomass (96% of bioenergy TES in 2021) and has played a key role in reducing fossil fuel use in both district heating networks and individual home heating systems (Figure 1.5).

Natural gas plays a relatively small and declining role in Estonia's energy system. From 2010 to 2021 the share of natural gas in TES fell from 9.6% to 8.6%, mainly due to a significant shift away from gas to bioenergy in district heating and lower gas demand from industry. In 2022, the share of natural gas in TES dropped to 5.8% mainly because of high prices.

The buildings sector is responsible for the highest share of energy demand (53% in 2021), followed by transport (30%) and industry (17%) (Figure 1.4). Energy demand has been growing for buildings and transport but declining for industry. Estonia's building sector relies on a diversified energy mix, mostly from district heating, bioenergy and electricity. The transport sector is dominated by oil products (most diesel and gasoline used in road transport). Estonia's relatively small industrial sector has a diverse energy mix with a notably high share of electricity.

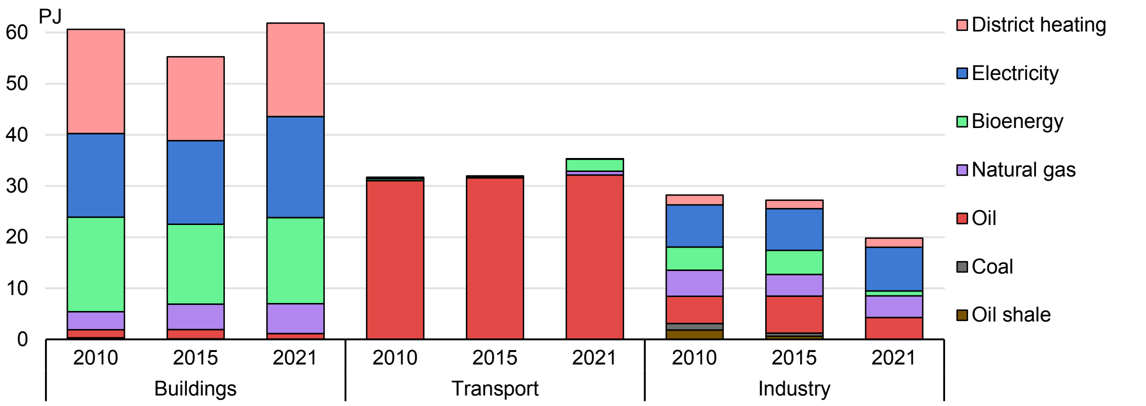
### Figure 1.3 Energy production, total energy supply and total final energy consumption by fuel in Estonia, 2010-2022






Source: IEA (2023), World Energy Balances.

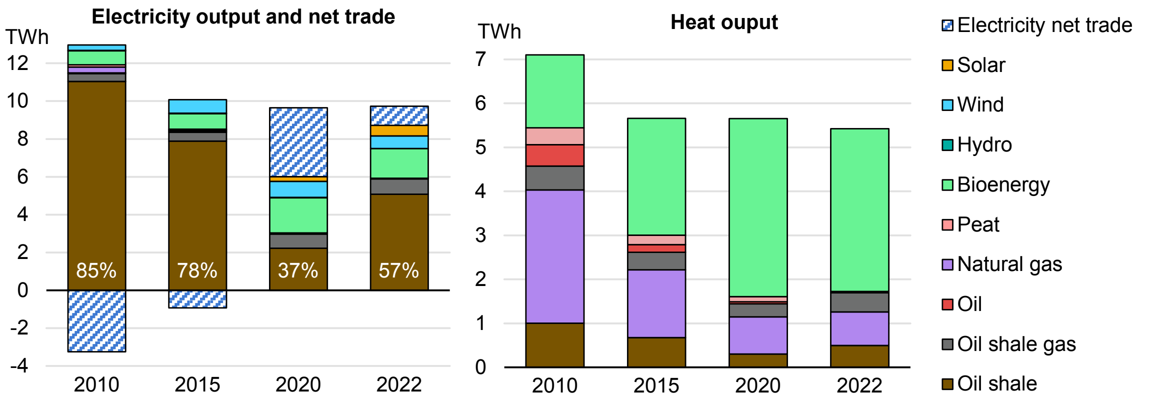
### Figure 1.4 Energy demand by sector and fuel in Estonia, 2010-2021






Source: IEA (2023), World Energy Balances.

### Figure 1.5 Electricity and heat supply by fuel in Estonia, 2005-2022






Source: IEA (2023), World Energy Balances.

## Estonia has ambitious climate and energy targets and created a Ministry of Climate with broad authority

Estonia's energy and climate policies aim to achieve climate neutrality by 2050 while maintaining a high share of energy independence and affordable access to energy. The key documents defining Estonia's energy and climate polices, targets and supporting measures are the Energy Sector Development Plan until 2030, adopted in 2017, and the National Energy and Climate Plan (NECP). The NECP is required for all European Union (EU) member states and must be regularly updated to detail a country's contributions to achieving EU-wide targets.

In June 2023, Estonia submitted an updated NECP that sets higher ambitions in line with the European Climate Law, the Fit-for-55 package and REPowerEU. The updated NECP will be finalised in 2024. Estonia is also in the process of developing an Energy Sector Development Plan until 2035 to reflect its 2050 carbon-neutrality target and increased ambition of EU climate and energy policies. Estonia has already updated most of its 2030 energy and climate targets, with the goal of putting the country on a path to carbon neutrality (Table 1.1).

**Table 1.1 Estonia's energy and climate targets**

| Target | Metric | 2021 status | 2030 target |
|---|---|---|---|
| Total GHG emissions (Mt $CO_2$-eq) | $CO_2$-eq emissions | 15.5 | 8 (in 2035) |
| Non-ETS GHG emissions | $CO_2$-eq emissions vs. 2005 | -2.37% | -24% |
| Energy efficiency (PJ) | Primary energy consumption | 186 | 165 |
| | Final energy consumption | 118.6 | 109 |
| Renewable energy (% of gross final energy consumption) | Total | 38% | 65% |
| | Electricity | 29% | 100% |
| | Heating and cooling | 61% | 63% |
| | Transport | 11% | 14% |

In addition to its national GHG emissions targets, Estonia has an EU mandate target to reduce GHG emissions from sources outside the EU Emissions Trading System (ETS). Estonia also has targets for energy efficiency under the EU Energy Efficiency Directive (see Chapters 3, 4 and 5). Under the EU Renewable Energy Directive, Estonia has targets for renewable energy in gross final energy consumption, electricity and transport. Estonia's target for renewable electricity to cover 100% of annual electricity demand by 2030 notably exceeds the EU requirement and is one of the most critical targets to put the country on a path to climate neutrality. The current target for renewables in transport is not sufficient to meet EU requirements and will need to be increased.

The government has indicated that existing policies are insufficient to meet the 2030 and 2050 targets and is working to expand existing policies and develop new ones that support stronger emissions reductions, with a focus on increasing the use of renewable energy, especially for electricity generation, and boosting electrification of energy demand (see Chapter 2). The government is also planning new measures to reduce sectoral emissions, especially from buildings and transport (see Chapters 3 and 4).

In July 2023, Estonia established a new Ministry of Climate with broad-ranging authority over energy, natural resources, housing and construction, transport, and transport infrastructure. The Ministry is responsible for the execution of the green transition; climate policy, including sectoral climate plans; promoting cleaner technologies; expediting renewable energy; organising the circular economy; and environmental and nature conservation, among other areas. The IEA commends this approach, as it signals that addressing the climate crisis is a top priority, allows co-ordination on climate action across the government and helps build political will for climate action.

The Ministry of Climate should be instrumental in supporting a "whole-of-government" approach to achieve Estonia's ambitious energy and climate targets. It should take a central role in co-ordinating the several state actors that collaborate on renewables, energy efficiency and other areas of the energy transition. This includes the Ministry of Finance, electricity and gas system operators, the Competition Authority, the Consumer Protection and Technical Supervisory Agency, the Environment Investment Centre, and the Estonian Business and Innovation Agency. The government should bring these players together, providing the necessary structures, governance, project management and support to ensure the 2030 and post-2030 targets will be delivered.

Numerous IEA member countries have put climate and energy-related matters under the responsibility of one ministry and have shown that this helps to push more aggressively for an energy transition. Estonia can look to the positive examples set by Canada (Ministry of Environment and Climate Change), Norway (Ministry of Climate and Environment), Portugal (Ministry of Environment and Climate Action) and Switzerland (Federal Office for the Environment).

The IEA commends Estonia for starting work on a climate framework law, which most other European countries have adopted. In September 2023, the Ministry of Climate started drafting a national climate law with the aim for it to enter into force by 2025. A climate framework law generally enshrines in legislation the long-term carbon-neutrality goal; sets mechanisms to define intermediate targets; allocates responsibilities and accountability mechanisms for achieving the targets; and establishes an independent advisory body to support policy making and review implementation and progress.

Examples of well-implemented climate laws that could serve to guide Estonia include France's Law on Energy and Climate, Ireland's Climate Action and Low Carbon Development Act, New Zealand's Climate Change Response (Zero Carbon) Amendment Act, Norway's Climate Change Act, and the United Kingdom's Climate Change Act. These countries' experiences show that a climate law strengthens evidence-based policy making, stimulates public debate and helps focus climate change policy on the long-term goal. Estonia has a GHG reduction target for transport but not for other sectors. The government should consider establishing GHG emissions targets for all sectors, backed with sectoral carbon budgets clarifying how each sector contributes to meeting overall GHG emissions targets. This approach has proved useful in France, Greece and Ireland.

A climate law also provides an opportunity to establish policy clarity on key topics such as legally binding dates for phasing out fossil fuels. For example, Greece's 2021 National Climate Law requires a complete phase-out of lignite-fired generation by 2028 (lignite-fired generation was historically the largest source of electricity in Greece, covering around 60% of generation as recently as 2005). Estonia should consider establishing a legally binding date for phasing out oil shale-fired generation.

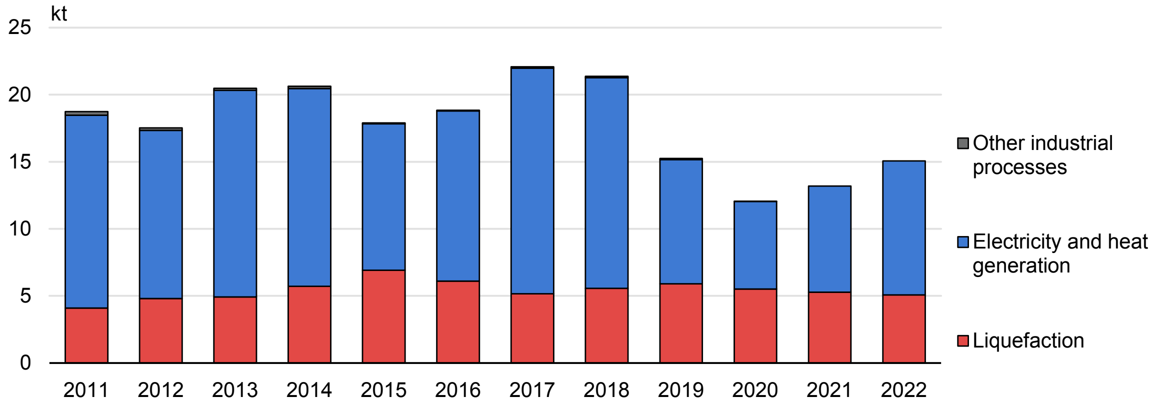
Estonia's Development Plan for Climate Change Adaptation to 2030 provides a comprehensive roadmap to identify climate hazards and build climate resilience. However, climate resilience and adaptation are now as well reflected in key energy sector policy documents. The formation of the Ministry of Climate and the passage of a climate law should be used to mainstream climate resilience and adaptation across the energy sector, including policy making and implementation, and infrastructure planning and investments. The IEA's Estonia Climate Resilience Policy Indicator and Climate Resilience for Energy Security report can support energy sector stakeholders to take concrete steps to boost climate resilience and adaptation.

## Use of high emissions oil shale has significantly declined but is still a key part of Estonia's energy system

Estonia is unique among IEA member countries as its energy supply relies on oil shale, a hydrocarbon-rich sedimentary rock that has slightly higher energy density than lignite. Oil shale is mined domestically; burned to generate electricity and heat; and liquefied to produce shale oil, a synthetic crude oil. Estonia does not have any oil refineries and all shale oil is exported, mainly to the Netherlands, where it is blended with heavy fuel oil used for shipping.

Estonia's use of oil shale has declined, but it is still the country's largest energy source. From 2011 to 2021, the share of oil shale dropped in both TES, from 71% to 60%, and electricity generation, from 85% to 48% (with a rebound to 57% in 2022). The lower use of oil shale helped Estonia to drop from the 3rd-highest carbon intensity of energy supply in the IEA in 2017 to the 18th-highest in 2022, 41.5 tonnes carbon dioxide per terajoule (t $CO_2$/TJ), versus the IEA average of 44.4 t $CO_2$/TJ); however, that year Estonia had the fourth-highest carbon intensity of electricity generation. Oil shale production has fluctuated notably in recent years, driven mainly by variation in the demand for oil shale for electricity generation (Figure 1.6). In 2022, 66% of oil shale was used for electricity generation followed by liquefaction (34%).

**Figure 1.6 Oil shale production by use in Estonia, 2011-2022**






Source: IEA analysis based on Statistics Estonia (2023), Consumption of Fuels by Economic Activity and Type of Fuel.

Estonia's oil shale industry has many negative environmental impacts. It is one of the most carbon-intensive forms of electricity and heat generation and of oil production. It results in large volumes of solid waste and air pollution and requires significant volumes of water. The government has expressed a general goal to reduce oil shale use, but Estonia does not have legally binding targets regarding the phase-out of oil shale generation, liquefaction or mining.

Eesti Energia, a state-owned energy company, is the largest oil shale producer and owns all oil shale power plants. The company's long-term action plan adopted in 2021 aims to end oil shale electricity generation by 2030 and transition to 100% renewable generation. Eesti Energia has taken steps to reduce electricity generation from oil shale. From 2020 to 2021, 619 megawatts (MW) of oil shale generation capacity was permanently closed. Based on concerns over generation adequacy, Eesti Energia has been required to keep 1.0 gigawatt (GW) of oil shale generation available until 2026 at a significant financial loss (see Chapter 2).

The IEA recommends that the government establish a more ambitious and legally binding target to phase out electricity generation from oil shale by at least 2030, which could be done in the climate law. The government should also examine what investments are needed to ensure secure operation of the electricity system as oil shale generation is phased out and whether government support may be needed to ensure such investments are realised in the needed time frame. This would help market actors to take relevant decisions and contribute to reducing Estonia's GHG emissions.

Estonia plans to continue liquefaction of oil shale. In 2020, the government provided Eesti Energia with EUR 125 million to support the construction of a new oil shale liquefaction plant. The plant is expected to start full operations around 2025. Eesti Energia's long-term action plan notes that the company aims to stop producing liquid fuels from oil shale after 2040, with the goal to instead produce raw materials for the chemical industry. The plan aims for all shale oil production to be carbon-neutral by 2045 at the latest; however, it is not clear how this can be achieved or how much it would cost. The IEA recommends that the government does not provide any funding or support to oil shale liquefication and clarifies how continued oil shale liquefaction is compatible with Estonia's 2050 climate-neutrality target.

Oil shale mining, electricity generation and liquefaction all take place in Ida-Viru County, located in the north-east of Estonia along the border with the Russian Federation (hereafter "Russia"). The plans to significantly reduce oil shale production and use will have notable impacts in this region, as the oil shale industry is the key driver of the economy. Estonia aims to reduce these impacts through a Territorial Just Transition Plan that is supported with EUR 354 million from the EU Just Transition Fund from 2021 to 2027. This funding will support local investments in renewable energy and the reskilling of local workers. The government should closely monitor the implementation of the territorial just transition plan and complement EU funding with national funding as needed, especially if this can help accelerate the phase-out of oil shale production.

In 2021, the IEA convened a Global Commission on People-Centred Clean Energy Transitions, including ministers and civil society leaders from IEA member and non-member countries. The Commission published 12 recommendations for countries to make the energy transition truly people-centred and inclusive. When designing and implementing just transition policies, the IEA suggests Estonia follow the Commission's framework, defining the principles for just energy transitions.

## Accelerated infrastructure permitting, clarity on a market-focused policy approach and an expanded electricity market would help drive the energy transition

For Estonia to achieve its climate and energy targets, there will need to be a strong acceleration in the deployment of energy infrastructure, including new electricity generation capacity, expansion of the electricity transmission and distribution network, biomethane production, EV charging, among many others. The IEA commends Estonia for the work reducing barriers to the deployment of renewable energy and electricity infrastructure projects. However, the IEA notes that there are still risks related to permitting, environmental impact assessments and defence concerns. In addition, the current spatial planning process creates great uncertainties around project investment decisions and deployment timelines. The government needs to support the energy transition by developing streamlined and transparent permitting processes and a broadly consulted spatial plan, underpinned by robust data. This will require a transparent and efficient system for infrastructure planning and permitting. The IEA report Electricity Grids and Secure Energy Transitions provides recommendations on the key challenges to accelerating electricity infrastructure deployment.

The government places a strong reliance on market measures and aims to limit subsidies and state intervention needed to achieve its climate goals. However, the need to accelerate the energy transition, especially in relation to reaching the 100% renewable electricity goal, will likely require targeted subsidies. In addition, Eesti Energia, a large state-owned company play a major role in energy markets. Some transparency on its expected role is provided through the owner's expectations for Eesti Energia. However, in some cases its actions do not align with energy market signals, for example, the government requirement for Eesti Energia to keep 1.0 GW of oil shale generation available through 2026. There is a need for the government to clarify where its sees markets driving the energy transition and maintaining energy security, where economic incentives or other non-market measures are needed, and where state-owned companies will take a leading role. Transparency in these areas will help to ensure the needed investment can take place in an efficient and timely manner.

The IEA notes that Estonia's small market creates challenges in attracting the investment needed to drive the energy transition. The IEA encourages Estonia to continue working to establish a common electricity wholesale market covering all three Baltic states (see Chapter 2) and to expand the common gas market (see Chapter 7). Through the Baltic Energy Market Interconnection Plan, Estonia co-operates with Denmark, Finland, Germany, Latvia, Lithuania, Norway, Poland and Sweden to achieve open and integrated regional electricity and gas markets between EU countries in the Baltic Sea region. The government should ensure that this group remains sufficiently resourced and active and should use it as a forum to discuss and plan the feasibility of a cross-border bidding zone.

## Meeting greenhouse gas emissions targets will require stronger forestry and biomass policies

To meet its climate targets, Estonia needs to increase net carbon sinks from LULUCF by an additional 0.434 Mt $CO_2$-eq per year by 2030 compared to the average sink between 2016 and 2018. LULUCF was historically an emission sink, but LULUCF removals dropped sharply in 2014 and LULUCF has been a notable emissions source every year since 2018, reaching 2.9 Mt $CO_2$-eq in 2021. The recent transition of LULUCF from a GHG emissions sink to a source is a regional problem that has also impacted Finland and Latvia.

Forests have the largest effect on Estonia's LULUCF emissions. Historically, Estonia's forests sequestered carbon due to the rapid increase in growing stock. Forest carbon sequestration has declined in recent years due to the high proportion of mature and near-mature forest stands; increased logging; and a growing share of forest land being treeless areas, areas under regeneration and young stands. Conversion of other land areas to forests through afforestation and reforestation has been decreasing, and the total forest area is not increasing. Wetlands were also a major cause of increased LULUCF emissions, driven mainly by peat extraction.

The government estimates that LULUCF will continue to be a net source of GHG emissions and is developing measures to reverse this trend and improve the methodology to more accurately determine LULUCF emissions. The government should develop a strong set of measures to ensure LULUCF delivers net emissions reductions in line with climate targets. This should include a robust forest inventory methodology, well-enforced biomass sustainability criteria and clear limits on the environmentally sustainable level of logging. In addition, the use of peat for energy should be ended and non-energy uses of peat should be well regulated to ensure the health of peat bogs, which are one of the most effective carbon sinks. The climate law should include clear LULUCF emissions targets and biomass sustainability requirements.

Estonia's plans to achieve its climate and renewable energy targets rely on continued use of sustainably produced forestry biomass, especially through bioenergy use in district heating and individual heating systems. In addition, a notable share of Estonia's forestry biomass energy products is exported (40% in 2021, 32% in 2020, 34% in 2017). The high reliance on biomass creates risks. The EU ban of wood imports from Russia could substantially increase demand for Estonia's forestry biomass energy products, potentially increasing prices and reducing domestic availability. There is also a risk that measures to ensure that Estonia's forests deliver the needed LULUCF emissions reductions could reduce the availability of biomass for energy.

Given these concerns, the IEA recommends that efforts to reduce emissions from heating be focused on electrification through heat pumps and thermal storage. This would allow for more cost-effective and flexible operation of heating systems, supporting greater integration of variable generation from wind and solar PV. It could also reduce the environmental impact of logging and help forests make a greater contribution to LULUCF emissions reductions and address local air pollution resulting from the high share of direct biomass burning in individual residential heating systems. In 2022, the government supported a report (Transitioning to a Carbon Neutral Heating and Cooling in Estonia by 2050) that details options for deploying heat pumps and thermal storage.

## Estonia has taken steps to address the impacts of the pandemic and the energy crisis

In response to the Covid-19 pandemic, the European Union established the Recovery and Resilience Facility to support EU member states' recovery and resilience plans, which aim to make their economies more sustainable, resilient, and prepared for the green and digital transitions. The facility was expanded in 2022 with additional funding to support REPowerEU, the EU plan to rapidly reduce dependence on Russian fossil fuels and accelerate the green transition. In total, the facility will provide EUR 724 billion through 2026. Estonia's plan consists of 25 investments and 16 reforms supported by around EUR 1 billion in grants, 59.4% of which supports climate objectives, including investments in electricity infrastructure, renewable energy, clean transportation and building renovations.

Starting in late 2021, global energy prices began to rapidly increase, especially in Europe. Price spikes and high volatility have persisted though 2023, driven by Russia's invasion of Ukraine. Estonia has taken several steps to address the impact of high energy prices on consumers. In 2021 and 2022, around 380 000 low-income households were given discounted electricity prices and network fees were halved for all electricity consumers. The total cost of these measures was around

EUR 180 million. In 2022, Estonia established temporary subsidies covering a share of household bills for electricity, gas and district heating; the measure was in force through March 2023 and cost the government around EUR 125 million.

In late 2022, the government established a universal service, which created a regulated retail electricity price for households and small and medium-sized enterprises (SMEs), with the aim to protect consumers from price volatility through April 2026. The IEA understands the need to protect consumers in times of unprecedented energy price volatility, but recommends eliminating the universal service and providing relief as needed through temporary support programmes (see Chapter 2). More critically, efforts to protect consumers from high prices should focus on deep renovations that permanently lower energy costs (see Chapter 3).

## Estonia has ended its reliance on Russian energy imports and is working to boost energy security

The IEA strongly commends Estonia for taking quick action to end its reliance on Russian energy, including through efforts to reduce energy demand and co-operate to ensure regional energy security. Historically, Estonia relied on Russian imports for all its natural gas supply and a significant share of its oil products supply (39% in 2021). In response to Russia's invasion of Ukraine, Estonia stopped importing Russian pipeline gas in April 2022. In September 2022, the Estonian government banned imports and purchases of Russian natural gas, including LNG. In December 2022, Estonia banned the purchase and transfer of crude oil and oil products from Russia.

Estonia's gas supply is now imported via pipeline connections to the LNG terminal in Klaipeda, Lithuania and the new Inkoo LNG terminal in Finland (first commercial delivery in March 2023). Eesti Gaas (Estonia's main gas supplier) signed deals to bring ten LNG cargoes by autumn of 2023, including seven shipments via Finland and three via Lithuania's Klaipeda terminal (see Chapter 7).

Estonia has not traded electricity with Russia since 2005. There is a major ongoing project to desynchronise the Baltics from the Russian electricity system and synchronise with the continental European network (see Chapter 2). This project involves large investments in the electricity system and requires a significant commitment of the transmission system operator's (TSO) capacity. In August 2023, the Baltic states agreed to move synchronisation forward to February 2025. Current infrastructure allows for synchronisation to take place under emergency circumstances.

## Price signals need to be aligned with energy transition goals, requiring an update of taxation and fiscal policy

Estonia charges an excise duty on most energy products. In 2020, it reduced excise duties on all energy products as a response to the impacts of the Covid-19 pandemic. The reduced rates were extended twice to help consumers deal with the price impacts of the energy crisis. Starting in 2024, energy products excise duties will be gradually increased to return to pre-pandemic levels in 2027 (Table 1.2).

Estonia's excise duty rates are not based on GHG emissions or other environmental factors. Changes to fiscal and tax policy are needed to encourage consumers to move away from fossil fuels and support the uptake of low emission, efficient, renewable and innovative options. Changes to energy taxation are also likely needed to comply with the expected revision of the EU Energy Taxation Directive, which will likely require energy products to be taxed according to their energy content and environmental performance. This would require fossil fuels to be taxed at the highest rate and electricity at the lowest rate.

There is a particular need for better price signals in the transport sector, where Estonia is the only IEA member country without annual or registration taxation on private vehicles and has one of the oldest and least efficient vehicle fleets. The IEA commends Estonia for introducing a road use fee for heavy trucking and encourages the government to quickly move ahead with its plan to introduce vehicle taxation, which should be designed to drive the uptake of more efficient vehicles, including EVs (see Chapter 4).

**Table 1.2 Energy excise duties by product in Estonia, 2023-2027**

| Energy product | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|
| Diesel (EUR/1 000 L) | 372 | 399 | 428 | 459 | 493 |
| LPG (EUR/1 000 kg) | 55 | 65.01 | 79.91 | 90.98 | 107.71 |
| Light heating oil (EUR/1 000 L) | 372 | 399 | 428 | 459 | 493 |
| Heavy fuel oil (EUR/1 000 kg) | 422 | 456 | 490 | 525 | 559 |
| Shale oil (EUR/1 000 kg) | 414 | 447 | 481 | 515 | 548 |
| Natural gas (EUR/1 000 $m^3$) | 40 | 47.81 | 56.42 | 66.58 | 79.14 |
| CNG (EUR/1 000 $m^3$) | 40 | 41.83 | 43.66 | 45.5 | 47.32 |
| LNG (EUR/1 000 kg) | 55.79 | 58.34 | 60.9 | 63.45 | 66 |
| Electricity (EUR/MWh) | 1 | 1.45 | 2.1 | 3.07 | 4.47 |

Liquid biofuels are taxed at the same rates as fossil fuels according to the purpose of use. Biogas and biomethane are exempt from excise duties. In 2019, reduced excise duties were introduced for electricity- and gas-intensive enterprises. To receive the lower rate (0.5 EUR/MWh for electricity and 11.3 EUR/1 000 $m^3$ for natural gas), an enterprise's energy management system must comply with the ISO 50001 standard. The government has no plans to increase the reduced electricity and gas excise duties for energy-intensive industry.

The IEA commends Estonia's effort to make electricity a competitive option for industry, as electrification offers a clear pathway to energy savings and emissions reductions. The government should not implement measures that reduce the cost of natural gas or other fossil fuels, instead using limited budget resources to help industry stay competitive through investments that increase efficiency and support a transition to electricity or renewable energy, for example biomethane (see Chapter 7).

Estonia's fossil fuel subsidies have declined and in recent years have come primarily from temporary programmes that reduced the impact of the high energy prices due to the energy crisis. However, there are still notable subsidies being granted for fossil fuels in the form of excise duty exemptions and reduced rates for specific fuels and usages. In 2020, the government provided EUR 125 million to support the construction of a new oil shale liquefaction plant. The IEA encourages Estonia to continue working to eliminate fossil fuel subsidies and to avoid any government support for new fossil fuel investments.

Estonia's energy-intensive industrial facilities, large-scale electricity generation plants and domestic aviation are subject to carbon pricing through the EU ETS. Around half of Estonia's GHG emissions fall under the ETS. Entities covered by the ETS must have ETS allowances for their emissions; most allowances are purchased through auctions. Some allowances are free, but the number of free allowances has been steadily decreasing. Revenues from the allowance auctions are delivered to countries participating in the ETS based on the total value of allowances purchased by ETS-regulated entities operating inside their borders. In 2021, Estonia received EUR 248.6 million in ETS revenue. It has a legal requirement for 50% of ETS revenues to be earmarked for climate and energy, with the main programmes supporting energy efficiency in buildings, sustainable transportation, biomethane, international climate co-operation and pilot projects.

Estonia also has a low national carbon price of 2 EUR/t $CO_2$. The price is only paid for $CO_2$ emissions related to heat production and covers a small share of Estonia's emissions (around 6% in 2022). A proposal to increase the carbon price to 25 EUR/t $CO_2$ for smaller scale heat producers not covered by the ETS was sent to parliament in September 2023. The government should expand the coverage of the national carbon price and increase it to an impactful level. Numerous IEA member countries have national carbon pricing that is significantly higher than Estonia. Sweden, Switzerland, Norway and Finland have some of the highest carbon prices in the world, but have maintained strong economic growth. The IEA has published a commentary on carbon pricing and a report on emissions trading that provide insights on effective implementation of carbon pricing. The IEA is also part of the Global Carbon Pricing Challenge, which aims to triple the global coverage of carbon pricing from around 20% of global emissions in 2021 to 60% by 2030. The Carbon Pricing Leadership Coalition most recent report provides addition insights how carbon pricing can be effectively implemented.

## More effort is needed to ensure Estonia has the skills and capacity to drive the energy transition

Estonia's relatively small labour market limits the offer of a skilled workforce, especially in the energy sector. This could slow down the energy transition, delaying the realisation of energy projects and buildings renovation, and cause bottlenecks in the achievement of energy and climate targets. The government should ensure that the education system is optimised for the country's workforce needs, invest in upskilling and retraining programmes, and attract workforce from abroad. Efforts in this area can draw on studies conducted by the Estonian Qualifications Authority, including the 2021 overview of the skills needed for the digital and green transition.

There is also limited capacity in the Estonia Competition Authority, the energy sector regulator, which has numerous key roles related to energy permitting, reviewing network development plans and other critical areas but limited staff supporting energy sector regulation. This presents a high-risk bottleneck on the pathway to a clean energy transition. Capacity is also limited in numerous parts of the government that design and implement energy policy. The creation of the Ministry of Climate bringing together various governmental competences, including on energy, provides an opportunity to ensure that there is adequate capacity to support the achievement of energy and climate goals. The government needs to increase capacity and staffing across the areas relevant to achieving its ambitious climate and energy targets.

## Estonia is taking leadership on critical minerals and should determine its domestic production potential

Estonia is home to one of the few rare earth processing facilities outside of the People's Republic of China (hereafter "China"). The rare earth separation plant located at Sillamäe is owned by the private company Neo Performance Materials and produces critical minerals key to the energy transition. In July 2023, Neo started construction of a factory that will produce rare earth permanent magnets used in EVs and wind turbines. The factory will source rare earth oxides from the Sillamäe processing facility and is expected to start operating in 2025. If completed on schedule it would be the first rare earth magnet factory in Europe.

A diverse and reliable supply of critical minerals is a key component of a secure energy transition. Estonia has large phosphate deposits that may also contain other critical minerals and may present an opportunity for Estonia to support the energy transition globally and expand its economy, with the potential to use skills and expertise from the oil shale mining industry. For example, Neo's rare earth magnetic factory is being constructed in Narva, the main area of oil shale industrial activity. The IEA encourages Estonia to quickly determine its critical minerals production capacity and the investments needed to bring any such resource to market.

The IEA emphasises that expansion of critical minerals production should avoid and mitigate adverse impacts on the environment and local communities including water use and pollution, air pollution, and inadequate waste management and worker safety. Supply chain due diligence, with effective regulatory enforcement, is a critical tool to assess and mitigate risks and increase traceability and transparency. The IEA Critical Minerals Market Review 2023, the IEA Critical Minerals and Clean Energy Summit press release and the forthcoming Sustainable and Responsible Supply Policy Guidance Paper provide additional details on the important role of critical minerals and actions that Estonia and other governments can take to help develop secure, sustainable and responsible critical mineral supply chains.

# Recommendations

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

- Pass a climate law that sets legally binding targets for carbon neutrality and intermediate emissions reductions, allocates responsibilities for implementation and tracking, and sets clear targets for phasing out oil shale and other fossil fuels.
- Clarify where it sees markets driving the energy transition and maintaining energy security, where economic incentives or other non-market measures are needed, and where state-owned companies will take a leading role.
- Align price signals with climate and energy goals by updating energy excise duties; increasing carbon prices; quickly introducing vehicle taxation to drive uptake of efficient vehicles, including electric vehicles (EVs); and ending support for fossil fuels. This should be done in a way that generates sufficient revenue to support a just clean energy transition.
- Develop strong measures to ensure that land use, land-use change and forestry delivers net emissions reductions in line with climate targets. This should include a robust forest inventory methodology, well-enforced biomass sustainability criteria and clear estimates on the environmentally sustainable level of biomass available.

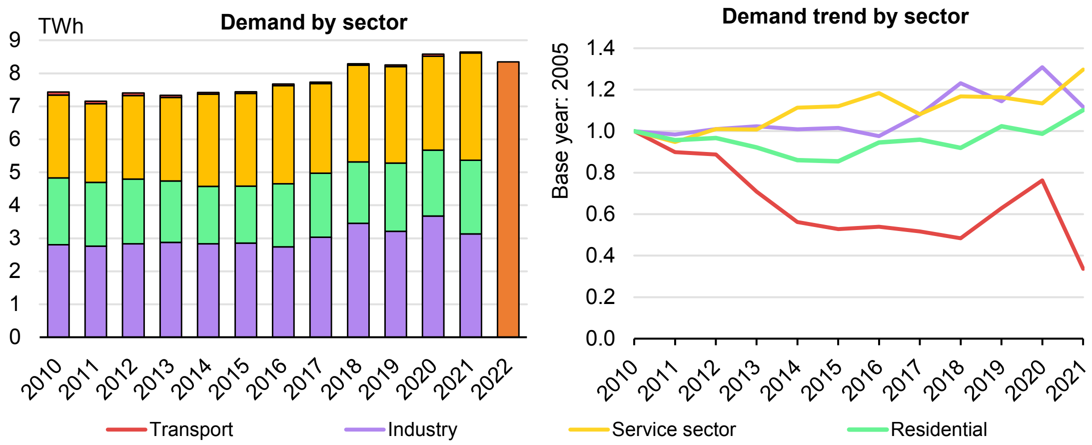
# 2. Electricity

## A secure clean energy transition in the electricity sector is critical to meet climate and energy targets

Estonia's electricity sector is undergoing major changes, with growing electricity demand, a strong reduction in oil shale generation, growth in renewable generation and a historic shift from being a net exporter to a net importer of electricity. The government plans for the electricity sector to play a key role in meeting its climate and energy targets and has set an ambitious target to cover 100% of electricity demand with renewables by 2030. The government is also working to finalise synchronisation with the European continental network and to boost regional electricity interconnections to ensure electricity security and a well-functioning electricity market.

From 2010 to 2021, Estonia's electricity demand increased from 7.4 terawatt hours (TWh) to a record-high of 8.6 TWh, driven by an overall increase in the electricity demand from buildings (from 4.5 TWh to 5.5 TWh) and industry (from 2.8 TWh to 3.1 TWh) (Figure 2.1). In 2022, electricity demand dropped to 8.3 TWh, driven by higher prices and government requests for consumers to save energy. Only a very small share of electricity demand come from the transport sector (0.4 % in 2021, mainly from rail) and from 2010 to 2021, transport electricity demand declined (from 0.09 TWh to 0.03 TWh). Peak electricity demand typically occurs in the winter and was around 1.4 to 1.55 GW in recent years.

**Figure 2.1 Electricity demand by sector in Estonia, 2010-2021 and preliminary total demand for 2022**



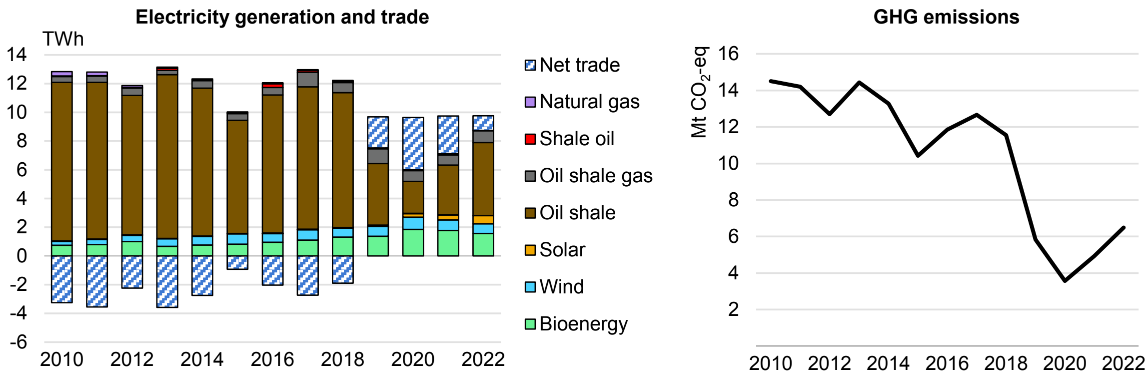



Source: IEA (2023), World Energy Balances.

Estonia's electricity generation and trade underwent major changes in 2019 (Figure 2.2). Historically, oil shale generation dominated, averaging 84% of electricity generation from 2005 to 2018. From 2018 to 2020, oil shale dropped from 76% to 37% of generation, driven by high EU ETS prices, low electricity prices and increased renewable electricity generation. Oil shale rebounded to 57% of generation in 2022, as high electricity prices made oil shale generation economically competitive. Electricity generation from oil shale gas (a by-product of oil shale liquefaction) increased from 0.4 TWh and 3.2% of generation in 2010 to 0.8 TWh and 9.1% of generation in 2022.

From 2010 to 2020, electricity sector GHG emissions experienced a significant overall decline from 15 Mt $CO_2$-eq to 3.6 Mt $CO_2$-eq. However, in 2021 and 2022, oil shale generation rebounded strongly, pushing electricity sector GHG emissions up to 6.5 Mt $CO_2$-eq. In 2022, Estonia had the fourth-highest carbon intensity of electricity generation among IEA member countries (359 t $CO_2$/MWh versus the IEA average of 230 t $CO_2$/MWh).

**Figure 2.2 Electricity generation by source, net trade and greenhouse gas emissions from electricity and heat in Estonia, 2010-2022**



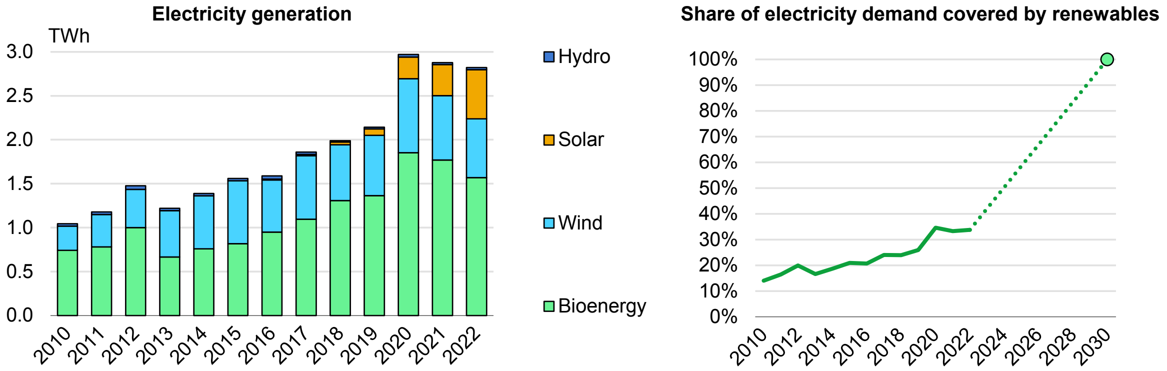

IEA. CC BY 4.0.

Source: IEA (2023), World Energy Balances.

From 2010 to 2020, renewable electricity generation tripled, from 1.0 TWh to 3.0 TWh, driven mainly by growth in generation from forestry biomass, and more recently solar PV (Figure 2.3). Despite a continued strong increase in PV generation, which reached 6.3% of generation in 2022, total generation from renewables decreased to 2.8 TWh in 2022 due to lower generation from forestry biomass (mainly because prices for forestry biomass increased notably following Russia's invasion of Ukraine) and wind (manly because of lower wind speeds across most of Europe). Renewable generation covered 34% of electricity demand in 2022, far from the 2030 target of 100%.

Historically, Estonia was a net electricity exporter. As a result of the overall decline in domestic electricity generation, resulting mainly from the sharp drop in oil shale generation, Estonia has been a net electricity importer since 2019. Electricity imports reached 42% of demand in 2020 but decreased to 12% in 2022, when generation from oil shale ramped up again. Electricity imports come mainly from Finland. Estonia still has small net electricity exports to Latvia.

**Figure 2.3 Renewables in electricity generation and demand in Estonia, 2010-2022 and 2030 target**






Source: IEA (2023), World Energy Balances.

Estonia's installed generation capacity declined from a peak of 2 844 MW in 2019 to 2 337 MW in 2021, but started growing again to reach 2 542 MW in Q3 2023. These changes were driven mainly by the permanent closure of 640 MW of oil shale capacity and strong deployment of solar PV. From 2019 through Q3 of 2023, oil shale capacity dropped from 1 970 MW to 1 330 MW while PV capacity increased from just 33 MW to 510 MW. In Q3 2023, wind capacity was 317 MW, with no growth in several years. Biomass capacity increased from 77 MW in 2016 to 157 MW in 2019 and has since been stable (153 MW in Q3 2023). Gas-fired capacity has not seen major changes and was 110 MW in Q3 2023.

## More effort is needed to clarify how to meet the 100% renewables target

The government has a general vision for a future electricity system based on wind and solar energy, various types of storage and flexibility options, strong interconnections with neighbouring EU countries, and synchronisation with the European continental network. There has been notable progress towards this vision but enacting it will require a radical transformation from Estonia's past reliance on an oil shale-dominated and export-oriented system. The target for renewable electricity to cover 100% of annual electricity demand serves as a central pillar for driving the energy transition in the electricity sector. However, several issues need to be clarified to ensure that the large investments and operational changes needed to achieve the target can be made in a timely manner.

The 100% target is ambiguous about the role of non-renewable sources and electricity trade, creating uncertainty over how the grid will be operated in the future and what investments are needed to ensure security of supply. The government has indicated that dispatchable generation could be needed through 2030 and beyond for system balancing but has not clarified how using non-renewable generation for balancing is compatible with the 100% renewables target. Market conditions and policy signals have already reduced oil shale electricity generation (the main source of dispatchable generation) and most of the new generation that has come online in Estonia is non-dispatchable and non-synchronous. To maintain system security, Eesti Energia has been asked to keep 1 000 MW of oil shale generation available until 2026 at a significant financial loss. The 2022 European Resource Adequacy Assessment shows that Estonia could continue to have generation adequacy issues through 2030.

The government is exploring the creation of a capacity market mechanism to address system adequacy issues. A draft concept note developed by the TSO indicates a preference for a technology-neutral strategic reverse. The government is currently working on legislation needed to define the roles and processes for setting up a capacity mechanism. It is also waiting for the 2023 European Resource Adequacy Assessment, which will need to show that Estonia continues to face generation adequacy issues so that it can start working with the European Union to get approval for a capacity mechanism under EU state aid rules. The IEA advises that before considering capacity mechanisms, Estonia should examine how expanding its bidding zone and load frequency control block to all three Baltic states and improving price formation in the wholesale electricity market could address system adequacy issues. If a capacity mechanism is adopted, it should be based on a well-defined reliability standard; be technology-neutral (with participation from demand-side resources); and pay for performance (with sufficient penalties for non-delivery).

In addition, the 100% renewable energy electricity target and Eesti Energia's plan to stop generation from oil shale by 2030 are not aligned. It is also possible that shale generation could exit the market before 2030. The government should establish a more ambitious and legally binding target to phase out electricity generation from oil shale by at least 2030, which could be done in the climate law. It should also examine what investments are needed to ensure secure operation of the electricity system as oil shale generation is phased out and whether government support may be needed to ensure such investments are realised within the needed time frame. This would help to clarify how the 100% renewable electricity target can be met while also achieving the goals for security of electricity supply.

A major transformation of the electricity system is needed to achieve the 100% target renewable electricity target and put Estonia on the path to climate neutrality. The IEA commends Estonia for taking important steps towards these targets, including working with several third-party energy experts to develop a detailed report on Transitioning to a Climate-neutral Electricity Generation. The report provides a detailed cost-benefit analysis of seven technology pathways against key criteria (including costs, security of supply and socio-economic impacts) and includes risk and sensitivity assessments and insights on key actions that would need to be taken for each pathway (in policy, markets and infrastructure). This report and other work such as the complementary report, Transitioning to a Carbon Neutral Heating and Cooling in Estonia by 2050, are a helpful step towards informing energy sector stakeholders on the pathways for Estonia to achieve the 100% renewable electricity and climate neutrality targets.

However, it is not clear whether such reports will be undertaken on a regular basis or which scenarios are expected to be supported by policy. The IEA recommends establishing a regular exercise like these two reports on the transition to carbon-neutral energy systems to provide insights on how changes in key variables such as technology costs and the ongoing development of energy infrastructure affect the pathways to carbon neutrality. A more regular process would also allow the government and other stakeholders to increase their capacity on developing/understanding the result of such studies and would ensure that long-term decisions are taken based on the most up-to-date information. In addition, while the two reports on carbon-neutral energy systems recommend several potential pathways, they do not provide clarity on the preferred or politically supported pathway, limiting the guidance it can provide to investors and power sector stakeholders. Based on the results of these studies, the government should clarify to stakeholders which pathway will receive policy support.

The link between the carbon neutrality studies and other key planning processes such as the TSO and distribution system operator's (DSO) long-term development plans is also not clear. For example, the TSO's Security of Supply Report provides a transmission network development plan to support increased renewable deployment but does not explicitly assess any of the pathways presented in the carbon neutrality reports, either for its network plan or adequacy analysis. Increasing co-ordination between the plans by examining the most relevant pathway(s) within the more detailed studies undertaken by the TSO and DSO can provide a better understanding of the technical implications of high-level policy direction and important feedback into policy target setting.

Given the large scale and fast pace of change needed to achieve these targets, the IEA recommends that Estonia establish regular integrated planning to provide clarity on which technology pathway is preferred and what policy, market regulations and subsidies will be put in place. This is needed to ensure that energy sector stakeholders can make the needed investments in a coherent a cost-effective manner. A high degree of transparency across the different studies that make up the integrated planning activities in terms of inputs, methodologies, results and the links between them is also essential to enable constructive stakeholder engagement and increased investor confidence.

Given the increasing complexity for planning and operating an electricity system to achieve the 100% renewable target, the government needs to ensure that the relevant entities (energy regulator, TSO, DSO, Ministry of Climate) have the needed capacity and staffing to plan for and operate a system that is significantly different from the current reliance on large-scale dispatchable oil shale generation.

The IEA recommends that the regular integrated planning examines high levels of electrification, as this is one of the best ways to achieve economy-wide emissions reductions (especially given the 100% renewable electricity target) and to introduce increased system flexibility through demand-side response (DSR) (for example, through heat pumps, energy storage and smart EV charging). Estonia also has a strong interested in expanding industrial activity to boost its economy. Achieve this goal will likely require an increased supply of secure of low-carbon electricity. Large-scale industrial electricity consumers can also present a relatively easy options for significant levels of demand-side response. The NECP currently shows that electricity demand is expected to grow to 9.4 TWh by 2030 (versus 8.3 TWh in 2022); however, this estimate includes relatively low expectations for electrification of heating and transport and for expansion of electricity intensive industry.

Australia's Integrated System Plan, conducted on a two-year cycle since 2018, provides an advanced best practice example for integrated power system planning in a liberalised electricity market. Key features of Australia's Plan include: an extensive stakeholder engagement process; consideration of multiple scenarios accounting for different paces of development in distributed energy and electrification; identification of transmission investment that supports renewables buildout based on resource-rich areas rather than a single-project basis; and a high degree of transparency, with publication where the power system model itself is made publicly available with all input data and detailed reporting on different aspects of the planning and consultation process.

Many other countries and regions are also taking steps to improve their planning integration and co-ordination in line with the needs of energy transitions and planners are taking steps to improve scenario development. For example, Ontario introduced its Pathways to Decarbonization study and Germany has introduced a range of power sector scenarios into its grid development plan. ENTSO-E's Ten Year Network Development Plan also illustrates scenario building at a European level. A number of countries, including Ireland and India, have introduced dedicated studies to reflect climate targets in power system plans.

Estonia is already a leader in heat pump deployment and should take advantage of consumer awareness and push for even stronger uptake of heat pumps for individual heating systems (see Chapter 3). Estonia is lagging on EV deployment and should make additional efforts to support the uptake of EVs, which is likely needed to reach its climate and renewable energy targets. The government should also develop a framework for smart EV charging to ensure that increased EV uptake supports integration or renewable electricity, while boosting system flexibility and minimising distribution system investments. The IEA report on Grid Integration of EVs provides valuable insights for policy makers (see Chapter 4).

More work is also needed to link the electricity and heating systems (for example, though thermal energy storage and large-scale heat pumps). Increasing regional trade would help to balance the electricity system while boosting the integration of renewables. Planning exercise scenarios should examine the impacts of increased ambition in all these areas. The IEA notes that a higher ambition for electrification, especially in the context of the 100% renewables target, would have notable implications for investment in and operation of the electricity system. This would likely require higher levels of renewable generation, transmission capacity, system flexibility, energy storage, DSR and regional trade, which should be examined with scenarios in the planning exercise. There should also be scenarios that examine how electricity security can be maintained if there is an accelerated market exit of oil shale generation and to clarify the role offshore wind can play in meeting Estonian and EU climate goals.

The planning exercise should include a transparent, integrated generation and transmission plan that considers the role of storage and demand response to clarify what components and actors in the system need to provide in terms of electricity generation, capability of meeting residual load or dispatchability, frequency-based and non-frequency based ancillary services, and remedial actions. It is especially relevant to examine impacts on building out electricity infrastructure and how increased flexibility could lower overall investment needs.

The planning process should include co-ordination with current and potential electricity trading partners to examine the role that electricity trade can play in supporting energy security and the energy transition. Any potential reliance on imports for security of supply during periods of low renewables production needs to be actively co-ordinated with electricity trading partners and explicit agreements to ensure access to capacity should be considered if necessary. Opportunities for exporting renewable energy should also be examined with a view to ensuring benefits for Estonia and supporting EU-wide decarbonisation.

## Major infrastructure projects are ongoing and planned to support the energy transition and security

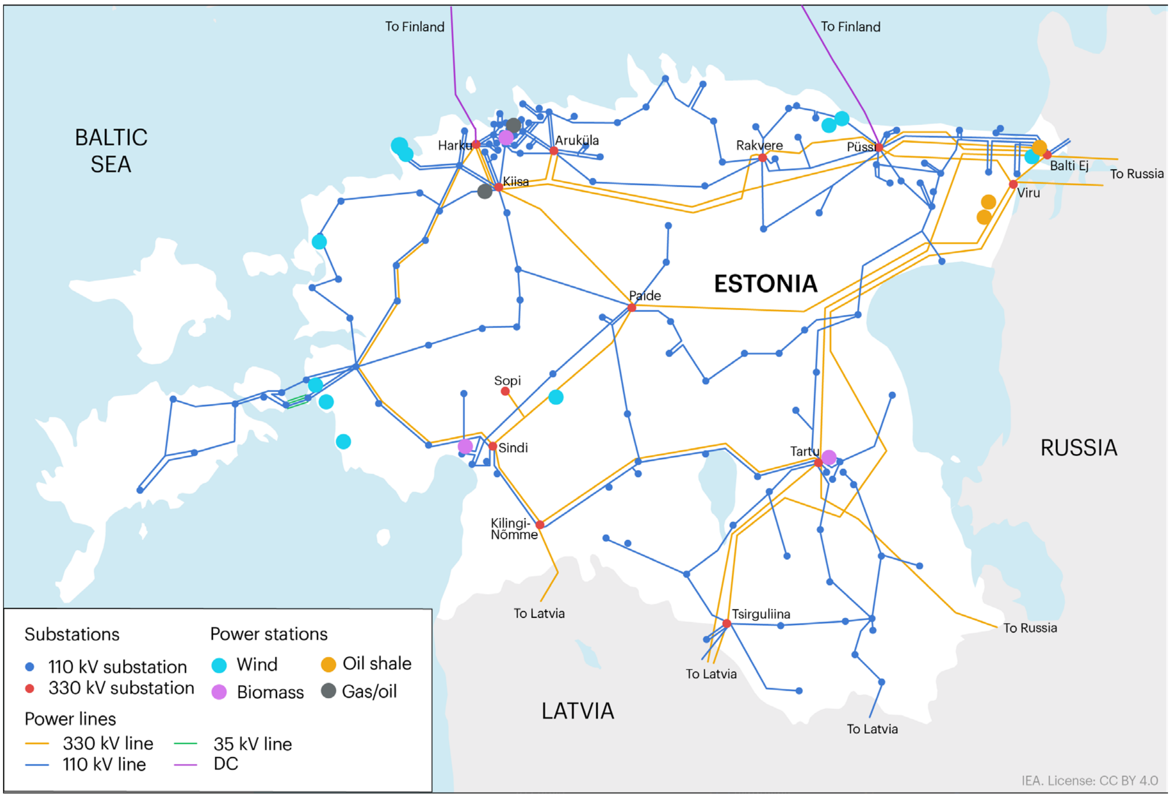
The government plans for the electricity sector to play a key role in meeting Estonia's climate and energy goals and has set an ambitious target for renewable energy to cover 100% of annual electricity demand. There are also goals to increase electricity system capacity, flexibility and reliability; and boost interconnection capacity to increase regional electricity trade and synchronise with the continental European network. To support these goals, Estonia continues to invest heavily in its electricity network (see the TSO's 2022 Security of Supply Report for details on investments).

The IEA commends Estonia's efforts to expand grid capacity and flexibility, but notes that additional efforts are needed to support the 100% renewable electricity target. The IEA report Electricity Grids and Secure Energy Transitions, released in October 2023, examines the urgent upgrades required of physical infrastructure and the way grids are planned and managed, quantifying the costs of delayed action. It provides key recommendations for policy makers, highlighting what is necessary in areas such as investment, regulation and planning.

In 2022, Estonia's transmission system consisted of 1 634 kilometres (km) of 330 kilovolt (kV) lines, 3 361 km of 110 kV lines and 5 km of 6-35 kV lines (Figure 2.4). Estonia is interconnected to Latvia via three alternating current (AC) 330 kV lines. The third line started operating in 2020, increasing interconnection capacity to 1 447 MW (Estonia to Latvia) and 1 259 MW (Latvia to Estonia). Estonia is interconnected with Finland via two direct current (DC) undersea cables – EstLink 1 (358 MW) and EstLink 2 (658 MW) – with a total bidirectional capacity of 1 016 MW.

There has not been electricity trade between Estonia and Russia since 2005. Estonia is part of a synchronous electricity zone that includes Belarus, Latvia, Lithuania and Russia. There is a major ongoing project to synchronise the Baltics with the continental European network. The project will increase Baltic energy security and support full integration into the European electricity market. It involves large investments, including new and upgraded transmission lines and other crucial grid assets such as synchronous compensators.

**Figure 2.4 Estonia's electricity transmission system and major generation in 2022**




In response to Russia's invasion of Ukraine, the Baltic TSOs agreed to reduce dependence on the Russian network. Since June 2022, balancing of supply and demand in the Baltics is ensured mainly through balancing capacities on the Baltic, Nordic and Polish markets. This allowed the Baltics to end payments to Russia for balancing services in July 2022. In August 2023, the Baltic states agreed to move synchronisation forward from the end of 2025 to February 2025. Synchronisation is already possible under emergency circumstances.

There are major ongoing and planned investments in the transmission system to support increased deployment of renewable energy, including expansion of the grid in western Estonia funded through the EU Recovery and Resilience Facility. There is ongoing work to boost interconnection capacity. The TSOs of Estonia and Latvia are planning a fourth interconnection via a 700 MW to 1 000 MW subsea DC cable to support increased trade and the development of a joint offshore wind project (ELWIND), with possible commissioning of the interconnection by 2035. The TSOs of Estonia and Finland are planning EstLink 3, a third DC subsea cable with a capacity of 700 MW to 1 000 MW, with possible commissioning by 2035. In May

2023, the TSOs of Estonia and Germany (50 Hertz) signed a letter of letter of intent to jointly develop the Baltic WindConnector, a hybrid submarine cable that would support the development of offshore wind projects and electricity trade between Estonia and Germany. This project is in the evaluation stage, with an indicative commissioning in 2037.

During 2023, Estonia's TSO will submit its first network development plan that follows EU legislative requirements. The process of adopting network development plans should include a broad base of stakeholders to incorporate the grid reinforcements needed to meet energy and climate goals. The plans can also be used to ensure healthy reinvestment strategies. Network development plans should set out the needed investments to accommodate expected new generation and loads and are required to be transparent and include public consultation.

Estonia should examine deployment of sensor-based dynamic line rating (DLR) on existing AC power lines and interconnections and inclusion of DLR in ongoing and future projects. Measurement data show that DLR supports a 10-20% increase in capacity 90% of the time, offering a low-cost option to boost transmission and interconnection capacity, and support the integration of renewable generation. Belgium, France and several other IEA member countries have extensive experience demonstrating the benefits of DLR. Regionally, Finland and Lithuania are deploying DLR.

## Expanding Estonia's small electricity market would help to boost investment and increase competition

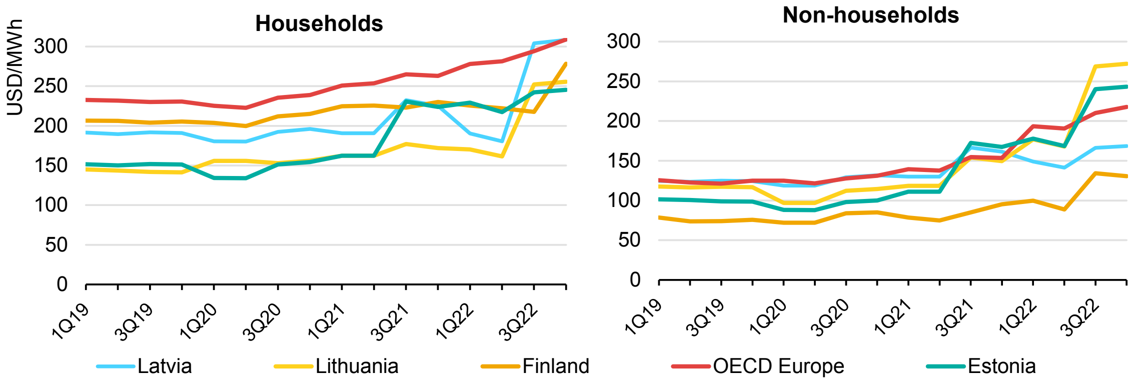
The Estonian Competition Authority is responsible for market regulation and publishes an annual report giving key metrics on the performance of electricity market. The 2020 report shows that Estonia has a relatively small electricity market, with around 750 000 consumers. There has been some reduction in market concentration, but the state-owned incumbent energy company, Eesti Energia, maintains a dominant position in both the wholesale market (56.2% of sales in 2022) and retail market (47.6% of sales in 2022). In 2022, Herfindahl-Hirschman Index values in most categories exceeded 4 000, reflecting a high level of market concentration.

The energy crisis notably increased electricity prices in Estonia and the Baltic/Nordic region. Estonia's household retail electricity prices increased notably from 2019 to 2022, but were the lowest in the region and below the average for OECD European countries (Figure 2.5). Estonia's non-household retail electricity prices also increased significantly. In Q4 of 2022 they were higher than the average for OECD European countries and the second-highest in the region after Lithuania.

Estonia's relatively small electricity market, both for energy products and frequency reserves, creates challenges in attracting the investment needed to drive the energy transition and support energy security. Expanding Estonia's bidding zone and load frequency control block to all three Baltic states would help boost liquidity, competition and investment. Estonia is working with Latvia and Lithuania to develop a common market; for example, the Baltic TSOs plan to establish a common load frequency control block. The government should examine what additional infrastructure investments and regulatory changes are needed for a well-functioning common Baltic electricity market and work with the Baltic TSOs and the energy regulators to ensure needed investments and regulatory changes are made as soon as possible. In line with the European Council's proposal to improve the EU electricity market design, Estonia could support the formation of a virtual hub covering all three Baltic states (and possibly other electricity trading partners) to boost liquidity in the forward markets.

In September the European Union Agency for the Cooperation of Energy Regulators (ACER) initiated a procedure to decide on the Baltic TSOs proposal on the alternative bidding zone configurations for the Baltic region. A decision from ACER is expected before the end of 2023.

**Figure 2.5 Electricity retail prices in Estonia and neighbouring countries, 2015-2022**






Source: IEA (2023), Energy Prices.

Estonia has a liberalised electricity market. However, in late 2022, the government established a universal service, which created a regulated retail electricity price for households and SMEs, with the aim to protect consumers from price volatility through April 2026. The universal service resulted in many consumers being removed from the retail market without their consent and in many cases being charged above market prices. The IEA understands the need to protect consumers in times of unprecedented energy price volatility. However, the IEA recommends eliminating the universal service and avoiding disruptive market interventions. Support, if needed, should come through temporary short duration programmes that do not force consumers to change energy contracts. More critically, efforts to protect consumers should focus on deep building renovations that result in sustained reductions in energy and heating bills and are targeted to support the most vulnerable households (see Chapter 3).

Estonia's TSO owns and operates a 250 MW dual fuel (gas/oil) emergency reserve power plant located at Kiisa. This plant is used in the case of a network failure or capacity shortfall and does not participate in the electricity market. The European Commission provided Estonia's TSO an exception to EU rules banning TSO ownership of generation assets for this plant. However, several energy sector stakeholders have expressed concerns that TSO ownership of the plant is causing market distortions. The TSO ownership and use of the Kiisa power plant beyond synchronisation with the continental European network should be clarified to provide proper market signals. The government should also consider how this plant could provide system balancing with renewable dispatchable generation, for example through use of biomethane and/or biofuels.

## Support for renewables has been updated to drive more cost-effective deployment

Estonia recently updated the way it awards subsidies for renewable electricity. Under the previous system (established in 2014 and amended in 2017) qualifying projects received a market premium on top of market revenue. The market premium is 57.3 EUR/MWh for renewable energy and 32 EUR/MWh for high-efficiency co-generation using natural gas, retort gas, peat and municipal waste. Market premiums are given for 12 years following the first delivery of generation. The cut-off date to qualify for this system was 31 December 2020. As of September 2023. this programme had awarded EUR 965 million in subsidies.

Since 1 January 2021, subsidies are awarded through reverse auctions that provide winning projects with payments through a contract for difference. The maximum subsidy is set at 20 EUR/MWh and the maximum bid (subsidy plus market price) at 45 EUR/MWh. Payments are given for 12 years from the first delivery of generation. Auctions were conducted in 2019, 2020 and 2021 for a total of 15 gigawatt hours (GWh), with all support awarded to PV. A second auction in 2021 awarded support to 430 GWh of PV and 110 GWh of wind generation. An auction opened in September 2023 for 650 GWh with a focus on wind generation. Auctions are planned in 2024 (500 GWh) and 2025 (500 GWh), with a focus on wind generation.

For upcoming and future auctions (especially any undertaken in relation to offshore wind) the government should consider indexing strike prices secured at auctions to reduce the risks that increases in costs beyond the control of project developers will prevent the delivery of auction-winning projects. Such risks include increased deployment costs relating to commodity prices, inflation and supply chain disruptions. Strike prices can be indexed against composite indices, such as the Harmonised Index of Consumer Prices or sector-specific indices, such as construction labour or steel price indices. The selected index, or formula of indices, should be balanced between selecting those that are most relevant and those that are practical to administrate, and should ideally avoid inadvertently introducing new risks by applying an irrelevant or overly specific indexing formula. Indexation does not necessarily need to apply for the full support period. The component of an auction bid deemed to reflect construction costs, for example, could be indexed to the point in time post-auction that these costs are fixed, for example signing of engineering, procurement, construction and installation contracts, or to a point where the project is considered to have been delivered, for example grid connection.

Both subsidy programmes are funded through a renewable energy charge paid by all electricity consumers to the TSO. The charge is updated annually based on the expected level of subsidy payments and the remaining funds from previous years. The charge (including value-added tax) has varied from a minimum of 9.2 EUR/MWh (2014) to a maximum of 13.6 EUR/MWh (2020 and 2021).

The IEA commends the move to awarding subsidies through auctions providing contracts for difference, as this should help to minimise the cost to consumers and allow reducing renewable electricity charges. If there remains a need for notable subsidies to drive the energy transition, the government should consider alternatives to charging electricity consumers, which increases the cost of electricity, decreasing the incentive for electrification. Alternative funding sources include an increased carbon price and higher excise duties on fossil fuels (both of which would  help to align price signals with the energy transition; see Chapter 1) and EU ETS revenues or direct funding from the state budget.

The government should also take steps to support the development of projects with no subsidies. This could include developing a template/standardisation of power purchase agreements to foster additional market-based financing and promote partnerships between renewable suppliers and energy consumers, especially SMEs and other small consumers. In addition, the government could lead by example, using power purchase agreements to deliver renewable electricity to government-owned sites while helping to establish power purchase agreements as a clear option for renewables deployment.

## Steps are being taken to reduce regulatory barriers, but more work is needed on permitting and spatial planning

Estonia is working to reduce barriers to the deployment of renewable energy and electricity infrastructure projects. This includes reforms to reduce the time to obtain a generation licence from around 3-5 years to 1.5 years and to streamline the environmental impact assessment process for renewable projects. EUR 26 million from Estonia’s Recovery and Resilience Plan supports reforms to streamline permitting and the hiring of additional staff at entities responsible for permitting.

The government is also working to remove wind turbine height restrictions that apply to a large part of Estonia's land and sea area to prevent turbines from interfering with military and civil aviation radar systems. From 2019 to 2022, the government invested EUR 74.5 million to upgrade radar systems to increase the area available for wind generation deployment. In 2022, an additional EUR 74.5 million was budgeted, with the goal to remove height restrictions from most of mainland Estonia by 2025. Solar PV projects have also faced barriers related to defence issues. In February 2022, the Ministry of Defence banned large-scale solar PV projects in some regions bordering Russia, which The restriction impacted several projects under development in Ida-Viru County. The Ministry of Defence is analysing mitigation measures to allow for PV projects to be deployed in this area.

The IEA commends the government for working to reduce regulatory barriers to renewable energy deployment. However, the IEA notes that there are still risks related to permitting and environmental impact assessments and a need to clarify at which point of the development process wind (and PV) projects receive clearance by the Ministry of Defence.

The government should develop a process map clearly identifying the regulatory pathway a project must follow from pre-planning to decommissioning and the roles of all the responsible authorities. Development of the process map and working to address the barriers identified would be greatly assisted by establishing a delivery taskforce, with Ireland serving a good example. Using the process map a taskforce can conduct gap analysis, identifying barriers and areas that can be improved and provide clarity to project developers. This would also help to determine if additional funding and/or staffing is needed to boost the capacity of the Ministry of Climate, the Estonian Competition Authority, the courts, local governments or other entities with responsibility over permitting. The taskforce can also serve as single point of contact in the government to help guide projects through the process and a digitalised one-stop shop that allows all paperwork to be submitted and processed on line and clearly informs project developers of their progress through the permitting process.

Best practices for accelerating permitting processes include the Danish Energy Agency's one-stop shop approach, Greece's Law on Modernization of the Licensing Process for Renewable Energy Sources and the United States' recent Improvements to Generator Interconnection Procedures and Agreements. Alternative models for permitting projects, such as auctioning available grid capacity, should also be explored. Performance bonds and/or delivery milestones should be incorporated into the permitting process to ensure delivery and prevent land/seabed hoarding and/or wasting valuable grid connection.

There is a need for a broadly consulted spatial plan underpinned by robust data and to ensure clarity on where renewable energy projects and support infrastructure can be built. In particular, the central and local governments' capacity to organise environmental data should be prioritised. The government should ensure that full and correct data sets underpin the designation of go-to areas for renewables and spatial plans, both onshore and offshore. One of the objectives should be to identify and avoid special protection areas (for example, the habitats of migratory birds) as part of the spatial planning process. In the designation of go-to areas, a transparent and participatory approach should be adopted to ensure all relevant stakeholders' views are considered and to minimise future planning objections.

## More work is needed to boost system flexibility through smart grids, demand response and energy storage

Since 2017, all electricity consumers in Estonia have smart meters that transmit at least hourly data to an online database. Consumers have free access to their data and can give service providers access to their data. By 2025, smart meters with a 15-minute resolution will be deployed to all metering points of the transmission system, generating installations with capacity more than 15 kilowatts and consumers with a connection with more than 200 Amps. By 2031, all metering points will have a smart meter with 15-minute resolution.

The advanced roll-out of smart meters and high level of digitalisation provide a clear opportunity for consumers to play an important role in ensuring a flexible and secure electricity system and supporting the clean energy transition, for example by providing DSR. However, there has only been limited use of smart meters and engagement of consumers to increase system flexibility. Flexibility can also play an important role by providing services to the TSO or DSO. For example, in 2022, the DSO published a tender to procure flexibility options on the island of Hiiumaa, which could enable increased PV connections without requiring grid investments. The project should be combined with flexibility research efforts and dissemination of results.

To support increased system flexibility, the government should enable the development of system service markets needed for a 100% renewable electricity system. This should facilitate the participation of variable generation, storage and energy service companies (ESCOs), and harness the considerable DSR potential among Estonia's electricity consumers, for example through the development of energy communities. In line with this, the government should take steps, such as establishing regulatory sandboxes, to allow for aggregated services, ESCOs and other market actors to gain experience in offering services in the ancillary markets that will open once synchronisation with continental Europe is completed. Estonia's report on Transitioning to a Climate-neutral Electricity Generation notes that expanding the electricity system balancing market to encourage investments in flexibility is a key action regardless of the technology pathway taken to achieve climate neutrality. The IEA provides resources on how policy makers and other energy sector stakeholders can better support the development of smart grids and demand response.

Estonia does not have significant deployment of energy storage. Several storage projects, including both pumped storage and batteries, are being planned in Estonia that have the size and technical potential to make significant contributions to the country's electricity system, both in terms of storing energy and providing ancillary services. In January 2023, approved construction of a large-scale pump-hydro storage project with a capacity of 500 MW and 6 GWh, that connects an underground cavern on the western coast of Estonia to the Finnish gulf. The project developer is backed by Estonia's main private sector energy companies and aims to start construction in 2024 and be operational in 2028. Eesti Energia is planning an innovate 225 MW pumped storage at an old oil shale mining site in eastern Estonia, which aims to start operating in 2026. These projects would create 725 MW of energy storage (compared to a peak demand of 1 400 GW to 1 550 GW in recent years) and would have a major positive impact on boosting integration of renewable energy and strengthening electricity security.

Estonia should take additional steps to boost the deployment of energy storage, as this is one of the key options for increasing system flexibility and integration of variable renewables and can help reduce traditional grid investments. Estonia should quickly complete the planned removal of double tariff charging of energy storage facilities and ensure the storage is allowed to participate in all electricity market segments. Further promotion of storage could be achieved by including storage in hybrid renewable auctions and/or dedicated energy storage auctions. For example, Greece has used both options to rapidly accelerate cost-effective deployment of energy storage, with a three-phase auction in 2023 offering support for 1 GW of storage.

Estonia should also expand support for thermal storage in conjunction with the electrification of the heating sector, as this presents an excellent option to boost the flexibility of the electricity and district heating systems while also increasing the integration of variable renewable generation. Finland has demonstrated notable success in deploying thermal storage systems linked to district heating in Helsinki and Vaskiluoto to reduce heating sector emissions and costs while boosting renewable integration (see Chapter 3).

## Clarity is needed on the expected role of offshore wind

Estonia currently has no offshore wind generation. The government has indicated that offshore wind could play a key role in meeting Estonia's climate targets, while also boosting economic activity and supporting the achievement of EU climate targets through the export of renewable electricity. In many respects, Estonia is preparing well for an offshore energy future. A marine spatial plan has been published and Estonia has good regional co-operation on offshore wind through the Baltic Energy Market Interconnection Plan, which has adopted a Baltic offshore wind work programme that supports co-operation on the development of the offshore grid, maritime spatial planning, enabling appropriate financing and acceleration of Baltic offshore wind projects and permitting.

Despite these steps, the government does not expect offshore wind generation to be deployed in Estonia before 2030 and there is a lack of clarity on Estonia's plans for offshore wind. Some key energy sector stakeholders have questioned if offshore wind deployment is needed to meet national targets, while others are clearly pushing for large-scale deployment. This is creating risks and uncertainties that could significantly slow and limit offshore wind deployment. The government should clarify what role it sees for offshore wind in Estonia and what level and timeline of deployment is needed to support this role.

In October 2023 the Ministry of Climate delivered a memorandum to the government providing options to achieve the 100% renewable energy target. It analysed the contribution of different generation technologies including offshore wind and estimated that the 100% renewable energy target can be met with only onshore renewable generation. It states it is important to maximise onshore renewable development but also acknowledges that starting development of offshore generation is important for long-term economic development.

It light of these findings, the Ministry of Climate proposed organising a tender process of sufficient scale and conditions to achieve the national target that allows for participation of onshore and offshore renewable energy technologies. Such a tender could offer support to up to 6 000 GWh/year with a deadline for delivery of electricity by 2030. It was decided that further work will be conducted and the specified terms for the tender will be elaborated for approval by the government in November 2023.

The IEA recommends that the analysis supporting the memorandum be made publicly available and notes concerns with the analysis, which estimated that offshore wind is two to three times more expensive than onshore renewables. This might be true when only considering the levelized cost of electricity, but any policy-informing analysis of cost, must also consider the overall system value. Offshore wind speeds are generally higher in magnitude and lower in variability than onshore, which is for example reflected in the higher capacity credit given to offshore wind in US of up to 42%, versus 13-15% for onshore wind. Onshore renewable projects could require more backup thermal generation to meet system security requirements, thus raising costs and emissions. Unless this is reflected in the auction design, offshore projects would be at a disadvantage when trying to compete.

The new tender system should have separate auctions for offshore wind (as has been done in most countries) or rules that will clearly allow competitive offshore projects to win support. The government also needs to clarify how the offshore electricity grid will be developed and who will bear this cost. In addition, the wider and longer term economic opportunities associated with offshore wind development in Estonia should be determined. A post-2030 strategic plan for the sector should be developed, bringing together interconnection policy, economic analysis and export potential analysis.

There are several ongoing efforts to support offshore wind deployment; however, they do not appear to be well co-ordinated with each other. Estonia and Latvia are working on a joint 1 GW offshore wind project (ELWIND), which includes the development of a fourth interconnection that will connect offshore wind farms while supporting electricity trade between Estonia and Latvia. In October 2022, the Estonia and Latvian deployment locations were selected. The aim is to hold an auction in 2026 to select a developer to deploy 700-1 000 MW of capacity by 2030.

Separate from ELWIND, three offshore wind projects have superficies licences and a “first mover” advantage, as they are in the advanced environmental impact assessment stage. The total generation potential of these three projects is estimated at 15 TWh, which is more than enough to meet current and forecasted domestic demand in Estonia. But there are currently no clear plans on how these projects would be connected to Estonia’s electricity grid, which would require major investments in onshore and offshore electricity infrastructure. Additionally, in 2023, the government accepted 44 offshore wind applications for an area covering nearly 1 800 km$^2$ south and west of the island of Saaremaa. In relation to this effort, the government plans to conduct auctions in 2023 that will award building permits for specific areas of the sea floor.

The IEA questions the value of proceeding with an auction for seabed licences without any viable route to market for these potential offshore wind projects and when several other processes are already ongoing that could likely support offshore wind generation well beyond Estonia's current electricity infrastructure capacity. The resources of the government and regulator required for this auction would be better directed elsewhere.

The government should also reflect on the value in progressing with an open-door policy for superficies licences, in the absence of any coherent offshore energy strategic policy or roadmap. It should be borne in mind that countries with advanced offshore renewable energy sectors such as Denmark (and other early-stage countries like Ireland) have taken the decision to suspend their open-door approach to licensing in favour of a strategically aligned, plan-led approach.

Estonia has an opportunity to develop a robust offshore wind framework with sound foundations and avoid the painful and potentially litigious decision of ending an untenable open-door approach in the future, being mindful of the administrative burden involved in running auctions and processing and granting licences to projects which are not viable and will likely not be required to meet energy targets.

It is recommended that the government focus on accelerating the ELWIND project, which is the most advanced in terms of planning, is already supported by the TSO's ongoing investments and supports increased interconnection capacity. The successful realisation of the ELWIND project will provide a model for delivering a commercial offshore project to scale which will thus provide market confidence, and in doing so establish a proven regulatory framework, including in respect to transmission assets.

## A decision on whether to proceed with nuclear power is expected in 2024

The government is examining an option to deploy nuclear generation and aims for a final decision on whether to proceed in 2024. The consideration of a civil-nuclear power programme dates from a November 2020 decision by the Cabinet of Ministers instructing relevant ministries to convene a national Working Party on Nuclear Energy. This led to the establishment of the Nuclear Energy Program Implementing Organization (NEPIO) working group in April 2021 charged with delivering a recommendation on whether to move forward with a nuclear programme. NEPIO plans to deliver a final report to the government by December 2023 on requirements for establishing a nuclear programme, accompanied by draft legislative and regulatory structures.

NEPIO's report will first be evaluated by the government then by the parliament to reach a final decision on whether to move forward on developing nuclear power. Without prejudice to the findings of the final report, the IEA assesses that Estonia's approach to weighing the benefits of establishing a nuclear power programme reflects a deliberate step-by-step approach to the necessary preparatory work to assess the country's readiness and capabilities for embarking on a nuclear power programme.[1] This includes close adherence to the International Atomic Energy

[1] The different areas under evaluation by NEPIO include but are not limited to legal and regulatory readiness, emergency preparedness, preliminary site selection, workforce development, waste management strategies, and safeguards.

Agency's (IAEA) best practices in addressing all 19 nuclear infrastructure issues outlined in the IAEA publication Milestones in the Development of a National Infrastructure for Nuclear Power. The government's decision will also consider the findings from the IAEA's Integrated Nuclear Infrastructure Review (October 2023), during which government officials and IAEA experts will assess Estonia's infrastructure preparedness to develop nuclear power.

Estonia has also prioritised early international engagement as part of its assessment process, notably with the IAEA and the European Union. Additional outreach includes co-operative exchanges with Canada, Finland, Latvia and the United States to exchange information in areas such as radiation, nuclear safety, regulatory frameworks and capacity building. These types of collaborations are instrumental for countries seeking to build the capabilities to develop a new nuclear programme.

Should a determination be made to move forward with nuclear energy, Estonia envisions a timeline for electricity production beginning in 2035, with reactor builds carried out by private sector investors. Current projects include plans by the Estonian energy company Fermi Energia to deploy GE-Hitachi's BWRX-300 small modular reactor. Financing models under consideration consist of a mix of debt, equity and export credits. In terms of equity, capital is expected from investors who are private, institutional or industrial consumers. The Finnish Mankala model has been cited as an example adjusted with 15-year fixed-price contracts.

Should a determination be made to move forward with nuclear energy, it is recommended that the government adopt the recommendations of Phase 1 and continue the stepwise process to complete Phase 2 of the IAEA Milestone approach, while taking all the necessary preparatory actions. In the short term, this should include: amending legal and regulatory frameworks to license, build and operate nuclear power facilities, drawing from best international practices to prepare for the establishment of a competent, independent and transparent regulatory authority; and investing in education, training and capacity building to develop a skilled and knowledgeable workforce at all levels. A determination to move forward would also require the government to continue the site selection process, while engaging with local communities and other relevant stakeholders to build trust and public acceptance; explore financing mechanisms allowing construction risks to be shared with the private sector; and foster international collaboration to access technical assistance, capacity building and knowledge-sharing opportunities.

If Estonia decides to develop a nuclear programme, it will need to quickly build up a robust capacity for nuclear energy regulation and safety. The government estimates that a regulatory authority dedicated to nuclear energy would require 62 full-time staff (up to 83 at peak periods), including 32 staff with specialised skills, significantly more than the current staffing of both energy regulator (24 staff) and the radiation safety regulator (18 staff), neither of which have experience with nuclear power. A nuclear programme would also impact the electricity grid by adding a large source of generation. The nuclear plant site selection process should consider how any needed grid expansion or reinforcement could be co-ordinated with ongoing and planned grid investments to support increased renewable generation and synchronise with the European continental network. The IEA report Nuclear Power and Secure Energy Transitions provides additional insights on the potential policy, regulatory and market reforms that can support safe, cost-effective and timely deployment of nuclear energy.

# Recommendations

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

- Ensure co-ordination between all components of electricity sector planning, including electrification, to clarify to energy sector stakeholders which pathways to climate-neutral electricity generation will be supported by policy, market regulations and incentives.
- Support higher levels of electrification, especially in transport and buildings, and ensure this growth is backed up by sufficient renewable generation and related electricity infrastructure.
- Increase electricity system flexibility through policy and market regulations supportive of smart grids, energy storage, demand-side response, other distributed energy resources, energy service companies, energy communities and non-wire alternatives, leveraging Estonia's high level of digitalisation.
- Develop a streamlined and transparent system for spatial planning and permitting of renewable energy and supporting infrastructure, working with a broad base of stakeholders, and using a whole-of-government approach, to ensure projects can be deployed at the needed pace.

# 3. Buildings

## There is great potential for increasing energy efficiency and reducing emissions from buildings

The building sector has the highest energy demand in Estonia (53% of TFEC in 2021)[2], with residential buildings accounting for 35% of TFEC and service sector buildings for 18% of TFEC. Energy use from buildings directly accounted for 6.5% of total GHG emissions in 2021, mostly a result from individual gas and oil boilers. However, building energy use indirectly drives a larger share of Estonia's emissions through demand for district heating (which still uses some natural gas) and for electricity (which still comes mostly from oil shale; see Chapter 2). When reallocating emissions for buildings' electricity and heat demand, the sector's share of total emissions rises to 46%.

The recent uptake of heat pump sales in Estonia indicates that households are already embracing cleaner energy sources. In 2021, 34% of households already had a heat pump, and in 2022 Estonia was fourth for heat pump sales in Europe, with around 32 heat pumps sold per 1 000 households.

However, Estonia's building stock is relatively old and inefficient, presenting a notable opportunity to reduce energy demand and GHG emissions (both direct and indirect). About 90% of buildings were built before 2000, and there is a low level of information on building energy demand, as less than 7% of buildings have an energy performance certificate (EPC). Of the buildings that have an EPC, more than 80% have an energy performance below class C, reflecting relatively low efficiency.[3]

Estonia's Long-term Strategy for Building Renovation includes a goal to renovate all buildings built before 2000 by 2050. There are about 141 000 such buildings (54 million m$^2$); 100 000 (14 million m$^2$) are private houses, 27 000 (22 million m$^2$) are non-residential buildings and 14 000 (18 million m$^2$) are apartment buildings. Apartment owners are organised in apartment associations by law, that are central point of contacts for renovation programmes. This structure presents an advantage for performing deep, whole-building renovations, but can slow down the decision-making process. Access to funding is mostly affected by the value of real estate prices in certain areas.

Estonia's national long-term development strategy (Estonia 2035) includes targets to reduce building sector energy demand by 12% and total GHG emissions by 42% by 2035 (versus 2019 levels). However, building sector energy demand increased

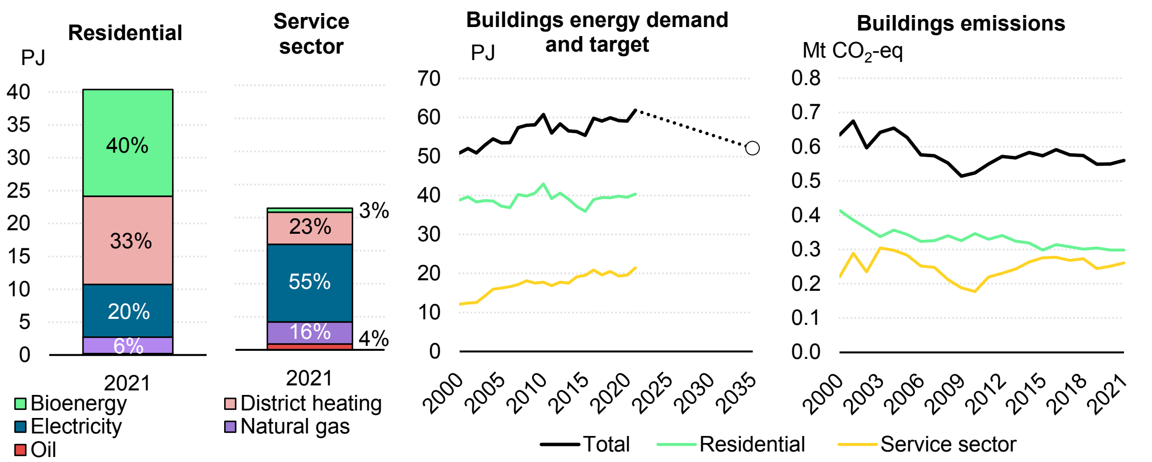
[2] Energy use for the operation of residential and commercial and public service buildings.
[3] Energy demand per square metre of each energy class varies with the type and size of the dwelling. For detached houses with a heated area between 120 m² and 220 m², class C corresponds to energy demand between 141 kWh/m² and 160 kWh/m² per year.

by 4.5% between 2019 and 2021, and direct emissions from buildings have not decreased significantly since 2009. The government should consider establishing a sectorial target for decreasing GHG emissions in the buildings sector, clarifying how the sector contributes to meeting the overall GHG emissions target. This could be done in the context of the development of a national climate law (see Chapter 1).

Energy demand in the buildings sector is mainly covered by electricity, district heating and bioenergy, each accounting for about one-third of buildings' TFEC. Estonia's building energy demand has one of the lowest shares of natural gas (9.5% in 2021, compared to the IEA average of 35%) and oil (2% in 2021, compared to the IEA average of 10%).

The energy mix is significantly different for residential and service sector buildings (Figure 3.1). Most of residential building energy demand comes from space heating (71% in 2021), which is mainly covered by bioenergy (almost all forest biomass, 50%) and district heating (37%) (Figure 3.2). Energy demand from the residential sector fluctuates depending on the fluctuating yearly demand for heating. In contrast, service sector building energy demand has been increasing (by 27% between 2011 and 2021), with higher demand for electricity and natural gas.

**Figure 3.1 Energy demand and emissions from buildings in Estonia**



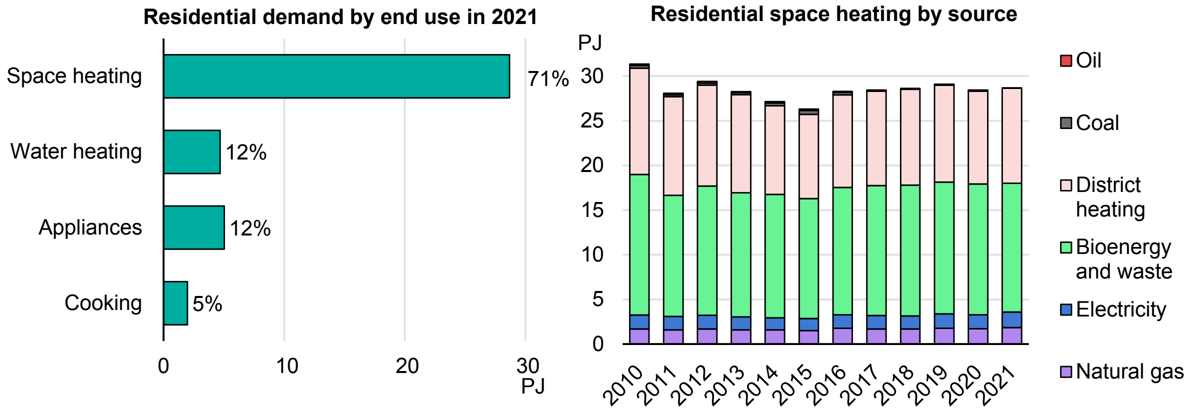



Source: IEA (2023), World Energy Balances.

## Switching from fossil fuels to bioenergy is decarbonising district heating supply, but electrification should increase

A large part of building heating demand is covered by district heating (37% in 2021). The fuel mix of Estonia's district heating sector has shifted away from fossil fuels, with decreasing shares of natural gas, oil shale, oil and peat and increasing shares of solid biomass and waste (Figure 3.3). This shift reduced the carbon intensity of district heating supply by more than 50% between 2008 and 2021. The share of renewables in heating and cooling has also increased significantly, reaching 61% in 2021, close to the 63% target set in the NECP for 2030. Further penetration of renewables in heating and cooling can be achieved by increasing electrification through heat pumps and increasing the share of renewables in electricity generation.

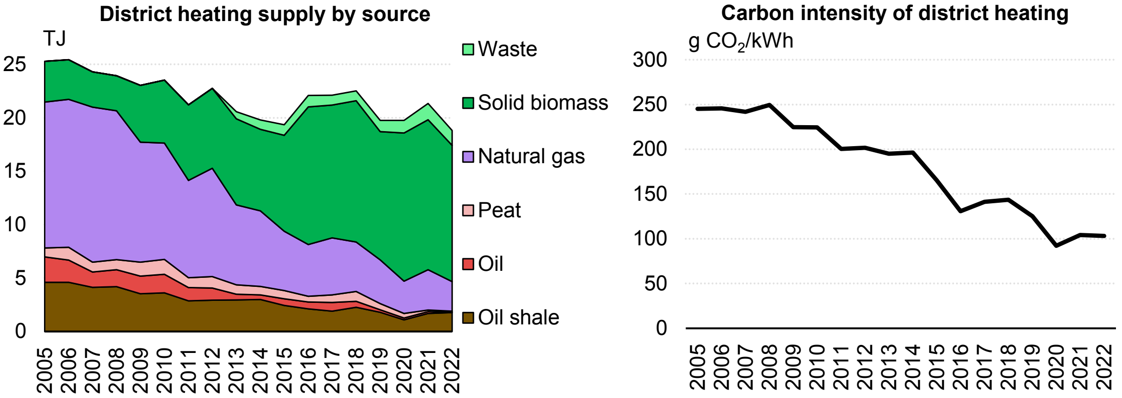
**Figure 3.2 Residential energy demand by end use and space heating source in Estonia, 2010-2021**






Source: IEA (2023), Energy End-Uses and Efficiency Indicators.

**Figure 3.3 District heating supply by source and carbon intensity in Estonia, 2005-2022**






Source: IEA (2023), World Energy Balances.

Estonia aims to complete the transition to carbon-neutral heating and cooling by 2050. A study carried out in 2022 identified five scenarios to achieve this goal with impact assessments and action plans. The scenarios are business-as-usual, all-electric, district heating and cooling, local heating and cooling, and technology-neutral. The study highlights that stricter sustainability criteria and higher biomass prices require a more diverse energy mix to achieve carbon-neutral heating.

The study recommends following a mix of the all-electric and district heating and cooling scenarios to reduce biomass demand while maintaining a more balanced electricity demand. Renovation of the building stock is expected to play an important role in reducing energy demand. The strategy also relies on boosting the deployment of heat pumps, the development of low-temperature district heating networks, heat storage solutions, and increased heat production from solar and geothermal sources. It is estimated that around EUR 19 billion will be needed between 2022 and 2050 to achieve carbon-neutral district heating, much of which will be spent on renovating buildings.

Estonia should boost the current positive trend of heat pump deployment and support the electrification of large heating systems dependent on fossil fuels and in the longer run a transition from biomass to electric heating. Large heat pump installations for commercial buildings or district heating can also exploit waste heat and can be more efficient if using ground- or water-sourced heat pumps. An operator of the Tallinn district heating network has a project to build a heating system powered by a heat pump with a seawater source. The IEA encourages the government to support such pilot projects that demonstrate clean technologies for heating at scale. The IEA also commends Estonia's participation in the District Heating and Cooling technology collaboration programme (TCP), providing opportunities for Estonia to connect with international experts and share best practices.

A pilot programme financed with EUR 8 million from the EU Recovery and Resilience Facility supports the use of energy storage to reduce the demand for fossil fuels at peak times. It provides financial support and aims to accelerate the use of heat or electricity produced and stored from renewable energy sources, increase the share of renewable energy (and electricity) in district heating, and reduce the use of fossil fuels. The development of thermal storage solutions should be further promoted, as it is an efficient solution that provides flexibility to both heating and electricity systems, especially as the electrification of heating and the share of variable renewable electricity are expected to increase. Increased use of thermal storage would help Estonia to reach its goal for 100% of electricity demand to be covered by renewables while ensuring the secure and efficient operation of the electricity and heating systems. Finland has demonstrated notable success in deploying thermal storage systems linked to district heating in Helsinki and Vaskiluoto to reduce heating sector emissions and costs while boosting renewable integration.

## Information, incentives and regulation should be improved to promote building renovation at a large scale

Estonia's long-term strategy for buildings renovation estimates the cost of renovating the entire building stock to be around EUR 30 billion (assuming a renovation cost of approximately 450 EUR/m$^2$). Improving energy efficiency in buildings requires a comprehensive package of policies, including detailed information on the building stock, information campaigns, and well-designed incentives and regulation. Estonian policy and measures include best practices in some areas (for example, the digitalisation of buildings' construction information), while presenting opportunities for extending and enhancing investment programmes for apartments and single-family houses and achieving the goals of its long-term strategy.

## Building stock information and information campaigns

Less than 10% of buildings in Estonia currently have a valid EPC. Better information on the energy performance of the building stock would help policy makers and building owners to identify opportunities for energy efficiency improvements. Estonia is developing a methodology to calculate dynamic EPCs based on actual metered energy demand, exploiting the country's high penetration of smart meters and high level of digitalisation, including the e-construction platform with digital twins of Estonia's building stock (see Box 3.1). Estonia plans to start developing dynamic EPCs in 2024 with the first version ready by 2025. The IEA strongly commends Estonia's efforts to increase the detail and transparency of its building stock energy data and encourages the government to support all buildings receiving a dynamic EPC in the near future.

The IEA also commends Estonia for developing the BuildEST project, which provides a platform for the main stakeholders involved in building renovation to share information, increase capacity and develop the necessary tools. The potential of this platform could be enhanced by further involving low-income households and raising their awareness of energy renovation programmes. More generally, given the high prevalence of owner-occupied multi-family dwellings, the IEA recommends strengthening the capacity of homeowners' associations and co-operatives to streamline the decision-making process for undertaking building renovations. This can be done through targeted information campaigns and workshops to engage homeowners on the issues of comfort and energy costs.

## Incentives

The main programmes providing incentives for building renovation provide grants that cover a share of the costs for renovating apartment buildings and single-family homes. The programme for apartment buildings provides grants for buildings built before 2000 that cover 30-50% of the costs of deep renovations, depending on where the apartment is located in Estonia and the type of work undertaken, with lower percentages for regions with higher average incomes. This programme also gives grants covering 30-50% of the cost of replacing gas-fired or electrical heating systems with systems using renewable energy or with a connection to a district heating network.

The programme for single-family homes provides grants covering 20-50% of the expenses, also depending on the location and type of work undertaken. For both programmes, the grant funding related to construction is provided once the renovation project is completed and the building must receive an EPC showing an energy class of at least C or higher.

The renovation programmes are run by the Estonian Business and Innovation Agency and have a combined budget of EUR 366 million funded by EU Structural Funds and EUR 28 million by the EU Recovery and Resilience Facility. The plan is to award this funding in tranches through regular openings of first-come, first-served applications. The first round of grants for apartment buildings opened in March 2023 and closed on 10 April 2023 once the budget of EUR 80 million was fully allocated. The grant for single-family homes is currently being prepared and will be opened later in 2023 and financed with the EUR 28 million from the EU Recovery and Resilience Facility.

The government estimates that the current budget of EUR 366 million will support the refurbishment of less than 5% of buildings built before 2000 and at the current rate of expenditure could be fully allocated in just a few years. The government should examine options to ensure the long-term stability of funding for renovations to provide clarity to the market and encourage the creation of ESCOs, which could support cost-efficient renovation of buildings at a larger scale.

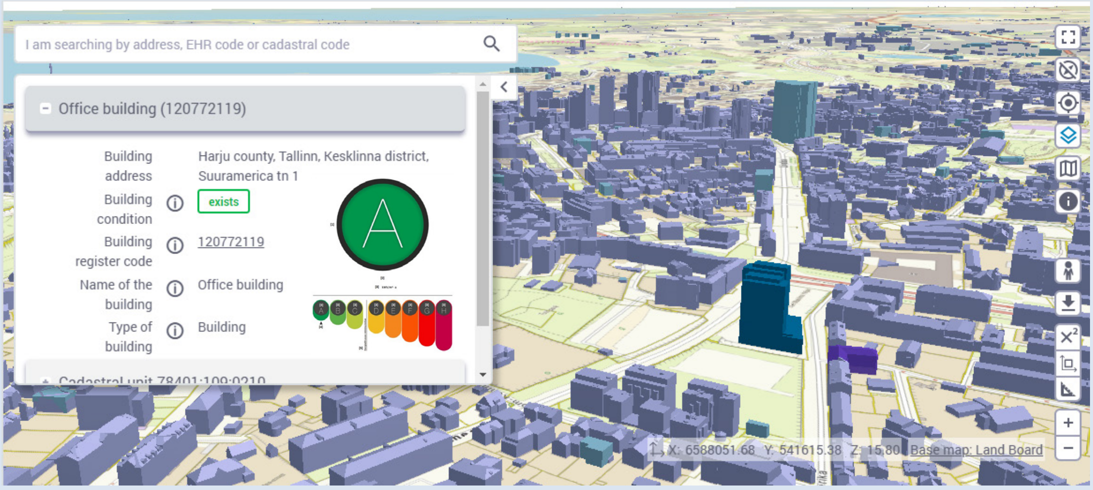
**Box 3.1 Digital twin and dynamic energy performance certificates**

Estonia's economy is highly digitised. Around 99% of government services are available online, including tax returns, residence registration and voting; it takes just a few hours to start a business; and digital signatures have led to savings equivalent to 2% of gross domestic product. Much of the energy demand is monitored by smart meters, which can monitor electricity, natural gas and district heating demand. To extend the benefits of digitalisation to the construction sector, the Estonian government has published a Long-Term View on Construction 2035, which includes the development of an e-construction platform. The platform aims to centralise building data and increase construction sector efficiency and productivity.

As part of the e-construction platform, an online application (building registry) allows users to navigate through Estonia's buildings and access the digital twin of each physical building (Figure 3.4). The digital twin collects information and documents related to the building, including building permits, technical indicators (including the type of heat supply) and the EPC. It also provides access to information about utility networks (electricity, district heating, Internet, etc.), survey documents (including flood risks), downloadable 3D data, allowing the study of building shadows (for example, for solar PV installation). The user can navigate the registry in a way similar to a digital map, such as Google Maps.

Once the project of developing dynamic EPCs is in a more advanced stage, the government should consider linking them with the e-construction platform, increasing transparency on the energy performance of buildings, and supporting better planning and the realisation of energy efficiency renovations.

**Figure 3.4 Screenshot from Estonia's e-construction platform showing building performance information**




IEA. CC BY 4.0.

Source: Livekluster (2023), [Estonia Building Register](#)

The Estonian Business and Innovation Agency also provides loans and loan guarantees, which together with grants form a complete financial service. From the EUR 366 million from EU Structural Funds, EUR 35 million were allocated to provide loans to those apartment associations that will not get a loan from private banks due to the property value.

Public funding should be complemented by private investment. To this end, the establishment of revolving loan funds should be supported to enable multi-family building renovation projects. A revolving loan fund reallocates money for new loans as it is repaid by borrowers, creating a revolving cycle of lending and repayment. Public funding should also encourage the achievement of the highest energy performance class, possibly with higher support for measures that achieve an energy class higher than C. The high investment cost to achieve deep renovations should not prohibit lower income households from accessing these programmes. The programmes currently cover a different share of the investment depending on the location of the building (30% in Tallinn and Tartu, 40% in their surroundings and 50% elsewhere). The government should consider refining the regional differentiation of the support, targeting higher support to areas with lower average incomes.

Estonia should support the creation of integrated home improvement programmes, so-called one-stop shops, which provide technical assistance combined with advice on financing, as these are key to scaling up building renovation. Such programmes can provide independent advice and guide homeowners through the renovation process, including assistance with administrative paperwork. For example, ProjectZero in the city of Sønderborg, Denmark, has launched several initiatives targeting energy inefficient buildings, ranging from training tradesmen in energy advice and guiding homeowners through potential renovation projects to introducing accessible loans to finance energy-saving measures and co-ordinating communication and monitoring efforts among stakeholders in the construction and renovation market. Of the 1 600 homeowners who received advice, 60% of them subsequently invested an average of around EUR 20 000 in energy renovations.

Deep renovation of buildings is profitable in the long term, but long refinancing periods reduce the attractiveness of deep renovation and make their financing difficult, especially in the case of multi-family houses, where complex ownership models and decision-making processes are a barrier to implementing energy efficiency projects. Such projects can be financed by ESCOs, which carry out renovations in multi-family buildings on the basis of energy performance contracts. Such a contract is a financing mechanism in which the receivables consist of cost savings achieved through the improved energy efficiency of buildings. The ESCO finances the renovations through a commercial bank and enters into a contract with the building owners. However, banks may be reluctant to lend to energy efficiency projects due to perceived risks. Financing risks can be mitigated by providing repayment guarantees to banks from a third party, as in the case of the Latvian Baltic Energy Efficiency Facility. Estonia should promote the creation of an ESCO market, set up the regulatory framework for the deployment of energy performance contracts and support the creation of repayment guarantee facilities. Investment barriers could also be lowered by facilitating access to loans with repayment deferred to when energy savings are achieved, and/or seasonal when energy costs are lower.

## Regulation

Building sector regulations are driven by EU directives and require new buildings to be nearly-zero energy buildings, using renewable solutions wherever possible. However, buildings undertaking major renovations must achieve an energy performance of at least class C. There needs to be a clear timeline or a roadmap for progressively tightening the requirement for buildings undergoing renovation to achieve a class A or near-zero energy class building energy performance. Such a roadmap would inform the industry and allow it time to adapt its refurbishment practices in time for, or even before, a new regulatory update comes into force. Such an approach has proven successful in Denmark, for example.

Energy-efficient renovations could also be stimulated by standardising and simplifying procedures and required documentation to facilitate access to government subsidy programmes. A number of such solutions have been implemented in Lithuania, where public procurement agencies have introduced shorter procedures and standardised templates (e.g. for a construction contract). The Housing Energy Efficiency Agency created simplified application forms and reduced the length of the administrative process.

Under EU requirements, Estonia is obliged to renovate 3% of the total floor area of such buildings, corresponding to about 24 000 m² per year. The government estimates that the actual rate of renovation between 2021 and 2026 will be around 14 000 m² per year, or around 60% of the required volume. The main obstacles the government has identified to fulfil the obligation are the rapid increase of building prices, decreasing the number of buildings that can be renovated with the allocated budget; repeated budget cuts; and the challenge to renovate certain types of public buildings that require higher investment. The government should ensure that a sufficient budget is allocated for renovating public buildings. ESCOs could be involved in the renovation of public buildings, also through energy performance contracts. Standardised energy performance contracts, guidelines for their preparation and protocols for monitoring would also help them become a more common tool in Estonia.

# Recommendations

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

- Ensure sufficient long-term funding for building renovations, increase the level of support when higher energy savings are achieved and prioritise low-income households, for example by refining the regional diversification of subsidies, introducing energy performance contracts and facilitating access to loans by providing guarantees to banks.
- Support the uptake of heat pumps for individual and district heating systems, the deployment of thermal storage, and the use of waste heat.
- In co-operation with BuildEST, improve the outreach to low-income households and increase the targeting of renovation assistance to these groups.

# 4. Transport

## Estonia aims to transition to clean multimodal transport, but remains reliant on oil and road vehicles

Reducing transport emissions will be essential to achieving Estonia's overall climate and energy goals. In 2021, the transport sector accounted for 30% of Estonia's energy demand (TFEC) and 28% of GHG emissions. Most transport sector energy demand comes from road transport (97% in 2021), with only small shares from rail (1.8%), domestic shipping (0.7%) and domestic aviation (0.2%). Oil products cover most transport energy demand, 91% in 2021, mostly diesel (66%) and gasoline (24%) (Figure 4.1).

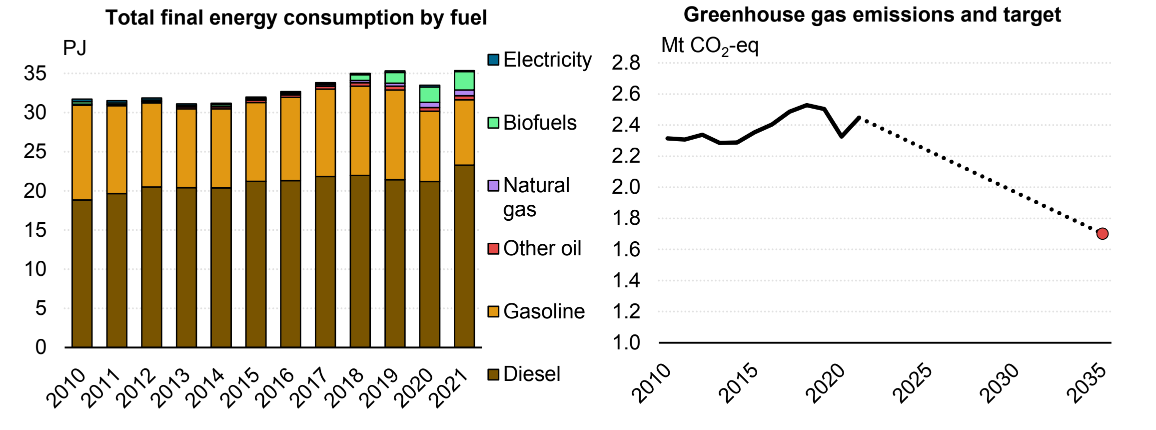
Estonia's goals for the transport sector are set in the Transport and Mobility Master Plan for 2021-2035. The plan focuses on reducing the transport sector's environmental impact to contribute to the achievement of the climate neutrality goal by 2050. It defines an interim goal to reduce transport sector GHG emissions to 1.7 Mt $CO_2$ in 2035. The plan calls for the introduction of low-carbon fuels in all modes of transport and supports modal shift, with the goal to increase the share of workers using public transport, cycling or walking from 38% in 2018 to 45-55% in 2035. The plan also notes that transport policy needs to follow the polluter-pays principle more closely.

Estonia is updating its transport policy to reflect increased EU targets for GHG emissions reductions and renewable energy in transport. This presents a good opportunity to increase ambition in certain areas, for example reducing the use of private cars in urban areas and electrifying road transport. More work is needed, as Estonia has seen a decline in commuting via public transport, walking and cycling, while the rate of car ownership has increased to one of the highest levels in the European Union.

## Transport greenhouse gas emissions peaked in 2018, but further reductions are limited by an inefficient vehicle fleet

Transport energy demand and emissions increased overall from 2013 to 2021, with a significant drop in 2020 due to the Covid-19 pandemic (Figure 4.1). Overall growth in transport energy demand and emissions is linked to an increase in the use of private cars and road freight. Thanks to the introduction of a biofuels mandate and a biomethane subsidy in 2018, Estonia has seen an increasing share of bioenergy in transport, which reached 6.7% of transport TFEC in 2021. Thanks to the increased uptake of biofuels, transport sector oil demand and GHG emissions peaked in 2018. However, the old age and relative inefficiency of Estonia's vehicle fleet present an opportunity to significantly reduce oil demand and GHG emissions.

**Figure 4.1 Transport sector energy demand and emissions in Estonia, 2010-2021 and target**






Sources: IEA (2023), World Energy Balances; Estonia, Ministry of Economic Affairs and Communications (2020), Transport and Mobility Master Plan for 2021-2035.

In 2021, Estonia's passenger car fleet was the second-oldest in the European Union (after Poland), with one-third of vehicles 20 years old or older. Passenger cars in Estonia also have bigger than average engines. In 2021, 10.8% of gasoline-powered cars had an engine larger than 2 000 $cm^3$, the third-highest share among EU countries after Liechtenstein and Switzerland; 18.3% of diesel-powered cars had an engine over 2 000 $cm^3$, the third-highest share after Albania and Latvia. The old age and large engine size result in notably higher average emissions. In 2021, average $CO_2$ emissions from Estonia's newly registered passenger cars was 142.6 grammes of carbon dioxide per kilometre (g $CO_2$/km), the second-highest in the European Union and much higher than the EU average of 114.7 g $CO_2$/km and the EU target of 95 g $CO_2$/km for 2021-24.

## Price signals should drive the uptake of low-emission and electric vehicles and cleaner transport options

Price signals in Estonia are not sufficiently targeted to encourage the purchase of low-emission and electric vehicles, and a modal shift away from private cars. Estonia is the only IEA country without vehicle taxation at vehicle purchase or annual registration. The IEA commends the introduction of a road use charge for heavy goods vehicles in 2018 that considers weight and emissions. The IEA encourages the government to quickly introduce vehicle taxation and notes that this provides an important opportunity to encourage consumers to adopt cleaner transportation options.

It is recommended that taxation at the vehicle purchase and annual registration be linked to GHG emissions levels and/or energy efficiency standards. Most EU countries link vehicle taxation at purchase and annually to $CO_2$ emissions, as these data are available for most vehicles. Given Estonia's older vehicle fleet, it could be beneficial to include a widely available or easy alternative measure, such as vehicle weight, engine size or power for vehicles that lack clear data on $CO_2$ emissions, to ensure that all vehicles are taxed in accordance with their environmental impact.

The introduction of vehicle taxation presents an opportunity to consider how other transportation-related taxes and fees could be updated to encourage cleaner transportation options. This could include an update of the road use fee that gives more weight to emissions, working with municipalities to introduce limitations for high polluting vehicles to access o city centres. Excise duties for diesel, gasoline and other fossil transport fuels should be set at a level that reflects their impact on the environment and climate, and excise duties for electricity (especially if used in transport) should be set to encourage the adoption of EVs (see Chapter 1).

In addition, updating the tax treatment of companies presents a notable opportunity to reduce emissions and support the introduction of low- and zero-emission vehicles. Company cars account for more than half of new cars purchased in Estonia and tend to be larger and have higher $CO_2$ emissions per kilometre. Company cars benefit from a value-added tax (VAT) deduction of 50-100% regardless of the vehicle's environmental impact. The government should adjust company car tax treatment to encourage the purchase of low- or zero-emission vehicles, which is a common practice in many IEA and EU countries. Portugal offers VAT deductions only for battery electric and plug-in hybrid electric company cars. Belgium uses a formula for calculating company car tax deductions based on $CO_2$ emissions, with the highest deduction for zero-emission cars and the lowest for the most polluting cars. Encouraging private companies to purchase low- and zero-emission vehicles would also help to increase the supply of these vehicles on Estonia's used vehicle market.

Most privately purchased cars in Estonia are used vehicles, many of which are inefficient imported vehicles with higher emissions. Several EU countries, including Denmark, Poland, Spain and Sweden, have introduced excise duties that aim to limit the import of older/ inefficient vehicles. In several cases, these excise duties are linked to environmental performance, including $CO_2$ and/or local pollutant emissions or engine size. Estonia should introduce a similar price signal to reflect the high environmental impact of importing older/inefficient vehicles.

Many IEA and EU countries provide the most favourable tax treatment to EVs as life cycle assessments show that EVs' GHG emissions are much lower than those of internal combustion engines, even in countries with carbon-intensive electricity generation. It is recommended that Estonia's vehicle taxation provide favourable treatment for EVs to help increase their adoption, especially given the country's goal to cover 100% of electricity demand with renewable energy by 2030.

The government should introduce a scrappage scheme under which vehicle owners receive a subsidy to purchase an efficient car if they scrap an older inefficient car. It is critical that the scrapping scheme include strong rules that focus on removing the most inefficient vehicles from the road while supporting the purchase of newer high-efficiency vehicles. For example, the CARS programme in the United States included a fuel economy standard that required the newly purchased vehicle to be much more efficient than the scrapped vehicle. Other countries, such as France and Lithuania, created schemes that offer incentives for scrapping a car and purchasing an electric bicycle.

In relation, Estonia has a large number of vehicles that are no longer in use but remain on the vehicle registration list. This appears to result from the relatively high cost that must be paid to properly dispose of the vehicle and is likely resulting in improper and environmental harmful disposal of old vehicles. The government should examine what changes can be made to ensure that vehicles reaching end-of-life are properly disposed of, noting that the oldest vehicles are often owned by low-income households.

Estonia should examine how increased revenue from vehicle-related taxation could be directed to low-income households to help them play a role in the clean energy transition (in the transport sector and beyond). Options could include lower tax rates/increased subsidies based on income. Recognising the importance of the used vehicle market to low-income households, several countries, such as the Netherlands and the United States, have introduced EV subsidies or tax credits for used EVs.

The IEA notes that Estonia's current transportation system often requires the use of private vehicles to commute to work and school and that having a reliable vehicle is especially critical for low-income households. As such, adequate consideration should be given to low-income households when designing tax and fiscal policy to encourage a transition to clean transportation options. Estonia is already considering this in policy design; for example, subsidies for EVs have a price cap to ensure limited public funds do not go to individuals who could afford an EV without state support.

Estonia's fiscal strategy in the transport sector should be well-defined in a roadmap outlining a timeline of how minimum standards and GHG emissions-related charges will change over time. This would set consumer expectations, provide certainty to the market and influence behaviour.

## Modal shift and public transport are pivotal to reduce emissions in the transport sector

Estonia's central goal in transport policy is to reduce dependence on the use of private cars. Estonia was one of the first countries to experiment with offering free public transport, with the goal of shifting people away from private cars. Free use of public transport was introduced in Tallinn in 2013 and expanded to cover most public buses in Estonia in 2018. In 2021, the National Audit Office of Estonia released the result of an extensive review of public transport, which noted that the free use of public transport had not led to the desired increase in public transport ridership or reduction in the use of private cars. At the same time, the review raised concerns over the reduction in funding resulting from free transport at a time when the cost of operating the system is increasing.

The IEA encourages the government to find a funding and planning model for public transport that ensures adequate revenue and allows expanding public transport to the areas and communities the most in need (including high-density urban areas but also public transport solutions for rural areas currently reliant on private cars). Low- or zero-cost public transport could be maintained for low-income households.

The Estonian government is using different instruments to incentivise the shift from private transport to a seamless multimodal system combining several modes of transport and movement. In April 2022, the Northern Estonia region introduced a 30-day joint ticket, which allows the use of different modes of transport with just one ticket in both Tallinn and Harju County (including trains and county lines). A support scheme also finances the development of the main networks of bicycle paths and parking lots in major Estonian cities and their urban areas, with a budget of EUR 56 million from the European Cohesion Fund. The IEA commends the Estonian government for these initiatives and encourages Estonia to continue pursuing efforts to remove barriers to the shift to sustainable mobility.

The urban area of Tallinn and its county (Harju County) account for around half of private car trips in Estonia. Many European cities have set low-emission zones (LEZs) in city centres, with positive results in terms of reducing local pollution. For example, the London Ultra LEZ has reduced $NO_2$ by 32 µg/m$^3$, traffic by 9% and $CO_2$ by 13%; the Berlin LEZ has reduced diesel particles by 58% and $NO_2$ emissions by 20%; the Milan Area C LEZ reduced $PM_{10}$ by 18%, $NO_x$ by 10% and $CO_2$ 22%. LEZs in Stockholm and Cologne also reduced the local concentration of pollutants. The government should co-operate with large municipalities to introduce LEZs in the main urban areas to reduce local pollution and emissions and encourage commuters to use public transport. Funding for transport infrastructure should prioritise public transport and active mobility over cars.

Revenues from increased transportation taxation/fees could be used to improve or expand specific public transport lines and walking and cycling infrastructure, increase commuting alternatives to private cars, and identify specific corridors where the provision of alternatives to cars would be most needed and/or could improve access to goods and services for people living on the periphery of urban areas.

## Rail electrification is underway and private car electrification lags behind

Estonia has a relatively limited rail network but is making major investments to expand the use of rail for passenger and freight transport. This includes targets to electrify the railways and increase maximum train speeds to 160 km/h. In 2021, only 7.4% of total rail energy demand was covered by electricity compared to the IEA average of 30%.

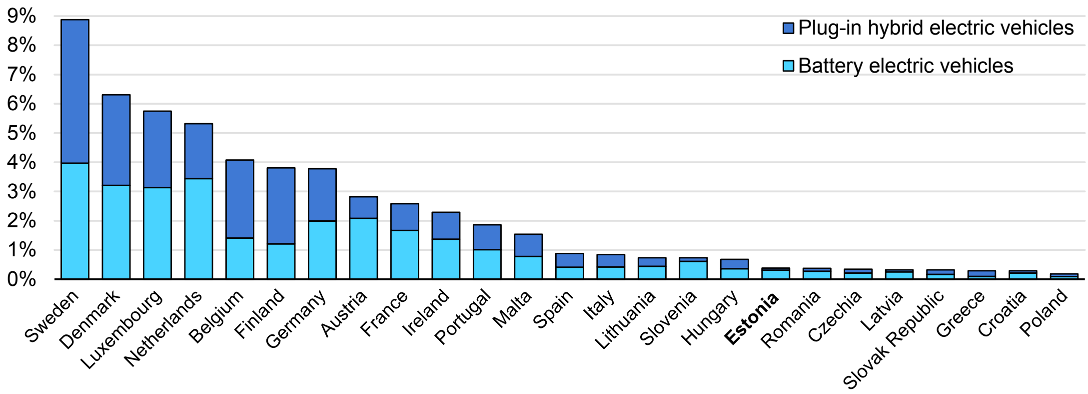
The IEA strongly commends Estonia's ambitious plan to boost the electrification of rail. An important ongoing project is the electrification of the Tallinn-Tartu and Tallinn-Narva railways. The project started in 2023 and will be completed by 2027, with a budget of around EUR 280 million. In addition, Estonia has purchased

16 new electric locomotives, which will enter into service as early as 2025. There is also an EU-funded project to develop electric trams in the Tallinn region. The project has a budget of EUR 40 million and aims to improve accessibility, increase competitiveness and reduce connection times. The self-financing rate of the local government is 30% of the eligible costs.

Rail Baltica is a major international rail infrastructure project funded by the European Union and the Baltic states. It will create high-speed passenger and freight lines in Estonia, Latvia and Lithuania, connecting the region to the rest of Europe via Poland. The project has a budget of around EUR 6 billion and is expected to be completed in 2030, with some sections of the railway potentially operating in 2028.

The electrification of transport should also focus on private cars, which are the largest contributor to Estonia's total transport emissions. EV deployment in Estonia is limited: the number of EVs only grew from 56 in 2012 to 3 633 in 2022. However, the shares of EVs in new sales and in the total vehicle fleet are very low (Figure 4.2). In 2022, EVs reached 3% of new sales (compared to the EU average 19%) and 0.43% of the total fleet (compared to the EU average of 2%).

**Figure 4.2 Share of electric vehicles in the total passenger car fleet in European Union countries, 2022**






Source: IEA analysis based on European Commission, European Alternative Fuels Observatory (2023), EAFO.

Estonia's latest programme offering subsidies for EVs started in February 2023. It provides EUR 4 000 for the purchase of a battery electric vehicle with a maximum price of EUR 60 000 (excluding VAT). The programme also supports the purchase of electric bicycles (covering 50% of their price up to EUR 1 000), light commercial EVs with a maximum price of EUR 80 000 (excluding VAT) and hydrogen vehicles with no price limit. The programme has a budget of EUR 8.5 million, which comes from ETS revenues. As of July 2023, 15% of the total budget had been used, for the purchase of 264 cars or light commercial vehicles and 95 bicycles.

The budget of the current EV purchase scheme will allow the share of EVs in the vehicle fleet to increase to around 4%. The government plans to have 100 000 EVs (around 20% of the total fleet) on the road by 2030. The government should increase the EV subsidy budget to achieve a level of EV penetration that supports a significant reduction in emissions from the transport sector. Such subsidies should prioritise the purchase of EVs that are used more intensively (e.g. taxi fleets, light commercial vehicles for urban delivery or other municipal operations, company cars), and should be gradually phased out as the share of EV sales increases and EV prices decline.

The government should also lead by example and adopt ambitious targets for all government-owned vehicles to be EVs in the near future, including working with regional and municipal governments to transition their vehicle fleets to 100% EV.

Estonia's bus fleet is mainly fuelled by natural gas. This type of fleet, combined with plans to increase domestic generation of biomethane, has lower emissions than diesel-fuelled buses. However, Estonia should invest in electrifying its bus fleet, as this would decrease the sector's demand for biomethane and allow the country to use it for applications that cannot be electrified (such as some industrial processes). Electric buses also have lower $CO_2$ and $NO_x$ emissions, and a lower total cost of ownership.

Increased adoption of EVs will also require a notable expansion of the EV charging infrastructure. In Q1 2023, Estonia only had 286 publicly accessible EV charging points. The government should support the expansion of the EV charging point network, especially for households that do not have their own parking space. The IEA commends the government for supporting the installation of EV charging when buildings are renovated. Support should also be given to local authorities to install public charging points. The government should also consider requirements for all new buildings to support the installation of EV charging.

## Smart electric vehicle charging provides opportunities for flexibility and higher integration of renewable generation

As a successful development of electric mobility will increase electricity demand, adopting smart EV charging strategies will reduce the level of investment in electricity infrastructure needed to accommodate this demand while boosting electricity system flexibility and supporting higher integration of variable renewable generation. The IEA has developed a manual for policy makers on the grid integration of electric vehicles, with recommendations on four steps to be followed in the development of electric mobility: 1) prepare institutions for the shift to electric mobility; 2) assess the impacts of electric mobility on the electricity sector; 3) deploy measures for grid integration; and 4) improve planning practices. This report can provide value to Estonia today, as it is in the early stages of EV uptake, but also in more advanced stages of electric mobility deployment.

Estonia's Transport and Mobility Master Plan 2021-2035 does not contain targets for EV deployment or a proper assessment of the interaction between EVs and the electricity sector. The government should better identify the role of a more electrified transport sector for achieving climate targets and supporting the electricity sector. For example, Chile's national electromobility strategy includes specific targets for the deployment of EVs and the expansion of charging infrastructure, including its integration with the grid.

Estonia can benefit from other countries' experiences by planning early the integration of EV charging. Unmanaged EV charging can have a significant impact on the electricity network, especially through large peaks in electricity demand if consumers start charging vehicles at the same time (often in the evening when returning from work when demand is already peaking). Beyond passenger cars, deploying larger electric vehicles, such as trucks and buses, can significantly compound the impacts due to their usually higher charging power requirements. Smart charging offers opportunities to solve these challenges and add benefits to the system, especially in the planned future electricity mix with high shares of variable renewables. EV charging, if properly managed, could help better integrate variable renewables, for example by helping shift charging load to when renewables are most available.

Load shifting of EV charging to more favourable times of the day (generally at home, nighttime charging for wind generation and at work, daytime charging for solar PV) can increase the integration of renewable generation and boost the GHG emissions reduction benefits of electric mobility. An IEA study of Korea's electricity market for net zero shows that flexible EV charging of 30% of the expected EV fleet in 2030 could reduce operating costs and lead to emissions reductions, also providing a better business case for renewable energy developers by reducing curtailment. Estonia should invest in integrated and smart EV charging infrastructure to support and take advantage of the 100% renewable electricity target by 2030. Instruments to encourage EV charging to optimal times include dynamic pricing or controlled/automated charging, which can be achieved via communication with EVs and/or EV chargers. Estonia should also support third-party access, standardisation and interoperability of EV infrastructure to reduce the barriers to consumer adoption.

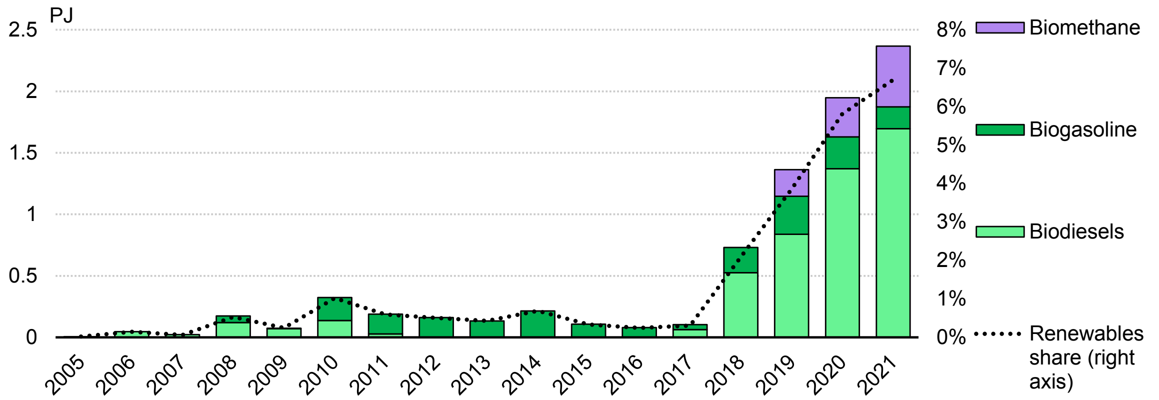
On the institutional side, the creation of the Ministry of Climate should be taken as an opportunity to break down silos in planning and policy making and align transport stakeholders with those in the energy and electricity sector. For example, this includes synchronising the increase in targets for EV uptake and variable renewable generation and co-ordinating the roll-out of charging infrastructure with electricity grid expansion.

## Impressive growth of biofuels displaces oil demand

Estonia has seen a remarkable increase in the share of renewable energy in transport, growing from 0.3% to 6.7% between 2017 and 2021 (Figure 4.3). This increase is due to the introduction of a biofuel mandate in 2018, which requires a minimum share of biofuels in gasoline and diesel used for road transport: 3.1% from May 2018 and 6.4% from April 2019. In 2020, the mandate was updated to require a minimum biofuel share of 7.5% from 1 January 2022, with at least 0.5% coming from advanced biofuels. The update also set a cap of 4.5% on the share of first-generation biofuels (derived from food/feed crops) that can count towards the target. The 2020 update to the biofuels mandate allows obligated suppliers to use biomethane or electricity to meet the 7.5% requirement. The IEA commends Estonia for rapidly increasing the share of biofuels in its transport sector (including a significant share of biomethane) in just four years and for the updates to the mandate, which should increase production and demand for biomethane and encourage fuel suppliers to invest in charging.

The increase of renewables in transport has also been supported by a subsidy for the use of biomethane introduced in 2018. If biomethane is used as a transport fuel, the subsidy is 100 EUR/MWh minus the average market price of natural gas for the current month. If biomethane is used for other purposes via the gas network, the subsidy is 93 EUR/MWh minus the average market price of natural gas for the current month. The subsidy is supported with a total budget of EUR 38.5 million and is available through the end of 2024, or until the funds are exhausted. Biomethane in transport is also supported by an EU-funded programme providing subsidies to biomethane-powered public buses and to biomethane refuelling stations.

**Figure 4.3 Renewables by source in transport in Estonia, 2005-2021**






Source: IEA (2023), World Energy Balances.

The revision of the EU Renewable Energy Directive set a new 14.5% emissions reduction target for the transport sector, or a 29% share of renewables in final energy consumption of transport and increased the sub-target for advanced biofuels, along with updated mechanisms to promote electromobility. Estonia needs to take significant additional measures to meet this increased ambition.

The government should consider changing the renewable energy targets for transport to a life cycle GHG intensity target. A GHG-based intensity requirement would reward those fuels with lower GHG emissions, rather than focusing on volume. The government should also consider setting a small but increasing target for sustainable aviation fuels including, but not limited to biofuels, in line with the goals for increased use of sustainable aviation fuels under the ReFuel EU Aviation initiative.

# Recommendations

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

- Promote more efficient vehicles through fiscal policy, including the introduction of:
  - an excise tax on imported cars
  - vehicle taxation based on $CO_2$ emissions
  - environmental criteria for accessing tax benefits for company cars
  - a scrappage scheme to replace old and inefficient cars
  - sufficient incentives for electric vehicles.
- Increase the ambition for deployment of electric vehicles in line with the transport emissions reduction target and ensure the adoption of smart charging to minimise grid investments and boost electricity system flexibility and the integration of renewables generation.
- Encourage the use of public transport, cycling and walking by improving the infrastructure and adapting spatial planning. Consider introducing low-emission zones.

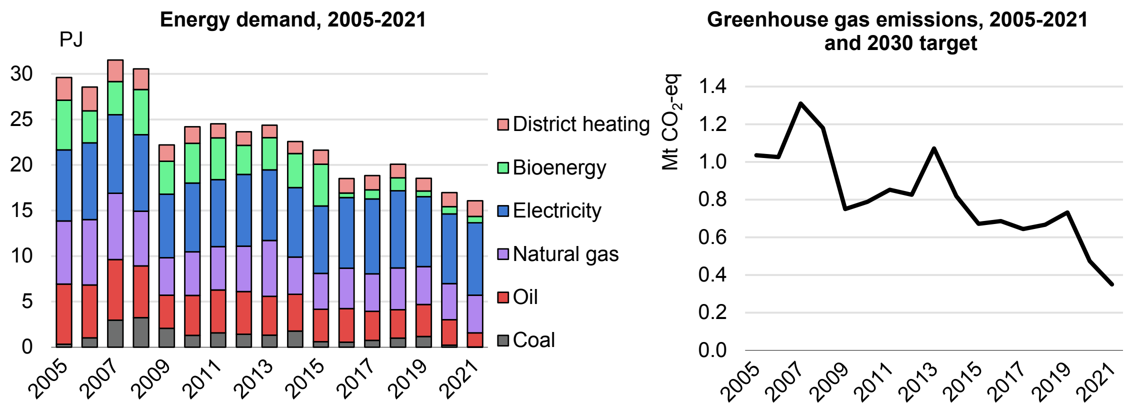
# 5. Industry

## The relatively small industry sector has significantly decreased its energy demand and greenhouse gas emissions

Estonia has a relatively small industry sector with a limited share of heavy industry and a high level of electrification. In 2021, Estonia's industry sector accounted for just 17% of TFEC (compared to the IEA average of 28%) and its direct emissions for 6.6% of GHG emissions (compared to the IEA average of 14%). When including indirect emissions from industry, the share of total GHG emissions increases to 19% (versus the IEA average of 27%). In 2021, industrial sector energy demand was covered mainly by electricity (43% of industry TFEC, compared to the IEA average of 33%), followed by oil (22%), natural gas (21%), and a smaller share of district heating (9%) and bioenergy (5%).

Industry sector energy demand decreased from a peak of 36 PJ in 2007 to 20 PJ in 2021, mainly because companies invested in energy efficiency to offset increasing energy costs (Figure 5.1). Industry sector GHG emissions decreased from a peak of 1.3 Mt $CO_2$-eq in 2007 to 0.35 Mt $CO_2$-eq in 2021. The decline in GHG emissions was driven by decreased energy demand and a shift away from fossil fuels. The share of industry energy demand covered by fossil fuels declined from 53% in 2007 to 35% 2021, primarily due to reduced demand for oil and coal. From 2010 to 2021, the carbon intensity per value added (Mt $CO_2$/USD) significantly decreased in the main industry subsectors (Figure 5.2). Despite these improvements, industry still has a key role to play in meeting Estonia's climate and energy targets, with continuing opportunities to improve efficiency, boost electrification and reduce the use of fossil fuels.

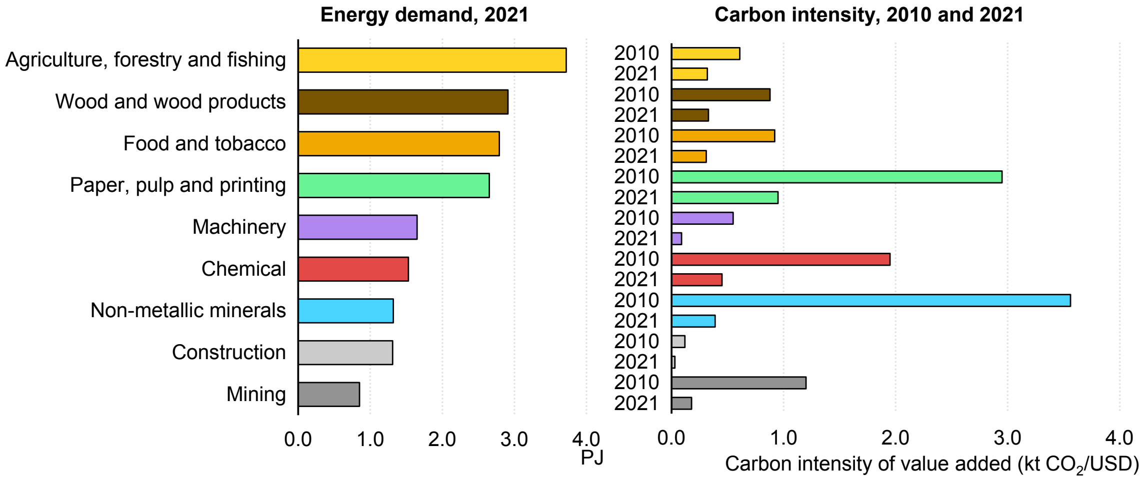
**Figure 5.1 Energy demand in industry by source and greenhouse gas emissions from industry, 2010-2021 in Estonia**






Source: IEA (2023), World Energy Balances and Greenhouse Gas Emissions from Energy.

**Figure 5.2 Energy demand and carbon intensity of industry subsectors in Estonia, 2010-2021**






Source: IEA (2023), Energy End-Uses and Efficiency Indicators.

## More action is needed for industry to achieve its full potential for energy savings and emissions reductions

Most of Estonia's policies encouraging industry energy efficiency and GHG emissions reductions are driven by EU climate policy and supported by EU funding. Additional policies beyond EU requirements would help the industry sector better contribute to achieving Estonia's climate and energy goals. The government should consider adopting a GHG emissions reduction target for the industry sector, potentially including a carbon budget. This could be part of a broader framework for GHG emissions reductions included in a climate law (see Chapter 1).

The EU Energy Efficiency Directive requires large companies to complete an energy audit every four years or to implement certain environmental or energy management systems and submit a summary of energy demand every four years. Estonia adopted the EU requirement for energy audits of large companies. In September 2023, 127 companies had completed their first 4-year audit and 12 had completed the second 4-year audit. Going forward, the government aims for around 30 companies to complete the audit each year.

A government report details results of 120 audits completed though March 2023, identifying total energy demand of 4 000 GWh per year; the first energy source of audited companies is electricity (1 400 GWh/year), followed by heat (1 300 GWh/year) and liquid transport fuels (1 000 GWh/year). The audits identified the largest energy-saving potential in the processing industry (70 GWh/year) and trade sectors (34 GWh/year). The audits showed that most companies do not measure where energy is consumed, and that systematic and more detailed monitoring of energy demand would pay for itself in less than three years.

The audits note that the easiest and profitable measure is investing in LED lighting, with an estimated savings of 18 GWh/year and payback of less than six years. They also show large savings potential through automation, improving climate systems, reviewing climate system parameters (for example, room temperature) and using residual heat. Total savings would be 56 GWh/year, but payback periods vary from five to ten years. The audits also show a large energy-saving potential through improving industrial processes, with a savings potential of 46 GWh/year, but longer payback periods, on average 13 years. The audits also indicate that replacing oil transport fuels with natural gas or electricity would lead to a savings of 15 GWh. The IEA recommends that efforts to reduce the use of oil transport fuels focus on electrification or biofuels and not natural gas, which has higher energy security risks and higher emissions, slowing progress towards Estonia's energy and climate targets (see Chapter 4).

The IEA notes that companies are not required to implement the energy-saving measures identified in the energy audits. As recommended in the IEA's previous Energy Policy Review of Estonia (published in 2019), the government should increase requirements on industry to implement the findings of the energy audits, which is a common practice in other IEA member countries. For example, the Netherlands' Energy Savings Obligation requires companies with high energy demand to implement measures with a payback period of five years or less.

Since 2017, the Environmental Investment Centre (KIK) provides grants to support resource efficiency investments and audits by qualifying mining and manufacturing companies. The grants aim to drive investments that would not occur under market conditions and are awarded on a first-come, first-served basis through calls for proposals that are open to large companies and SMEs. The budget for the grants comes from various EU funds. Companies awarded grants are required to submit a report within three to five years showing the level of resource/energy savings achieved. From 2014 to 2020, KIK awarded EUR 68.5 million to support 178 companies to undertake resource efficiency investments and/or audits. Another round of grants took place in 2023, with a budget of EUR 34.5 million.

The government supports SMEs in undertaking efficiency measures and, as part of the EU Leap4SME programme, has translated a guide for SMEs to conduct energy audits into Estonian. The government has also funded trainings and awareness-raising projects to improve experts' energy efficiency knowledge and assist with project implementation.

With companies completing the second round of audits, the government should identify which energy efficiency measures were undertaken and what savings have been achieved. These data should inform policy making and be used to determine if additional measures are needed to deliver big improvements in energy efficiency and reductions in GHG emissions. This could include offering increasing financial support and opening it to a wider range of companies, especially for energy-saving measures with high savings/emissions reductions potential but long payback periods.

The IEA recommends that the government complement the investment support with regularly updated guidance on cost-effective energy-saving technologies and measures relevant for the industrial processes most often found in the Estonian industry or those that account for a large share of fossil fuel use. For example, the Netherlands' Recognized Lists of Measures and the United Kingdom's Energy Technology List detail energy-saving investment that companies across a range of industries can use to reduce their energy demand.

Providing an updated list of the most relevant and impactful options (while allowing support for all investments that reduce energy demand or emissions) would help companies take proactive action and better respond to the findings of energy audits. Some high-potential technologies include high-efficiency industrial electric motors, pumps and compressors and waste heat utilisation and high-temperature heat pumps for process heat up to 150-200°C.

Estonia has already achieved a high level of electrification of industry energy demand, however, there are additional opportunities for industrial electrification. Sweden's Roadmaps for Fossil Free Competitiveness, provide details insights on options for electrification (and other decarbonisation options) across several industrial sectors and processes. The IEA report The Future of Heat Pumps, published in November 2022, provides insights on industrial heat pump application that could help Estonia continue boosting industry electrification, which would drive further efficiency gains and GHG emissions reductions.

Industry can play a notable role in supporting energy system flexibility, especially through DSR in the electricity sector. Industry offers a relatively easy option for DSR, as a large amount of electricity demand is concentrated among a smaller number of consumers (compared to the residential sector). In addition, a large share of Estonia's industry energy demand is covered by electricity. The government should ensure a supportive regulatory framework that allows industry DSR to participate in all electricity markets. Increased electrification of industry energy demand and deployment of thermal energy storage would help to boost industry DSR potential (see Chapter 2). Support to increase the role of ESCOs would also help to enable industry DSR.

Estonia is also looking to boost industrial activity, especially in clean technologies. For example, in October 2023, the governments Estonian and France signed a statement of intent on cooperation in CleanTech includes co-operation on batteries, energy storage, electrolysers, fuel cells, grid technologies and low-carbon electricity. Attracting new industry to Estonia will likely requiring additional deployment of renewable generation and supporting infrastructure and should be accounted for in electricity system planning (see Chapter 1).

EU funding to support industry energy savings and emissions reductions is also provided through Estonia's Recovery and Resilience Plan. The KIK grant programme supports resource efficiency in industrial companies. In September 2022, it awarded its entire budget of EUR 23.6 million in just a few hours. Other support programmes funded by the plan include the Promotion of Hydrogen Integrated Technologies (EUR 50 million), open for proposals through 2023; and a Green Technologies Development Programme (EUR 8 million) to support start-ups in bringing green technologies to market.

The IEA also recommends that the government implement additional measures that have driven industrial energy savings and emissions reductions in other IEA member countries. One key option is energy efficiency obligations, which typically require energy suppliers (or other obligated companies) to achieve a certain level of energy savings on an annual basis. Notably effective examples include the "white certificate" programmes in France and Italy, which allow the energy savings obligation to be met with tradeable energy-saving certificates that can be awarded to a wide variety of entities that undertake verified energy-saving measures. China has a similar system which aims to drive both energy savings and emissions reductions.

Another key option is voluntary energy efficiency agreements between the government and industry, under which entire industry sectors, associations of companies or individual companies commit to requirements on energy savings, energy data reports, energy management systems and other areas in exchange for subsidies, reduced taxation or other benefits. The government is responsible verifying that the conditions of the agreement are met and works with industry to adjust to requirements over time to ensure they continue to drive investments in energy-saving measures. Some key examples include energy efficiency agreements in Finland and long-term agreements in the Netherlands.

Germany's Energy Efficiency and Climate Protection Networks Initiative provides another example of successful co-operation between government and industry. Under this programme, government works with industry to establish networks of companies that set targets for energy savings and emissions reductions. The networks support the exchange of best practices. The government facilitates the creation of the networks and can offer financial support to help industry identify options to reduce energy demand and emissions.

ESCOs can play a key role in helping industry achieve energy savings and emissions reductions. ESCOs currently play only a limited role in Estonia and indicated to the IEA that there are notable barriers to growing their support to other companies in Estonia. The government should work with ESCOs and industry stakeholders to determine how ESCOs can play a greater role. The IEA has several products offering insights on how ESCOs can best help other companies and government achieve energy savings and the role of government and policy makers in supporting the ESCO industry. These include an overview report, a report on China (which has the world's largest ESCO market), a webinar with insight for policy makers and ESCOs, and a conference on ESCOs' role in reaching net zero emissions.

The IEA commends Estonia for taking a leadership role in the IEA Working Party on Industrial Decarbonisation. This group was formed in February 2023 and seeks to enhance the quality and impact of the IEA's work on industrial decarbonisation through its role as the principal advisory body to IEA member governments, the IEA Secretariat and other stakeholders (as appropriate) on matters relating to industrial decarbonisation.

## Roadmaps for industry energy savings and emissions reductions would help to develop effective policies

The rapid uptake of grants from Estonia's grant programmes supporting industrial energy efficiency measures indicates that many companies are ready to invest in energy savings. A better understanding of the potential savings of the industry subsector and type of needed investment would greatly help the government determine what type of support policies would be the most effective to help industry achieve its energy savings and emissions reduction potential. The current energy/resource audit requirements and grant programmes provide opportunities to collect needed data, but the government should also work with industry to develop energy savings/decarbonisation roadmaps for key industrial sectors.

In 2020, Estonia started working with the European Union through a Technical Support Instrument to identify the country's energy-saving potential and develop policy options to achieve its energy efficiency targets. The IEA commends Estonia for this work and encourages the government to use this opportunity to develop detailed roadmaps that clarify the potential for energy savings and emissions reductions in the industry sector, identify cost-optimal pathways, and support the design and targeting of policy measures. The IEA recommends that the government work with industry stakeholders to develop sectoral low-carbon roadmaps for key industrial energy sectors that cover the key areas (regulation, information and incentives) defined in the IEA Energy Efficiency Policy Toolkit.

Several IEA counties countries have developed detailed roadmaps for industry. Finland has 13 industrial sectors roadmaps that provide the government with estimates of anticipated sectoral development, including GHG emissions and energy demand, and indicate the investment needs of various sectors to support the energy transition. These roadmaps provide clarity to the government and industry on the areas where the most important investments should be made and where additional efforts are needed, for example in relation to increased research and development (R&D) for key technologies or the need for targeted subsidies. The roadmaps could also be helpful in setting a GHG reduction target and/or budget for the industry sector in relation to a broader climate framework law (see Chapter 1).

## Price signals should encourage industry to make investments that support the energy transition

Estonia's fiscal and taxation treatment of energy products is currently designed mainly to generate revenue, with less attention paid to aligning price signals with emissions reductions and climate-neutrality goals (see Chapter 1). The government needs to update fiscal and taxation policies covering energy products so that price signals drive investments in cleaner and more efficient options in all sectors, including industry.

Since 2019, some energy-intensive industries benefit from reduced excise duties on electricity and natural gas. To apply for the lower rate, an enterprise's energy management system must comply with the EVS-EN ISO 50001 standard. For qualifying companies, the electricity excise duty is reduced from 1.00 EUR/MWh to 0.50 EUR/MWh; the gas excise duty is reduced from 40 EUR per thousand cubic metres (tcm) to 11.4 EUR/tcm. The government plans to maintain these lower rates, even as excise duties for other energy products will be increased annually through at least 2027 (see Chapter 1).

The IEA commends Estonia's effort to make electricity a competitive option for industry, as electrification offers a clear pathway to energy savings and emissions reductions. The government could consider a stricter requirement than the ISO 50001 standard for companies to receive the lower electricity excise rate, for example requiring investments in cost-effective energy efficiency measures. The government should not implement measures that reduce the cost of natural gas or other fossil fuels, and instead use limited budgetary resources to help industry stay competitive through investments that increase efficiency and support a transition to electricity or renewable energy.

Estonia's main carbon-pricing mechanism is the EU ETS. Because of the limited role of heavy industry, only one-third of GHG emissions from Estonia's industry sector are covered by the ETS. Estonia has a national carbon price of just 2.00 EUR/Mt $CO_2$-eq, but it only covers thermal power plants. While reviewing fiscal and taxation policies, the government should consider introducing carbon pricing for activities not covered by the ETS to ensure that price signals are aligned to drive investment that save energy and reduce emissions. This work should also seek to remove any fossil fuel subsidies.

IEA analysis shows that carbon pricing is one of the most effective measures to achieve cost-effective GHG emissions reductions. National carbon-pricing schemes have been successful at reducing emissions while maintaining industrial competitiveness in several IEA countries including Finland, Norway and Sweden. Analysis from the International Monetary Fund indicates that increasing the carbon price is one of the most cost-effective options for Estonia to reach its climate and energy targets.

# Recommendations

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

- Work with industry stakeholders to develop sectoral low-carbon roadmaps that cover the key areas (regulation, information and incentives) defined in the IEA Energy Efficiency Policy Toolkit.
- Expand the resource efficiency grant programme to better trigger the uptake of energy efficiency measures, including developing a list of technologies relevant for Estonia's industry sector.

# 6. Energy research and innovation

## A new strategy adopted in 2021 aims to boost the role of R&D in the economy

The Research, Development, Innovation and Entrepreneurship (RDIE) Strategy 2021-2035, adopted in 2021, is the key document defining Estonia's R&D policy. It sets objectives for research, development, innovation and entrepreneurship to increase the well-being of society and the productivity of the economy. Key metrics to measure progress on these objectives are for the public budget allocated to R&D to be greater than 1% of GDP from 2021 onwards (it was 0.91% in 2021 and 0.99% in 2022), for private sector R&D spending to be at least 2% of GDP by 2035 (it was 1% in 2021) and for Estonia to be an innovation leader in the EU Innovation Scoreboard. Estonia was a moderate innovator in the 2023 Scoreboard. The Energy Sector Development Plan until 2035 (to be published in 2024) will set R&D priorities and actions for the energy sector.

The RDIE Strategy defines five focus areas were co-operation between the government, the private sector and research institutions is considered key to achieving the strategy's objectives. Each focus area has an implementation roadmap defining key actions for developing the focus area. One of these focus areas, Smart and Sustainable Energy Solutions, targets the energy sector with three priority R&D directions: 1) climate-neutral energy production; 2) energy efficiency and resource savings; and 3) storage and smart grids.

The government has indicated that the RDIE Strategy's focus areas and roadmaps will be used to develop and refine R&D support measures and evaluate which R&D proposals receive government funding. This raises some concerns, as the Smart and Sustainable Energy Solutions "priority R&D directions" and "key actions for developing the focus area" are very broad and it is unclear if those R&D challenges will receive sufficient public R&D funding.

The IEA commends Estonia's high-quality R&D activities in key areas related to its energy challenges. A research group at the Tallinn University of Technology has published promising work on heat pumps and district heating. Estonia has made notable advances on high-efficiency fuel cells. The electricity transmission system operator (Elering) has commissioned several R&D projects on smart grids. Estonia is also a global leader on digitalisation of building energy data, including an online platform providing detailed data on building energy use (see Chapter 3). However, a more structured approach is needed so that Estonia's R&D strategy directs limited resources to areas with the most potential to help address pressing climate and energy challenges.

The IEA recommends that overall R&D policy and sector-specific plans, including the Energy Sector Development Plan until 2035, are updated to prioritise energy innovation in areas that match Estonia's R&D capacity and competitive advantages with the country's energy sector challenges and opportunities. For example, Estonia's 100% renewable electricity target creates a pressing need for increased flexibility of the electricity system, especially though DSR. There are also unique opportunities to create additional system flexibility by linking the electricity and heating sectors through heat pumps and thermal storage. These aspects present prospects for high-impact R&D projects that could leverage Estonia's strengths in digitalisation and energy system data collection to address key energy sector challenges.

Recent IEA work provides insights on unleashing the benefits of data for energy systems and unlocking smart grid opportunities that could help Estonia identify additional areas that link its R&D strengths with its climate and energy challenges. The IEA framework for energy innovation policies provides insights on the policies needed to support successful energy innovation.

## Numerous actors play key roles in Estonia's innovation ecosystem

Estonia's Organisation of Research and Development Act defines the roles of the key actors in the country's R&D system. R&D policies are designed, implemented, monitored and evaluated by the Ministry of Education and Research and the Ministry of Economic Affairs and Communications, which jointly prepare an annual performance report that provides an overview of the implementation of the RDIE Strategy and proposals for improvements as needed. Parliament approves the overall R&D strategy and budget. Under the ministries' supervision, the Estonian Research Council primarily funds basic research and co-ordinates international R&D efforts. The Estonian Business and Innovation Agency primarily funds private sector applied research. The Environmental Investment Centre funds innovation and pilot projects on biodiversity and climate; circular economy and resource efficiency; energy and mobility; and forestry. R&D projects are carried out by universities, public and private sector research institutions, and private companies.

## Estonia aims to boost R&D spending

Looking to the future, the RDIE Strategy sets targets for the public R&D budget to be more than 1% of GDP from 2021 onwards and private R&D spending more than 2% of GDP by 2035. The public budget for 2021-27 provides around EUR 400 million for R&D to meet the 1% target. This budget funds numerous R&D support measures, most of which award grant funding through competitive calls. Given the pressing need for additional R&D to meet climate goals in Estonia and globally, the IEA recommends that Estonia consider setting higher and legally binding R&D spending targets. For example, Finland's R&D Funding Act set a legally binding target that public spending on R&D reach 1.33% of GDP by 2030 and requires an annual increase in public R&D spending to ensure this goal is achieved and to provide certainty to R&D entities seeking funding.

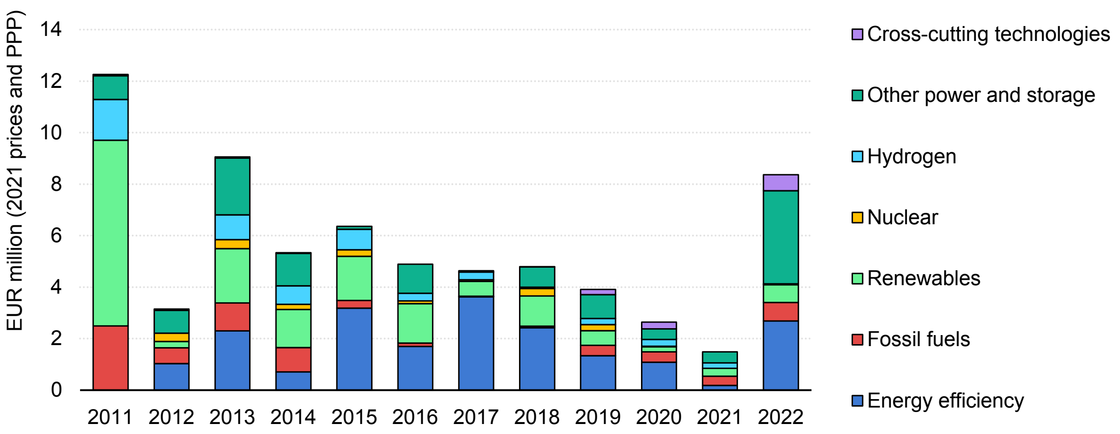
## There are no dedicated support measures for public spending on energy R&D

The IEA Net Zero by 2050 Roadmap notes that while most of the reductions in $CO_2$ emissions through 2030 can be achieved with technologies already on the market today, almost half the reductions needed to reach net zero in 2050 come from technologies that are currently at the demonstration or prototype phase. Major innovation efforts must take place before 2030 to bring new technologies to the market in time. Despite its small size, Estonia has some notable advantages, like a high level of digitalisation, that give it a role in advancing R&D on key technologies.

Numerous energy-related R&D projects relevant to Estonia's energy challenges have received public funding and some support programmes aim to drive energy sector innovation. This includes support for pilot projects in energy storage and clean transport (biomethane and hydrogen), among others. In addition, a small share of R&D funding from EU sources is earmarked for certain technologies, such as hydrogen. However, Estonia does not have a dedicated budget for energy-related R&D projects and all R&D proposals compete for limited funding based on general quality and innovation metrics that do not consider alignment with Estonia's most pressing energy and climate challenges or the relative strengths of Estonia's energy and innovation systems.

Estonia's current bottom-up approach to awarding R&D funding is not sufficient to develop the technological pathways and solutions needed for the energy transition. This approach has contributed to energy R&D receiving a small and shrinking share of public R&D support. From 2021 to 2022, only 11% of the R&D funding awarded by the Estonian Business and Innovation Agency went to energy R&D. However, in 2022, Estonia notably increased public spending on energy-related R&D to EUR 8.5 million, the highest level since 2013 (Figure 6.1). However, this level is still relatively low for energy R&D, ranking Estonia 13th among the 17 IEA countries reporting data for 2022. A small share (8%) of public R&D funding is dedicated to fossil fuels. The IEA recommends ending public R&D support for fossil fuels.

**Figure 6.1 Energy-related R&D public spending by sector in Estonia, 2011-2021**






Source: IEA (2023), Energy Technology RD&D Budgets.

The government should introduce a top-down approach that includes clear targeted research questions and funding programmes aligned with its energy policy goals and the most pressing energy sector challenges, while making use of the R&D strengths of Estonian public research entities and the private sector. It would be beneficial to allocate a dedicated budget to these programmes, thus offering long-term certainty to encourage R&D entities to expand their capacity and the scale of their work. The government could also consider setting a target for the share of spending allocated to energy R&D.

Several R&D entities have raised concerns that current funding instruments do not cover the whole innovation cycle, especially in relation to bringing innovative technologies and services to market. The RDIE Strategy notes an important need to support the uptake of research results (e.g. knowledge and technology transfer) in the energy sector.

The creation of the Ministry of Climate creates an opportunity to accelerate the market uptake of technologies and services by linking R&D support measures in a coherent manner so that projects can easily pass from one support programme to the next as they progress through the innovation cycle. It would be beneficial to create a single point of contact in the government and a one-stop shop that clearly details how the government provides support across the entire innovation cycle and to guide promising projects through this process.

The government should introduce regulatory sandboxes to help develop market-ready technologies and services relevant to Estonia's energy sector challenges. Regulatory sandboxes would be especially helpful for developing new products, services and technologies in the electricity and heat markets where there is a strong opportunity and need to increase system flexibility and integration of renewable energy. This could be done through the existing AccelerateEstonia programme, which has created regulatory sandboxes in other sectors. In 2020, the EU published a conclusion highlighting the need to improve innovation friendliness by strengthening the approach to designing experimental regulation, including regulatory sandboxes. In 2022, the Council of European Energy Regulation published a Paper on Regulatory Sandboxes in Incentive Regulation that provides detailed insights on how national energy regulators can use regulatory sandboxes to support innovation in the energy sector.

Germany has developed a regulatory sandbox strategy; published a fact sheet on the key steps to successfully develop regulatory sandboxes; and has provided funding for companies and research entities to establish regulatory sandboxes, including one that supports innovative energy technologies and services in electricity and heat markets. Austria made legislative changes to allow its energy regulator to establish regulatory sandboxes in the energy sector (in particular, exemptions from system usage fees) and set up the Energy.Free.Space programme to provide funding to companies and research entities to use regulatory sandboxes to support renewable energy, energy storage and energy efficiency technologies, for example through innovative business models. Portugal's

Technological Free Zones programme supports regulatory sandboxes for the development of new technologies and solutions and innovative technology-based products, services and processes.

There are similar efforts to use regulatory sandboxes to help bring innovative energy technologies and services to market in numerous countries. The International Smart Grid Action Network, one of the IEA TCPs, published a Casebook on Innovative Regulatory Approaches with a Focus on Experimental Sandboxes that provides examples from Australia, Austria, Germany, Italy, the Netherlands and the United Kingdom. The International Smart Grid Action Network continues its work in this area and the IEA recommends that Estonia join this TCP.

## Estonia increased success in winning EU R&D funding

R&D in Estonia is also supported by EU funding, especially through the EU Framework Programme for Research and Innovation, the European Union's main mechanism for directing innovation funding to member states. Horizon 2020, the framework programme from 2014 to 2020, provided EUR 80 billion for R&D through a competitive process open to all EU public and private entities and was designed to increase public-private partnerships and international co-operation.

Horizon 2020 provided a total of EUR 275 million for R&D projects in Estonia; however, only around EUR 54 million of this went to energy and climate projects. Estonia was relatively competitive at winning Horizon 2020 funding. Among EU member states, Estonia received the second-highest share of Horizon 2020 funding by GDP and the tenth-highest share of funding per capita.

Horizon Europe, the EU Framework Programme for 2021-27, which aims to provide EUR 95.5 billion in innovation funding, will continue to support energy-related innovation and sets goals to increase international R&D co-operation. Based on lessons learnt from Horizon 2020, Estonia implemented changes to increase R&D awarded through Horizon Europe and aims for this funding to support R&D that is in line with its RDIE Strategy. The government is providing EUR 27 million to help Estonian R&D entities participate in Horizon Europe partnerships. As of August 2023, Estonia had improved its success rate, winning 20.8% of Horizon Europe funding (versus 13.8% for Horizon 2020) and had already received EUR 117 million. However, only EUR 19 million of this funding has gone to the thematic priority of climate, energy and mobility.

## Private sector spending is encouraged through several programmes

Private sector R&D spending is encouraged by government funded programmes that aim to leverage additional private sector spending. The RDIE Strategy notes that the share of public R&D expenditure going to private sector R&D will be maintained at least at the level reached in 2019 (0.12% of GDP). In addition, Estonia's tax system encourages the growth of businesses with a 0% corporate income tax rate on reinvested profits. Profits are only taxed when they are distributed. Investments in R&D are eligible for the 0% tax rate but there is nothing in the tax code to encourage profits to be spent on R&D versus any other reinvestment.

## Estonia is a global leader in venture capital investment for green start-ups

Estonia is a global leader in the share venture capital (VC) investment going to green start-ups. From 2016 to 2020, around 67% of Estonia's VC investments went to green start-ups. This was the third-highest share among OECD countries and well above the OECD average of just 7.8%. In 2020, Estonia's VC investment going to green start-ups share of GDP (0.33%) was by far the highest among OECD countries; Israel[4] had the second-highest share (0.08%) and the OECD average was just 0.02%. From 2013 to 2020, most VC investment in Estonia supported green start-ups working on batteries or low-carbon mobility. In 2022, Estonia established the Smartcap Green Fund, which will invest EUR 100 million from 2022 to 2026 to increase VC available to Estonia's innovative and/or research-intensive green technology companies. In addition, the SmartCap Venture Capital Fund provides another EUR 100 million to increase the availability of VC to a broad range of start-ups.

## Estonia should take steps to increase international co-operation on energy R&D

Estonia co-operates internationally on R&D through several platforms. Its top collaborators through Horizon 2020 (based on the level of investment) were Spain, Italy, Germany, France, the United Kingdom, the Netherlands, Belgium, Greece, Finland and Sweden. Estonia continues international R&D co-operation through Horizon Europe and the EU CETPartnership. It also co-operates on regional R&D efforts through the Joint Baltic-Nordic Energy Research Programme, which promotes R&D in the Baltic states and intra-Baltic and Baltic-Nordic R&D co-operation, with several research projects focused on energy, including renewables and district heating.

IEA TCPs support international groups of experts that enable governments and industries to lead programmes and projects on a wide range of energy technologies and related issues. TCP collaborations involve over 6 000 experts who represent nearly 300 public and private organisations in 55 countries working on 38 technology-specific programmes. Estonia currently participates in the Fluidised Bed Conversion TCP and just joined the District Heating and Cooling TCP.

The IEA encourages Estonia to join TCPs relevant for its climate goals and those where it can share best practices, such as the International Smart Grid Action Network TCP, the Heat Pump Technologies TCP and the Advanced Fuel Cells

[4] The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

TCP, and to rejoin the Bioenergy TCP (Estonia was a member in 2018). Estonia should also consider joining Mission Innovation and the Clean Energy Ministerial, key groups that support international co-operation on energy R&D. One of the challenges the Estonian R&D system is facing is its small size and the dominance of SMEs in its economy. Estonia is addressing these through clusters, including the GreenTech Cluster, a country-wide partnership between green tech-related stakeholders in Estonia.

# Recommendations

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

- Increase energy R&D funding and introduce a top-down approach that prioritises energy innovation that matches Estonia's research, development and innovation capacity and competitive advantage with the country's energy sector challenges and opportunities.
- Support market uptake of innovative energy technologies and services. This includes ensuring that public R&D support measures cover the entire innovation cycle and introducing regulatory sandboxes to test ideas under real conditions.

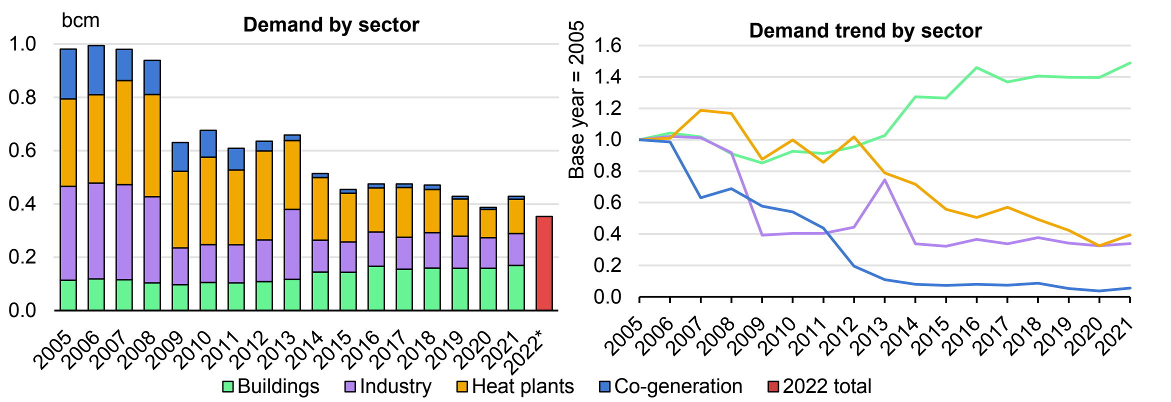
# 7. Gas decarbonisation and security

## Natural gas demand is low and is expected to decline

Natural gas plays a relatively small role in Estonia's energy system. This reflects its historic reliance on oil shale and the limited role of heavy industry in the Estonian economy. In addition, policy support has prioritised biomass over natural gas in district heating. In 2021, natural gas accounted for just 8.6% of TES (down from 15% in 2005) versus the IEA average of 30%. Gas demand has significantly declined, from 701 million cubic metres (mcm) in 2010 to 477 mcm in 2021 (Figure 7.1). This decline came mainly from a significant shift away from gas to bioenergy in district heating and lower gas demand from industry, which more than offset a small increase in gas demand from buildings.

Gas demand dropped to a historic low of just 354 mcm in 2022, mainly because of high gas prices and measures to end Russian gas imports following the Russian invasion of Ukraine. It is expected that natural gas demand will continue to decline in line with Estonia's goal for climate neutrality. The 2023-2032 development plan of the gas TSO (Elering) shows natural gas demand dropping by around 18% from 2022 to 2030 and falling to almost zero by 2050.

**Figure 7.1 Natural gas demand by sector and trend in Estonia, 2005-2021**






Source: IEA (2023), World Energy Balances.

The government has clear plans to end the use of natural gas for heating, which is the largest source of gas demand, accounting for 65% in 2021, including gas demand from district heating and individual gas boilers. Estonia conducted a study on Transitioning to a Carbon Neutral Heating and Cooling in Estonia by 2050, which informed policy options in the NECP to transition district heating and individual heating systems away from gas to renewable energy. Estonia is also working to boost biomethane production, which has the potential to replace natural gas in industry and other hard-to-decarbonise end-uses.

## Estonia quickly ended Russian gas imports while ensuring a secure gas supply

Historically, Estonia relied on Russian imports for all its natural gas supply. Following the Russian invasion of Ukraine, Estonia took swift action to end its reliance on Russian gas. The IEA commends Estonia for stopping imports of Russian pipeline gas in April 2022 and banning imports and purchases of Russian gas, including LNG, from 1 January 2023. Estonia also took steps to reduce gas demand, which declined by 26% in 2022 compared to 2021. This decline came from district heating co-generation plants temporarily switching to shale oil, reduced gas demand in industry and increased uptake of heat pumps.

The IEA also commends Estonia for the steps taken to ensure a secure gas supply, including co-operation with Finland to deploy the subsea Balticconnector pipeline (commercial operation started 2020) and to bring a new floating storage and regasification unit (FSRU) to the Inkoo LNG terminal in Finland (commercial operation started March 2023). This created a new gas supply route for Estonia. LNG cargoes regasified at the Inkoo LNG terminal in Finland (5 bcm capacity) are delivered via the Balticconnector (2.7 bcm capacity).

On 8 October 2023, the Balticconnetor was shut down because of a rupture in a section of the pipe in Finland's waters. Investigations were still ongoing at the time this report was published, but it is believed that the rupture was a deliberate act of sabotage. The pipeline will be out of service for several months. The disabling of the Balticconenctor, does not create immediate security of supply concerns. Estonia's natural gas supply now relies on an existing LNG delivery route through Lithuania and gas storage in Latvia. LNG imports regasified at the Klaipeda LNG terminal in Lithuania (3.75 bcm capacity) are delivered via the Karksi interconnections with Latvia (3.65 bcm capacity) (Figure 7.2). In February 2023, Eesti Gas (the private company that is Estonia's main gas supplier) signed deals for the delivery of ten LNG cargoes by Q3 2023, including seven shipments via Finland and three via Lithuania.

Estonia is co-operating with Latvia to ensure a secure gas supply. Estonia does not have any domestic natural gas storage but has access to the Inčukalns gas storage facility in Latvia. This facility has a total working capacity of 2.32 bcm, compared to an annual combined demand of 3.9 bcm for Estonia, Latvia and Lithuania in 2021. The IEA commends Estonia for establishing a 0.09 mcm emergency gas reserve held in Latvia's storage facility. This reserve is held by the Estonian state stockpiling agency (Espa).

In March 2023, Espa purchased the LNG infrastructure and property at Paldiski. This site was prepared to host an FSRU (including investments to connect it to the gas transmission system) as an alternative in case of delays in developing the Inkoo LNG terminal. In May 2023, Estonia and Latvia signed a memorandum of understanding agreeing to co-operate to bring an FSRU to Paldiski if an emergency situation threatens gas supply through existing routes. Regional gas security was also improved thanks to the Gas Interconnection Poland-Lithuania (GIPL), which started operating in May 2022 and connects the Baltics with Poland and the rest of Europe. The bidirectional GIPL has a capacity of 1.9 bcm to Poland and 2.4 bcm to Lithuania. The Lithuania TSO [Amber Grid](Amber Grid) indicates that since the GIPL started operation, it has delivered 0.57 bcm from Lithuania to Poland and 0.15 bcm from Poland to Lithuania.

**Figure 7.2 Baltic natural gas transmission network**

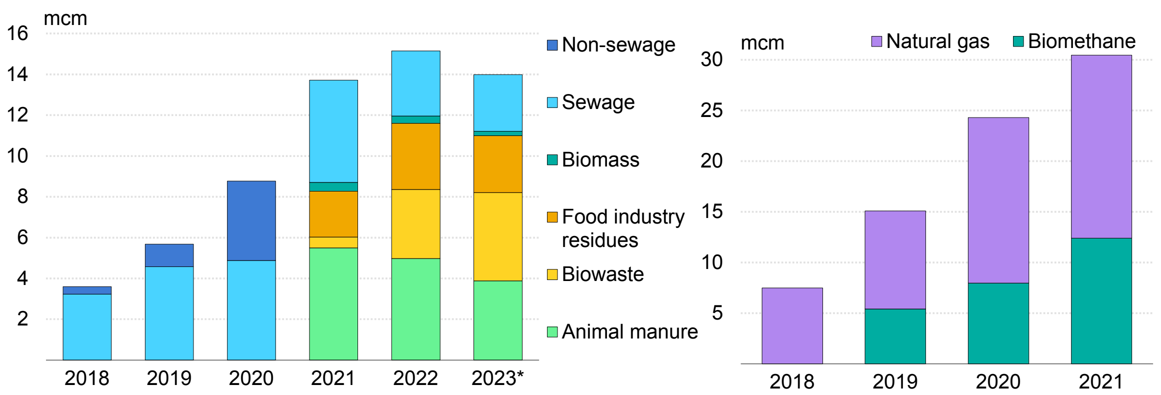

While commending Estonia's quick action to end Russian gas imports and ensure a secure gas supply, the IEA notes that the recent transition from reliance on pipeline gas from Russia to reliance on LNG imports is a significant change for all the players in Estonia's gas sector. The IEA encourages the government to work with regional gas sector stakeholders to ensure that Estonia maintains a secure LNG supply as it works to reduce gas demand and decarbonise gas supply.

A natural gas supply reliant on spot LNG procurements could potentially expose Estonia to price volatility. It is important to have both mid-term (three to five years) capacity and booked capacity at the LNG terminals and through the interconnections, while keeping a fine balance between the mid-term contracts and spot procurements. The government should monitor natural markets and work with gas sector stakeholders to ensure that adequate supply and interconnection capacity are available for Estonia's gas market. To maintain security of supply, the government should also more closely monitor the source of imported and stored natural gas.

## Growing biomethane production presents an opportunity to decarbonise the gas supply

Estonia has seen a notable increase in biomethane production (Figure 7.3). In 2022, it had 17 biogas plants, 6 producing biomethane. From 2018 to 2022, biomethane production increased from 3.6 mcm to 15 mcm coming from animal manure (5.0 mcm), biowaste (3.4 mcm), food residues (3.2 mcm), sewage sludge (3.2 mcm) and other biomass (0.4 mcm). By September 2023, biomethane production had already reached 14 mcm. Through September 2023, all biomethane produced in Estonia has been used as transportation fuel, mainly in public buses.

**Figure 7.3 Biomethane production by feedstock, 2018-2022 and transport gas demand by fuel, 2018-2021 in Estonia**






* Only includes production through September 2023.
Sources: IEA analysis based on Elering (2023), Certificates of origin for biomethane,; IEA (2023), World Energy Balances.

Estimates show that Estonia's annual biomethane production potential could be 450 mcm or higher, which is close to or greater than its annual natural gas every year since 2014. Estonia's relatively limited and declining gas demand and high biomethane potential present an opportunity for decarbonising gas supply in line with the country's carbon neutrality goal. The government is taking steps to boost biomethane production and aims for biomethane to play a notable role in achieving climate neutrality. A subsidy introduced in 2018 provides biomethane producers with 100 EUR/MWh minus the average monthly natural gas price for biomethane used as a transport fuel and 93 EUR/MWh minus the average monthly natural gas price for biomethane supplied to the gas network. The subsidy is supported with a total budget of EUR 38.5 million and is available through the end of 2024 or until funds are exhausted. Biomethane and biogas are also exempt from the excise duty charged on most energy products.

Other measures support biomethane in transport. Since 2020, biomethane counts toward the mandate for biofuels to cover 7.5% of annual sales of transport fuel suppliers. Estonia has an EU-funded subsidy programme that supports the purchase of biomethane-powered public buses and building biomethane refuelling stations (see Chapter 4). The Estonian Recovery and Resilience Plan includes EUR 20 million to support the development of an action plan to identify possible bottlenecks and opportunities, and maps out legislative changes and investments necessary for increasing the production and use of biogas and biomethane by 4 mcm. The funding also supports co-financing of biomethane projects by local governments and private companies.

## Estonia is working to develop a larger regional gas market and increase competition

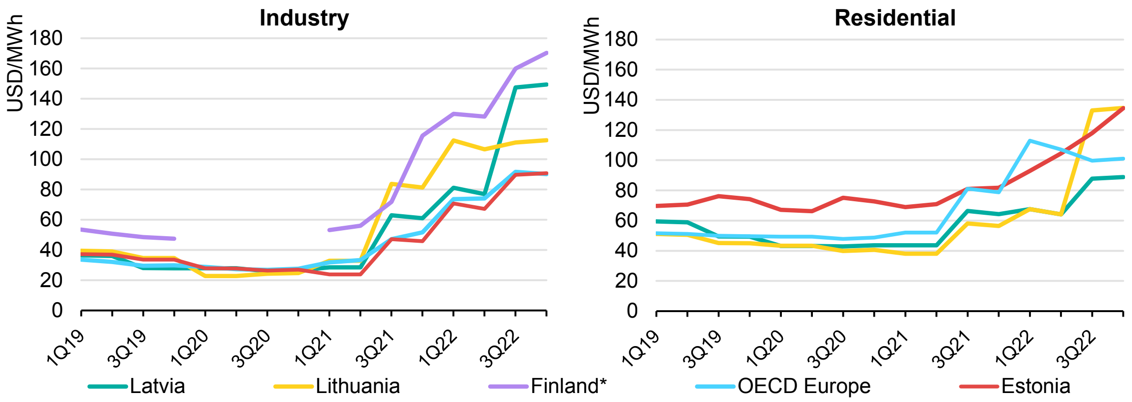
Developing regional gas and electricity markets with the Nordic and Baltic countries is one of the main objectives of Estonia's energy policy. Creating a larger gas market would help increase competition and efficiency, especially as the region's key infrastructure (LNG terminals and gas storage) is in different countries, while the interconnectivity of national markets has improved in recent years. The IEA commends Estonia's progress on developing regional energy markets and increasing market competition and encourages continued regional co-operation on developing more integrated and efficient energy markets. At the start of 2020, Estonia, Finland and Latvia began operating as one common integrated market area (FINESTLAT) with two balancing zones (Estonia-Latvia and Finland) in the European wholesale gas market. There is ongoing co-operation to create a single market area with one balancing zone that includes Estonia, Finland, Latvia and Lithuania by 2024. The Baltic governments are also considering the creation of a common retail gas market.

Estonia is also working to increase wholesale and retail gas market competition. The Energy Sector Development Plan until 2030 sets 2030 goals for less than 70% of gas supply to come from one source and for the market share of the largest wholesale gas supplier to be less than 32%. The NECP sets a target for the Herfindahl-Hirschman Index of the non-household retail gas market to be less than 2 000. The Estonian energy regulator's 2022 electricity and gas market report gives key metrics for the wholesale and retail gas markets. Eesti Gaas (the incumbent supplier) maintains a dominant position, with 60% of the gas wholesale market in 2022, 57% of the non-household retail market (which accounts for most gas demand) and 61% of the small household retail market, the largest share in the wholesale and retail gas markets. In 2022, Herfindahl-Hirschman Index values for the retail market ranged from around 3 700 to 5 500, reflecting a high level of market concentration.

## Gas prices increased rapidly and excise duties will be increased for all consumers except energy-intensive companies

As the rest of Europe, Estonia experienced a rapid increase in natural gas prices resulting from the energy crisis and Russia's invasion of Ukraine. Estonia's residential sector gas prices remain higher than most countries in the region and above the average for European OECD countries. In contrast, Estonia's industry sector gas prices continue to be among the lowest in the region while remaining close to the average for European OECD countries (Figure 7.4).

**Figure 7.4 Industry and residential natural gas price trends in Estonia and neighbouring countries by quarter, 2019-2022**






* Data for Finland's industry natural gas prices are not available for 2020. Data for Finland's residential natural gas prices are not available.

Source: IEA (2023), Energy Prices.

In 2019, reduced excise duties were introduced for electricity- and gas-intensive companies. To apply for the lower rate, an enterprise's energy management system must comply with the EVS-EN ISO 50001 standard. For qualifying companies, the gas excise duty was reduced from 40 EUR/1 000m$^3$ to 11.3 EUR/1 000m$^3$. This reduced rate will be maintained even as the rate for other uses of natural gas will be increased on an annual basis to reach 79.14 EUR/1 000m$^3$ in 2027 (see Chapter 1). The government should end the reduced excise rate for gas, and instead use the limited budgetary resources to help industry stay competitive through investments that increase efficiency and support a transition to electricity or renewable energy, for example biomethane.

# Recommendations

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

- Decarbonise the gas sector by developing a comprehensive policy for boosting biomethane production and demand.
- Until then, closely monitor natural gas markets and work with gas sector stakeholders to ensure adequate gas supply and import/interconnection capacity.

# Acknowledgements

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# Annex

## Abbreviations and acronyms

| | |
|---|---|
| AC | alternating current |
| ACER | Agency for the Cooperation of Energy Regulators |
| CNG | compressed natural gas |
| DC | direct current |
| DLR | dynamic line rating |
| DSO | distribution system operator |
| DSR | demand-side response |
| EPC | energy performance certificate |
| ESCO | energy service company |
| ETS | Emissions Trading System |
| EU | European Union |
| EUR | euro |
| EV | electric vehicle |
| FSRU | floating storage and regasification unit |
| GDP | gross domestic product |
| GHG | greenhouse gas |
| GIPL | Gas Interconnection Poland-Lithuania |
| IEA | International Energy Agency |
| IAEA | International Atomic Energy Agency |
| KIK | Environmental Investment Centre |
| LEZ | low-emission zone |
| LNG | liquefied natural gas |
| LPG | liquefied petroleum gas |
| LULUCF | land use, land-use change and forestry |
| $NO_2$ | nitrogen dioxide |
| $NO_x$ | nitrogen oxides |
| NECP | National Energy and Climate Plan |
| NEPIO | Nuclear Energy Program Implementing Organization |
| PV | photovoltaic |
| R&D | research and development |
| RDIE | research, development, innovation and entrepreneurship |
| SME | small and medium-sized enterprise |
| TCP | Technology collaboration programme |
| TES | total energy supply |
| TFEC | total final energy consumption |
| TSO | transmission system operator |
| USD | United States dollar |
| VAT | value-added tax |
| VC | venture capital |

# Units of measures

| | |
|---|---|
| bcm | billion cubic metres |
| $cm^3$ | cubic centimetre |
| g $CO_2$ | gramme of carbon dioxide |
| GW | gigawatt |
| GWh | gigawatt hour |
| kg | kilogramme |
| km | kilometre |
| kt | kilotonne |
| kV | kilovolt |
| kW | kilowatt |
| L | litre |
| $m^2$ | square metre |
| mcm | million cubic metres |
| Mt $CO_2$-eq | million tonnes carbon dioxide equivalent |
| MW | megawatt |
| PJ | petajoule |
| t $CO_2$ | tonne of carbon dioxide |
| tcm | thousand cubic metres |
| TJ | terajoule |
| TWh | terawatt hour |
| µg | microgram |

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## Estonia 2023

Energy Policy Review

Government action plays a pivotal role in ensuring secure and sustainable energy transitions and combatting the climate crisis. Energy policy is critical not just for the energy sector but also for meeting environmental, economic and social goals. Governments need to respond to their country's specific needs, adapt to regional contexts and help address global challenges. In this context, the International Energy Agency (IEA) conducts Energy Policy Reviews to support governments in developing more impactful energy and climate policies.

This *Energy Policy Review* was prepared in partnership between the Government of Estonia and the IEA. It draws on the IEA's extensive knowledge and the inputs of expert peers from IEA member countries to assess Estonia's most pressing energy sector challenges and provide recommendations on how to address them, backed by international best practices. The report also highlights areas where Estonia's leadership can serve as an example in promoting secure clean energy transitions. It also promotes the exchange of best practices among countries to foster learning, build consensus and strengthen political will for a sustainable and affordable clean energy future.